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Mineral resources of the United States

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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1887

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY

WASHINGTON

GOVERNMENT PRINTING OFFICE

1888

ADVERTISEMENT.

[Mineral Resources of the United States, 1887.]

The publications of the United States Geological Survey are issued in accordance with the statute approved March 3, 1879, which declares that—

"The publications of the Geological Survey shall consist of the annual report of operations, geological and economic maps illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. The annual report of operations of the Geological Survey shall accompany the annual report of the Secretary of the Interior. All special memoirs and reports of said Survey shall be issued in uniform quarto series if deemed necessary by the Director, but otherwise in ordinary octavos. Three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization: And the money resulting from the sale of such publications shall be covered into the Treasury of the United States."

On July 7, 1882, the following joint resolution, referring to all Government publications, was passed by Congress:

"That whenever any document or report shall be ordered printed by Congress, there shall be printed, in addition to the number in each case stated, the 'usual number' (1,900) of copies for binding and distribution among those entitled to receive them."

Except in those cases in which an extra number of any publication has been supplied to the Survey by special resolution of Congress or has been ordered by the Secretary of the Interior, this Office has no copies for gratuitous distribution.

ANNUAL REPORTS.

Of the Annual Reports there have been already published:

I. First Annual Report of the United States Geological Survey to the Hon. Carl Schurz, by Clarence King. 1880. 8°. 79 pp. 1 map.—A preliminary report describing plan of organization and publications.

II. Second Annual Report of the United States Geological Survey, 1880-'81, by J. W. Powell. 1882. 8°. lv, 588 pp. 61 pl. 1 map.

III. Third Annual Report of the United States Geological Survey, 1881-'82, by J. W. Powell. 1883. 8°. xviii, 564 pp. 67 pl. and maps.

IV. Fourth Annual Report of the United States Geological Survey, 1882-'83, by J. W. Powell. 1884. 8°. xxxii, 473 pp. 85 pl. and maps.

V. Fifth Annual Report of the United States Geological Survey, 1883-'84, by J. W. Powell. 1885. 8°. xxxvi, 469 pp. 58 pl. and maps.

VI. Sixth Annual Report of the United States Geological Survey, 1884-'85, by J. W. Powell. 1886. 8°. xxix, 570 pp. 65 pl. and maps.

The Seventh and Eighth Annual Reports are in press.

MONOGRAPHS.

Of the Monographs, Nos. II, III, IV, V, VI, VII, VIII, IX, X, XI, and XII are now published, viz:

II. Tertiary History of the Grand Cañon District, with atlas, by Clarence E. Dutton, Capt. U. S. A. 1882. 4°. xiv, 264 pp. 42 pl. and atlas of 24 sheets folio. Price $10.12.

III. Geology of the Comstock Lode and the Washoe District, with atlas, by George F. Becker. 1882. 4°. xv, 422 pp. 7 pl. and atlas of 21 sheets folio. Price $11.

IV. Comstock Mining and Miners, by Eliot Lord. 1883. 4°. xiv, 451 pp. 3 pl. Price $1.50.

V. Copper-Bearing Rocks of Lake Superior, by Roland D. Irving. 1883. 4°. xvi, 464 pp. 15 l. 29 pl. Price $1.85.

VI. Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by Wm. M. Fontaine. 1883. 4°. xi, 144 pp. 54 l. 54 pl. Price $1.05.

VII. Silver-Lead Deposits of Eureka, Nevada, by Joseph S. Curtis. 1884. 4°. xiii, 200 pp. 16 pl. Price $1.20.

VIII. Paleontology of the Eureka District, by Charles D. Walcott. 1884. 4°. xiii, 298 pp. 24 l. 24 pl. Price $1.10.

IX. Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey, by Robert P. Whitfield. 1885. 4°. xx, 338 pp. 35 pl. Price $1.15.

X. Dinocerata. A Monograph of an Extinct Order of Gigantic Mammals, by Othniel Charles Marsh. 1885. 4°. xviii, 243 pp. 56 l. 56 pl. Price $2.70.

XI. Geological History of Lake Lahontan, a Quaternary Lake of Northwestern Nevada, by Israel Cook Russell. 1885. 4°. xiv, 288 pp. 46 pl. Price $1.75.

XII. Geology and Mining Industry of Leadville, with atlas, by S. F. Emmons. 1886. 4°. xxix, 770 pp. 45 pl. and atlas of 35 sheets folio. Price $8.40.

The following are in press:

XIII. Geology of the Quicksilver Deposits of the Pacific Slope, with atlas, by George F. Becker.

XIV. The Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley, by J. S. Newberry.

The following are in preparation:

I. The Precious Metals, by Clarence King.

XV. Paleozoic Fishes of North America, by J. S. Newberry.

XVI. Younger Mesozoic Flora of Virginia, by William M. Fontaine.

XVII. Description of New Fossil Plants from the Dakota Group, by Leo Lesquereux.

— Gasteropoda of the New Jersey Cretaceous and Eocene Marls, by R. P. Whitfield.

— Geology of the Eureka Mining District, Nevada, with atlas, by Arnold Hague.

— Lake Bonneville, by G. K. Gilbert.

— Sauropoda, by Prof. O. C. Marsh.

— Stegosauria, by Prof. O. C. Marsh.

— Brontotheridæ, by Prof. O. C. Marsh.

— The Penokee-Gogebic Iron-Bearing Series of North Wisconsin and Michigan, by Roland D. Irving.

— Report on the Denver Coal Basin, by S. F. Emmons.

— Report on Silver Cliff and Ten-Mile Mining District, Colorado, by S. F. Emmons.

— Flora of the Dakota Group, by J. S. Newberry.

— The Glacial Lake Agassiz, by Warren Upham.

— Geology of the Potomac Formation in Virginia, by W. M. Fontaine.

BULLETINS.

Each of the Bulletins contains but one paper and is complete in itself. They are, however, numbered in a continuous series, and may be bound in volumes of convenient size. To facilitate this, each Bulletin has two paginations, one proper to itself and another which belongs to it as part of the volume.

Of this series of Bulletins Nos. 1 to 45 are already published, viz:

1. On Hypersthene-Andesite and on Triclinic Pyroxene in Augitic Rocks, by Whitman Cross, with a Geological Sketch of Buffalo Peaks, Colorado, by S. F. Emmons. 1883. 8°. 42 pp. 2 pl. Price 10 cents.

2. Gold and Silver Conversion Tables, giving the coining values of troy ounces of fine metal, etc., by Albert Williams, jr. 1883. 8°. 8 pp. Price 5 cents.

3. On the Fossil Faunas of the Upper Devonian, along the meridian of 76° 30′, from Tompkins County, New York, to Bradford County, Pennsylvania, by Henry S. Williams. 1884. 8°. 36 pp. Price 5 cents.

4. On Mesozoic Fossils, by Charles A. White. 1884. 8°. 36 pp. 9 pl. Price 5 cents.

5. A Dictionary of Altitudes in the United States, compiled by Henry Gannett. 1884. 8°. 325 pp. Price 20 cents.

6. Elevations in the Dominion of Canada, by J. W. Spencer. 1884. 8°. 43 pp. Price 5 cents.

7. Mapoteca Geologica Americana. A Catalogue of Geological Maps of America (North and South), 1752-1881, by Jules Marcou and John Belknap Marcou. 1884. 8°. 184 pp. Price 10 cents.

8. On Secondary Enlargements of Mineral Fragments in Certain Rocks, by R. D. Irving and C. R. Van Hise. 1884. 8°. 56 pp. 6 pl. Price 10 cents.

9. Report of work done in the Washington Laboratory during the fiscal year 1883-'84. F. W. Clarke, chief chemist; T. M. Chatard, assistant. 1884. 8°. 40 pp. Price 5 cents.

10. On the Cambrian Faunas of North America. Preliminary Studies, by Charles D. Walcott. 1884. 8°. 74 pp. 10 pl. Price 5 cents.

11. On the Quaternary and Recent Mollusca of the Great Basin, with Descriptions of New Forms, by R. Ellsworth Call. Introduced by a Sketch of the Quaternary Lakes of the Great Basin, by G. K. Gilbert. 1884. 8°. 66 pp. 6 pl. Price 5 cents.

12. A Crystallographic Study of the Thinolite of Lake Lahontan, by Edward S. Dana. 1884. 8°. 34 pp. 3 pl. Price 5 cents.

13. Boundaries of the United States and of the several States and Territories, by Henry Gannett. 1885. 8°. 135 pp. Price 10 cents.

14. The Electrical and Magnetic Properties of the Iron-Carburets, by Carl Barus and Vincent Strouhal. 1885. 8°. 238 pp. Price 15 cents.

15. On the Mesozoic and Cenozoic Paleontology of California, by Charles A. White. 1885. 8°. 33 pp. Price 5 cents.

50. Invertebrate Fossils from California, Oregon, Washington Territory, and Alaska, by C. A. White.

51. On the Subaërial Decay of Rocks and the Origin of the Red Color of Certain Formations, by Israel C. Russell.

52. Geology of the Island of Nantucket, by N. S. Shaler.

In preparation:

— Notes on the Geology of Southwestern Kansas, by Robert Hay.

— On the Glacial Boundary, by G. F. Wright.

— The Gabbros and Associated Rocks in Delaware, by F. D. Chester.

— Fossil Woods and Lignites of the Potomac Formation, by F. H. Knowlton.

— Mineralogy of the Pacific Coast, by W. H. Melville and Waldemar Lindgren.

— Report of Work Done in the Division of Chemistry and Physics, mainly during the fiscal year 1886–'87.

— A Report on the Thermo-Electrical Measurement and High Temperatures, by Carl Barus.

— The Greenstone Schist Areas of the Menominee and Marquette Regions of Michigan, by George H. Williams; with an Introduction by R. D. Irving.

— Bibliography of the Paleozoic Crustacea, by A. W. Vogdes.

STATISTICAL PAPERS.

A fourth series of publications, having special reference to the mineral resources of the United States, has been undertaken.

Of that series the following have been published:

Mineral Resources of the United States [1882], by Albert Williams, jr. 1883. 8°. xvii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1883 and 1884, by Albert Williams, jr. 1885. 8°. xiv, 1016 pp. Price 60 cents.

Mineral Resources of the United States, 1885. Division of Mining Statistics and Technology. 1886. 8°. vii, 576 pp. Price 40 cents.

Mineral Resources of the United States, 1886, by David T. Day. 1887. 8°. viii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1887, by David T. Day. 1888. 8°. Price — cents.

In preparation:

Mineral Resources of the United States, 1888, by David T. Day. 1889. 8°.

The money received from the sale of these publications is deposited in the Treasury, and the Secretary of that Department declines to receive bank checks, drafts, or postage stamps. All remittances, therefore, must be by POSTAL NOTE OR MONEY ORDER, made payable to the Librarian of the U. S. Geological Survey, or in CURRENCY, for the exact amount; and all correspondence relating to the publications of the Survey should be addressed

TO THE DIRECTOR OF THE
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

WASHINGTON, D. C., *November* 1, 1888.

NOTICE.

This volume, "Mineral Resources of the United States, 1887," is the fifth of a series which began in 1882. Its price is 50 cents. In ordering the different volumes of this series care should be taken to designate them as:

1. Mineral Resources of the United States, 1882. Price 50 cents.
2. Mineral Resources of the United States, 1883–'84. Price 60 cents.
3. Mineral Resources of the United States, 1885. Price 40 cents.
4. Mineral Resources of the United States, 1886. Price 50 cents.
5. Mineral Resources of the United States, 1887. Price 50 cents.

Remittances should be made by postal note (not stamps), and should be addressed to the Director United States Geological Survey, Washington, D. C.

Corrections, additions, or notice of important omissions, reports and maps of mines and mining districts, pamphlets on metallurgical processes, brief notes on new mineral localities, etc., will be highly appreciated, and should be addressed to David T. Day, U. S. Geological Survey, Washington, D. C. Duplicate copies of such reports, etc., are especially desired for extending the fine set of mining pamphlets in the library of the Survey, and will be thankfully acknowledged if sent to the

DIRECTOR UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C.

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LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF MINING STATISTICS AND TECHNOLOGY,
Washington, D. C., September 10, 1888.

SIR: I have the honor to transmit herewith the fifth volume of the series entitled "Mineral Resources of the United States." The present volume contains a summary statement of the mineral substances produced in the calendar year 1887, and chapters showing the features of the principal mining industries during that period. In accordance with your instructions it is proposed to issue a similar report early in 1889, extending the statistics to December 31, 1888.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

Hon. J. W. POWELL,
Director United States Geological Survey.

CONTENTS.

INTRODUCTION.

This volume is the fifth of the series "Mineral Resources of the United States." It extends the information contained in the previous volumes to include the calendar year 1887. The statistical tables have been brought forward, but with this exception only such information as is supplementary to the previous volumes should be looked for. Repetition of descriptive matter has been avoided wherever possible, therefore all the volumes should be consulted for complete information on any subject.

Uniformity of arrangement in all the volumes has been observed as nearly as consistent with the object of showing the changes constantly occurring in the mineral industries. Where a supplementary report was not necessary some subjects have been dropped from the list, while others have been dwelt upon at greater length. The methods of collecting the statistics and the units of quantity adopted are defined in the previous volumes. The units are those in common trade use for the particular substances treated, and are further explained in connection with each chapter. In cases of marked variance in trade usage, the terms least liable to confusion have been adopted; for example, the ton of 2,240 pounds is, in this report, called the "long" ton, and that of 2,000 pounds the "short" ton, the terms "gross" ton and "net" ton, although in common usage, being sometimes misleading; for instance, where a gross ton of ore may be taken to mean a ton (of perhaps only 2,000 pounds) including moisture and where net ton might be understood as referring to the weight after deducting the tare of package, etc.

Acknowledgments.—The names of contributors of special articles usually appear in connection with the subjects treated. In so far as possible the chief sources of information are noted in connection with each subject, although it is not possible to mention the many items which have been furnished by agents in the Pacific coast and Rocky Mountain divisions, or to give in detail the proper credit to the correspondents, now many thousands, who have given much valuable time and cheerful co-operation in preparing answers to the heavy demands upon their time and patience. The statistics of imports and exports are, as usual, taken from the reports of the Bureau of Statistics of the Treasury Department.

Publication.—In advance of the publication of the completed volume the principal statistics concerning the more important substances have been given prompt publication in special bulletins, and grateful acknowledgment is due to the active co-operation in this effort given by the daily and technical press.

MINERAL RESOURCES OF THE UNITED STATES.

CALENDAR YEAR 1887.

DAVID T. DAY,
Chief of Division of Mining Statistics and Technology.

SUMMARY, 1887.

METALS.

Iron.—The principal statistics for 1887 were: Domestic iron ore consumed, about 11,300,000 long tons; value at mines, $33,900,000. This is an increase over 1886 of 1,300,000 tons in quantity and $5,900,000 in value. Imported iron ore consumed, 1,194,301 long tons; total iron ore consumed in 1887, about 12,494,301 long tons, or 1,454,868 tons more than in 1886. Pig iron made, 6,417,148 long tons; value at furnace, $121,925,800. This is an increase over 1886 of 733,819 tons in quantity and $26,730,040 in value. Steel of all kinds produced, 3,339,071 long tons, an increase of 776,569 tons over 1886; value at works, $103,811,000. Total spot value of all iron and steel in the first stage of manufacture, excluding all duplications, $171,103,000, an increase of $28,603,000, as compared with 1886. Limestone, used as flux in the manufacture of pig iron in 1887, about 5,377,000 long tons; value at quarry, about $3,226,200.

Gold and silver.—The total value of gold produced in 1887 was $33,100,000, a decrease of $1,900,000 from 1886. Silver increased from $51,000,000 in 1886, to $53,441,300 (coining value) in 1887.

Copper.—Total production 184,670,524 pounds, of which 3,750,000 pounds were made from imported pyrites. The total value was $21,052,440, at an average of 11.4 cents per pound. The estimated total consumption of copper in the United States increased by about 14 per cent.

Lead.—The production of lead was 160,700 short tons, valued at $14,463,000 at $90 per short ton. The heavy increase of "desilverized" lead from 114,829 short tons in 1886 to 135,552 in 1887 was probably due to the importation of Mexican lead-silver ores. The large product of non-argentiferous lead, 25,148 short tons, is due chiefly to the development of the Saint Joe district in Missouri. The production of white lead, and the several oxides, from pig lead increased to a total of about 75,000 short tons.

Zinc.—The producers' returns show an increase from 42,641 short tons in 1886 to 50,340 in 1887. The price increased to 4¾ cents per pound, making the total value in 1887, $4,782,300. The production of zinc oxide was practically steady at 18,000 short tons, valued at $1,440,000.

Quicksilver.—Production and value increased from 29,981 flasks, valued at $1,060,000, to 33,825 flasks, valued at $1,429,000. Except 65 flasks from Oregon the total supply came from California. The price in 1887 varied from $36.50 to $48 per flask in San Francisco.

Nickel.—The supply includes 183,125 pounds of metallic nickel, valued at $117,200; 10,846 pounds of metallic nickel contained in matte, and 11,595 pounds contained in nickel ammonium sulphate. Total value, $133,200.

Cobalt oxide.—The product includes 5,769 pounds of cobalt oxide for potters' use, and 12,571 pounds of oxide in matte exported to Europe. Total value, $18,774.

Chromium.—Shipments from California increased to 3,000 long tons on account of better freight facilities by rail to the Eastern States. The total value in San Francisco was $40,000.

Manganese.—The total production of manganese ore in the year ending December 31, 1887, was 34,524 long tons, valued at $333,844. The production of manganiferous iron ore was 211,751 tons, valued at about $600,000. The production of argentiferous manganese ores was 60,000 tons, valued, chiefly for its silver, at about $600,000.

Antimony.—The production, all in California, was 75 tons, valued at $15,500. This is an increase from 35 tons in 1886, valued at $7,000.

Aluminum.—The production of aluminum bronze containing 10 per cent. of aluminum increased to 144,764 pounds in 1887, valued at $57,905. Other alloys, principally of iron and aluminum, amounted to 42,617 pounds, worth $17,000.

Platinum.—Considerable search by dealers produced 448 ounces of crude platinum, valued at $1,838. Part of this came from British Columbia.

FUELS.

Coal.—The total production of all kinds of commercial coal in 1887 was 124,015,255 short tons (increase over 1886, 16,333,046 tons), valued at the mines at $173,595,996 (increase, $26,483,241). This may be divided into Pennsylvania anthracite, 39,506,255 short tons (increase, 2,809,780 short tons), or 35,273,442 long tons (increase, 2,508,732 long tons), valued at $79,365,244 (increase, $7,807,118); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 6,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 84,509,000 short tons (increase, 13,523,266 tons), valued at $94,230,752 (increase, $18,-676,123).

The colliery consumption at the individual mines varies from nothing to 8 per cent. of the total output of the mines, being greatest at special Pennsylvania anthracite mines and lowest at those bituminous mines where the coal bed lies nearly horizontal and where no steam-power or ventilating furnaces are used. The averages for the different States vary from 2.1 to 6$\frac{1}{7}$ per cent., the minimum average being in the Pennsylvania bituminous and the maximum average in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was: Pennsylvania anthracite, 37,578,747 long tons (increase over 1886 2,725,670 long tons), or 42,088,197 short tons (increase, 3,052,751 short tons); all other coals, 87,887,360 short tons (increase, 14,179,403 tons); making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 129,975,557 short tons (increase, 17,232,154 tons), valued as follows: Anthracite, $84,552,181 (increase, $8,433,061); bituminous, $98,004,656 (increase, $19,523,600); total value, $182,556,837 (increase, $27,956,661). The above figures show a notable increase in 1887 over 1886 in the aggregate output and value of both anthracite and bituminous coal.

Coke.—The total production of coke in the United States for the year ending December 31, 1887, was 7,857,487 short tons, and was valued at $15,723,574. This is the greatest product ever reached in the United States, being 1,022,419 tons greater than in 1886.

Petroleum.—Total production, 28,249,597 barrels of 42 gallons each. The total value, at an average of 66$\frac{3}{4}$ cents, was $18,856,606. The increase over 1886 was very slight, only 139,482 barrels. There was a decrease of 4$\frac{1}{2}$ cents per barrel in the average price.

Natural gas.—The production of natural gas in the United States in 1887 was equivalent to 9,867,000 short tons of coal displaced. The value of the coal displaced by natural gas (which is the measure of the value of the gas) was $15,838,500. In 1886 the corresponding quantity was 6,353,000 tons, worth $9,847,150.

STRUCTURAL MATERIALS.

Building stone.—Direct returns from producers show a total value of $25,000,000. This marked increase shows that the statement for 1886 was too small.

Brick and tile.—Value, $47,000,000. This represents an increase of about 13 per cent. in the production of brick and a decrease in tile, owing to the drought in 1887 in Indiana and Ohio. Prices were slightly lower.

Lime.—The production is estimated at 46,750,000 barrels, with an average value of 50 cents per barrel.

Cement.—The production of cement from natural rock was 6,692,744 barrels, valued at 77½ cents per barrel, making $5,186,877 as the value of the year's product.

ABRASIVE MATERIALS.

Buhr-stones.—The value of the total product is estimated at $200,000.

Grindstones.—In Ohio and Michigan 37,400 tons were produced, valued at $224,400.

Corundum.—Total production from North Carolina and Georgia 600 short tons, with a spot value of $108,000.

Novaculite.—Production 1,200,000 pounds, valued in the rough state at $16,000.

Infusorial earth.—Maryland produced 3,000 short tons, worth $15,000. A small quantity was produced in Nevada and in New Mexico.

MISCELLANEOUS.

Precious stones.—The value of American gems in the rough state amounted to $88,600, besides gold quartz for specimens and gems, valued at $75,000.

Phosphate rock.—South Carolina phosphate rock, 480,558 long tons, valued at $1,836,818; an increase of 50,009 tons, but a decrease of $36,118 in value, due to greater competition, reducing the price to $3.75 per ton for land and $4 for river rock.

Marls.—In New Jersey the production is estimated at 600,000 tons, worth about $300,000. While the New Jersey marl is yielding slowly to commercial fertilizers, the Virginia marls, as well as those in North and South Carolina, Georgia, Mississippi, and Florida, are finding increased local use.

Salt.—Production in 1887, 7,831,962 barrels (of 280 pounds), value $4,093,846. The annual production has increased each year since 1883, but the total value has declined, being less in 1887 than in 1884, although only 6,514,937 barrels were made in that year.

Bromine.—Stocks accumulated in 1886 and reduced the output of 1887 to 199,087 pounds, valued at $61,717. The price was held at 31 cents per pound.

Borax.—Production, 11,000,000 pounds, all from California and Nevada. Total value, $550,000, at 5 cents per pound for the average grade. The price was rising at the close of 1887.

Sulphur.—Production about 3,000 tons from Utah, worth $100,000. Litigation checked the use of an increased plant. The imports of Sicilian sulphur, with small shipments from Japan, were 96,882 long tons, valued at $1,688,360.

Pyrites.—Production 52,500 long tons, valued at $210,000, at $4 per ton at the mines.

Barytes.—The production increased to 15,000 long tons of crude barytes, valued at $75,000 at the mines.

Gypsum.—The condition of the industry is practically unchanged. The estimated total product was 95,000 short tons of crude gypsum, valued at $425,000. In addition, there were imported 162,154 long tons of crude gypsum, chiefly from Nova Scotia.

Mica.—The production increased to 70,500 pounds, valued at $142,250. The increase was chiefly in North Carolina. New Hampshire, Massachusetts, and Virginia also produced mica. No shipments were reported from the Black Hills or New Mexico. The use of mica waste is increasing; 2,000 tons, worth $15,000, were ground in 1887.

Feldspar.—The amount consumed, principally by potters, was 10,200 long tons, valued at $56,100 before grinding. This includes freight to the principal markets, Trenton or New York. The consumption in 1886 was about 5,000 tons less than the production returned by quarrymen.

Flint.—For pottery 19,800 tons were used. Including the use for sand-paper and in glass manufacture, the total consumption was about 32,000 tons, worth, unground, $185,000.

Potters' clay.—The consumption of kaolin and ball clay by potters aggregated 28,000 tons, valued at $290,000. In addition, the potters used 15,000 tons of fire-clay, worth $50,000.

Asbestus.—The total product hardly exceeded 150 tons, worth $4,500. In addition, several hundred tons of fibrous actinolite were used for weighting paper.

Mineral paints.—Including ocher, metallic paints, and small quantities of umber and sienna, the production amounted to 20,000 long tons, selling for $310,000 at the mines.

Graphite.—The production at Ticonderoga is reported unchanged. Small lots ranging from graphitic clay to pure graphite were produced in North Carolina. Total production, 416,000 pounds, worth $34,000. This does not include 500 tons of impure graphite mined in Rhode Island for foundry facings.

Fluorspar.—The production remained constant at 5,000 tons in Indiana. The total value was $20,000.

Mineral waters.—The product which was sold amounted to 8,259,609 gallons, worth $1,261,473.

Totals.—The following tabular statement shows an aggregate value of $538,056,345 for the year. This is the largest total ever reached by the mineral industries of any country. It is nearly $73,000,000 more than the product of the United States in 1886 and considerably more than $100,000,000 in excess of the year 1885. Of many items which have contributed to this result it will be noted that all the metals increased in quantity, except gold and the minor metal, nickel, and nearly all increased in price. The significance of this is seen in the increased production of the fuels necessary for reducing these metals and preparing them for use. All of these fuels, including natural gas, show a marked increase. The increased value of building stone is principally due to a more careful canvass of this industry than has been possible in previous years. It is not probable that the great total recorded for 1887 will be equaled in the present year, 1888.

Metallic products of the United States in 1887.

	Quantity.	Value.
Pig iron, spot value....long tons..	6,417,148	$121,925,800
Silver, coining value....troy ounces..	41,269,240	53,441,300
Gold, coining value....do....	1,596,500	33,100,000
Copper, value at New York City....pounds..	184,670,524	21,052,440
Lead, value at New York City....short tons..	160,700	14,463,000
Zinc, value at New York City....do....	50,340	4,782,300
Quicksilver, value at San Francisco....flasks..	33,825	1,429,000
Nickel, value at Philadelphia....pounds..	205,556	133,200
Aluminum contained in alloys....	....	74,905
Antimony, value at San Francisco....short tons..	75	15,500
Platinum, value (crude) at New York City....troy ounces..	448	1,838
Total....	....	$250,419,283

Non-metallic mineral products of the United States in 1887 (*spot values*).

	Quantity.	Value.
Bituminous coal....long tons..	78,470,857	$98,004,656
Pennsylvania anthracite....do....	37,578,747	84,552,181
Building stone....	....	25,000,000
Lime....barrels..	46,750,000	23,375,000
Petroleum....do....	28,249,597	18,856,606
Natural gas....	....	15,838,500
Cement....barrels..	6,692,744	5,186,877
Salt....do....	7,831,962	4,093,846
Limestone for iron flux....long tons..	5,377,000	3,226,200
South Carolina phosphate rock....do....	480,558	1,836,818
Zinc-white....short tons..	18,000	1,440,000
Mineral waters....gallons sold..	8,259,609	1,261,473
Borax....pounds..	11,000,000	550,000
Gypsum....short tons..	95,000	425,000
Manganese ore....long tons..	34,524	333,844
Mineral paints....do....	20,000	310,000
New Jersey marls....short tons..	600,000	300,000
Pyrites....long tons..	52,500	210,000
Flint....do....	32,000	185,000
Mica....pounds..	70,500	142,250
Corundum....short tons..	600	108,000
Sulphur....do....	3,000	100,000
Precious stones....	....	88,600
Crude barytes....long tons..	15,000	75,000
Gold quartz, souvenirs, jewelry, etc....	....	75,000
Bromine....pounds..	199,087	61,717
Feldspar....long tons..	10,200	56,100
Chrome iron ore....do....	3,000	40,000

Non-metallic mineral products of the United States in 1887 (*spot values*)—Continued.

	Quantity.	Value.
Graphite .... pounds..	416,000	$34,000
Fluorspar .... short tons..	5,000	20,000
Slate, ground as pigment .... long tons..	2,000	20,000
Cobalt oxide .... pounds..	18,340	18,774
Novaculite .... do....	1,200,000	16,000
Asphaltum .... short tons..	4,000	16,000
Asbestus .... do....	150	4,500
Rutile .... pounds..	1,000	3,000
Total	....	$285,864,942

Résumé of the values of the metallic and non-metallic mineral substances produced in the United States in 1887.

Metals	$250,419,283
Mineral substances named in the foregoing table	285,864,942
	536,284,225
Estimated value of mineral products unspecified	6,000,000
Grand total	$542,284,225

Summary of the mineral products of the United

	Products.	1882.		1883.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, spot value....long tons..	4, 623, 323	$106, 336, 429	4, 595, 510	$91, 910, 200
2	Silver, coining value....troy ounces..	36, 197, 695	46, 800, 000	35, 733, 622	46, 200, 000
3	Gold, coining value....do....	1, 572, 186	32, 500, 000	1, 451, 249	30, 000, 000
4	Copper, value at New York City....pounds..	91, 646, 232	16, 038, 091	117, 151, 795	18, 064, 807
5	Lead, value at New York City....short tons..	132, 890	12, 624, 550	143, 957	12, 322, 719
6	Zinc, value at New York City....do....	33, 765	3, 646, 620	36, 872	3, 311, 106
7	Quicksilver, value at San Francisco....flasks..	52, 732	1, 487, 042	46, 725	1, 253, 632
8	Nickel, value at Philadelphia....pounds..	281, 616	309, 777	58, 800	52, 920
9	Aluminum, value at Philadelphia.troy ounces..	....	....	1, 000	875
10	Antimony, value at San Francisco.short tons..	60	12, 000	60	12, 000
11	Platinum, value (crude) at New York City, troy ounces....	200	600	200	600
	Total value metallic products....	....	219, 755, 109	....	203, 128, 859
	NON-METALLIC (SPOT VALUES).				
12	Bituminous coal....long tons..	60, 861, 190	76, 076, 487	68, 531, 500	82, 237, 800
13	Pennsylvania anthracite....do....	31, 358, 264	70, 556, 094	34, 336, 469	77, 257, 055
14	Building stone....	....	21, 000, 000	....	20, 000, 000
15	Lime....barrels..	31, 000, 000	21, 700, 000	32, 000, 000	19, 200, 000
16	Petroleum....do....	30, 053, 500	23, 704, 698	23, 400, 229	25, 740, 252
17	Natural gas....		215, 000		475, 000
18	Cement....barrels..	3, 250, 000	3, 672, 750	4, 190, 000	4, 293, 500
19	Salt....do....	6, 412, 373	4, 340, 140	6, 192, 231	4, 211, 042
20	Limestone for iron flux....long tons..	3, 850, 000	2, 310, 000	3, 814, 273	1, 907, 136
21	South Carolina phosphate rock....do....	332, 077	1, 992, 462	378, 380	2, 270, 280
22	Zinc-white....short tons..	10, 000	700, 000	12, 000	840, 000
23	Mineral waters....gallons sold..	....	....	7, 529, 423	1, 119, 603
24	Borax....pounds..	4, 236, 291	338, 903	6, 500, 000	585, 000
25	Gypsum....short tons..	....	....	....	....
26	Manganese ore....long tons..	3, 500	52, 500	8, 000	120, 000
27	Mineral paints....do....	7, 000	105, 000	7, 000	84, 000
28	New Jersey marls....short tons..	1, 080, 000	540, 000	972, 000	486, 000
29	Pyrites....long tons..	12, 000	72, 000	25, 000	137, 500
30	Flint....do....	25, 000	100, 000	25, 000	100, 000
31	Mica....pounds..	100, 000	250, 000	114, 000	285, 000
32	Corundum....short tons..	500	80, 000	550	100, 000
33	Sulphur....do....	600	21, 000	1, 000	27, 000
34	Precious stones....	....	75, 000	....	74, 050
35	Gold-quartz souvenirs, jewelry, etc	....	75, 000	....	115, 000
36	Crude barytes....long tons..	20, 000	80, 000	27, 000	108, 000
37	Bromine....pounds..	250, 000	75, 000	301, 100	72, 264
38	Feldspar....long tons..	14, 000	70, 000	14, 100	71, 112
39	Chrome iron ore....do....	2, 500	50, 000	3, 000	60, 000
40	Graphite....pounds..	425, 000	34, 000	575, 000	46, 000
41	Fluorspar....short tons..	4, 000	20, 000	4, 000	20, 000
42	Slate ground as a pigment....long tons..	2, 000	24, 000	2, 000	24, 000
43	Cobalt oxide....pounds..	11, 653	32, 046	1, 096	2, 795
44	Novaculite....do....	....	....	....	....
45	Asphaltum....short tons..	3, 000	10, 500	3, 000	10, 500
46	Asbestus....do....	1, 200	36, 000	1, 000	30, 000
47	Rutile....pounds..	500	1, 800	550	2, 000
	Total value non-metallic mineral products	....	228, 410, 380	....	242, 111, 889
	Total value metallic products....	....	219, 755, 109	....	203, 128, 859
	Estimated value of mineral products unspecified....	....	8, 000, 000	....	8, 000, 000
	Grand total....	....	456, 165, 489	....	453, 240, 748

States, calendar years 1882 *to* 1887 *inclusive.*

1884.		1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4, 097, 868	$73, 761, 624	4, 044, 525	$64, 712, 400	5, 683, 329	$95, 195, 760	6, 417, 148	$121, 925, 800	1
37, 744, 605	48, 800, 000	39, 910, 279	51, 600, 000	39, 445, 312	51, 000, 000	41, 269, 240	53, 441, 300	2
1, 489, 949	30, 800, 000	1, 538, 376	31, 801, 000	1, 881, 250	35, 000, 000	1, 596, 500	33, 100, 000	3
147, 805, 407	18, 106, 162	170, 962, 607	18, 292, 999	161, 235, 381	16, 527, 651	184, 670, 524	21, 052, 440	4
139, 897	10, 537, 042	129, 412	10, 469, 431	135, 629	12, 667, 749	160, 700	14, 463, 000	5
38, 544	3, 422, 707	40, 688	3, 539, 856	42, 641	3, 752, 408	50, 340	4, 782, 300	6
31, 913	936, 327	32, 073	979, 189	29, 981	1, 060, 000	33, 825	1, 429, 000	7
64, 550	48, 412	277, 904	191, 753	214, 992	127, 157	205, 556	133, 200	8
1, 800	1, 350	3, 400	2, 550	....	27, 000	....	74, 905	9
60	12, 000	50	10, 000	35	7, 000	75	15, 500	10
150	450	250	187	50	100	448	1, 838	11
....	186, 426, 074	....	181, 599, 365	....	215, 364, 825	....	250, 419, 283	
73, 730, 539	77, 417, 066	64, 840, 668	82, 347, 648	65, 810, 676	78, 481, 056	78, 470, 857	98, 004, 656	12
33, 175, 756	66, 351, 512	34, 228, 548	76, 671, 948	34, 853, 077	76, 119, 120	37, 578, 747	84, 552, 181	13
....	19, 000, 000	....	19, 000, 000	....	19, 000, 000	....	25, 000, 000	14
37, 000, 000	18, 500, 000	40, 000, 000	20, 000, 000	42, 500, 000	21, 250, 000	46, 750, 000	23, 375, 000	15
24, 089, 758	20, 476, 294	21, 842, 041	19, 193, 694	28, 110, 115	20, 028, 457	28, 249, 597	18, 856, 606	16
....	1, 460, 000	....	4, 854, 200	....	9, 847, 150	....	15, 838, 500	17
4, 000, 000	3, 720, 000	4, 150, 000	3, 492, 500	4, 500, 000	3, 990, 000	6, 692, 744	5, 186, 877	18
6, 514, 937	4, 197, 734	7, 038, 653	4, 825, 345	7, 707, 081	4, 736, 585	7, 831, 962	4, 093, 846	19
3, 401, 930	1, 709, 965	3, 356, 956	1, 678, 478	4, 717, 163	2, 830, 297	5, 377, 000	3, 226, 200	20
431, 779	2, 374, 784	437, 856	2, 846, 064	430, 549	1, 872, 936	480, 558	1, 836, 818	21
13, 000	910, 000	15, 000	1, 050, 000	18, 000	1, 440, 000	18, 000	1, 440, 000	22
10, 215, 328	1, 459, 143	9, 148, 401	1, 312, 845	8, 950, 317	1, 284, 070	8, 259, 609	1, 261, 473	23
7, 000, 000	490, 000	8, 000, 000	480, 000	9, 778, 290	488, 915	11, 000, 000	550, 000	24
....	....	90, 405	405, 000	95, 250	428, 625	95, 000	425, 000	25
10, 000	120, 000	23, 258	190, 281	30, 193	277, 636	34, 524	333, 844	26
7, 000	84, 000	3, 950	43, 575	15, 800	285, 000	20, 000	310, 000	27
875, 000	437, 500	875, 000	437, 500	800, 000	400, 000	600, 000	300, 000	28
35, 000	175, 000	49, 000	220, 500	55, 000	247, 500	52, 500	210, 000	29
30, 000	120, 000	30, 000	120, 000	30, 000	120, 000	32, 000	185, 000	30
147, 410	368, 525	92, 000	161, 000	40, 000	70, 000	70, 500	142, 250	31
600	108, 000	600	108, 000	645	116, 190	600	108, 000	32
500	12, 000	715	17, 875	2, 500	75, 000	3, 000	100, 000	33
....	82, 975	....	69, 900	....	79, 056	....	88, 600	34
....	140, 000	....	140, 000	....	40, 000	....	75, 000	35
25, 000	100, 000	15, 000	75, 000	10, 000	50, 000	15, 000	75, 000	36
281, 100	67, 464	310, 000	89, 900	428, 334	141, 350	199, 087	61, 717	37
10, 900	55, 112	13, 600	68, 000	14, 900	74, 500	10, 200	56, 100	38
2, 000	35, 000	2, 700	40, 000	2, 000	30, 000	3, 000	40, 000	39
....	....	327, 883	26, 231	415, 525	33, 242	416, 000	34, 000	40
4, 000	20, 000	5, 000	22, 500	5, 000	22, 500	5, 000	20, 000	41
2, 000	20, 000	1, 975	24, 687	3, 000	30, 000	2, 000	20, 000	42
2, 000	5, 100	68, 723	65, 373	....	36, 878	18, 340	18, 774	43
....	....	1, 000, 000	15, 000	1, 160, 000	15, 000	1, 200, 000	16, 000	44
3, 000	10, 500	3, 000	10, 500	3, 500	14, 000	4, 000	16, 000	45
1, 000	30, 000	300	9, 000	200	6, 000	150	4, 500	46
600	2, 000	600	2, 000	600	2, 000	1, 000	3, 000	47
....	220, 059, 674	....	240, 114, 544	....	243, 963, 063	....	285, 864, 942	
....	186, 426, 074	....	181, 599, 365	....	215, 364, 825	....	250, 419, 283	
....	7, 000, 000	....	7, 000, 000	....	6, 000, 000	....	6, 000, 000	
....	413, 485, 748	....	428, 713, 909	....	465, 327, 888	....	542, 284, 225	

IRON.

THE IRON AND STEEL INDUSTRIES OF THE UNITED STATES IN 1887 AND 1888.

By James M. Swank,

General Manager of the American Iron and Steel Association.

Production, importation, and consumption of iron and steel in 1887.—If 1886 was a remarkable year in the manufacture of iron and steel in the United States, 1887 was certainly a phenomenal year. The aggregate production of these articles in 1887 was not only larger than that of 1886, but it was very much larger. The most progressive of our iron and steel manufacturers only ten years ago never dreamed of such wonderful results as have just been accomplished.

Our production of iron and steel in 1887 was as follows, compared with that of 1885 and 1886, and also compared with our production in the centennial year 1876:

Production of iron and steel in 1887.

Products short tons of 2,000 pounds, except nails.	1876.	1885.	1886.	1887.
Pig iron	2,093,236	4,529,869	6,365,328	7,187,206
Bessemer steel ingots	525,996	1,701,762	2,541,493	3,288,357
Bessemer steel rails	412,461	1,074,607	1,763,667	2,354,132
Open-hearth steel ingots	21,490	149,381	245,250	360,717
Open-hearth steel rails	none.	4,793	5,255	19,203
Crucible steel ingots	39,382	64,511	80,609	84,421
Rolled iron, except rails	1,042,101	1,789,711	2,259,943	2,565,438
Iron rails	467,168	14,815	23,679	23,062
Pig, scrap, and ore blooms	44,628	41,700	41,909	43,306
Cut nails, in kegs of 100 pounds	4,157,814	6,696,815	8,160,973	6,908,870

No calculation of percentages which could be added to this table would more graphically exhibit our growth as iron and steel manufacturers from 1876 to 1885, and from 1885 to 1887, than the figures themselves when read across the page. No other nation can present a record of metallurgical progress which is at all comparable with this. Our progress from 1885 to 1887, especially in the manufacture of pig iron, Bessemer steel, and Bessemer steel rails, may well excite the world's wonder.

Our production of pig iron in 1887 was obtained in twenty-two States and one Territory; our production of rolled iron in twenty-six States and one Territory; our production of Bessemer steel in eleven States;

our production of open-hearth steel in nine States; and our production of crucible steel in ten States.

The following table shows the production of leading articles of iron and steel in the United States, by States, in the calendar year 1887:

Production of leading articles of iron and steel in 1887.

States and Territories.	Short tons of 2,000 pounds, except nails.						
	Pig-iron.	Rolled iron, including iron rails.	Iron and steel cut nails, kegs of 100 pounds.	Steel rails.	Total iron and steel rails.	Bessemer steel ingots and other steel.	Blooms from pig, scrap, and iron ore.
Maine	4,397	8,097					
Vermont							
New Hampshire		4,680				3,640	
Massachusetts	11,114	45,853	267,453	40,683	40,683	51,332	
Rhode Island		12,622					
Connecticut	21,741	13,849				2,400	
New England	37,252	85,101	267,453	40,683	40,683	57,372	
New York	296,572	112,688		90,875	90,875	132,289	15,043
New Jersey	172,554	73,844	346,117			13,299	1,062
Pennsylvania	3,684,618	1,361,270	2,238,165	1,283,639	1,292,986	2,094,411	21,982
Delaware		43,864					
Middle States	4,153,744	1,591,666	2,584,282	1,374,514	1,383,861	2,239,999	38,087
Maryland	37,427	20,790				750	5,074
District of Columbia							
Virginia	175,715	49,967	250,519			100	
North Carolina	3,640						
Georgia	40,947						
Alabama	292,762	24,443	54,000		1,270		
Texas	4,383	1,131			504		
West Virginia	82,311	10,730	827,325	1,684	1,684	96,935	
Kentucky	41,907	51,267	159,720		100		
Tennessee	250,344	16,547	36,473	7,040	9,040	9,147	45
Southern States	929,436	174,875	1,328,037	8,724	12,598	106,932	5,119
Ohio	975,539	408,263	1,672,128	84,193	88,199	318,765	100
Indiana	13,211	46,904	399,040	3,000	5,445	7,560	
Illinois	565,453	143,206	275,072	728,526	729,717	859,119	
Missouri	138,643	14,354		105,128	105,128	117,637	
Iowa		200					
Michigan	213,543	29,717				2,215	
Wisconsin	133,508	38,265	78,940	1,898	1,898		
Minnesota		1,400					
Nebraska							
Western States	2,039,897	682,309	2,425,180	922,745	930,387	1,305,296	100
Colorado	25,291	4,664	45,725	18,450	19,421	24,850	
Wyoming Territory		7,699			599		
California		42,186	258,193	8,219	8,848	5,311	
Oregon							
Washington Territory	1,586						
Far Western States	26,877	54,549	303,918	26,669	28,868	30,161	
Grand total	7,187,206	2,588,500	6,908,870	2,373,335	2,396,397	3,739,760	43,306

But, if our production of iron and steel in 1887 was so large that it was a surprise and a marvel, our consumption of both these products in that year was still more surprising and still more marvelous, for we not only consumed virtually all of these products which we ourselves produced but we consumed a large additional quantity which we imported from foreign countries. We also worked into new forms and consumed many thousand tons of rails, taken from the tracks of American railroads, and of scrap iron and scrap steel obtained from various domestic sources.

In the calendar year 1887 we imported 1,997,241 short tons of iron and steel in miscellaneous forms, in addition to our imports of machinery, cutlery, fire-arms, and other minor manufactures of iron and steel the weight of which is not obtainable, all of which imports may be assumed to have entered into consumption in the year in which they were imported. The following table presents the statistics, derived from official Government sources, of our imports of iron and steel in the calendar years 1884, 1885, 1886, and 1887:

Imports of iron and steel.

Commodities (short tons of 2,000 pounds).	1884.	1885.	1886.	1887.
Pig iron	206, 381	164, 349	405, 180	523, 625
Scrap iron	30, 192	15, 480	97, 635	351, 028
Scrap steel	8, 388	2, 196	11, 353	29, 716
Bar iron	40, 998	35, 251	32, 647	40, 565
Iron rails	94	57	7	270
Steel rails	3, 074	2, 395	46, 571	154, 099
Cotton ties	17, 518	20, 576	11, 561	24, 276
Hoop, band, and scroll iron	332	103	128	35
Steel hoops, sheets, and plates	1, 500	2, 644	4, 719	26, 885
Steel ingots, bars, etc	24, 610	33, 718	167, 257	347, 818
Sheet, plate, and taggers' iron	7, 863	6, 200	6, 852	8, 012
Tin plates and terne plates	242, 123	256, 028	288, 761	317, 896
Iron and steel wire rods	145, 525	105, 148	153, 401	167, 272
Wire and wire rope	2, 732	2, 475	2, 689	3, 247
Anvils, forgings, etc	967	642	963	1, 474
Chains	963	633	669	1, 023
Total	733, 260	647, 895	1, 230, 393	1, 997, 241

Our consumption of iron and steel in 1887 embraced, therefore, first, our own production of these articles in that year; next, the very heavy imports of the year; and, lastly, a large but unknown quantity of old iron and steel of domestic origin, the grand total being far in excess of our consumption of iron and steel in any previous year, and far in excess also of that of any other country in 1887 or any other year. Indeed, we have annually for several years consumed more iron and steel than any of the great European countries. In 1887 our consumption of finished iron and steel exceeded 300 pounds per capita, estimating our population for the year at 60,000,000. The per capita consumption of iron and steel by the United States is greater than that of any other country.

We have never imported so large a quantity of iron and steel in any year as in 1887, except in the "boom" year 1880, when the imports amounted to 2,112,341 short tons. The imports in 1887 were over 62 per cent. greater than in 1886. In 1886 they were almost 90 per cent. greater than in 1885. The imports into the United States of iron and steel and manufactures thereof from Great Britain alone amounted in 1887 to 1,436,338 short tons, which was more than one-fourth of the total British exports of these articles in that year. From 1880 to 1887, both years included, we imported a larger aggregate of iron and steel products from Great Britain than was imported from the mother country by all the British colonies in Asia, Africa, Australia, and America.

The foreign value of all the imports into the United States of iron and steel and manufactures thereof in 1887 was \$56,420,607, and in 1886 it was \$41,630,779, or nearly \$100,000,000 in the two years.

Nearly one-half of all the iron ore consumed and nearly one-half of all the pig iron produced in the United States in 1887 were absorbed by our Bessemer steel industry, which also created a market for about one-third of all the fuel and about one-half of all the limestone that our iron and steel industries of every description required in that year.

Production of iron and steel in the first half of 1888.—The iron and steel industries of the United States are not so prosperous in 1888 as they were in 1887. The demand is much less, and production and imports have both declined. Our consumption of iron and steel will be much less in 1888 than in 1887.

The total production of pig iron in the United States in the first six months of 1888 amounted to 3,382,503 short tons, or 3,020,092 long tons. Our production in the last six months of 1887 was 3,771,996 short tons, or 3,367,853 long tons. The production in the first half of 1888 was 347,761 long tons less than in the second half of 1887. Our decreased production in the first half of 1888, as compared with the last half of 1887, was wholly in Bessemer pig iron, as the following figures will show:

Comparison of the production of pig iron in the last half of 1887 *with the first half of* 1888.

Short tons.	Last half 1887.	First half 1888.
Total production	3,771,996	3,382,503
Bessemer pig iron and spiegeleisen	1,770,550	1,341,091
Foundry and mill pig iron	2,001,446	2,041,412

These figures show that the production of foundry and mill pig iron in the first half of 1888 was slightly in excess of that of the last half of 1887. But the decrease in Bessemer pig iron was very great. All the important northern and western pig iron producing States show a decreased production of pig iron in the first half of 1888 as compared with the last half of 1887, except Ohio, whose production in the first six months of 1888 was the highest attained in the history of the State in a similar period. The production of pig iron by the nine southern States of Alabama, Tennessee, Virginia, West Virginia, Kentucky, Georgia, Maryland, Texas, and North Carolina in the first half of 1888 was 485,852 short tons, against 484,210 short tons in the last half of 1887.

The production of Bessemer steel ingots in the United States in the first half of 1888, including 36,070 short tons of Clapp-Griffiths ingots, was 1,384,288 short tons, or 1,235,971 long tons, against 1,650,785 short tons, or 1,473,915 long tons, in the last half of 1887, a decrease of 237,944 long tons.

The production of Bessemer steel rails in the first half of 1888 was 775,261 short tons, or 692,197 long tons, against 1,146,117 short tons, or 1,023,320 long tons, in the last half of 1887, showing a decrease of 331,123 long tons. These figures do not include a few thousand tons of Bessemer steel rails rolled in each period in iron rollingmills from purchased blooms. The production of Bessemer steel rails in the first half of 1888 was reduced much more than that of ingots, indicating an increased use of Bessemer steel for miscellaneous purposes thus far in 1888 of nearly 100,000 long tons over the last half of 1887.

Prices of iron and steel in 1887 *and* 1888.—During 1886 the prices of iron and steel in the United States advanced slowly, and in the early part of 1887 this advancing movement was maintained, but in the remainder of the year prices steadily declined. Thus far in 1888 the decline has continued, and prices of most products are now as low as in the dull year 1885. In May, 1888, prices of pig iron suddenly fell off one dollar and two dollars per ton. The average prices of leading articles during 1887 and the first half of 1888 have been as follows—the first five articles per long ton, the next two per pound, and the last named per keg of 100 pounds:

Average prices of leading articles of iron and steel in 1887 *and the first half of* 1888.

Months.	Old iron T rails, at Philadelphia.	No. 1 anthracite foundry pig iron, at Philadelphia.	Gray forge pig iron, at Philadelphia.	Gray forge pig iron, Lake ore mixed, at Pittsburgh.	Steel rails, at mills in Pennsylvania.	Best refined bar iron, from store, Philadelphia.	All muck bar iron, at Pittsburgh.	Iron nails (gross price), at Pittsburgh.
						Cents.	Cents.	
January, 1887	$25.25	$21.50	$18.50	$20.50	$38.50	2.15	2.0	$2.35
February	24.00	21.50	19.00	21.00	39.50	2.25	2.0	2.60
March	23.00	21.00	19.00	20.50	39.50	2.3	2.0	2.60
April	22.75	20.75	18.50	20.25	39.25	2.3	2.0	2.35
May	21.85	20.85	18.00	19.00	39.00	2.3	2.0	2.15
June	22.60	21.00	17.85	18.50	39.00	2.2	2.0	2.05
July	23.50	21.00	17.60	18.50	38.50	2.2	1.9	2.00
August	24.00	21.00	17.25	18.50	37.00	2.2	1.9	2.00
September	22.75	21.00	17.00	18.50	36.00	2.2	1.9	2.00
October	22.00	20.50	17.00	18.25	34.25	2.15	1.9	2.00
November	22.00	20.50	17.00	17.75	32.50	2.1	1.9	1.85
December	22.00	20.50	16.75	17.00	32.00	2.1	1.85	1.90
January, 1888	21.75	21.00	16.75	17.00	31.50	2.2	1.85	1.90
February	22.00	20.75	17.00	16.75	31.50	2.2	1.80	1.90
March	21.50	20.50	17.00	16.50	31.50	2.1	1.80	1.90
April	21.50	19.75	16.50	15.65	31.50	1.95	1.75	1.90
May	21.75	18.50	16.00	15.50	31.00	1.90	1.75	1.90
June	21.00	18.00	15.75	15.25	30.00	1.85	1.70	1.90

In the following table are given the yearly prices of a standard brand of American pig iron from 1842 to 1888:

Average prices per long ton of No. 1 *anthracite foundry pig iron at Philadelphia since* 1842.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.
1842	......	......	......	......	$27	$27	$26⅓	$24⅛	$25⅛	$25	$25	$25	......
1844	$24	$24	$24	$24	24	26⅛	26½	26½	27¼	28	27½	26¾	$25¾
1845	26¾	26½	27¾	33⅛	34⅛	33	31	28⅓	27	26⅞	28⅓	28	29¼
1846	28	28	28¼	28	28½	28	29	26⅛	27¼	27	28½	28⅛	27⅞
1847	28½	28½	28⅝	29	29	28⅝	28	28½	30⅛	33¾	35¾	33¾	30¼
1848	31	28½	27¼	26⅝	26½	26½	25¾	25⅜	25⅛	25	25	24⅞	26⅛
1849	25	24½	24¾	24	23½	23	22¾	22½	21⅛	21½	20	21	22¾
1850	21	21	20⅜	20⅞	20⅞	20⅛	20	20⅜	21	21	21	21¾	20⅞
1851	21½	22	22	22	21½	21½	21	21	21	21	21	21	21⅜
1852	21¼	21¼	20¾	20⅜	20¼	20½	20¼	21¼	23¼	26½	27¾	28¼	22⅝
1853	32¾	36⅞	35⅝	35⅞	35⅞	36	36	36	36¼	37⅓	37⅝	36¾	36⅛
1854	37	36¼	37	38	38	38	38	38	37¾	36½	35½	32⅞	36⅞
1855	31⅛	29½	27½	26¾	26½	26½	26⅛	26½	28	28⅝	28½	27¾	27¾
1856	27½	27½	27⅜	28	28	27⅝	27	27	27	26⅞	26	26	27⅛
1857	26¼	26½	26⅝	27¾	27⅞	27¾	27¼	26¾	26⅜	25¾	23½	23¾	26⅜
1858	23½	22½	22½	22⅛	22½	22⅛	21⅜	21½	22	21½	21½	22½	22¼
1859	22¾	23⅝	24½	23⅞	23½	23⅛	23	23⅛	22⅞	23¼	23¼	23⅛	23⅜
1860	23	23	23⅜	22⅝	22¾	22¾	22¾	22½	22¼	22⅜	22¾	22½	22¾
1861	22⅛	21¾	21¼	21⅞	21⅛	20½	19⅞	18¾	18¾	18⅝	18⅞	19⅝	20¼
1862	20	20¾	20¾	21⅛	21½	22¾	24	24⅜	24½	25¼	30½	31⅛	23⅞
1863	32	33¼	35½	36	34¾	33½	32¾	31¾	33	35¾	41⅛	43½	35¼
1864	43⅛	48⅝	50⅛	54½	57¼	57⅝	69⅓	*a*73⅝	72¼	63¾	61½	59⅛	*c*59¼
1865	58⅛	53⅛	50⅜	45½	39⅛	35	35⅔	40⅛	44⅓	49⅞	51	50¾	46⅛
1866	50⅜	49	46⅛	41¾	41⅜	43⅞	46½	47¼	48⅛	48¾	49½	49½	46⅞
1867	48¾	46½	44¾	41	42¾	43	43⅓	44	44½	44½	43¾	42⅛	44⅛
1868	38⅔	36¾	37⅞	38⅓	37	37	38⅛	39½	40⅙	41⅜	42⅞	43¼	39¼
1869	42	40¼	41½	40	39½	40⅞	41⅝	41⅛	40¾	40½	39¾	39½	40⅝
1870	36¼	34½	34½	33½	33¼	32½	32¾	33½	33¼	32¼	31½	31¼	33¼
1871	30½	30⅞	34¼	35⅜	35½	35	35¾	36	36½	36⅜	37¼	37¼	35⅛
1872	37	40¾	47	49½	49½	53⅜	51⅛	52¾	53⅞	53⅓	51¼	47⅝	48⅞
1873	45⅛	48	48⅜	47¾	46	45	43¾	43½	42½	38	33	32½	42¾
1874	32	32	32	32	31½	31½	31½	31	29½	29	26¼	24	30¼
1875	25⅔	26½	27	27	26	26	26	26	25	24	23¾	23½	25⅛
1876	23¼	23	23	22¾	22	22	22	22	21¾	21¾	21½	21¼	22¼
1877	20¾	20	20	19½	19	18¾	18¼	18	18¼	18½	18	18	18⅞
1878	18½	18½	18½	18½	18	17¼	17¼	17½	17½	17	*b*16½	17	*d*17⅝
1879	17¼	17½	17⅞	18	18½	18¾	19¼	20¾	24¼	30	28	30½	21⅛
1880	40	41	37½	31	25	23	23½	25	23¼	23	24½	25	28⅛
1881	25	25½	26	25	25	24	24½	24½	25¼	25½	25¾	26	25⅛
1882	26	26	25¾	25½	25½	25½	25½	25½	26	26¼	26	25¾	25¾
1883	25	24½	24	23½	22	21	21½	22	22	21½	21	21	22⅜
1884	20½	20½	20½	20	20	20	20	19½	19½	19½	19¼	18½	19⅞
1885	18	18	18	18	17⅞	17¾	17¾	17¾	18	18¼	18¼	18¼	18
1886	18½	18½	18¾	18½	18½	18¼	18¼	18¼	18½	19	19½	20	18¾
1887	21½	21½	21	20¾	20⅞	21	21	21	21	20½	20½	20½	21
1888	21	20¾	20½	19¾	18½	18	......	......	......	......	......	......	......

a Highest average for month, $73⅝—August, 1864.
b Lowest average for month, $16½—November, 1878.
c Highest average for year, $59¼—1864.
d Lowest average for year, $17⅝—1878.

Production and importation of iron ore in 1887.—The total production of iron ore in the United States can not be exactly ascertained except in census years, but it may be very closely estimated for each year, while exact statistics for leading districts are always obtainable. We estimate the total quantity of iron ore consumed in the United States in 1887 at 12,500,000 long tons, against a little over 11,000,000 tons in 1886. Our imports of iron ore in 1887 amounted to 1,194,301 long tons; this amount subtracted from the amount consumed would leave, in round numbers, 11,300,000 tons as the production of domestic mines in 1887 which entered into consumption, against 10,000,000 tons in 1886. Nearly all the figures given in the following table represent shipments from the mines, and take no account of the ore that is left in the stock piles, from year to year, either at the mines or at ports of delivery.

Production of iron ore in leading districts.

Districts.	Long tons.	
	1886.	1887.
Lake Superior mines of Michigan and Wisconsin	3, 263, 961	4, 344, 651
Vermilion Lake mines of Minnesota	304, 396	394, 252
Missouri mines	379, 776	427, 785
Cornwall, Pennsylvania	688, 054	667, 210
New Jersey mines	500, 501	547, 889
Chateaugay mines, near Lake Champlain, New York	214, 800	219, 390
Crown Point mines, New York	60, 084	64, 940
Port Henry mines, New York	298, 868	428, 522
Other Lake Champlain mines, New York	15, 000	29, 000
Hudson River Ore and Iron Company, New York	75, 000	142, 422
Tilly Foster mines, New York	17, 728	14, 316
Forest of Dean mines, New York	18, 000	21, 164
Salisbury region, Connecticut	36, 000	30, 000
Cranberry mines, North Carolina	24, 106	45, 032
Tennessee Coal, Iron and Railroad Company's Inman mines	81, 650	102, 601
Ohio (whole State)	344, 484	377, 465
Alleghany county, Virginia, (statistics not collected in 1886)	....	150, 000
Preston county, West Virginia, (statistics not collected in 1886)	....	15, 408
Calhoun, Etowah, and Shelby counties, Alabama (statistics not collected in 1886).	....	129, 000
Total of the above districts	6, 322, 408	8, 151, 047

The iron ore actually taken from the mines in 1887 largely exceeded that which was consumed, as the stimulus of high prices led to an overproduction, particularly in the Lake Superior region. Iron ore was sent to market from this region in large quantities which was still unsold at the opening of navigation in 1888. The total quantity of iron ore on the docks at Lake Erie ports at the opening of navigation in 1888 was 703,720 long tons, or nearly five times the surplus at the beginning of 1887. The total quantity of ore on the docks at these ports at the opening of navigation in the past six years has been reported to the "Iron Trade Review," of Cleveland, as follows:

Total quantity of iron ore on the docks at Lake Erie ports at the opening of navigation.

Years.	Long tons.	Years.	Long tons.
1883	524, 749	1886	313, 321
1884	388, 739	1887	149, 304
1885	556, 657	1888	703, 720

In the following table the shipments of iron ore from the mines in the Lake Superior region in the last four years are given in the revised figures of the *Marquette Mining Journal.*

Iron ore shipments from the mines of Lake Superior, 1884 *to* 1887.

Districts.	Long tons.			
	1884.	1885.	1886.	1887.
Marquette range, Michigan	1, 558, 033	1, 430, 422	1, 627, 383	1, 860, 043
Menominee range, Michigan and Wisconsin	895, 634	690, 435	880, 006	1, 199, 343
Gogebic range, Michigan and Wisconsin	1, 022	119, 756	756, 572	1, 285, 265
Vermilion lake, Minnesota	62, 124	225, 484	304, 396	394, 252
Miscellaneous mines, Michigan	1, 879	441	....	....
Total	2, 518, 692	2, 466, 538	3, 568, 357	4, 738, 903

The total shipments of iron ore by rail and lake from the mines of Lake Superior since 1850, when the first shipment was made, amounted at the close of 1887 to 35,789,083 long tons.

During recent years successful efforts have been made to introduce the use of Lake Superior ores in eastern Pennsylvania and in the Hudson River valley, but these ores were used only in small quantities and exclusively for Bessemer purposes. In the present year larger quantities will be used in the two districts mentioned, particularly in the Hudson River valley, more satisfactory freight rates by railroad and dockage facilities at Buffalo having been secured. The Lackawanna Iron and Coal Company, at Scranton, Pennsylvania, first began the use of Lake Superior ores in June, 1883, and this company now has under contract a supply of these ores for use in 1888. The Troy Steel and Iron Company, at Troy, New York, used Lake Superior ores in 1887 and is now using them. With reasonable freight rates on the lakes and railroads the shipments of Lake Superior ores to eastern furnaces should annually increase, and we confidently look for this result to take place.

Our imports of iron ore in 1887 were larger than in 1886 or in any preceding year. They amounted to 1,194,301 long tons, against 1,039,433 long tons in 1886, and 390,786 tons in 1885. The foreign value of the iron ore imported in 1887 was \$2,206,958, or \$1.84 per ton, against \$1,912,437, or \$1.84 per ton, in 1886. The imports thus far in 1888 show a great falling off as compared with 1887. In the first six months of 1888 they amounted to 323,276 long tons, against 600,826 long tons in the first six months of 1887. The cheaper cost of domestic ores and the increased cost of ocean freight rates on foreign ores in 1888 as compared with 1887 are the leading causes of the present decreased importations.

Production of iron ore and coal by the United States compared with that of other countries.—In the production of iron ore and coal, "raw materials" of the manufacture of pig iron, the United States is only excelled by Great Britain. The following table shows our production of these minerals in 1887 in comparison with their production by other countries in that year or in the most recent years for which statistics or data for a careful estimate are available. English tons of 2,240 pounds are used in giving the statistics of Great Britain, the United States, Russia, and "other countries," and metric tons of 2,204 pounds are used for all the continental countries of Europe except Russia. As the difference between the long ton and the metric ton is so trifling it is not necessary to change official figures. The tons used are in each case the same as those used in the preceding table, which gives the world's production of pig iron and steel. The unofficial figures are prefixed with a star.

World's annual production of iron ore and coal.

Countries.	Iron ore.		Coal.	
	Years.	Tons.	Years.	Tons.
Great Britain	1887	13, 098, 041	1887	162, 119, 812
United States	1887	*11, 300, 000	1887	a116, 049, 604
Germany and Luxemburg	1887	9, 299, 500	1886	73, 637, 596
France	1887	*2, 600, 000	1887	21, 402, 949
Belgium	1886	153, 378	1887	18, 378, 624
Austria and Hungary	1887	*2, 000, 000	1886	20, 779, 441
Russia	1887	*1, 500, 000	1886	*4, 650, 000
Sweden	1886	872, 479	1887	*300, 000
Spain	1887	*6, 000, 000	1887	*1, 000, 000
Italy	1886	209, 082	1886	243, 325
Other countries	1887	*2, 000, 000	1887	*10, 000, 000
Total	....	49, 032, 480	....	428, 561, 351
Percentage of the United States	....	23	....	27

a Including colliery consumption.

Production of pig iron and steel by the United States compared with that of other countries.—We now pass to a consideration of our production of two leading iron and steel products, namely, pig iron and ingot steel, in 1887, as compared with that of foreign countries. From these two "raw materials" virtually all the world's production of finished iron and steel is obtained, a scarcely appreciable quantity of finished products being made directly from the ore.

The following table gives the world's production of pig iron and ingot steel. This table is virtually for the year 1887, as the figures for the leading iron and steel producing countries are for that year; for other countries they are for the most recent years for which statistics are available:

World's annual production of iron and steel.

Countries.	Pig iron.		Steel in ingots.	
	Years.	Tons.	Years.	Tons.
Great Britain	1887	7, 559, 518	1887	3, 170, 507
United States	1887	6, 417, 148	1887	3, 339, 071
Germany and Luxemburg	1887	3, 907, 364	1887	1, 685, 400
France	1887	1, 580, 851	1887	440, 956
Belgium	1887	754, 481	1887	206, 350
Austria and Hungary	1887	679, 224	1887	276, 920
Russia	1882	498, 400	1882	225, 140
Sweden	1886	442, 457	1886	78, 231
Spain	1885	159, 225	1886	25, 000
Italy	1886	12, 291	1886	23, 760
Other countries (estimated)	1887	160, 000	1887	35, 000
Total	....	22, 170, 959	....	9, 506, 335
Percentage of the United States	....	29	....	35

In 1886 the United States produced 28 per cent. of the world's production of pig iron and 34 per cent. of its production of steel. In 1887 these percentages were increased to 29 and 35, respectively, notwithstanding an increased production in that year of iron and steel in nearly all other iron and steel producing countries. In Great Britain, France, Germany, Belgium, Austria, Sweden, Italy, and even in Spain, 1887 was a year of great activity in the manufacture of iron and steel.

For many years this country has been second only to Great Britain in the production of pig iron. In 1886 we surpassed that country for the first time in the production of steel of all kinds, producing 197,832 long tons more than our great rival. In 1887 this leadership was maintained, as the above table shows. The production of steel by all processes in Great Britain and in the United States in 1887 was as follows, in long tons:

Total production of all kinds of steel in Great Britain and the United States in 1887.

Ingots, long tons.	Great Britain.	United States.
Bessemer steel (including Clapp-Griffiths)....	2,089,403	2,936,033
Open-hearth steel....	981,104	322,069
Crucible steel....	about 100,000	75,376
Other steel	nominal if any	5,593
Total	3,170,507	3,339,071

We add to the above the interesting fact that in 1887 the United States produced more than *twice* as many tons of Bessemer steel rails as Great Britain, the production of the former country having been 2,044,819 long tons from ingots made in its own works, and that of the latter country having been 1,021,847 long tons.

It may, perhaps, be necessary to explain to the reader that the disparity which will be noticed between the production of pig iron and the output of iron ore in most of the countries mentioned in the foregoing tables is accounted for by the fact that some of these countries are large exporters of iron ore to other countries which are large producers of pig iron.

THE WORLD'S PRODUCTION OF PIG IRON.

From the most reliable information that is obtainable we have compiled the following table of the world's production of pig iron at various periods since the close of the last century:

Years.	Long tons.	Years.	Long tons.	Years.	Long tons.
1800	825,000	1870	11,900,000	1879	13,950,000
1830	1,825,000	1871	12,500,000	1880	17,950,000
1850	4,750,000	1872	13,925,000	1881	19,400,000
1856	7,000,000	1873	14,675,000	1882	20,750,000
1865	9,250,000	1874	13,500,000	1883	21,000,000
1866	9,300,000	1875	13,675,000	1884	19,475,000
1867	9,850,000	1876	13,475,000	1885	19,100,000
1868	10,400,000	1877	13,675,000	1886	20,385,571
1869	11,575,000	1878	13,925,000	1887	22,170,959

It will be seen that the world's production of pig iron in 1887 was not only the largest but that it was also much the largest of any year in this century of wonderful iron and steel production. To produce this large quantity of pig iron there were required about 50,000,000 tons of iron ore, or an average of two and a quarter tons of ore to the ton of pig iron.

RECENT RAPID GROWTH OF THE SOUTHERN IRON INDUSTRY.

The activity in the development of the southern iron industry which was so conspicuous in the latter half of 1885 and in 1886 was continued in 1887 and during the first half of 1888. This activity has been chiefly displayed in the erection of blast furnaces for the manufacture of pig iron.

Since the beginning of 1886 there have been built in the States south of the Potomac and the Ohio rivers 21 large and well equipped furnaces, and 14 furnaces were in course of erection in those States on July 1, 1888. Fifteen of the completed furnaces have been finished in 1888. Of the 21 completed furnaces 18 were built to use coke and 3 to use charcoal as fuel; of the 14 building, 10 will use coke and 4 will use charcoal as fuel. These 35 new furnaces, built and building, are situated in the following States: Alabama, 13 coke furnaces built and 10 coke and 3 charcoal furnaces building; Virginia, 3 coke furnaces built; Tennessee, 1 coke and 3 charcoal furnaces built; Kentucky, 1 coke furnace built; Georgia, 1 charcoal furnace building. Preparations are also being made to remove a coke furnace from Missouri to Kentucky. All of these new furnaces are of large capacity, and most of them rank among the best in the country.

Discarding all abandoned furnaces, the total number of completed furnaces in the States south of the Potomac and the Ohio, not including Missouri, which were in blast on July 1, 1888, or in a condition to be readily put in blast, was 109, and, as above stated, 14 furnaces were in course of erection in those States on that date. Of the completed furnaces 57 use coke and 52 use charcoal as fuel. They are situated in the following States: Alabama, 23 coke and 10 charcoal furnaces; Virginia, 12 coke and 21 charcoal furnaces (and 1 of the charcoal furnaces is being changed to a coke furnace); Tennessee, 10 coke and 10 charcoal furnaces; West Virginia, 6 coke and 3 charcoal furnaces; Kentucky, 4 coke and 3 charcoal furnaces; Georgia, 2 coke and 2 charcoal furnaces; North Carolina, 2 charcoal furnaces; and Texas, 1 charcoal furnace. In the whole country there were on January 1, 1888, 583 completed furnaces, not counting those abandoned.

In addition to the foregoing enumeration there are two entirely new and large coke furnaces now in course of erection at Sparrow's Point, on the Patapsco river, a few miles below Baltimore, Maryland, which may be classed among southern iron enterprises. These furnaces will be completed this year. Two additional furnaces at the same place are contemplated.

A year ago there was much comment in southern newspapers concerning the probable scarcity of a supply of good coke for the new southern furnaces the construction of which had then been completed or undertaken, and the prediction was freely made that some of the new furnaces would be compelled to remain idle until new coal fields could be found or fields already discovered could be developed. With the lapse of time it has been found that the supply of good coke from southern coal fields has fairly if not entirely kept pace with the increasing demand for this fuel for furnace use. New coke ovens have been built in connection with newly-opened coal mines, and the quality of coke obtained from the coal of some of the older mines has been improved by more careful methods of selecting the coal and making the coke. There is particularly no longer any apprehension of a scarcity of coke for the supply of the furnaces at Birmingham and in its vicinity. There is still room, however, for further improvement in the quality of southern coke.

One of the most promising signs of an abundant supply of coke for southern furnaces is seen in the success which has attended the coking of the celebrated New River coal in West Virginia and the no less celebrated Pocahontas coal in Virginia. The coke from these fields has been shipped to Carondelet, Missouri, and Joliet and Chicago, Illinois, at all of which places it has been used in blast furnaces in competition with Connellsville coke. New River coke has also been shipped as far west as the silver mines of New Mexico. We stated a year ago that "railroad facilities in the South are being so perfected that but little inconvenience need be experienced in taking good coke from where it is made to where it is wanted, as, for instance, from southwestern Virginia to eastern Tennessee," and the shipping of New River and Pocahontas coke to the points above named illustrates the facility and economy with which southern coke may be taken long distances for furnace use.

During 1887 the South made some progress in the development of her steel industry, but not much. Two small Bessemer steel works were completed in the South in that year. The works of the Roane Iron Company, at Chattanooga, Tennessee, made their first blow on May 7, 1887, and on that day the first Bessemer steel rail ever made in the South outside of Wheeling was successfully rolled at these works, which have since continued in operation. On October 10, 1887, the steel works of the Old Dominion Iron and Nail Works Company, at Richmond, Virginia, made their first blow. They did not, however, continue in operation, as a necessity arose for changing the plans upon which they had been constructed. At Birmingham, Alabama, the Henderson Steel and Manufacturing Company built an experimental Henderson open-hearth steel furnace in 1887, to use pig iron made from native Alabama ores above the Bessemer limit in phosphorus, and on February 27, 1888, the first steel ever produced in Alabama was successfully made at these works. The erection of a larger furnace is contemplated. But the manufacture of Bessemer steel by the basic process in the South has not yet been attempted.

In the manufacture into finished forms of the pig iron produced within her borders the South has made considerable progress since we last referred to this subject. At Nashville, South Pittsburgh, Chattanooga, Knoxville, Birmingham, Anniston, and other points in the South may now be seen foundries, machine shops, and other reproductive iron enterprises which did not exist a year ago, and which would be creditable to any northern State.

THE FIRST COKE FURNACE IN THE SOUTH.

The progress which the South is now making in the manufacture of coke pig iron naturally recalls the history of the first coke furnace in that section, and of the first coke furnaces in the United States.

The first notable success in the use of bituminous coal in blast furnaces in this country was achieved at Lonaconing furnace, 8 miles northwest of Frostburg, in Allegany county, Maryland, in 1839. In June of that year this furnace was making about 70 tons of good foundry iron per week with coke made from Frostburg coal. The Lonaconing furnace was built in 1837 and 1838 by the George's Creek Company, expressly to use coke. In the same coal basin, 9 miles northwest of Cumberland, and also in Allegany county, two successful coke furnaces were built in 1840 by the Mount Savage Iron Company. These three furnaces were the first successful coke furnaces in the United States. If we regard Maryland as a southern State the honor of first successfully using coke in the blast furnace in this country belongs, therefore, to the South. It is scant justice to add that the first comprehensive treatise published in this country concerning the manufacture of pig iron with coke was embodied in a report to the governor of Maryland by Mr. J. H. Alexander, of that State, and published in 1840.

The furnaces above mentioned were located north of the Potomac. The first furnaces south of the Potomac which successfully used coke as fuel appear to have been Clinton furnace, 9 miles south of Morgantown, in Monongalia county, West Virginia, and Potomac furnace, on the Potomac, in Loudoun county, Virginia, about three-quarters of a mile below Point of Rocks. These furnaces were originally built to use charcoal, but they used small quantities of coke a few years before the outbreak of the civil war. We know of no other coke furnaces south of the Potomac and the Ohio rivers prior to 1860. Even the two which have been mentioned were not signally successful. The Potomac furnace was owned in 1859 by Mr. John W. Geary, afterwards governor of Pennsylvania.

The first coke pig iron made in the States of Tennessee and Alabama, which are now the theater of such great present and prospective activity in the manufacture of pig iron with this fuel, was made in 1860 at Chattanooga by the East Tennessee Iron Company, of which Mr. James Henderson, of New York, was the manager and a leading member.

Bluff furnace had been erected in 1854 at Chattanooga by Robert Cravens, James A. Whiteside, and James P. Boyce, to use charcoal. In 1857 Lesley said of this furnace: "The bituminous coal of the Raccoon mines, now leased and worked by the Etna Mining Company, can be brought to the furnace by railway; it is excellent for coke, and some thoughts are entertained of turning the present furnace into a coke furnace." In 1859 its limestone stack was torn down by the company first above mentioned, and a new iron cupola stack, 11 feet wide at the boshes, was built, and Raccoon coke was thereafter used as fuel. The new furnace was blown in in May, 1860, but owing to a short supply of coke the blast lasted only long enough to permit the production of about 500 tons of pig iron. All the machinery and appointments of the furnace worked satisfactorily. The furnace was started on a second blast on November 6, the day of the Presidential election, but political complications and the demoralized state of the workmen were obstacles too great to be overcome. The furnace soon chilled from the cause last mentioned, and in December Mr. Henderson abandoned his enterprise and returned to New York.

The final chapter in the history of this first coke furnace in the extreme South is worth recording. In the summer of 1862, before the Union troops took possession of Chattanooga, the machinery of the furnace was removed to Alabama by Mr. Giles Edwards, who used it in the equipment of a small charcoal furnace near the site of the present town of Anniston. This furnace was in operation for about two years. The stack of the Chattanooga furnace was used as a lime kiln by the Union troops, by whom it was subsequently torn down and a fortification built on its site.

The first coke furnace that was built in the South after the war was the first of the two Rockwood furnaces, at Rockwood, Roane county, Tennessee. This furnace was built in 1867 by the Roane Iron Company, of which General J. T. Wilder and Capt. H. S. Chamberlain, two northern men, were the leading spirits. This furnace was successful from the start. It is still active.

It will be seen that it was not until some years after the close of the civil war that the manufacture of coke pig iron may be said to have been really established in any of the States south of the Potomac and the Ohio rivers. Now there are more coke furnaces built and building south of these rivers than there are charcoal furnaces in that section, there being over sixty coke furnaces. This is remarkable progress in a period of time covering only about twenty years.

The manufacture of coke pig iron in the States north of the Potomac and the Ohio made but slow progress until 1859, in which year the first coke furnace at Pittsburgh (the Clinton) was built. At this furnace in the year mentioned occurred the first regular and continuous use of the since celebrated Connellsville coke. After 1859 the manufacture of coke pig iron made steady progress in the northern States.

NATURAL GAS IN THE MANUFACTURE OF IRON AND STEEL.

The prominence which natural gas has recently attained as a fuel in the manufacture of iron and steel in the United States naturally directs attention to its relation to other kinds of fuel which are used in this great American industry.

It may be premised that no other country, not even Great Britain, is so richly endowed as this country with fuel adapted to the various processes used in the manufacture of iron and steel, in both their crude and finished forms. We have in some sections extensive forests for the supply of charcoal; in others there is an abundance of bituminous coal, much of which makes excellent coke; in eastern Pennsylvania are extensive fields of anthracite coal; and in western Pennsylvania and neighboring territory is the natural gas region. As iron ore is also widely distributed in the United States, no natural obstacles exist to prevent this country from becoming in all respects the most conspicuous leader in the world's iron and steel industries, and this position it is rapidly attaining, as the figures already given abundantly show. In many respects it has already attained this distinction.

Originally all our iron and steel was made with charcoal, which remained our principal fuel for making iron and steel for many years. In the last century bituminous coal was sparingly used in heating furnaces; in the early part of this century it began to be used in puddling furnaces; in 1839 we commenced to make pig iron with bituminous coal in the form of coke, and in 1845 we successfully introduced the use of raw coal in the blast furnace. To-day most of our pig iron is made with coke, either alone or as a mixture with anthracite or raw bituminous coal. In the early part of this century we began to use anthracite coal in the heating furnace, and subsequently in the puddling furnace. A few years before 1840 we successfully experimented with the use of anthracite coal in the blast furnace, and in that year its use in the manufacture of pig iron was fully established. Anthracite coal is no longer used in puddling furnaces, except in very rare instances, and its use in heating furnaces is rapidly yielding to the encroachments of bituminous coal. Except where natural gas is used, bituminous coal is generally used in our puddling and heating furnaces. Charcoal is still used in the manufacture of "charcoal" blooms, whether made from ore or pig iron and scrap, and it is used in the manufacture of our very small annual product of cemented steel, but it is not used in the manufacture of any other finished forms of iron or steel.. In the production of gas for use in Siemen's and other regenerative heating furnaces our dependence was chiefly upon bituminous coal and very slightly upon anthracite coal until the advent of natural gas.

In 1854 the United States made more pig iron with charcoal than with anthracite coal. The next year charcoal was passed by anthracite coal, and in 1869 it was passed by bituminous coal. Anthracite continued, however, to be the leading fuel until 1875, when it too was passed by bituminous coal, which has since continued to be the favorite blast-furnace fuel. In the following table the production of pig iron in this country in the last five years, classified according to the fuel used, is given in tons of 2,000 pounds.

Production of pig iron according to the kinds of fuel used.

Fuel used—short tons.	1883.	1884.	1885.	1886.	1887.
Bituminous	2,689,650	2,544,742	2,675,635	3,806,174	4,270,635
Anthracite and coke	920,142	1,339,883	1,176,477	1,655,851	1,919,640
Anthracite alone	965,454	246,570	277,913	443,746	418,749
Charcoal	571,726	458,418	399,844	459,557	578,182
Total	5,146,972	4,589,613	4,529,869	6,365,328	7,187,206

The development of natural gas in this country as a fuel in the manufacture of the finished forms of iron and steel dates from 1874. (It is scarcely necessary to say that natural gas is not used in the manufacture of pig iron.) At the Siberian rolling mill of Rogers & Burchfield, at Leechburg, in Armstrong county, Pennsylvania, natural gas, taken from a well 1,200 feet deep, was first used as a fuel in connection with our iron and steel industries. In the fall of 1874 it was announced that during the preceding six months the gas had furnished all the fuel required for puddling, heating, and making steam at these works, not one bushel of coal having been used. Between 1874 and 1881 natural gas for puddling was successfully used at the same rolling mill; at the mills of Spang, Chalfant & Co., and Graff, Bennett & Co., in Allegheny county, Pennsylvania; and at the rolling mill of the Kittanning Iron Company, at Kittanning, Pennsylvania. In each instance the gas used at these works was obtained from wells that were sunk for oil, but were found to produce only gas. In 1883 the substitution of natural gas for bituminous coal in rolling mills and steel works received much attention at Pittsburgh, owing to the discovery of natural gas in large quantities at the neighboring town of Murrysville, in Westmoreland county, Pennsylvania, but as late as September, 1884, there were in all only six rolling mills and steel works in the United States which were using the new fuel. During the next two years the use of natural gas in the manufacture of iron and steel made rapid progress. In August, 1886, there were 68 rolling mills and steel works which used the new fuel. During the next fifteen months still further progress was made. In November, 1887, there were 96 rolling mills and steel works which wholly or in part used natural gas as fuel, and over 100 are now using it. The whole number of rolling mills and steel works in the United States in November, 1887, completed or in course of erection, was 445, of which, as will be seen from the above figures, nearly one-fourth used natural gas as fuel.

Of the total number of rolling mills and steel works which were using natural gas in November, 1887, 57 were located at Pittsburgh and elsewhere in Allegheny county, Pennsylvania; 15 were in the western district of Pennsylvania outside of Allegheny county; 7 were in Wheeling or its vicinity, in West Virginia, and 17 were in Ohio. The territory in which are located the iron and steel works which use natural gas for fuel extends as far east as Johnstown, Pennsylvania, 79 miles east of Pittsburgh. In Ohio natural gas is used in the mills at Youngstown in the northeastern section of the State, piped from wells in Pennsylvania, and at Findlay and Bowling Green in the northwestern section of the State, obtained from local wells. In the intervening country between Youngstown and Findlay, which contains many large iron and steel works, including those at Cleveland, natural gas is not used. At Steubenville, Bridgeport, Bellaire, Martin's Ferry, and a few neighboring places on the Ohio side of the Ohio river, natural gas, piped from wells in Pennsylvania, is used in iron and steel works. Natural gas has been found at a few points in the central and eastern parts of Indiana, but at the end of 1887 the supply was so small that no rolling mill or steel works in that State was then using this fuel. The gas used in West Virginia is obtained from wells in Washington county, Pennsylvania. Natural gas not having been found in the anthracite coal region or in its vicinity its use has not interfered with that of anthracite coal in rolling mills and steel works, but wherever it is used it displaces bituminous coal. It displaces no other fuel.

Nor has the use of natural gas as a fuel reduced the production of bituminous coal in any State, not even in Pennsylvania, where natural gas is most used. On the contrary, the production and consumption of bituminous coal in this country have steadily increased in recent years. In nearly every State and Territory, including Pennsylvania, the production of bituminous coal in 1887, according to Mr. Ashburner, was greater than in 1886, while the aggregate for the country at large was much greater. The greatly increased production in 1887 of pig iron manufactured with coke, and with coke mixed with anthracite will account for a large part of the increased production of bituminous coal in that year. In 1888 the consumption of bituminous coal for this purpose will be less than in 1887. We do not think that the consumption of natural gas in our iron and steel works will increase in 1888. It did not increase in 1887 as much as in 1886.

The remarkable increase in our production of iron and steel in 1886 and 1887 was, of course, possible without the possession of natural gas, but the cheapness and abundance of this new fuel, and the temptation which it offered to enlarge old plants and construct new ones, are influences which have certainly had much to do with the present tendency to glut the market with finished iron and steel products. Natural gas is, however, not now supplied at as cheap rates as a few years ago.

The possession of natural gas, desirable and valuable as it is, does not insure any of the localities which use it in the manufacture of iron and steel against the sharp competition of other localities which do not have it but which possess other advantages, as, for instance, proximity to markets of large consumption. This fact is well illustrated by a comparison which we recently made of the production of Bessemer steel in Allegheny county, Pennsylvania, which includes Pittsburgh, and in Cook county, Illinois, which includes Chicago—the former possessing natural gas and the latter lacking it entirely. Chicago made more tons of Bessemer steel ingots in 1887 than Allegheny county, Pennsylvania. And it made many more tons of Bessemer steel rails. The figures are as follows: Chicago—ingots, 531,054 long tons; rails, 439,345 tons. Allegheny county—ingots, 518,694 long tons; rails, 287,363 tons. Joliet is a near neighbor of Chicago, in the same State, and Johnstown, Pennsylvania, is a near neighbor of Allegheny county, the former lacking natural gas and the latter possessing it. Adding the production of Bessemer ingots and rails at Joliet in 1887 to the figures for Chicago, and adding the production of Johnstown to that of Allegheny county, we have the following totals: Chicago and Joliet—ingots, 748,271 long tons; rails, 642,580 tons. Allegheny county and Johnstown—ingots, 728,797 long tons; rails, 414,027 tons. Who would have predicted ten years ago that Chicago would make more Bessemer steel in 1887 than Allegheny county, Pennsylvania?

But natural gas, strange as it may appear, has a rival as a cheap and cleanly fuel in water-oil gas produced from petroleum, which is steadily growing in popularity among our iron and steel and a few other manufacturers. It is claimed that this fuel is cheaper than coal or than gas made from it, and that it possesses all the desirable qualities of natural gas and is far safer. This new fuel possesses also the advantage that it can be produced and used where natural gas can not be obtained, and even where the cost of coal may be too expensive to justify the use of the latter fuel.

CONCLUSION.

No section of our country possesses a monopoly of all the advantages for producing iron and steel. Pittsburgh has natural gas for its rolling mills and steel works, and is close to the Connellsville coke field, but it brings its ores long distances. Chicago is nearer than Pittsburgh to Lake Superior ores, but it is hundreds of miles away from Connellsville coke, and it lacks natural gas as a substitute for raw bituminous coal. In Alabama and Tennessee ores and fuel are found in close proximity, and unskilled labor is cheaper than in the North, but much of the pig iron made in these States must be hauled to distant markets at great expense. In New England but little iron and steel in their crude forms is now made, but the skill in their manipulation which has been accumulated in two hundred years yet remains. The iron industry of the Rocky Mountain region will always have the stimulus of a home market remote from destructive competition. There is room in almost every section of this great country for the iron and steel industries which we have in late years so wonderfully developed, and which are destined to expand still further as the years roll on.

IRON IN THE ROCKY MOUNTAIN DIVISION.

BY F. F. CHISOLM.

Colorado.—The year 1887 was marked in Colorado by the erection of a second furnace by the Colorado Coal and Iron Company and the opening of at least three new iron ore mines of proved value. The new mines are, however, all at so great a distance from the principal market, Pueblo, that it is unprofitable at present to ship the ore. All of the newer mines are in the valley of the Roaring Fork of Grand river, and in Pitkin and Garfield counties. Near Ashcroft, and about eighteen miles from Aspen, the Colorado Coal and Iron Company has acquired the title to a very large body of excellent iron ore, to which, it is reported, the Colorado Midland Railway may build. No definite information is given regarding the character of the ore, beyond the statement that the owners had bought, after careful and thorough examination, and were satisfied of its value.

Near Snow Mass mountain, on Rock creek, a seam of iron ore is exposed which varies from 4½ to 6 feet in thickness. The ore is remarkably pure magnetite, containing from 60 to 70 per cent. of metallic iron, free from titanium and carrying very small percentages of phosphorus and sulphur. This mine is without railway communication as yet.

On Avalanche creek occurs a body of iron ore the extent of which is yet unexplored. The ore is remarkably free from titanium and phosphorus, and analysis shows it to contain 56 per cent. of metallic iron.

Near Tomichi, in Gunnison county, the iron ore bed, which has been opened for some time, has proved to be more extensive than at first suspected, and the ore is remarkably pure. So far the ore has only been shipped to the Tomichi Valley smelter, at Gunnison, for use as flux.

The large amount of railway building in Colorado in 1887 induced great activity in rail manufacturing and caused the building of the second furnace by the Colorado Coal and Iron Company, but recently the possibility of being able to purchase rails under a reduced tariff has caused the cancellation by purchasers of all contracts for steel rails. The industry in Colorado is protected by a freight rate of $14 per ton from Chicago. The present prices (March, 1888,) of steel rails in Colorado range from $45.50 to $48 per ton.

The only steel rails of English manufacture in the State are those in the track of the Denver, Texas and Gulf Railway between Denver and Pueble.

Production of iron by the Colorado Coal and Iron Company in 1887.

Pig iron ....short tons..	25,293
Iron castings ....do......	1,324
Cast-iron water pipe ....do......	1,194
Steel rails ....do......	18,500
Nails { iron, 17,398 / steel, 28,327 } ....kegs of 100 pounds..	45,725
Spikes ....kegs of 150 pounds..	2,514
Merchant bar ....short tons..	4,752
Iron ore:	
Calumet mine ....short tons..	12,123
Hot Springs ....do......	19,556
Total	31,679

Much iron ore was purchased, partly from the Breece iron mine at Leadville.

IRON ORE MINING IN 1887.

BY JOHN BIRKINBINE.

The amount of iron ore mined in or imported into the United States in 1887 and smelted to produce pig iron and blooms, or used for fettling in rolling mills, or in fluxing silver ores is considerably in excess of the figures of any other year. As the major portion of the iron ores mined and imported pass through the blast furnaces of the country, it is possible, from the exact statistics prepared by the American Iron and Steel Association, to arrive at a close estimate of the total quantity consumed. Since the data collected for the census of 1880 and those obtained by Mr. James M. Swank in 1884, many mines have entered the market with large quantities of rich iron ores; and the competition which these offer has stimulated the enrichment of leaner domestic ores. In addition, the increased importation of foreign ores has been chiefly of the higher class. From the best data obtainable it is believed that the average consumption of ore per ton of pig iron made in American blast furnaces in 1887 was 1.95 long tons, and the estimate of ore consumed in 1887 therefrom, calculated, is exhibited in the following statement:

Iron ore consumption in the United States in 1887.

	Long tons.
Used in making 6,417,148 long tons of pig iron	12,513,439
Used in the manufacture of blooms and in silver smelting, etc	125,000
Used as "fix" in rolling mill furnaces, etc	475,000
Total consumption	13,113,439
From which deduct foreign ore imported	1,194,301
From which deduct rolling mill cinder used	470,000
	1,664,301
Leaving an approximate consumption of iron ores of	11,449,138

or in round numbers 11,500,000 long tons.

Unusual activity in iron industries developed in the latter part of 1886, and the demand for ore left stocks light at the end of the year; the consumption continued with advances in price and caused many mines to operate to their full capacity. This was assisted by some unfortunate speculative developments, which compelled the prompt sale of the product of the mines, obtained in some cases in advance of judicious exploitation. As a consequence the shipments from the more prominent districts were greatly stimulated, and the stock of ore available at the close of the year 1887 was probably 750,000 long tons in advance of that at the close of 1886. This would increase the production of the iron ore mines of the United States in 1887 to 12,250,000 long tons.

These figures exhibit trade of considerable importance, and to appreciate its value we may estimate the railroad traffic which it represents, although all of the ore does not pass over railroads and much of it reaches the blast furnace by both rail and water transportation. The majority of the ore from the Lake Superior and Lake Champlain regions is carried by rail to shipping points and thence by vessel to the lower lake or river ports, and there rehandled into cars which travel over the railroads to the blast furnaces. Several blast furnace plants are located so as to unload foreign ores at their docks, but most of the foreign ore is transported from the ports where received by railroad cars or by lighters to the points of consumption. A number of our iron works rely largely on local ore deposits or cinder from adjoining rolling mills, from which the ore is carried by wagons or carts by wire rope transmission or by tram-roads to the furnaces. The proportion of ore which is not hauled over our systems of railroads is comparatively small, and an illustration of the volume of business based upon the railroad tonnage is a proper one.

Allowing an average load of 15 short tons per car (which is more probably above than below the actual average as loaded), the amount of ore of all kinds consumed in 1887, viz., 13,113,439 long tons, or 14,687,052 short tons, would require 979,137 cars to carry it, or, say, 32,638 trains of 30 cars; five of these trains, with motive power and caboose, would occupy 1 mile of track when standing close, or the year's product would occupy 6,527 miles of track, a distance about equal to twice that from New York to San Francisco. If all this traffic passed a given point there would be eighty-nine trains per day, or a train every sixteen minutes during the year.

The traffic of the Pennsylvania Railroad and branches in 1887, as exhibited by the annual report, shows a total tonnage of through freight of 6,278,628 long tons, or less than one-half of the total amount represented by the iron ore as above, and the local freight (43,754,669 long tons) is about three times as great as the total iron ore consumption. The iron ore carried by the different railroads in the United States in 1887 would therefore represent nearly 30 per cent. of the entire freight traffic of the Pennsylvania Railroad and branches.

The tabulated figures presented in this paper indicate the sources from which much of the iron ore is obtained, and from these figures we find that of the estimated output of iron ore in 1887 the following approximate percentages came from:

Percentages of the total consumption of iron ore obtained from specified sources.

	Per cent.
Lake Superior region	36.8
Foreign ores	9.4
Alabama, estimated	5.8
Lake Champlain district	5.8
Cornwall Ore Hills, Pennsylvania	5.3
Tennessee, estimated	4.7
New Jersey	4.3
Virginia, estimated	3.6
Missouri	3.4
Ohio	3.0
Salisbury region	1.0
Georgia, estimated	.8

From these figures an approximate estimate of the volume represented by the iron ore shipment of any one source of supply can be made. As the ores vary in the yield of iron it will be of interest to place them in something near their relative rank by estimating the probable percentage of the total amount of pig iron which these ores produced.

Estimated percentages of total pig iron produced in the United States from various ores.

	Per cent.
Lake Superior ores	44.4
Foreign ores	10.5
Champlain ores	6.5
Cornwall ores	5.0
Alabama ores	5.0
New Jersey ores	4.4
Tennessee ores	4.1
Missouri ores	3.5
Virginia ores	3.2
Ohio ores	2.4
Salisbury region	.8
Georgia ores	.7

The strikes in the anthracite coal regions and in the coke regions during the year materially reduced the demand for ores and curtailed the 1887 output of some of the important eastern districts, such as the Lake Champlain, Cornwall, and New Jersey mines.

A careful estimate of the amount of rolling-mill cinder used in our blast furnaces shows that it represents 3.6 per cent. of the total consumption of iron ore in 1887, and about 4 per cent. of the iron produced in the country in that year was made from it.

As no continuous effort is made to collect the statistics of iron ore production, the data obtained from individual workings must be supplemented by estimates based upon the amount of pig iron produced; but without actual information as to the source of furnace supplies or the destination of mine output such estimates would be misleading, and will not be attempted except for localities where the complications are reduced to a minimum. From the most reliable sources possible the following data have been collected or estimated so as to give the actual or approximate figures of production in 1887 of various iron-ore districts. The importations of foreign ores are also added. No attempt has been made to estimate the total amount of red hematite, fossil ores, brown hematites, or carbonate ores obtained from New York, Pennsylvania, Maryland, Kentucky, etc., on account of the difficulty of determining the quantity of foreign or Lake Superior ores which are used as mixtures. For convenience of comparison corresponding figures for the year 1886 are presented in parallel columns:

Shipments of iron ore from certain prominent districts in 1887 *and* 1886.

	1887.	1886.
	Long tons.	*Long tons.*
Marquette region, Lake Superior district	1,836,953	1,621,887
Gogebic range, Lake Superior district	1,237,704	756,281
Menominee range, Lake Superior district	1,198,743	880,006
Imported iron ores	1,194,301	1,039,433
Lake Champlain magnetites	788,084	663,752
Cornwall Ore Hills, Pennsylvania	667,210	688,054
New Jersey magnetites	547,889	500,501
Missouri mines	427,785	379,776
Vermilion Lake region, Minnesota	394,252	304,396
Ohio carbonates and hematites	377,465	344,484
New York mines, other than Lake Champlain	36,000	35,728
Cranberry mines, North Carolina	45,032	24,106

Estimated production of iron ores in other sections in 1887 *and* 1886.

	1887.	1886.
	Long tons.	*Long tons.*
Alabama	740,000	700,000
Tennessee	600,000	500,000
Virignia	450,000	380,000
Georgia	105,000	105,000

The annexed general summary of output or development is presented as giving a general index of the progress of the iron-ore industry in 1887, and such additions as are considered of value are presented to make more complete the paper published in Mineral Resources, 1886 (*a*). Some analyses are presented to supplement those given in the contribution named, and where serious errors or omissions have occurred an attempt to correct them is made.

Exports of iron ores for the years 1886 *and* 1887.

	Long tons.
1886	3,777
1887	6,253

a Iron ores east of the Mississippi river, by John Birkinbine, "Mineral Resources of the United States, 1886," pp. 39–103,

LAKE SUPERIOR REGION.

Mining was very active in each of the four districts comprising this region during 1887, and the total output of 4,667,652 long tons places that year in advance of any other; the year 1886 ranking second, with 3,577,357 long tons. This brings the total production from the Lake Superior district in thirty-four years to 35,714,610 long tons.

Marquette district.—This region still holds first place, with a product of 1,836,953 long tons in 1887, 7,569 more than the previous maximum output of 1882 (1,829,384 tons). Seventy mines in Marquette county are reported as having shipped iron ore in 1887, making a grand total of 25,183,592 long tons since mining commenced in the Marquette district. Ishpeming, 700 feet above and 15 miles from Lake Superior, has in its corporate limits the following large mines:

Production of the principal mines of Ishpeming, Michigan.

Mines.	Output in 1887.
	Long tons.
Lake Superior	302,909
Cleveland	207,441
Lake Angeline	191,120
Salisbury	35,611
Barnum	16,123
York	5,128
Total for six mines	758,332

The Lake Superior mine, which continues to lead in the Marquette district as a producer of iron ore, yielded an output of 302,909 long tons in 1887, and was exceeded in that year only by the Chapin mine, of the Menominee range, the Minnesota Iron Company's mines, in the Vermilion district of Minnesota, and by the Cornwall ore hills of Pennsylvania.

Mr. H. B. Sturtevant, M. E., describes this deposit (the Lake Superior mine) as "a synclinal fold, trending east and west, the western extremity outcropping. Occasionally lenticular masses of ore occur near the main deposit, separated from it by thin seams of chloritic schist." The deposit has been wrought a total length of 1,400 feet. The plan of mining is by parallel chambers 18 feet wide, leaving pillars of 18 feet between them. The chambers cross the formation. Commencing at the lowest part of the deposit, work progressed upwards and on the length of the chamber, mining the ore to its full length north and south. To prevent caving, timber sets are made to replace the ore. To prevent crushing the timber by the great pressure brought to bear upon it, rock is run into the chamber from the level above. The entire deposit is underlaid by chloritic schist and overlaid by "hematite jasper," a jaspery rock containing 20 to 40 per cent. of hematite. Part of the open pit work was carried to a depth of more than 200 feet, and the underground operations of the mine now approximate 800 feet below the surface.

The product of the prominent mines of the Marquette district in 1887 which have records of total outputs of one million tons or over and their total shipment since their opening to date, are:

Output of prominent mines in the Marquette district.

Mines.	Shipments in 1887.	Total.
	Long tons.	*Long tons.*
Lake Superior	302,909	4,195,131
Cleveland	207,441	3,704,654
Republic	220,624	2,811,450
Jackson	109,906	2,714,460
Champion	146,330	1,907,892
Lake Angeline	191,120	1,088,106
York	5,128	1,040,129
These seven mines show a total to date of		17,461,822

This is 69.4 per cent. of the product of the Marquette district.

The Gogebic range in the third year of its development outstripped the Menominee district by 38,961 long tons, the figures being:

	Long tons.
Product of the Gogebic range in 1887	1,237,704
Product of the Menominee range in 1887	1,198,743

This is accounted for by the mistaken policy of over capitalization, which transformed the Gogebic range into a center for stock speculation, rather than for legitimate iron ore mining enterprises. The result was that, with the desire to realize on the money invested, developments of some mines were made in advance of actual requirements and without studying judicious methods. Each organization strove to get its ore to market and to be recognized as a shipping mine, and the competition for lake freights forced them to rates ruinous to the shippers. These rates also encouraged all-rail shipments, and the Gogebic range in 1887 increased its output 63.6 per cent. over that of 1886, taking precedence of the Menominee range. But it is probable that in 1888 it will go behind its older rival, for the "bubble" which floated so many mining companies into prominence has collapsed and some Gogebic mines have suspended operation; the leases of others have reverted to the owners of the fee on account of defaults on royalties, and others which have been opened by imperfect methods must practically be developed anew. But the Gogebic range will continue as a very important factor in the Lake Superior region, and will be a large producer of ores; in fact under management which seeks to win ore cheaply and maintain the mines, the success of the district is more assured than when the operations were largely so regulated as to bolster the stock shares above their intrinsic value. The four large mines, which up to the close of 1887 had produced almost 70 per cent. of the ore mined, give promise of continuing to add to the ore supply of the country and to maintain the Gogebic range as an important center of iron ore mining.

The products of these four mines in 1887 are given as follows:

Output of prominent mines in the Gogebic district in 1887.

	Quantity.
	Long tons.
Colby	258, 518
Norrie	217, 254
Ashland	175, 561
Aurora	159, 252

The bulk of the ore taken from the mines of the Gogebic range has been transported by the Michigan, Lake Shore and Western Railroad to its ore docks at Ashland, Wisconsin, on Lake Superior. These ore docks, each 1,400 feet long, have capacities of 24,000 and 30,000 tons of ore, respectively, but considerable ore has also been forwarded by all-rail shipments; and during the past season connection was made with the docks at Escanaba, on Lake Michigan. The destination of the ore shipped by this railroad in 1887 is given by Mr. W. R. Hancock, auditor, as follows:

Destination of Gogebic ores handled by the Michigan, Lake Shore and Western Railroad.

	Quantity.
	Long tons.
To Ashland docks	829, 769
Escanaba docks	53, 448
Other points, all-rail shipments	183, 899
Total	1, 067, 116

This road also handled, during 1886, 772,175 tons; and in 1885, 119,862 tons.

The Wisconsin Central Railroad shipped ore from the Gogebic range in 1887 to its ore dock at Ashland, which is 1,404 feet long and has a capacity of 28,250 tons. Mr. T. J. Hyman, auditor, states that during the year 1887 the shipments over their lines were:

Shipments of iron ore over the Wisconsin Central Railroad in 1887.

	Long tons.
To Ashland	209, 511
Other points (all rail)	33, 324
Total	242, 835

Mr. W. J. Olcott reports that a vertical depth of 350 feet has been reached in the workings of the Ashland mine. The shaft where this depth has been attained is vertical for 150 feet from the surface, there it followed the foot-wall at an angle of 67° 30′, but at 120 feet farther—that is, 270 feet vertically from the surface—the foot-wall flattens to 53°.

Twenty-one analyses of the ore taken from various parts of the workings of this mine and from stock piles at the close of 1887 show the following:

Analyses of iron ore from the Ashland mine, Wisconsin.

	Maximum.	Minimum.	Average.
	Per cent.	*Per cent.*	*Per cent.*
Iron	68.60	60.87	65.87
Phosphorus	.059	.036	.0405

Other analyses of over 25,000 tons of ore show:

Iron.	Phosphorus.
Per cent.	*Per cent.*
64.91	0.029
65.57	0.049
63.39	0.054

A check sample, finely pulverized and well mixed, submitted to ten different chemists, showed the following average:

	Per cent.
Iron	63.018
Phosphorus	0.0436
Silica	4.43

Concerning the iron ore deposits of the Gogebic range, Mr. Richard A. Parker, M. E., indorses the opinion that there are not two veins. He says of the ore-bearing strata confined by the red slates and jasper hanging wall that "there are not in any sense two veins; in twenty or more miles of development there are but three well-established lenses of ore lying to the north of the strong foot-wall deposits, which have been called north veins, and their interrupted occurrence is so rare, compared to the continuity of more southerly deposits on the Laurentian schists, as to be scarcely sufficient to warrant the use of the significant term 'vein,' which was adopted and widely advertised by those interested in stock operations. As for manganese being made the basis of distinction between two veins, there may be instanced the continued occurrence of quite a regular percentage of it in the Kakagon and Bessemer mines, while the developed properties upon either side upon the same strike (Nimikon and Superior mines) are entirely free from it."

The Anvil mine, some two miles east of the town of Bessemer, presents an entirely analogous case to the foregoing; it has a south vein of manganiferous iron ore, while the properties adjacent have not yielded an appreciable quantity in the ore.

The Kakagon mine, located one mile west of the Montreal river, yields a manganiferous ore. The combined units of iron and manganese average 63 per cent. or over, the latter element varying from 0.5 to 8.34 per cent. Some few characteristic analyses of Kakagon ore are as follows:

Analyses of iron ore (a) from the Kakagon mine, Gogebic region.

Metallic iron.	Manganese.	Silica.	Phosphorus.	Total metallic units.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
60.16	3.68	3.12	0.064	63.84
60.38	4.49	3.31	0.067	64.87
64.26	.76	....	....	55.02
60.20	4.09	....	....	64.29
59.21	5.56	4.31	0.062	64.77
58.11	5.34	5.06	0.059	63.45
62.01	2.03	3.90	0.069	64.04
54.88	8.34	4.48	0.065	63.22
57.76	5.97	5.22	0.061	63.73

a Dried at 212° Fahrenheit.

Mr. Parker notes another point of interest in the frequency with which sheets of talcose matter, locally known as "soap rock," penetrate the ore bodies. At some period of development of all of the large mines these sheets have been found, varying from 1 to 25 feet in thickness. One of the cleanest and most easily observed sheets is seen as the floor of the open pit at the Aurora mine. It has a pitch about the same as that of the ore lenses, but cuts across the deposit at right angles to the dip, ending when it reaches the foot-wall quartzite. It is soft, of smooth even grain, and comparatively free from iron or iron stain. Where the ore came in contact with it the former was decomposed for a foot or so, and the analysis showed that it contained a higher percentage of phosphorus than usual.

Concerning the developments on the eastern end of the range, Mr. Parker says "some of the workings of the Brotherton property underlie Sunday Lake, and water has been a source of trouble and expense, as these mines are very wet. The latter mine is the deeper, being about 200 feet from the surface. The ores are exceptionally good, the average of all the assays obtained from the mine and cargo samples yielding, when dried at 212° Fahrenheit:

Analysis of iron ore from Brotherton mine, Michigan.

	Per cent.
Metallic iron	63.8708
Phosphorus	0.0401
Silica	6.3320

Considerable attention has been directed to the method of successfully exploiting large deposits of soft ores, as in the Menominee and Gogebic ranges. In some mines of the latter the Nevada system of square sills has been adopted, but instead of having the square mortise and tenon, a round one is used, with decided advantage in point of time saved in setting in place and strength to resist torsional strain. Specially designed machinery insures uniformity of size of these mortises and tenons, which in square ends is often a source of trouble, and requires at times chipping or wedging to secure proper adjustment. Should a side thrust occur with the square ends a rupture of the post is threatened, but with the round mortise the caps will, it is claimed, slide around the post tenon, and the pieces be given an opportunity to re-adjust themselves to the pressure.

Menominee range.—Mr. Per Larsson, M. E., reports the output of the Chapin mine for 1887 at 334,028 long tons, and anticipates that the product of 1888 could be even greater, as the mine is in condition to yield a large amount of ore. The Chapin, except the Vermilion mines of the Minnesota Iron Company, was the largest producer in the Lake Superior region in 1887.

The ores of the Chapin, Vulcan, Ludington, and part of the Norway and some other mines are classed as Bessemer. Mr. Larsson gives the following analyses of the average ore mined during 1887:

Analyses of iron ores from the Chapin mine, Menominee range.

	Output of 1887.	Stock pile, winter, 1887-'88.
	Per cent.	*Per cent.*
Metallic iron	62.93	63.10
Phosphorus	0.072	0.070

Outputs for 1886 *and* 1887 *of the larger mines of the Menominee range.*

Mines.	1887.	1886.
	Long tons.	*Long tons.*
Chapin	334,028	198,871
Vulcan	205,036	143,930
Ludington	101,653	74,721
Norway	95,726	93,878
Iron River	83,018	78,591
Florence	79,399	8,210

The total amount of ore credited to the Menominee range for 1887 (1,198,743 long tons) makes 1887 the year of maximum product, for it exceeds the output of 1882 by 62,725 long tons. The total shipments from this range since its opening in 1877 to the close of 1887 amount to 7,427,398 long tons, of which the Chapin mine produced 1,663,739; the Norway, 1,025,475; the Vulcan, 1,021,341 long tons; a total of 3,710,555 tons, or practically one-half of the entire output of the range.

MINNESOTA.

The shipments from the mines near Vermilion lake in 1887 fell some 6,000 long tons short of the estimates made for the year, but they exceeded the shipments of 1886 by almost 90,000 long tons, the figures since the opening of the mines being as follows:

Shipments of iron ore from Minnesota mines.

	Quantity.
	Long tons.
1884. August 1 to November 1	62, 124
1885. May to November	225, 484
1886. May to November	304, 396
1887. May to November	394, 252
Total	986, 256

The excessive freight rates prevailing undoubtedly reduced the output of 1887, for although the shipment was large in 1886, the mines had about 100,000 tons more in stock at the opening of navigation in 1887 than at the same time in 1886.

The relative development of the various openings which shipped ore from the Vermilion range, and the dates of their opening, are exhibited by the following data, supplied by Mr. Elisha Morcum:

Total shipments of iron ore from individual Minnesota mines.

Names of openings.	When opened.	Total product to July 25, 1887.
		Long tons.
Stone	May 1, 1884	239, 866
Brietung	May 8, 1884	62, 098
Tower No. 1	July 20, 1884	214, 794
Stuntz	August 1, 1884	24, 399
Lee	December 13, 1884.	50, 270
Tower No. 2	April 11, 1886	173, 831
Ely	December 29, 1886.	88, 307
Total		853, 565

The product is given to the close of July 25, 1887, at which time the property was transferred to the present owners. Mr. D. H. Bacon, general manager of the Minnesota Iron Company, states that the machinery has been largely augmented, and that new shafts have been sunk in the foot wall so as to make them secure and permit of deeper sinking. Work has been prosecuted upon some of the outlying deposits of comparatively lean ore. He states that a shaft 270 feet deep is in good ore. The deepest workings are 200 feet, and show ore. He estimates the shipments for 1888 at 450,000 long tons.

The Duluth and Iron Range railroad has been extended 25 miles east of Tower, to give shipping facilities to deposits being developed, which exhibit a different structure but composition nearly identical with those now exploited. Of the deposit known as the Chandler, Mr. H. S. Pickands says "the vein has been proved for a length of over 1,000 feet, a width of over 100 feet, and a depth of 90 feet, showing at every point of test high quality Bessemer ore;" latest analyses at a depth of nearly 60 feet and over 150 feet distant in width gave respectively:

Analyses of iron ore from the Chandler mine, Minnesota.

Metallic iron.	Phosphorus.	Silica.
Per cent.	*Per cent.*	*Per cent.*
69.00	0.018	0.82
66.79	0.036	4.07

Sulphur and titanic acid both imperceptible.

Between Tower and the Chandler mine, in about a straight line, the formation of country rock and Jasper is nearly continuous; but although much exploiting work has been done, no other remarkably valuable deposit of ore has thus far been found, and to the east of the Chandler the same may probably be said. The formation extends almost unbroken in a northeasterly direction to the Canada border, and shows ore at various points. A lean black ore outcrops for miles in length and of great width; but, as now determined, its metallic iron is not over 50 per cent., and silica from 20 to 30 per cent. It is of course to be expected that other valuable mines beside the Chandler will be found in all this extensive formation, but there is no reason to suppose that they will be any more frequent or more easily discovered than in the older districts. The Chandler entered the lists of shipping mines in 1888; its output is expected to reach 40,000 tons.

Although the South or Messaba range is generally considered as producing titaniferous ores, Mr. C. S. Robinson reports that "out of 15 samples, some of which are known and the rest reported to have come from this range, 9 were without titanic acid, and 6 carried it in amounts from a trace to about 12 per cent. Of these 6 samples, 3 were reported from the same property, whereas, with the possible exception of 2 from the same land, the 9 samples were taken from different locations."

The following analyses of Minnesota iron ores are furnished by Mr. Robinson:

Analyses of hematite from the Vermilion range outside of the Minnesota Iron Company's properties.

Iron.	Phosphorus.	Silica.
Per cent.	*Per cent.*	*Per cent.*
69.10	....	....
68.70	0.096	....
34.00	0.110	....
60.75	0.094	....
69.10	0.102	....
(a)62.45	0.017	....
66.75	0.115	1.14
(b)67.75	0.060	....
66.10	0.022	3.00
69.70	0.125	0.80
54.70	0.077	21.04
65.70	0.084	....

a Manganese, 0.45. b Sulphur, 0.133.

Analyses of magnetic iron ores from northern Minnesota.

Iron.	Phosphorus.	Silica.
Per cent.	*Per cent.*	*Per cent.*
39.85	0.063	....
62.50	0.040	....
54.30	....	....
66.50	0.069	2.07
64.00	0.466	1.97
59.00	0.050	13.11
57.70	0.021	12.41
64.30	0.262	....
46.45	0.137	....
53.10	0.059	....
(*a*)62.70	0.023	....
33.50	0.068	....
51.55	0.056	21.56
(*b*)58.20	0.031	....
59.60	0.063	....
56.15	0.047	....
59.25	0.116	11.14
47.35	0.060	....
66.00	0.054	....
64.15	0.066	....
57.90	....	....
50.80	0.123	19.13

a Manganese, 2.69. *b* Titanic acid, 4.50.

Analyses of iron ores from the Messaba range, Minnesota.

	Hematite.	Magnetic ore, etc.				
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Metallic iron	60.20	57.75	49.45	49.00	57.27	52.80
Phosphorus	0.020	0.052	0.164	0.056	0.012	0.022
Silica	9.89	....	....	24.41	7.50	14.90
Titanic acid	....	None.	None.	....	0.34	Trace.

MAINE.

Maine may be credited with mining about 8,700 long tons of iron ore in 1887.

VERMONT.

A deposit of specular ore near Saint Albans worked on a limited scale was used in the open-hearth furnace at Saint Albans. It is reported by Mr. A. F. Brainerd as a specular hematite of the following average composition:

Average composition of specular iron ore near Saint Albans, Vermont.

	Per cent.
Iron	62.50
Phosphorus	0.105
Lime	C.20

SALISBURY REGION.

The mines of western Connecticut and Massachusetts, and of the section of New York adjacent, recognized as comprising the Salisbury region, produced 120,000 long tons of brown hematite ores in 1887.

NEW YORK.

The Lake Champlain magnetite mines were quite active during 1887, and produced more ore than in 1886; the quantities being:

Production of magnetic iron ore from Lake Champlain, New York, in 1887.

Mines.	Long tons.
Port Henry	428 522
Crown Point	64, 940
Chateaugay	219, 390
Other Lake Champlain mines	56, 000
Total	768, 852
To this we may add from other New York mines	36, 000
Total magnetic iron ore mined in New York	784, 852

A considerable amount of Lake Champlain magnetite is used for fettling in rolling mills, and the ore is sent largely to New York and Pennsylvania blast furnaces. Regular shipments of Saint Lawrence county red hematites and some Salisbury brown hematites have been made to eastern Pennsylvania furnaces, and as an offset some of the harder Lake Superior ores have been shipped as far east as Troy. Developments are in progress of some promising deposits of magnetite on the western slope of the Adirondack mountains.

At the mines of the Chateaugay Ore and Iron Company the concentration of the leaner ores has received attention, and works are in operation capable of handling one-third of the product of the mines. The ores shipped are sold not to fall below 47 per cent., and the leaner ores are therefore concentrated to yield from 63 to 65 per cent. of iron in a finely divided state.

Mr. A. L. Inman furnishes the following analysis, showing the average composition of one hundred and thirty-eight daily samplings of the ore mined by the Chateaugay Ore and Iron Company at Lyon Mountain, New York.

Analysis of ore as shipped from Chateaugay mines, New York.

	Per cent.
Peroxide of iron	49. 979
Protoxide of iron	22. 489
Protoxide of manganese	0. 169
Alumina	1. 363
Lime	4. 049
Magnesia	1. 970
Silica	18. 447
Phosphoric acid	0. 068
Sulphur	0. 052
Total	100. 586
Iron	52. 470
Phosphorus	0. 029

The most extensive operation in connection with the development of a single mine is at the deposit of magnetic ore at the Tilly Foster mine, Putnam county, New York. The entire hanging wall for about 300 feet in depth is being removed by blasting, and it is estimated that 350,000 cubic yards of rock will be handled. This will convert what is now largely an open-ground mine into an open pit from which it is expected to secure in pillars, etc., sufficient ore to make the heroic method of stripping pay well.

NEW JERSEY.

New Jersey augmented its output in 1887, the figures, as reported by Prof. George H. Cook, being: Iron ore, 547,889 long tons; zinc ore (franklinite), 50,220 long tons. Several developments of good promise have been made during the year.

Professor Cook corrects the estimate given on page 50 of "Mineral Resources of the United States, 1886," by the statement that the total output of the New Jersey mines since their opening to the close of 1887 is fully 16,000,000 long tons.

The equipment of some of the New Jersey magnetite mines does not encourage cheap mining, and excessive royalties still paid for ore taken from leased mines continue to restrict the output of the group of mines within 50 miles of New York City.

PENNSYLVANIA.

In Pennsylvania the Cornwall Ore Bank Company still leads as a producer, although the output of 667,210 long tons was 20,844 tons less than that of 1886. The total product of this remarkable deposit to the the end of 1887 is 8,637,000 long tons.

Mr. J. H. Harden, M. E., states that "there are two distinct deposits of magnetic ore at Boyertown, Pennsylvania, known as the 'blue' and the 'black.' The dip of the former is about 45° and of the latter from 32° to 45°. The deposits vary in thickness from 5 to 50 feet, the average being about 20 feet. The ores range in composition from 35 per cent. in the "blue" to 56 per cent. of iron in the "black." The following are some of last year's analyses, in natural condition, of the "black" ore from the Phœnix Iron Company's mines; the samples were taken from all the cars during one month:"

Average analyses of iron ore from the Phœnix mines at Boyertown, Pennsylvania.

1887.	Iron.	Phosphorus.	Sulphur.	Manganese.	Silica.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
June	59.22	0.033	2.73	....	....
July	58.36	.038	2.08	0.247	....
August	57.07	....	....	....	....
September	58.83	....	....	....	....
November	56.15	.042	2.87	....	9.43

The analyses of the Jones magnetic ore mined from the "Warwick reserve," near Joanna, Berks county, which yielded 12,230 long tons in 1887, are given by Mr. Harden as:

Analyses of magnetic iron ore from Joanna, Pennsylvania.

1887.	Iron.	Phosphorus.	Sulphur.	Silica.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
June	44.07	0.021	1.56	8.48
July	39.48			
August	46.57	.020	1.38	11.10

From the French Creek mines during 1887 there were taken 10,451 long tons.

The total output of the Boyertown mines for the year is estimated at 50,000 long tons, and from the data presented it is possible to form an approximation of the total production of magnetic ore in Pennsylvania in 1887, exclusive of Cornwall, as 79,000 long tons, or, including Cornwall, 746,000 long tons. Fully 700,000 tons of this magnetic iron ore were roasted to drive off part of the sulphur which it contains.

One of the earliest iron ore developments in Pennsylvania was in what we know as the Durham hills, near the Delaware river, and about 10 miles below Easton. It is claimed that ore was mined here as early as 1698, and that operations have been carried on quite regularly since 1727. A total of 550,000 long tons has been won from this deposit of "primitive but non-magnetic ore," of which the following analyses are supplied by Mr. B. F. Fackenthal, jr.:

Analyses of iron ore from the Durham hills, Pennsylvania.

	Per cent.	Per cent.	Per cent.
Oxide of iron	56.72	66.73	71.66
Silica	35.84	30.45	23.80
Lime	0.47	0.07	0.16
Magnesia	1.22	0.17	0.82
Alumina	3.33	0.96	2.22
Phosphoric acid	0.07	0.06	0.096
Sulphuric acid	0.35	0.32	0.260
Combined water	1.64	1.15	1.00
Total	99.64	99.81	100.116
Metallic iron	41.02	47.15	51.51
Phosphorus	0.034	0.026	0.042
Sulphur	0.140	0.127	0.105

In addition to the above a considerable amount of brown hematite ores has been obtained from the vicinity.

Mining has been quite active lately in the hematites of central Pennsylvania to supply some new blast furnace plants, and systematic efforts are now being made to introduce the rich Lake Superior iron ores as a regular portion of the blast furnace charge in eastern Pennsylvania. A considerable quantity of Minnesota and some Marquette ores have been contracted for.

OHIO.

Last year's product of iron ore, according to State Mine Inspector Bancroft's annual report, is in excess of the year before by 32,981 long tons. Most of this increase is in the hematite column. The output by counties is as follows:

Amount of iron ore mined in Ohio in 1887.

Counties.	Black Band.	Hematite.
	Long tons.	*Long tons.*
Columbiana	....	7,800
Gallia	....	8,326
Hocking	....	9,118
Jackson	....	36,362
Lawrence	....	147,479
Mahoning	21,630	....
Perry	....	27,711
Scioto	....	14,784
Tuscarawas	61,595	....
Trumbull	4,740	....
Vinton	....	37,920
Totals	87,965	289,500
Total, long tons	....	377,465

Mr. Bancroft says the column headed "hematite" includes all red ores or ores other than Black Band. This classification is not strictly correct, however; nearly all of such ore in the State is limonite, or brown hematite, and if not properly hematite when dug becomes such to all intents and purposes before it is used.

MISSOURI.

Prof. William B. Potter, of the Saint Louis Sampling Works, reports the output of the iron ores of Missouri for 1887 as follows:

Production of iron ore in Missouri in 1887.

	Long tons.
Pilot Knob	206,000
Iron Mountain	113,589
Other mines in southeastern Missouri	1,387
Soft hematites from central Missouri counties	106,809
Total	427,785

The developments at Pilot Knob have been such as to cause apprehension as to the continuance of the deposit as an important producer of iron ore, and although the mine can not be stated to be worked out, the present outlook is not encouraging. The practice of hydraulicing at Iron Mountain is continued, and the finer ores are separated from the gangue by jigs; but no ore is crushed for separation.

A statement of the iron ore mined and shipped from Iron mountain, from the beginning as far as recorded, is as follows:

Shipments of iron ore from Iron Mountain, Missouri.

Prior to and including—	Long tons.
1870	791,077
1871	157,904
1872	269,480
1873	235,130
1874	103,680
1875	107,220
1876	107,430
1877	75,468
1878	95,930
1879	142,368
1880	108,045
1881	77,434
1882	62,043
1883	51,352
1884	47,220
1885	52,993
1886	138,082
1887	113,589
Total	2,736,445

A deposit of hematite, probably a carbonate altered by exposure, is reported in Callaway county, Missouri, 7 miles north of Jefferson City, the mineral lying in veins or lenses 3.5 to 7 feet thick near the surface. Some of this ore has been used at the steel works at Joliet, Illinois, and is of the following composition:

Analysis of iron ore from Callaway county, Missouri.

	Per cent.
Ferric oxide	97.02
Manganese oxide	0.35
Alumina	0.42
Lime	0.83
Magnesia	0.20
Silica	1.21
Phosphoric acid	Trace.
Sulphuric acid	0.02
Water	0.66
Total	100.71
Metallic iron	67.01

IOWA.

The limonite resulting from a weathering of carbonates apparently covers considerable territory in the valley of the Mississippi river and its tributaries. A sample from near Council Bluffs, analyzed by Mr. H. S. Fleming, shows metallic iron 58.86 per cent., silica 8.12 per cent.

Three miles northeast of the town of Waukon, Allamakee county, Iowa, a deposit of limonite is reported as a hill of ore extending over an area of 300 acres. The deposit lies at an average of 4½ feet below the surface, and test pits (one to the depth of 32 feet) are claimed to show continued richness and solidity as far as worked. "Geologically, this iron ore deposit occupies the place of a portion of the Trenton limestone on top of the Saint Peter's sandstone, among the Lower Silurian rocks." The face of the adjacent country is hilly, and the crest of this iron deposit is the highest point in eastern Iowa, being 1,409 feet above the level of the sea, and about 760 feet above the Mississippi river, which is 14 miles distant.

Professor Fisher, of Milwaukee, Wisconsin, who supplied the above data, reports the following analyses of samples of iron ore taken personally from the mines:

Analyses of limonites from Allamakee county, Iowa.

	Black.	Yellow.	Average ore.
	Per cent.	*Per cent.*	*Per cent.*
Metallic iron	58.59	54.79	....
Oxide of iron	....	....	76.74
Silica	4.00	5.12	11.02
Water	....	11.92	11.92
Phosphorus and phosphoric acid	....	0.131	0.30
Sulphur	....	....	....
Lime	....	0.70	0.70
Magnesia	....	....	Trace.
Alumina	....	....	Trace.
Manganese	....	....	Trace.

MISSISSIPPI.

In northern Mississippi there are indications of carbonate iron ores over a considerable area; they appear as outcrops of limonite, probably weathered by exposure, and are interesting as occurring in the Tertiary formation. The ore lies at but a slight dip, and, unless it should become leaner under cover, can be economically exploited.

Mr. Alfred F. Brainerd reports the following analyses:

Analyses of iron ore from Clark county, Mississippi.

	Iron.	Silica.	Phosphorus.
	Per cent.	*Per cent.*	*Per cent.*
1	31.82	40.30	0.382
2	51.11	7.54	0.078
3	42.82	19.62	....
4	39.62	20.52	....
5	14.75	....	0.150
6	46.80	....	0.028
7	30.12	36.00	0.620
8	35.38	45.40	....
9 dried	52.63	....	....
10 dried	58.725	....	....
11 dried	58.32	....	....
12 dried	45.718	....	....

Commenting on these analyses, Mr. Brainerd says they show the principal constituents of the ore, except the carbonate of lime, which occurs in small shells, rendering the material nearly self-fluxing. No, 5 was selected as being high in lime to ascertain whether it would be high in phosphorus, and it ought not to go in as ore. No. 7 also shows 5.50 per cent. carbonate of lime. About 60 tons of ore were roasted and shipped to Birmingham, and a furnace run was made, yielding an output of 40 per cent. of No. 3 foundry iron. In this test the mixture was one-half Red mountain, Alabama, soft ore, and one-half Enterprise, Mississippi, roasted carbonate ore. The iron compares favorably with No. 3 foundry iron, made two years ago at the same place, but with different cinder and burden.

A personal examination of these ores in Benton and Tippah counties, Mississippi, indicates that the deposit is of considerable extent. Analyses of specimens collected were made by Mr. H. S. Fleming; these show that the ores carry from 35.4 per cent. to 48.6 per cent. of iron. The phosphorus varies from 0.112 to 0.16 per cent.; the silica from 11.89 to 19.26 per cent., and the alumina in two samples shows 5.87 and 5.21 per cent. The manganese in one sample shows 0.042 per cent.

SOME SOUTHERN IRON ORES.

Arkansas has considerable iron ore; one deposit of pisolitic ore has attracted considerable attention on account of being discussed during the year in the metallurgical press.

As prominence was given to the iron ores of the southern States in "Mineral Resources of the United States, 1886," further general mention is not now necessary. Attention has been directed to the limonites of western Kentucky, and the district adjacent to the Cumberland and Tennessee rivers has been brought into notice by efforts to establish iron manufacturing enterprises.

Expectations favor the belief that a supply of Bessemer ores will be obtained from eastern Tennessee and western North Carolina. Professor Procter reports that "along the flanks of the Unaka mountains the specular ores have from 55 to 65 per cent. of iron and from 0.003 to 0.044 per cent. of phosphorus. Extending through Ashe and Mitchell counties, in North Carolina, and in a portion of Carter county, Tennessee, are found deposits of magnetic iron ores which range from 45 to 66 per cent. of iron, and are always very free from phosphorus and sulphur in the counties named." The only development yet attempted on this line of ores is at Cranberry, Mitchell county, North Carolina. The face of the hill has been uncovered, showing a mass of very pure magnetic ore nearly 400 feet thick to a height of 300 feet. The mining is now simply quarrying in open cut. The output of the Cranberry iron ore mines in 1887 was 45,032 long tons.

ALABAMA.

The Morris Mining Company reports that it "mined from the Alice and Redding mines about 300,000 tons in 1887. The ore is mined from outcrops, drifts, and slopes. The vein is about 22 feet thick, and dips at an angle of 24°. From the top of the mountain for about 500 feet the ore is 'soft,' and after that depth is reached it becomes 'hard,' and contains a greater quantity of lime, and is known as lime ore."

Messrs. J. R. & J. C. Smith state that they "are now shipping about 900 tons per day, and have opened three separate mines—one at Fossil, one at Ware, and one at Reader. They are sinking slopes at each of these mines, from which hard (or lime) ore will be mined exclusively. The soft ore is surface mining. The slopes will be from 400 to 800 feet deep."

Mr. Alfred F. Brainerd reports analyses of a limonite high in phosphorus and low in silica from near Columbiana, as follows:

Analyses of limonite from Columbiana, Alabama.

	Black.	Yellow.
	Per cent.	*Per cent.*
Iron	55.045	51.51
Silica	2.96	4.36
Phosphorus	2.853	2.14

LOUISIANA.

In a report, "The Iron Regions of Northern Louisiana and Eastern Texas," Prof. Lawrence C. Johnson, of the U. S. Geological Survey, notes the occurrence of carbonate and brown hematite iron ores in northern Louisiana and eastern Texas, and gives the following analyses:

Analyses of iron ores of Louisiana.

	1.	2.	3.	4.	5.	6.	7.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Phosphorus	0.18	0.62	0.247	1.65	0.382	0.859	Trace
Sulphur	0.34	0.08	0.17	0.056	0.26	0.09	0.10
Loss by ignition	....	....	11.25	....	10.53	9.05	10.26
Siliceous matter	21.40	12.15	18.72	11.42	21.77	23.20	6.37
Manganese	....	....	0.007	....	0.01	0.006	0.079
Metallic iron	38.35	49.97	45.72	43.17	43.17	44.54	50.32

No. 1. Is an average sample of ore taken from 100 pounds of partly altered nodules, and therefore representative of the mixed carbonate and limonite, from Miller's Bluff, Bossier parish.
No. 2. A piece of brown ore from Gilmer field, Phelps lake, Bossier parish.
No. 3. Ore from Allen's creek, near Shongaloo, Webster parish.
No. 4. Ore from Aubrey, Claiborne parish.
No. 5. Ore from McClish's, eight miles south of Homer, Claiborne parish.
No. 6. Ore from Vienna, Lincoln parish.
No. 7. Ore from Greenwood, Caddo parish.

The following determinations of Louisiana limonite were made by Mr. Alfred F. Brainerd:

Further analyses of Louisiana limonite.

	Per cent.	Per cent.	Per cent.
Peroxide of iron	52.165	67.949	74.307
Silica	30.760	16.780	8.000
Alumina	0.948	1.285	....
Lime	0.474	0.519	....
Magnesia	2.068	1.536	....
Manganese dioxide	0.770	0.320	....
Sulphuric acid	Trace.	Trace.	....
Phosphoric acid	1.577	2.095	1.649
Undetermined loss and water (combined)	11.238	10.516	....
Totals	100.000	100.000	....
Metallic iron	36.517	47.565	52.005
Sulphur	Trace.	Trace.	....
Phosphorus	0.689	0.919	0.727

TEXAS.

A large area of northeastern Texas exposes limonite ore which is of excellent quality. The deposits do not indicate great depth, but their liberal distribution would suggest quantities sufficient to maintain iron industries. Two blast-furnace plants now depend on these ores, one being operated in connection with the State penitentiary. Estimated upon the production of pig iron in 1887 the amount of these ores mined was about 9,000 long tons. The following analyses show the composition of the ore near Alcade furnace:

Composition of limonite near Rusk, Cherokee county, Texas.

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Iron	46.55	45.65	45.17	40.63	48.31	48.11
Silica	17.53	17.67	20.36	23.84	16.62	10.43
Sulphur	....	....	0.038	0.01	0.027	....
Phosphorus	0.153	0.069	0.062	0.315	0.284	2.12
Water	....	13.09	15.25	15.76	13.71	14.64

A sample personally collected in Cherokee county was analyzed by the Saint Louis Sampling and Testing Works with the following result:

Analysis of limonite from Cherokee county, Texas.

	Per cent.
Moisture	1.63
Loss by ignition	11.65
Silica	10.81
Alumina	3.40
Metallic iron	48.24
Manganese	0.43
Lime	0.24
Magnesia	Trace.
Sulphur	1.176
Phosphorus	0.268

Exploration has been active in Llano county, about 90 miles northwest of Austin, where at an elevation of 1,000 feet above the ocean a deposit of red hematite iron ore has been exposed along a chain of hills running northwest and southeast. The iron formations crop out prominently throughout the valley, mostly in the quartzite belts. On the table lands and ridegs mica schist, ferruginous sandstones, black shale, and tilted veins of slate are encountered at various places. Outcroppings are reported as numerous and indicating large bodies of ore. Samples of the ores submitted to Mr. Davenport Fisher, and one to the North Chicago Rolling Mills, show as follows:

Analyses of hematite iron ores from Llano county, Texas.

Iron.	Silica.	Phosphorus.	Manganese.	Sulphur.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
63.25	6.35	0.049	Trace.	None.
67.43	4.03	0.059	Trace.	Trace.
66.27	2.81	0.47	Trace.	Trace.
68.26	....	....	....	....
68.82	2.52	0.038	Trace.	Trace.
69.30	3.83	0.034	Trace.	None.
70.95	2.89	0.024	Trace.	Trace.
67.54	2.45	0.041	None.	None.
69.17	2.99	0.009	None.	None.
60.49	15.67	0.020	Trace.	None.
50.99	26.05	0.019	None.	None.
63.74	10.08	0.018	None.	None.
67.27	4.83	0.018	Trace.	None.
70.25	1.23	0.014	Trace.	None.

COLORADO.

In Colorado numerous important and apparently extensive deposits of magnetite, hematite, and bog ores, a few of which have been exploited, are found.

Mr. Charles M. Rolker gives analyses of brown hematites in southeastern Colorado, which have been worked to a considerable extent, as follows:

Analyses of brown hematites from southeastern Colorado.

	Per cent.	Per cent.	Per cent.	Per cent.
Iron	53.37	57.60	56.60	57.30
Silica	7.90	5.60	6.06	5.03
Phosphorus	0.034	0.014	0.022	0.019
Sulphur	0.20	0.005	0.000	0.006
Lime	0.35	....	0.000	Not det.
Alumina	0.70	0.74	0.40	Not det.
Magnesia	0.05	0.40	Trace.	Not det.
Manganese	1.05	1.59	1.65	1.87

A mixed red hematite and magnetite near Leadville shows:

Analyses of mixed red hematite and magnetite mined near Leadville, Colorado.

	Per cent.	Per cent.	Per cent.	Per cent.
Iron	68.3	65.6	63.0	63.7
Silica	1.18	2.40	6.68	4.6
Phosphorus	0.005	0.018	0.03	0.003
Sulphur	0.102	0.072	....	....
Lime	Trace.	Trace.	....	....
Magnesia	1.50	0.90	Not determined.	
Alumina	0.6	0.80	....	....
Manganese	0.08	0.13	....	....

The carbonaceous or kidney ores occurring south of Pueblo, and used in the mixtures for foundry iron, average about 22 to 32 per cent. of iron and 11 to 17 per cent. of siliceous matter, but they run high in phosphorus and carbonate of lime.

In Costilla county, near Pacer station, magnetites occur in syenite of the composition shown in the following table:

Analysis of magnetites from Costilla county, Colorado.

	Per cent.
Iron	52.00
Silica	12.6
Phosphorus	0.051
Sulphur	0.017
Lime	5.7
Magnesia	1.12
Alumina	3.6
Manganese	0.34
Titanic acid	Trace.

NOTE.—This ore also contains some copper.

The Grape creek magnetite carries 45 to 50 per cent. of iron, 13 to 15 per cent. of titanic acid, and 5 per cent. of silica. Magnetite beds containing a high percentage of titanic acid are also found near Gunnison, in Gunnison county, and others might be enumerated. The fault of many Colorado magnetite deposits is titanic acid, and too high a percentage of silica.

The Chaffee County deposits, on the contrary, are reported as superior, and contain some notable mines, among which are the Calumet, Hecla, and Smithville. These lie between the Arkansas valley and the Park range, on a chain of mountains running northwest and southeast, at an elevation of 9,050 feet, 19 miles distant from Salida, which in turn is 97 miles by rail from South Pueblo, where Bessemer works are located.

The following are some analyses: No. 1 is an average from a large lot of raw ore; No. 2 is an average from large lots of pulverulent ore, also raw; No. 3 is an average sample of roasted ore from a very large pile. These analyses, like others here quoted, were made by the chemist of the Colorado Coal and Iron Company:

Analyses of iron ores from Chaffee county, Colorado.

	1	2	3
	Per cent.	*Per cent.*	*Per cent.*
Iron	51.3	59.6	50.44
Silica	12.4	7.1	14.97
Sulphur	1.42	1.26	0.75
Phosphorus			
Lime			5.41
Alumina			3.24
Magnesia			4.09
Copper			0.017
Manganese			0.22

ORE CONCENTRATION.

The demand for richer ores has stimulated renewed investigation into methods of concentration, a subject upon which large amounts of money have been spent with but meager returns, but one which offers inducements for investigation, experiment, and practice. For years the separation of iron ore from its gangue has been practiced in the Lake Champlain region, and several bloomary plants operate their own mines and separators. Mining companies in this region and also in southeastern New York have concentrating plants, and some of the Missouri ores are enriched by separation. Large plants have also been established in the Marquette region, but their success is questionable.

The following analysis, by J. Blodget Britton, of one of the Lake Champlain magnetites before separation and of the iron made from it by the bloomary process is presented:

Analysis of crude magnetite from Palmer, New York.

	Per cent.
Metallic iron	46.56
Oxygen with the iron	17.99
Water	0.57
Insoluble siliceous matter (white sand)	30.98
Sulphur	(*a*)
Phosphoric acid (phosphorus, 0.054)	0.13
Alumina	1.67
Lime	0.68
Magnesia	0.58
Oxide of manganese	0.14
Organic and undetermined matter and loss	0.70
Total	100.00

a Practically none.

Analysis of iron from Palmer magnetite by the J. & J. Rogers Iron Company.

	Per cent.
Pure iron	99.440
Phosphorus	0.042
Sulphur	None.
Silica	0.280
Carbon	0.170
Oxygen, undetermined matter, and loss	0.068
Total	100.00

The Chateaugay Ore and Iron Company in the Adirondack region of New York produces annually about 50,000 tons of separated ore, which is in good demand at the furnaces. In treating the leaner ores, which carry an average of 35 per cent. of iron, about 1 ton of separated ore, yielding 63 to 65 per cent., is obtained from 3 tons of ore as mined, the loss of iron in the tailings being about 16 per cent. In this case the ore is reduced to small grains by crushers and treated in rotating hydraulic jigs.

At the Croton magnetic iron ore mines in Putnam county, New York, the ore is reduced to proper size and separated by hydraulic plunger jigs. The following analyses show the results obtained by coarse and fine jigging:

Analyses of concentrates from fine and coarse jigs, Croton mines, New York.

	Ore.	Concentrates.			Tailings.
	Metallic iron.	Metallic iron.	Phosphorus.	Sulphur.	Metallic iron.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Fine jigs	26.48	65.56	0.047	0.97	14.31
Coarse jigs	36.48	58.78	0.129	0.83	22.16

The waste piles and dumps containing over 100,000 tons of ore have been carefully analyzed and found to contain an average of 37.29 per cent. of metallic iron.

In some ores only the siliceous gangue is separated by gravity, but in others, where the phosphorus occurs as apatite, a partial dephosphorization may be secured by mechanical means. Magnetic attraction appears to offer the most promise for concentrating magnetic ores. This has been attempted in numerous ways, but has not achieved commercial success; the cost of reducing the ore to such degrees of comminution and the loss in tailings overcoming the apparent advantages as far as the enrichment of the ore is concerned. Whether the production of a Bessemer from a non-Bessemer ore would counteract these objections is to be determined. Experiments are now in progress at some of the magnetic iron ore mines in southeastern New York and in

New Jersey with magnetic separators. At Iron Mountain, Missouri, all the fines from the workings are passed through hydraulic jigs for separation, but no lump ore is crushed for this purpose. The demand from blast furnace managers is for richer ores, which must either be obtained from distant points or by concentration. The success of some important iron ore mines depends, therefore, upon successful separation.

Efforts are being made to utilize the magnetic iron sands which are found along our coasts, and experiments to separate the fine particles of magnetic iron ore from the siliceous material have been made near Westerly, and on Block Island, Rhode Island. The ore forms from 15 to 20 per cent. of the bulk of the sand, and analyses by Prof. J. Blodget Britton of some of the Block Island iron sand cleaned by magnetic separator show:

Analysis of separated magnetic iron sands from Block Island, Rhode Island.

	Per cent.
Metallic iron	71.42
Oxygen with the iron	27.22
Water	0.18
Silica	0.58
Sulphur	None.
Phosphoric acid (phosphorus, 0.027)	0.061
Alumina	0.47
Lime	0.03
Magnesia	Trace.
Undetermined matter and loss	0.039
Total	100.000

Some of this ore was treated with powdered charcoal in retorts, and the carbureted iron sponge produced was analyzed by the Bethlehem Iron Company, with the following results:

Analysis of iron sponge.

	Per cent.	Per cent.
Iron	69.03	74.8
Phosphorus	0.017	0.018

CUBAN IRON ORE.

The entire product of the Cuban iron ore mines, or to speak more properly, quarries (for the ore is taken from open cuts), comes to this country to the Pennsylvania Steel Company and the Bethlehem Iron Company, who control the Jurugua Company, under whose management the development has so far been made.

The ore is obtained from a ridge located a few miles inland from and running nearly parallel with the shore of the Caribbean sea, near Santiago de Cuba, on the southwestern portion of the island. Shipments commenced in 1884.

Shipments of Cuban ores, 1884 to 1887, inclusive.

	Long tons.
1884	22,000
1885	80,000
1886	110,000
1887	108,000
Total	320,000

Professor Kimball reports that "the ore is anhydrous red hematite, presenting all the varieties of form of that mineral, such as lustrous, specular, and micaceous, as well as amorphous and lusterless forms." Some samples of the ore carry considerable sulphur, but Mr. T. H. Graham, M. E., in a monograph, gives the composition of the ore as mined. He states that the present developments cover but a portion of the iron range, which is 14 miles long.

Composition of Cuban iron ore.

	Per cent.	
Metallic iron	62 to 66	
Phosphorus	0.006	0.026
Sulphur	0.02	0.04

From the interest exhibited in other developments, and the location of a large blast furnace plant near Baltimore to smelt these ores, they will probably continue to be a factor of considerable importance in the supply of foreign ore, and are expected to be utilized in mixture with some of the Alabama ores.

Mr. S. M. Keiper supplies the following analyses of ores personally collected from Lola Denouncements in Cuba, covering over 300 acres. The sample from which analysis No. 1 was taken was composed of 79 fragments broken from the surface on the eastern section; No. 2 was of 83 fragments from bowlders and small pieces from the southern section; No. 3 was of 18 pieces from the north section, and No. 4 was 2 pounds of disintegrated surface ore from the western section of the property. The analyses were made by the Lackawanna Coal and Iron Company.

Analyses of Cuban ores not marketed.

	1.	2.	3.	4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica	4.38	0.80	1.06	3.60
Water and carbonic acid	0.05	0.55	0.52	0.18
Protoxide and peroxide of iron	93.439	95.495	95.324	94.771
Alumina	0.61	1.52	1.74	0.15
Lime	0.55	0.10	0.20	0.60
Magnesia	0.51	0.69	0.47	0.33
Manganese oxide	0.24	0.20	0.38	0.26
Sulphur	0.048	0.031	0.029	0.018
Phosphoric acid	0.173	0.115	0.077	0.097
Totals	100.000	99.501	99.700	100.006
Metallic iron	66.42	68.91	68.72	66.61
Phosphorus	0.075	0.050	0.033	0.040

GOLD AND SILVER.

Production statistics.—The Hon. James P. Kimball, Director of the Mint, makes an annual estimate of the production of the precious metals, which is accepted as authoritative in this report, no provision having yet been made for the collection of the statistics of gold and silver in this office. The production of gold is estimated at 1,596,500 fine ounces, valued at $33,000,000. This is a decrease in value of $2,000,000 as compared with the product of 1886. Silver increased from 39,445,312 fine ounces, worth $51,000,000, to 41,269,240 fine ounces, with a coining value of $53,357,000, in 1887. The combined value of the gold and silver product in 1887 was $86,357,000. The following geographic distribution of the product is intended as approximate only.

Approximate distribution in round numbers, by States and Territories, of the estimated total production of precious metals in the United States during the calendar years 1881 *to* 1886 *inclusive.*

States and Territories.	1881.			1882.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$15, 000	....	$15, 000	$150, 000	....	$150, 000
Arizona	1, 060, 000	$7, 300, 000	8, 360, 000	1, 065, 000	$7, 500, 000	8, 565, 000
California	18, 200, 000	750, 000	18, 950, 000	16, 800, 000	845, 000	17, 645, 000
Colorado	3, 300, 000	17, 160, 000	20, 460, 000	3, 360, 000	16, 500, 000	19, 860, 000
Dakota	4, 000, 000	70, 000	4, 070, 000	3, 300, 000	175, 000	3, 475, 000
Georgia	125, 000	....	125, 000	250, 000	....	250, 000
Idaho	1, 700, 000	1, 300, 000	3, 000, 000	1, 500, 000	2, 000, 000	3, 500, 000
Maine	....	5, 000	5, 000	....	....	....
Montana	2, 330, 000	2, 630, 000	4, 960, 000	2, 550, 000	4, 370, 000	6, 920, 000
Nevada	2, 250, 000	7, 060, 000	9, 310, 000	2, 000, 000	6, 750, 000	8, 750, 000
New Mexico	185, 000	275, 000	460, 000	150, 000	1, 800, 000	1, 950, 000
North Carolina	115, 000	....	115, 000	190, 000	25, 000	215, 000
Oregon	1, 100, 000	50, 000	1, 150, 000	830, 000	35, 000	865, 000
South Carolina	35, 000	....	35, 000	25, 000	....	25, 000
Tennessee	5, 000	....	5, 000	....	....	....
Utah	145, 000	6, 400, 000	6, 545, 000	190, 000	6, 800, 000	6, 990, 000
Virginia	10, 000	....	10, 000	15, 000	....	15, 000
Washington	120, 000	....	120, 000	120, 000	....	120, 000
Wyoming	5, 000	....	5, 000	5, 000	....	5, 000
Total	34, 700, 000	43, 000, 000	77, 700, 000	32, 500, 000	46, 800, 000	79, 300, 000

Approximate distribution in round numbers, by States and Territories, of the estimated total production of precious metals in the United States, etc.—Continued.

	1883.			1884.		
Alaska	$300,000	....	$300,000	$200,000	....	$200,000
Arizona	950,000	$5,200,000	6,150,000	930,000	$4,500,000	5,430,000
California	14,120,000	1,460,000	15,580,000	13,600,000	3,000,000	16,600,000
Colorado	4,100,000	17,370,000	21,470,000	4,250,000	16,000,000	20,250,000
Dakota	3,200,000	150,000	3,350,000	3,300,000	150,000	3,450,000
Georgia	199,000	1,000	200,000	137,000	....	137,000
Idaho	1,400,000	2,100,000	3,500,000	1,250,000	2,720,000	3,970,000
Montana	1,800,000	6,000,000	7,800,000	2,170,000	7,000,000	9,170,000
Nevada	2,520,000	5,430,000	7,950,000	3,500,000	5,600,000	9,100,000
New Mexico	280,000	2,845,000	3,125,000	300,000	3,000,000	3,300,000
North Carolina	167,000	3,000	170,000	157,000	3,500	160,500
Oregon	660,000	20,000	680,000	660,000	20,000	680,000
South Carolina	56,500	500	57,000	57,000	500	57,500
Utah	140,000	5,620,000	5,760,000	120,000	6,800,000	6,920,000
Virginia	6,000	....	6,000	2,000	....	2,000
Washington	80,000	500	80,500	85,000	1,000	86,000
Wyoming	4,000	....	4,000	6,000	....	6,000
Other	17,500	....	17,500	76,000	5,000	81,000
Total	30,000,000	46,200,000	76,200,000	30,800,000	48,800,000	79,600,000

	1885.			1886.		
Alaska	$300,000	$2,000	$302,000	$446,000	$2,000	$448,000
Arizona	880,000	3,800,000	4,680,000	1,110,000	3,400,000	4,510,000
California	12,700,000	2,500,000	15,200,000	14,725,000	1,400,000	16,125,000
Colorado	4,200,000	15,800,000	20,000,000	4,450,000	16,000,000	20,450,000
Dakota	3,200,000	100,000	3,300,000	2,700,000	425,000	3,125,000
Georgia	136,000	....	136,000	152,500	1,000	153,500
Idaho	1,800,000	3,500,000	5,300,000	1,800,000	3,600,000	5,400,000
Montana	3,300,000	10,060,000	13,360,000	4,425,000	12,400,000	16,825,000
Nevada	3,100,000	6,000,000	9,100,000	3,090,000	5,000,000	8,090,000
New Mexico	800,000	3,000,000	3,800,000	400,000	2,300,000	2,700,000
North Carolina	152,000	3,000	155,000	175,000	3,000	178,000
Oregon	800,000	10,000	810,000	990,000	5,000	995,000
South Carolina	43,000	....	43,000	37,500	500	38,000
Utah	180,000	6,750,000	6,930,000	216,000	6,500,000	6,716,000
Washington	120,000	70,000	190,000	147,000	80,000	227,000
Texas, Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	90,000	5,000	95,000	5,000	205,000	210,000
Total	31,801,000	51,600,000	83,401,000	34,869,000	51,321,500	86,190,500

Estimated production of gold and silver in 1887.

States and Territories.	Gold.	Silver.	Total.
Alaska	$675,000	$300	$675,300
Arizona	830,000	3,800,000	4,630,000
California	13,400,000	1,500,000	14,900,000
Colorado	4,000,000	15,000,000	19,000,000
Dakota	2,400,000	40,000	2,440,000
Georgia	110,000	500	110,500
Idaho	1,900,000	3 000,000	4,900,000
Michigan	35,000	26,000	61,000
Montana	5,230,000	15,500,000	20,730,000
Nevada	2,500,000	4,900,000	7,400,000
New Mexico	500,000	2,300,000	2,800,000
North Carolina	225,000	5,000	230,000
Oregon	900,000	10,000	910,000
South Carolina	50,000	500	50,500
Utah	220,000	7,000,000	7,220,000
Washington	150,000	100,000	250,000
Texas	....	250,000	250,000
Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	22,000	1,000	23,000
Total	33,147,000	53,433,300	86,580,300

Rank of the States and Territories in the production of gold and silver in 1886.

Gold.	Silver.	Total.
1. California.	1. Colorado.	1. Colorado.
2. Colorado.	2. Montana.	2. Montana.
3. Montana.	3. Utah.	3. California.
4. Nevada.	4. Nevada.	4. Nevada.
5. Dakota.	5. Idaho.	5. Utah.
6. Idaho.	6. Arizona.	6. Idaho.
7. Arizona.	7. New Mexico.	7. Arizona.
8. Oregon.	8. California.	8. Dakota.
9. Alaska.	9. Dakota.	9. New Mexico.
10. New Mexico.	10. "Other."	10. Oregon.
11. Utah.	11. Washington.	11. Alaska.
12. North Carolina.	12. Oregon.	12. Washington.
13. Georgia.	13. North Carolina.	13. "Other."
14. Washington.	14. Alaska.	14. North Carolina.
15. South Carolina.	15. Georgia.	15. Georgia.
16. "Other."	16. South Carolina.	16. South Carolina.

Rank of the States and Territories in the production of gold and silver in 1887.

Gold.	Silver.	Total.
1. California.	1. Montana.	1. Montana.
2. Montana.	2. Colorado.	2. Colorado.
3. Colorado.	3. Utah.	3. California.
4. Nevada.	4. Nevada.	4. Nevada.
5. Dakota.	5. Arizona.	5. Utah.
6. Idaho.	6. Idaho.	6. Idaho.
7. Oregon.	7. New Mexico.	7. Arizona.
8. Arizona.	8. California.	8. New Mexico.
9. Alaska.	9. Texas.	9. Dakota.
10. New Mexico.	10. Washington.	10. Oregon.
11. North Carolina.	11. "Other."	11. Alaska.
12. Utah.	12. Dakota.	12. Washington.
13. Washington.	13. Michigan.	13. Texas.
14. Georgia.	14. Oregon.	14. North Carolina.
15. South Carolina.	15. North Carolina.	15. Georgia.
16. Michigan.	16. Georgia.	16. "Other."
17. "Other."	17. South Carolina.	17. South Carolina.
	18. Alaska.	18. Michigan.

The following table shows the production of gold and silver in the United States since 1804, silver being valued at the coining rate in silver dollars, equivalent to $1.2929 per troy ounce fine:

Production of gold and silver in the United States to December 31, 1887.

Periods.	Gold.	Silver.	Total.
Output of the southern States from 1804 to the discovery of gold in California in 1848 (based on estimates of Prof. J. D. Whitney)	$13, 243, 475	....	$13, 243, 475
Product from 1848 to 1879, inclusive, by fiscal years	1, 484, 041, 532	$422, 722, 260	1, 906, 763, 792
Fiscal year ending June 30, 1880 (census figures, covering a period one month earlier, assumed)	33, 379, 663	41, 110, 957	74, 490, 620
July 1, 1880, to December 31, 1880 (estimated on the basis of half the product of the fiscal year 1881, as reported by Hon. Horatio C. Burchard, Director of the Mint)	18, 250, 000	21, 050, 000	39, 300, 000
Calendar years 1881 to 1884, inclusive (as reported by Hon. Horatio C. Burchard, Director of the Mint)	128, 000, 000	184, 800, 000	312, 800, 000
Calendar years 1885, 1886, and 1887 (as reported by Dr. James P. Kimball, Director of the Mint)	99, 941, 000	156, 041, 300	255, 982, 300
Total product of the United States to close of 1887	1, 776, 855, 670	825, 724, 517	2, 602, 580, 187

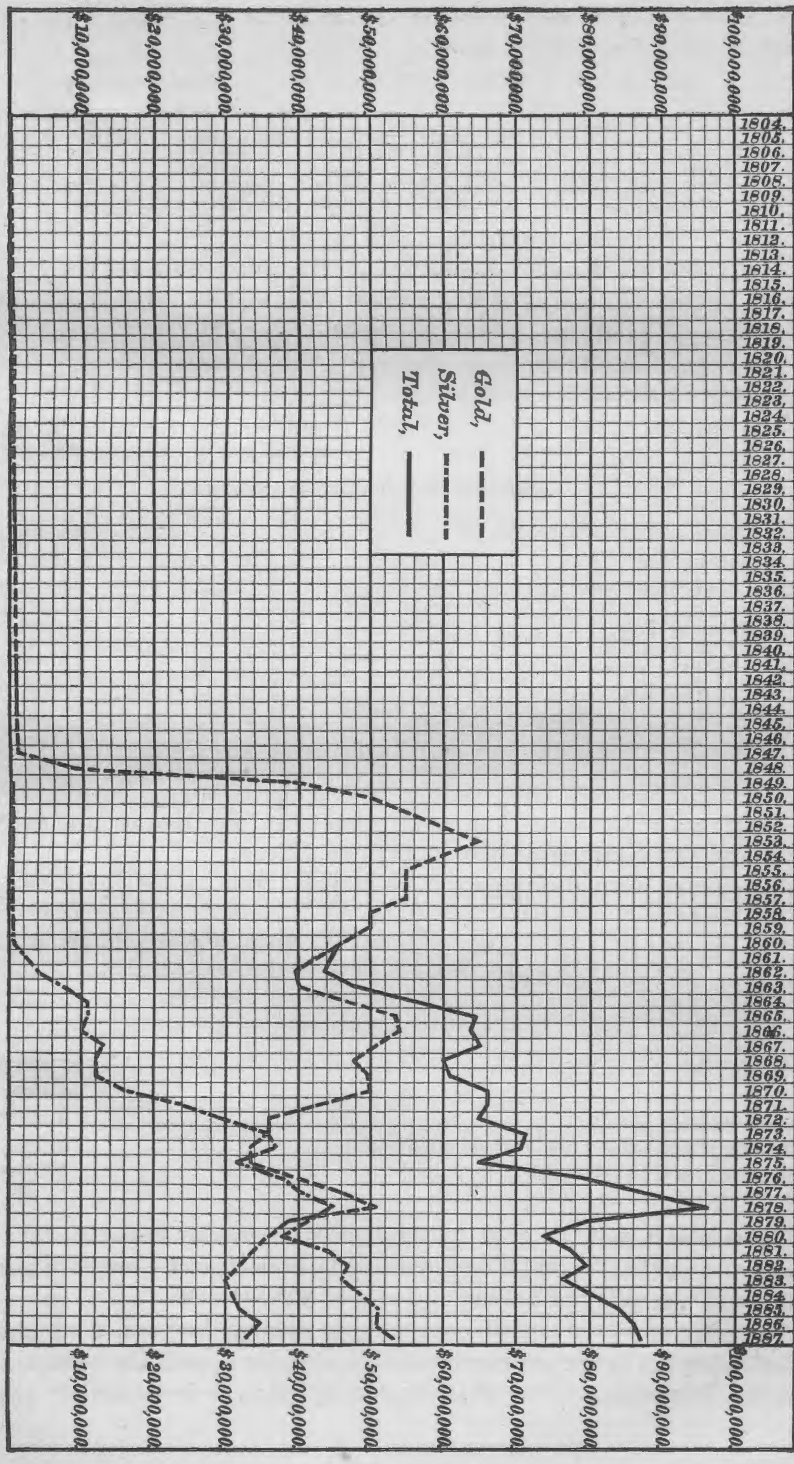

FIG. 1.—Production of gold and silver in the United States to December 31, 1887.

The production of gold and silver in the world was as follows:

Calendar years.	Gold.	Value.	Silver.	Value.
	Kilograms.	*Dollars.*	*Kilograms.*	*Dollars.*
1883	143,533	95,392,000	2,774,227	115,297,000
1884	153,017	101,694,000	2,665,386	110,773,000
1885	155,891	103,603,000	2,954,766	122,799,800
1886	148,625	98,764,235	3,037,319	126,457,500

The value of the gold deposited at the mints was $84,667,712, of which $32,444,067 was of domestic production, and $39,092,051 consisted of foreign gold bullion and coin imported into the United States.

The deposits and purchases of silver at the mints amounted, at coining rate, to $46,947,792.

The imports of gold into the United States during the calendar year 1887 were:

Imports of gold and silver in 1887.

Gold bullion (principally foreign)	$19,524,641
Gold coin (foreign)	19,652,042
Gold coin (United States)	5,712,616
Total gold	$44,889,299
Silver bullion	5,373,001
Silver coin (foreign)	10,197,139
Trade dollars	831,176
Subsidiary silver coin	371,298
Total silver	$16,772,614

Nearly all of the silver bullion imported was from Mexico, and nearly all of the silver coin consisted of Mexican dollars.

Silver ores were also imported, principally from Mexico, of the value of $4,242,135.

The exports of bullion and coin from the United States in the calendar year 1887 consisted of:

Exports of gold and silver in 1887.

Gold bullion	$1,089,776
Foreign gold coin	4,048,991
United States gold coin	4,005,659
Domestic silver bullion (at its commercial value)	19,703,551
Foreign silver coin (principally to China)	7,894,041
Subsidiary coin	47,396

There was a gain in gold to the United States by imports over exports of $35,671,297, and a loss of silver by exports of $7,159,667; a net gain to this country of bullion and coin of $28,511,630.

The price of silver varied considerably during the year, the highest price being 47½ pence per ounce (British standard), and the lowest 43¼ pence. The average price of silver during the year was about 98 cents per fine ounce. The amount of silver purchased for the silver-dollar coinage was 24,797,279 fine ounces, costing $24,221,257; the average cost to the Government being $0.9768 per ounce fine.

Coinage of the mints during the calendar year 1887.

Coins.	Pieces.	Value.
Gold	3, 086, 873	$23, 972, 383. 00
Silver dollars	33, 611, 710	33, 611, 710. 00
Subsidiary silver	15, 754, 809	1, 579, 371. 40
Minor	60, 498, 096	1, 215, 686. 26
Total	112, 951, 488	60, 379, 150. 66

In addition to the large coinage of silver dollars by the United States a very large coinage of full legal-tender silver coins was executed at the mints of Mexico, India, and Japan, and some at the Austrian mints.

Reports of the coinages executed by the mints of the world show that the coinage of the world during the calendar years 1884, 1885, 1886, and 1887 was as follows:

The world's coinage from 1884 *to* 1887.

Calendar years.	Gold.	Silver.
1884	$99, 432, 795	$95, 832, 084
1885	95, 712, 008	105, 324, 736
1886	94, 642, 070	124, 706, 065
1887	124, 998, 797	133, 502, 066

This includes recoinages, which were not less in value than $10,000,000 in gold and $15,000,000 in silver in 1886.

An inquiry as to the value of the gold and silver used in the industrial arts in the United States during the year 1887 shows a consumption of gold of $11,672,606, and of silver $5,241,998; total, $16,914,604. Including the melting down of United States gold coin, the Director of the Mint estimates the value of the gold used in the United States in the industrial arts during 1887 at about $14,600,000, and of silver $5,280,000. This is an increase over the consumption of prior years.

The reported consumption of gold in the industrial arts in the world was in 1886 approximately—gold, $46,000,000; silver, $22,000,000.

Imports of gold and silver, 1868 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Gold.			Silver.	
	Dust. (*a*)	Bullion.	Coin.	Bullion.	Coin.
1868	....	$1, 909, 503	$6, 558, 602	$151, 238	$5, 304, 835
1869	....	890, 064	13, 240, 191	54, 267	5, 622, 548
1870	....	697, 904	11, 452, 414	161, 982	14, 217, 406
1871	....	1, 177, 387	5, 704, 298	69, 836	11, 591, 875
1872	$258, 329	1, 101, 617	7, 339, 572	405, 631	4, 647, 034
1873	7, 771	1, 549, 899	7, 092, 011	476, 608	12, 318, 911
1874	20, 842	1, 349, 346	18, 089, 155	830, 639	8, 153, 087
1875	15, 222	1, 562, 767	12, 018, 537	1, 294, 763	5, 913, 474
1876	28, 802	1, 167, 102	6, 596, 692	1, 057, 377	6, 885, 795
1877	85, 858	2, 032, 907	24, 131, 925	4, 693, 605	9, 829, 666
1878	17, 602	1, 955, 005	11, 365, 656	6, 971, 849	9, 512, 704
1879	17, 949	1, 275, 749	4, 373, 168	2, 424, 675	12, 203, 871
1880	883, 690	19, 453, 755	60, 420, 951	1, 981, 425	10, 294, 489
1881	697, 467	30, 301, 452	69, 032, 340	2, 303, 472	8, 240, 766
1882	647, 551	8, 758, 502	24, 971, 001	2, 121, 833	5, 973, 603
1883	....	3, 334, 708	14, 399, 441	2, 475, 968	8, 279, 274
1884	....	4, 997, 571	17, 833, 746	2, 910, 451	11, 684, 494
1885	....	8, 849, 237	17, 842, 459	4, 530, 384	12, 020, 243
1886	....	4, 073, 458	16, 669, 891	4, 151, 438	13, 698, 869
1887	....	19, 770, 714	23, 139, 887	4, 932, 697	12, 327, 494

a In 1868–1871 and 1883–1887 included under head of gold bullion.

Exports of gold and silver of domestic production, 1851 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Gold and silver coin. (*a*)	Gold.		Silver.	
		Bullion.	Coin.	Bullion.	Coin.
1851	$18, 069, 580	....	....	....	....
1852	37, 437, 837	....	....	....	....
1853	23, 548, 535	....	....	....	....
1854	38, 062, 570	....	....	....	....
1855	19, 842, 423	$34, 114, 995	....	....	....
1856	15, 458, 333	28, 689, 946	....	....	....
1857	28, 777, 372	31, 300, 980	....	....	....
1858	19, 474, 040	22, 933, 206	....	....	....
1859	24, 172, 442	33, 329, 863	....	....	....
1860	26, 033, 678	30, 913, 173	....	....	....
1861	10, 488, 590	13, 311, 280	....	....	....
1862	....	13, 267, 739	$17, 776, 912	....	....
1863	44, 608, 529	11, 385, 033	....	....	....
1864	....	10, 985, 703	86, 148, 921	836, 387	$2, 502, 551
1865	....	21, 145, 055	35, 413, 651	6, 311, 986	1, 747, 432
1866	....	20, 731, 473	49, 395, 993	10, 832, 849	1, 683, 059
1867	....	13, 867, 641	22, 362, 035	15, 853, 530	2, 892, 990
1868	....	23, 841, 155	44, 390, 003	12, 978, 311	2, 536, 506
1869	....	13, 584, 407	14, 858, 369	13, 573, 427	899, 763
1870	....	15, 812, 108	12, 768, 501	11, 748, 864	3, 554, 329
1871	....	9, 089, 959	55, 491, 719	17, 285, 916	2, 535, 765
1872	....	7, 986, 145	40, 391, 357	22, 729, 657	1, 691, 081
1873	....	8, 810, 175	35, 661, 863	27, 759, 066	1, 674, 442
1874	....	3, 878, 543	28, 766, 943	22, 498, 782	4, 555, 418
1875	....	2, 233, 775	59, 309, 770	17, 197, 914	5, 115, 670
1876	....	1, 888, 896	27, 542, 861	15, 240, 344	5, 366, 590
1877	....	1, 084, 536	21, 274, 565	11, 482, 894	9, 292, 743
1878	....	205, 319	6, 427, 251	15, 035, 045	5, 394, 270
1879	....	24, 774	4, 120, 311	11, 883, 064	1, 526, 886
1880	....	87, 066	1, 687, 973	6, 912, 864	659, 990
1881	....	84, 943	1, 741, 364	11, 852, 995	547, 642
1882	....	1, 598, 336	29, 805, 289	11, 653, 547	423, 099
1883	....	4, 118, 455	4, 802, 454	12, 551, 378	150, 894
1884	....	23, 052, 183	12, 242, 021	14, 241, 050	690, 381
1885	....	395, 750	2, 345, 809	20, 422, 924	1, 211, 627
1886	....	27, 365, 090	5, 400, 769	18, 693, 313	463, 738
1887	....	2, 154, 534	3, 550, 770	16, 941, 713	63, 323

a In 1862 and 1864–1887 segregated, appearing in the other columns.

The price of silver varied considerably during the year, the highest price being $47\frac{1}{8}$ pence per ounce (British standard), and the lowest $43\frac{1}{4}$ pence. The average price of silver during the year was about 98 cents per fine ounce.

The amount of silver purchased for the silver dollar coinage was 24,797,279 fine ounces, costing $24,221,257, the average cost to the Government being $0.9768 per ounce fine.

Reports of the coinages executed by the mints of the world show that the coinage of the world during the calendar years 1884, 1885, 1886, and 1887 was as follows:

Calendar years.	Gold.	Silver.
1884	$99, 432, 795	$95, 832, 084
1885	95, 712, 008	105, 324, 736
1886	94, 642, 070	124, 706, 065
1887	124, 998, 797	133, 502, 066

This includes recoinages, which were not less in value than $10,000,000 in gold and $15,000,000 in silver in 1886.

COPPER.

By C. Kirchhoff, jr.

During the first eleven months of 1887 the history of the copper industry at home and abroad was a continuation of the gloomy record of 1886. With slight rallies, values remained extremely low, averaging even less during that time than during any period of equal length in this century, the market fluctuating between £39 and £40 for Chili bars in London. The long continued depression had led to a moderate decline in the aggregate production of the world, so that in England and France the imports of copper of all kinds had fallen off in the first ten months of 1887 to 70,046 tons fine, against 83,488 tons respectively in 1886, and 91,629 tons in 1885, while the deliveries had risen from 75,164 tons in 1886 to 83,890 tons in the first ten months of 1887. Although the visible supply had not fallen off considerably, the stocks of raw material in the hands of smelters and manufacturers and of finished goods in the hands of dealers and consumers were very low. Consumption had overtaken production, the latter not having yielded adequate returns to investment for a long time in any part of the world. The opportunity was seized upon by speculators, the movement obtaining such an impetus that those who initiated it were driven step by step to perfect the most comprehensive effort at control ever attempted in the history of any metal. In a very short time the price has been doubled, rising far above the normal figure, which may be stated to be that price at which a sufficient quantity can be produced at a good profit to the mines, to supply the world's markets and stimulate the opening out of new deposits and the development of existing properties to keep pace with growing consumption. A study of published reports of copper companies in different parts of the world, details of many of which are given in the following pages, will suffice to show that £52 to £55 for "best selected" in London, or 11 to 12 cents in New York for its equivalent, yields sufficiently ample returns to producers to induce an output of the metal capable of covering consumptive requirements. Although values may be kept above the normal level for a considerable period, they must ultimately recede to it after a reaction, carrying them considerably below it. Temporarily the copper-mining companies all over the world are reaping enormous profits, and the reopening of old mines and the development of new territory has begun in many sections. For a time the financial resources of a group of capitalists may succeed in holding up prices by buying all that is offered. That period may be extended if the speculators have reserved the power in their contracts or can exert sufficient pressure in the absence of a clause providing for a reduction in the output by those mines over which they have some control. But even the latter expedient can not long be effective since the great companies which have made enormous sacrifices in the past to check exuberant production will not long be parties to a scheme which practically fosters competition which they must cope with in the end.

Full details concerning the character and scope of the contracts entered into between the Société des Métaux and the leading mining companies have not reached the public. Their provisions appear to vary within pretty wide limits. Through the proceedings of a number of public companies some of the leading features are well known. Generally speaking they fix a maximum output on which the Société guaranties a price ranging between £60 and £65 in England, and between 12 and 13 cents in the United States, the producer and the Société dividing the excess above that figure on the price realized. Usually the French syndicate furnishes adequate guaranties in the shape of bankers' credits, the sums involved being very large. It is estimated by good authority that out of an annual output in the world of 275,000 long tons, the Société des Métaux has contracted for about 175,000 tons. This includes the leading Spanish companies, the two Cape of Good Hope companies, the Venezuela output, the Canadian mines, the principal Australian producers, the largest Japanese mine, the Panulcillo in Chili, and nearly all the great companies of Lake Superior, Montana, and Arizona.

In addition to the copper thus secured a party of operators known as the French syndicate, apart from but acting in harmony with the Société des Métaux, controls 45,000 tons of Chili bars, the greater part of which was taken over from the latter at £64, the average cost of which has, however, been estimated at £70.

The future of the metal must depend largely upon the ability of the speculators to finance the undertakings in which they are engaged. They sustained a shock in the collapse of the cornering operation in tin in which they were engaged, a collapse which was due to the rapid increase in the production on the one hand and to the decline of consumption on the other. It would not be safe to draw inferences from the course of the tin speculation upon that in which practically the same parties are involved. In tin no direct control of the producing interests was possible and consumption is more sensitive to extreme fluctuations. In copper the arrangements with the producing and refining and smelting interests are comprehensive and well planned. The resistance of the copper manufacturers against the sudden advance was determined and sustained. Doubts in the ability of the speculators to uphold values have been widespread, and have led to the adoption of a policy of purchasing sparingly and only for early requirements, in exhausting stocks of raw material and allowing supplies of manufactured goods to run low, and in using old material so far as possible. The efficacy of these measures has been thoroughly tested without causing much effect, since the speculators have been able to take care of the apparently heavily increased visible supply. The consumption of copper throughout the world has undoubtedly been adversely affected, but it is not probable that it has declined to the extent which many authorities appear to believe. Its slow growth during a long period of low prices allows the inference to be drawn that a sustained higher level of values is not likely to cause any very marked decline, though it may have checked the rapid progress it had been making during 1884, 1885, and 1886. The speculators have resisted the first shock well. The next trial of its strength will come when it is compelled to take care of the product of old and new mines opened under the stimulus of high prices.

So far as the reopening of old mines is concerned it is retarded by a number of circumstances. The first fact which told against operations of this kind was the lack of confidence felt in the permanency of high values. This was removed when the character of the contracts entered into by the Société became generally known. Another feature tending to delay operations in formerly worked properties was the fact that few of them stopped work before all available ore had been extracted and after development work had been long neglected. Under such circumstances the raising of funds for renewal of work and the placing of a property and its machinery in a condition to turn out even a moderate quantity takes considerable time. In the case of new, undeveloped mining property the delays are more serious still.

The principal increase in the output of 1888 in the United States is therefore likely to come rather from the old mines, which are straining every nerve to reach the maximum production allowed to them, than from old, idle, or new mines. The Lake Superior district is expected to show a heavy increase, especially in the second half of 1888, but the largest addition to output will come from Montana, which looks forward toward eclipsing its 1887 record by reaching close to 100,000,000 pounds of fine copper. In Arizona the record of 1884 may be reached, through the operation principally of the leading mines.

Work has begun or is in contemplation in Vermont, at the Ely mines; in New Mexico, by the San Pedro and Santa Rita; in Arizona, at the old Globe, United Verde, Copper Basin, Copper Mountain, Yuma, and others; in Wyoming, at the Sunrise; in Idaho, at the Adelaide, at Lost River; and in California, Colorado, and Utah, at a number of points. In Lake Superior, the Peninsula and other mines resumed during 1888. In the aggregate, however, these mines are not likely to approach in output the additions in make coming from some of the leading older properties.

DOMESTIC PRODUCTION.

The growth in the production of copper in the United States, compiled up to 1887, inclusive, from the best data available, is shown in the following table. It proves in a striking manner how preponderating was, until the past few years, the influence of the Lake Superior district; and again of one great mine in it, the Calumet and Hecla, for more than a decade. In order to point out more clearly how the influence of the Lake district has declined, a column has been added giving its percentage of the total product from year to year. It should be stated that the yield of copper from pyrites is not here included.

Production of copper in the United States from 1845 *to* 1887 *inclusive.*

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.	Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Long tons.	*Long tons.*	*Long tons.*			*Long tons.*	*Long tons.*	*Long tons.*	
1845....	100	12	....	12.0	1867...	10,000	7,824	603	78.2
1846....	150	26	....	17.0	1868...	11,600	9,346	2,276	80.6
1847 ...	300	213	....	71.0	1869...	12,500	11,886	5,497	95.1
1848....	500	461	....	92.5	1870...	12,600	10,992	6,277	87.2
1849....	700	672	....	96.0	1871...	13,000	11,942	7,242	91.9
1850....	650	572	....	88.0	1872...	12,500	10,961	7,215	95.7
1851....	900	779	....	86.6	1873...	15,500	13,433	8,414	87.3
1852....	1,100	792	....	72.0	1874...	17,500	15,327	8,984	87.6
1853....	2,000	1,297	....	64.9	1875...	18,000	16,089	9,586	89.4
1854....	2,250	1,819	....	71.1	1876...	19,000	17,085	9,683	88.9
1855....	3,000	2,593	....	86.4	1877...	21,000	17,422	10,075	82.9
1856....	4,000	3,666	....	91.6	1878 ..	21,500	17,719	11,272	82.4
1857....	4,800	4,255	....	88.7	1879...	23,000	19,129	11,728	83.2
1858....	5,500	4,088	....	74.3	1880...	27,000	22,204	14,140	82.2
1859....	6,300	3,985	....	63.3	1881...	32,000	24,363	14,000	76.1
1860....	7,200	5,388	....	74.8	1882...	40,467	25,439	14,309	62.1
1861....	7,500	6,713	....	89.1	1883...	51,574	26,653	14,788	50.1
1862 ...	9,000	6,065	....	67.4	1884...	63,555	30,916	17,812	48.4
1863 ...	8,500	5,797	....	67.0	1885...	74,053	32,206	21,093	43.5
1864....	8,000	5,576	....	69.7	1886 ..	69,971	35,666	25,259	50.1
1865 ...	8,500	6,410	....	75.4	1887...	80,768	33,693	20,543	41.7
1866 ...	8,900	6,138	....	68.8					

For the western States and Territories the geographic distribution of the product is becoming more and more difficult.

Territorially distributed, the pro duction of the United States in 1887 has been as follows as compared with previous years:

Total copper production in the United States, 1882 *to* 1887.

Source.	1882.	1883.	1884.	1885.	1886.	1887.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	56,982,765	59,702,404	69,353,202	72,148,172	79,890,798	75,471,890
Arizona	17,984,415	23,874,963	26,734,345	22,706,366	15,657,035	17,720,462
Montana	9,058,284	24,664,346	43,093,054	67,797,864	57,611,621	78,699,677
New Mexico..............	869,498	823,511	59,450	79,839	558,385	283,664
California..............	826,695	1,060,862	876,166	469,028	430,210	1,600,000
Colorado................	1,494,000	1,152,652	2,013,125	1,146,460	409,306	2,012,027
Utah	605,880	341,885	265,526	126,199	500,000	2,500,000
Wyoming.................	100,000	962,468	....	....	....	....
Nevada..................	350,000	288,077	100,000	8,871	50,000	....
Idaho...................	....	....	46,667	40,381	....	....
Missouri................	294,695	260,306	230,000	....	....	....
Maine and New Hampshire	290,000	212,124	249,018	} 211,602	315,719	200,000
Vermont.................	1,265,000	400,000	655,405			
Southern States.........	400,000	395,175	317,711	40,199	29,811	....
Middle States...........	....	64,400	2,114	190,641	....	....
Lead desilverizers, etc...	125,000	782,880	950,870	910,144	1,282,496	2,432,804
Total domestic copper	90,646,232	115,526,053	144,946,653	165,875,766	156,735,381	180,920,524
From imported pyrites and ores	1,000,000	1,625,742	2,858,754	5,086,841	4,500,000	3,750,000
Total (including copper from imported pyrites)...	91,646,232	117,151,795	147,805,407	170,962,607	161,235,381	184,670,524

The following is, in detail, the output of the Lake Superior mines. In the majority of cases it is the official product based on smelting works returns; in a few instances it is an official estimate of the ingot product based on the known output of mineral. The total is accurate, therefore, within a few thousand pounds.

Production of Lake Superior copper mines, 1881 *to* 1887.

Mines.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Calumet and Hecla	31, 360, 781	32, 053, 539	33, 125, 045	40, 473, 585	47, 247, 990	50, 518, 222	46, 016, 123
Quincy	5, 506, 848	5, 665, 796	6, 012, 239	5, 650, 436	5, 848, 530	5, 888, 517	5, 603, 691
Osceola	4, 179, 976	4, 176, 782	4, 256, 409	4, 247, 630	1, 945, 208	3, 560, 786	3, 574, 972
Franklin	2, 677, 932	3, 264, 120	3, 488, 708	3, 748, 652	4, 007, 105	4, 264, 297	3, 915, 838
Allouez	1, 473, 007	1, 683, 557	1, 751, 377	1, 928, 174	2, 170, 476	1, 725, 463	885, 010
Atlantic	2, 528, 009	2, 631, 708	2, 682, 197	3, 163, 585	3, 582, 633	3, 503, 670	3, 641, 865
Pewabic	1, 876, 244	1, 482, 666	1, 171, 847	227, 834	....	....	....
Central	1, 418, 465	1, 353, 597	1, 268, 556	1, 446, 747	2, 157, 408	2, 512, 886	2, 199, 133
Grand Portage	26, 264	757, 080	735, 598	255, 860	....	....	....
Conglomerate	386, 091	734, 249	222, 117	1, 198, 691	....	....	....
Mass	467, 684	737, 440	659, 474	481, 396	365, 000	200, 000	....
Copper Falls	669, 121	587, 500	804, 000	891, 168	1, 168, 000	1, 400, 000	560, 000
Phœnix	409, 357	537, 177	512, 291	631, 004	344, 355	100, 000	11; 000
Hancock	571, 897	540, 575	484, 906	562, 636	203, 037	150, 000	....
Huron	254, 515	364, 579	720, 213	1, 927, 660	2, 252, 484	1, 992, 695	1, 484, 103
Ridge	235, 606	102, 936	60, 155	74, 030	63, 390	158, 272	84, 902
Saint Clair	135, 493	87, 126	125, 225	139, 407	....	....	....
Cliff	79, 382	66, 053	10, 374	28, 225	....	22, 342	....
Wolverine	....	25, 623	699, 622	751, 763	328, 610	3, 125	2, 300
Nonesuch	119, 061	46, 450	....	23, 867	28, 484	....	....
Isle Royal	47, 308	35, 447	....	16, 074	....	....	....
Minong	15, 397	21, 380	3, 582	....	....	....	....
National	....	17, 060	26, 006	87, 368	162, 252	184, 706	25, 187
Minnesota	24, 227	10, 672	6, 226	1, 144	12, 608	....	....
Belt	....	5, 625	16, 402	130, 851	27, 433	7, 300	....
Sheldon and Columbia	10, 031	3, 299	....	9, 828	....	....	....
Aztec	....	3, 129	....	....	....	....	....
Adventure	7, 500	429	....	4, 333	4, 000	1, 000	....
Peninsula	....	....	849, 400	1, 225, 981	....	....	....
Tamarack	....	....	7, 435	....	181, 669	3, 646, 517	7, 396, 529
Ogima	16, 776	4, 207	3, 000	1, 106	12, 000	....	....
Concord	28, 849	....	....	....	....	....	....
Kearsarge	....	....	....	....	....	....	21, 237
Evergreen Bluff	968	....	....	954	1, 500	1, 000	....
Flint Steel River	4, 140	....	....	....	....	....	....
Madison	1, 534	....	....	....	....	....	....
Ash Bed	24, 804	72, 636	....	1, 517	....	....	....
Centennial	....	83, 554	....	....	....	....	....
Sundry companies—tributers	1, 642	....	....	21, 696	34, 000	50, 000	50, 000
Total	54, 558, 909	57, 155, 991	59, 702, 404	69, 353, 202	72, 148, 172	79, 890, 798	75, 471, 890

THE COPPER DISTRICTS OF THE UNITED STATES.

Lake Superior.—The low range of values during the greater part of 1887 and the disasters at the leading mine caused a falling off in spite of the greater output of the Tamarack. The production of the Lake mines is not susceptible of rapid expansion, since the usual low grade of the rock calls for elaborate preparations in mining development, plant, and crushing and dressing machinery. A long time is necessary to put mines idle for any length of time into condition for active work, and then, too, it can not be so readily done during the winter. While an increase is taking place in 1888, it is not as marked or as sudden as the advance in prices would seem to warrant.

The following table gives the cost of production at the principal mines in the years 1875 and 1882 to 1887:

Cost of production of Lake copper per pound.

Mines.	Cost of production (in cents per pound).							Yield (per cent.).						
	1887.	1886.	1885.	1884.	1883.	1882.	1875.	1887.	1886.	1885.	1884.	1883.	1882.	1875.
Quincy	8.63*a*	6.78	7.50	8.63	9.00	9.55	15.79	3.23	2.54	2.51	2.70	2.86	3.21	.....
Osceola	9.88	8.67	10.90	11.24	12.21	12.97	......	1.23	1.29	.....	1.17	1.21	.....	.....
Atlantic ...	10.20*a*	9.52	9.37	10.88	12.56	13.80	22.12	.71	.71	.74	.75	.68	.69	.78
Central	....	8.74	8.83	15.10	15.40	14.76	15.81	......	......	3.37	2.48	1.90	2.20	2.65
Allouez	....	......	11.29	13.46	15.98	17.38	......	......	......	.84	.85	.86	.85	.....
Franklin ...	....	9.34	10.03	11.62	12.96	13.00	......	1.12	1.21	1.46	1.45	1.38	1.10	.....
Huron	....	13.59	11.75	14.78	.....	.....	......	......	1.54	1.18	1.45	.....	.....	.....
Tamarack .	5.39	7.49	......	......	.....	.....	......	......	......	.....	.....	.....	.....	.....

a Including building and construction.

The principal events of the year in the Lake Superior district were the fires in the Calumet and Hecla mine, the first taking place on August 3, 1887. The mine was opened again on September 6, and resumed work on the 12th of that month. Fire again broke out on November 20, and that part of the property affected by it was sealed until, on April 24, 1888, the opening of shafts by vents was begun. Calumet No. 5 shaft was opened in May, but no rock was hoisted during that month, as the workings were full of water. Serious as the conflagration was in its effect upon the output of the mine it did not cause entire stoppage, because the seat of the fire was in the old mine, which could be and was isolated from that part of the ground known as the Black Hills, which had been developed during the past few years, but from which little ore had been stoped. The ore from this part of the property is not as rich as that of the main chute, but the management was very successful in rapidly increasing the output under adverse circumstances. The effect of the disaster upon the production is best illustrated by the following figures of monthly yield of mineral:

Monthly production of mineral from the Calumet and Hecla mine.

1887.	Short tons.	
July	2,647	Old mine.
August	1,347	Black Hills, fire, August 3.
September	2,016	Reopened September 12.
October	2,933	Old mine.
November	2,299	Fire, November 20.
December	1,510	Black Hills.
1888.		
January	1,802	Black Hills.
February	1,830	Black Hills.
March	2,280	Black Hills.
April	2,468	Black Hills.
May	2,592	Black Hills.

For the first five months the output in 1888 was 10,982 tons of mineral against 13,542 during the same period of 1887, when the ore was drawn from the old mine.

The mine is now equipped with sixteen heads of Leavitt stamps, of which twelve are in commission. Some of the orders for additional mining machinery were cancelled in June, 1888. The new smelting works will have a capacity at the end of the season of 1888 of 60,000,000 pounds of refined copper annually, and will, therefore, be ample to take care of the product of the mines which is treated in them.

The official statement of the Tamarack Mining Company for the six months ended December 31, 1887, is of particular interest, since it shows the capacity of that mine to produce copper cheaply. The product of mineral was 6,070,600 pounds, which yielded 76.06 per cent., or 4,617,371 pounds of refined copper, realizing an average of 12.88 cents, or $594,805.33. The running expenses at the mine were $183,905.45, the smelting, transportation, and market expenses were $64,823.43, showing a mining profit of $346,076.45. The outlay for mine plant during the period reviewed was $91,756.23, which, with a balance of assets on July 1, carried the total assets to $279,765.48. The mining costs per pound of copper were 3.98 cents, and adding the cost of smelting and selling the product, 1.41 cents, a total cost of 5.39 cents is reached. Including outlays for construction and the cost of sinking the second shaft, now in progress, the total cost of laying down the refined copper in the New York market, sold, was 7.37 cents. Since the work of development is still going on, and will continue for a considerable period to come, the latter figure should be accepted as the basis of comparison.

The principal event in connection with the Osceola during the year 1887 has been the failure to develop a productive territory in the continuation of the Calumet lode. A drift was run from the 16th level of the Osceola mine 741 feet west from the hanging wall of the amygdaloid to the foot wall of the conglomerate, and the latter was drifted on south 82 feet, without opening anything but poor ground. For the present work in that direction has been stopped. The Osceola mill stamped, during 1887, 183,900 tons of rock, of which 38,700 tons was for the Tamarack mine, the cost being 35.05 cents per ton of rock. The Osceola mine yielded 171,038 tons of rock, of which 25,838 tons were discarded before going to the mill, the total cost per ton of rock hoisted being $1.74, and per ton of rock stamped $2.05. The income for the year was $425,136.35, while the expenses were $354,146.94, thus leaving a mining profit of $70,989.41. The cost per pound of copper at the mine was 8.31 cents, and adding 1.57 cents for the cost of smelting, freight, and all other expenses, a total of 9.88 cents is reached as the cost per pound of refined copper laid down in New York.

In spite of two accidents, the burning of the rock house and the destruction of its machinery, on June 7, and the stoppage of the mill during the greater part of September, owing to the breakage of both main engine shafts, the Quincy produced 5,609,762 pounds of ingot copper at an expense of $484,464.10. Its earnings for the year were $187,728.29. The balance on January 1, 1887, was $548,781.46. From this dividends aggregating $200,000 were declared, leaving a balance of assets of $536,509.75, consisting of loans on call, cash, copper on hand sold, and supplies at mine. The average price realized for copper sold and delivered was 11.56 cents; the cost of production being 8.63 cents, including $75,586.73 building, construction, and real estate account.

The Franklin produced slightly less copper in 1887, partly because a smaller quantity of rock—137,137 tons against 138,385 tons—was stamped and partly because the percentage of ingot copper in the rock hoisted fell off from 1.21 per cent. in 1886 to 1.12 per cent. in 1887. On the other hand, the cost of manipulating a ton of rock hoisted was reduced from $1.90 to $1.87. It is not expected that the output for 1888 will be as large as that of 1887. With sales at an average of 11.43 cents, the mines yielded a profit of $90,851.99, the year closing with a surplus of $259,988.

Chiefly on account of an increase of 65 cents in the price of coal, costs at the Atlantic mine have been slightly higher in 1887, as shown by the following statement:

Cost at the Atlantic mine.

Items of cost.	1885.	1886.	1887.
	Cents.	*Cents.*	*Cents.*
Mining, selecting, breaking, and all surface expenses, including taxes	78.62	80.88	87.23
Transportation to mill	4.80	3.48	3.80
Stamping and separating	30.36	26.53	27.31
Freight, smelting, marketing, and New York expenses	25.45	24.25	23.07
Total working expenses	139.23	135.14	141.41
Total expenditures	143.60	138.01	145.22
Net profit	22.05	15.29	30.53
Yield of copper, per cent	0.743	0.709	0.712

As compared with 1886 the profit has been doubled by the fact that the average price realized has improved from 10.92 cents to 12.34 cents. The quantity of rock stamped was 255,750 tons against 247,035 tons in 1886, due principally to the substitution of two 18-inch cylinders for two 16-inch. Some additions to the machinery are being made which will enable a maintenance of the present rate of production of 4,000,000 pounds of ingot. In 1887 the mine produced 3,641,865 pounds of ingot at an outlay of $371,412.91, including cost of additions to plant and a small bad debt, leaving a net gain of $80,866.04, from which a dividend of $60,000 was paid. This left a balance of $284,966.13 in cash, loans, copper on hand sold, and supplies at mine.

The Kearsarge appears as a new mine, which has produced some copper during the course of development work. Up to January 1, 1888, the outlay for running expenses had been $68,868.37 and the construction account $28,503.50. The Ridge during 1887 was in the hands of tributers, and was operated at a loss of $1,645.13 during the year, suffering somewhat from the exodus of miners to the adjacent Gogebic iron-ore district. The Alloucz did very little in 1887, the parties who had leased the mine for three years from June 1, 1885, succumbing to the pressure of low prices in July. The improvement in the market led to a resumption of work on the part of the company, which on January 1, 1888, had a balance of quick assets of $48,497.97.

Montana.—The Anaconda Company is still engaged in enlarging its works, adding 10 Ball steam stamps and a large number of jigs to its concentrating plant, and is building an additional smelting works, chiefly for the purpose of treating the argentiferous copper ores of the Chambers syndicate group. It is estimated that unless there are unlooked-for disturbances, the total product for 1888 will reach 80,000,000 pounds fine. It is reported that the sale of the copper of the company to the Société des Métaux covers only one year. Early in 1887 the ore of the Anaconda averaged 11.3 per cent., the yield in the concentrators being 69 per cent. and 67 per cent. in the smelter product. The concentrators reached a capacity of 1,200 tons a day.

Arizona.—The Old Dominion mine at Globe worked only during the first half of 1887, and even during that period work was not continuous, the product being 722 tons. The mine resumed in January, 1888, and early in June was turning out copper at the rate of about 220 tons per month. The lack of transportation facilities still hampers the district, so that, although a number of promising deposits are well known to exist, the high costs render the smelting of ores under 15 per cent. prohibitory. The cost of English coke as charged against the furnace, inclusive of all waste, is $52 per ton, this including $30 freight between Globe and the railroad. It is estimated that the cost at the Old Dominion mine is 5½ cents per pound spot, and to this must be added 3 cents for freight, refining, commissions, interest, and general expenses, making the total cost laid down in the market 8½ cents. For the past four years there have been no material changes in the costs, except that wages and freights have been slightly reduced and the strictest economy has been practiced. The Old Dominion is the only mine which has been worked for several years, but it is reported that in the near future a number of others may start.

The Copper Queen Company did not produce up to capacity during 1887, the works having been closed down for a part of the time. A concentrating plant has been built to handle accumulations of low-grade carbonate ore, running about 4 per cent. of copper. The concentrates are carried up to 15 to 20 per cent., while the tailings range between 1½ and 2 per cent. The company controls by purchase the greater number of the smaller mines in the district which are not capable of being worked to advantage individually, although they furnish small quantities of ore suitable in mixture to the main operations and save the principal body of ore from too rapid exhaustion. The only exception is the Holbrook & Cave property, adjoining claims, owned by other parties. They are so located that the ore can be handled through the Copper Queen shafts, the company receiving a fixed sum for hoisting. The ore is smelted by the Copper Queen Company at a price per ton, the Holbrook & Cave having made its own arrangement for the sale of the product with the French syndicate, which has purchased also at a fixed price the output of the Copper Queen Company. The latter has decided to build a short line of railroad to connect with the existing line, in order to reduce the cost of hauling coke, supplies, and copper, which, by axle, was costing $7 per ton. Since the rise in copper the company voluntarily advanced wages, which had been sharply reduced during the depression. Coke freights, which at one time were as low as $7 from New Orleans to the station, have been advanced since the higher price for copper was established, so that with ore yielding about 8 per cent. in the furnace in 1887 the cost has been increased.

The rise in copper came very opportunely to the Arizona Copper Company, limited, a Scotch corporation controlling the Arizona mines in the Clifton district. The capital of the company has been reduced from £800,000 in 160,000 preferred shares of £5 each and £75,000 in deferred shares of £1, to £640,000 in 160,000 £1 preferred shares and £75,000 deferred shares. Besides, £266,000 of 10 per cent. debenture stock was created not to be redeemed until £266,000 of railroad bonds have been paid off by the operation of a sinking fund of £16,000. The fixed charges are £13,960 interest and £16,000 sinking fund on the railroad bonds and 10 per cent. on the debenture stock, or £26,600, a total of £58,640. Adding 10 per cent. on the reduced capital, £64,000, a total of £122,560 is reached, or close upon $600,000. According to the statement of the chairman, at a meeting held in May, the company was then earning profits at a rate to pay that sum. The contrast between the period of low prices and that of high values is illustrated by the following figures, which are of interest, since they coincide fairly well with the beginning of the advance. During the half year ending September 30, 1887, the loss on the mines was $16,500, the profit on the stores was $19,000, and on the railroad, $40,700. For the six months ending March 31, 1888, the profits were $67,700 on the mining, $23,000 on stores, and $83,700 on the railroad.

During 1888 a number of copper enterprises have been revived or have been started, though none of them will seriously add to the output, which will be swelled, as compared with 1887, by the full operation of the four leading mines, the Old Dominion, Copper Queen, Detroit, and Arizona. The United Verde has been leased by Mr. W. A. Clark, well known in connection with Butte copper interests. The Copper Basin and Copper Mountain mines have resumed, and work has begun in connection with the Yuma property.

New Mexico.—In August, 1887, the San Pedro mines, leased by Mr. W. A. Clark from the New Mexico Milling and Smelting Company, re-resumed, and have been producing matte carrying about 66 per cent. of metal, at the rate of about 50,000 pounds of fine copper per month. A second producer, during a part of 1887, was the San Miguel. The Santa Rita property, which turned out considerable copper in past years, was being unwatered in 1888, and may become a producer during the current year.

At Hillsborough the Copper King Mining, Smelting and Refining Company has begun work, and expects to build works in 1888 to smelt and refine metal. It is the intention to use reverberatory furnaces.

California.—The advance has stimulated production. The mines at Spencerville have resumed, and the Union mine at Copperopolis, which, previous to closing down in 1866, had been the scene of much activity, was unwatered early in 1888. The Hercules mine, San Bernardino county, is also being worked, and operations in Esmeralda county are being taken up.

Wyoming—The Wyoming Mining and Smelting Company, of Fairbanks, did not produce any copper from the Sunrise mine in 1887. Work was resumed, however, in March, 1888, and black copper was then regularly shipped to market.

In the New England States the Milan Mining Company produced some copper, and in 1888 the old Vermont Copper Company's mine is being reopened.

In the South the only operations of any consequence are the mines at Blue Wing, North Carolina. During 1887 the company shipped about 75 tons of ore, and it is estimated that about 500 tons have been accumulated on the dump. Reduction works are to be built during 1888.

IMPORTS.

The imports of fine copper contained in ores, and of regulus and black copper, and of ingot copper, old copper, plates not rolled, rolled plates, sheathing metal, and manufactures not otherwise specified, and of brass, are given in the following tables:

Fine copper contained in ores, and regulus and black copper imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Fine copper contained in ores.		Regulus and black copper. (*a*)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1867		$936, 271			$936, 271
1868	3, 496, 994	197, 203			197, 203
1869	24, 960, 604	448, 487			448, 487
1870	1, 936, 875	134, 736			134, 736
1871	411, 315	42, 453	499	$60	42, 513
1872	584, 878	69, 017	4, 247	1, 083	70, 100
1873	702, 086	80, 132	1, 444, 239	279, 631	359, 763
1874	606, 266	70, 633	28, 880	5, 397	76, 030
1875	1, 337, 104	161, 903	12, 518	2, 076	163, 979
1876	538, 972	68, 922	8, 584	1, 613	70, 535
1877	76, 637	9, 756	1, 874	260	10, 016
1878	87, 039	11, 785			11, 785
1879	51, 959	6, 199			6, 199
1880	1, 165, 283	173, 712	2, 201, 394	337, 163	510, 875
1881	1, 077, 217	124, 477	402, 640	51, 633	176, 110
1882	1, 473, 109	147, 416	224, 052	30, 013	177, 429
1883	1, 115, 386	113, 349			113, 349
1884	2, 204, 070	219, 957	2, 036	204	220, 161
1885	3, 665, 739	343, 793	285, 322	20, 807	364, 600
1886	4, 123, 842	413, 276	186, 887	14, 962	428, 238
1887	4, 149, 412	209, 005	29, 094	1, 443	210, 448

a Not enumerated till 1871.

Copper imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Bars, ingots, and pigs.		Old, fit only for remanufacture.		Old, taken from bottoms of American ships abroad. (*a*)		Plates not rolled.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	1, 635, 953	$287, 831	569, 732	$81, 930				
1868	61, 394	6, 935	318, 705	42, 652				
1869	13, 212	2, 143	290, 780	34, 820				
1870	5, 157	418	255, 386	31, 931				
1871	3, 316	491	369, 634	45, 672			430	$129
1872	2, 638, 589	578, 695	1, 144, 142	178, 536			148, 192	33, 770
1873	9, 697, 608	1, 984, 122	1, 413, 040	255, 711	32, 307	$4, 913	550, 431	97, 888
1874	713, 935	134, 326	733, 326	137, 087	9, 500	930		
1875	58, 475	10, 741	396, 320	55, 564	11, 636	1, 124	8	4
1876	5, 281	788	239, 987	35, 545	10, 304	1, 981	5, 467	600
1877	230	30	219, 443	28, 608	41, 482	5, 136		
1878	1	1	198, 749	25, 585		6, 004		
1879	2, 515	352	112, 642	11, 997	11, 000	1, 107	27, 074	4, 496
1880	1, 242, 103	206, 121	695, 255	91, 234			120	11
1881	219, 802	36, 168	541, 074	63, 383	14, 680	1, 504	20	3
1882	6, 200	836	508, 901	59, 629	16, 075	1, 629		
1883			330, 495	36, 166	9, 415	666		
1884	(*b*) 542	107	149, 701	12, 099		554		
1885	914	172	81, 312	6, 658		1, 160		
1886	159	24	41, 025	2, 647		374		
1887	415	40	37, 786	2, 198		442		

a Not enumerated until 1873. *b* Includes "Plates not rolled" since 1884.

Copper imported and entered for consumption in the United States, 1867 *to* 1887.—Contin'd.

Fiscal years ending June 30—	Plates rolled, sheets, pipes, etc.		Sheathing metal, in part copper. (a)		Manufactures not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$1,101	220,889	$37,717	$15,986	$424,565
1868	....	1	101,488	18,852	21,492	89,932
1869	....	39	43,669	6,592	43,212	86,806
1870	....	2,039	....	....	485,220	519,608
1871	....	7,487	....	....	668,894	722,673
1872	....	18,895	....	....	1,007,744	1,817,910
1873	....	4,514	....	....	869,281	3,216,429
1874	....	27	282,406	50,174	125,708	448,252
1875	....	617	136,055	23,650	35,572	127,272
1876	....	326	18,014	2,903	29,806	71,949
1877	....	203	110	22	41,762	75,761
1878	....	1,201	647	55	35,473	68,318
1879	....	786	300	20	39,277	58,035
1880	....	4,134	6,044	693	130,329	432,522
1881	....	82	39,520	4,669	284,509	390,318
1882	5,855	1,551	....	....	77,727	141,372
1883	2,842	379	6,791	1,047	40,343	78,601
1884	6,529	2,330	19,637	926	55,274	71,290
1885	470	120	86,619	9,894	61,023	79,027
1886	374	21	662,466	78,572	19,093	100,731
1887	6,262	666	34,289	3,124	48,216	54,686

a Does not include copper sheathing in 1867, 1868, and 1869.

Brass imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Bars and pigs.		Old, fit only for remanufacture.		Not otherwise provided for.	Total Value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Pounds.*			
1867	....	$3,099	....	$26,468	$170,873	$200,440
1868	31,104	2,671	120,913	11,699	181,114	194,884
1869	33,179	2,457	131,640	10,838	198,310	211,605
1870	54,108	3,791	98,825	6,918	49,845	60,554
1871	28,453	2,803	438,085	37,922	13,659	54,384
1872	17,963	1,664	829,964	73,098	23,738	98,500
1873	56,656	7,147	699,478	71,494	114,767	193,408
1874	253	19	682,151	64,848	350,266	415,133
1875	370,273	38,867	124,285	12,786	273,873	325,526
1876	....	....	618,191	54,771	232,870	287,641
1877	....	....	689,633	59,402	207,642	267,044
1878	....	....	713,171	57,551	205,209	262,760
1879	950	49	485,354	32,278	232,030	264,357
1880	....	....	958,590	75,093	339,131	414,224
1881	85,370	11,202	1,615,402	151,541	331,506	494,249
1882	30,769	3,768	2,954,148	263,891	400,477	667,536
1883	6,380	559	1,015,345	84,786	485,321	570,666
1884	1,611	445	508,923	40,766	429,224	470,435
1885	2,305	532	166,317	15,717	400,175	416,424
1886	1,956	91	173,511	30,076	363,934	394,101
1887	7,005	756	182,304	31,229	372,782	404,767

EXPORTS.

The wide fluctuations in the quantities of copper, copper ore, and manufactured copper exported for a series of years are exhibited in the following tables:

Value of copper, brass, and manufactured copper exported from the United States,* 1791 *to* 1863 *inclusive.

Fiscal years ending September 30 until 1842, and June 30 since.	Value.	Fiscal years ending September 30 until 1842, and June 30 since.	Value.
1791	$493	1833	$203,880
1803	6,233	1834	198,273
1804	8,654	1835	69,791
1805	12,977	1836	72,991
1806	25,340	1837	91,724
1807	12,742	1838	81,368
1808	4,031	1839	81,334
1809	3,095	1840	86,954
1810	17,426	1841	72,932
1811	9,282	1842	97,021
1812	2,644	1843 (nine months)	79,234
1813	....	1844	91,446
1814		1845	94,736
1815	366	1846	62,088
1816	16,152	1847	64,980
1817	8,765	1848	61,468
1818	33,379	1849	66,203
1819	12,721	1850	105,060
1820	18,547	1851	91,871
1821	26,694	1852	103,039
1822	36,974	1853	108,205
1823	16,768	1854	91,984
1824	26,981	1855	690,766
1825	30,472	1856	534,846
1826	60,083	1857	607,054
1827	52,341	1858	1,985,223
1828	60,452	1859	1,048,246
1829	129,647	1860	1,664,122
1830	36,601	1861	2,375,029
1831	55,755	1862	1,098,546
1832	105,774	1863	1,026,038

Copper and copper ore of domestic production exported from the United States,* 1864 *to* 1887 *inclusive.

[Cwts. are long hundredweights of 112 pounds.]

Fiscal years ending June 30—	Ore.		Pigs, bars, sheets, and old.		Value of manufactured.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.		*Pounds.*			
1864	109,581	$181,298	102,831	$43,229	$208,043	$432,570
1865	225,197	553,124	1,572,382	709,106	282,640	1,544,870
1866	215,080	792,450	123,444	33,553	110,208	936,211
1867	87,731	317,791	(a)4,637,867	303,048	171,062	791,901
1868	92,612	442,921	1,350,896	327,287	152,201	922,409
1869	121,418	237,424	1,134,360	233,932	121,342	592,698
1870	(a)19,198	537,505	2,214,658	385,815	118,926	1,042,246
1871	(a)54,445	727,213	581,650	133,020	55,198	915,431
1872	35,564	101,752	267,868	64,844	121,139	287,735
1873	45,252	170,365	38,958	10,423	78,288	259,076
1874	13,326	110,450	503,160	123,457	233,301	467,208
1875	(a)51,305	729,578	5,123,470	1,042,536	43,152	1,815,266
1876	15,304	84,471	14,304,160	3,098,395	343,544	3,526,410
1877	21,432	109,451	13,461,553	2,718,213	195,730	3,023,394
1878	32,947	169,020	11,297,876	2,102,455	217,446	2,488,921
1879	23,070	102,152	17,200,739	2,751,153	79,900	2,933,205
1880	21,623	55,763	4,206,258	667,242	126,213	849,218
1881	9,958	51,499	4,865,407	786,860	38,036	876,395
1882	25,936	89,515	3,340,531	565,295	93,646	748,456
1883	112,923	943,771	8,221,363	1,293,947	110,286	2,348,004
1884	386,140	2,930,895	17,044,760	2,527,829	137,135	5,595,859
1885	432,300	4,739,601	44,731,858	5,339,887	107,536	10,187,024
1886	544,020	3,068,879	24,292,393	2,493,898	108,971	5,671,748
1887	307,280	1,693,924	19,735,666	1,947,900	85,623	3,727,447

(a) Evidently errors in quantities.

Value of brass and its manufactures, exported from the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1867........	$12,864	1874........	$503,531	1881........	$216,057
1868........	16,841	1875........	1,000,629	1882........	322,439
1869........	40,063	1876........	256,974	1883........	287,847
1870........	169,997	1877........	327,817	1884........	301,014
1871........	210,816	1878........	589,451	1885........	538,118
1872........	229,458	1879........	200,871	1886........	150,807
1873........	494,575	1880........	183,468	1887........	228,341

Consumption.

The difficulty of securing reliable statements of stocks in producers' and dealers' hands, and in transit, has suggested the plan of obtaining relative statements from consumers, which would afford the basis of a close numerical expression of the percentage rate of increase in consumption. The following establishments have reported to us the quantity of copper used in their manufactures for a series of years. They are mainly copper and brass rolling mills and wire drawers:

American Tube Works, Boston, Massachusetts.

Ansonia Brass and Copper Company, Ansonia, Connecticut.

Baltimore Copper Smelting and Rolling Mill Company, Baltimore, Maryland.

Bristol Brass and Clock Company, Bristol, Connecticut.

Brown Brothers' Tubing Company, Waterbury, Connecticut.

Bridgeport Brass Company, Bridgeport, Connecticut.

Coe Brass Manufacturing Company, Torrington, Connecticut.

Cheshire Brass Manufacturing Company, West Cheshire, Connecticut.

Chicago Brass Company, Chicago, Illinois.

Detroit Copper and Brass Rolling Mills, Detroit, Michigan.

DeWitt Wire Cloth Company, New York.

Hendricks Brothers, New York and Belleville, New Jersey.

Haydenville Manufacturing Company, Haydenville, Massachusetts.

C. G. Hussey & Co., Pittsburgh, Pennsylvania.

Holmes, Booth & Haydens, Waterbury, Connecticut.

Landers, Frary & Clark, New Britain, Connecticut.

Manhattan Brass Company, New York.

E. Miller & Co., Meriden, Connecticut.

New Haven Copper Company, Seymour, Connecticut.

New Bedford Copper Company, New Bedford, Connecticut.

Osborne & Cheeseman Company, Birmingham, Connecticut.

Peck Brothers & Co., New Haven, Connecticut.

The J. A. Roebling's Sons Company, Trenton, New Jersey.

The Rome Iron Works, Rome, New York.

Revere Copper Company, Boston, Massachusetts.

Scovill Manufacturing Company, Waterbury, Connecticut.

Seymour Manufacturing Company, Seymour, Connecticut.

Taunton Copper Manufacturing Company, Taunton, Massachusetts.

Washburn & Moen Manufacturing Company, Worcester, Massachusetts.

Wallace & Sons, Ansonia, Connecticut.

Waterbury Brass Company, Waterbury, Connecticut.

Yale & Towne Manufacturing Company, Stamford, Connecticut.

For these works, figures are available for the years 1885, 1886, and 1887, the aggregate being 51,110,522 pounds in 1885, against 63,921,217 pounds in 1886, and 72,521,287 pounds in 1887.

For the following, almost exclusively brass founders, figures have been furnished for the years 1886 and 1887:

C. Aultman & Co., Canton, Ohio.

Ashcroft Manufacturing Company, Bridgeport, Connecticut.

Adams & Westlake Company, Chicago, Illinois.

Atwood & McCaffery, Pittsburgh, Pennsylvania.

Aherns & Ott Manufacturing Company, Louisville, Kentucky.

Barnett Brass Company, Mansfield, Ohio.

Best, Fox & Company, Pittsburgh, Pennsylvania.

Belknap Manufacturing Company, Bridgeport, Connecticut.

H. Belfield & Co., Philadelphia, Pennsylvania.

Chapman Valve Manufacturing Company, Indian Orchard, Massachusetts.

J. I. Case Thresher Machine Company, Racine, Wisconsin.

Cincinnati Brass Works, Cincinnati, Ohio.

C. & G. Cooper Company, Mount Vernon, Ohio.

Crosby Steam Gauge and Valve Company, Boston, Massachusetts.

Craighead & Kintz Manufacturing Company, Ballard Vale, Massachusetts.

A. W. Cadman & Co., Pittsburgh, Pennsylvania.

Crane Brothers Manufacturing Company, Chicago, Illinois.

Dubuque Brass and Metal Company, Dubuque, Iowa.

Douglas & Connard, Reading, Pennsylvania.

Davis, Creswell & Co., Denver, Colorado.

Eddy Valve Company, Waterford, New York.

Eaton, Cole & Burnham Company, Bridgeport, Connecticut.

Frick Company, Waynesborough, Pennsylvania.

Farman's Brass Works, Cleveland, Ohio.

Gaar, Scott & Co, Richmond, Indiana.

Galvin Brass and Iron Works, Detroit, Michigan.

Haxtum Steam Heater Works, Kewanee, Illinois.

Hinckley Locomotive Works, Boston, Massachusetts.

Haines, Jones & Cadbury, Philadelphia, Pennsylvania.

Peter Hayden, Newark, New Jersey.

Hoffmann & Billings Manufacturing Company, Milwaukee, Wisconsin.
Hardwicke & Ware, Buffalo, New York.
Jarecki Manufacturing Company, Erie, Pennsylvania.
D. June & Co., Fremont, Ohio.
James Jones Manufacturing Company, Saint Louis, Missouri.
W. Kirkup & Son, Cincinnati, Ohio.
Kinsley & Mahler Company, Peoria, Illinois.
Kelley & Jones Company, New York.
Lane & Bodley Company, Cincinnati, Ohio.
Ludlow Valve Manufacturing Company, Troy, New York.
Lehner, Johnson, Neyer & Co., Chicago, Illinois.
Peter Lamp & Co., Milwaukee, Wisconsin.
McCambridge & Co., Philadelphia, Pennsylvania.
David Morrison, New York.
McNab & Harlin Manufacturing Company, New York.
John H. McGowan Company, Cincinnati, Ohio.
Manchester Locomotive Works, Manchester, New Hampshire.
McKay Manufacturing Company, Pittsburgh, Pennsylvania.
Mayor, Lane & Co., New York.
A. Y. McDonald, Dubuque, Iowa.
J. L. Mott Iron Works, New York.
Mansfield & Co., Pittsburgh, Pennsylvania.
T. R. McMann & Bro., New York.
Nelson & Finkel, New York.
F. M. Nagle, Erie, Pennsylvania.
N. O. Nelson Manufacturing Company, Saint Louis, Missouri.
Portsmouth Machine Company, Portsmouth, New Hampshire.
G. K. Paul & Co., Boston, Massachusetts.
Peck, Stow & Wilcox Company, Southington, Connecticut.
Providence Steam and Gas Pipe Company, Providence, Rhode Island.
Walter S. Payne & Co., Fostoria, Ohio.
The Wm. Powell Company, Cincinnati, Ohio.
Rundle, Spence & Co., Milwaukee, Wisconsin.
Rees, Shook & Co., Pittsburgh, Pennsylvania.
M. Rumfey & Co., La Porte, Indiana.
Russell & Co., Massillon, Ohio.
E. Stebbins Manufacturing Company, Springfield, Massachusetts.
Stewart & Mattson Manufacturing Company, Philadelphia, Pennsylvania.
T. Somerville & Sons, Washington, District of Columbia.
Swamscot Machine Company, South Newmarket, New Hampshire.
Springfield Brass Company, Springfield, Ohio.
Shaw, Kendall & Co., Toledo, Ohio.
Thomas & Wentworth Manufacturing Company, Milwaukee, Wisconsin.
Union Foundry and Machine Company, Pittsburgh, Pennsylvania.

Walworth Manufacturing Company, Boston, Massachusetts.

R. D. Wood & Co., Philadelphia, Pennsylvania.

W. H. Ward & Co., Boston, Massachusetts.

Wilson Snyder Manufacturing Company, Pittsburgh, Pennsylvania.

Westinghouse Co., Schenectady, New York.

Henry R. Worthington, New York.

In the aggregate, the 1886 consumption of these eighty concerns was 8,146,866 pounds, which rose to 9,822,731 pounds in 1887, an increase of 20.5 per cent. in one year. Among the firms reporting, not less than thirty-three consumed 100,000 pounds and upwards, a number melting 500,000 pounds and upwards. This is almost exclusively casting copper, while the bulk of the copper used by the firms first enumerated is Lake Superior copper. Adding the two series of figures, a total consumption is reached of 82,344,018 pounds in 1887 as against 72,068,083 pounds, an increase of 14 per cent. This may be accepted as a very close approximation to the truth, since a study of the list of firms will show that it includes, with a few exceptions, every brass and copper mill of any consequence in the country. The brass founders are similarly complete. Figures are available from concerns who nave reported in former years, indicating a consumption of about 5,000,000 pounds additional.

These figures would point to a consumption in the United States, during 1887, of about 100,000,000 pounds of new copper. The point is urged that this total neglects entirely the large quantity of metal consumed by the railroad companies in the car-shops, machine-shops, and repair-shops. It may be questioned whether the allowance of over 10,000,000 pounds does not fully cover these quantities. In addition to the quantity of metal absorbed directly, from 4,000,000 to 4,500,000 pounds of copper go into bluestone manufacture.

THE COPPER MARKETS.

The following table summarizes the highest and lowest prices obtained for Lake copper monthly in the New York market from 1860 to 1887, both inclusive:

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 to 1887.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860..	24	23½	24	23¾	23¾	23	23½	23	23¼	22½	22⅛	21¾
1861...	20	19	19½	19	19¾	19¼	19¾	19	19¾	19¼	19	18
1862...	28	27	28	25	25	23	23	21½	21½	20¾	23	20¾
1863...	35	31	37	35	37	31	31	30	30½	30	30½	30
1864..	41¼	39	42	41¼	42½	41½	44	42½	44	43	49	44
1865...	50½	46	46	44	44½	34	35	34	34	30	30½	28½
1866...	42	38	38	35½	35½	29½	30	28½	31	29	33	31
1867...	29¼	27	27¾	27½	27½	24	24½	23½	24¼	24	24½	24
1868...	23½	21½	24	22½	24	23¼	24¼	23¼	24¼	24	24	23⅛
1869...	26¼	23¾	27	26	26¾	24	24	23¼	24¼	23¾	23¾	22
1870...	22	21⅛	21¼	20⅞	20¾	19	19¾	19¼	19½	19	20⅝	19
1871...	22⅞	22	22⅜	21⅞	22	21½	21¾	21¼	21¾	21⅜	21½	21¼
1872...	28½	27⅛	28⅜	28¼	30½	28⅜	44	30½	42	36	34¾	33
1873...	35	32½	35	34	35	34½	34½	33½	33½	32	31½	29⅛
1874...	25	24½	25	24⅛	24¾	24	25	24¾	25	24½	24¾	24¼
1875...	23½	21½	22¾	21¾	21¾	21½	21¾	21½	23¼	22⅝	23	23
1876...	23¼	23	22⅞	22½	22¼	22	22⅝	22	22⅛	21	21	19¼
1877...	19½	19	20½	19½	19½	19	19½	19¼	19¼	19	19⅜	19
1878...	17⅝	17¼	17½	17⅛	17⅛	16⅞	17	16⅞	16¾	16¼	16⅜	16¼
1879...	16	15½	15½	15⅛	15¾	15¾	16	15¾	16¼	16	16¼	16⅛
1880...	25	21⅜	24½	24	24	22¾	22½	24	21	18	18½	17⅞
1881...	19⅜	19⅛	19⅜	19⅛	19⅜	19	19	18¾	18⅞	18¼	18¼	16⅜
1882...	20⅜	20¼	20	19	19¼	18⅞	18⅞	17⅞	18¼	18	18¼	18
1883...	18⅛	18	17⅞	17¾	17⅝	17⅛	16	15¾	16	15⅞	15⅞	15
1884...	15	14⅞	15	14⅞	15	14⅞	15	14½	14¼	14⅛	14¼	14
1885...	11½	10⅜	11⅛	10⅘	11⅛	10⅖	11¼	10.1	11½	9⅘	11½	11
1886...	11⅝	11⅜	11⅝	11⅜	11½	11⅜	11½	11⅜	11⅓	10	10⅛	10
1887...	12	11⅛	11⅛	10½	10½	10⅜	10.20	10	10	9.95	10¼	10

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860...	21¾	21½	21½	21½	22	21¼	22	21½	21½	20¼	20¼	19¾
1861...	18	17½	19	17¾	20¼	19	20¼	20	22½	20¼	27	22½
1862...	24½	22½	24½	24	27	24¼	32⅞	27	32⅞	30½	31½	30½
1863...	32	29	31	29	32¼	31	34½	32¼	38½	34½	38¾	38½
1864...	55	49	52½	50	52½	47½	48	47	49	47	50	48½
1865...	30¼	28	32	30½	32¾	31½	33	32½	45½	33	45½	39¼
1866...	33½	31	31	30	31½	30¾	31	30¾	30¾	26½	29	26½
1867...	26	24	26¼	25¾	27¼	26¼	26¾	22¾	23	22¾	23	21½
1868...	24½	23⅛	24¼	24	24	23¾	24	23	24	22½	24½	23¾
1869...	22¼	21⅞	23⅛	21⅞	23	22	22¾	22	22½	22	22	21½
1870...	20½	20⅜	21⅜	20⅛	21½	20¾	21¾	21½	23⅜	21¾	22⅝	22¼
1871...	22¼	21⅝	23	22⅜	23⅞	22⅞	23⅞	23¼	24¼	23¼	27	24½
1872...	34	33	35	32½	35¼	33	34¾	31¼	32¼	30¾	32½	30½
1873...	29	26⅝	27½	27	27	25½	25½	24	24	21	25	23
1874...	24¼	20	21	19	21¼	21	22¼	21¼	23¾	22¼	23¼	23¼
1875...	23	22⅝	23⅜	23	23⅞	23⅛	23¼	23	23¼	23	23⅜	23⅜
1876...	20	19½	19½	18¾	21	18¾	21¼	20½	20½	20	20	19⅝
1877...	19¼	19	19	17⅞	18½	17⅞	18	17¾	17¾	17⅝	17¾	17½
1878...	16¼	16	16	16	16¼	16	16	15½	15⅞	15½	16	15⅞
1879...	16⅛	16	16⅜	16	17	16¼	21½	18	21¾	21	21½	21
1880...	18⅞	18½	19⅛	19	18⅞	18¾	18⅞	18¾	18⅞	18¾	19⅛	18⅞
1881...	16½	16	16⅝	16⅜	18⅛	16¾	18⅜	18	19	18⅛	20⅜	19¼
1882...	18¼	18⅛	18¼	18⅛	18¼	18	18¼	18	18⅛	18	18	17⅞
1883...	15⅛	15	15	15	15¼	15⅛	15¼	15⅛	15	14⅞	15	14⅞
1884...	14⅛	13⅞	14	13⅞	13⅛	13	13⅛	12⅞	13	12½	12⅛	11
1885...	11¼	10⅞	11¼	11	11⅛	10.95	11⅓	10⅘	11⅛	10⅘	11½	11.1
1886...	10⅛	10	10¼	10	11⅛	10¼	11¾	11⅛	12	11¾	12⅛	11⅞
1887...	10¾	10⅛	10¾	10.60	11	10⅝	12.15	10.30	14.95	11.55	17.75	14.95

The best data to compute an average of the prices of the year are obtained from the reports of a number of the Lake companies. The following table, not including the Calumet and Hecla sales, is compiled from these reports:

Prices realized for Lake Superior copper in 1883, 1885, 1886, *and* 1887.

[Cents per pound.]

Mines.	1883.		1885.		1886.		1887.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
Allouez	1, 751, 377	15. 13	(*a*)1, 050, 546	11. 03	....	....	85, 640	10. 38
Franklin	3, 418, 456	15, 66	3, 291, 806	11. 04	2, 943, 794	10. 71	3, 475, 664	11. 84
Atlantic	2, 385, 585	15. 08	(*b*)2, 729, 588	11. 08	(*b*)3, 488, 790	10. 92	3, 641, 865	12. 34
Central	1, 125, 910	15. 08	(*b*)1, 609, 899	11. 02	2, 033, 922	10. 67	....	....
Huron	647, 787	15. 69	2, 729, 588	10. 92	2, 059, 206	10. 99	....	....
Osceola	4, 256, 409	14. 96	1, 639, 169	10. 75	3, 560, 786	10. 51	3, 583, 723	11. 86

a First five months. *b* Not including copper on hand sold.

A very good illustration of the fluctuations of copper prices from year to year is furnished by the following sales and averages of the Osceola Consolidated Mining Company:

Sales of copper and average prices by the Osceola Mining Company, 1874 *to* 1887.

Years.	Sales.	Average price.	Years.	Sales.	Average price.
	Pounds.	*Cts. per lb.*		*Pounds.*	*Cts. per lb.*
1874	936,002	23. 37	1881	4, 176,976	17. 77
1875	1,330, 313	22. 77	1882	4, 179, 782	17. 70
1876	1,693,737	20. 57	1883	4,256, 409	14. 96
1877	2, 774, 777	18. 19	1884	4, 247,630	12. 82
1878	2, 705, 998	15. 53	1885	1, 639, 169	10. 75
1879	3, 197, 387	17. 79	1886	3,560, 786	10. 51
1880	3,381,061	19. 15	1887	3, 583, 723	11. 86

Since the English quotations have become of such direct importance to American copper miners, the following table, showing a comparison of values in 1887 with former years, is of interest:

Average values of copper in England.

Years.	Chili bars.			Ore, 25 per cent.			Precipitate.		
	Long ton.			*Per unit.*			*Per unit.*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
1880	62	10	0	0	12	9	0	12	11
1881	61	10	0		12	6		13	$8\frac{3}{16}$
1882	66	17	0		13	$6\frac{3}{4}$		13	$10\frac{1}{16}$
1883	63	5	10		12	$4\frac{1}{2}$		12	$10\frac{1}{16}$
1884	54	9	1		10	$5\frac{1}{2}$		11	1
1885	44	0	10		8	4		9	$0\frac{1}{8}$
1886	40	9	3		7	9		8	$3\frac{5}{8}$
1887	43	16	11		8	6		8	$11\frac{3}{4}$

In detail the average prices monthly during 1885, 1886, and 1887 were as follows:

Monthly averages of values in England in 1885, 1886 and 1887.

Months.	1885.					1886.					1887.				
	Chili bars, per long ton.			Precipitate, per unit.		Chili bars, per long ton.			Precipitate, per unit.		Chili bars, per long ton.			Precipitate, per unit.	
	£	s.	d.	s.	d.	£	s.	d.	s.	d.	£	s.	d.	s.	d.
January	48	14	7	9	11½	40	5	8	8	3⅛	39	3	8	8	0½
February	47	13	6	9	8⅞	40	5	3	8	3⅛	39	7	0	8	1
March	46	4	9	9	5⅛	42	6	9	8	8⅛	39	11	1	8	1⅜
April	44	9	2	9	1¼	41	15	9	8	6¾	39	15	2	8	1⅞
May	44	13	6	9	1⅝	40	9	10	8	3⅝	39	8	6	8	1⅛
June	44	18	3	9	2½	39	18	0	8	2¼	39	14	3	8	1¾
July	44	4	9	9	0⅝	39	7	5	8	1	40	0	0	8	2½
August	43	5	11	8	10½	39	10	0	8	1¼	40	7	0	8	3⅜
September	41	17	6	8	7	40	5	10	8	3¼	39	19	2	8	2⅜
October	39	18	6	8	2⅜	41	9	11	8	6⅛	40	15	9	8	4⅜
November	41	3	0	8	5¼	40	12	4	8	4	50	14	10	10	4¼
December	41	6	6	8	5⅝	39	4	3	8	0⅝	77	6	8	15	8⅝

The following sales of furnace material, compiled from the monthly reports of Messrs. James Lewis & Son, of Liverpool, are of interest, as reflecting the magnitude of the business and its fluctuations.

Sales of American furnace material in England.

Dates.	Quantities.		Copper.	Delivery.	Price.	
1887.	Tons.		Per ct.		s.	d.
Jan. 7	200	Matte	48	Liverpool	7	9
Jan. 14	750	Montana matte	65	......do	7	10½
Apr. 22	20	Anaconda matte	65	To arrive Liverpool	8	1½
May 5	2,250	......do	65	Spot and to arrive Liverpool	7	9
May 28	80	......do	65	......do	8	0
June 8	2,100	......do	65	......do	7	9
June 30	50	Precipitate	70	To arrive Liverpool	(a)	
July 19	2,100	Anaconda matte	65	Spot and to arrive Liverpool	7	10½
July 29	150	......do	65	To arrive Liverpool	8	0
Aug. 9-13	4,650	......do	65	August, September, October, Liverpool	8	0
Aug. 11	90	Montana matte	55	......do	8	0
Aug. 27	2,200	Anaconda matte	65	To arrive Liverpool	8	0
Sept. 12	1,800	......do	65	November, December, Liverpool	8	0
Sept. 22	50	Precipitate (Rio Tinto ore)	60	To arrive Liverpool	8	1½
Oct. 10	3,600	Anaconda matte	60	December, January, Liverpool	8	0
Nov. 1	500	......do	60	January, Liverpool	9	0
Nov. 4	1,350	......do	60	......do	9	0
Nov. 7	500	......do	60	......do	9	6
Nov. 7	300	......do	60	For export	9	6
Nov. 8	500	American matte	50	January to May, Liverpool	9	6
Nov. 10	600	......do	50	June to November, Liverpool	9	1½
Nov. 16	600	Anaconda matte	60	February, Liverpool	9	6
Nov. 16	700	......do	60	For export	9	6
Nov. 22	500	......do	60	February, Liverpool	10	0
Dec. 15	200	Montana matte	60	December, January shipment	14	6
Dec. 20	200	......do	60	January, February shipment	15	0

a Private terms.

January opened quietly, with the metal selling at 11⅞ to 12 cents, until a sale by the Calumet and Hecla Company of 10,000,000 pounds at 11 cents for February and March delivery was announced. As usual after such a sale, the following month, February, was dull and feature-less, the market developing a declining tendency, which continued during March, the price falling to 10.20 cents, when at the close of the month the announcement was made that the Calumet and Hecla Company had sold 32,000,000 pounds for delivery up to December at 10 cents, sales aggregating about 5,000,000 pounds being made simultaneously by the company named and by the Quincy for export at the same figure.

In May prices were first weak, but towards the end of the month and in June a better feeling prevailed, which gradually carried the price up to 10¼ cents. In July evidences of a speculative interest in the metal manifested themselves, causing a gradual rally to 10¾ cents for Lake. Contrary to expectations, the fire which broke out in the Calumet and Hecla did not have a very great effect, the price advancing only to 11 cents, from which it receded to 10⅝ in September, when the mine was again opened. In October, however, speculative buying in the London market on the part of operators known as the French syndicate led to a rapid rise there, New York at first following slowly, advancing from 10¾ to 12¼ cents at the close of the month. The operations for an advance gained further headway in November, and received an additional impulse when a second and more serious fire broke out in the Calumet and Hecla main mine on November 20. This practically paralyzed the influence of a powerful party openly adverse to the undue speculative advance, and prices rapidly rose further in December, reaching 17¾ cents at the close of that month.

THE PRINCIPAL FOREIGN PRODUCERS.

The copper production of the world, 1879 to 1887 inclusive.

Countries.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
EUROPE.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Great Britain	(*a*)1, 500	(*a*)1, 471	2, 773	3, 350	2, 620	3, 464	3, 875	3, 662	3, 462
Spain and Portugal:									
Rio Tinto	26, 663	(*a*)24, 700	23, 484	21, 564	20, 472	17, 389	16, 666	16, 215	13, 751
Tharsis	(*a*)11, 000	(*a*)11, 000	(*a*)11, 500	(*a*)10, 800	9, 800	9, 000	10, 203	9, 151	11, 324
Mason & Barry	(*a*)7, 000	(*a*)7, 000	(*a*)7, 000	7, 500	8, 000	8, 000	8, 170	6, 603	4, 692
Sevilla	2, 300	2, 135	1, 800	2, 000	2, 026	1, 885	1, 340	1, 705	1, 360
Portugueza	*a*856	1, 258	1, 665	(*a*)2, 300	2, 357	1, 700	1, 410	1, 000	770
Poderosa	(*a*)4, 400	3, 560	2, 424	2, 251	1, 000	800	800	800	800
Germany:									
Mansfeld	13, 025	12, 595	12, 450	12, 582	12, 634	11, 536	10, 999	9, 800	8, 400
Other German	(*a*)1, 850	1, 870	(*a*)2, 800	(*a*)2, 200	3, 568	3, 552	1, 743	1, 000	605
Austria	(*a*)700	550	585	670	572	474	474	500	259
Hungary	(*a*)500	500	504	614	661	661	800	900	1, 010
Sweden	(*a*)500	600	775	662	732	798	995	1, 074	800
Norway	1, 450	2, 220	2, 560	2, 706	2, 630	2, 590	2, 640	2, 426	2, 412
Italy	(*a*)2, 500	900	835	1, 325	1, 600	1, 400	1, 480	1, 380	1, 140
Russia	5, 000	4, 875	(*a*)5, 100	4, 700	3, 500	3, 537	3, 411	3, 154	3, 081
Total Europe	79, 244	75, 234	76, 255	75, 224	72, 172	66, 786	65, 006	59, 370	53, 866
NORTH AMERICA.									
United States	80, 768	69, 971	74, 053	63, 555	51, 574	40, 467	32, 000	27, 000	23, 000
Canada	1, 400	1, 440	2, 500	236	1, 055	500	500	50	50
Newfoundland:									
Bett's Cove	1, 180	1, 125	778	668	1, 053	1, 500	1, 718	1, 500	1, 500
Mexico	2, 050	850	375	291	489	401	333	400	400
Total North America	85, 398	73, 386	77, 706	64, 750	54, 171	42, 868	34, 551	28, 950	24, 950

a Estimated.

The copper production of the world, 1879 *to* 1887 *inclusive*.—Continued.

Countries.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
SOUTH AMERICA.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	29, 150	35, 025	38, 500	41, 648	41, 099	42, 909	37, 989	42, 916	49, 31
Bolivia:									
Corocoro	(*a*)1, 300	1, 100	(*a*)1, 500	(*a*)1, 500	1, 680	3, 259	2, 6[illegible]5	2, 000	2, 000
Peru	50	75	229	362	395	440	615	600	600
Venezuela:									
New Quebrada	2, 900	3, 708	4, 111	4, 600	4, 018	3, 700	2, 823	1, 800	1, 597
Argentine Republic	170	180	233	159	293	800	307	300	300
Total South America	33, 570	40, 088	44, 573	48, 269	47, 485	51, 108	44, 389	47, 616	53, 815
AFRICA.									
Algiers	150	110	250	260	600	600	600	500	500
Cape of Good Hope	7, 250	6, 015	5, 450	5, 000	5, 975	5, 716	3, 467	4, 739	4, 328
Total Africa	7, 400	6, 125	5, 700	5, 260	6, 575	6, 316	4, 067	5, 239	4, 828
ASIA.									
Japan	(*a*)11, 000	10, 000	(*a*)10, 000	(*a*)10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
Total Asia	11, 000	10, 000	10, 000	10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
AUSTRALIA.									
Australia	7, 700	9, 700	11, 400	14, 100	12, 271	8, 512	10, 000	9, 700	9, 500

a Estimated.

The copper production of the world, 1879 *to* 1887 *inclusive*—Continued.

RECAPITULATION.

	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.	1879.
Europe	79, 244	75, 234	74, 839	73, 959	72, 172	66, 786	65, 006	59, 370	53, 866
North America	85, 398	73, 386	77, 706	64, 750	54, 171	42, 868	34, 551	28, 950	24, 950
South America	33, 570	40, 088	44, 573	48, 269	47, 485	51, 108	44, 389	47, 616	53, 815
Africa	7, 400	6, 125	5, 700	5, 260	6, 575	6, 316	4, 067	5, 239	4, 828
Asia	11, 000	10, 000	10, 000	10, 000	7, 600	4, 800	3, 900	3, 900	3, 900
Australia	7, 700	9, 700	11, 400	14, 100	12, 271	8, 512	10, 000	9, 700	9, 500
Total	224, 312	214, 533	224, 218	216, 338	200, 274	180, 390	161, 913	154, 775	150, 859

Great Britain.—The following are the official returns of the quantity of ore and precipitate produced by English mines, and their copper contents, or, as the last report puts it, "metallic copper obtainable by smelting:"

Production of copper in Great Britain.

Years.	Ore.	Copper.	Years.	Ore.	Copper.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1860	362, 696	15, 968	1878	56, 094	3, 952
1865	198, 298	11, 888	1879	51, 035	3, 462
1870	106, 698	7, 175	1880	52, 118	3, 662
1871	97, 129	6, 280	1881	52, 556	3, 875
1872	91, 893	5, 703	1882	52, 810	3, 464
1873	80, 188	5, 240	1883	46, 820	2, 620
1874	78, 521	4, 981	1884	42, 149	3, 350
1875	71, 528	4, 323	1885	36, 379	2, 773
1876	79, 252	4, 694	1886	18, 617	1, 471
1877	73, 143	4, 486			

According to the official returns of the Board of Trade, the British imports and exports of copper have been as follows for a series of years:

British imports and exports of copper.

Years.	Imports of— Bars, cakes, and ingots.	Imports of— Copper in ores and furnace products.	Total imports.	Exports.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1860	13, 142	13, 715	26, 857	26, 117
1865	23, 137	23, 922	47, 059	41, 398
1870	30, 724	27, 025	57, 749	53, 006
1871	33, 228	23, 671	56, 899	56, 633
1872	49, 000	21, 702	70, 702	53, 195
1873	35, 840	26, 756	62, 596	55, 716
1874	39, 906	27, 894	67, 800	59, 742
1875	41, 931	29, 483	71, 414	51, 870
1876	39, 145	36, 191	75, 336	52, 468
1877	39, 743	53, 582	93, 325	54, 088
1878	39, 360	48, 212	87, 572	55, 001
1879	46, 670	50, 421	97, 091	62, 412
1880	36, 509	56, 225	92, 734	59, 482
1881	32, 170	54, 057	86, 227	61. 689
1882	35, 509	58, 366	93, 875	55, 683
1883	35, 653	63, 493	99, 146	59, 350
1884	39, 767	69, 623	109, 390	64, 692
1885	41, 993	81, 616	123, 609	62, 050
1886	43, 069	65, 046	108, 115	60, 510
1887	29, 198	73, 891	103, 089	....

The following figures, from the Board of Trade returns for the past nine years, show in detail the form in which the copper is brought into Great Britain, and in what form it is exported:

Imports of copper into Great Britain from 1879 *to* 1887 *inclusive.*

Character.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Pure in pyrites	12, 040	16, 446	13, 551	15, 672	15, 016	14, 077	16, 333	13, 905	14, 940
Pure in precipitate	18, 159	18, 205	18, 619	17, 935	23, 645	19, 688	21, 398	19, 323	21, 819
Pure in ore	13, 173	14, 976	15, 396	15, 489	15, 880	24, 677	15, 683	13, 749	15, 148
Pure in regulus	7, 049	6, 598	6, 491	9, 270	8, 952	11, 181	28, 202	18, 069	21, 984
Bars, cakes, etc	46, 670	36, 509	32, 170	35, 509	35, 653	39, 767	41, 993	43, 069	29, 198
Total	97, 091	92, 734	86, 227	93, 875	99, 146	109, 390	123, 611	108, 115	103, 089

Turning first to the imports of pyrites, we find the following table of the imports and their sources since 1873 in the volume of the "Mineral Statistics of Great Britain:"

Imports of pyrites into Great Britain.

Years.	Norway.	Portugal.	Spain.	Germany.	Other countries.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1873	67,462	199,559	246,692		6,634	520,347
1874	41,044	162,569	294,117		907	498,637
1875	21,820	165,433	344,019		6,283	537,555
1876	7,688	56,579	419,068		21,417	504,752
1877	8,564	149,562	498,977		22,209	679,312
1878	5,773	136,705	419,561		12,318	574,357
1879	8,485	82,529	374,505		15,783	481,302
1880	10,952	166,519	463,199	8,695	8,684	658,049
1881	6,009	140,079	379,216	8,412	8,662	542,378
1882		114,132	497,807		15,761	627,700
1883	1,271	121,137	473,343		5,537	601,288
1884	522	85,454	471,556		5,541	563,073
1885	2,608	28,899	619,523		3,491	654,521
1886	4,117	28,656	521,718		2,497	556,988
1887						597,595

The following table, compiled by Mr. John Arthur Phillips, exhibits the quantity of burned pyrites treated at the twenty-two metal-extraction works, together with the quantities of metallic copper, gold and silver extracted by the Claudet process:

Metals extracted from burned cupriferous pyrites.

Years.	Ore.	Copper.	Gold.	Silver.
	Long tons.	*Long tons.*	*Ounces.*	*Ounces.*
1880	415,567	15,000	1,043	246,981
1881	396,737	14,000	1,490	258,463
1882	434,427	15,300	1,500	400,000
1883	439,156	15,370	1,511	348,210
1884	416,412	15,200	1,900	335,000
1885	407,700	14,880	1,840	328,000
1886	393,699	14,370	1,780	316,000

Another great source of supply of the English metallurgical works is ore. The following table gives the board of trade returns, the average values being computed by this office:

Imports of copper ore into Great Britain.

Countries.	Quantities.				Average value per ton.			
	1884.	1885.	1886.	1887.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*				
Italy	11,100	7,405	6,262	9,234	£4.79	£5.42	£4.65	£4.55
Venezuela	25,900	38,613	27,318	17,835	6.16	4.46	3.72	3.58
Bolivia	2,067	4,642	508	315	8.81	8.22	7.65	9.00
Chili	245	529	331	453	19.92	17.10	10.71	17.16
Cape of Good Hope	22,330	20,875	24,613	30,602	15.35	11.80	11.48	10.79
British North America	2,067	5,002	5,167	3,453	4.35	2.02	4.41	6.47
United States	31,316	5,970	2,035	224	18.94	14.27	12.99	15.70
Other countries	29,189	18,941	18,896	27,531	6.76	6.79	5.95	5.48
Total ore and average value	124,214	101,977	85,130	89,647	11.09	7.07	6.84	6.96
Total fine copper	24,842	15,683	13,749	15,148				
Average percentage	20.00	14.43	16.15	16.89				

The most striking fact shown in this table is the rapid decline from the high figures reached in 1884 of the receipts in England of ore from the United States.

Imports of precipitate and regulus into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	Fine copper.	1887.	Fine copper.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Portugal	5, 358	8, 144	7, 301	8, 873	7, 161	8, 283	6, 657	24, 032	10, 758	24, 754
Spain	20, 482	21, 647	21, 398	28, 962	27, 621	38, 267	38, 666		37, 892	
Chili	14, 659	8, 116	10, 882	6, 384	10, 699	5, 255	1, 637	737	1, 595	718
United States	....	....	....	....	5, 805	29, 861	13, 105	10, 853	24, 229	15, 039
Other countries	4, 502	6, 309	9, 716	13, 509	11, 124	6, 000	5, 240	1, 770	5, 366	2, 292
Total	45, 001	44, 216	49, 297	57, 728	62, 410	87, 666	68, 305	....	79, 840	......
Fine copper	24, 772	25, 110	27, 205	32, 597	34, 172	49, 600	....	37, 392	....	42, 803

The chief sources of the receipts of ingot copper and of bars are Australia, furnishing the former, and Chili, which sends the latter. A comparatively small quantity is received from the United States.

Imports of copper, wrought and unwrought, into Great Britain.

Countries.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	24, 258	21, 019	22, 585	22, 799	22, 843	24, 832	24, 748	17, 516
Australia	9, 406	9, 150	8, 152	9, 531	9, 329	8, 564	9, 933	5, 412
United States	....	....	....	1, 866	3, 408	3, 259	2, 121	2, 013
Other countries	2, 845	2, 001	4, 772	1, 457	4, 235	5, 338	6, 328	4, 227
Total	36, 509	32, 170	35, 509	35, 653	39, 815	41, 993	43, 130	29, 168

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of other than Chili copper into Liverpool, London and Swansea during the years 1882, 1883, 1884, 1885, 1886 and 1887, which represents the total imports, with the exception of precipitate, into Newcastle and Cardiff, reliable returns of which cannot be obtained, but which is estimated to vary from 10,000 to 12,000 tons fine per annum:

Imports of copper produce into Liverpool, Swansea and London.

Countries.	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chili	30, 112	27, 504	31, 298	28, 985	27, 191	20, 008
United States	745	9, 410	17, 309	24, 037	13, 483	16, 534
Spain and Portugal	464	2, 788	2, 359	4, 655	5, 721	5, 178
Spain (precipitate)	8, 757	11, 249	10, 009	9, 186	10, 038	13, 042
Spain (pyrites)	15, 673	15, 017	14, 077	16, 333	13, 905	14, 940
Australia	9, 847	9, 694	9, 685	8, 951	10, 096	6, 047
Cape of Good Hope	5, 298	5, 670	6, 042	5, 405	7, 073	8, 271
New Quebrada	3, 164	3, 960	3, 675	4, 074	3, 055	2, 261
Japan	....	....	1, 064	3, 010	3, 572	209
Italy	1, 386	1, 091	1, 310	835	889	1, 055
Norway	446	296	289	27	....	....
Canada	347	448	266	....	8	94
Newfoundland	1, 362	1, 185	224	723	891	859
Mexico	372	489	291	374	243	61
Peru	821	426	408	229	68	13
River Plate	260	319	131	233	179	167
Other countries	925	946	284	325	1, 049	1, 074
Total tons fine	79, 979	90, 492	98, 721	107, 382	97, 461	89, 304

The receipts of copper from the United States in Great Britain and France have been as follows for a series of years, estimated in tons of fine copper:

Imports of copper from the United States in England and France.

	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
England:						
Ore	274	4,940	11,023	1,875	420	26
Matte	471	2,512	2,722	18,895	10,853	15,039
Bars and ingots	....	1,773	3,584	3,375	2,210	1,469
Total England	745	9,225	17,329	24,145	13,483	16,534
Total France	1,072	4,513	7,205	9,235	4,167	3,910
United States into England and France	1,817	13,738	24,534	33,380	17,650	20,444
Chili into England and France	42,306	43,568	42,384	35,342	35,448	29,019

These figures best illustrate the rapid growth in importance to the markets abroad of that part of our output which we export. The imports of Chili copper into France and Great Britain are added to show the influence which competition has had upon the position of that country, which at one time dominated the markets of the world.

The exports of copper from Great Britain in different forms were as follows:

Exports of copper from Great Britain from 1879 *to* 1887 *inclusive.*

Character.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Raw English	16,370	15,202	18,737	12,776	16,777	17,943	18,766	19,036	40,700
Sheets	15,402	16,580	15,960	15,698	16,071	20,669	21,108	17,927	
Yellow metal, at 60 per cent	10,042	10,128	9,939	10,892	11,918	11,602	12,551	11,958	10,153
Brass, at 70 per cent	2,761	2,677	3,263	3,499	3,381	3,735	3,233	3,001	3,146
	44,575	44,587	47,899	42,865	48,147	53,949	55,658	51,922	53,999
Fine foreign	17,837	14,895	13,790	12,818	11,203	10,742	6,422	8,589	15,454
Total	62,412	59,482	61,689	55,683	59,350	64,691	62,080	60,511	69,453

Chili.—The following table gives the record of the exports of copper from Chili for a long series of years, no official statements of the production being available:

Exports of copper from Chili.

Years.	Tons.	Years.	Tons.	Years.	Tons.
1855	20,250	1866	44,820	1877	45,400
1856	21,938	1867	44,654	1878	46,770
1857	25,498	1868	43,669	1879	49,560
1858	30,470	1869	54,867	1880	43,135
1859	28,250	1870	49,130	1881	38,160
1860	36,289	1871	41,200	1882	43,129
1861	38,371	1872	46,337	1883	41,229
1862	43,109	1873	42,165	1884	43,780
1863	32,540	1874	48,240	1885	38,636
1864	47,500	1875	45,430	1886	35,138
1865	48,327	1876	50,740	1887	29,150

The last report of the Copiapo Mining Company, covering as it does the period of a year of low prices, ending June 30, 1887, showed a profit of £11,918. During the first three months of 1888 the average profit was £6,000 per month. The Panulcillo Copper Company is the only other Chilian mine controlled by a public company in England. For the year 1887 the profit, after adding to the reserve fund and paying interest on debentures, was £6,244. The company sold 12,500 new shares, at 50 per cent. premium, to the French syndicate, realizing £25,000 for the stock and £11,365 premium, with which they have extinguished the debenture debt, and have paid a bonus of 2*s.* and a 2*s.* dividend on the £2 share. The company has made a contract for the sale of its copper with the Société des Métaux, the quantity being restricted to 3,000 tons per annum.

Spain.—An interesting estimate of the actual output of copper in the Peninsula, including the fine copper both in precipitate and pyrites, has been made by Messrs. H. R. Merton & Co., of London, whose figures are accepted by this office with the exception of Rio Tinto. The product of the latter, according to the annual report, was 26,663 tons:

Copper production of Spain and Portugal.

Mines.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rio Tinto (Spain)	16, 666	17, 389	20, 472	21, 564	23, 484	24, 700	26, 663
Tharsis (Spain)	10, 203	9, 000	9, 800	11, 800	11, 500	11, 000	11, 000
Mason & Barry (Port.)	8, 170	8, 000	8, 000	7, 500	7, 000	7, 000	7, 000
Sevilla (Spain)	1, 340	1, 885	2, 026	2, 000	1, 800	2, 135	2, 300
Portugueza (Port.)	1, 410	1, 700	2, 357	2, 300	1, 665	1, 258	856
Poderosa (Spain)	800	800	1, 000	2, 251	2, 424	3, 560	4, 400
Total	38, 589	38, 774	43, 655	47, 415	47, 873	49, 653	52, 219

The year 1887, therefore, showed a further increase, due principally to the operations at the Rio Tinto. Early in 1888 a question arose which may seriously interfere with the output at the Spanish mines. A general agitation was set on foot in the province of Huelva on the subject of damage to property done by sulphurous smoke produced by the calcination of pyrites in the open air. A riot took place on February 4, and on the 29th of that month a decree was issued by the Spanish minister of the interior prohibiting open-air calcination, to take effect on January 1, 1889, though providing only for a gradual cessation of that work. The pyrites companies have protested vigorously against the measure. Even if it should be carried into effect, it would only lead to a more general adoption of the Dortsch process of leaching raw ore, which the Rio Tinto Company has been gradually introducing for a number of years.

The Rio Tinto mines have made further progress, their production for a series of years having been as follows:

Production of the Rio Tinto mines.

Years.	Pyrites for shipment.	For extraction of copper by local treatment.	Total.	Production of metallic copper at Rio Tinto.	Actual consumption of pyrites in England, Germany, etc.	Average copper contents of ore mined.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Per cent.*
1877......	251, 360	520, 391	771, 751	2, 620	....	....
1878	218, 818	652, 289	871, 107	4, 393	....	....
1879......	243, 241	663, 359	906, 600	[illegible], 538	236, 849	....
1880......	277, 590	637, 567	915, 157	8, 987	274, 201	2, 619
1881......	249, 098	743, 949	993, 047	9, 939	256, 827	2, 750
1882......	259, 924	688, 307	948, 231	10, 217	292, 826	2, 805
1883......	313, 291	786, 682	1, 099, 973	12, 910	288, 104	2, 956
1884......	312, 028	1, 057, 890	1, 369, 918	13, 301	314, 751	3, 234
1885......	406, 772	944, 694	1, 351, 466	15, 322	354, 501	3, 102
1886......	336, 548	1, 041, 833	1, 378, 381	16, 656	347, 024	3, 046
1887......	362, 796	819, 642	1, 182, 438	18, 704	385, 842	3, 047

According to the annual report the company obtained 7,920 tons of 21 cwts. of copper from the 385,842 tons of pyrites delivered, while the manufacture of copper at the mines amounted to 17,813 tons of 21 cwts. net. The sales of sulphur in the pyrites shipped showed an increase of 39,000 tons in 1887 over 1886, and are as large for the year 1888 at the same prices. After writing off £108,608 there was left for dividends £352,269, against £105,103 in 1887; the dividend paid being 20 shillings a share, or 10 per cent., which absorbed £276,250, leaving a balance to be carried over of £27,269. Since the average price realized during the year was £48, the profits made would indicate that the Rio Tinto Company can live at about £35.2 for Chili bars, provided all the profits realized from the sale of pyrites are made to bear a part of the cost of producing copper. At the annual meeting Mr. H. M. Matteson, the chairman, announced that the company has made a contract "for the entire copper production of the company at the mines in 1888, 1889, and 1890, in excess of what is required to satisfy the already existing contracts". Details asked for by the shareholders were withheld, but it was stated: "All proper mercantile precautions were stipulated for by us, and have been given to us, to assure the due fulfillment of this important engagement. With this contract entered into, the position of the company in regard to revenue can be easily judged by yourselves when I say that the average price we obtained for our copper in 1887 was about £48 per ton, and that we shall receive an addition of at least £20 per ton upon the 26,000 tons which we expect to turn out annually during the three years."

The Tharsis Sulphur and Copper Company mined a larger quantity of pyrites during the year 1887, and was favored with a more copious rainfall, the total being 32 inches as compared with 21.44 inches in 1886 and 41.19 inches in 1885. In spite of the advantage thus afforded in extraction, the shipments of precipitate were slightly less. The company has completed its new railway to the Calañas mine at an outlay of £133,000, and has spent an additional £100,000 in opening out that deposit and preparing for production. Hitherto, the Tharsis mines have been the main reliance of the company, the product in 1887 having been 568,194 tons against 502,443 tons in 1886, while the Calañas yielded 67,021 and 71,003 respectively. With the railroad completed to the coast and the mine opened, it is expected in 1888 to yield a large quantity of ore for export, and to allow of an important quantity being treated on the spot. The outlays incident to this work have led to the issue of debentures to the extent of £209,700, falling due in 1890, 1891, and 1892, and by loans on the deposits at interest. The directors propose to dispose of 37,670 shares unissued to meet the indebtedness and reduce the debentures, the paid-up capital being £1,174,660 while the authorized capital is £1,250,000. The net profit for the year was £130,528, out of which a dividend of £117,466—equal to 10 per cent.—was paid, against 7½ per cent. in 1886, 10 per cent. in 1885, and 20 per cent. in 1884.

The following table gives an epitome of the business of the Tharsis company for a number of years:

Operations of the Tharsis company.

Years.	Ore raised.	Pyrites shipped.	Precipitate shipped.	Net profits.	Dividends.
	Long tons.	*Long tons.*	*Long tons.*		
1882	486, 860	218, 218	5, 534	(?)	(?)
1883	490, 033	202, 318	6, 717	£334, 491	£323, 032
1884	518, 552	206, 939	7, 095	(?)	(?)
1885	587, 303	311, 151	6, 110	104, 211	117, 466
1886	573, 446	273, 298	6, 463	91, 240	88, 099
1887	635, 215	282, 653	6, 390	130, 527	117, 466

Portugal.—The leading pyrites mine is Mason & Barry, limited, a company having a paid-up capital of £1,851,640, and a reserve fund at the end of 1887 of £113,944. The total quantity of ore raised was 329,128 tons, or 39,000 tons more than in 1886, while the cash outlay was £10,000 less. This was, however, due to the fact that during the low price for copper the company postponed the carrying out of certain works that must be eventually proceeded with. This has now been commenced. The ore sales amounted to 80,838 tons, against 74,871 tons in 1886. The company expended during 1887 £17,295 on the open cost, the whole charged to income. The total outlay on this work has been £407,554, written down as an asset in the balance sheet at £104,794. Including this, the company had assets of £2,076,772, which embraces £790,510 for the mining property in Spain. The profit for 1887 was £03,009, out of which a dividend of 5 per cent., or £92,582, was paid. At the annual meeting the chairman stated that the company had entered into a contract with the Société des Métaux for the sale of the shipments of copper precipitate during the years 1888, 1889, and 1890, the price being based on an assumed market value of £65 per ton for copper in Chili bars. It appears that both the price and the quantity reserved from the contract fluctuate according to the price of Chili bars.

Venezuela.—At a meeting of the Quebrada Railway, Land and Copper Company, limited, the statement was officially made that the contract with the Société des Métaux provided for the payment of the entire product of the mine, for three years, on the basis of £70 per ton of best selected copper, the output being limited to 12,960 tons of copper, or its equivalent, for three years. The annual profits under this contract are estimated at £121,000 for 1889 and 1890. Deducting £36,650 for interest and administration, and £23,000 for new works, the profit for 1889 is estimated at £61,530, while that of 1888 is placed at £53,944 net. The company has been in financial straits for years, having lost considerable money annually before the rise.

Australia.—The Wallaroo Mines, limited, one of the leading Australian corporations, produced in 1887, 5,981 tons of copper, the greater part of which is obtained from the smelting of Moonta ore. The Wallaroo and Kurilla mines proper yielded 11,604 tons of $12\frac{3}{4}$ per cent. ore. The estimated profit for the year 1887 was £40,071, of which, however, £30,535 was due to the increased value of copper ore and copper unsold. The question of consolidating with the Moonta company is being discussed.

The Moonta Mines, one of the large copper corporations of Australia, during the second half of 1887 produced 9,170 tons of 21 cwts. of ore averaging $21\frac{1}{2}$ per cent. of copper on net dry weight, shipping thereof 8,752 tons to the Wallaroo company, leaving 3,053 tons on hand. During that period 1,915 tons of copper smelted by the Wallaroo company were shipped, the gross profit being £90,000, of which £24,000 were written off for depreciation of plant and machinery. The net profit was £64,684, of which £43,896 was derived from the increase in value of copper and ore in excess of the valuation on August 31, 1887. At the meeting of the company held at Adelaide, South Australia, in March, 1888, the directors reported that they had made arrangements with the French syndicate for the monthly disposal of the company's production of copper from March 1, 1888, to December 1, 1889, at an advance of £5 on the monthly cash value of Chili bars. At the time of the meeting a proposal had been received from the same quarter, and was then under consideration, for a modification of the agreement with a view of substituting one extending until the end of 1890, with option on the part of the buyers to continue it until the end of 1893. Under the latter proposal a minimum basis price of £65 was to be guarantied for the total production of the Moonta mines, the company dividing the excess, if any, over £65 with the French syndicate in certain proportions. For one-third of its output the Moonta company was to receive £65 per ton, with special terms as to the other two-thirds.

Cape of Good Hope.—At a meeting of the Cape Copper Mining Company, limited, held early in April, a contract with the Société des Métaux was ratified. Its essential features are that the company sells to the société 5,750 tons of best selected copper per annum for three years, with an option to the société of extending it for a further like period, the price to be paid being £70 per ton. A provision is added that the copper company shall continue to smelt at its English works the Quebrada ores, converting also the regulus of the latter mine, which thus far it has not done. It was stipulated also that the Cape Copper Company shall smelt for the société the Namaqua ores, retaining the privilege to treat the ore of the Tilt Cove Company, a mine in which the same parties interested in the Cape Copper Mining Company are the principal owners. This work is to be the limit of the smelting operations of the Cape Copper Mining Company. The latter, in order to retain its customers for its brand of best selected copper, has secured the right to sell to them as heretofore, but for and on account of the société, which pays the copper company a small commission. The contract is guaranteed by the Comptoir d'Escompte, and it is estimated that it will insure the Cape Copper Mining Company a profit of between £220,000 and £230,000 per annum.

A younger neighbor and rival of the Cape Copper Mining Company is the Namaqua United Copper Company, lately reorganized under the title Namaqua Copper Company, limited, with a capital of £200,000 in £2 shares. At a meeting the chairman stated that the company has entered into a contract with the Société des Métaux providing for the delivery of 5,500 tons of 32 per cent. ore in 1888, 7,000 tons in 1889, and 8,500 in 1890. The price agreed upon is 12¾*s.* per unit. Deducting £9, 10*s.* for costs and expenses, the officers of the company expect to realize £59,950, or 30 per cent., in 1888; £76,300, or 38 per cent., in 1889; and £92,650 in 1890, or 46 per cent., on a capital of £200,000.

Canada.—In Canada the most important development of recent date is that of the Canadian Copper Company, of Sudbury, Ontario, which has proved, down to 300 feet, the existence of a large body of nickel-copper ore. Smelting works are now being built by Dr. Edward D. Peters, jr.

LEAD.

By C. Kirchhoff, Jr.

The expected increase in the production of lead in the United States in 1887 over 1886 took place, the year going far beyond 1883, which until 1887 had shown the heaviest make. Generally speaking, all the leading districts have held their own well, the additions to the output being due principally to: importations of argentiferous lead ores from Mexico, estimated to have been at least 15,000 tons of metal, to the developments in the Cœur d'Alene region, and to increased operations in Missouri. All these leading causes, tending to swell the quantity of metal thrown on the market, have not yet exhausted their influence. It may be stated that their full effect will not be brought out even during the current year. The building of large smelting works in the southwest, the construction now begun of two great reduction plants in Montana, besides smaller works, coupled with extensions of railroads, followed by lower freights and cheaper fuel, will prove a great stimulus to increased output. As yet values have been little affected by the heavier supplies and the prospects of further additions to the supplies. The restriction of output on a declining market is usually a process accomplished far more slowly than a study of costs would appear to warrant. Should the fall come which leading authorities in the trade expect during the second half of 1888, it is not likely to bring about a precipitate curtailment of production. Its first effect will probably be to cause a more general and emphatic agitation of the system of allowing the lead contents of silver ores to be imported free of duty.

Production.—Up to the year 1873 no specific data concerning the relative output of the different producing districts were available. For the succeeding years the quantities of desilverized lead and of non-argentiferous lead and the former's percentage of the total have been added, because they reveal clearly the growing importance of the former industry, which has its seat in the Rocky mountains; while almost the whole of the non-argentiferous lead is produced in Missouri, Kansas, Illinois and Wisconsin, only a small quantity being made in Virginia. In this table and throughout this paper the tons are short tons of 2,000 pounds.

Production of lead in the United States.

Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.	Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.
	Short tons.	*Short tons.*	*Short tons.*	*Per cent.*		*Short tons.*	*Short tons.*	*Short tons.*	*Per cent.*
1825	1,500				1859	16,400			
1830	8,000				1860	15,600			
1831	7,500				1861	14,100			
1832	10,000				1862	14,200			
1833	11,000				1863	14,800			
1834	12,000				1864	15,300			
1835	13,000				1865	14,700			
1836	15,000				1866	16,100			
1837	13,500				1867	15,200			
1838	15,000				1868	16,400			
1839	17,500				1869	17,500			
1840	17,000				1870	17,830			
1841	20,500				1871	20,000			
1842	24,000				1872	25,880			
1843	25,000				1873	42,540	20,159	22,381	47.7
1844	26,000				1874	52,080			
1845	30,000				1875	59,640	34,909	24,699	58.5
1846	28,000				1876	64,070	37,649	26,421	58.8
1847	28,000				1877	81,900	50,748	31,152	62.0
1848	25,000				1878	91,060	64,290	26,770	70.6
1849	23,500				1879	92,780	64,650	28,130	69.7
1850	22,000				1880	97,825	70,135	27,690	71.7
1851	18,500				1881	117,085	86,315	30,770	73.7
1852	15,700				1882	132,890	103,875	29,015	78.3
1853	16,800				1883	143,957	122,157	21,800	84.8
1854	16,500				1884	139,897	119,965	19,932	86.4
1855	15,800				1885	129,412	107,437	21,975	83.0
1856	16,000				1886	135,629	114,829	20,800	85.0
1857	15,800				1887	160,700	135,552	25,148	84.3
1858	15,300								

Ores from Mexico.—The imports of silver ores containing lead, from Mexico, which began to be a factor in 1886, developed in importance during 1887. No complete record of the quantities of lead thus brought into the country during the calendar year are available. Through the courtesy of Hon. Wm. F. Switzler, Chief of the Bureau of Statistics of the Treasury Department, this office has been placed in possession of the following data, covering the fiscal year ended June 30, 1887. The silver ore which entered Corpus Christi, Texas, during that period contained 205,029.25 ounces of silver, valued at $173,362.74, and 4,943,926 pounds of lead, valued at $49,439.26. At Saluria, Texas, ore was imported containing silver valued at $41,727 and 1,467,900 pounds of lead valued at $14,679. At El Paso, Texas, the ore imported contained 24,564,752 pounds, valued at $491,295.05. These three points, which embrace the leading ports of entry, therefore account alone for 15,488 short tons of lead, and it is probable that the fiscal year 1888 will show even heavier imports. During 1888 the completion of the plant of the International Company will tend to swell considerably the quantity of lead which thus enters this country practically duty free, since lead is not the component of greater value.

The bulk of the lead ore thus imported has been handled by the El Paso Smelting Company, of El Paso, Texas; a second plant, that of the International Smelting Company, being under construction during 1887.

It has since been completed and is now running. Lead ore from Mexico goes also to New Mexico and Colorado smelters, to Omaha, Kansas City, and Saint Louis.

The principal source of the silver-lead ores is the Sierra Mojada district, in the State of Coahuila, the mines being either owned or leased by the Mexican Ore Company, which is affiliated with the El Paso Smelting Company.

Among their mines are the "Indulge," "Torment," "San Isidoro," and "San Pedro." Several Mexican companies are also shippers of ore, among them being the "Esmeralda." The ore of the district is a carbonate, with some sulphate of lead carrying silver. The ore is hauled 90 miles to Escalon, a station on the Mexican Central railroad. From there it is carried to El Paso, 417 miles, the freight rate being $6.90 in Mexican silver. The smelters handling these ores have schedules differing somewhat in detail. All pay 90 per cent. of New York prices for silver in ores carrying less than 101 ounces per ton. Above that grade some add one per cent. for each 50 ounces, while others add one per cent. of the New York price of silver for every 100 ounces above the first 100. For lead the usual schedule is 35 cents per unit when the price of lead is 3.75 cents per pound at New York; 40 cents per unit when it advances to 4 cents; 45 cents per unit when the price of lead in New York is 4.25 cents; 50 cents per unit on a 4.50-cent base; 55 cents per unit on a 4.75-cent lead price, and 60 cents per unit of lead contents in the ore when the New York price for pig lead is 5 cents a pound. The treatment charges are scaled according to the percentage of lead in the ore. For ore rich in that metal they go as low as $7 to $8 a ton, rising to $15 and over for dry or very base ores.

Some ore is derived also from Sabinal and Cowalitos, both in Canton; Galeana, Chihuahua and from a number of minor districts. The Mexican National Railroad, now being completed, will open up further sources of supply, though as yet many of the prospects are undeveloped. The Guadalupe mine has put up a large concentrating plant at Laredo, to treat daily 200 tons of ore, its product now going to Kansas City. The Mexican National Railroad is pushing into Durango, which will probably lead to the development of a number of prospects in that section.

REVIEW OF THE LEAD MARKET.

The following table gives the highest and lowest prices monthly for a series of years:

Highest and lowest prices of lead at New York City, monthly, from* 1870 *to* 1887 *inclusive.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870....	(*a*)6.30	6.20	6.25	6.17	6.20	6.10	6.25	6.15	6.25	6.20	6.25	6.20
1871....	(*a*)6.30	6.15	6.25	6.20	6.20	6.15	6.20	6.10	6.18	6.10	6.15	6.12
1872....	(*a*)6.00	5.90	6.00	5.87	6.00	5.87	6.12	5.90	6.62	6.25	6.62	6.40
1873....	(*a*)6.37	6.25	6.50	6.40	6.50	6.25	6.50	6.25	6.62	6.35	6.55	6.12
1874....	(*a*)6.00	5.90	6.25	6.00	6.25	6.12	5.25	5.90	6.00	5.75	6.00	5.62
1875....	(*a*)6.20	6.00	5.90	5.85	5.75	5.62	5.87	5.80	5.95	5.90	5.90	5.75
1876....	(*a*)6.00	5.87	6.37	6.00	6.50	6.40	6.40	6.12	6.50	6.10	6.50	6.25
1877....	(*b*)6.15	6.12	6.40	6.20	6.75	6.50	6.50	6.25	6.00	5.55	5.70	5.60
1878 ...	4.35	4.00	3.87	3.65	3.87	3.62	3.75	3.50	3.50	3.25	3.50	3.12
1879....	4.50	4.00	4.50	4.50	4.50	3.25	3.25	2.87	3.12	2.87	3.80	3.12
1880....	6.10	5.50	6.00	5.87	5.95	5.30	5.75	5.40	5.25	4.40	4.75	4.50
1881....	5.00	4.30	5.10	4.80	4.85	4.62	4.85	4.37	4.70	4.25	4.50	4.25
1882....	5.15	4.95	5.20	5.00	5.12	4.85	5.00	4.90	4.85	4.60	4.90	4.55
1883....	4.70	4.60	4.60	4.50	4.65	4.50	4.62	4.40	4.55	4.40	4.45	4.40
1884....	4.50	3.75	4.10	3.75	4.15	4.10	4.05	3.62½	3.75	3.52½	3.65	3.57½
1885....	3.70	3.55	3.70	3.60	3.70	3.62½	3.70	3.62½	3.75	3.60	3.85	3.62½
1886....	4.70	4.50	4.90	4.60	4.95	4.85	4.90	4.65	4.75	4.65	4.90	4.65
1887....	4.45	4.15	4.50	4.25	4.45	4.25	4.32½	4.20	4.70	4.30	4.70	4.50

a Gold. *b* Currency.

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870....	6.30	6.20	6.37	6.32	6.37	6.30	6.37	6.25	6.35	6.25	6.35	6.25
1871....	6.15	6.10	6.12	6.00	6.10	6.00	6.00	5.87	6.00	5.90	6.00	5.75
1872....	6.02	6.40	6.50	6.40	6.50	6.30	6.62	6.40	6.60	6.50	6.60	6.42
1873....	6.12	6.00	6.25	6.00	6.62	6.37	6.75	6.25	6.50	6.00	6.12	6.00
1874....	5.80	5.62	5.80	5.65	6.10	5.65	6.35	6.10	6.50	6.25	6.40	6.12
1875....	6.00	5.95	5.95	5.87	5.87	5.70	5.65	5.60	5.87	5.65	5.95	5.87
1876....	6.35	6.20	6.37	6.25	5.25	6.00	6.00	5 80	5.80	5.70	5.70	5.65
1877....	5.60	5.37	5.12	4.90	4.85	4.75	4.85	4.25	4.75	4.50	4.60	4.50
1878....	3.62	3.25	3.50	3.20	3.45	3.25	3.60	3.37	3.95	3.60	4.00	3.90
1879....	4.10	3.90	4.05	4.00	4.00	3.75	5.50	4.00	5.62	5.00	5.60	5.50
1880....	4.75	4.25	5.00	4.30	4.90	4.80	4.87	4.65	4.85	4.75	4.75	4.25
1881....	4.90	4.50	4.95	4.75	5.37	4.95	5.25	4.87	5.25	4.90	5.25	5.00
1882....	5.15	4.90	5.10	4.95	5.15	4.95	5.15	4.85	4.90	4.50	4.75	4.50
1883....	4.40	4.30	4.30	4.20	4.32	4.30	4.32	4.12	4.05	3.65	3.75	3.60
1884....	3.70	3.55	3.70	3.52½	3.75	3.55	3.75	3.60	3.55	3.37½	3.75	3.50
1885....	4.15	3.87½	4.25	4.12	4.25	4.00	4.25	4.00	4.60	4.00	4.67½	4.50
1886....	4.90	4.75	4.80	4.75	4.70	4.45	4.30	4.00	4.40	4.10	4.35	4.25
1887....	4.67½	4.40	4.62½	4.55	4.55	4.25	4.40	4.20	4.75	4.25	5.15	4.90

In January lead opened with a declining tendency, 4.15 cents being accepted. Toward the middle of the month, however, a reaction took place under moderate sales, the price reaching 4.45 cents. The market weakened quickly, however, the month closing at 4.25 cents, only a small transaction taking place at that figure. In the first few days of February the metal recovered almost immediately to 4.50 cents, heavy sales being made on the rise, with additional transactions at 4.45 and 4.40 cents. The demand being pretty well supplied, the market continued quiet during the rest of the month. The apathy continued throughout March, the price declining slowly under a light business to 4.25 cents and closing at 4.30 cents. During April, under a moderate business, the market fluctuated little, but showed a downward tendency, prices touching 4.20 cents towards the close. Early in May, however, a speculative movement caused a reaction which gained in strength under growing purchases; manufacturers, however, participating only moderately in the buying. The price rose from 4.30 cents early in the month to 4.70 cents, close to the importing point, some foreign lead being bought in June, during which month the market was sustained by moderate speculative purchases and by some buying by consumers at the range of 4.60 cents to 4.70 cents until the close, when 4.50 cents was accepted. The weaker feeling developed during the earlier part of July, the market receding to 4.40 cents. Under manipulation of foreign and domestic markets the price recovered after the middle of the month to 4.65 cents, reaching temporarily 4.67½ cents towards its close under light sales of both domestic and foreign lead, but winding up at 4.65 cents. August opened with a few lots selling at 4.55 cents. These being cleared away, 4.60 and 4.62½ cents became the ruling price on a dull market, the speculative interest holding the metal. Early in September efforts to place foreign lead at 4.62½ cents caused sales by holders down to 4.55 cents. Consumers held off until towards the middle of the month, when weakness abroad was reflected by a decline of domestic lead down to 4.25 cents. Consumers buying caused a reaction early in October to 4.40 cents, but an unsettled feeling soon developed which carried values back temporarily to 4.20 cents, the month closing with common domestic at 4.25 cents. Early in November, however, under some large purchases, a reaction brought the price up to 4.55 cents, followed by a rapid weakening to 4.25 cents. Under small offerings values were lifted to nominally 4.45 cents. Under the initiative of London the last days of November and the beginning of December witnessed an excited rise under heavy sales to 5.12 cents, followed by large purchases during the succeeding week of both spot and futures by consumers and speculators at the range of 4.95 and 5 cents for spot, the market quieting down towards the last days of the year with holders asking 5.15 cents for spot. During the greater part of the year the market was swayed by speculative influences, culminating at its close in a movement fostered by the great speculation on both sides of the Atlantic in copper, tin and the majority of the minor metals.

During the year 1887 the foreign markets have frequently attracted attention on this side of the Atlantic, and have not been without occasional influence upon our own. Prices fluctuated in London and in Paris as follows:

Fluctuations in the price of lead in London and Paris.

Months.	English lead.			Spanish lead.			Paris.
	Per long. ton.			Per long ton.			Per 100 kilograms.
	£	*s.*	*d.*	*£*	*s.*	*d.*	*Francs.*
January	12	19	4	12	15	0	33.38
February	12	18	1	12	12	11	33.08
March	12	16	6	12	11	3	32.56
April	12	14	6	12	8	7	32.05
May	12	8	9	12	2	0	31.18
June	12	11	3	12	5	7	31.81
July	12	6	0	11	19	1	31.15
August	12	5	7	11	19	10	31.00
September	12	3	6	11	19	3	31.15
October	12	6	3	12	2	0	31.38
November	13	1	3	12	15	0	33.25
December	15	7	6	15	4	0	40.20
Average 1887	12	16	6	12	11	2	32.68
Average 1886	13	4	9	12	17	2	....

These figures clearly show the rapid rise in December, short lived though it proved to be early in 1888.

THE LEAD PRODUCING REGIONS OF THE UNITED STATES.

The growing interchange of ores between the different States and Territories of the Rocky mountains has rendered it practically impossible to distribute the lead product territorially. Idaho smelts but little of its ore, shipping to Utah, Montana and Colorado smelters, and to refineries at Omaha and elsewhere. Utah receives ore from other sources, and ships part of the product of its own mines, and the same is true of Colorado. Without a far-reaching inquiry into the private business of smelters, sampling works, producing mines and railrood shipments, it would be impossible to trace exactly the origin of the metal marketed.

Utah.—According to the statement of Messrs. Wells, Fargo & Co. the production of the smelters of Utah was as follows:

Wells, Fargo & Co.'s statement of the lead product of Utah for 1885, 1886, *and* 1887.

Works.	1885, base bullion.	1886, base bullion.	1887, base bullion.
	Pounds.	*Pounds.*	*Pounds.*
Germania Lead Works	7,975,400	9,834,700	7,215,616
Hanauer	9,352,644	11,741,763	12,064,000
Horn Silver Mining Company	4,905,932	....	....
Mingo Furnace Company	11,744,000	11,743,749	5,215,310
Other smelters	....	523,631	....
Net product base bullion	33,977,976	33,843,843	24,494,926
Lead in ores shipped	20,340,800	14,612,417	21,182,035
Total lead	54,318,773	48,456,260	45,676,961

Wells, Fargo & Company's statement for 1887 segregates the lead contents of the Daly and Ontario ore shipped to smelters, enumerating it among the smelters' product, without stating whether all or a part of it was treated at Utah works.

There have been no striking developments in Utah during 1887. The Ontario, Daly and Crescent mines continue shipments of ore to smelters, the first sending 9,747 dry tons, containing 2,015 tons of lead; the Daly 3,240 tons, carrying 782 tons of lead, and the Crescent 5,806 tons. The total, with 1,355 tons from various mines, aggregating 20,148 tons.

In the Bingham Cañon district, the estimated shipments of which footed up to a total of 24,000 tons, the Brooklyn led with about 6,000 tons, followed by the Lead mine with 3,500 tons of ore, carrying about 36 per cent. of lead, 12 ounces of silver, and $2 to $3 of gold. The Jordan, in the same district, has improved its concentrating facilities. The Big and Little Cottonwood districts did not produce heavy amounts of ore during 1887.

Mr. C. E. Mitchener, superintendent of the Honorine Mining Company, of Stockton, summarizes the principal features affecting the lead supply of the district as follows: There has been a tendency to increase the output of ore through deeper mining, *i. e.*, going below the water level in the leading mines, the Calumet, Silver King, and Honorine, which has involved considerable expenditure for pumping machinery, etc. The grade of the ore in lead decreases below the water level, while so far the silver remains about the same. The Calumet company is building a small concentrator, the second in the district.

The Tintic district is estimated to have shipped about 32,000 tons, of which about 11,000 tons was iron ore flux. The operations of two of the leading mines, the Eureka Hill and the Beck and Bullion, were curtailed somewhat by litigation.

California.—The total output of this State from local ores is estimated, by the Selby Lead and Smelting Company, of San Francisco, at about 800 tons.

Nevada.—The Richmond Consolidated and the Eureka Consolidated companies continue to be the only mines of any consequence as lead producers in Nevada, both companies purchasing the greater part of small lots of ore brought to market in the State by outside parties. The former produced about 2,000 tons, while the latter made 1,103 tons. Small smelters, running intermittently in other parts of the State, may have swelled the total to 3,400 tons.

Since 1877 the production of lead in the State has been as follows:

Production of lead in Nevada since 1877.

Years.	Quantity.	Years.	Quantity.	Years.	Quantity.
	Short tons		*Short tons*		*Short tons*
1877	19,724	1881	12,826	1885	3,500
1878	31,063	1882	8,590	1886	3,400
1879	22,805	1883	6,000	1887	3,400
1880	16,659	1884	4,000		

Colorado.—The total output of the smelters of Colorado during 1887 was 74,815 short tons. It is estimated that of this quantity about 11,000 tons was from ores outside of the State, leaving its product 63,000 tons against an estimate of 59,000 tons in 1886. A number of additions and improvements were carried out in connection with some of the smelters, and a new plant is building at Denver. In detail the produc tion of lead at the Colorado smelting works was as follows in 1886 and 1887:

Production of lead by Colorado smelting works.

Name of works.	1886.	1887.
	Short tons.	*Short tons.*
American Smelting Works, Leadville and Cañon City	6,134	9,168
Arkansas Valley Smelting Company, Leadville	8,613	7,801
Harrison Reduction Works, Leadville	4,020	5,428
La Plata Smelting Company, Leadville	4,370	2,719
Manville Smelting Works, Leadville	2,826	2,548
Colorado Smelting Company, Pueblo	9,327	8,668
Pueblo Smelting and Refining Company, Pueblo	9,250	5,795
San Juan and New York Smelting Company	2,006	....
Royal Gorge Smelting Works	2,342	700
Golden Smelting Company	1,020	1,800
Holden Smelting Company	1,454	9,743
Omaha and Grant Smelting Company (Colorado ores)	8,645	(*a*)12,171
Miscellaneous	1,282	2,800
Total	61,289	69,341

a The total lead produced by the Omaha and Grant works from ores from all sources was 17,645 tons.

Leadville continues to be overwhelmingly the heaviest producer of lead ores in the State, its shipments of base bullion during 1887 having been 30,575 tons, while the shipments of lead, siliceous and sulphide ores to valley smelters aggregated 34,600 tons. A considerable quantity of ore treated in Leadville has, however, come from other quarters. At the close of 1887 the three railroads entering Leadville reduced the freight on bullion from Leadville to Colorado Springs, Denver, or Pueblo from $12 to $10 and lowered the cost of coke on cars to the smelters to $10 a ton, while the rate on ore from Leadville to valley smelters at Pueblo and Denver was lowered from $5 to $4.70 per ton for the old tariff for ore valued at $100 or under. The unfavorable position of the Leadville works in their competition with the valley smelters has thus been improved. The mines of the district maintained their productiveness, although the most readily smelted ores are growing scarce. Concentrating equipment has been increased and the outlook points to a continuance of the present rate of supply of the metal for the current year.

In the Monarch district, the Madonna has fallen off heavily, declining in shipments from 40,000 tons of ore in 1886 to 15,000 tons in 1887. The Eclipse, in the same camp, has, however, come to the front with a production of 36,000 tons.

Very little ore was shipped from Aspen in 1887 prior to the advent of the railroads, the Denver and Rio Grande arriving in November and the Colorado Midland in December of that year, the freights to Denver, which had been between $20 and $25 per ton, declining to $8 per ton of ore. Mr. Carl Heurich has furnished the following figures, which will afford a clear idea of the magnitude of the shipments and the grade of the ore so far as their lead contents are concerned. In November and December, 1887, 11,700 tons of ore were shipped from Aspen with an average lead contents of about 7 per cent., prior wagon shipments having been about 12,500 tons. For the first five months of 1888, the shipments over both railroads were as follows:

Shipments of lead ore from Aspen, Colorado, during the first five months of 1888.

Months.	Denver and Rio Grande.	Colorado Midland.	Total.
	Tons.	*Tons.*	*Tons.*
January	2,170	4,617	6,787
February	2,530	3,590	6,120
March	3,056	3,875	6,931
April	1,805	4,684	6,489
May	1,687	7,659	9,346

The total shipments for the first five months were 35,673 short tons, carrying about 8½ per cent. of moisture.

The lead contents can be estimated from the following shipments of two sampling works and one of the leading mines. One of the former shipped from March 27, to June 1, 1888, 9,850,701 pounds, dry weight, of ore containing 790,543 pounds of lead, or 8 per cent. The other forwarded from March 15, to June 1, 1888, 2,057,860 pounds dry weight of ore, containing 123,320 pounds of lead, or nearly 6 per cent. The mining company referred to shipped in 1887, 4,706,652 pounds of ore, carrying 206,797 pounds of lead, or 4.4 per cent.; and from January to May, inclusive, of the current year, 25,309,156 pounds of ore, dry weight, carrying 1,869,984 pounds of lead, or 7.4 per cent. A part of the product of this mine, about 8,000 tons out of 20,000 tons, carried 15 per cent., the balance being low in lead. Mr. F. G. Bulkley, general manager of the Aspen Mining and Smelting Company, notes that recently developments in Smuggler mountain, north of the town of Aspen, in the Park, Regent and Tiger, Smuggler, J. C. Johnson and Boulder claims have shown considerable quantities of lead where baryta ores only had heretofore been found. On Aspen mountain, as depth has gained in the Aspen mine, and in the workings of the mines of the Compromise, Aspen, and Enterprise companies, large bodies of lead ore have been found and are now being mined and shipped. Taking the average of the ores sent to market thus far, on which data are available, the contribution of Aspen to the lead product for the year 1888, on the basis of the shipments of the first five months, would be close to six thousand tons.

The bugbear of the Aspen ores has been their baryta. Mr. Heurich claims that their deleterious influence has been much overestimated.

On an average there is not over 12 per cent. of baryta in them, and the best lead ores of the district are nearly free from it. The dry ores, those carrying very little or no lead, are generally those which have a large percentage of baryta. In some of them gray copper makes its appearance, and most of them will find their natural market at the works of the Boston and Colorado Smelting Company at Argo. Mr. Heurich claims that if these dry ores are eliminated from those to be treated in a lead furnace, the remaining ores will not contain on an average 5 per cent. of baryta, which ought not to occasion any difficulties in lead smelting.

Idaho.—The total production of lead in Idaho amounted in 1887 to about 20,000 short tons. Of this less than one-third was from smelters in the Territory; the remainder was contained in ores which were smelted in Montana, Colorado, California, and elsewhere. In the Wood River region, the Philadelphia and Idaho Company smelted all the ores produced in the region about Ketchum and some from the mines about Hailey. Their output in 1887 was 1,131 short tons of lead, mostly from Ketchum ores. The sampling works at Hailey handled 3,517 short tons of ore, of which 1,850 tons were from the Idahoan mine. A portion of this ore went to the Philadelphia and Idaho smelter at Ketchum, the remainder to points outside the Territory. The sampling works at Bellevue handled 8,326 short tons of ore in 1887. Most of this was from the Minnie Moore mine, which furnished 5,745 tons, and the Queen of the Hills, which furnished 2,372 tons. About four-fifths of the ore shipped from Bellevue went to Omaha and Denver, most of the remainder went to California, and a few tons were smelted at Ketchum. The ores from Hailey and Bellevue average about 60 per cent. of lead, and carry 80 to 100 ounces of silver to the ton. Allowing for loss in smelting, the lead contents of the ores from these two points can be estimated at 6,400 short tons. Adding to this the output of the Philadelphia and Idaho smelter and allowing for duplication, the total production of the Wood River region can be placed at 7,100 short tons of lead.

The Viola Mining and Smelting Company, at Nicholia, Lemhi county, produced 4,900 tons of lead bullion in 1887. Two furnaces were in operation, but were shut down during two months of the year. All the ore smelted was from one mine—the Viola—and no ore was shipped from the district.

The smelter at Clayton, Custer county, produced 100 short tons of lead bullion in 1887. The output of the Ramshorn smelter at Bay Horse, Custer county, has not been ascertained. Allowing for this, and possibly some mines which have not been reported, the total lead production of southern Idaho probably amounted to 13,000 short tons.

The chief producers in the Cœur d'Alene region were the Bunker Hill and Sullivan, the Sierra Nevada, and the Stemwinder mines. The Bunker Hill and Sullivan shipped about 10,000 tons of argentiferous lead concentrates in 1887, the two latter mines about 500 tons each.

These mines are all at Wardner, Shoshone county. The total lead output probably amounted to nearly 7,000 short tons from the Cœur d'Alene region. No new district in the United States promises to play so important a part in the lead markets of the country as the Cœur d'Alene. Mr. F. Burbridge, of the Cœur d'Alene Sampling Works, estimates the production for 1888 at from 25,000 to 26,000 tons of lead, made up as follows:

Estimated output of lead ore concentrates in the Cœur d'Alene region, Idaho, in 1888.

Mines.	Concentrates.	Grade.	Lead.
	Short tons.	*Per cent.*	*Short tons.*
Bunker Hill and Sullivan	13,200	65	8,580
Stemwinder and Tyler	3,500	60	2,100
Sierra Nevada	4,500	55	2,475
Tiger	12,000	57	6,840
Poorman	6,500	60	3,900
Granite	3,000	60	1,800
Total	42,700	..	25,695

During the first half of 1888 three new concentrators began running, and two more were building which were expected to be ready for operations in August or September. The concentrates, which carry about 30 ounces of silver, are shipped to Portland, Oregon, where reduction plants have been built, to Wickes, Montana, and to Denver and Omaha. The only transportation thus far is by the Cœur d'Alene Railway and Navigation Company, connecting with the Northern Pacific Railroad at Cœur d'Alene City, to which point the ore rates are $5.50 to $6 per ton. From there the rates are $10.40 to Portland, $8 to Helena, $8.30 to Wickes, $17 to Omaha, and $18 to Denver. It is stated that the Oregon Railway and Navigation Company will soon extend its line from Farmington into the Cœur d'Alene country, a step which might force the Northern Pacific Railroad to build a direct line also. These roads, besides aiding development by lowering freights, would come through districts containing promising mines, like those at Mullan and the Sunset group, which are now too far from the railroad to be worked profitably.

The principal increase in 1888 will, therefore, come from the Cœur d'Alene district. The Viola company is expected to produce 8,000 tons this year, or 3,000 tons more than in 1887, while the Wood River section will not, probably, show any material change.

Prospecting has been going on also in the Burke district, where Mr. J. K. Clark, of Butte, is operating the Poorman-Laland and Blue-eyed Nellie mines. The former, during the months of March and April, 1888, shipped 1,000 tons of ore, assaying 55 per cent. of lead and 55 ounces of silver. A 150-ton concentrating mill was building, to be completed in August, 1888, future shipments to be regulated by its capacity. During April and May, 1888, 1,000 tons of ore, carrying 35 per cent. of lead and 35 ounces of silver, were sent to market from the Blue-eyed Nellie, but no definite plans in regard to future output have been formulated as yet.

Montana.—The leading producer in Montana is the Helena Mining and Reduction Company at Wickes, which leased also the Amazon smelter in Boulder valley and the works of the Toston Smelting Company at Toston, closed in 1887 by the alien act. The output of the company in 1887 was 6,447 tons of lead, of which, however, about 30 per cent. was derived from Cœur d'Alene ores.

Next in importance in the Territory is the Hecla Consolidated Mining Company at Glendale, which in 1887 produced 2,332 short tons of lead, 474,719.37 ounces of silver, and 123,642 pounds of copper. The annual report of the general manager, Mr. H. Knippenberg, contains some interesting details of costs. The mines produced 9,925 tons of first-class and 11,359 tons of second-class ore, at a cost per long ton of first and second class ore of $5.70 per ton. The concentrator handled in 288.8 shifts, actual running time, 10,522 tons of ore, producing 1,426 tons of concentrates, at a cost of 57⅜ cents per ton of crude ore, or $4.253 per ton of concentrates. The latter carried 48.98 per cent. of lead, 63.74 ounces of silver, and 12.9 per cent. of silica. The smelting works treated 11,224 tons of ore, using 4,504 tons of iron ore, 3,090 tons of limestone, 4,967 tons of slag, 685 tons of skimmings, and 35 tons of flue dust, a total smelting charge of 24,505 tons. The fuel consumption was 670,535 bushels of charcoal and 618 tons of coke, the fuel cost per ton of charge mixture being $4.06. The total profit for the year was $144,981.98, out of which $30,000 was paid in dividends, leaving a cash balance at the close of the year of $178,171.69. From July, 1881, to December, 1887, the mine had paid $885,000 in dividends, a debt of $77,785.13 on January 1, 1881, and has cash and product on hand valued at $178,171.69, making the net profits for the period $1,140,956.82. A small quantity of lead, 210 tons, carrying 31,500 ounces of silver and 630 ounces of gold, was made by the Tuscarora Mining and Smelting Company at Argenta, a concern the output of which is expected to be larger in 1888. This would carry the aggregate of lead produced from Montana ore to about 7,000 tons.

The most important development in Montana is, however, the establishment of two large smelting plants, the Montana Smelting Company at Great Falls on the Missouri river, under the auspices of the Saint Paul, Indianapolis and Manitoba railway, and the Helena and Livingstone Company at Helena, under the auspices of the Northern Pacific railroad. Each of these concerns is reputed to represent a cash capital investment of $600,000, and both have secured low rates of freight on bullion, $6 instead of $18 charged thus far, and cheap coke, $7 as against $16 hitherto. The Montana Smelting Company at Great Falls is now building 6 large blast furnaces and 20 reverberatory roasting furnaces, the ores to be treated being almost exclusively sulphurets. The stimulus thus given to mining operations throughout Montana and parts of Idaho through a good market for ores, and the increased shipping facilities growing out of the extension of the railroad systems of the section affected, are likely to lead to a marked increase in the output of lead in that quarter. Among others the Castle Mountain district, 50 miles north of Livingstone, is looked forward to as a source of supply, and the Barker district is expected to furnish considerable ore.

Arizona.—What little lead ore is mined goes chiefly to smelters outside of the Territory. Some interest has attached to rumors of large bodies of lead ore in the Cataract Creek district, which have been examined with a view to providing railroad facilities.

New Mexico.—The total lead product of this Territory reached over 8,000 tons, largely derived from Mexican ores. The Rio Grande and Graphic smelters at Socorro turned out together 7,325 tons, in spite of the fact that the principal source of supply of lead ore of the former, the Kelly mine, was at one time regarded as exhausted, the lower levels having entered undecomposed sulphurets. The subsequent discovery by a lessee of a new ore body has, however, restored it to its old rank. No striking developments promising a sudden increase in the quantity of lead ore mined have been made during 1887.

Dakota.—A small quantity of metal has been produced in Dakota, the leading concern being the Iron Hill Mining Company, of Lawrence county, which, with a new smelting plant, turned out 966 tons of base bullion during the second half of 1887. At Galena the Galena Mining and Smelting Company produced 155 tons of base bullion, so that, in round figures, the lead product of the Territory may be placed at 1,000 tons. In both places the ore does not appear to be abundant, the cost of coke is high, and freights to refinery and refining charges are heavy items, so that the prospects of any considerable increase are not bright.

Missouri and Kansas.—Production has been increased during 1887, both southwest Missouri and the Bonne Terre district increasing the output, while Mine la Motte has added its usual quota. In southwest Missouri two works are now running at Aurora—the Aurora Mining and Smelting Company and the Dwight Smelting Company, the latter having started March 1, 1887. These, with the Joplin, Picker, Granby and Kansas works, produced 8,687 tons. At Bonne Terre the Saint Joseph Lead Company is turning out lead at the rate of 13,500 tons a year, while the new Doe Run plant is running at the rate of about 3,500 tons a year. It is probable, therefore, that 1888 will witness an increase in the product of this section of the country.

IMPORTS.

Since the temporary shortage in the supply of domestic lead early in 1887, the imports have again assumed significance. The following tables give in detail the quantities of ore and dross, pigs and bars, sheets, pipe and shot, and other manufactures not specified. imported since 1867:

Lead imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*			
1867....	611	$25	65, 322, 923	$2, 812, 668	185, 825	$9, 560	....	......	$6, 222	$2, 828, 475
1868....	6, 945	239	63, 254, 677	2, 668, 915	142, 137	7, 229	....	......	6, 604	2, 682, 987
1869....	....	....	87, 865, 471	3, 653, 481	307, 424	15, 531	....	......	18, 885	3, 687, 897
1870....	5, 973	176	85, 895, 724	3, 530, 837	141, 681	6, 879	....	......	10, 444	3, 548, 336
1871....	316	10	91, 496, 715	3, 721, 096	86, 712	4, 209	....	......	8, 730	3, 734, 045
1872....	32, 331	1, 425	73, 086, 657	2, 929, 623	15, 518	859	....	......	20, 191	2, 952, 098
1873....	....	....	72, 423, 641	3, 233, 011	105	12	420	$50	21, 503	3, 254, 576
1874....	....	....	46, 205, 154	2, 231, 817			30, 219	1, 349	36, 484	2, 269, 650
1875....	13, 206	320	32, 770, 712	1, 559, 017	....	....	58	4	25, 774	1, 585, 115
1876....	....	....	14, 329, 366	682, 132	....	....	20, 007	1, 204	27, 106	710, 442
1877....	1, 000	20	14, 583, 845	671, 482	....	....	16, 502	1, 242	1, 041	673, 785
1878....	....	....	6, 717, 052	294, 233	....	....	15, 829	963	113	295, 309
1879....	....	....	1, 216, 500	42, 983	....	....	3, 748	209	930	44, 122
1880....	....	....	6, 723, 706	246, 015	....	....	1, 120	54	371	246, 440
1881....	5, 981	97	4, 322, 068	159, 129	....	....	900	65	1, 443	160, 734
1882....	21, 698	500	6, 079, 304	202, 603	....	....	1, 469	99	2, 449	205, 651
1883....	600	17	4, 037, 867	130, 108	....	....	1, 510	79	8, 030	138, 234
1884....	419	13	3, 072, 738	85, 395	15, 040	630	....	......	1, 992	88, 030
1885....	4, 218	57	5, 862, 474	143, 103	971, 951	22, 217	....	......	1, 372	166, 749
1886....	....	....	11, 005, 083	294, 856	24, 087	1, 023	....	......	1, 698	297, 577
1887....	814, 142	20, 605	11, 148, 211	323, 256	19, 260	950	....	......	360	345, 171

Old and scrap lead imported and entered for consumption in the United States, 1867 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867..............	1, 255, 233	$53, 202	1878..............	106, 342	$3, 756
1868..............	2, 465, 575	101, 586	1879..............	42, 283	1, 153
1869..............	2, 983, 272	123, 068	1880..............	213, 063	5, 262
1870..............	3, 756, 785	150, 379	1881..............	123, 018	2, 729
1871..............	2, 289, 688	94, 467	1882..............	220, 702	5, 949
1872..............	4, 257, 778	171, 324	1883..............	1, 094, 133	31, 724
1873..............	3, 545, 098	151, 756	1884..............	160, 356	4, 830
1874..............	395, 516	13, 897	1885..............	4, 866	106
1875..............	382, 150	13, 964	1886..............	17, 943	666
1876..............	265, 860	9, 534	1887..............	35, 081	1, 452
1877..............	249, 645	8, 383			

Lead and manufactures of lead, of domestic production, exported from the United States.

Fiscal years ending September 30 until 1842, and June 30 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1790..................	13, 440	$810	....	....	....	$810
1803 (barrels)	900	....	....	....	....	....
1804..................	19, 804	....	....	....	....	....
1805..................	8, 000	....	....	....	....	....
1808..................	40, 583	....	....	....	....	....
1809..................	126, 537	....	....	....	....	....
1810..................	172, 323	....	....	....	....	....
1811..................	65, 497	....	....	....	....	....
1812..................	74, 875	....	....	....	....	....
1813..................	276, 940	....	....	....	....	....
1814..................	43, 600	....	....	....	....	....

Lead aud manufactures of lead, of domestic production, etc.—Continued.

Fiscal years ending September 30 until 1842, and June 30 since.	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
1815	40, 245					
1816	35, 844					
1817	111, 034	$9, 993				$9, 993
1818	281, 168	22, 493				22, 493
1819	94, 362	7, 549				7, 549
1820	25, 699	1, 799				1, 799
1821	56, 192	3, 512				3, 512
1822	66, 316	4, 244				4, 244
1823	51, 549	3, 098				3, 098
1824	18, 604	1, 356				1, 136
1825	189, 930	12, 697				12, 697
1826	47, 337	3, 347	$1, 820			5, 167
1827	50, 160	3, 761	6, 183			9, 944
1828	76, 882	4, 184	5, 545			9, 729
1829	179, 952	8, 417	5, 185			13, 602
1830	128, 417	4, 831	4, 172			9, 003
1831	152, 578	7, 068	6, 422			13, 490
1832	72, 439	4, 483	983			5, 466
1833	119, 407	5, 685	2, 010			7, 695
1834	13, 480	805	2, 224			3, 029
1835	50, 418	2, 741	433			3, 174
1836	34, 600	2, 218	4, 777			6, 995
1837	297, 488	17, 015	3, 132			20, 147
1838	375, 231	21, 747	6, 461			28, 208
1839	81, 377	6, 003	12, 637			18, 640
1840	882, 620	39, 687	15, 296			54, 983
1841	2, 177, 164	96, 748	20, 546			117, 294
1842	14, 552, 357	523, 428	16, 789			540, 217
1843 (nine months)	15, 366, 918	492, 765	7, 121			499, 886
1844	18, 420, 407	595, 238	10, 018			605, 256
1845	10, 188, 024	342, 646	14, 404			357, 050
1846	16, 823, 766	614, 518	10, 278			624, 796
1847	3, 326, 028	124, 981	13, 694			138, 675
1848	1, 994, 704	84, 278	7, 739			92, 017
1849	680, 249	30, 198	13, 196			43, 394
1850	261, 123	12, 797	22, 682			35, 479
1851			16, 426	229, 448	$11, 774	28, 200
1852			18, 469	747, 930	32, 725	51, 194
1853			14, 064	100, 778	5, 540	19, 604
1854			16, 478	404, 247	26, 874	43, 352
1855			5, 233	165, 533	14, 298	19, 531
1856			5, 628	310, 029	27, 512	33, 140
1857			4, 818	870, 544	58, 624	63, 442
1858			27, 327	900, 607	48, 119	75. 446
1859			28, 782	313, 988	28, 575	57, 357
1860			56, 081	903, 468	50, 446	106, 527
1861			30, 534	109, 023	6, 241	36, 775
1862			28, 832	79, 231	7, 334	36, 166
1863			30, 609	237, 239	22, 634	53, 243
1864			30, 411	223, 752	18, 718	49, 129
1865			29, 271	852, 895	132, 666	161, 937
1866			44, 483	25, 278	2, 323	46, 806
1867			27, 559	99, 158	5, 300	32, 859
1868			37, 111	438, 040	34, 218	71, 329
1869			17, 249			17, 249
1870		28, 315				28, 315
1871		79, 880				79, 880
1872		48, 132				48, 132
1873		13, 392				13, 392
1874		302, 044				302, 044
1875		429, 309				429, 309
1876		102, 726				102, 726
1877		49, 835				49, 835
1878		314, 904				314, 904
1879		280, 771				280, 771
1880		49, 899				49, 899
1881		39, 710				39, 710
1882		178, 779				178, 779
1883		43, 108				43, 108
1884		135, 156				135, 156
1885		123, 466				123, 466
1886		114, 098				114, 098
1887		141, 154				141, 154

ZINC.

BY C. KIRCHHOFF, JR.

In the year 1887 the zinc works of the United States reached an output not hitherto attained. On the whole the year was uneventful, the price of the metal remaining nearly stationary until the closing months. The heavy demand for iron and steel aided spelter producers, since it led to a large consumption by galvanizers. The brass trade was very active until the rapid speculative advance in copper caused a shrinkage in buying by consumers, which was not without its influence on the quantity of spelter melted.

PRODUCTION.

Official returns from every producer of spelter in the United States in 1887, with the exception of one, whose agent furnished a close estimate, shows the following total as compared with previous years:

Production of spelter in the United States.

Years.	Short tons.
1873	7,343
1875	15,833
1880 (census year ending May 31)	23,239
1882	33,765
1883	36,872
1884	38,544
1885	40,688
1886	42,641
1887	50,340

Grouped by States, the product has been as follows:

Production of spelter in the United States, 1882 *to* 1887, *inclusive, by States.*

States.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	18,201	16,792	17,594	19,427	21,077	22,279
Kansas	7,366	9,010	7,859	8,502	8,932	11,955
Missouri	2,500	5,730	5,230	4,677	5,870	8,660
Eastern and southern States	5,698	5,340	7,861	8,082	6,762	7,446
Total	33,765	36,872	38,544	40,688	42,641	50,340

The number of active works was nineteen, controlled by seventeen companies, there being three establishments in Illinois, five in Kansas, six in Missouri, three in New Jersey and Pennsylvania, and two in the South. In Illinois the two principal works, by far the largest in the country, the Matthiessen and Hegeler Zinc Company, at La Salle, and the Illinois Zinc Company, at Peru, produced practically the same amount as in 1886. Tne third, Otto F. Meister & Co., the Collinsville Zinc Works, at Collinsville, enlarged their plant during 1887, running 872 retorts during the last three months, as compared with 616 previously. In Kansas, the increased output was distributed among a number of the plants, several contributing a larger output. New zinc works have been completed during 1888 at Scammonville, and a plant is being built at Girard. It is reported also that a third plant is contemplated, to be put up at Columbus, Kansas. In Missouri the new works of Robert Lanyon & Co., who have been producers at Pittsburgh, Kansas, for a number of years, erected by them at Nevada, were put in operation on December 20, thus contributing a small quantity even to the 1887 total. The older Missouri works, notably the Glendale Zinc Company, which is running two plants, increased their production. On the whole, therefore, the output of zinc is increasing considerably in the West, and early in 1888, even the Far West contributed its first metal, the Denver Zinc Company, under the management of Mr. H. C. Rudge, having made its first slab in January; the plant has a capacity of 1,200 tons per annum, being dependent chiefly, if not exclusively, upon blende from silver-lead mines as raw material. In the East the product has remained moderate, and no special changes have taken place, the Lehigh Zinc and Iron Company, at Bethlehem, remaining the largest producer. In the South the Bertha Zinc Company, at Pulaski, Virginia, has increased largely, six new furnaces having been put up during 1887, which carry the capacity to 3,000 tons annually. Since the beginning of the year it has been determined to add ten furnaces more, which are to double the capacity of the plant. The Edes, Mixter & Heald Zinc Company, of Knoxville, Tennessee, has also decided to carry out plans of enlargement. Everything points, therefore, to a considerably increased production of spelter, although the full effect of the additions to old works, and the establishment of new concerns is not likely to be felt until the second half of 1888.

IMPORTS AND EXPORTS.

Zinc imported and entered for consumption in the United States, 1867 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Blocks or pigs.		Sheets.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	5,752,611	$256,366	5,142,417	$311,767	$1,835	$569,968
1868	9,327,968	417,273	3,557,448	203,883	1,623	622,779
1869	13,211,575	590,332	8,306,723	478,646	2,083	1,071,061
1870	9,221,121	415,497	9,542,687	509,860	21,696	947,053
1871	11,159,040	508,355	7,646,821	409,243	26,366	943,964
1872	11,802,247	522,524	10,704,944	593,885	58,668	1,175,077
1873	6,836,897	331,399	11,122,143	715,706	56,813	1,103,918
1874	3,593,570	203,479	6,016,835	424,504	48,304	676,287
1875	2,034,252	101,766	7,320,713	444,539	26,330	572,635
1876	947,322	56,082	4,611,360	298,308	18,427	372,817
1877	1,266,894	63,250	1,341,333	81,815	2,496	147,561
1878	1,270,184	57,753	1,255,620	69,381	4,892	132,026
1879	1,419,791	53,294	1,111,225	53,050	3,374	109,718
1880	8,092,620	371,920	4,069,310	210,230	3,571	585,721
1881	2,859,216	125,457	2,727,324	129,158	7,603	262,218
1882	18,408,391	736,964	4,413,042	207,032	4,940	948,936
1883	17,067,211	655,503	3,309,239	141,823	5,606	802,932
1884	5,869,738	208,852	952,253	36,120	4,795	249,767
1885	3,515,840	113,268	1,839,860	64,781	2,054	180,103
1886	3,616,462	115,813	1,037,951	38,359	10,650	164,822
1887	7,432,490	240,535	757,245	26,668	8,116	275,319

Exports of zinc and zinc ore of domestic production, 1864 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwt.		*Pounds.*			
1864	14,810	$116,431	95,738	$12,269	....	$128,700
1865	99,371	114,149	184,183	22,740	....	136,889
1866	4,485	25,091	140,798	13,290	....	38,381
1867	3,676	32,041	312,227	30,587	....	62,628
1868	8,344	74,706	1,022,699	68,214	....	142,920
1869	....	65,411	....	....	....	65,411
1870	15,286	81,487	110,157	10,672	....	92,159
1871	9,621	48,292	76,380	7,823	....	56,115
1872	3,686	20,880	62,919	5,726	....	26,606
1873	234	2,304	73,953	4,656	....	6,960
1874	2,550	20,037	43,566	3,612	....	23,649
1875	3,083	20,659	38,090	4,245	$1,000	25,904
1876	10,178	66,259	134,542	11,651	4,333	82,243
1877	6,428	34,468	1,419,922	115,122	1,118	150,708
1878	16,050	83,831	2,545,320	216,580	567	300,978
1879	10,660	40,399	2,132,949	170,654	....	211,053
1880	13,024	42,036	1,368,302	119,264	....	161,300
1881	11,390	16,405	1,491,786	132,805	168	149,378
1882	10,904	13,736	1,489,552	124,638	....	138,374
1883	3,045	11,509	852,333	70,981	734	83,224
1884	4,780	16,685	126,043	9,576	4,666	30,927
1885	6,840	22,824	101,685	7,270	4,991	35,085
1886	8,740	24,951	770,558	64,410	12,749	102,110
1887	1,209	44,152	363,199	25,403	18,554	88,109

Imports of zinc oxide in 1885, 1886, *and* 1887.

Fiscal years ending June 30—	Dry.	In oil.
	Pounds.	*Pounds.*
1885	2,233,128	98,566
1886	2,670,019	106,042
1887	2,763,642	82,486

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875 *to* 1887 *inclusive.*

[Cents per pound. Figures in parentheses are combination prices.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875.....	6.75	6.37	6.67	6.25	6.50	6.20	(7.00)	6.50	(7.25)	7.15	(7.25)	7.15
1876.....	(7.60)	7.40	(7.75)	7.50	(7.75)	7.62	(8.00)	7.60	(8.00)	7.75	(8.00)	7.25
1877.....	6.50	6.25	6.62	6.50	6.50	6.37	6.37	6.25	6.25	6.00	6.12	5.87
1878.....	5.75	5.50	5.62	5.25	5.62	5.25	5.25	5.00	5.00	4.62	4.62	4.25
1879.....	4.50	4.25	4.62	4.40	4.62	4.37	4.75	4.25	4.50	4.25	4.37	4.12
1880.....	6.50	5.87	6.75	6.37	6.75	6.50	6.50	6.12	6.00	5.62	5.50	5.12
1881.....	5.25	4.87	5.25	5.12	5.00	4.87	5.12	4.75	5.00	5.87	5.00	4.75
1882.....	6.00	5.75	5.75	5.62	5.62	5.37	5.50	5.25	5.62	5.25	5.37	5.25
1883.....	4.62	4.50	4.62	4.50	4.75	4.62	4.75	4.60	4.75	4.50	4.62	4.37
1884.....	4.37	4.20	4.40	4.25	4.60	4.40	4.65	4.50	4.60	4.45	4.60	4.45
1885.....	4.50	4.12	4.30	4.25	4.30	4.12	4.30	4.12	4.25	4.10	4.10	4.00
1886.....	4.50	4.30	4.55	4.30	4.60	4.50	4.60	4.50	4.60	4.40	4.40	4.35
1887.....	4.60	4.50	4.60	4.40	4.60	4.40	4.65	4.45	4.65	4.45	4.65	4.50

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875.....	(7.35)	7.25	(7.25)	7.10	(7.25)	7.10	(7.40)	7.15	(7.40)	7.15	(7.40)	7.15
1876.....	7.25	7.12	7.25	7.00	7.12	6.80	6.75	6.62	6.62	6.37	6.50	6.37
1877.....	5.87	5.62	5.90	5.80	5.87	5.75	5.90	5.70	5.87	5.62	5.75	5.50
1878.....	4.75	4.50	4.87	4.50	4.87	4.75	4.82	4.50	4.75	4.50	4.37	4.25
1879.....	4.75	4.37	5.62	4.80	6.00	5.62	6.37	6.00	6.25	5.87	6.25	6.00
1880.....	5.00	4.87	5.25	4.87	5.12	4.75	5.00	4.87	4.90	4.65	4.75	4.65
1881.....	5.00	4.75	5.12	5.00	5.25	5.00	5.37	5.25	5.87	5.50	6.00	5.87
1882.....	5.37	5.12	5.50	5.12	5.37	5.12	5.37	5.12	5.12	4.87	4.87	4.50
1883.....	4.50	4.30	4.40	4.30	4.50	4.40	4.45	4.35	4.40	4.37	4.37	4.35
1884.....	4.55	4.45	4.62	4.52	4.62	4.50	4.55	4.40	4.40	4.30	4.25	4.00
1885.....	4.40	4.10	4.60	4.40	4.62	4.50	4.62	4.50	4.60	4.45	4.60	4.45
1886.....	4.40	4.30	4.40	4.30	4.40	4.25	4.30	4.25	4.30	4.25	4.50	4.35
1887.....	4.50	4.50	4.60	4.55	4.65	4.60	4.65	4.50	4.80	4.52	5.87	5.00

For the first ten months of the year 1887 the extreme range of prices of spelter was only between 4.40 and 4.60 cents per pound, and it was not until the close of November that an advancing tendency developed, which gained ground rapidly in December. It was largely due to the speculative tendencies in all metals, which were the features of the end of the year on both sides of the Atlantic, aided by reports of heavy speculative buying of spelter in the West. On the whole matters have been shaping unfavorably during 1888. The demand in the two great industries of which the spelter business is an accessory, the iron and the brass trades, has been lighter in 1888, while the supply of the metal is increasing.

Messrs. Henry Merton & Co., of London, have compiled the following statement of the product of spelter in the world for a series of years:

Merton's estimate of the world's production of zinc.

Countries.	1887.	1886.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	130,995	129,020	129,754	130,522	123,891	119,193	110,989	98,830
Silesia	81,375	81,630	79,623	76,116	70,405	68,811	66,497	64,459
Great Britain	19,319	20,730	23,099	29,259	28,661	25,581	24,419	(*a*)22,000
France and Spain	16,028	15,305	14,847	15,341	14,671	18,075	(*a*)18,358	15,000
Poland	3,580	4,145	5,019	4,164	3,733	4,400	(*a*) 4,000	(*a*) 4,000
Australia	3,566	3,760	3,890	4,470	4,672	5,094	4,270	(*a*) 2,520
Total, Europe	254,863	254,590	256,232	259,872	246,033	241,154	228,533	206,809
Total, United States	44,947	38,072	36,339	34,414	32,921	30,148	(*a*)30,000	20.749
Grand total	299,810	292,662	292,571	294,286	278,954	271,302	258,533	227,558

a Estimated.

The figures published by this office for the wages and prices for ore in the Upper Silesia district, Germany, having been frequently quoted, the following data are given for 1887, from official reports: The product of 34 mines in Upper Silesia, the great zinc district of Germany, was 49,079 metric tons of calamine, 193,826 tons of blende, 28,580 tons of lead ore, and 2,930 tons of iron pyrites, having an aggregate value of 8,081,448 marks. Owing to the improvement in price of the metal the value of the calamine rose from 3.29 marks, or from 79 cents per metric ton in 1886 to 5.51 marks, or $1.32, while blende advanced from 11.43 marks, or $2.74, to 14.66 marks, equivalent to $3.52. In the mines 7,423 men and 2,672 women received aggregate wages in 1887 of 4,196,730 marks, the average annual earnings of men being 505.45 marks or $121.31; of boys under sixteen years of age, 214.11 marks, or $51.38, while the average annual earnings of the women were 201.58 marks, or $48.39.

Twenty-two zinc works, producing 82,640 tons of spelter, 7.321 tons of cadmium, and 827 tons of lead, employed 4,513 men and 1,592 women, to whom wages aggregating 3,429,704 marks were paid. The average annual wages of men over sixteen years of age amounted to 677.45 marks, equivalent to $162.59; to boys, 237.76 marks, or $57.06; and to women 264.16 marks, or $63.40. The production of sheet zinc was 29,141 metric tons.

QUICKSILVER.

Production.—Under the stimulus of greater activity in gold mining and consequently better prices, the production of quicksilver in the United States increased from 29,981 flasks in 1886 to 33,825 flasks (or over 2,607,613 pounds) in 1887. This was all produced in California except, in the latter year, 65 flasks from Oregon. The average price increased from $35.35 per flask in 1886 to $42.25 in 1887, making the total value of the year's product $1,429,000. No statement of an output in 1887 has been received from Marysville, Utah. The increase noted above is the result of active mining in California, and it is not probable that the higher prices can notably increase the product of 1888. In this connection Mr. J. B. Randol, by whom these statistics have been collected, states in the *Engineering and Mining Journal:* "Stocks in first hands are unusually small; the demand is good and a fair price is likely to be maintained. I am still of the opinion that the American mines can not increase their production even with the stimulus of an increased price, and for the year 1888 I look for a falling off in their yield." The following table shows the production of quicksilver in the United States from the discovery of gold in California to the close of 1887:

Production of quicksilver in the United States to the close of 1887.

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Pope Valley.	Napa Consolidated. (a)	St. John.	Altoona.	Oceanic.	Oakland.	California.	Great Eastern.	Sunderland.	Cloverdale.	Abbott.	Manhattan.	Various mines.	Total yearly production of California mines.
	Flasks.	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Fl'ks.*	*Flasks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Fl'ks.*	*Flasks.*	*Flasks.*	*Flasks.*
1850	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.			Yearly production previous to 1875 not obtainable (estimated at 20,000 flasks), included in production of various mines.					Some was produced prior to 1875, but no record kept (estimated production previous to 1875, 1,000 flasks), included in production of various mines.								Yearly production previous to 1876 not obtainable (estimated at 3,594 flasks), included in production of various mines.		7,723
1851	27,779																			27,779
1852	15,901																		4,099	20,000
1853	22,284																			22,284
1854	30,004																			30,004
1855	29,142																		3,858	33,000
1856	27,138																		2,862	30,000
1857	28,204																			28,204
1858	25,761																		5,239	31,000
1859	1,294																		11,706	13,000
1860	7,061																		2,939	10,000
1861	34,429																		571	35,000
1862	39,671		444																1,885	42,031
1863	32,803		852																6,876	40,589
1864	42,489		1,914				800												2,286	47,400
1865	47,194		3,545																2,261	53,000
1866	35,150	6,525	2,254																2,621	46,550
1867	24,461	11,493	7,862																3,184	47,000
1868	25,628	12,180	8,686				1,122												112	47,728
1869	16,898	10,315	5,018				1,580													33,811
1870	14,423	9,888	4,546				1,220													30,077
1871	18,568	8,180	2,128				1,970												840	31,686
1872	18,574	8,171	3,046				1,830													31,621
1873	11,042	7,735	3,294			340	1,955												3,276	27,642
1874	9,084	6,911	6,678	573		1,122	1,645		1,743											27,756
1875	13,648	8,432	7,513	5,372	3,342	3,384	1,940		1,927	533				412					3,747	50,250
1876	20,549	7,272	9,183	8,367	7,381	4,322	300	573	1,683	1,979	2,358	2,150	965	387	1,570	1,028	1,436	976	2,595	75,074
1877	23,996	6,316	9,399	10,993	6,241	5,856	1,060	2,229	1,463	1,317	2,575	1,395	1,516	505	735	1,291	836	439	1,234	79,396
1878	15,852	5,138	6,686	9,465	9,072	4,963	1,075	3,049		1,534	1,679	1,615	1,640	1,366	472	116			158	63,880
1879	20,514	4,425	4,516	9,249	15,540	6,333	1,325	3,605	1,290	1,919	779	1,505	1,110	1,455		18			101	73,684
1880	23,465	3,209	2,139	10,706	6,670	6,442	275	4,416	492	245		166	422	1,279						59,926
1881	26,060	2,775	2,194	11,152	5,228	6,241		5,552						1,065		208			376	60,851
1882	28,070	1,953	2,171	5,014	1,138	5,179		6,842						2,124					241	52,732
1883	29,000	1,606	1,894	2,612	84	3,869		5,890						1,669					101	46,725
1884	20,000	1,025	881	890	1,179	3,292		4,307						332					7	31,913
1885	21,400	1,144	385	1,296	35	3,469		3,506						446					392	32,073
1886	18,000	1,406	409	1,449		1,949		5,247						735					786	29,981
1887	20,000	1,890	673	1,490		1,446		5,574						689					(b)2,063	33,825
Total	873,259	127,989	96,310	78,628	55,910	58,207	18,097	50,790	8,598	7,527	7,391	6,831	5,653	12,464	2,777	2,661	2,272	1,415	66,416	1,485,195

a Including Etna.

b Including 65 flasks from Oregon.

Production of quicksilver (flasks) in California by months, from 1883 *to* 1887.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna. (a)	Napa. (a)	Great Eastern.	Bradford. (b)	Various.	Total.
1883.	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*	*Flks.*
January	2, 497	112	367	280	77	390	......	590	262	......	7	4, 582
February	2, 150	133	181	310	7	364	......	295	156	......	4	3, 600
March	2, 230	142	202	335	......	305	......	485	162	......	14	3, 875
April	1, 756	76	243	310	......	294	......	530	142	......	3	3, 354
May	2, 344	144	135	350	......	293	......	325	164	......	13	3, 768
June	2, 214	137	165	91	......	400	......	360	184	......	10	3, 561
July	2, 618	85	141	130	......	446	......	452	150	......	2	4, 024
August	3, 000	139	94	112	......	315	......	695	76	......	......	4, 431
September	3, 010	164	45	265	......	297	......	750	81	......	30	4, 642
October	2, 672	272	109	206	......	215	......	521	134	......	......	4, 129
November	2, 212	115	78	160	......	208	......	613	102	......	......	3, 488
December	2, 297	87	134	63	......	342	......	274	56	......	18	3, 271
Total	29, 000	1, 606	1, 894	2, 612	84	3, 869	......	5, 890	1, 669	......	101	46, 725
1884.												
January	1, 440	103	127	263	......	373	329	135	28	......	7	2, 805
February	1, 458	59	104	......	......	241	276	174	9	......	......	2, 321
March	1, 606	36	123	68	......	223	249	152	2	......	......	2, 459
April	1, 785	75	50	76	......	232	422	69	......	......	......	2, 709
May	1, 672	125	53	200	......	169	245	6	......	......	......	2, 470
June	1, 859	44	118	......	200	258	215	......	......	......	......	2, 694
July	1, 543	29	71	52	200	258	374	101	......	......	......	2, 628
August	1, 804	68	47	20	306	334	228	110	......	......	......	2, 912
September	1, 448	67	52	35	58	354	136	169	58	......	......	2, 377
October	1, 625	115	68	25	160	328	153	90	104	......	......	2, 668
November	1, 900	157	32	53	150	230	132	240	91	......	......	2, 985
December	1, 860	152	36	98	105	292	172	130	40	......	......	2, 885
Total	20, 000	1, 025	881	890	1, 179	3, 292	2, 931	1, 376	332	......	7	31, 913
1885.												
January	1, 700	172	40	24	......	190	189	131	37	......	......	2, 483
February	1, 506	245	24	85	35	70	96	180	75	......	......	2, 316
March	1, 500	314	......	83	......	80	88	145	33	......	19	2, 262
April	2, 003	340	......	69	......	80	142	145	37	......	......	2, 816
May	2, 000	209	......	194	......	75	62	190	......	......	3	2, 793
June	1, 750	330	50	91	......	62	112	250	63	......	5	2, 713
July	1, 750	321	43	209	......	75	45	191	50	......	10	2, 694
August	2, 104	324	40	150	......	80	118	175	......	......	47	2, 047
September	1, 936	347	57	85	......	95	201	180	......	......	77	2, 978
October	1, 598	236	42	123	......	85	52	185	65	......	82	2, 468
November	1, 576	292	43	61	......	122	54	190	43	......	87	2, 468
December	1, 977	279	37	122	......	130	150	235	43	......	62	3, 035
Total	21, 400	3, 469	385	1, 296	35	1, 144	1, 309	2, 197	446	......	392	32, 073
1886.												
January	1, 431	70	42	100	......	339	162	147	73	......	34	2, 398
February	1, 100	175	24	108	......	274	132	192	53	......	45	2, 103
March	1, 522	20	21	91	......	226	209	218	43	......	75	2, 425
April	1, 256	90	36	172	......	115	328	172	62	......	62	2, 293
May	1, 600	101	18	36	......	99	228	128	76	......	95	2, 381
June	1, 806	110	19	113	......	126	276	123	71	......	78	2, 722
July	1, 572	95	24	98	......	138	345	138	64	......	127	2, 601
August	1, 240	105	35	119	......	156	313	74	76	......	84	2, 202
September	1, 210	179	30	100	......	107	303	82	64	......	33	2, 108
October	1, 280	106	50	150	......	171	392	124	65	......	52	2, 390
November	1, 900	180	76	191	......	109	477	209	55	......	35	3, 232
December	2, 083	175	34	171	......	89	313	162	33	......	66	3, 126
Total	18, 000	1, 406	409	1, 449	......	1, 949	3, 478	1, 769	735	......	786	29, 981
1887.												
January	1, 9[illegible]	185	51	162	......	56	450	181	76	......	12	3, 077
February	1, 700	40	......	149	......	86	240	150	43	......	......	2, 408
March	1, 584	95	74	110	......	105	125	275	48	......	140	2, 456
April	1, 671	105	91	157	......	90	200	212	29	......	31	2, 586
May	2, 040	50	80	126	......	152	100	215	27	......	40	2, 830
June	1, 700	170	82	127	......	126	200	220	93	......	104	2, 822
July	1, 567	125	56	175	......	194	200	205	57	201	40	2, 820
August	1, 517	90	72	160	......	108	200	275	61	220	78	2, 881
September	1, 535	120	26	297	......	123	400	160	42	195	25	2, 923
October	1, 405	140	66	171	......	132	300	304	64	228	49	2, 859
November	1, 225	214	82	113	......	127	165	247	71	295	74	2, 613
December	2, 152	156	9	143	......	147	300	250	62	232	34	3, 485
Total	20, 000	1, 490	689	1, 890	......	1, 446	2, 880	2, 694	673	1, 371	627	33, 760

a Production of Ætna and Napa mines in 1883 under heading of Napa mine. *b* New mine.

Price.—The general and remarkable rise in the prices of metals, light stocks of quicksilver and renewed activity in hydraulic mining, have been significant factors in the quicksilver market and have added their force to the usual tendency for speculation in it. The closing price of quicksilver in December, 1886, $38.50, held in spite of a general lower tendency until March, when it declined to $37.50, coincident with a decline from £7, 5*s*. in London. A rise to $40 followed in April; then the price gradually gave way to $36.50 in August. In September the price advanced to $38, was about stationary in October and November, and rapidly rose to $48 in December. In London the decline continued to £6, 7½*s*. in May, but recovered to £6, 11*s*. in the middle of June. From this date a gradual advance took place to £6, 12½*s*. at the end of June, £6, 17½*s*. in July, and £7, 5*s*. in August. It increased gradually to £8 at the end of November, and closed that month with a remarkable jump to £9, 15*s*. In December the price was first fixed at £10, 15*s*., but advanced to £11, 5*s*. on December 12, closing the year at £11. The *Iron Age*, in commenting on these prices, states that the general advance in metals under the impulse of speculation assisted materially in pushing quicksilver to such extreme rates; when, therefore, a reaction began in the general metal market after the opening of 1888, there was a sudden drop to £9, 15*s*., since which time the declining tendency has made further headway and on March 31, 1888, quicksilver had returned to £7, 12½*s*. in the London market. A statement of the San Francisco market by months is given below.

Monthly quotations of quicksilver at San Francisco from 1883 *to* 1887, *per flask.*

Months.	1883.		1884.		1885.		1886.		1887.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
January	$26.75	$26.00	$26.25	$26.00	$33.00	$32.50	$32.50	$32.00	$38.75	$38.50
February	27.25	26.00	29.00	26.00	32.50	32.50	32.50	32.50	38.75	38.50
March	28.00	26.75	29.00	28.00	32.50	31.00	33.00	32.50	38.50	37.00
April	27.00	26.75	29.00	28.00	31.00	30.00	33.00	33.00	40.00	37.50
May	27.00	26.75	29.00	29.00	29.00	28.50	34.00	33.00	38.00	37.50
June	28.50	26.75	29.00	29.00	30.00	29.00	36.00	34.00	39.00	38.00
July	28.50	27.50	29.00	28.75	30.00	29.75	37.00	36.00	38.00	37.50
August	27.50	26.25	30.00	28.75	29.75	29.50	37.00	36.75	37.00	36.50
September	26.75	26.25	31.00	30.00	30.50	29.50	37.00	36.50	38.00	36.50
October	26.50	26.50	30.50	29.00	30.50	30.00	39.00	38.75	39.00	37.00
November	26.50	26.00	34.00	29.00	30.00	29.75	38.75	38.50	40.00	37.00
December	26.25	26.00	35.00	32.00	32.00	30.00	38.75	38.50	48.00	45.00
Extreme range	28.50	26.00	35.00	26.00	33.00	28.50	39.00	32.00	48.00	36.50
Average	$26.83		$29.34		$30.53		$35.35		$42.25	

The following table shows the range in price of quicksilver in the San Francisco markets for the past thirty-seven years:

Highest and lowest prices of quicksilver during the past thirty-eight years.

Years.	Price in San Francisco, per flask.		Price in London, per flask.					
	Highest.	Lowest.	Highest.			Lowest.		
			£	s.	d.	£	s.	d.
1850	$114.75	$84.15	15	0	0	13	2	6
1851	76.50	57.35	13	15	0	12	5	0
1852	61.20	55.45	11	10	0	9	7	6
1853	55.45	55.45	8	15	0	8	2	6
1854	55.45	55.45	7	15	0	7	5	0
1855	55.45	51.65	6	17	6	6	10	0
1856	51.65	51.65	6	10	0	6	10	0
1857	53.55	45.90	6	10	0	6	10	0
1858	49.75	49.90	7	10	0	7	5	0
1859	76.50	49.75	7	5	0	7	0	0
1860	57.35	49.75	7	0	0	7	0	0
1861	49.75	34.45	7	0	0	7	0	0
1862	38.25	34.45	7	0	0	7	0	0
1863	45.90	38.25	7	0	0	7	0	0
1864	45.90	45.90	9	0	0	7	10	0
1865	45.90	45.90	8	0	0	7	17	6
1866	57.35	45.90	8	0	0	6	17	6
1867	45.90	45.90	7	0	0	6	16	0
1868	45.90	45.90	6	17	0	6	16	0
1869	45.90	45.90	6	17	0	6	16	0
1870	68.85	45.90	10	0	0	6	16	0
1871	68.85	57.35	12	0	0	9	0	0
1872	66.95	65.00	13	0	0	10	0	0
1873	91.80	68.85	20	0	0	12	10	0
1874	118.55	91.80	26	0	0	19	0	0
1875	118.55	49.75	24	0	0	9	17	6
1876	53.55	34.45	12	0	0	7	17	6
1877	44.00	30.60	9	10	0	7	2	6
1878	35.95	29.85	7	5	0	6	7	6
1879	34.45	25.25	8	15	0	5	17	6
1880	34.45	27.55	7	15	0	6	7	6
1881	31.75	27.90	7	0	0	6	2	6
1882	29.10	27.35	6	5	0	5	15	0
1883	28.50	26.00	5	17	6	5	5	0
1884	35.00	26.00	6	15	0	5	2	6
1885	33.00	28.50	6	15	0	5	10	0
1886	39.00	32.00	7	10	0	5	16	3
1887	50.00	36.50	11	5	0	6	7	6
Extreme range in thirty-seven years.	118.55	25.25	26	0	0	5	2	6

The following chart shows graphically the variation in the price and production of quicksilver since the discovery of gold in California:

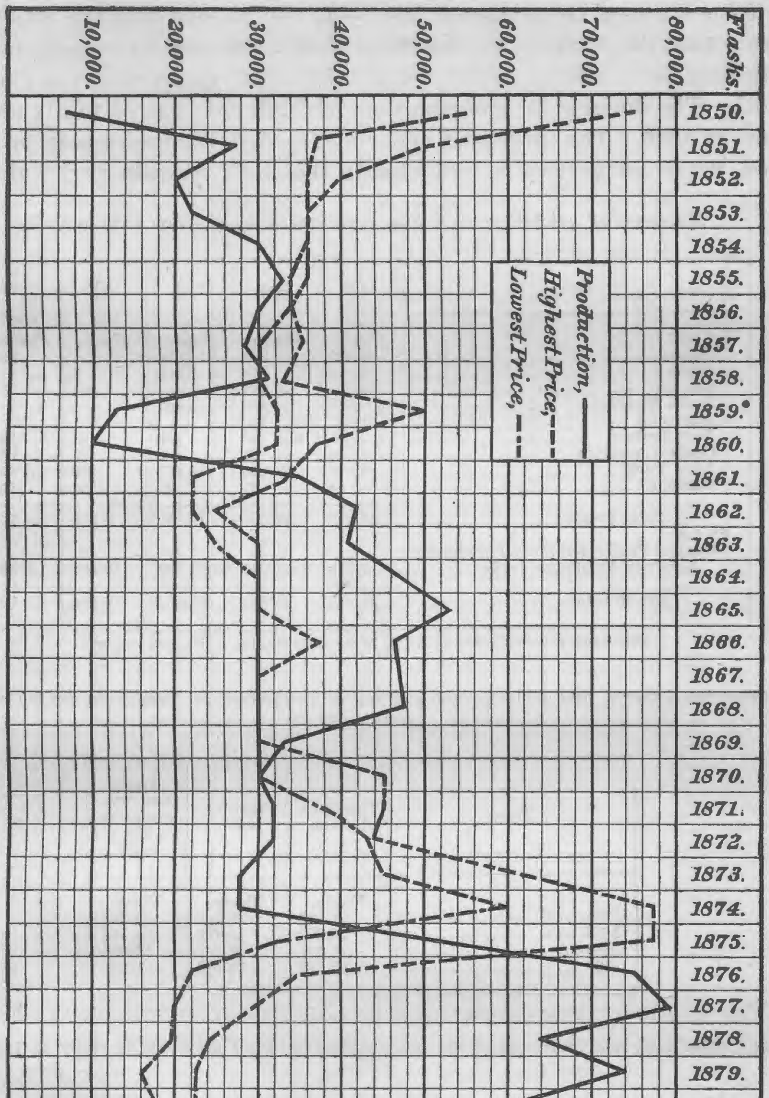

Fig. 2.—Production and price of quicksilver in the United States to December 31, 1887.

Disposition of the product in 1887.—It will be seen from the following table that the exports by sea from San Francisco increased largely. The trade with China revived and took 3,105 flasks near the close of 1887. The demand for consumption in California was certainly no less than in 1886. The increased exports exceeded the increase in production, hence no increase is indicated in the stock, already very light.

Movement of quicksilver from San Francisco in detail, from 1883 *to* 1887.

To—	1883.	1884.	1885.	1886.	1887.
By sea:	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*	*Flasks.*
China	16,330	200	233	....	3,105
Japan	1,253	588	302	3	....
Mexico	10,764	5,404	5,884	5,530	6,397
South America	970	155	100	....	....
Australia	600	110	....	....	....
New Zealand	160	20	100	91	100
Central America	59	52	9	23	119
New York	3,100	8,350	9,055	600	8,370
Various	11	22	47	54	28
Total by sea	33,247	14,901	15,730	6,301	18,119
By rail:					
Central Pacific, Southern Pacific, and Northern Pacific railroads	4,620	(*a*)7,000	(*a*)10,000	10,000	4,000
Grand total	37,867	21,901	25,730	16,301	22,119

a Including about 3,500 flasks to Mexico by Southern Pacific railroad.

Production, exports, and domestic consumption of quicksilver in California during the last four years.

Years.	Total production.	Total exports.	Stock and consumption on Pacific coast.
	Flasks.	*Flasks.*	*Flasks.*
1884	31,913	21,901	10,012
1885	32,073	25,730	6,343
1886	29,981	16,301	13,680
1887	33,760	22,119	11,641

Quicksilver imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$15,248	1878	294,207	$135,178
1868	152	68	1879	519,125	217,770
1869	....	11	1880	116,700	48,463
1870	239,223	107,646	1881	138,517	57,733
1871	304,965	137,332	1882	597,898	233,057
1872	370,353	189,943	1883	1,552,738	593,367
1873	99,898	74,146	1884	136,615	44,035
1874	51,202	52,093	1885	257,659	90,416
1875	6,870	20,957	1886	402,140	142,325
1876	78,902	50,164	1887	693,547	290,380
1877	38,250	19,558			

Mercurial preparations imported and entered for consumption in the United States, 1867 to 1883; inclusive. (a)

Fiscal years ending June 30—	Blue-mass.		Calomel.		Mercurial preparations not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867				$4, 242		$4, 242
1868				4, 440		4, 440
1869				4, 516		4, 516
1870				6, 306		6, 306
1871				3, 147		3, 147
1872	1, 009	$667	8, 241	6, 590	$629	7, 886
1873	919	660	5, 520	5, 240	699	6, 599
1874	259	192	6, 138	6, 676	4, 334	11, 202
1875	125	109	2, 424	2, 817	52	2, 978
1876	489	365	5, 433	5, 820	92	6, 277
1877	455	327	4, 649	4, 305	90	4, 722
1878	397	252	4, 133	3, 576	363	4, 191
1879	485	266	5, 875	4, 635	6, 453	11, 354
1880	533	262	4, 780	3, 230	30	3, 622
1881	395	236	8, 177	5, 640	116	5, 992
1882	207	124	5, 215	3, 411	58	3, 593
1883	188	79	8, 732	5, 503	190	5, 772

a Not specified since 1883.

Oregon.—A small amount of quicksilver was produced in southern Oregon during the year 1887, the total output being 65 flasks, valued at $2,470. Two mines were in operation during the year. The Elk Head mine is situated 6 miles east of Yoncalla, Douglas county, a station on the California and Oregon railroad. It was worked during four months of 1887, and produced 50 flasks. The remaining 15 flasks were produced in December, 1887, by the Bonanza mine. This mine is situated 9 miles east of Oakland, Douglas county, a station on the California and Oregon railroad. The product of these mines went to Portland, San Francisco, and points in southern Oregon. Both mines anticipate an increased output in 1888.

The monograph "Geology of the Quicksilver Deposits of the Pacific Coast," by Mr. George F. Becker, referred to in the last report and published as Number XIII of the U. S. Geological Survey monographs, contains much interesting statistical information and a very complete survey of the occurrence of quicksilver deposits of the world. The total production of quicksilver from the principal districts up to January 1, 1886, is given as 8,448,650 Spanish flasks of 75 Spanish pounds each. The production is divided as follows:

Product of the principal districts of the world, in Spanish flasks of 75 Spanish pounds, or 34.507 kilograms.

	First record.	Up to 1700.	1700 to 1800.	1800 to 1850.	1850 to 1886.	Total to Jan., 1886.
	Year.					
Almaden	1564	517, 684	1, 221, 477	1, 091, 075	1, 135, 576	3, 965, 812
Idria	1525	399, 861	608, 743	242, 226	301, 549	1, 552, 379
Huancavelica	1571	881, 867	543, 642	75, 604		1, 501, 113
California	1850				1, 429, 346	1, 429, 346
		1, 799, 412	2, 373, 862	1, 408, 905	2, 866, 471	8, 448, 650

NICKEL.

Production.—From the well known sources of supply the total production of nickel in the United States decreased slightly, but an increase in the average price made the total value of the product exceed that of last year, as shown in the following table:

Production of nickel in the United States in 1885, 1886, *and* 1887.

	1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Metallic nickel	245, 504	$169, 398	182, 345	$109, 407	183, 125	$117, 200
Nickel in nickel ammonium sulphate			7, 047	9, 000	11, 595	12, 000
Nickel in matte	14, 400	4, 577	20, 000	7, 000	10, 846	4, 000
Nickel in ore	18, 000	6, 000	5, 600	1, 750		
Total	277, 904	179, 975	214, 992	127, 157	205, 566	133, 200

As in 1886, the increase in importations is more than enough to compensate for the decrease in domestic production, showing that the total consumption, principally for nickel plating, is fully up to that of previous years.

Nickel imported and entered for consumption in the United States, 1868 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1868		$118, 058			$118, 058
1869		134, 327			134, 327
1870		99, 111			99, 111
1871	17, 701	48, 133	4, 438	$3, 911	52, 044
1872	26, 140	27, 144			27, 144
1873	2, 842	4, 717			4, 717
1874	3, 172	5, 883			5, 883
1875	1, 255	3, 157	12	36	3, 193
1876			156	10	10
1877	5, 978	9, 522	716	824	10, 346
1878	7, 486	8, 837	8, 518	7, 847	16, 684
1879	10, 496	7, 829	8, 314	5, 570	13, 399
1880	38, 276	25, 758	61, 869	40, 311	66, 069
1881	17, 933	14, 503	135, 744	107, 627	122, 130
1882	22, 906	17, 924	177, 822	125, 736	143, 660
1883	19, 015	13, 098	161, 159	119, 386	132, 484
1884			(*a*) 194, 711	129, 733	129, 733
1885			105, 603	64, 166	64, 166
1886			159, 760	88, 760	(*b*) 89, 003
1887			390, 586	190, 652	(*c*) 190, 930

a Including metallic nickel.
b Including $243 worth of manufactured nickel.
c Including $278 worth of manufactured nickel.

Value of exports of nickel and nickel ore of domestic production from the United States.

Fiscal years ending June 30—	Manufactured nickel.	Nickel coin.	Nickel ore.
1864	....	....	$25,494
1865	....	....	36,710
1869	....	....	11,350
1872	....	....	43,500
1873	$19,780	....	19,891
1874	16,062	....	75,696
1875	26,000	....	72,020
1876	168,050	....	35,100
1877	8,200	....	....
1878	....	....	2,452
1880	4,120	....	....
1881	6,600	$32,880	....
1882	12,474	7,200	....
1883	9,911	....	(*a*) 12,182
1884	....	....	(*a*) 22,249
1885	1,223	....	10,500
1886	35,302	....	11,687
1887	55,910	....	7,500

a Classed as "nickel and cobalt ore."

Price.—The total values given above are computed according to the estimated value of the nickel in the stage of manufacture in which it was actually sold. For example, the value is given to the nickel in the matte which it commanded before transportation to England and subsequent reduction to the metallic state. The nickel in the form of nickel ammonium sulphate is that which appears in that form directly from ore and is not to be considered as a secondary product from the metallic nickel. In this form the nickel is worth more than the metal itself, as it is ready for a special use—nickel plating. The price of metallic nickel increased, largely in sympathy with the increased value of other metals, but this does not indicate any considerable increase in consumption.

Development of new localities.—Both the localities mentioned in the last report as promising for yielding nickel have been further prospected. Major E. Willis, a Charleston capitalist, has bought the deposits of nickel silicate at Webster, North Carolina, and proposes to develop the property. In Douglas county, Oregon, development is also in progress. In regard to the latter locality Mr. Henry J. Biddle makes the following report under date of March 16, 1888:

Oregon.—Nickel ores have been found in three localities, viz: On "Piney" or Nickel mountain; on Upper Dads creek, in Douglas county, and near Rock Point, in Jackson county. At the two latter places, according to Mr. W. Q. Brown, it occurs in veins of pyrrhotite, associated with copper pyrites and contains a small amount of cobalt. Assays of typical samples gave nickel 2 per cent., copper 2.5 per cent., cobalt 0.5 per cent. No work has been done on the veins at either of these localities. The mines at Nickel mountain are known collectively as the Oregon Nickel Mines, and are situated about 3 miles west of Riddle station on the California and Oregon railroad. The mountain has an elevation of 2,800 feet above Riddle, or about 3,600 feet above the sea. At an elevation of 1,000 feet above the valley the nickel ores are first found, and from this height, on all sides of the mountain to the very summit, are found beds of ore covering areas of from 1 to 20 acres, and averaging 6 feet in thickness. The ores are invariably found either in bowlders disseminated through a highly ferruginous earth or in a stratified bed underlaid by an altered serpentine. In places the ore in these beds is not more than a foot in thickness, but in others it will run to a depth of 30 feet. Nothing like vein formation has yet been encountered. Occurring with the nickel ores is chromic iron and chalcedonic silica; sometimes the latter contains nickel oxides, forming the beautiful gem stone chrysoprase. Nearly all the hydrated nickel and magnesium silicates are found in greater or less quantities at these mines. No nickel minerals other than the silicates have been found. The ore bodies have been developed by numerous cuts, drifts, shafts and quarries, all of which are in ore that, in bulk, contains five per cent. of nickel. Some 2,000 tons of this class of ore are now on the various dumps. No works have yet been erected for treating the ore, but it is confidently expected that the year 1888 will see this inaugurated.

A specimen of the unaltered country rock from Nickel mountain was determined by Mr. George P. Merrill, of the National Museum, at Washington, as chiefly olivine, with a mineral of the pyroxene group, probably bronzite. The nickel silicates found near Webster, Jackson county, North Carolina, are the result of the decomposition of an olivine rock, and the occurrence in southern Oregon can be similarly explained. The association with chrome ores adds to the analogy between the two occurrences.

Lately Prof. F. W. Clarke has further substantiated the view advanced by Mr. Biddle as to the genesis of these silicates of nickel, and has extended the comparison to the silicates from New Caledonia.

Mr. E. L. Fletcher, of Fayetteville, Arkansas, has called attention to the discovery of nickel in that State. It was not known to exist in this State until May, 1887, when it was discovered in Saline county, near Benton, 23 miles south of Little Rock. The ore runs 54¼ pounds of nickel per ton of rock. It is millerite, which is generally but a curiosity, but in this mine—the Rabbit Foot—it is in the greatest abundance and of commercial importance, increasing with the depth. The vein which bears the nickel is white quartz, running through slate. Three shafts have been sunk. The deposit is reported as a fissure vein. Besides the nickel there are cobalt, silver, gold (only a trace), iron pyrites, and galena. In the first two shafts no galena was found, but only millerite, but assays gave nearly always silver from a trace up to 6½ ounces. In the third shaft galena was struck with the millerite and assays 30 ounces of silver to a ton of rock. The mine is on the silver-bearing belt, which stretches from the Kellogg mine, north of Little Rock, in a southwesterly direction through the State. The granite crops out in places in Saline county. The nickel-bearing vein steadily increases in width with the downward development. At the bottom of a 35-foot shaft the vein is 4 feet wide. Mr. Fletcher is getting out ore to ship to Saint Louis smelters.

It is probable that the deposit of nickeliferous pyrites at Sudbury, Canada, will be developed if the copper extraction continues profitable.

COBALT.

The total amount of cobalt oxide consumed in the United States is comparatively constant, for its principal use is as a raw material in well established industries, particularly white pottery ware, where it is used to correct the yellow tint due to iron in the other materials. The contributors to this consumption are, mainly, a few manufacturers in England and Germany and the well known manufactory of Mr. Joseph Wharton, in Camden, New Jersey. Usually the domestic product amounts to one-third or one-half of the total consumption; but in 1887 only 5,769 pounds were made here which came into the United States market, although matte was exported containing 9,219 pounds of cobalt oxide, and this served as part of the raw material for the foreign manufacturers.

The total product of cobalt oxide in late years is given in the following table:

Production of cobalt oxide in the United States.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
1869	811	1876	5,162	1883	1,096
1870	3,854	1877	7,328	1884	2,000
1871	5,086	1878	4,508	1885	8,423
1872	5,749	1879	4,376	1886	8,689
1873	5,128	1880	7,251	1887	5,769
1874	4,145	1881	8,280		
1875	3,441	1882	11,653		

This does not include the cobalt oxide contained in matte exported from Mine la Motte. Including this, the total production of cobalt compounds would be as follows:

Total production of cobalt oxide in various forms in the past three years.

	1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Cobalt oxide	8,423	$19,373	8,689	$17,378	5,769	$10,961
Cobalt oxide in matte	19,204	14,500	26,605	20,000	12,571	7,813
Cobalt oxide in ore	30,000	31,500	3,500	3,500	....	....
Total	57,627	65,373	38,794	40,878	18,340	18,774

The above table differs in form from the preceding report, inasmuch as the table now gives an estimate of the contents of cobalt oxide in the matte and ore; it shows a marked decrease in production of cobalt in all forms. No ore was reported as sold at the mines at Lovelock station, Nevada. It does not appear that the mines are exhausted, but that mining operations were suspended pending negotiations for sale of the property.

Imports and exports.—The imports of cobalt oxide were about as much greater in 1887 as the decrease in domestic production, the consumption remaining about constant. The exports consist of ore and matte containing small percentages of nickel and cobalt. They are given under nickel.

Cobalt oxide imported and entered for consumption in the United States, 1868 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Oxide.		Fiscal years ending June 30—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
1868	....	$7,208	1878	2,860	$8,693
1869	....	2,330	1879	7,531	15,208
1870	....	5,019	1880	9,819	18,457
1871	....	2,766	1881	21,844	13,837
1872	....	1,920	1882	17,758	12,764
1873	1,480	4,714	1883	13,067	22,323
1874	1,404	5,500	1884	25,963	43,611
1875	678	2,604	1885	16,162	28,138
1876	4,440	11,180	1886	14,215	22,757
1877	19,752	11,056	1887	28,681	42,034

Prices.—Following the course of this material in past years the price decreased slowly and reached the lowest point in several years. The average price was $1.90 per pound in large lots, although small sales were made as high as $2.50 and other special sales as low as $1.80. In April of 1888 an attempt towards combination among the foreign producers raised the price suddenly to $2.50 per pound, but it is not probable that this figure will be maintained. No new sources of supply have been noted, although the Oregon and Arkansas nickel localities will probably yield some cobalt from the pyrrhotite when these ores are worked.

CHROMIUM.

Production.—California produced about 3,000 long tons of chrome iron ore, worth in San Francisco, $40,000. This estimate is probably very nearly correct, although other estimates increase the amount to 4,000 tons, and still others claim a decrease to 1,200 tons. Del Norte, Shasta, Alameda, Placer, and San Luis Obispo were the chief producing counties, with small shipments from Sonoma and Tehama counties.

Production of chrome iron ore from 1882 *to* 1887.

Years.	Quantity.	Value in California.
	Long tons.	
1882	2,500	$50,000
1883	3,000	60,000
1884	2,000	35,000
1885	2,700	40,000
1886	2,000	30,000
1887	3,000	40,000

The material was shipped principally to Baltimore and Philadelphia. The rail shipments were increased by more favorable rates, and this may account for the increased production. San Luis Obispo county has been a significant producer in previous years, but the output declined by about one-third in 1887. The reason for this appears to be that the ore can not be mined for much less than the prevalent price for it. Estimates carefully prepared by Mr. Charles G. Yale show that the cost of mining chrome ore and transporting it to Eastern ports ranges from $17.25 to $20.95 per ton in different localities. The demand for California chrome ore is further embarrassed by the fact that a large proportion of it ranges between 45 and 48 per cent. of chromic oxide, while it is not difficult to import ore containing 50 to 55 per cent.

The deposit of chrome iron ore discovered two years ago near Sim's station, in Shasta county, California, has been partially opened up and promises to be of great extent. During the past year several small lots of this ore were sent to Baltimore and Philadelphia, where it sold for a fair price, being considered of good quality by the purchasers. The average percentage of chromic oxide is not known. The quantity of ore is undoubtedly large and the exceptional position of the deposit, directly on the line of a railroad, gives it great advantages by avoiding the costly item of wagon transportation.

The production of potassium and sodium bichromates did not increase, the price advanced to 10⅛ cents per pound for potassium bichromate and 8¼ cents for sodium bichromate. The latter substance comprised about one-third of the total product.

Aniline and alizarine colors are now used in many cases where chromates were formerly used. This accounts for the fact that the consumption of chromates shows no increase.

The total value of the imports of chromium compounds during the fiscal year shows a marked decrease, due chiefly to smaller receipts of ore. Chromic acid was imported in quantity for the first time, showing that some means of safe packing has been adopted which is acceptable to the underwriters.

Chromate and bichromate of potash and chromic acid imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
1867	875,205	$88,787					$88,787
1868	777,855	68,634					68,634
1869	877,432	78,288		$3			78,291
1870	1,235,946	127,333		8			127,341
1871	2,170,473	223,529		5			223,534
1872	1,174,274	220,111	514	49			220,160
1873	1,121,357	178,472	922	276			178,748
1874	1,387,051	218,517	44	13			218,530
1875	1,417,812	183,424	45	22			183,446
1876	1,665,011	175,795	120	45			175,840
1877	2,471,669	264,392	13	10			264,402
1878	1,929,670	211,136	32	35			211,171
1879	2,624,403	221,151					221,151
1880	3,505,740	350,279	5	3			350,282
1881	4,404,237	402,088	124	89			402,177
1882	2,449,875	261,006	52	42			261,048
1883	1,990,140	208,681	290	338			209,019
1884	2,593,115	210,677		120	2,677	$73,586	284,383
1885	1,448,539	92,556		39	12	239	92,834
1886	1,985,809	139,117		101	3,356	43,731	182,949
1887	1,722,465	120,305		5,571	1,404	20,812	146,668

TIN.

American developments.—The search for tin ore continued actively in the Black Hills of Dakota during 1887 in spite of the fact that no tin has yet been sold for commercial purposes from mines in the United States, and notwithstanding the unsuccessful effort to extend the Harney Peak Company in London with a capital of £2,000,000. In fact, search for tin ores has been prosecuted with remarkable persistency ever since attention was first directed to the Black Hills in 1883. This search at first radiated in all directions from the Etta mine. The mines are now located in three separate regions where, by denudation, the tin-bearing greisen has been left near the surface. These regions are known as the Nigger Hill, in Lawrence county; Harney Peak, in Pennington county; and Warren's Gulch, in Custer county. In each region many claims have been located, but comparatively few have been sufficiently developed to give even an indication as to their extent. The region farthest north is in Lawrence county, and is known as the Nigger Hill, or Bear Gulch, or Deadwood region. The principal tin claims and mines are on the divide between Bear gulch and Sand creek in Rawlins mining district, about 14 miles southwest of Spearfish and 18 miles west of Deadwood. Accompanying the tin-bearing greisen are slate and porphyry as wall rock, and generally porphyry foot wall. The region is bounded on the north, east, and west by limestone and sandstone, and on the south by many acres of free-milling, gold-bearing cement, assaying from $1 to $6 of gold per ton. The belt including the mines is about 4 miles wide and the general course of the greisen is traceable about 6 miles northwest and southeast, with a dip of 63° to the westward. In working the placers for gold a heavy, dark-colored mineral was encountered which the miners called black sand or "iron rock," but which proved to be cassiterite, stream tin probably from the greisen above. Previous to 1884 none of this material was collected, but when the developments began farther south many samples were sent to eastern experts and were shown to be cassiterite. Since that time many claims have been located, chiefly owing to the activity of the American and Cleveland Tin Mining Company, of New York and Dakota. Mr. D. McLean, foreman for this company, states that it owns over fifty locations which received due attention in 1887; among them the Cleveland was selected for the heaviest operations, as the surface indicated a very large vein, upon which a shaft 150 feet deep has been sunk. At the 100-foot level the ledge has been crosscut, showing 80 feet, and in the east drift the end of the greisen has not yet been reached, and the surface indicates that it extends 200 feet farther on. Prof. Alonzo Chase, formerly of Cornell University, has personally superintended this mine. He reports assays ranging from 1.10 to 5.24 per cent., and gives 2.90 to 3.22 per cent. of metallic tin as the best obtainable averages for the whole width of the mine. Hoisting plant and suitable buildings have been erected, and smelting works are in contemplation. Several tons of ore, 3 tons of stream tin and 250 pounds of metallic tin, have been shipped away from the mine.

The other principal claims are the Giant Lode, Rough and Ready, Michigan, Ohio, and Indiana, Valley View, Uncle Sam, Swansea, Boston, and Commercial. All of these have been developed by shafts or open cuts, usually exposing from 50 to 100 feet of the greisen. There are many other undeveloped claims.

The tin mines of Pennington and Custer counties make a semi-circle around the north side of Harney Peak. This semi-circular belt is divided into nine districts. These districts are, Iron Creek, at the east end, in Custer county, extending up to Harney district, in Pennington county; then follow Bismark, Hill City, Sunday Gulch, and Toe Calk districts, all in Pennington county, and ending with Tenderfoot, Park, and Warren's Gulch districts, where the semi-circle reaches Custer county near its western border. The ore is found in albitic greisen rock, albite, granite, and quartz. In Harney Peak district the albite and greisen predominate. In Bismark district the tin occurs almost exclusively in quartz. In the remaining districts the containing rocks are granitic and albitic greisen. The Harney Peak Tin Mining, Milling and Manufacturing Company has been most prominent in this region, and while independent development is on foot by other companies, the Harney Peak company owns the great majority of claims. These developments are already sufficiently well known. Mr. Charles D. Deshler, secretary, states that during 1887 the gentlemen connected with the company have busied themselves in prospecting for and securing additional tin-mining properties, and have added a considerable number of mines of very promising richness to those already owned. The acquisition and development of these and other properties have occupied all the time. The mill has not been run, nor do they expect to run it for several months, certainly not until they have completed all the preliminary work which is considered essential. Over 150 mining claims, 20 placers, and 15 water rights, mill sites, etc., are owned by the company. Nearly all have been developed by shafts, etc., to some extent. Some have been developed to a depth of more than 100 feet, one more than 200 feet, and perhaps 40 to more than 50 feet.

The other companies in this region are the Stevens Mining Company with 13 claims; the Tin City Tin Mining Company with one claim; the Dolphin Tin Mining Company with 13 claims; the Consolidated Tin Mining Company with 15 claims; the Harney City Mining Company with 15 claims. In Warren Gulch district Mr. H. W. Fowler is operating a mine on Tin mountain, where a cyclone pulverizer, with a capacity of 50 tons per day, is to take the place of stamps, an advantage being claimed on account of the mica present. Concentrates were produced in December, 1887, and were shipped to the company's headquarters, in Chicago, in 1888, to be smelted, but the tin was not sold.

It is reported that the Irish Creek tin mine, in Virginia, has been sold to northern parties; statements are again made relative to developments at Glenwood, Mason county, West Virginia. The occurrence of cassiterite at King's mountain, North Carolina, has led to some exploitation there, which has not yet decided favorably.

Some further prospecting work was done during the past summer on the San Jacinto tin mines in the Temescal mountains, San Bernardino county, California. This work did not develop any considerable quantity of ore or even markedly improve the prospects of its being found at that point. Some lots of cassiterite have been taken out in time past, but not decisively large quantities.

Value of tin manufactures exported from the United States (*a*)

Fiscal years ending September 30, until 1843, and June 30 since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1826	$4,515	1847	$6,363	1868	$27,110
1827	2,967	1848	12,353	1869	18,994
1828	5,049	1849	13,143	1870	46,007
1829	1,757	1850	13,590	1871	70,366
1830	4,497	1851	27,823	1872	67,244
1831	3,909	1852	23,420	1873	69,865
1832	3,157	1853	22,988	1874	62,973
1833	2,928	1854	30,698	1875	48,194
1834	2,230	1855	14,279	1876	48,144
1835	2,545	1856	13,610	1877	87,057
1836	5,604	1857	5,622	1878	116,274
1837	10,892	1858	24,186	1879	103,467
1838	10,179	1859	39,289	1880	144,185
1839	19,981	1860	39,064	1881	498,524
1840	7,501	1861	30,229	1882	198,608
1841	3,751	1862	62,286	1883	191,947
1842	5,682	1863	41,558	1884	166,819
1843 (nine months)	5,026	1864	46,968	1885	162,304
1844	6,421	1865	106,244	1886	157,724
1845	10,114	1866	79,461	1887	137,551
1846	8,902	1867	40,642		

a Classed as "tin, and manufactures of," from 1851.

Tin imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	In blocks, bars, or pigs, and grain tin.		In plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Cwts.		*Cwts.*		
1867		$1,210,354.02		$6,276,136.78	$7,486,490.80
1868		1,454,327.36		6,893,072.07	8,347,399.43
1869	80,811	1,709,385.00	1,534,324	8,565,432.56	10,274,817.56
1870	81,702	2,042,887.71	1,333,150	7,628,871.51	9,671,759.22
1871	106,595	2,938,409.82	1,556,023	9,490,778.64	12,429,188.46
1872	102,006	3,033,837.45	1,617,627	10,736,906.59	13,770,744.04
1873	130,469	3,938,032.25	1,854,956	15,906,446.82	19,844,479.07
1874	116,442	3,199,807.07	1,553,860	13,322,976.14	16,522,783.21
1875	102,904	2,329,487.96	1,540,600	12,557,630.75	14,887,118.71
1876	93,176	1,816,506.00	1,767,210	10,226,802.87	12,043,308.87
1877	98,209	1,783,765.00	1,984,893	9,818,069.69	11,601,834.69
1878	128,849	2,167,350.00	2,166,489	9,893,639.61	12,060,989.61
1879	142,927	2,301,944.00	2,487,007	10,248,720.34	12,550,664.34
1880	290,007	6,153,005.68	3,298,534	16,524,590.19	22,677,595.87
1881	171,146	3,971,756.67	3,366,720	14,641,057.87	18,612,814.54
1882	197,544	5,204,251.68	3,926,311	16,550,834.64	21,755,086.32
1883	237,348	6,106,250.37	4,051,108	16,688,276.67	22,794,527.04
1884	(a)26,081,992	5,429,184.01	(a)527,881,321	18,931,072.70	24,360,256.71
1885	23,947,523	4,263,447.00	505,559,076	16,610,104.56	20,873,552.00
1886	27,960,761	5,873,773.00	574,098,405	17,719,957.12	23,593,730.12
1887	29,645,531	6,927,710.00	570,643,389	16,883,813.95	23,811,523.95

a Pounds in 1884, 1885, and 1886.

Prices.—The principal feature of 1887 was the advance in price in the last three months, due not only to sympathy with the general metal movement but to the direct control of the visible supply by the Société des Métaux. Even at the beginning of the year prices were firm, owing to reduced stocks. The consumption had overtaken the production. The speculative movement began in May, but was retarded by somewhat larger increase in the shipments from the Straits than had been expected. The price ranged from 21.9 to 37.25 cents per pound in New York.

Opening, highest, lowest, and closing prices of Straits tin at New York in each month of the last three years.

Months.	1887.				1886.				1885.			
	Opening.	Highest.	Lowest.	Closing.	Opening.	Highest.	Lowest.	Closing.	Opening.	Highest.	Lowest.	Closing.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
January	21.95	22.65	21.90	22½	20.80	20.80	20.45	20½	16¼	17½	16.10	17⅛
February	22½	22.60	22.40	22.55	20½	20⅞	20½	20.90	17⅜	17⅝	17¼	17⅝
March	22.60	22.70	22.40	22½	20.90	20.85	20.70	20.95	17⅝	17.80	16.95	17.70
April	22.55	22.60	22.40	22.60	20.95	21	20.65	21	17⅝	18¼	17⅜	18.20
May	22.60	23.30	22.60	23.10	21	21¾	20.85	21¾	18	19¼	18	19¼
June	23.10	23.40	23.10	23¼	21¾	23¼	21¾	22.90	19¼	21⅜	19¼	21⅜
July	23¼	23½	23.20	23½	22.80	22.80	21¾	21¾	21¼	23⅛	21¼	22
August	23½	23½	23.10	23.10	21.70	21.80	21.70	21.80	22	22	20½	20⅞
September	23.10	23.30	22.95	23¼	21.80	22.65	21.70	22½	20¾	21⅛	20¾	20.80
October	23¼	27	23¼	27	22½	22.60	21.90	22⅜	20.70	20.70	21¼	20⅛
November	27⅛	35	27⅛	35	22⅜	22.65	22.17½	22¾	20½	21¼	20.05	21⅛
December	35	37¼	35	37	22¾	22¾	21¾	22	21⅛	21⅛	20.55	20.80

ALUMINUM.

By R. L. Packard.

Metallic aluminum.—No progress in the methods of extracting aluminum appears to have been made in this country since the last report. The Castner process of manufacturing sodium cheapens the production of that metal to such an extent that by its employment in the process of extracting aluminum it is said that the latter metal can be produced for less than $5 per pound. A company has been formed in England to use this process, but no advantage appears to have been taken of it in this country. The patents for extracting aluminum issued within the past year, cover processes which have not yet been put into successful operation. Notices of new processes for the same purpose, and of new enterprises, supported by companies with large capital, have appeared from time to time in the newspapers, but the returns received from dealers and workers in aluminum do not show that there is any real production of the metal in the United States.

The price of metallic aluminum during the past year varied from 90 cents to $1.25 per troy ounce, according to the dealers and workers, and was quoted as low as $11 per avoirdupois pound in the trade journals. In considerable quantities it was sold for less than $10 per pound. Its applications were confined, as before, to small articles, such as dental plates, parts of surgical, electrical, optical, and surveying instruments, beams of fine assay balances, apothecaries' weights, tobacco boxes, spoons, etc., it was used in the form of foil, and leaf for lettering, and for various other articles where lightness and strength are desired. Its use seems to be extending in this direction, but its price and limited production prevent its application on a large scale. The following table, taken from the report of the Bureau of Statistics of the Treasury Department, shows the amount of aluminum imported and entered for consumption in the United States from 1870 to 1887 inclusive:

Aluminum imported and entered for consumption in the United States, from 1870 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1870	....	$98	1880	340.75	$4,042
1871	....	341	1881	517.10	6,071
1873	2	2	1882	566.50	6,459
1874	683	2,125	1883	426.25	5,079
1875	434	1,355	1884	595.00	8,416
1876	139	1,412	1885	439.00	4,736
1877	131	1,551	1886	464.50	5,297
1878	251	2,978	1887	796.60	9,458
1879	284.44	3,423			

Alloys of aluminum.—The manufacture of aluminum bronze has become an established industry, and is carried on by the Cowles Electric Smelting and Aluminum Company, of Lockport, New York, where the company has a large establishment for producing aluminum bronze and brass and ferro-aluminum. The Cowles process was described in "Mineral Resources of the United States, 1885," and is now presumably well known to persons interested in the subject. The use of the bronze is extending, and the Cowles company produced 144,764 pounds in 1887. It contains about 10 per cent. of aluminum on the average, and its price at the works was 40 cents per pound in 1887. It is furnished in castings of every description, in ingots, billets, and slabs, and in rods, sheeting, bars, and wire. Its great tensile strength was mentioned in the report for 1885. The following table is taken from the official report of William H. Harris, Chief Engineer, U. S. Navy, to Engineer-in-Chief George W. Melville, U. S. Navy, of tests made at Watertown on specimens of aluminum bronze and brass, which alloys were recommended for making propeller castings for the Navy:

Test made on specimens of aluminum bronze and brass.

Mark or number.	Approximate composition.	Length between reference marks.	Diameter.	Area.	Tensile strength per square inch.	Elastic limit per square inch.	Elongation in 15 inches.	Reduction of area.	Diameter at fracture.	Hardness.	
										Head.	Stem.
		Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pr. ct.*	*Pr. ct.*	*Inch.*		
1 C	Cu 91.5, Al 7.75, Si .75.	15	1.875	2.7612	60,700	18,000	23.2	30.7	(*a*)1.56	9.39	13.85
7 C	Cu 88.66, Al 10, Si 1.33	15	1.875	2.7612	66,000	27,000	3.8	7.8	(*a*)1.8	14.12	14.26
9 C	Cu 91.5, Al 7.75, Si .75	15	1.875	2.7612	67,600	24,000	13.00	21.62	(*a*)1.66	11.18	13.59
10 C	Cu 90, Al 9, Si 1	15	1.875	2.7612	72,830	33,000	2.40	5.78	(*a*)1.82		
11 C	Cu 63, Zn 33.33, Al 3⅓, Si .33	15	1.875	2.7612	82,200	60–73,000	2.33	9.88	(*a*)1.78	14.69	10.60
13 C	Cu 92, Al 7.5, Si .5 ..	15	1.875	2.7612	59,100	19,000	15.1	23.59	(*a*)1.64		
9 D	Cu 91.5, Al 7.75, Si .75	15	1 9	2.84	53,000	19,000	6.2	15.50	(*b*)1.75		
10 D	Cu 90, Al 9, Si 1	15	1.89	2.81	69,930	33,000	1.33	3.30	(*b*)1.86		
11 D	Cu 63, Zn 33.33, Al 3.33, Si .33..........	15	1.9	2.84	70,400	55,000	0.4	4.33	(*b*)1.86		
13 D	Cu 92, Al 7.5. Si .5...	15	1.93	2.93	46,550	17,000	7.8	19.19	(*b*)1.73		

a Chill castings. *b* Dry sand castings.

The great tensile strength of the bronze and its resistance to corrosion have led to comparative tests between it and the manganese bronze used for propellers in England, which resulted, it is said, in favor of the aluminum bronze. The Cowles company received the contract to cast the propeller for gunboat No. 2 of the U. S. Navy. Aluminum brass possesses great rigidity, costs less than the grade of bronze used for propellers, and is said to resist the action of sea water. Propellers made from it by the Herreschoff Manufacturing Company are said to have been preferred by them to those made of bronze.

The extraordinary tensile strength of aluminum bronze and its high limit of elasticity have suggested, among other proposed uses, its employment as material for cannon, as noticed in "Mineral Resources of the United States, 1885." At the meeting of the Naval Institute in October, 1887, a paper was read by Mr. Cowles, pointing out in detail the advantages of aluminum bronze for heavy ordnance and suggesting a method of casting it.

Another proposed use of the bronze, based on the power of resisting corrosion, which it is claimed to have in a high degree, is for pumps and other machinery subject to the action of acid mine waters or corroding fumes, and for battery, sizing, and jig screens. It is understood that experiments are to be made at Newport to test the resistance of the alloy to the action of sea water.

Ferro-aluminum.—In the report for 1885 a brief notice was given of a paper by Petter Östberg on the use of aluminum in very small quantities (0.05 per cent. to 0.1 per cent.) in melting wrought iron in crucibles. The aluminum was added in the form of an alloy of iron and aluminum, containing about 9 or 10 per cent. of the latter metal, and a small quantity of the alloy was made by the Cowles company in that year for the purpose above described. Since then this use of aluminum has been put in practice, notably by the United States Mitis Company, and the same application has been made in casting steel. The tensile strength of the wrought iron treated with ferro-aluminum is said to be increased, and it is important to note that this feature, together with the facility of casting, due to the addition of the aluminum, gives to the puddling furnace a power to produce iron equal to mild Siemens-Martin steel. The limited production of ferro-aluminum and the large demand for it to add to steel in making castings have hitherto prevented any extended application of it to wrought iron, but it is understood that the Mitis company is about to put in operation a plant for the production of Mitis wrought-iron castings.

The use of ferro-aluminum in the manufacture of cast-steel is increasing. It is stated positively that the addition of 0.1 per cent. of aluminum to the steel effectually prevents the formation of blowholes. The results of experiments and of a heat of 45,000 pounds of open-hearth steel treated in this manner showed, according to the reply from a firm of manufacturers, "a more liquid cast and almost an entire absence of blowholes in the resulting ingots. The tensile strength was considerably increased and ductility apparently not impaired so far as we discovered."

An idea of the growing demand for ferro-aluminum for this metallurgical use is obtained from the statement of the Cowles company that 42,617 pounds were produced in 1887 against 2,000 to 3,000 the previous year. This alloy contains on an average 7.8 per cent. of aluminum, and its price at the works was $5 per pound of the contained aluminum and 1½ cents per pound of iron.

A résumé of the statistics of the production of aluminum bronze and ferro-aluminum, derived from the replies of the manufacturers, is as follows:

Amounts of aluminum bronze and ferro-aluminum produced in the United States from 1885 to 1887 inclusive.

Years.	Aluminum bronze.		Ferro-aluminum.	
	Pounds.	Value.	Pounds.	Value. (a)
1885	4,000 to 5,000	$1,600 to $2,000	....	....
1886	50,000	20,000	2,500	$1,000
1887	144,764	57,905	42,617	17,000

a At $5 per pound of aluminum contained.

Thus while there is practically no production of metallic aluminum in the United States as yet, the manufacture of its alloys increases from year to year, and we may expect an annual increase as new uses are found for the bronze. The sudden increase in the production of ferro-aluminum shows that its importance as a metallurgical agent is becoming recognized by the iron and steel manufacturers of the country.

PLATINUM.

During the summer of 1887, when the price of refined platinum rose significantly, inquiry was made as to sources from which the crude material could be obtained. After dealers in this country had learned that it is very difficult to get any crude platinum from the operators of the Ural mines, efforts were made to obtain this material from the Pacific coast. American consumers of platinum employed agents in Oregon and Washington to look for platinum among the placer gold workings. As a result, 448 ounces of platinum in all were sold in New York, Boston, San Francisco, and elsewhere, for $1,838. It has become the prevalent opinion that considerable platinum may thus be obtained if it is saved from the tailings.

In Oregon platinum has been found, especially in the placers near Waldo, Josephine county; near Port Orford and Eckley, Curry county, and near Randolph, Coos county. At Port Orford and Randolph it occurs in the "black sand" mines on the sea beach.

A reduction in the price of foreign platinum from $7.50 to $6.80 per ounce lessened the demand, since scrap platinum could then be worked over almost as cheaply as the crude material, and little attention has since been paid to the matter.

The exports and imports of platinum, principally as sheets and wire, are given below. The uses for this metal are increasing. A use involving a large and steady consumption of platinum wire is for stems on porcelain teeth. It is estimated that 40,000 ounces of platinum are thus consumed in the United States yearly.

Value of platinum exports.

Fiscal years ending June 30—	Unmanufactured.	Manufactured.	Old platinum.
1880			$600
1881			4,222
1882		$19,244	
1883	$6,250	21,600	
1884		18,587	1,130
1885			7,000
1886		4,048	2,000
1887		2,200	17,500

Platinum imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Manufactured.	Unmanufactured.		Vases or retorts, etc.
		Quantity.	Value.	
		Pounds.		
1867	$456			
1868	290		$95, 208	$20, 274
1869	184		80, 014	22, 004
1870	648		99, 984	16, 294
1871	48		108, 244	22, 470
1872	310		91, 472	21, 816
1873	43		90, 771	9
1874	143		123, 293	59, 698
1875	173		141, 188	18, 082
1876	6		141, 207	7, 421
1877	11		81, 925	18, 611
1878	241		120, 121	50, 133
1879	73		166, 178	34, 209
1880	964		217, 144	41, 827
1881	290		273, 343	21, 292
1882	1, 731	3, 125. 60	285, 731	48, 452
1883	4	3. 104. 15	298, 799	92, 967
1884		2, 846. 00	289, 898	83, 112
1885	3	2, 612. 34	285. 239	17, 473
1886		3, 204. 28	356, 020	83, 752
1887		3, 861. 37	438, 516	58, 925

Iridium imported and entered for consumption in the United States, 1873 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1873	$429	1881	$1, 730
1874	275	1882	7, 307
1875	500	1883	495
1876	180	1884	(*a*)
1877	311	1885	5, 852
1878	(*a*)	1886	(*a*)
1879	425	1887	(*a*)
1880	(*a*)		

a None reported.

MANGANESE.

BY JOSEPH D. WEEKS.

In this report on the occurrence and production of manganese in the United States the ores of the metal will be divided, for the present purposes, into three general classes: first, manganese ores; second, manganiferous iron ores; and third, argentiferous manganese ores. The dividing line between the first two grades is taken at 70 per cent. binoxide, equal to 44.252 per cent. of metallic manganese, this being the standard of shipments to the English chemical works. In the third class are included those argentiferous manganese ores of Montana and Colorado which are utilized not only for their silver content but have an added value by reason of the fluxing qualities imparted to them by the presence of the manganese.

The long ton of 2,240 pounds is uniformly used in this chapter.

Localities in which manganese occurs in the United States.—While there has been a constant and persistent search for new deposits of manganese during the past year, no new development of any importance has been reported outside of the localities that have been described in the previous volumes of Mineral Resources. Indeed, some localities regarded as quite promising at the time the report for 1886 was made up have proved to be of little value, and the chief production is still confined to the localities that have been noted as manganese producers for many years. The extensions of the iron-ore regions in the Lake Superior district, in which it was hoped deposits of manganese ores might be found, have so far produced only insignificant quantities of an ore with more than 44¼ per cent. of metallic manganese, the chief product being a manganiferous iron ore containing from 4 to 10 per cent. There are somewhat encouraging prospects of the discovery of manganese ore in North Carolina, and also in western Arkansas. Yet it is still true that Crimora (Virginia), Cartersville (Georgia), and Batesville (Arkansas,) furnish practically all the manganese ores mined in the United States.

During the past year, however, manganiferous iron ores have been mined in sections that either produced little or no ore of this grade in 1886, or that have not produced any for some years. In the report on manganese in Mineral Resources for 1886, so little manganiferous iron ore was produced outside of the Lake Superior region and the argentiferous manganese ores of Montana, Colorado, etc., that the distinction between manganese and manganiferous ores, except in these two cases, was entirely ignored. This year, however, manganiferous iron ore is reported as mined, outside of the Lake Superior region, in Virginia, Georgia, Vermont, and Maine, but the quantity produced was quite small.

Production of manganese in the United States in 1887.—The total production of manganese ores in the United States in 1887 was 34,524 tons, valued at $333,844, or an average of $9.67 a ton. This is an increase of 4,331 tons over 1886, an increase in total value of $56,208, and in average value of 47½ cents a ton. Of the 34,524 tons, Virginia produced 19,835, or 732 tons less than in 1886. Georgia's production in 1887 was 9,024, an increase over 1886 of 2,983 tons. Arkansas produced in 1887, 5,651 tons, an increase over 1886 of 2,335 tons. California, Alabama, Tennessee, and Nevada drop out of the list as producers of manganese, while North Carolina produced in 1887 the same amount as in 1886, viz., 14 tons, or about a carload. Virginia's percentage of the total production in 1887 was 57 per cent. as compared with 68 per cent. in 1886; Georgia's 26 per cent. in 1887 as compared with 20 per cent. in 1886; and Arkansas's production 16 per cent. in 1887 and 11 per cent. in 1886.

The distribution of the production of manganese ores in the United States in 1887 is as follows:

Amount and value of manganese ores produced in the United States in 1887.

States.	Production.	Total value.	Average per long ton delivered on cars.
	Long tons.		
Virginia	19,835	$253,833	$12.79
Georgia	9,024	51,728	5.74
Arkansas	5,651	28,255	5.00
North Carolina	14	28	2.00
Total	34,524	333,844	9.67

Value of manganese ores.—From the above table it will be seen that the total value of the 34,524 tons of manganese ores produced in the United States in 1887 was $333,844, an average value of $9.67 a ton. The average value of the ores of the several States varied from $2 in North Carolina to $12.79 in Virginia, the Arkansas value being $5 a ton and the Georgia value $5.74. The range of values in Virginia was from $4.13 to $20; in Georgia, from $2.50 to $6.50, while in Arkansas a uniform price of $5 was given as the value of the ore. It should be distinctly understood that these values are free on board carts or cars at the mines. Where ore is sold delivered on cars or at localities distant from the mines, the cost of carting the ore to the cars or to the locality is deducted from the f. o. b. price.

Production of manganese ores, 1880 *to* 1887.—Continuing the table published in the last volume of Mineral Resources, we give below the production of manganese in the United States, so far as the same has been ascertained, in the years 1880 to 1887:

Production of manganese ores (over 44½ per cent. of metallic manganese) in the United States, from 1880 to 1887 inclusive.

States.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Virginia	3,661	3,295	2,982	5,355	8,980	18,745	20,567	19,835
Arkansas	....	100	175	400	800	1,483	3,316	5,651
Georgia	1,800	1,200	1,000	....	....	2,580	6,041	9,024
Other States	300	300	375	400	400	450	269	14
Total	5,761	4,895	4,532	6,155	10,180	23,258	30,193	34,524

Prior to 1885 the statement is simply the best approximation to the actual figures that could be secured. The Virginia production is very nearly correct through all the years; Georgia's figures are taken from railroad manifests; the Arkansas figures have been collected from several sources, and checked as far as possible, and are believed to be substantially correct. The statements for 1885 and 1886 are compiled from actual returns.

Production of manganiferous iron ores.—As has already been stated, the distinction between manganese ores and manganiferous iron ores was not preserved in the report for 1886, owing to the small quantity of manganiferous iron ores produced outside of the Lake Superior region. It is still true that the larger part of the manganiferous iron ores produced in the United States comes from the Lake Superior mines, chiefly from the Colby mine in Michigan. Quite a number of the mines in other parts of the Lake Superior district produced iron ores containing a greater or less percentage of manganese, but it has been impossible to obtain a statement as to the amounts of these ores, as the quantity of manganese contained was so small that no attempt was made to distinguish between the ores carrying manganese to the extent of 2 per cent. or more and those having less than this amount. In many cases the contents of manganese did not increase the money value of the ore above what its value would have been as an iron ore. The iron produced from these ores, however, had an additional value because of its quality, even though in many cases there was no increased money value. Some little ore, probably 10,000 tons, was produced that contained 10 per cent. of manganese, and this had an additional value from its contents of manganese.

The total production of manganiferous iron ores in the United States was 211,751 tons. Of this, 210,000 tons were produced in the Lake Superior region, 200,000 tons containing 4 per cent. and 10,000 tons 10 per cent. of manganese. The total amount of manganiferous iron ores produced outside of this region was 1,751 tons, 1,025 tons of which was produced in Virginia, 195 tons in Georgia, 481 tons in Vermont, and 50 tons in Maine. It is very difficult to arrive at the value of this ore at the mines. But little Lake Superior ore is sold delivered at the point of production, but at the lake ports. The price at the lake ports can be readily ascertained, but the cost of transportation during the year varies so greatly that it is almost an impossible task to attempt to arrive at the positive value of the ore on carts and cars at the mines. It is assumed, however, that the total value of the manganiferous iron ore produced in the United States in 1887 was $600,000. This would be on the basis of $2.80 for the 4 per cent. ore, which constitutes 200,000 of the 211,751 tons produced.

Production of argentiferous manganese ores.—It is estimated from the best data obtainable that the production of manganiferous iron ores containing silver in the Rocky Mountain region in 1887 was some 60,000 tons, valued at $10 a ton. These ores are not utilized for their manganese directly, but for their silver, the manganese they contain adding to their value because of its fluxing qualities.

Total production of all classes of ores containing manganese in 1887.—Regarding all these three classes of ores as manganese ores, the total production of all manganese ores in the United States in 1887 was as follows:

Production of all kinds of manganese ores in 1887.

	Quantity.	Value.
	Long tons.	
Manganese ores	34, 524	$333, 844
Argentiferous manganese ores	60, 000	600, 000
Manganiferous iron ores	211, 751	600, 000
Total	306, 275	1, 533, 844

ARKANSAS.

Arkansas still maintains its relative rank in the production of manganese in the United States, being the third State in total amount of production. It has, however, showed a marked increase in the amount produced, the production of 1887 being 5,651 tons as compared with 3,316 tons in 1886, and 1,483 tons in 1885. The production here given is entirely from the so-called Batesville district, which has been so thoroughly described in previous volumes of Mineral Resources as to render unnecessary any detailed description in this report. The railroad referred to in the report for 1886 as being in course of completion has been finished as far as Cushman, and most of the ore is now being shipped by rail, the shipments in the last seven months of 1887 from this point being 3,036 tons.

In addition to the analyses given in previous volumes of Mineral Resources we have the following analysis of ore from the deposit of Messrs. Matthews & Cole in the Batesville district. This deposit is found in a body of 1,200 acres of land. It occurs in pockets, *Analysis of manganese ore from the deposit of Matthews & Cole, near Batesville, Independence county, Arkansas.*

	Per cent.
Metallic manganese	52.50
Silica	4.25
Iron	2.35
Phosphorus	0.137

This sample was dried at 212° F. As taken from the car load this sample contained 9 per cent. The analysis was made by Carnegie, Bros. & Co., Pittsburgh, Pennsylvania.

The following is an additional analysis of ore from the mines of the Keystone Manganese and Iron Company, the analysis being made by Mr. T. T. Morrell, chemist of the Cambria Iron Company's works at Johnstown, Pennsylvania. It is an average of all of the ores received in December, 1886.

Analysis of manganese ore from the mines of the Keystone Manganese and Iron Company, near Cushman, Batesville District, Independence county, Arkansas.

	In the ore as received.	In the ore dried at 212° F.
	Per cent.	*Per cent.*
Metallic iron	2.17	2.24
Metallic manganese	52.55	54.33
Phosphorus	.155	.160
Water	3.28	....

During the year 1887 considerable attention was attracted to the deposits of manganese in southwestern Arkansas, to which reference has already been made in previous volumes of Mineral Resources. As to the extent of these deposits there is no question. There were two obstacles, however, in the way of the utilization of the ore—one, its distance from railroad transportation, and the other the high content of phosphorus, which seemed to render it useless in steel manufacture. Late in 1887 Saint Louis parties organized the Arkansas Development Company, and were pushing explorations, bringing the deposits to the attention of the public. Through the courtesy of Mr. W. E. Barns, vice president of this company, we have the following statement of the location of these deposits, their character, and the progress of developments.

The south range of the Ozark mountains runs east and west, and forms the boundary line between Howard and Polk counties. There are only three gaps in the mountains from the Indian Nation line to the eastern boundary of Montgomery—Cossatot river, Saline river, and Caddo creek, and it is through these gaps that the railroads now under construction must pass en route to Fort Smith. Township 4 south, range 28 west, in Polk county, contains, in addition to large bodies of limonite ore running over 56 per cent. metallic iron, immense deposits of manganese ore or pyrolusite, the richness and extent of which will be determined in the near future. The ores found in this locality might be termed in a general way manganiferous iron ores. The deposits are discovered from surface indications or "blow outs" from veins which lie in a vertical position between clearly defined walls, said to be novaculite. The general course of the veins is from east to west, and they are discoverable at many points along their course. That true fissure veins of manganese ore exist in this region there can be no doubt. Recent analyses of surface specimens, made by Professors W. B. Potter and Regis Chauvenet & Bro., of Saint Louis, show the following results:

Analyses of Polk county, Arkansas, manganese ore.

	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica	9.02	3.72	1.88	3.28
Iron	.00	.50	35.39	4.40
Metallic manganese	58.36	55.80	27.68	52.22
Phosphorus	.41	.03	.23	.04

An analysis of No. 4 is as follows:

	Per cent.		Per cent.
Moisture	0.4412	Magnesium	0.5117
Silica	3.2873	Phosphorus	0.044
Alumina	2.3700	Iron	4.4030
Calcium oxide	1.8640	Manganese	52.2254
		Binoxide of manganese in ore	69.8322

An analysis of a soft ore taken from a shaft in the central part of this county gives 60.28 per cent. metallic manganese and 0.167 per cent. phosphorus. The specimens run from 60 to 70 per cent. in binoxide and from 15 to 23 in the sesquioxide of manganese. Twenty-six different specimens sent to Birmingham and Sheffield, England, gave the first of the following analyses:

Analyses of manganese ore from Polk county, Arkansas.

	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent*	*Per cent.*
Silica	3.00	2.766	1.190	....
Iron	....	....	2.696	....
Metallic iron	....	....	....	17.00
Metallic manganese	53.10	71.20	54.269	47.00
Phosphorus	.13	trace.	.09	.06

Number 2 is the average of four assays by Professor Waite, of the Missouri School of Mines.

Number 3 is by Prof. J. Blodget Britton, of Philadelphia.

Number 4 was made at the Smithsonian Institution.

In developing these ores, a shaft 37 feet in depth has been sunk at Dallas, but beside this little has been done in the way of development. The analyses are all of surface specimens. Whether the phosphorus will decrease as the ore is struck under cover is an open question. The outcroppings are extensive, and extend for miles east and west. The veins are almost vertical, the north wall in most cases being novaculite, while the south wall is of slate. In the shaft referred to, which was commenced on a small blow out, the vein increased in width from 12 inches at the surface to 30 inches at a depth of 37 feet. The vein matter clearly defines itself and is separated from the north wall by selvage.

The two tunnels now being driven by the Arkansas Development Company are in section 27, township 3, range 30, and in section 32, township 4, range 28. One of them is now in 60 feet; the other 43 feet.

The only way at present to reach this district is from Nashville or Fort Smith. The former is 45 miles by the road, and the latter 90 miles.

The following shows the production of manganiferous ores in Arkansas since 1880. The remarks relative to the accuracy of the figures for Virginia will apply here also.

Production of manganese ores in Arkansas, 1880 to 1887.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1880	....	1884	800
1881	100	1885	1,483
1882	175	1886	3,316
1883	400	1887	5,651

The above quantities are based on railroad and other shipments.

Some estimates place the production of ore in this State prior to 1885 at 5,000 tons. This is probably an overestimate.

GEORGIA.

Georgia produced in 1887, 9,024 tons of manganese; an increase from 6,041 tons in 1886 and 2,580 tons in 1885. It thus still retains its position as second in rank in the production of manganese ore.

As stated above, practically all the ore mined in this State is from the Cartersville district; the great increase in production, however, being from the Dade mines.

This district and the character of the ore have been so thoroughly described in previous volumes of Mineral Resources that the description need not be repeated here. The following is the production of the Cartersville region since 1866:

Production of manganese ore in the Cartersville region, Georgia.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1866	550	1877	2,400
1867		1878	2,400
1868		1879	2,400
1869		1880	1,800
1870	5,000	1881	1,200
1871		1882	1,000
1872		1883	....
1873		1884	....
1874	2,400	1885	2,580
1875	2,400	1886	5,981
1876	2,400	1887	9,024

MICHIGAN AND WISCONSIN.

But little can be added to the statement given in the volume of Mineral Resources for 1886 relative to the character of the deposits of manganiferous iron ores found in Michigan and Wisconsin, or in what is generally known, for want of a better term, as the Lake Superior region. Manganese ores, or those containing more than 44¼ per cent. of metallic manganese, have not been found in commercial quantities during the year. It was reported that a deposit of ore containing 55 per cent. of metallic manganese had been found on the Menominee range, in the same hills in which the Florence mines occur, but nothing further can be learned relative to it.

The Colby mine, which produced 257,000 tons of manganiferous iron ore in 1886, and which was described in Mineral Resources, 1886, page 189, produced in 1887, 210,000 tons, 200,000 of which contained 4 per cent. of metallic manganese, and 10,000 tons of 10 per cent. The latter was used as manganese ore in the manufacture of spiegeleisen.

NORTH CAROLINA.

The only manganese mined in this State in 1887, so far as has been ascertained, was a sample car load, which was shipped to Pittsburgh for test. The deposits which promised so well in 1886 have not, as yet, justified the anticipations entertained of them at that time.

VIRGINIA.

Virginia still maintains its pre-eminence in the production of manganese ore in the United States, though the percentage mined in 1887 was reduced, owing to the increased production of Georgia and Arkansas. The total production of manganese ores in this State in 1887 was 19,835 tons, out of a total of 34,524 tons, or 58 per cent. of the total produced in the United States. There were also produced in this State 1,025 tons of manganiferous iron ores.

From the Crimora mine, and its neighboring mines, owned by the Old Dominion Manganese Company, and leased by the American Manganese Company, which also operates the Crimora mine, there were produced in 1887, 19,100 tons out of a total of 19,835 tons produced in this State, still making this company the largest producer of manganese ores in this country, and possibly, with the exception of the mines in Russia, the largest in the world.

The production of these mines brought down to 1887 is as follows:

Production of the Crimora mine, Virginia.

	Quantity.
	Long tons.
Prior to 1869	5,684
May, 1869, to February, 1876	280
February, 1876, to December, 1878	2,326
December, 1878, to December, 1879	1,602
1880	2,963
1881	2,495
1882	1,652
1883	5,185
1884	8,804
1885	18,212
1886	19,382
1887	19,100

From this it will be seen that the production of the Crimora mine, which in 1887 also included the production of the Old Dominion mine, was less than in 1886.

Among the new developments in this region may be mentioned that of the Midvale Manganese Company, at Midvale, Rockbridge county, which, in 1887, produced 250 tons of manganese, averaging, it is claimed, 59 per cent. of metallic manganese. This company owns about 300 acres of land, upon which two shafts have been sunk a quarter of a mile apart, ore being found in both shafts.

Near Marion, in Smith county, Mr. H. B. Hull mined in 1887 some 100 tons of manganese, the ore varying from 35.769 per cent. to 40.862 per cent. of metallic manganese. The workings have developed a mass of ore, but the mines have not been opened sufficiently to determine completely the nature of the deposit.

In the neighborhood of Wytheville, on a tract of some 700 acres of land, an ore containing from 40 to 53 per cent. of metallic manganese and from 0.04 to 0.167 per cent. of phosphorus, and low in silica, has been opened, and some 300 tons were taken out in 1887.

The Piedmont Manganese Company, composed of Baltimore capitalists, has opened a deposit of soft ore near the James river in Nelson county, near Warminster. The deposit is extensive, and it is proposed to use concentrating machinery in preparing the ore for market. In this way ore containing as high as 90 per cent. of manganese dioxide has been separated. This is the first known attempt to improve manganese ore by concentration, although the manganese ore used in making ferro-manganese is frequently cleaned by washing.

ROCKY MOUNTAIN REGION.

The character of the manganese ores in the Rocky Mountain region was set forth in detail in the last two volumes of Mineral Resources, and will be found on page 379 of the volume for 1883–'84 and on pages 348 and 349 of the volume for 1885. The ore is practically manganiferous iron ore, containing silver, and is used entirely as a flux to help smelt siliceous ores. The ore carries some lead, and from 5 to 30 ounces of silver per ton; from 3 to 15 per cent. of manganese, and from 35 to 50 per cent. of iron. The amount of these ores used at some of the smelters is quite large, one establishment using as much as 18,000 long tons in 1886.

The amount of these argentiferous manganese ores treated in the country in 1887 is estimated at 60,000 tons, valued at an average of $10 a ton.

FOREIGN SOURCES.

Canada.—Concerning the distribution of manganese ores there is nothing to add to the very full description given in previous volumes of Mineral Resources. No statement of the production of New Brunswick has been received. Mr. E. Gilpin, jr., chief inspector of mines for the province of Nova Scotia, has again furnished a statement of the production of manganese in that province for 1887, which is added to the table in the last report, giving the production of manganese in Nova Scotia since 1861:

Production of manganese ore in Nova Scotia from 1861 *to* 1887 *inclusive.*

Years.	Mines.	Production.	Value.
		Long tons.	
1861 to 1871		1,500	$10,500
1872		40	1,400
1873		131	
1874			
1875		7	
1876		16	
1877		97	5,335
1878	Tenny Cape No. 1	79	4,345
	Tenny Cape No. 2	48	2,160
		127	6,505
1879	Tenny Cape No. 1	90	4,950
	Tenny Cape No. 2	55	2,220
		145	7,170
1880	Windsor	62	2,831
	Walton	81	3,600
	Cheverie	70	7,000
	Others	70	1,400
		283	14,831
1881	Tenny Cape	125	
	Walton	7	
	Cheverie	17	
	Pembroke	6	
	Windsor	6	
	Loch Lomond, Cape Breton	70	
		231	

Production of manganese ore in Nova Scotia—Continued.

Years.	Mines.	Production.	Value.
		Long tons.	
1882	Tenny Cape	120	....
	Walton	6	....
	Cheverie	21	....
	Onslow	6	....
	Loch Lomond, Cape Breton	56	....
		209	....
1883	Tenny Cape	125	$12,462
	Walton	5	
	Cheverie	4	
	Loch Lomond, Cape Breton	16	....
		150	12,462
1884	Tenny Cape	126	11,970
	Windsor	5	550
	Cheverie	2	180
	Walton	89	8,430
	Onslow	30	2,700
	Loch Lomond, Cape Breton	50	....
		302	23,830
1885	....	354	....
1886	Tenny Cape	171	12,066
	Cheverie	6	358
	Cornwallis	250	750
	Onslow	20	85
	Stewiacke	18	590
		465	13,849
1887	Tenny Cape	235	16,450
	Cheverie	5	200
	Cornwallis	385	2,233
	Onslow	40	2,800
		665	21,683

It is believed from its low price that the Cornwallis ore is ocher. The great value of most of these ores, as compared with those of the United States, will be noted. The ores are high grade, mined chiefly for glass making, and command a high price. Some of the Truro ore runs 92 to 95 per cent. manganese dioxide.

Belgium.—There were produced in the province of Liège, in 1886, 700 tons of manganiferous ores carrying sufficient manganese to be of value for this metal. There is but little manganese found in Belgium, though here, as elsewhere, it is often found associated with hematite ores.

Cuba.—There were produced in Cuba in the year 1887, 40 tons of manganese ore.

Great Britain.—We are indebted to the courtesy of Mr. George E. Blackwell, of Liverpool, England, who is one of the oldest, if not the oldest dealer in manganese in the world, for the following brief but very interesting statement of the production and consumption of manganese in England in the past forty years:

"The first manganese ever produced in this country was in Warwickshire, England, over forty years ago. A few years afterwards discoveries of some large deposits were made in Devonshire, and some thirty-five years ago large deposits were also discovered and worked in Germany, some of which are worked up to the present, but in comparatively small quantities.

"The quality of the Warwickshire and Devonshire ore was very good, and it brought high prices. Three-fourths of the German ore, on the other hand, was of very low quality. It came very strongly in competition with the English production, however, reducing prices in 1860–'64 to 60 shillings on 70 per cent. ore.

"This reduction was brought about to a large extent by discoveries and large importations from Spain of a very good quality. Spain continued to export very largely for many years, but in consequence of the increased demand prices ran in stages up to £7 and £8 per ton, until about the year 1869, when Weldon's process was introduced, and prices gradually dropped until they came to 75 shillings on 70 per cent. In consequence, however, of the Franco-German war another advance took place, until the price reached £8, 10*s*, and then receded at short intervals to the present low prices."

The importations into this country, dating from 1859, are as follows:

Imports of manganese ore into Great Britain.

Years.	Tons.	Years.	Tons.	Years.	Tons.
1859	25,536	1869	51,517	1879	12,172
1860	24,299	1870	32,703	1880	16,085
1861	20,664	1871	29,982	1881	18,743
1862	21,054	1872	38,934	1882	29,766
1863	34,591	1873	25,777	1883	22,362
1864	51,299	1874	17,582	1884	26,048
1865	46,478	1875	16,505	1885	47,250
1866	48,700	1876	8,914	1886	47,581
1867	51,811	1877	13,176		
1868	50,042	1878	9,829		

The present prices have been brought about by the large importations of high-class mineral and the low prices of articles manufactured therefrom.

Relative to the production of Great Britain, the details are very meager. It has varied greatly in different years. It is estimated that from 1835 to 1839 the production was 5,000 tons a year. In 1873 it was 8,254 tons; in 1875 there were sixteen mines in operation, producing 3,725 tons; in 1882 there were 1,548 tons mined, valued at £3,907; in 1883, 1,287 tons, worth £2,976; in 1885 the production was 1,688 tons, which had risen in 1886, owing to the utilization of the manganese ore in the Cambrian rocks, to 12,763 tons. Of these, 99 tons, valued at £142, were produced in Carnarvonshire, 11,285 tons in Merionethshire, and 364 tons in the Midlands district.

The production of 1887, so far as it can be ascertained from the reports of the inspectors of mines for that year, was 13,054 tons, of which there were produced in Carnarvonshire 208 tons, valued at £276; and Merionethshire, 12,391 tons, valued at £8,982. In the Midlands district the production was 455 tons. For the latter no value is given.

Relative to the ore raised in the Midlands Mr. Arthur H. Stokes, inspector of mines of the Midlands district, states that it occurs in different conditions, sometimes in layers a few inches thick, and at others, and more generally, in masses of a dark brown or blackish color, having a friable, earthy appearance, not unlike hard balls of soot. It is unctuous to the touch, and stains the fingers black when handled. It is found at various depths, some of the shafts being 80 yards deep. It appears to have been deposited in layers, for where it forms a bed it has every appearance of being a sedimentary deposit, and can be plainly seen in consecutive horizontal layers. It is found in layers varying from 6 inches to 2 feet thick, resting upon limestone blocks, the geological formation being the mountain limestone. The ore has not been used for obtaining metallic manganese, but as a mixture for paint. Nearly the whole of the ore raised in the Midlands or in Derbyshire is sold to the paint mills and converted into paint. The price at the mines is from 10 shillings ($2.42) to 12 shillings ($2.90) per ton. The following is an analysis of the Derbyshire ore, made by Mr. Wedgwood some years ago:

Analysis of manganese ore from Derbyshire, England.

	Per cent.
Twenty-two parts of black wad gave:	
Insoluble earth, chiefly micaceous	2
Iron	9¾
Manganese	9¼
Lead	1
Total	22

The deposits of carbonate of manganese found in the Cambrian rocks at several places near Barmouth and Harlech were described briefly in last year's volume of Mineral Resources. As this deposit, however, is of some importance, in view of the fact that carbonate of manganese has not heretofore played an important part in the manganese market, it may be interesting to speak of it more at length, which I am enabled to do by reference to a paper by Mr. Edward Halse, "The Occurrence of Manganese Ore in the Cambrian Rocks of Merionethshire."

These rocks, which are comprised in a broad mountain tract forming an irregular oval, the longer axis being 17 miles and the shorter axis 10, consist principally of coarse quartzite, greenish gray grit, the quartz grain being sometimes interspersed with granules of feldspar. There are three manganese lodes, one running in an unbroken line for about 2 miles, in an almost true north and south direction. Two miles and a half farther north and a little to the west is another lode nearly a mile long, and a half mile still farther north is a third lode about the same length. These so-called lodes were worked superficially for black oxide of manganese from about 1835 to 1840, the ore being sent to Glasgow for the manufacture of bleaching powder, and valued at 50 to 60 shillings per ton at Barmouth. The outcrop of the Barmouth deposit can be traced for 2 miles by means of these old workings. These workings are in no instance more than a few fathoms deep, the black oxide being found not to extend to any great depth. The workings, it seems, were abandoned about 1840. Sometime in 1855 it was discovered that the deposits were really the outcrops of one or more beds of impure carbonate of manganese. Mr. Halse points out that workable beds of carbonate of manganese are found to occur in the Cambrian rocks of North Wales and are traceable for a length of 17 miles; a fact of great interest, both from a geological and an economic point of view. The only other workable bed of carbonate of manganese (rhodochrosite or diallogite) known is said to occur in the Upper Silurian rocks of Chevron, Belgium.

In the Harlech mine the bed of ore is a little over a foot thick, consisting of grit of medium grain, overlaid by a thin band of quartzite, probably metamorphosed grit. The roof proper consists of about 2 feet of very hard schistose rock, termed "blue stone" by the miners. Specimens of ore taken from the mine are seen to be formed of uniform layers, having gray, yellowish, white, greenish, and chocolate-brown colors. Fifteen cubic feet of ore weigh about a ton. The mine is 1 mile from Harlech station, the cost of cartage to the station being 9 pence per ton. The bed is very faulty, the ore of the lower grade averaging only 27 per cent. of metal. The work proving very hard, the mining operations were stopped in 1887. At the Artro mine the thickness of the vein varied from 8 to 18 inches. The cost of cartage to the station was 2 shillings 9 pence per ton, the ore being worth about 16 shillings per ton at the Llanbedr station. In the Moelfre mine the bed is remarkable for its contortions, sharp folds occurring every 2 or 3 yards, and often every 2 or 3 feet. The ore contains 4½ per cent. of iron. In the Hafodty mine the ore is of a light brown color and of low uniform quality. The percentage of manganese varies from 30 to 32 per cent., and that of silica from 18 to 19 per cent. The richest ore is where the bed is thinnest. The weight of 10 cubic feet of ore is about a ton. The ore is worth about 30 shillings per ton at Barmouth. The only other important mine is the Diphwys. The ore assays from 31 to 32 per cent. of metal.

The following is an analysis of the Merionethshire ore, as compared with the Chevron, Belgium, ore:

Analysis of the Merionethshire ore, as compared with the Chevron, Belgium, ore.

Constituents.	Merionethshire ore (analyst Mr. Holgate) dried at 212° F.	Merionethshire ore (analyst Mr. Holgate) as received.	Chevron ore (analyst M. F. Lacone) from Heid Julien.	Chevron ore (analyst M. F. Lacone) from Heid Cossin.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	......	2.499	......	......
Manganese peroxide	8.07	7.87	28.42	31.75
Manganese protoxide	26.72	26.05		
Iron peroxide	5.71	5.57	29.62	24.15
Alumina	10.99	10.72	3.87	4.06
Lime	4.31	4.20	3.90	2.83
Magnesia	0.62	0.60	1.15	0.88
Silica	26.67	26.00	23.22	22.01
Potash and soda	0.25	0.24	......	......
Phosphoric acid	0.074	0.072	0.55	0.46
Sulphuric acid	0.17	0.16	Trace.	0.01
Copper and lead	Nil.	Nil.	CO_2	CO_2 ....
Loss on ignition, inclusive of 12.83 carbonic acid	15.70	15.31	10.63	14.51
Totals	99.284	99.291	101.36	100.66
Manganese	25.8	25.05	20.48	22.87
Iron	4.0	3.90	20.73	16.90
Phosphorus	0.043	0.042	0.24	0 20

If the whole of the carbonic acid present in the Welsh ore is in combination with the protoxide of manganese, it contains 33½ per cent. of the carbonate; but doubtless there are present several per cent. of iron, magnesium, and calcium carbonates. Mr. Holgate finds there are 4 per cent. of silicate of manganese in the ore.

The ore is clearly a mechanical mixture, and seems to be made up of about 30 per cent. carbonate of manganese, 4 per cent. silicate of manganese, 40 per cent. oxides of manganese, iron as oxide (magnetite), carbonate and sulphide (iron pyrites), magnesium carbonate, etc., free silica and 26 per cent. of clay.

If the whole of the carbonic acid in the Belgian ore is combined with protoxide of manganese, it contains 32½ per cent. of the carbonate. Hence the curious fact appears that both these deposits contain about the same quantity of the latter mineral.

The ground is set by the yard, the average price being 35 shillings, but of course it varies much. The writer is unable to give any figures with regard to the cost of getting. As the beds of ore are of only moderate thickness and quality, and as the ground has proved to be of very stubborn nature, the margin for profit can only be a moderate one.

Last autumn the Dyffryn Mining Company's yield was about as follows:

Output of the Dyffryn company's mines, Wales, in 1887.

Mines.	Tons per week.
Harlech	100
Artro	130
Moelfre	70
Hafodty	100

This shows a total of 400 tons per week. Although the Harlech mine is being stopped, this output will not be diminished, as the Diphwys deposit, which has only very recently been opened out, supplies the smelting works with 100 tons weekly. The manager believes he can double the above output. The writer has no figures relating to the output of the Merionethshire Manganese Company, which is working the chief remaining setts, but it probably does not exceed 100 tons per week.

The ore is calcined and then smelted in a blast furnace with iron and a richer class of manganese ores, so as to produce an alloy between spiegeleisen and ferro-manganese, and which, containing 45 per cent. of manganese, is known in the market as "forty-five." It is mainly exported to America, and is used in steel industries.

Spain.—The statistics of the production of manganese in Spain in 1886 are as follows, the figures being official:

Number of mines	3
Number of men employed	49
Ore produced (metric tons)	400
Spot value (pesetas)	7,275

Through the kindness of Mr. William D. Marvel, of New York, who is largely interested in iron mines in Spain, we have the following statement of the manganiferous iron ores in the neighborhood of Cartagena, Spain: The manganiferous iron ores of the Cartagena region are found in a mountain consisting of a range of hills running in an almost east and west direction, and of about three leagues in extent. Throughout the entire length of this range, iron ore, more or less manganiferous, is found. In many cases it crops out on the surface, but the greater part of the ore proper is found at depths varying from 30 to 70 meters, and the mines are worked generally with hand-windlasses or horse-winches. There are several workings that are carried on by small winding engines, averaging about 10 horse power. The engines are mostly of Belgian manufacture, although some are made in Spain and some in England. The engines perform also the work of pumping water from the mines. In many of the mines of this class lead and considerable silver are found underlying the "dry iron ore" and the manganiferous iron ore, The manganiferous iron ores generally contain from 10 to 20 per cent. of metallic manganese, with metallic iron, respectively, from 35 to 20 per cent. These manganiferous ores are manipulated at the points of deposit as brought from the mines and "prepared" for shipping. The aim is to obtain an ore of about 15 per cent. manganese and about 30 per cent. iron, or for a better type, about 20 per cent. manganese and 20 per cent. iron.

Another very important consideration in the manipulation of this class of ores is their contents of silica. The extreme limit of silica allowed is generally 10 per cent. An excess of silica is a matter of commercial agreement, an excess reducing the value according to the percentage agreed upon in the commercial transaction. These ores are shipped chiefly from Santa Lucia (which is within the harbor of Cartagena), where is located the terminus of the Cartagena and Herrerias Steam Tramways Company, limited, a meter gauge road about 10 miles in length. The company is English and has a capital of £300,000. Most of the ores referred to are brought down by this railway from many mines in which the railway company has no immediate interest. The supply of this class of ores, considering the comparatively small consumption, is, for all present demands, inexhaustible.

From the mines the ore is transported to the railway by donkeys, the distances varying, of course, and the donkeys making on an average ten or twelve journeys daily, and each donkey carrying about 3 hundred weight at a time. At the other shipping ports the method of carrying by donkeys is the only means of transportation from the mines, the ore being taken direct from the mines on donkeys to the deposits on the sea-beach for shipment. The other shipping ports are Portman (or Porman), Escombrera, and Gorguel. A little is also shipped from Garrucha.

The ores of this class are shipped almost entirely to England and South Wales, occasionally some to Cette for the French manufacturers, and also a quantity, varying and uncertain, to the United States. At Portman nearly all the ores are exhausted and the business practically suspended.

There is another region in which there is a large quantity of ore of this class, near Cape Palos, which is properly within the Cartagena district, and which has ores of good quality, but so far away from any means of shipping as to be useless by reason of the cost of transportation. In passing it may be mentioned that there are also a few manganese deposits, but they are not generally of importance.

With the exception of Cartagena all the shipping places for these ores are open roadsteads, unsafe for vessels, and wrecks are frequent. This disadvantage implies bigger rates of freight than are paid at safe harbors. Cartagena is a safe and quite commodious harbor, but difficult for sailing ships to enter and to get out of. Most of the shipping is done by steamers trading regularly to the British ports.

Other European deposits.—Reported discoveries of manganese ore in various parts of Europe, and the increased development of known deposits, follow one another with great rapidity. Unfortunately, however, with the exception of the Russian deposits, no recent developments have proved of any great value as yet. A new deposit has recently been opened, it is reported, at Heckholzhausen, in Nassau, Germany. The deposit is covered with about 45 feet of Tertiary clays and basaltic gravel, and shows a thickness of from 15 to 21 feet. It is reported to be quite pure, amorphous, manganic oxide, averaging from 65 to 70 per cent. Distributed through the mass are very large pockets of pure crystalline ore of manganite and pyrolusite, averaging from 85 to 90 per cent. Another discovery is reported from Salerno, Italy, which is located right on the coast. This ore is reported as averaging from 73 to 75 per cent., and the deposit is said to be of enormous extent and depth. As, in addition to the pure mineral, there is also a vast quantity of manganiferous iron ore in the same locality, and as the fuel supply from the neighboring mountains, in the shape of oak wood, is practically inexhaustible, a company has been formed to make ferro-manganese on the spot. The Russian trans-Caucasian deposits are also being developed to a very large extent. The difficulty of development in these deposits of manganese is that the ores have to be carried great distances, either in wagons or on the backs of mules, to reach railroad transportation, and consequently only the richest lump ore will stand the cost of transportation. Should the railroad which is projected be put through to the mines, a vast quantity of what would elsewhere be considered good ore, already mined and thrown into the rock piles, will be available for transportation.

HADFIELD'S MANGANESE STEEL.

The most notable contribution to the metallurgy of manganese and its alloys made in recent years is the paper read before the Institution of Civil Engineers of Great Britain by Mr. Robert A. Hadfield, of Hadfield's Steel Foundry Company, Sheffield, on manganese steel, the invention of his father, but which the author of the paper has done so much to perfect. This steel has been described in previous reports, but Mr. Hadfield's paper sets forth so clearly some of the very peculiar properties that manganese in large quantities imparts to steel, that, with his permission, we quote from it at considerable length.

The most noticeable characteristics of the Hadfield manganese steel are its peculiar hardness, combined with great toughness, the effect of water-quenching upon the steel, and its electrical properties.

Peculiar hardness.—It is difficult to describe this quality accurately, because all the specimens are exceedingly hard; in fact, it is scarcely possible to machine any of them on a practical scale, yet such hardness varies considerably in degree, being most intense in the cast material, containing 5 to 6 per cent. manganese, which no tool will face or touch.

A gradual decrease is then noted, and when about 10 per cent. is reached the softest condition occurs. Then an increase again takes place, and at 22 per cent. it is very hard, still not so much so as in the 5 per cent. After passing 22 per cent. the cause of hardness becomes more complicated, owing to the presence of more carbon, 2 per cent. and upwards; in fact the material begins to partake more of the nature of cast iron, though as to strength, when compared with the latter, specimen No. 225 (carbon 2 per cent., manganese 23.5 per cent.), had a transverse strength of 34 tons against 10 tons for cast iron.

The 8 to 20 per cent. material can be machined, although only with the utmost difficulty, as will be seen from the following example. The test bar No. 22 B (manganese 14 per cent.), which elongated 44.5 per cent. without fracture and had a tensile strength of 67 tons, was put under a doubled-geared 18-inch drill. Over an hour was occupied in drilling one hole one-half inch in diameter by three-fourths of an inch deep, and even to do this it was requisite to run at the lowest speed, or the edge of the drill would have given way. During this time fifteen to twenty holes of the same size could have been easily drilled in mild steel. Similar results from specimens sent to different engineering firms in Sheffield and elsewhere confirm this test, yet this specimen could be indented by an ordinary hand hammer, so that while so hard it may be said to possess "a special kind of softness." Although, when being turned, it appears harder than chilled iron, its softness is particularly noticeable when testing the material for compression. Specimens of 10 per cent. manganese steel 1 inch long by 0.79 inch in diameter, notwithstanding they require several days' preparation in the lathe, owing to their hardness, yet, under a compression load of 100 tons per square inch, shorten 0.25 inch, and the harder kind (manganese 15 to 20 per cent.) 0.1 inch to 0.13 inch. Chilled iron or hardened steel would stand this test without any alteration. A cast specimen, No. 24 B (manganese 14.75 per cent.), not forged, made into a standard Whitworth test piece, took nearly a fortnight to tool and finish.

The test bar of the specimen (12.75 per cent.), tested by Mr. Wellman, of the Otis Iron and Steel Company, Cleveland, Ohio, was a day and a half in the lathe, as against half an hour for ordinary mild steel.

Owing to this peculiar hardness its general application to castings has been limited by the difficulty of machining them, no method having yet been perfected by which the heads or runners can be cut off, or the castings otherwise tooled to shape. Tool steels from the best makers have been tried, including self-hardening kinds and tools made of manganese steel, but without success. The tests and applications, therefore, have necessarily been confined to castings, where the runners could be broken off cold or pared off hot.

Water-quenching, and the effect of heat upon manganese steel.—Naturally one of the questions asked, when examining a new material said to be steel or possessing the properties of steel, is what effect has water or other cooling medium on it when plunged therein in a heated condition? in other words, will it harden? Again, the behavior was found to be quite different when compared with ordinary carbon steel, no hardening action taking place. Water certainly causes the material to become stiffer, but in an entirely different degree to hardened carbon steel; for a piece of manganese steel after such treatment is slightly more easily touched by a file; therefore for the following reasons the process now described is termed "water-toughening." The increase in stiffness is most marked, the tensile strength rising from 40 to 60 and in some cases over 70 tons per square inch; but this is not a mere stiffening or hardening effect in the ordinary sense of the term, for in all carbon steel such rise is invariably accompanied, when the cooling medium is water, by a considerable decrease in the ductility or elongation, whereas in this material just the opposite effect is produced. In specimens Nos. 22 B. and D^2. the tensile strength of the bar as received from the forge was only 36 tons per square inch, with 1.56 per cent. elongation; this latter is exceptionally low, usually being 6 to 8 per cent. After water-toughening it rose to the extraordinary amount of 67 tons with 44.44 per cent. elongation, and even then the specimen was not fractured, as at this point it was considered worthy of being retained unbroken. The same result occurs if the piece under treatment be dipped when at a welding heat, though the carbon be as high as 1 per cent. or more. With regard to those samples containing below about 7 per cent. manganese this treatment seems to exercise little or no influence, and the material is comparatively valuless where toughness is requisite. While touching upon this point, the results obtained by the Terre Noire Company of France with high manganese steel (1.75 to 2.25 per cent.) should be referred to. It is stated that it was not possible to obtain test bars when dipped in water or oil, as they either cracked or broke into pieces. Strange to say, not a single bar in these experiments has behaved so. Take, for example, No. 4 B, with 6.95 per cent. of manganese, which may be termed comparatively low and more approaching to the Terre Noire material: the test bar when heated to a white heat could be safely plunged into either water or oil without being water-cracked.

After a large number of tests with regard to the action of heat and sudden cooling upon this material, generally speaking it has been found that the higher the heat of the piece treated, and the more sudden and rapid the cooling, the higher will be the breaking load and the greater the toughness or elongation. Six of the bars were heated as uniformly as possible to a yellow heat, and plunged into water of 72° F.; these gave breaking loads varying from 57 to 63 tons per square inch and elongations of 39.8 per cent. to 50 per cent. As a comparative test another test bar of the same material, heated in precisely the same way and to the same degree, but plunged into water at a temperature of 202° F., gave only 53 tons and 32.8 per cent. The more rapid cooling of the other test bars was evidently the cause of their superiority, the chemical composition of all being the same.

It was also thought that sulphuric acid, being a rapid conductor of heat, might give good results as a cooling medium. The experiment was therefore made with a bath consisting of equal volumes of water and of sulphuric acid, and on 8 inches the extraordinary elongation of 50.7 per cent. was reached with a breaking load of 65 tons, the bar being thus drawn cold $4\frac{1}{16}$ inches before fracture. Another specimen on a 4-inch length gave 56.75 per cent. The operation of merely heating the forged test bar to a yellow heat and cooling it in air has a very beneficial effect, the elongation in most instances being increased to 15 and 20 per cent., the tensile strength also rising 8 or 10 tons per square inch.

As before pointed out, the temperature to which the bar is subjected has a marked influence. Although good tests result when the specimens are treated at lower temperatures, the best are obtained with as high a temperature as possible, the bars being thoroughly soaked and plunged into cold water; care, of course, must be taken that they are not burnt or heated beyond a welding heat. In those specimens where the alloy is not so pure a mixture of iron and manganese, and the material can not be heated so hot without crumbling, lower temperatures also give good results, viz., 40 to 46 per cent. elongation. The best tests have been obtained with material containing 12 to 14 per cent. of manganese, though those with 10.83 per cent. are also good, considering their high breaking loads as compared with mild steel. However, special attention is drawn to the peculiar fact that an increase of 4 per cent. in the manganese causes such a considerable rise both in tenacity and elongation. The cause of this is very obscure, the only explanation offered being that the peculiar crystallization in the cast ingots seems to disappear gradually after passing about 11 per cent., and the fiber noticed is not so much a cause of weakness; this is only surmise, as to the eye the fiber in even the lower percentages entirely disappears in the hammered bar.

It is not easy to understand the action of the water-quenching process. As so ably explained by Chernoff, the effect of oil tempering on ordinary steel is to produce a metal of fine grain, which possesses much greater strength than open, coarse-grained steel. If, however, forged manganese steel possesses any real difference of structure, after being heated and water-toughened, it is rather in the direction of a more open than a closer grain. But the most puzzling case in the author's experience is that of the cast toughened 9 per cent. specimens, at which percentage, as before pointed out, the crystallization is very peculiar. An ingot $2\frac{1}{2}$ inches square and 2 feet long was cast in an iron mould. When cold, a piece was broken off, requiring four blows under a steam hammer. The fracture showed the usual peculiar form of the 9 per cent. material, a form which, to outward appearance, is unchanged by any heats short of the actual melting point. The other piece was reheated to a yellow heat and water-quenched. In this the toughness was increased in a remarkable manner, ten blows of the steam hammer being required to break the bar. The appearance of fracture was unchanged. What caused the increase of toughness? In this case, certainly, it was not owing to structural changes, the pronounced form of ingot not being to the eye in any way altered. It will therefore be understood how difficult it is to offer any satisfactory explanation of these peculiarities.

Considering the effects of water-toughening, special attention is drawn to a specimen containing carbon 1.85 per cent., manganese 9.42 per cent. Ordinary steel with this amount of carbon would be excessively hard if water-quenched even at a dull red heat; in fact, it is questionable whether it could be hardened at all without being water-cracked. Yet the above specimen was heated to a high heat, plunged into cold water, and the bar was not water-cracked, and, if changed at all, slightly softer. Carbon seems, therefore, entirely deprived of its usual hardening properties, and it is probable that manganese must be partly considered as the cause of the high tensile strength of this material, that is, unless iron itself possesses the property of taking some other form not hitherto suspected. Further, iron so combined with manganese is rendered capable of elongating 50 per cent. on 8 inches, against about 30 per cent. in the best brands of wrought iron, which contain about 99.5 per cent. of iron, against 84 per cent. in the manganese steel.

Electrical properties.—This material possesses the peculiar property of being almost entirely non-magnetic. Rinman mentioned in 1773 that manganese diminishes and in the end destroys the magnetic properties of iron. This was also noticed in some specimens of manganese alloys made by Mr. David Mushet about 1830. This is especially curious seeing that iron is present in amounts eight or nine times greater than the manganese itself. An approximate idea of the amount of manganese contained in the steel may be formed by passing a magnet over specimens; as the percentage of manganese increases the magnet's power decreases. Upon reaching about 8 per cent. there is no attraction in the bulk, though fine drillings are influenced; but even this diminishes, as when 20 per cent. is reached, a magnet capable of lifting 30 pounds of ordinary steel or iron will only lift pieces weighing a few milligrams. On this point the material behaves in the same manner either in its forged or cast state; water or oil-quenching making practically no difference.

Some interesting experiments with regard to the physical properties of manganese steel have been made by Sir William Thomson, Mr. Bottomley, of Glasgow, and Professor Reinold, of the Royal Naval College, Greenwich. Prof. W. F. Barrett, of the Royal College of Science, Dublin, has also experimented respecting its non-magnetic character and electrical properties. His experiments were carried out upon a sample containing carbon 0.85 per cent., manganese 13.75 per cent.; the wire being drawn to No. 19 b. w. g. The author first attempted to draw direct from the rods, but with little progress; the wire, owing to its hardness, breaking into short lengths when being pulled through the wortles. Ordinary annealing was tried, but with no better results. As exceedingly good bending tests had been obtained with bars from the same steel, when heated to a yellow heat and plunged into cold water, the rods were treated in the same manner. These were coiled up, heated to whiteness, and plunged into cold water. The material was then easily drawn, but after every reduction through two sizes its ductility was again lost, and the operation of heating to whiteness and quenching in cold water was again necessary. A specimen has been subjected to white heat no less than five times and is yet uninjured, as will be seen from the remarkable tensile tests obtained from it by Professor Barrett, viz., 110 tons per square inch, in its hard state. A similar result was obtained by the manager of the wire department at the Barrow Steel Works, the report being "that it would stand any tensile load up to 100 tons per square inch, according to the temper, and the elongation was extraordinary." The density, according to Professor Barrett, was 7.81, which is somewhat lower compared with the specific gravity obtained at the Hecla laboratory, viz., 7.83 on the same wire. The electric conductivity was found to be very low, No. 19 b. w. g. wire 0.96 millimeter in diameter having a resistance of 1.112 legal ohm per meter, or 75 microhms per cubic centimeter at 15° C. Ordinary iron wire is only 9,800, and German silver 21,170, so that use might be made of the manganese steel for resistance coils in electric lighting. This has since been successfully applied by Dr. E. Hopkinson, in Messrs. Mather & Platt's electric department. Its high specific resistance and capacity to stand heating make it very useful for resistance boxes. A length of 1,180 yards 8 b. w. g. (No. 634, manganese 13.95 per cent.) was cut into three lengths, coupled parallel, the conductor consisting of three strands, No. 8, then coiled into a box 3 feet by 2 feet by 2 feet, gave a resistance of 6.5 ohms, carrying 80 amperes without overheating. It was therefore capable of absorbing 55 h. p. To produce the same resistance with iron wire 5,000 to 8,000 yards would be required, or of expensive German silver wire 4,780 yards. Professor Barrett also finds that its increase when heated is only 0.136 per cent. for each degree carbon, as against iron 0.5 per cent.

In the same way it is a bad conductor of heat. A rough test was made at the Hecla works by putting a bar of this material and one of ordinary wrought iron into a smith's fire; the latter became too hot to handle in about half the time required for the former. From this will be seen the importance of thoroughly "soaking" this steel when forging it, or the outside only may be heated.

As regards its non-magnetic properties, a small piece of the No. 552 wire was not attracted in the slightest degree by the most powerful electro-magnet capable of lifting a ton, but suspended by a thread it behaved like a para-magnetic body. Professor Reinold found that the water-quenched or softenedwire acquired slightly more permanent magnetism, but that with both, a most sensitive galvanometer needle was required to show that the material was not copper or other non-magnetic body. The exact amount was determined by Professor Barrett after most careful experiments. In comparing this with ordinary steel he states that it was like weighing hundred-weights and grains on the same balance; the magnetism of ordinary iron being represented by the figure 100,000, manganese steel is 20, and its susceptibility, *i. e.*, the induced magnetization, is about as low as zinc or other non-magnetic metal. It is somewhat extraordinary to find no sensible attraction exerted on this steel by the most powerful magnetic field that could be obtained, this agreeing with Dr. Hopkinson's experiments. If other difficulties can be overcome, this peculiar quality should make it suitable for dynamo bed plates. Ships built of such steel would have no sensible deviation of the compass. Magnetic influence, while not affecting this material, passes through it, so that a needle placed upon a flat sheet of manganese steel can be readily moved by a magnet placed underneath. The same thing occurs if brass or sheet copper be substituted, but not with ordinary steel or iron.

Further interesting experiments have also been lately made (September, 1887) by Professors J. A. Ewing and William Low. The former concludes his experiments by stating that even under magnetic forces extending to 10,000 C.G.S. units, the resistance which this manganese steel offers to being magnetized suffers no change in any way comparable to that which occurs in wrought iron, cast iron, or ordinary steel, at a very early stage in the magnetizing process. On the contrary, the permeability is approximately constant under large and small forces, and may be therefore concluded as being only fractionally greater than that of copper, brass, or air.

COAL.

By Charles A. Ashburner.

INTRODUCTION.

The coal statistics in the United States for the year 1887 have been collected from various sources. For the State of Colorado and the Territories of New Mexico, Wyoming, Montana, and Dakota they have been compiled from returns made to Mr. F. F. Chisolm, special agent at Denver, and for Oregon and Washington Territory from returns made to Mr. Henry J. Biddle, special agent at Portland, Oregon. For States where the mine inspectors, or other State officials, collect the production of the coal mines under the authority of State law the statistics have been compiled from returns made by them; full credit being given in each case. In States and Territories where there are no mine inspectors, or where the law does not charge them or other officials with the collection of the coal statistics, the reports have been compiled from statistics and general information obtained from detailed returns made directly to the Survey by individual coal operators, railroad agents, and personal correspondents familiar with special coal developments. In the preparation of this report valuable assistance has been rendered the author by Mr. Amos P. Brown, assistant, Geological Survey of Pennsylvania.

THE COAL FIELDS OF THE UNITED STATES.

For convenience of description the coal areas of the United States have been grouped into the Anthracite division and the Bituminous division.

The Anthracite division, in a commercial sense, may be said to include the anthracite districts of Pennsylvania alone, although small amounts of anthracite are mined in Colorado and Arkansas. In the New England basin the original coal beds have been metamorphosed into graphite and graphitic coal, which have special uses (see Rhode Island report), although not classified by the coal trade as anthracite.

The Bituminous division includes the following coal fields: (1) The Triassic field, embracing the coal beds of the Triassic or New Red Sandstone formation in the Richmond basin in Virginia, and in the coal basins along the Deep and Dan rivers in North Carolina; (2) the Appalachian field, which extends from the State of New York on the north to the State of Alabama on the south, having a length northeast and southwest of over 900 miles, and a width ranging from 30 to 180 miles; (3) the Northern field, which is confined exclusively to the central part of Michigan; (4) the Central field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the Western field, including the coal areas west of the Mississippi river, south of the forty-third parallel of north latitude and east of the Rocky mountains; (6) the Rocky Mountain field, containing the coal areas in the States and Territories lying along the Rocky mountains; (7) the Pacific Coast field, embracing the coal districts of Washington Territory, Oregon, and California. (See "Mineral Resources," 1886, for detailed descriptions.)

The following table contains the approximate areas of these coal fields, with the total production (exclusive of colliery consumption) of each during 1887:

Classification of the coal fields of the United States.

	Area.	Production in 1887.
Anthracite.	*Square miles.*	*Short tons.*
New England (Rhode Island and Massachusetts)	500	6,000
Pennsylvania	470	39,506,255
Colorado		36,000
	970	39,548,255
Bituminous. (a)		
Triassic:		
Virginia	180	30,000
North Carolina		
Appalachian:		
Pennsylvania	9,000	30,866,602
Ohio	10,000	10,301,708
Maryland	550	3,278,023
Virginia	185	795,263
West Virginia	16,000	4,836,820
Kentucky	9,000	950,903
Tennessee	5,100	1,900,000
Georgia	200	313,715
Alabama	8,660	1,950,000
	58,695	55,193,034
Northern:		
Michigan	6,700	71,461
Central:		
Indiana	6,450	3,217,711
Kentucky	4,000	982,282
Illinois	36,800	10,278,890
	47,250	14,478,883
Western:		
Iowa	18,000	4,473,828
Missouri	26,887	3,209,916
Nebraska	3,000	1,500
Kansas	17,000	1,596,879
Arkansas	9,043	150,000
Indian Territory		685,911
Texas	4,500	75,000
		10,193,034
Rocky Mountains, etc.:		
Dakota		21,470
Montana		10,202
Idaho		500
Wyoming		1,170,318
Utah		180,021
Colorado		1,755,735
New Mexico		508,034
		3,646,280
Pacific Coast:		
Washington		772,612
Oregon		31,696
California		50,000
		854,308
Total production sold		124,015,255
Colliery consumption		5,960,302
Total production, including colliery consumption		129,975,557

a Including lignite, brown coal, and scattering lots of anthracite.

PRODUCTION.

The total production of all kinds of commercial coal in 1887 was 124,015,255 short tons (increase over 1886, 16,333,046 tons), valued at the mines at $173,595,996 (increase $26,483,241). This may be divided into Pennsylvania anthracite, 39,506,255 short tons (increase 2,809,780 short tons), or 35,273,442 long tons (increase 2,508,732 long tons), valued at $79,365,244 (increase $7,807,118); all other coals, including bituminous, brown coal, lignite, and small lots of anthracite produced in Colorado and Arkansas, and 6,000 tons of graphitic coal mined in Rhode Island, 84,509,000 short tons (increase 13,523,266 tons), valued at $94,230,752 (increase $18,676,123).

The colliery consumption at the individual mines varies from nothing to 8 per cent. of the total output of the mines, being greatest at special Pennsylvania anthracite mines, and lowest at those bituminous mines where the coal bed lies nearly horizontal, and where no steam power or ventilating furnaces are used. The averages for the different States vary from $2\frac{1}{10}$ to $6\frac{1}{7}$ per cent., the minimum average being in the Pennsylvania bituminous, and the maximum average being in the Pennsylvania anthracite region.

The total output of the coal mines, including colliery consumption, was: Pennsylvania anthracite, 37,578,747 long tons (increase over 1886, 2,725,670 long tons), or 42,088,197 short tons (increase 3,052,751 short tons); all other coals 87,887,360 short tons (increase 14,179,403 tons), making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 129,975,557 short tons (increase 17,232,154 tons), valued as follows: Anthracite, $84,552,181 (increase $8,433,061); bituminous, $98,004,656 (increase $19,523,600); total value $182,556,837 (increase $27,956,661).

The above figures show a notable increase, in 1887 over 1886, in the aggregate output and value of both anthracite and bituminous coal.

The total production, exclusive of colliery consumption, in each State and Territory, and corresponding spot values, are shown in the following table:

Production of coal in the United States in 1887.

States and Territories.	Total production, not including colliery consumption.	Value of coal at mines.	States and Territories.	Total production, not including colliery consumption.	Value of coal at mines.
Pennsylvania:			New Mexico	508, 034	$1, 524, 102
Anthracite	39, 506, 255	$79, 365, 244	Georgia	313, 715	470, 573
Bituminous	30, 866, 602	27, 806, 941	Utah	180, 021	360, 042
Ohio	10, 301, 708	9, 096, 848	Arkansas	150, 000	252, 500
Illinois	10, 278, 890	11, 152, 596	Texas	75, 000	150, 000
West Virginia	4, 836, 820	4, 594, 979	Michigan	71, 461	107, 191
Iowa	4, 473, 828	5, 991, 735	California	50, 000	150, 000
Maryland	3, 278, 023	3, 114, 122	Oregon	31, 696	70, 000
Indiana	3, 217, 711	4, 324, 604	Dakota	21, 470	32, 205
Missouri	3, 209, 916	4, 298, 994	Montana	10, 202	35, 707
Kentucky	1, 933, 185	2, 233, 163	Rhode Island	6, 000	16, 250
Alabama	1, 950, 000	2, 535, 000	Nebraska	1, 500	3, 000
Tennessee	1, 900, 000	2, 470, 000	Idaho	500	2, 000
Colorado	1, 791, 735	3, 941, 817			
Kansas	1, 596, 879	2, 235, 631	Total	124, 015, 255	173, 595, 996
Wyoming	1, 170, 318	3, 510, 954	Colliery consumption	5, 960, 302	8, 960, 841
Virginia	825, 263	773, 360			
Washington	772, 612	1, 699, 746			
Indian Territory	685, 911	1, 286, 692	Grand total	129, 975, 557	182, 556, 837

IMPORTS AND EXPORTS.

The following tables show the imports and exports of coal for the past twenty years, compiled from official returns of the Bureau of Statistics of the Treasury Department. The values given are much higher than the "spot" rates which have been used in computing the total annual value of the coal produced in each State and Territory.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846, 30 per cent. ad valorem; 1847 to 1861, 24 per cent. ad valorem: 1862 to 1864, $1 per ton; 1865, $1.10 per ton; 1866 to 1872, $1.25 per ton; since August, 1872, 75 cents per ton. During the period from June, 1854, to March, 1866, the reciprocity treaty was in force, and coal from the British possessions in North America was admitted into the United States duty free.

The exports consist both of anthracite and bituminous coal, the amount of anthracite being the greater. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to San Francisco, from Great Britian to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

Coal of domestic production exported from the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867	192, 912	$1, 333, 457	92, 189	$512, 742
1868	192, 291	1, 082, 745	86, 367	433, 475
1869	283, 783	1, 553, 115	....	....
1870	121, 098	803, 135	106, 820	503, 223
1871	134, 571	805, 169	133, 380	564, 067
1872	259, 567	1, 375, 342	141, 311	586, 264
1873	342, 180	1, 827, 822	242, 453	1, 086, 253
1874	401, 912	2, 236, 084	361, 490	1, 587, 666
1875	316, 157	1, 791, 626	203, 189	828, 943
1876	337, 934	1, 869, 434	230, 144	850, 711
1877	418, 791	1, 891, 351	321, 665	1, 024, 711
1878	319, 477	1, 006, 843	340, 661	1, 352, 624
1879	386, 916	1, 427, 886	276, 000	891, 512
1880	392, 626	1, 362, 901	222, 634	695, 179
1881	462, 208	2, 091, 928	191, 038	739, 532
1882	553, 742	2, 589, 887	314, 320	1, 102, 898
1883	557, 813	2, 648, 033	463, 051	1, 593, 214
1884	649, 040	3, 053, 550	646, 265	1, 977, 959
1885	588, 461	2, 586, 421	683, 481	1, 989, 541
1886	682, 975	2, 707, 590	532, 846	1, 480, 940
1887	680, 138	2, 822, 833	643, 563	1, 703, 492

Coal imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1867	....	....	509, 802	$1, 412, 597
1868	....	....	394, 021	1, 250, 513
1869	....	....	437, 228	1, 222, 119
1870	....	....	415, 729	1, 103, 965
1871	973	$4, 177	430, 508	1, 121, 914
1872	390	1, 322	485, 063	1, 279, 686
1873	2, 221	10, 764	460, 028	1, 548, 208
1874	471	3, 224	492, 063	1, 937, 274
1875	138	963	436, 714	1, 791, 601
1876	1, 428	8, 560	400, 632	1, 592, 846
1877	630	2, 220	495, 816	1, 782, 941
1878	158	518	572, 846	1, 929, 660
1879	488	721	486, 501	1, 716, 209
1880	8	40	471, 818	1, 688, 312
1881	1, 207	2, 628	652, 963	1, 988, 199
1882	36	148	795, 722	2, 141, 373
1883	507	1, 172	645, 924	2, 013, 555
1884	1, 448	4, 404	748, 995	2, 494, 228
1885	4, 976	15, 848	768, 477	2, 548, 432
1886	7, 638	20, 140	774, 800	2, 492, 318
1887	3, 922	8, 951	872, 652	2, 692, 087

COAL TRADE REVIEW.

There was phenomenal growth in the coal trade of the United States during 1887. The percentage of increase over 1886 in the amount of coal handled and in its value was greater than in any previous year. There were shipped to market during the year 16,333,046 short tons of coal more than during 1886, and the increased value over the shipments of that year was $26,483,241. In 1886 there was an increase of only 1,785,881 short tons over 1885 in the amount of coal produced, including the colliery consumption, and a decrease of $4,419,420 in the total value of the coal.

There was an increase in the shipments of coal from the mines of every State and Territory in which the total shipments for the year exceeded 200,000 tons; while the average price per ton was greater than in 1886 in every State and Territory. The most notable increase in production was in the States of Pennsylvania, Ohio, Maryland, and West Virginia, where the coal is of higher calorific value than that mined elsewhere, and is therefore in greater demand at points where it can be shipped and sold in successful competition with poorer local coals.

The Pennsylvania bituminous and Ohio coal were distributed to more distant markets than ever before, and at prices which varied less from the prices commanded by local coal at consuming points than in any previous year. The cause of this result is in a large measure chargeable to the development of the Pennsylvania and Ohio natural gas fields. The local consumption of natural gas in these two States has necessarily driven a large amount of coal out of the local markets and forced it to find customers at distant points. This wider distribution gave the railroads a larger tonnage and longer hauls, and permitted of more favorable rates to all shippers. This fact, together with reduced costs of production, due to more economical management and more careful methods of mining, with a disposition on the part of the producers to accept more favorable terms of purchase, have all helped the coal from the States mentioned to enter distant markets under more favorable conditions than heretofore.

An appreciation on the part of consumers of the advantages to be derived from the use of higher-grade coal has increased the popularity, and consequently the consumption, of such coal. In Allegheny county, Pennsylvania, in which is contained the Pittsburgh natural-gas fields, the mines produced 478,838 tons, or 11 per cent. more coal in 1887 than in 1886.

In the States of California, Texas, and Oregon, and in the Territories of Utah, Montana, and Dakota, there was a falling off in the production of coal during 1887 over 1886. This was due to local causes and the increased facilities and more favorable prices at which purer and distant coals were sold. The production of coal in all of these States and Territories is comparatively so small, that the fact of the decreased production needs no comment in a review of the general coal trade.

The average price for the year, in each State and Territory, at which the coal sold at the mines, was greater than during 1886. The lowest average price was for the product of the Pennsylvania bituminous mines. This was 90 cents per ton; being 10 cents per ton more than the same coal commanded during 1886. In the Rocky Mountain region there was a notable increase in the coal produced by the Colorado and New Mexican mines.

One of the causes of the increase in the coal production of the United States in 1887 has been the expansion in the production of pig iron, manufactured iron, and steel. The extent to which the increase in the production of coal can be accounted for by the iron blast-furnace consumption may be appreciated by an inspection of the following figures:

The total production of pig iron in the United States for 1886 was 6,365,328 short tons, and for 1887, 7,187,206 tons. Of the total production for 1887, 2,338,389 tons were made with anthracite coal and coke; 578,182 tons were manufactured with charcoal; and 4,270,635 tons were manufactured with bituminous coal and coke. The production of pig iron in the following States was greater in 1887 than in 1886: Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, Alabama, Texas, Tennessee, Ohio, Illinois, Michigan, Wisconsin, Missouri, and Colorado; while in the following States the production for 1887 was less than it was for 1886: Maine, Georgia, West Virginia, Kentucky, and Indiana.

The most important increase in the production was in Pennsylvania, although its product for 1887 was only 11 per cent. over that for 1886, and in Ohio, where the product for 1887 was over 7 per cent. more than for 1886. This increase was principally in pig iron manufactured with anthracite and bituminous coal in conjunction with coke, so that the increase in the pig iron production means a corresponding increase in the coal production in these two States. The increase in the production of pig iron means a greater proportionate increase in the production of coal from the Pennsylvania mines than from the Ohio mines, since in a number of States where there is an increase in the pig iron production the iron is manufactured exclusively or largely with Pennsylvania coal and coke. Among such States may be noted the following: Massachusetts, Connecticut, New York, New Jersey, Michigan, and Wisconsin. In the State of Colorado 1,791,735 tons of coal were produced in 1887, as against 1,368,338 tons in 1886, and there was a corresponding increase in the production of pig iron, which for 1886 was 10,451 tons, and for 1887 was 25,291 tons.

No immediate increase in the production of the coal mines of the United States can be looked for during the first quarter of 1888, due to the consumption of coal by blast furnaces, on account of the condition of the iron trade and the increase of stock on hand January 1, 1888, over that on hand January 1, 1887.

The amount of pig iron manufactured with coal which was on hand January 1, 1887, and also January 1, 1888, is shown by the following table:

	1887.	1888.
	Short tons.	*Short tons.*
Anthracite and coke pig iron......	50,503	114,107
Bituminous and coke pig iron	70,634	127,978

The greatest amount of these stocks on January 1, 1888, was in the Lehigh valley, in the Shenango valley, and in Allegheny county, Pennsylvania, about 30,000 tons being in each locality; the iron in the Lehigh valley being made with anthracite and coke, and that in the latter two localities being made with bituminous coal and coke. These facts are interesting as showing the relation existing between the coal and the pig iron produced in the United States.

Mr. Frederick E. Saward, in referring to the Pennsylvania anthracite trade for 1887, says: "Anthracite was in especially good demand for all purposes—industrial and domestic—and the yearly figures of shipments show an increase of 2,500,000 tons over the preceding year; therefore the largest in the history of the industry. There was quite an increase in the tonnage furnished to the iron furnaces of the Lehigh and Schuylkill valleys; the trade with Canada has increased, and the direct trade by rail to all sections of the country has grown. It is becoming more and more evident that the all-rail trade is an increasing one, and as prices appreciate the opportunity for an expansion of this branch of the trade will naturally improve. Many places which can receive by both rail and water-routes now have the larger part of their tonnage supplied by rail.

"The strength given to prices in April, when the prices of the Philadelphia and Reading Company were announced to be the same as they had been in the closing months of 1886, was of extraordinary value to the whole trade. They were not well received, and dealers maintained that a reduction must be made. During the three months next succeeding these figures nominally ruled, being reduced at certain times; after that there was continued strength, and later in the season prices were taken out of the hands of the sellers. This continued with gradual advances until the middle of December; after the last-named date prices were weaker by fully 60 cents a ton from the higher prices, and would have fallen still lower but for the anticipation of a short supply, owing to the strike of the employés in the Schuylkill district.

"During the month of January the tidewater trade was much crippled in securing supplies, owing to the strike at the loading points, which kept back the receipts from all the districts. There was a large tonnage of the harder grades of coal lost by reason of the continued strike in the Lehigh region, from September forward to the close of the year; the output from the Wyoming district in the meantime had grown to amazing proportions, and the Schuylkill increased somewhat. The demand for the free-burning coal for domestic purposes can apparently be supplied by the one district known as the Wyoming. Considerable delay in the forwarding of supplies to the interior trade was, no doubt, caused by the uncertainty as to the result to be obtained from enforcing the interstate commerce act—during April and May particularly, and it was not until after July 4 that the trade set in with any activity, but from that time to the close of the year there was the greatest activity, and prices at the mines were held up to $3.50 per ton, an almost unheard of figure hitherto."

Wider distribution of the better coals among the States during the past few years has created a demand for information as to the special coals which can be commanded at the more prominent distributing centers. The following market reports, compiled by the authorities stated, on the first of the year (1888) will convey an idea as to the general condition of the coal markets throughout the United States at the close of 1887. Most of the prices given may be taken as averages for the winter, although on account of the long continued strike in the Lehigh district of the Pennsylvania anthracite region, the prices of anthracite at the close of the year were slightly higher than they were either at the opening or closing of the winter trade.

The following reports for Boston, New York, Philadelphia, Baltimore, and New Orleans have been made by Mr. F. E. Saward:

Boston coal market.—Current prices for Pennsylvania anthracite may be quoted as follows: $4 to $4.10 for furnace, $4.25 to $4.40 for egg, $4.75 to $5 for stove and nut, $3 to $3.10 for pea; the above delivered free on board at the New York ports, with fair dispatch in loading. Freights from New York during the first week of 1888 were quoted at $1.25 to this port, but, owing to the sudden cold snap, were advanced to $1.50.

Baltimore freights from the same cause jumped from $1.75 to $2, and charters were made at $2.25 to this port. Barges were offered to Boston shippers at $1.35.

The consumption of soft coal is increasing in the mills and factories of the eastern States from its low cost. Sales have been made within the range of $3.50 to $3.75, delivered at Boston, during the past year.

New York City coal market.—The quotations for free-burning Pennsylvania anthracites at the loading points—Hoboken, Weehawken, Port Johnson, etc.—in this harbor are $4 for broken, $4.25 for egg, $4.75 for stove and chestnut. Hard white ash is quoted at $4.25 for broken, $4.50 for egg, $4.75 for stove, $4.50 for chestnut. Lykens Valley brings $4.90 for grate and chestnut, and $5.50 for egg and stove. Plymouth red ash brings $5 for stove and chestnut, and $4.40 for egg. Water freights are 25 cents per ton delivered alongside. Pea coal is quoted at $2.65 to $3.25 per ton according to quantity.

Few of the anthracite companies now issue circulars of prices; the last issued by the Philadelphia and Reading Coal and Iron Company gave prices at Elizabethport as follows:

Prices for anthracite at Elizabethport, January 1, 1888.

	Lump.	Broken.	Egg.	Stove.	Chestnut.	Pea.
Hard white ash	$4.25	$4.25	$4.50	$4.75	$4.50	$2.65
Free-burning white ash	....	4.00	4.25	4.75	4.50	2.65
North Franklin white ash	....	....	4.45	4.75	4.35	....
Shamokin white ash	....	....	4.25	4.85	4.35	....
Shamokin red ash	....	....	4.40	5.00	4.45	....
Schuylkill red ash	....	....	4.30	4.75	4.35	....
Lorberry	....	....	4.65	5.10	4.45	....
Lykens Valley	....	4.85	5.50	5.50	4.85	....

The bituminous quotation on the basis of $2.60 at the loading ports—Norfolk, Newport News, Baltimore—is $4 alongside here, and the coals loaded at the shipping ports in this harbor can be had at nominally the same figure. Gas coal, American, is $4 per ton alongside. House cannel is quoted at $7 per net ton for the American qualities delivered.

Retail prices of anthracite coal at New York in 1887.

	Per ton.
White ash stove and nut, per short ton delivered	$6.00
White ash egg and furnace, per short ton delivered	5.75
Red ash stove and nut, per short ton delivered	6.50
Red ash egg and furnace, per short ton delivered	6.25
Peddlers (any kind of coal), per short ton at yard	5.25
Grocers and coal sellers, per short ton at yard	5.75

Consumption of coal in New York and vicinity.

	Short tons.
1. New York.	
Anthracite—for domestic purposes, manufactures, steam and heating, on the railways, ferries, etc. (*a*)	3,700,000
Bituminous—for factory, steamship, and general uses (*b*)	1,500,000
Gas and cannel coal for house use, etc.	300,000
2. Brooklyn and Long Island.	
Anthracite	1,500,000
Bituminous	400,000
3. Jersey City.	
Anthracite	350,000
Bituminous	150,000
4. Staten Island.	
Anthracite	185,000
Bituminous	40,000
Total	8,125,000

a Elevated railways 250,000 tons.
b Ocean steamships 1,000,000 tons, principally Clearfield.

Coal prices for points in Central New York.

Bituminous (average quotations free on board cars).

REYNOLDSVILLE.		FAIRMOUNT.	
Screened lump	$2.60	Lump	$2.60
Lump and nut	2.50	Lump and nut	2.50
Run of mines	2.30	Run of mines	2.30
Screened nut	2.25	Nut and slack	2.15
Nut and slack	2.15	Slack	1.95
Slack	1.90		

Anthracite (wholesale free on board cars).

Egg	$4.15	Stove	$4.38
Grate	4.15	Chestnut	4.38

Philadelphia coal market.—The freight on soft coal for local use per 2,240 pounds from Clearfield and Beech Creek districts via Pennsylvania Railroad or Philadelphia and Reading is $2.10; from Cumberland, Piedmont, and Newburgh districts, via Baltimore and Ohio, $2.20; from Meyersdale district, $2.20; from Fairmount, Tyrconnell, Clarksburgh, Bridgeport, Wilsonburgh, Wolf's Summit, Moundsville, and Youghiogheny regions, $2.80. Bituminous or soft coal is quoted at $2.70 per long ton, free on board, for coal to points east of Cape Cod.

Freight on anthracite coal for local use per 2,240 pounds, from mines in Schuylkill Haven and Tamaqua regions, $1.80; from mines near Hazleton, Beaver Meadow, Mahanoy, and Shamokin, $1.85; from mines in Pine Grove, Nanticoke, and Wilkes Barre regions, $1.95; on pea, buckwheat, and culm, 15 cents less.

Prices of hard white ash coal at the mines for Philadelphia and the line trade.

SCHUYLKILL.		LEHIGH.	
Lump and steamer	$2.60	Lump	$2.70
Broken	2.85	Broken	2.45
Egg	3.00	Egg	2.45
Stove and small stove	3.00	Stove	2.70
Chestnut No. 1	3.00	Small stove	2.70
Pea	1.35	Chestnut	2.55
Buckwheat	1.10	Pea	1.50

The circular of the Philadelphia and Reading Coal and Iron Company, for anthracite, free on board at Port Richmond, is as below:

Prices for anthracite at Port Richmond, January 1, 1888.

	Lump.	Broken.	Egg.	Stove.	Chestnut.	Pea.
Hard white ash	$4.00	$4.00	$4.25	$4.50	$4.25	$2.40
Free-burning white ash	....	3.75	4.00	4.50	4.25	2.40
North Franklin white ash	....	....	4.20	4.50	4.10	......
Shamokin white-ash coal	....	....	4.00	4.60	4.10	......
Shamokin red-ash coal	....	....	4.15	4.75	4.20	......
Schuylkill red ash	....	....	4.05	4.45	4.10	......
Lorberry	....	....	4.40	4.85	4.20	......
Lykens valley	....	4.60	5.25	5.25	4.60	......

Philadelphia freights to coastwise ports are quoted as below:

Philadelphia freights to coastwise ports.

	Per ton.		Per ton.
Portland	$1.65 and dis.	Baltimore	$0.60 alongside.
Lynn	2.00 and dis.	Charleston	.90
Boston	1.70 and dis.	Savannah	1.25
Providence	1.25 and dis.	Washington	1.15
New Bedford	1.25 and dis.	Norfolk	.90
New York	.90 alongside.	Richmond	1.02½

Baltimore coal market.

Prices for anthracite coals in cars at Baltimore and via Canton pier.

White ash.	Hard white ash.	Shamokin.	Lykens valley.	Bernice.
Broken	$4.85	....	$4.75	$5.00
Egg	5.00	$5.25	5.40	5.00
Stove	5.00	5.25	5.55	5.25
Chestnut	5.00	5.00	5.25	5.25
Pea	3.10	3.10	3.60	....
Buckwheat	2.70	2.70	....	....

Bituminous coal is quoted at $2.60 per long ton, free on board at Locust Point or Canton piers. Hampton Roads quotations are the same.

Baltimore rates of freight to coastwise ports.

	Per short ton.		Per short ton.
Bath	$2.00	New York	$1.45
Portsmouth	2.00	Hoboken	1.40
Boston	2.00	Key West	2.00
Bridgeport	1.45	Galveston	3.00
Providence	1.45	Savannah	1.25
Cuba, N. S	1.75	Charleston	1.00

The Baltimore and Ohio railroad shipped to Baltimore during the year 2,167,007 tons of coal, and the Northern Central railroad (operated by the Pennsylvania railroad) 765,082 tons.

Prices of coal in New Orleans.

By boat load	per barrel	$0.38
To steamboats	do	.45
To steamships	per ton	4.00
To families, 50 cents per barrel	per hogshead	5.00
Alabama coal:		
Splint, to families	per barrel	$0.50
Corona, to families	do	.50
Cahaba, to families	do	.55
Montevallo, to families	do	.60
Pratt coal, on cars, per Louisville and Nashville railroad	per ton	4.25
Anthracite, per ton		$10.50 to $11.00

It is estimated that there were shipped to New Orleans during the year 5,450,000 barrels of coal, and that 5,100,000 were consumed in the city.

The following market reports, except those for which special credit is given, have been reported by Mr. H. A. Bischoff, editor of *The Black Diamond.*

Pittsburgh coal market.—Following are the ruling prices of coal (mined from the Pittsburgh coal bed) at the tipple per 100 bushels (26¼ bushels per short ton):

Prices of coal in Pittsburgh.

First pool	$4.75	Third pool	$3.90
Second pool	4.50	Fourth pool	3.25
Railroad coal, on the wall	$5.00 to 5.25		
Coke, free on board at ovens.			
Blast furnace	$1.75 to 2.00	Foundry	$2.00 to 2.30

The year 1887 will long be remembered as one of unusual low water in the Monongahela and Ohio rivers. It is very doubtful whether the coal men will find an even balance for the season, considering the enormous expense of taking care of a large fleet lying positively idle from June 15 to January 1. The past year shows the smallest amount of coal shipped for a long time, a decrease, as compared with the shipments of 1886, of 34,921,000 bushels. Pittsburgh could easily ship 100,000,000 bushels of coal per annum, whereas the total figures for 1887 represent little more than half that amount.

The price of Monongahela coal at Cincinnati from January to July averaged 6¼ cents per bushel, from August to December at 7¾ cents per bushel, and during December at 11 to 12 cents per bushel.

Prices of coal in Cincinnati.

Anthracite.	Free on board car.	Delivered.	Bituminous.	Free on board car.	Free on board barge.
	Short ton.	*Short ton.*		*Short ton.*	*Short ton.*
Chestnut	$7.00	$8.00	Youghiogheny. 2d pool.	$3.33	$2.78
Range or stove	7.00	8.00	Kanawha river	3.06	2.50
Grate	7.00	8.00	Ohio river	1.94	2.50
Egg	7.00	8.00			

The first coal barge after June 15, 1887, arrived at Cincinnati the first week in January, 1888. This long period of low water is without a precedent. The markets between Pittsburgh and New Orleans were all sold out in the early winter, and some cities actually suffered for want of coal. During the early part of January, 1888, the movement of coal from both the Pittsburgh and Kanawha regions was large. The shippers agreed upon 10 cents per bushel afloat for second pool and 9 cents for fourth pool at Cincinnati. The total receipts of coal in 1887 were 63,345,532 short tons.

Prices of coal in Louisville, Kentucky.

Anthracite.	Free on board car.	Bituminous.	Per bushel.
	Short ton.		*Cents.*
Chestnut	$7.50	Pittsburgh	13 to 15
Range or stove	7.50	Kentucky	11
Grate	7.25		
Egg	7.25		

Coal consumed at Louisville during 1887.

	Short tons.
Pittsburgh by river	646,000
Ohio river and Kanawha	72,800
Bituminous by rail	232,107
Anthracite	4,241
Coke	49,688
	1,004,836

Buffalo coal market.—The nominal quotations ruling at Buffalo at the end of the year were as follows:

Prices of coal at Buffalo, New York.

Sizes.	Free on board vessel. Buffalo.	To dealers on cars at Buffalo.	To dealers on cars at bridges for shipment West.	Retail, screened and delivered.
	Long ton.	*Long ton.*	*Long ton.*	*Short ton.*
Grate	$5.75	$5.75	$5.50	$5.50
Egg	5.75	5.75	5.50	5.50
Stove	6.00	6.00	5.75	5.75
Chestnut	6.00	6.00	5.75	5.75
Pea	....	....	....	4.50

Bituminous (per short ton on track nominal).

REYNOLDSVILLE REGION.		ALLEGHENY VALLEY RAILROAD AND MERCER COUNTY REGION.	
Screened lump	$2.60	Lump, screened	$2.50
Lump and nut mixed	2.50	Lump and nut, screened and mixed	2.40
Run of mines	2.35	Run of mines	2.25
Screened nut	2.35	Nut and slack mixed	2.05
Nut and slack mixed	2.05	Slack	1.85
Slack	1.85		
BRIAR HILL REGION.		FAIRMOUNT AND LOWER GRADE DIVISION OF ALLEGHENY VALLEY RAILROAD.	
No. 1 lump	3.50	Lump, screened	2.50
No. 2 lump	2.75	Lump and nut mixed, screened	2.40
PITTSBURGH REGION.		Run of mines	2.25
Lump, screened	2.60	Nut screened	2.25
Lump and nut mixed	2.50	Nut and slack mixed	2.05
Run of mines	2.35	Slack	1.85

Cannel (per short ton on track).

Ohio	$4.75

Coke (per short ton on track in car lots).

Connellsville	$5.00	Reynoldsville	$4.00

Loyalsock coal (per short ton delivered).

Stove	$5.00	Egg	$4.75
Chestnut	5.00	No. 2 chestnut	4.00

There were shipped from Buffalo by lake during the year 1,894,000 tons of anthracite and by rail 1,174,131 tons.

Detroit coal market.—The ruling rates per ton, delivered, are as follows:

Prices of coal per short ton in Detroit, Michigan.

Anthracite:		Bituminous (domestic)—Cont'd.	
Grate and egg	$6.75	Massillon lump	$4.50
Stove and chestnut	7.00	Massillon nut	3.50
No. 2 chestnut	5.75	Crushed coke	5.50
Lehigh lump	8.25	Gas coke	4.50
Lehigh nut	7.75	Bituminous (steam):	
Bituminous (domestic):		Lump	3.10
Cannel lump	5.00	Nut	2.75
Cambridge, Hocking and O. C. lump	4.00	Lump and nut mixed	3.00
Cambridge, Hocking and O. C. nut	3.50	Pea coal	2.50
		Slack	2.00
		Connellsville coke	5.75

Chicago coal market.—The following are the current quotations:

Prices of coal per short ton in Chicago, Illinois. (*a*)

Erie	$4.50	Blossburgh	$4.00
Pittsburgh	3.35	Brookfield, Briar Hill	4.50
Youghiogheny	3.40	Indiana block	2.80
Mount Vernon smithing	3.90	Wilmington	2.25
Cumberland smithing	3.90	Grape Creek	2.25
Sonman smithing	3.90	Fountain County	2.25
Hocking Valley	3.25	Minonk	2.25
Shawnee	3.25	Streator	2.25
Brush Creek cannel	4.50	Morris	2.25
Kanawha cannel	4.75	Norton Creek	2.25
Buckeye cannel	4.25	Mount Olive	2.25
Wellston	3.40	Jackson Hill	3.40
Winifrede lump	3.50	Connellsville coke	5.35
Winifrede nut	3.25	Pittsburgh coke	4.25
Fire Creek smithing	3.50	Walston coke	5.15
Raymond	4.00	Walston coke, crushed	5.70
Sunday Creek	3.25	New River coke	5.50
Peacock	2.50	Pocahontas coke	5.50
Summit semi-block	2.50		

a January 1, 1888.

Anthracite, free on board cars in Chicago.

Lehigh lump	$6.00	Stove	6.75
Grate	6.50	Chestnut	6.75
Egg, small	6.75	Egg, large	6.55

Following are the receipts of coal and coke at and shipments from this market during December, and for the year 1887, as compared with those of a like period in 1886.

Coal receipts and shipments at Chicago.

RECEIPTS.

	December.		From January 1 to December 31.	
	1887.	1886.	1887.	1886.
Anthracite by lake	36,619	46,644	853,158	768,164
Anthracite by rail	85,869	98,104	845,386	616,997
Pennsylvania and West Virginia	57,134	49,571	537,022	166,762
Ohio	115,913	94,783	782,523	888,771
Illinois	150,894	143,666	1,375,759	1,175,001
Indiana	118,440	95,392	1,154,681	732,191
Coke	68,946	51,263	592,980	540,204
Total	633,815	579,164	6,141,509	4,888,090

SHIPMENTS.

Anthracite	67,772	44,363	559,560	451,869
Bituminous coal and coke	103,260	71,688	952,577	539,184
Total	171,032	116,051	1,512,137	991,053

Milwaukee coal market.—The prices of coal in this market vary but slightly from those already given as ruling in the Chicago market. The following statistics are taken from the report of Mr. C. H. Swan, secretary of the Milwaukee coal exchange; they show the tonnage of coal received by lake during 1887, also stocks in hand December 1, 1887, and a comparison with similar statistics for 1886:

Milwaukee coal trade.

	Short tons.	
Total amount of anthracite coal received during season of 1886	523, 807	
Total amount of soft coal received during season of 1886	252, 580	
Total hard and soft coal received by lake		776, 387
Total amount of anthracite coal received during season of 1887	528, 992	
Total amount of soft coal received during season of 1887	239, 624	
		768, 616
Showing a decrease of only		7, 771
Total amount of anthracite coal received during season of 1887	528, 992	
The total amount of anthracite coal received during the season of 1886, as reported by the custom-house, was 468,607 tons. Of this amount I find 8,607 was short tons, and 460,000 was long tons; reduced to short tons would be	523, 807	
Increase over 1886		5, 185
Total amount of soft coal received during season of 1887	239, 624	
Total amount of soft coal received during season of 1886	252, 580	
Decrease as compared with 1886		12, 956
Total amount of anthracite coal received as stated		528, 992
Deliveries to December 1, 1887		380, 320
Amount of anthracite in stock December 1, 1887		148, 672
Total amount of soft coal received as stated	239, 624	
Deliveries to December 1, 1887	189, 871	
Balance as reported on hand December 1, 1887		49, 753
Of this amount (49,753 tons) it is safe to estimate fully 20,000 tons still due on contracts running to May 1, 1888, which would leave subject to future sales		29, 753
Amount of anthracite coal in stock in dealers' hands May 1, 1886	50, 000	
Amount received as herein noted during 1886	523, 807	
Total		573, 807
Amount in stock May 1, 1887	7, 000	
Amount received as herein noted	528, 992	
		535, 992
Showing an actual shortage of		37, 815
Stock of anthracite coal in dealers' hands as reported December 1, 1887		148, 672
Statistics according to sizes:		
Grate		17, 547
Egg		23, 275
Stove		55, 850
Chestnut		52, 000

Ruling coal prices in Saint Paul and Minneapolis.

Anthracite.			
Chestnut	$9. 50	Egg	$9. 50
Stove	9. 50	Grate	9. 25
Bituminous.			
Cannel	$8. 00	Kincaid	$6. 50
Briar Hill	7. 50	Indiana block	5. 75
Cumberland	7. 00	Illinois	4. 50
Mansfield	6. 75		

The stock of anthracite coal (290,116 tons) received at the head of the lakes during the navigation season of 1887 has been drawn upon in a manner which naturally suggests the probability that, before navigation opens, fresh supplies must come forward by rail. This does not indicate a decline in prices.

Prices of coal in Fargo, Dakota.

Anthracite coal.	Free on board car.	Bituminous coal.	Free on board car.
	Short ton.		*Short ton.*
Chestnut	$9.75	Mansfield	$7.25
Range or stove	9.75	Hocking	6.50
Grate	9.50	Youghiogheny	7.00
Egg	9.75	Briar Hill	8.00
		Cannel	7.50

Prices of coal in Indianapolis, Indiana.

Anthracite (free on board cars) per short ton.			
Broken	$6.30	Stove	$6.53
Egg	6.30	Chestnut	6.53
No. 4	6.53	Dust	1.25
Bituminous (free on board cars) per short ton.			
Indiana block	$2.60	Pittsburgh lump	$3.25
Lower vein block	2.70	Peacock lump	2.10
Jackson lump	3.10	Highland	2.00
Raymond lump	3.25	Highland nut	1.25
Winifrede lump	3.25	Peacock nut	1.35

Gas coke, 12 cents per bushel; crushed gas coke, 13 cents per bushel.

Prices of coal in Joliet, Illinois.

Anthracite coal.	Retail, delivered.	Bituminous coal.	Retail, delivered.
	Short ton.		*Short ton.*
Chestnut	$8.50	Wilmington	$3.50
Range or stove	8.50	La Salle	3.25
Grate	8.25	Streator	3.00
Egg	8.50	Block	4.75
		Cannel and Briar Hill	6.50

Prices of coal in Dubuque, Iowa.

Anthracite coal.	Retail.	Bituminous coal.	Retail.
	Short ton.		*Short ton.*
Chestnut	$9.00	Cannel	$7.00
Range or stove	9.00	Cumberland	7.00
Grate	8.75	Wilmington	3.52
Egg	8.75	La Salle	3.25
		Minonk	3.25
		Streator	3.00

Prices of coal in Davenport, Iowa.

Anthracite.	Retail.	Bituminous.	Retail.
	Short ton.		*Short ton.*
Chestnut	$9.00	La Salle	$3.50
Range or stove	9.00	Mercer County	3.25
Grate	9.00	Hocking Valley	6.50
Egg	9.00		

The retail trade at this point is in excellent condition. The jobbing trade in Illinois coal, at mine prices, is very steady and of quite a large volume.

Prices of coal in Saint Louis, Missouri.

(Bituminous.)

	B.	C.	D.	Big Muddy.
East Saint Louis (free on board)	$1.50	$1.62½	$1.75	$2.25
Saint Louis (free on board)	1.87½	2.00	2.12½	2.62½
Delivered	2.50	2.50	2.50	3.25

Anthracite (free on board).

Grate and egg	$9.25
Stove and nut	9.50

At the close of 1887 the anthracite market was much easier, the supply having increased and the demand decreased. This state of affairs did not, however, result in any decrease in prices, they remained $9.25 to $9.50 per ton. December receipts, for the first time in that year, showed a decrease all around, bituminous, anthracite, and coke; but the year's business showed a very creditable increase, as the following figures will demonstrate:

Coal and coke receipts at Saint Louis, Missouri.

	Receipts for month.		Receipts for year.
Bituminous:	*Short tons.*	Butuminous:	*Short tons.*
December, 1886	224,545	1886	2,082,019
December, 1887	222,720	1887	2,321,814
Decrease	1,825	Increase	239,795
Anthracite:		Anthracite:	
December, 1886	15,899	1886	96,440
December, 1887	13,083	1887	131,600
Decrease	2,816	Increase	35,160
Coke:		Coke:	
December, 1886	21,173	1886	104,036
December, 1887	16,679	1887	175,550
Decrease	4,494	Increase	71,514

The following prices are for coal, free on board cars, at Kansas City:

Prices of coal in Kansas City, Missouri.

	Short ton.		Short ton.
Bituminous:		Bituminous—Continued.	
Farmers' lump	$3.00	Wellington	$2.75
Weir City lump	2.75	Cannel	4.50
Weir City nut	2.50	Anthracite:	
Oakdale lump	2.75	Nut size	10.75
Oakdale nut	2.50	Stove size	10.75
Rich Hill lump	2.60	Egg size	10.75
Rich Hill nut	2.40	Grate size	10.50
Lexington lump	2.50	Smithing coal:	
Higginsville lump	2.75	Piedmont	8.25
Excelsior lump	3.00	Blossburgh	8.25
Clinton lump	2.60	Coke:	
Foster lump	2.50	Gas-house	5.00
Deepwater lump	2.60	Connellsville	8.00

For further facts relating to the various coal markets, particularly those in California, reference should be made to the State reports which are given farther on.

WAGES AND STRIKES.

The prices paid for mining coal depend upon the character of the coal, which determines the difficulty of mining, and upon the selling price which the coal will command at the mine.

In the Pennsylvania anthracite region the prices paid have been largely influenced by the ruling prices in the Schuylkill district. For a number of years these have been determined by the average price at which coal sold at several collieries selected from time to time. Upon this basis the price of coal is never taken at less than $2.50 per ton at Schuylkill Haven, even when the coal may be sold at a lower figure. If the selling price is above $2.50 per ton the wages are advanced 1 per cent. for each advance of 2½ cents in selling price. The following table exhibits the variation in the rate of wages during each month of the year:

Months.	Average price of coal.	Wages paid on.
January	\$2.51 $\frac{16}{100}$	Basis.
February	2.51 $\frac{4}{100}$	Basis.
March	2.55	2 per cent. over.
April	2.58 $\frac{6}{100}$	3 per cent. over.
May	2.50 $\frac{9}{100}$	Basis.
June	2.60 $\frac{56}{100}$	4 per cent. over.
July	2.50 $\frac{6}{100}$	Basis.
August	2.48 $\frac{6}{100}$	Basis.
September (and 2 weeks of October)	2.44 $\frac{5}{100}$	Basis.
October (and 2 weeks of November)	2.61 $\frac{92}{100}$	4 per cent. over.
November (and 2 weeks of December)	2.85 $\frac{49}{100}$	12 per cent. over.
December	2.71 $\frac{5}{100}$	7 per cent. over.

In September it was agreed that wages on the $2.50 basis should be 8 per cent. more than they had previously been on that basis; thus, if a man earned $2 a day on the $2.50 basis previously, he would then be entitled by the new $2.50 basis (granting 8 per cent. advance) to $2.16 per day, plus the percentages due by any increase in the average price of coal above $2.50 per ton. Thus in November they had virtually 20 per cent., and in December 15 per cent., more wages than in January and February.

In the Pennsylvania bituminous region there is not as great uniformity in wages as in the anthracite region. This is due largely to greater differences in the character of the coal in the various districts.

Throughout the Pittsburgh region the rate for mining was fixed for lump coal over 1½ inch screen at 74 cents per ton of 2,000 pounds, from May to November, and at 79 cents from November, 1887, to May, 1888. Among the River operators of the Monongahela region, the rate above the Third Lock on the Monongahela river decreased as the bed became thicker and the mining easier; thus the Fourth pool had a different rate from the Third and the latter a different rate from the Second and First pools, respectively. Throughout the Connellsville region the rate varied slightly during the year at the different mines, but averaged about $1 per 100 bushels (76 pounds each) of coal mined. In this region mining is comparatively easy, and as lump coal is not desired for coking, in the greater part of the region mining is done by shooting the coal down by blasts; in the remainder of the region the coal is mined by the pick. Bearing in and shearing are seldom practiced in the coking region.

The Clearfield district had its special rate, 50 cents per ton; the Reynoldsville 45 to 55 cents, and the Mountain district 45 cents. The Clearfield district may be said to include the Moshannon and Snowshoe region in Clearfield and Centre counties. The Reynoldsville district is confined to Jefferson county and to the vicinity of Du Bois, in Clearfield county, while the Mountain district embraces Cambria and Blair counties, with parts of Clearfield county. Throughout these districts the coal is sold as run-of-mine, and this is the basis of the mining rate, while in the Pittsburgh district the mining rate is based on the amount of lump coal mined; hence the rate in the former district was in reality not much below that paid in the Pittsburgh region. The rate in the Broad Top region, including Huntingdon and Bedford counties, was about the same as that in the Mountain and Clearfield districts.

The Somerset or Meyersdale region being in reality a part of the Cumberland coal basin in Maryland, its mining rate (40 to 50 cents) is largely regulated by the current rate adopted in the Cumberland region, which is 50 cents. The same comparison might be made between the Sharon block coal of Mercer county and the Briar Hill region in Ohio. Other small districts have special rates of their own.

The following table contains the prices paid for mining in a number of important districts, in addition to those which have been specially noted above and in the body of the report:

Prices paid for mining coal.

Mines.	Prices paid.
Alabama:	
Generally	65 cents per ton.
Montevallo mines	$1 per ton, 2 foot bed.
Colorado, Boulder mines	82½ cents per ton.
Iowa:	
Angus mines	90 cents per ton.
Ottumwa mines	80 cents per ton.
What Cheer mines	75 cents per ton.
Indiana:	
Block coal	85 cents per ton.
Bituminous coal	72½ cents per ton.
Illinois:	
Mount Olive mines	61½ cents per ton.
Peoria mines	70 cents per ton.
Wilmington mines	80 cents per ton.
Kansas:	
Generally	6 cents per bushel.
Leavenworth mines	4 cents per bushel.
Kentucky:	
Eastern mines	75 to 87½ cents per ton.
Western mines	62½ to 75 cents per ton.
Maryland, George's Creek mines	50 cents per ton.
Missouri:	
Lexington mines	$1 per ton.
Richmond mines	4 cents per bushel.
Ohio, Hocking Valley mines	65 cents per ton.
Oregon, Coos Bay mines	$1.12½ per ton.
Virginia, Pocahontas mines	45 cents per ton.
West Virginia:	
Clarksburg mines	45 cents per ton.
Elk Garden mines	50 cents per ton,
Kanawha mines	2½ cents per bushel.

During the year, according to *Bradstreet's*, there was a total of 56 strikes among the coal miners and laborers concerned directly or indirectly in mining or handling the product of the coal mines. In these strikes there were 30,475 men involved, the total number of idle days aggregating 876. None of these strikes can be considered strictly successful in accomplishing all that was claimed by the laborers, yet 39 of them seem to have improved to some extent the condition of the laboring class after the strike, compared to the condition which existed before the strike took place. It is believed, however, that in most of these 39 strikes the same recognition of the claims of the laborers would have been obtained from the employers if a fair demand had been made by them and the result had been left open as a matter of adjustment or arbitration. The time and money lost by the men from the commencement of the strikes to their close was so great that it is questionable whether any real gain was obtained.

In the 39 strikes which are reported as successful, 24,115 men were involved, and the aggregate number of days during which the strikes lasted was 648. In the remaining 17 strikes 6,360 men were involved, and the aggregate number of idle days was 228. These strikes were absolute failures, as far as accomplishing any of the objects for which they were planned, and resulted in pecuniary loss to both employés and employers, the greater loss, however, being suffered by the employés, not only in actual money which they might otherwise have gained by remaining at work, but in many cases in personal distress (suffering from the want of proper shelter, food, and clothing) to both themselves and their families.

The principal strikes which have been noted as successful are as follows:

Successful coal strikes in 1887.

Localities.	Days out.	Number of miners.	Localities.	Days out.	Number of miners.
Blossburgh, Pennsylvania	14	1,200	Hocking Valley	2	2,500
Monongahela Valley	10	7,000	Laurel, Kentucky	49	1,000
Peoria, Illinois	21	2,000	Springfield, Illinois	60	1,500

Among the unsuccessful strikes may be noted the following: Coal handlers at Jersey City, 3,000 men, out 42 days; coal miners at Parkersburgh, West Virginia, 1,000 men, out 7 days. A lockout occurred among the Blossburgh, Pennsylvania, coal miners during the year which involved 1,200 employés. This lockout was compromised between the employers and the employés, and is noted as one of the most successful strikes, since strikes or lockouts which end in a compromise are usually considered successful by the employés. At the close of the year there were four strikes which were still in progress, as follows: Among the coal miners at Tamaqua, Pennsylvania, the strike began

August 10, and continued to the end of the year, 140 days, and involved 100 men. The largest strike which was not ended on January 1, was that of the coal miners in the Lehigh valley, Pennsylvania, which commenced on September 10, 110 days prior to January 1, 1888, and in which 25,000 employés were concerned. At Sharon, Pennsylvania, a strike was begun by 500 miners on November 21, which up to the end of the year had lasted 41 days, and at Pittsburgh the same number of coal miners struck on December 24. These strikes were all existing at the end of the year.

It is estimated that the coal handlers' and sympathetic strikes in New York and New Jersey aggregated a loss to the men of $2,650,000, while the direct loss to the laboring class by the strike of the 25,000 men and boys in the Lehigh coal region, up to January 1, was at least $2,500,000.

THE WORLD'S COAL PRODUCTION.

The following table shows the commercial coal produced by the principal countries of the world.

Long tons of 2,240 pounds are used in giving the statistics of Great Britain, the United States, Australia, India, Nova Scotia, New Zealand, British Columbia, and Russia, and the metric ton of 2,204 pounds for all continental countries except Russia.

The world's production of coal.

Countries.	Quantity.	Countries.	Quantity.
	Tons.		*Tons.*
Great Britain (1887)	162,119,812	New Zealand (1886)	534,353
United States (1887)	116,049,604	India, Bengal (1886)	951,001
Germany (1886)	73,637,596	Borneo (1884)	5,866
France (1887)	21,402,949	Nova Scotia (1887	1,700,000
Belgium (1887)	19,216,031	British Columbia (1886)	326,635
Austria and Hungary (1886)	20,779,441	Japan (1884)	900,000
Russia (1886)	4,650,000	Australia (1886)	2,830,175
Sweden (1885)	264,000	Other countries (1887)	5,000,000
Spain (1886)	1,000,000		
Italy (1886)	314,145	Total	431,681,598

ALABAMA.

Total production in 1887, 1,950,000 short tons; spot value, $2,535,-000.(*a*) The coal regions of the State lie in the extreme southern part of the Appalachian coal field, the northern end of which lies along the western New York-Pennsylvania State line; between these limits, portions of the field are contained in Pennsylvania, Ohio, Maryland, Virginia, West Virginia, Kentucky, Tennessee, and Georgia. During the past year no extended surveys have been made which give any more exact knowledge as to the area of the Alabama fields, which according

a Since the publication of the summary report, June 15, 1888, additional returns have been received from Alabama mines which has increased the total production for the year 50,000 short tons, and the spot value $65,000, about the amount then given.

to the latest estimates made by Mr. Henry McCalley, of the State survey, cover 8,660 square miles.

Many local names are being employed by local mining men to designate special parts of the region, although for general descriptive purposes a division into the Warrior, Cahaba, and Coosa fields is quite sufficient, the first named covering an area over ten times as large as the area of the other two combined. All the area underlaid by coal measures and drained by both forks of the Warrior river, its tributaries, and the Tennessee river and its tributaries in Alabama, is known as the Warrior coal field. The Coosa field extends northeast and southwest from Calera to Eastport, a distance of about 60 miles, the width of the field ranging from 5 to 12 miles. It has been recently estimated that the Coosa field embraces about 30 square miles in the northwestern part of Calhoun county, about 150 square miles in Saint Clair county, and about 235 square miles in Shelby county, making an aggregate of 415 square miles. It has been estimated also that the Cahaba field includes about 50 square miles in Saint Clair county, 100 in Jefferson county, 160 in Shelby county, and 125 in Bibb county, aggregating 435 square miles. Only 75 square miles in Bibb county are free from drift, so that the area depending upon the coal measures for its soil is reduced to 385 square miles.

The relative importance of the several counties in the production of coal may be gathered from the following summary table:

Production of coal in Alabama in 1887 by counties.

Counties.	Production.	
	Short tons.	Per cent.
Jefferson	1,384,000	70
Bibb	230,000	12
Saint Clair	53,000	3
Walker	222,000	11.5
Tuscaloosa	9,000	.5
Shelby	52,000	3
Total	1,950,000	100.0

It has been estimated in a rough way that there are 108,394,000,000 tons of available coal in the Warrior field in seams over 18 inches thick, of which there are 50 included in the Coal Measures, which attain their maximum thickness of 3,000 feet, more or less, near Tuscaloosa. Such estimates as these are of no practical value, since it is a matter of very little importance to the interests of the State or the coal trade whether the coal fields contain 50,000,000,000 tons more or less, while there may be said to be in sight sufficient coal, excluding all other fields, to meet the wants of the entire United States for many years. These estimates, however, have been the basis for the most absurd statements as to the preponderance of coal in Alabama over all other States, and it may be of interest in this connection to give some general figures for other coal fields as a basis for comparison. The thickness of the bituminous Coal Measures proper in Pennsylvania is 2,600 feet, to which must now be added 1,200 feet, the thickness of the Pocono Sandstone, No. X., which contains valuable coal beds now being extensively worked in the vicinity of Altoona, making a total thickness of productive coal measures of 3,800 feet, containing workable coal beds aggregating in thickness, in many places, over 100 feet. In the Pennsylvania anthracite region the thickness of the Coal Measures in the Pottsville basin is 3,100 feet, containing workable coal beds having an average aggregate thickness of 120 feet, although in one part of the region the Mammoth coal bed attains a thickness of over 100 feet; a thickness of over 50 feet in extended areas is not infrequent in this bed. In the Pennsylvania bituminous region, there are estimated to be at least 33,500,000,000 tons of merchantable coal within easily attainable depths in coal beds which are over 2 feet 6 inches thick. In beds over 18 inches thick and at all depths there certainly are in Pennsylvania 120,000,000,000 tons of merchantable coal. A very conservative estimate of the amount of merchantable coal in Illinois in beds of present workable dimensions is 30,000,000,000 tons. In Ohio and West Virginia the amount of merchantable coal contained is quite comparable with that contained in Illinois and Pennsylvania. While no practical advantage is to be gained by general statements to prove the importance of the field of any one State, the above figures would hardly warrant the statement which is currently made, that Alabama contains a greater thickness of Coal Measures and more available merchantable coal than any other State.

The geological structure of the coal beds of Alabama is variable as to their dip. In the Warrior or more western field the coal beds lie in more generally horizontal positions than in either the Cahaba or Coosa fields, where they dip at all angles, in some cases being completely overturned.

The most valuable coal bed developed in the State, and from which the greater amount of coal is mined, is the Pratt bed, in the Warrior field, though there are believed to be several other seams equally as good. According to Prof. Eugene A. Smith, State geologist, the seam at Blocton, in the Cahaba field (Bibb county), is over 6 feet thick, free from shale, and in every respect equal to the Pratt seam. There are other coals which coke equally well, though not mined or coked to the same extent as the Pratt bed. The thickness of the Pratt bed varies from 4 to 6 feet; the average thickness of the bed for mining purposes throughout the field may be considered to be 4½ feet. One of the most persistent geological features of this bed is the occurrence of a slate parting from 2 to 3 inches thick 7 inches from the top of the bed. As the bed is mined its product is generally 33 per cent. of lump coal and 66 per cent. of nut and slack, the latter percentage being utilized chiefly in the coke ovens. It is generally estimated that the Pratt bed will yield, on an average, about 4,000 tons of merchantable coal to an acre.

Statistics for 1887, from all the known mines in the State, were obtained through returns made by each company direct to the Survey; the names of a number of new coal-mining establishments being furnished by Professor Smith, State geologist. The total production from these returns is 1,945,812 short tons, including all the coal mined, whether used for making coke or whether shipped as coal.

If all the coal which is mined at country banks for local consumption should be included, and for which no returns have been reported, it is believed that 1,950,000 tons would be a maximum estimate for 1887. A summary of the returns received from the individual mines is given in the following table:

Returns from individual coal mines in Alabama in 1887.

Names of companies.	Location.	Production.	No. of mines.	Miners, etc.	Wages.	Price at mines.	Days worked.
JEFFERSON COUNTY.		*Short tons.*			*Per ton.*		
Tennessee Coal, Iron and Railroad Company.	Pratt mines	711,606	4				
Henry Ellen Coal Company	Henry Ellen	*a*41,000	2				
Sloss Iron and Steel Company.	Coalburg and Brookside.	189,555	4				
Watts Coal and Iron Company.	Warrior	23,000	3	75	$0.70	$1.20	200
Warrior Coal and Coke Company.	......do	42,050	7	100	.70	1.20	250
Mabel Mining Company	......do	30,000	1	90		1.20	200
Pierce Warrior Coal Company.	......do	51,900	3	55 to 90	.70	1.20	
Hoene Consolidated Coal Company.	......do	58,220	3	200	.70	1.20	262
Milner Coal and Railroad Company.	Newcastle	65,000	2			1.25	
Woodward Iron Company	Woodward	60,676	1	100	.50		310
J. S. Carr & Co	Morrow's mines	110,000	1				
Total		1,383,007	31				
BIBB COUNTY.							
Brierfield Coal and Coke Company.	Brierfield	72,000	2	200	.70	1.50	250
Cahaba Coal Mining Company.	Blocton	157,821	6	550	.55		250
Total		229,821	8	750			
SAINT CLAIR COUNTY.							
Coosa Coal and Coke Company.	Brokenarrow	None	2				
Saint Clair Coal Company	Ragland	52,141	1	50	.40	1.15	275
Total		52,141	3				
WALKER COUNTY.							
Wolf Creek Coal Company	Corona	530	1	24	.72½	1.50	19
Penn. Mobile Coal Company	......do	*a*44,000	1				
O'Brien Coal Company	......do	10,500	1	45	.72½	1.30	175
Virginia and Alabama Mining and Manufacturing Company.	Patton and Coal valley.	60,000	3	263	.72½	1.37½	146
T. H. Dunn & Co	York	*a*18,750	1				
Frief & Moore	Horse Creek mines	15,000	1				
Kansas City Coal and Coke Company.	Carbon Hill	2,000	1	75	.55	1.40	24

a No returns received; production estimated to be same as that reported for 1886.

Returns from individual coal mines in Alabama in 1887—Continued.

Names of companies.	Location.	Production.	No. of mines.	Miners, etc.	Wages.	Price at mines.	Days worked.
WALKER COUNTY—continued.		*Short tons.*			*Per ton.*		
B. M. Long & Co	Cordova	10,000	1				
E. Donaldson & Co	Coal valley	14,000	2	50	.55-.60	1.37½	146
Black Diamond Coal Company.	Patton	12,500	1	50		1.25	150
Norrell & Co	Day's gap	13,758	1	23	.60-.72½	1.25	100
Corona Coal and Coke Company.	Corona	20,000	1	125	.62½-.72½		
Total		221,038	15				
TUSCALOOSA COUNTY.							
A. Durie and others	Tuscaloosa	5,250	1				
Mines near Clement's Station, no returns.							
Alabama Insane Hospital	Tuscaloosa	3,000	1	4	.87½		
Total		8,250	2				
SHELBY COUNTY.							
Montevallo Coal and Iron Company.	Aldrich	36,555	1	175	1.00	2.50	260
Unreported	Stonestreet mines	15,000					
Total		51,555	1			2.50	
Total for the State		1,945,812	60			1.30	

The Pratt mines are operated by the Tennessee Coal, Iron, and Railroad Company, which also operates the Tracy City and Whitwell mines, in Tennessee. The Pratt mines one year ago had a daily capacity of 2,500 tons; at the end of 1887 this had been increased to 3,000 tons. It is planned to increase this to 4,000 tons during the early part of 1888, and to 5,000 tons by the spring of 1889.

Although the proportion of the company's coal mined in Alabama which is coked is not reported, a comparative idea may be gained from the following complete returns:

Statistics of the Tennessee Coal, Iron, and Railroad Company, 1887.

	Production.
	Short tons.
Pratt mines	711,606
Tracy City	415,485
Whitwell	12,529
Total	1,139,620
Total consumed at mines, including amount made into coke	509,288
Total shipped to outside markets	630,332
Total	1,139,620

Exclusive of the above company, the amount of coal coked, as reported by the different companies, was as follows:

Coal made into coke in Alabama in 1887. (a)

Name of company.	Coal coked.	Name of company.	Coal coked.
	Short tons.		*Short tons.*
Sloss Iron and Steel Company.	63,600	Woodward Iron Company.....	60,676
Watts Coal and Iron Company	2,000	Briarfield Coal and Coke Company	48,000
Warrior Coal and Coke Company	2,042	St. Clair Coal Company	15,047

a Exclusive of the Tennessee Coal, Iron and Railroad Company.

An analysis of the coal produced by the Sloss Iron and Steel Company, made by Prof. J. L. Campbell, and reported by the company as showing the average quality of the coal produced from their mines, is as follows:

Analysis of coal from the Sloss Iron and Steel Company, Alabama.

	Per cent.
Ash..	3.014
Fixed carbon	65.075
Volatile matter	30.745
Sulphur..	1.203
Water	.935

Specific gravity 1.295.

The Sloss Company is operating four drift openings into the Pratt seam, a mile back from Coalburgh railroad station, and two small openings have been made near the depot. The coal in this part of the field will average about 3 feet in thickness. A new mine has also been opened at Brookside station, 6 miles west of Coalburgh, from which it is hoped good coal can be mined. The bed shows a somewhat greater thickness than at Coalburgh.

The 95 bee-hive coke ovens near the No. 4 and B mines are kept constantly in blast, supplying coke for the Williamson furnaces in Birmingham.

The Sloss Iron and Steel Company is preparing to make extensive improvements about its coal plants, and expects in the near future to furnish the coal from these works for the 250 coke ovens at its two large furnaces in Birmingham, and also to make coke for supplying the two new furnaces now building at North Birmingham, one of which will probably be blown in about the first of April. At No. 3 mine, the tail-rope haulage system has been introduced, enabling the coal to be moved more rapidly. The rope is 3,300 feet long. A Thomas coal crusher and washer is in operation at this tipple, through which the screenings from several mines will be run, adding to the quality of the coke.

A plant of 63 of the Thomas coke ovens is nearly finished. The Thomas oven is a new one, for which great advantages are claimed over the bee-hive. The ovens are built similar to the bee-hive, except they are long instead of round. Each oven is 6 feet wide, 36 feet long, and 5 feet high in the clear. A 14-inch wall separates each oven from the next. They are charged from the top like the bee-hive oven, taking a charge of 12 tons of coal to each oven. Steam machinery, mounted on wheels, is run in front of the ovens, and the charge thus withdrawn after the coke is made. The mouth of the oven is a few inches wider than the back part, allowing the charge to slide out freely. It is claimed the coke can be taken from the oven and loaded directly into the cars with this machinery. The ovens can be recharged immediately, thus keeping them at a greater heat and making a better quality of coke. A number of new houses have been built during the year by the Sloss Iron and Steel Company. At present work is light in the mines. About 275 free laborers are employed and 275 convicts. The miners receive 60 cents per ton for run-of-mine coal.

The Watts Coal and Iron Company's mines are situated on the north bank of Warrior river, about 2½ miles southeast of the town of Warrior, in township 14 south, range 3 west. Owing to the burning of the machinery, the mines closed during the months of November and December, operations being resumed in January, 1888; in consequence, the total production for the year was much smaller than it would otherwise have been. The coal bed mined averages about 3 feet 6 inches thick. The analysis of the coal, made by Prof. N. T. Lupton, and of the coke, by Mr. Brainerd, are reported by the company as follows:

Analyses of the Watts Company's coal and coke.

	Coal.	Coke.
	Per cent.	*Per cent.*
Ash	1.92	4.780
Fixed carbon	63.03	92.304
Volatile matter	33.88	1.600
Sulphur	1.20	1.116
Water	1.17	.200

The company is opening a new mine on Blue creek, southwest of Birmingham, in the Pratt coal bed. The mines during 1888 will be prepared to produce 300 tons of coal daily. The coal from this mine, other than that which is coked, is shipped to the Louisville and Nashville Railroad.

The Woodward Coal and Coke Company has 7 drift openings, which are all connected together as one mine, located near Coaldale; the mines were worked during 1887 about 250 days. The average thickness of the bed which is at present worked is 3 feet; it is reported that there are three other coal beds which underlie the entire area of the company's property, one 4 feet thick and the other two 3 feet thick respectively.

An analysis of the coal which is at present mined, made by Prof. N. T. Lupton and reported by the company, shows:

Analysis of the Woodward Company's coal.

	Per cent.
Ash	1.27
Fixed carbon	65.12
Volatile matter	32.24
Sulphur	.56

The coal is shipped to local points in Alabama, to southwest Georgia, to Florida, and New Orleans.

The Mabel Mining Company's mines are located one mile north of the town of Warrior. The coal bed which is mined has an average thickness of 2 feet 10 inches; the coal is particularly adapted to steam purposes and shows on analysis:

Analysis of the Mabel Mining Company's coal.

	Per cent.
Ash	1.27
Fixed carbon	65.13
Volatile matter	32.24
Sulphur	.50

The mines employ at times from 75 to 100 miners, and the product is shipped to points along the Louisville and Nashville railroad, lying between Nashville and New Orleans.

The Pierce-Warrior Coal Company is operating three mines in the vicinity of Warrior, Jefferson county, located as follows: Old Shaft mine, half a mile north of Warrior station; New Shaft, the largest and best mine, half a mile south of the station, and the Wolfden Hollow mine. The New Shaft mine was not worked during 1887. The present company is a reorganization of the old Pierce-Warrior Coal Company, and took charge of the mines on March 1, 1887. During January and February, 1887, 5,500 tons had been mined by the old company; since March 1, the new organization mined 45,397 tons, making a total for the year of 50,897 tons; about 1,000 tons in addition were consumed at the mines. The coal bed varies from 2 feet to 3 feet 8 inches thick; the coal is used principally for steam and blacksmithing purposes. The following partial analysis of the coal is reported by the company:

Analysis of Pierce-Warrior coal.

	Per cent.
Ash	1.27
Fixed carbon	65.18
Volatile matter	32.24

The number of men employed at these mines varies from 55 to 90; miners are paid 70 cents per ton for mining; laborers earn from $1 to $2 per day. The coal is shipped to Nashville, Tennessee, and to Decatur and Mobile, Alabama, the average selling price per ton during 1887 being $1.20 on cars at the mine.

The two mines of the Milner Coal and Railroad Company are located in the vicinity of New Castle, in Jefferson county. Two coal beds are worked at these mines, the Black Creek bed, from which 60,000 tons of coal were mined in 1887, and the New Castle bed, from which 5,000 tons of coal were mined in 1887. This coal was shipped to Montgomery, Mobile, and New Orleans; 60,000 tons being sent to market and the remaining 5,000 tons consumed locally at the mines. The coal commanded, for run of mine coal, a price of $1.25 per ton at the mines in 1887.

The Hoene Consolidated Coal and Iron Company's mines, with the production of each for 1887, are as follows:

Production of the Hoene Consolidated Company, Alabama.

Name of mine.	Location.	Production.
		Short tons.
Alabama	At Warrior	26,324
Jefferson	3 miles south of Warrior	20,396
Drake	2 miles south of Warrior	15,000
Total		61,720

The average thickness of the bed at the Alabama mines is 2 feet 10 inches, while at the Jefferson and Drake mines it is 3 feet 6 inches. The coal is particularly adapted to steam and gas purposes. The mines were worked 262 days during the year, and there were employed, on an average, 200 men, including both inside and outside.

About two-thirds of the product of the mines was shipped to the Louisville and Nashville railroad, and one-third to Montgomery, Alabama, to Mobile, New Orleans, Selma, and to several points in Georgia.

The Woodward Iron Company is operating mines at Woodward, in Jefferson county, the coal bed being opened by slopes. During 1887 the production of coal was 60,676 tons, all of which was consumed by the company in making coke for use at its two furnaces located at Woodward. A new slope has recently been driven in the coal bed, and gives promise of becoming an extensive mine. The coal bed at Woodward is 4 feet 8 inches thick, and is particularly adapted to coking purposes. The mines are operated steadily throughout the year, having worked 310 days in 1887. They employ 100 men.

The mines of the Briarfield Coal and Iron Company are located in Bibb county, near the edge of Shelby county, and 3 miles from Briarfield, with which they are connected by a standard gauge railroad. During 1887 this company produced 72,000 tons of coal, of which 48,000 tons were manufactured into coke, and the remainder shipped to various points in Alabama, Georgia, Mississippi, and Louisiana. Four coal beds are worked by this company, each being about 4 feet thick; their extent is not known. The coal is used for domestic purposes and for making coke. During 1887 the company employed about 200 persons, the mines being worked 250 days during the year.

The Cahaba Coal Mining Company's mines are located at Blocton, in Bibb county, 10 miles from Woodstock station, on the Alabama and Great Southern railroad, and 29 miles south of Birmingham. The village of Blocton, where all their works are located, contains 350 neat houses, built by the company. The company built and is operating a standard gauge road from Blocton to Woodstock, where a junction is formed with the Alabama and Great Southern road. A junction has also just been made at Woodstock with the new mineral branch of the Louisville and Nashville railroad, giving two good outlets. It is possible another branch from the East Tennessee, Virginia and Georgia road will tap the company's line the present year, giving a short route to Anniston, where two large blast furnaces will be supplied with coke. Up to 1887 the company had but one mine; but five new mines, from which shipments were commenced in November, were opened during the year. Two separate coal beds are mined, locally known as No. 1 and No. 2. Two slopes and a shaft are driven into bed No. 1, and two slopes and a drift into bed No. 2.

The largest and most extensively operated mine of the six is the No. 2 slope opened into the No. 2 seam. This opening was made one mile back from headquarters, into 6 feet of fine coal. This is a fine double track opening, following the coal down 1,500 feet at an average pitch of 9°. Seven lifts have been opened, 200 feet apart. The entries of each lift are run east and west from the slope track, some of them extending back 1 mile from the slope. Mr. Thomas Belch has charge of the underground work. About 700 tons are hoisted daily. No. 3 slope was recently opened into the No. 2 seam, 2 miles from No. 2 slope. This is also a fine double-track opening, from which a large amount of coal will soon be hoisted. Already two headings have been turned off from the first lift and rooms working in them, and two others are being turned off on the second lift. The slope headings are being driven down as fast as possible, running double shifts. No. 6 is a drift opened into this seam opposite the tipple of No. 3. These two works are in charge of Mr. Herbert Thomas. An additional force of miners will be placed in these two mines as fast as room is made. In this seam the miners are paid 55 cents a ton for forked coal and 50 cents for run-of-mine coal.

No. 1 slope opening was made into the No. 2 seam. This slope was idle in 1887, but has recently been repaired and started up. The coal bed at this opening has a dip of about 5°. The seam averages 3 feet in thickness. New engine, boiler, and other machinery have recently been set up and preparations made for hoisting a large amount of coal. Mr. James Wilcox has charge of the underground work. The miners working in this seam receive 60 cents per ton for run-of-mine. This slope is down 800 feet. No. 4, another new slope into No. 2 seam, was made 1 mile north of headquarters. It is now down 700 feet, going towards No. 1. Mr. James Waugh is in charge. No. 5 is a shaft sunk to No. 2 seam, midway between No. 1 and No. 2 slopes, both of which are driving towards it. When connections are made this shaft will drain the other two mines opened by slopes. This will be an important work. Good machinery is being placed in position for hoisting coal and pumping the water that may accumulate in all three mines. The shaft measured 10 by 18 feet, and will be fitted up with an automatic hoist built by the Crane Elevator Company. The mine will be in charge of Mr. Andrew Bryson. The company is about ready to commence hoisting coal. The same power which operates the shaft will draw water from the creek near by and force it up into a large tank on the hillside 50 feet above the coke ovens. The pump for this purpose has a capacity of 5,000 gallons per minute, guaranteeing abundance of water for the coke plant.

The following analyses show the composition of the coal produced from each bed, No. 1 coal having been analyzed by J. B. Porter and Co., of Cincinnati, and No. 2 coal by Mr. E. Nichols:

Analyses of coal from the Cahaba mines, Alabama.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Ash	3.20	2.41
Fixed carbon	55.76	60.75
Volatile matter	41.04	34.12
Sulphur	1.01	.48
Water	....	2.24
Specific gravity	1.27	....

The thickness of No. 1 bed is 3 feet 6 inches, and of No. 2 bed 6 feet. The character of the coal is hard bituminous, and it is particularly adapted for steam, gas, and domestic uses. The product of the mines is shipped to local points in Alabama, to Louisiana and Texas.

The Southern Pacific Company takes 20 cars daily, and the Queen and Crescent route 18 cars daily. With the present openings, when all are in full operation, the company has a mining capacity of about 2,500 tons daily. The coke ovens, of which 300 are being built about half a mile from the mines, will be charged with the screenings from the No. 2 seam and coal from the No. 3 seam. The Thomas Furnace coke plant of 150 ovens, near Ensley City, will be supplied with coal from these mines. At the present time (March 1, 1888) 800 men are employed in and about these mines and on construction work.

The St. Clair Coal Company, operating a mine at Ragland, is at present the largest coal operator in Saint Clair county. During 1887 the production reached 52,141 tons of coal, of which 15,047 tons were consumed in the manufacture of coke.

The coal bed here is 3 feet thick, and the coal is adapted for steam, coke, gas, forge and domestic purposes. The company employs from 40 to 55 men, and in 1887 the mines were worked 275 days, the product, excepting that portion made into coke, being shipped principally to Atlanta and Rome, in Georgia, and to Anniston, Alabama.

The Wolf Creek Coal Company's mines are located at Corona, in Walker county. These mines were operated during January, 1887, but were idle the remainder of the year; the production was only 530 tons. The coal bed shows a thickness of 3 feet 6 inches, and the coal is adapted for domestic, steam, and gas purposes, while the analysis is as follows:

Analysis of coal from Corona, Alabama.

	Per cent.
Ash	1.903
Fixed carbon	58.811
Volatile matter	37.735
Sulphur	1.953
Total	100.402
Per cent. of coke	60.714
Specific gravity	1.317

The company employs 24 men, and the coal is shipped to Memphis, Mobile, and New Orleans.

The mine of the O'Brien Coal Company is located on Wolf creek, one mile west of Corona. The bed here dips more, and is a little thinner than at Corona and Patton, to the east. It, however, still averages nearly 4 feet thick. The mine is opened by a slope 100 feet in length. During 1887 10,500 tons of coal were mined, the mines being idle five months on account of strikes. About 40 men were employed on the average, and the entire product of the mines was shipped to New Orleans, Mobile, Memphis, and Montgomery for steam, gas, and domestic purposes.

The Virginia and Alabama Mining and Manufacturing Company is at present the largest operator in Walker county. The company owns six mines in the vicinity of Corona, all located on the Georgia Pacific railway. Three are operated by the company and the remainder are leased. The mines produced 78,000 tons in 1887, as follows:

Production of the Virginia and Alabama Mining Company's mines.

	Quantity.
	Short tons.
Patton	35,000
Coal Valley, No. 6 and No. 7	25,000
Coal Valley, No. 4 and No. 5	14,000
Day's Gap	4,000
Total	78,000

The Patton mine is located three-quarters of a mile back from Patton station, one mile east of Corona. The mine is opened by drift in the Corona coal bed, which here varies from 3 feet 8 inches to 4 feet 4 inches in thickness, and contains a slate parting one-half to 1½ inches thick. This mine employs 130 men, and but for the general strike which occurred in this district on February 1, 1887, and lasted five months, the output would have doubtless been nearly doubled. The Coal Valley mines, Nos. 6 and 7, are located 2 miles back from Day's Gap station, five miles east of Patton. There are also drift openings on the same seam as at Patton, the thickness of the bed being also about the same, averaging over 4 feet. This coal is shipped, as run-of-mine, for steam purposes. The coal bed in both of these mines lies nearly level. No faults of any kind have been encountered. Mr. David Kirkwood, formerly of the Corona mine, has charge of the underground work. Eighty-five men are employed.

The Coal Valley mines, Nos. 4 and 5, are operated by Messrs. Donaldson & Co. These mines are leased from the Virginia and Alabama Mining and Manufacturing Company, and are being worked in the Corona seam. About 160 tons are shipped daily and 50 men are employed.

The Day's Gap mine, also leased from this company, is operated by Messrs. Norrell & Co. They ship run-of-mine coal, employ 30 men, and produce from 60 to 70 tons daily. The coal from the Corona bed in this company's mines is particularly adapted for domestic and steam purposes, but it is also used for the manufacture of gas. An analysis shows as follows:

Analysis of coal from the Corona bed, Alabama.

	Per cent.
Ash	7.36
Fixed carbon	50.69
Volatile matter	41.12
Water	0.83
Total	100.00
Sulphur	0.42
Specific gravity	1.32

This coal is shipped, principally for domestic and steam purposes, to Atlanta, Birmingham, Vicksburg, Memphis, New Orleans, Shreveport, and points in Texas, also to various railway lines, as the Maryland and Ohio railroad, Georgia Pacific railway, Southern Pacific railway, and Texas and Pacific railway.

The Deer Creek mines of the Black Diamond Coal Company are located at Patton Junction, in Walker county. These mines were operated, during the early part of the year, by Messrs. Turner, Morris & Co., who produced 3,000 tons of coal. The Black Diamond Coal Company, after taking charge of the mines, produced 9,500 tons, making the total production for the year 12,500 tons. The coal bed worked at the Deer Creek mine averages about 4 feet 6 inches in thickness and underlies several square miles of territory. The coal is used for steam and domestic purposes. The following analysis will show its character:

Analysis of coal from the Deer Creek mines, Alabama.

	Per cent.
Ash	6.00
Fixed carbon	68.34
Volatile matter	22.15
Sulphur	1.85
Water	1.66
Total	100.00

The mines were only run on half time during the year; fifty men are employed at the mines; the wages earned by the miners average $2.50 per day, and day hands earned $1.25 to $1.50. Shipments were made to New Orleans, Mobile, Birmingham, Atlanta, and other points in the South. The average price of the coal delivered on cars at the mines during 1887 was $1.25.

Among the newer companies that have been organized in Walker county, the Corona Coal and Coke Company is probably the most important. It operates one of the largest mines yet opened in Walker county, at Corona station, 55 miles west of Birmingham, on the Georgia Pacific railroad. The company owns some 1,000 acres of coal property in the neighborhood. It has made a double drift opening into what has become known as the Corona bed, which averages about 4 feet in thickness. In parts of the workings a thickness of only 3 feet 8 to 10 inches is found. The coal is of fine quality for steam and domestic purposes. It is a hard splint coal; stands handling well, and can be conveniently stocked in yards during the dull summer months for winter use, thus enabling all the companies operating in this bed to run steadily during the summer months, and to take advantage of summer freight rates. Its quality as a coking coal has not yet been satisfactorily established. The coal lies almost horizontal in a hill, giving a level haul to the mouth of the mine. No fault of any kind has been encountered in the bed, thus permitting of economical mining. The present capacity of the mines is about 400 tons daily; this can be increased on short notice. An addition has recently been built to the tipple, to enable the coal to be supplied to engines on the road. In February, 1888, 125 men were employed.

Another new establishment in this county is the Kansas City Coal and Coke Company, with a mine located at Carbon Hill, in section 25, township 13 south, range 10 west, Walker county. Active operations were begun in December, 1887, and 2,000 tons were shipped during the month. This mine is opened by a shaft 62 feet deep to the bottom of the coal bed, and is equipped with hoisting machinery with a capacity of 50 tons per hour. The estimated capacity of the mine is about 400 tons per day. The coal bed worked is the Jagger bed, 4 feet 8 inches thick, with a seam of slate 6 inches in thickness and 8 inches from the top of the bed. The coal bed is said to underlie an area 20 miles in length by 3 miles in width. This Jagger coal is claimed to be the best in the State for steam and grate purposes. At present three-fourths of the production is consumed by the locomotives on the Kansas City, Memphis and Birmingham railroad, on the line of which the mine is situated; the remaining one-fourth is shipped to Memphis for domestic uses. The mine employs 75 regular miners, and works regularly every working day on 10 hour shifts.

In the vicinity of Tuscaloosa, in Tuscaloosa county, several small establishments have been working mines for some years, supplying the local demand at the city of Tuscaloosa. The most important of these mines is that of Mr. A. Durie, located 2 miles from the city, which produced during 1887 a total of 3,500 tons. Other small mines in this vicinity produced 1,750 tons more. The Alabama Insane Hospital at Tuscaloosa also operates a small mine for the supply of fuel for the hospital. This mine is located 2 miles north of Tuscaloosa, on the Warrior river, producing during 1887 about 3,000 tons of coal, which was all consumed at the hospital. The bed is 2 feet thick, and is said to furnish a good gas coal. Tests show a yield of gas of 4 cubic feet per pound of coal. This mine was worked steadily throughout the year, about 4 men being employed.

The most important mining establishment in Shelby county is that of the Montevallo Coal and Transportation Company, located at Aldrich. During 1887 this company produced 36,355 tons of coal, all of which was shipped to points in Alabama, Georgia, Mississippi, and Louisiana for domestic purposes. The coal bed here averages about 2 feet in thickness, and the coal is particularly adapted for burning in grates as a house coal. The mines were operated 260 days in 1887, and 75 miners were employed.

The wages paid to miners and the price at which coal is sold at the different mines in the State varies according to local conditions, and probably more so than in any of the States producing coal from the Appalachian coal field. A number of interesting statistics showing averages by counties is exhibited in the following table:

Average wages, days worked, and prices for coal in Alabama, by counties, in 1887.

Counties.	Average wages of miners per ton of coal mined.		Average selling price of coal at mines		Average number of days worked.
	Lump.	Run of mine.	Lump.	Run of mine.	
Jefferson	$0.70	$0.50	$1.20	....	244
Bibb	.70	.55	1.50	....	250
Saint Clair	....	.40	....	$1.15	275
Walker	.72½	.55	1.35	....	161
Tuscaloosa	.87½	....	....	....	310
Shelby	1.00	....	2.50	....	260
Average for State	.71	.51	$1.274		250

Valuable statistics have recently been collected by the *Birmingham Age* which exhibit the present and prospective furnace consumption of coal in the Birmingham district, also the present capacity of a number of coal mines now being operated, and of others being opened, and the coal acreage which is controlled by a number of the larger companies. The statistics are as follows. The furnaces given in the table showing the consumption of coal are those already in blast or in course of construction. Several projected furnaces and other industries, which will undoubtedly be built, are not included in the list:

Furnace consumption of coal in the Birmingham district, Alabama.

Furnaces.	Coal consumed daily.	Furnaces.	Coal consumed daily.
	Tons.		*Tons.*
Mary Pratt, 1	180	Gadsden, 2	500
Rolling mills	200	Sheffield, 5	1,500
Alice and Ensley, 6	2,600	Anniston, 2	600
Sloss, 4	1,200		
Williamson, 1	200	Total for furnaces	10,130
Eureka, 2	600	Railroads	1,500
Thomas, 1	300	Commercial purposes	3,000
Woodward, 4	600	Mechanical purposes	1,500
Bessemer, 2	1,200		
Trussville, 1	300	Total	16,130
Edwards, 1	150		

To supply this demand the following mines are in operation.

The capacity of the mines is given, and it must be remembered that the average output (daily) will fall below the maximum capacity of the mine:

Daily capacity of coal mines in the Warrior and Cahaba fields, Alabama.

Mines.	Capacity.	Mines.	Capacity.
	Short tons.		*Short tons.*
Pratt	3,000	Mines now being opened:	
Blocton	600	Eureka	500
Henry-Ellen	800	Blocton	1,400
Coalburgh	600	Woodward	300
New Castle	200	De Bardeleben's Blue creek	500
Mines at Warrior	400	Alabama-Connellsville	200
Montevallo	200		
Other mines in the Warrior field	1,000	Total prospective	2,900
Total present capacity	6,800		

The opening of the new mines, as given above, will make a grand total daily output of coal in the Warrior and Cahaba fields of 9,700 tons. The present and prospective local consumption of coal is shown by the tables above to be 16,130 tons. The shortage in supply is, therefore, 6,430 tons per day. To supply this shortage there is an urgent demand for the opening of more coal mines. Of the vast body of coal lands in Alabama, 1,000,000 acres still belong to the Government, and are open to homestead entry. Most of the public mineral lands lie in the Warrior coal fields. The coal companies now operating in Alabama own the following amounts of coal lands:

Land owned by coal companies in Alabama.

Names of companies.	Acres.	Names of companies.	Acres.
Pratt company	75,000	DeBardeleben company	20,000
Blocton company	30,000	Samuel Thomas company	3,000
Henry-Ellen company	16,000	Montevallo company	5,000
Coalburgh company	15,000	Alabama-Connellsville company	3,000
Milner company	5,000	Other companies	20,000
Companies at Warrior	16,000		
Eureka company	10,000		
Woodward Company	15,000	Total	233,000

The De Bardeleben Coal and Iron Company's lands noted above are located in the vicinity of Bessemer, in Jefferson county, and its operations at the Blue Creek mines and elsewhere bid fair to be almost as large as that of the Tennessee Coal, Iron, and Railroad Company. Its first half dozen openings were unfortunately located, and have been abandoned, but others have been successfully driven—one to a depth of 1,200 feet—and promise some 500 tons of coal a day by the last of March, 1888, when it is expected one of the company's two furnaces will be ready to go into blast. During the latter part of the year a slope was being sunk, but had not been completed up to January 1, 1888. The company proposes to consume at the furnaces located at Bessemer the entire output of its mines, which it is estimated will range from 2,000 to 3,000 tons per day inside of twelve months.

The average thickness of the coal bed is 7 feet, and the company reported that the area underlaid by workable coal is 8 miles long by about 2½ miles wide.

The following are analyses made by Mr. A. F. Brainerd of coke made from the company's coals:

Analyses of coke made by the De Bardeleben Company, Alabama.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Ash	10.490	6.200
Fixed carbon	85.776	92.327
Volatile matter	3.040	.400
Sulphur	.544	.823
Water	.150	.250
Total	100.000	100.000

No. 1 coke was made from outcrop coal, while No. 2 was made from coal mined under a good solid roof, and is considered a more representative specimen. This company has 150 coke ovens under way and will build as many more when these are completed. All of the above developments are being made within 20 miles of Birmingham. About twice valley, as far from Birmingham, in the untouched field of Murphree's which is very rich in both coal and iron, the company is locating a number of mines with a view to very extensive operations.

The Bessemer Coal and Coke Company, made up largely of the same persons as the De Bardeleben company, is opening seven drifts on Coal creek, near Parksville, on the Kansas City, Memphis and Birmingham railroad, in Jefferson county, some 25 miles from Birmingham. These openings are being made in the Pratt seam, and it is expected that coal shipments will be begun in June, 1888, at the rate of 800 to 1,000 tons daily. The mining engineers of the two companies say that in two years, according to their present plans, they will be able to take out 5,000 tons daily. It is expected to send all this coal to Bessemer and Sheffield for local and furnace consumption.

An analysis made by Mr. A. F. Brainerd of 12 tons of the company's coke shows the following composition:

Analysis of coke from Parksville, Alabama.

	Per cent.
Ash	10.545
Fixed carbon	87.299
Volatile matter	.803
Sulphur	1.195
Water	.157
Total	100.000

The Alabama-Connellsville Coal and Coke Company, a new concern, neighbors to the De Bardeleben, will be able to mine 500 tons a day from now on if their present projects turn out fairly. Their coal bed is reported to be in places 11 feet thick, and has but one parting. The dip, however, is such as to make mining more difficult than elsewhere in the district. A considerable coal interest will be developed during the year in the West Warrior field, mainly in Walker county, but how this will affect the iron industry is as yet largely a matter of conjecture, no satisfactory smelting coke having been made from any of the coals of this region, simply because they have never had a fair test.

The Eureka Company, which has bought the Helena property of the Tennessee Coal, Iron and Railroad Company, proposes duplicating the coking plant of 100 ovens. The Cahaba Coal and Mining Company, whose property is located in the Cahaba field, has made a beginning on 400 ovens, mainly to supply the Woodstock furnaces, in and near Anniston, and the Pioneer furnace, near Birmingham. The Woodstock Coal and Iron Company recently bought an interest in the Cahaba concern. The Pioneer Manufacturing Company's contract runs for only one year from the completion of their furnace, after which period it is expected to make its own fuel somewhere on its own coal property, which is quite extensive.

The Sheffield people place great confidence in the qualities of the West Warrior coal for iron making. The Alabama and Tennessee Coal and Iron Company has broken ground for 300 coke ovens at Jasper, Walker county. Several coal operators in the same county have contributed to build six experimental ovens at the same place on the general plan of the Coppèe oven, after the patent of Mr. Koerner, who is superintending the construction.

The Tuscaloosa Coal, Iron and Land Company is making extensive explorations in the vicinity of Tuscaloosa.

During the year much has been said relative to the Huntington Inter-Oceanic Railway enterprise, which proposes a southern outlet for the coal and other products of the Mississippi valley. Birmingham coal is delivered in Mobile and along the coast of the Gulf of Mexico at \$1.37½ per ton, and may be delivered in barges at any port on the Bay of Honduras at \$2.50 to \$3 a ton. English coal is sold annually to the amount of about \$50,000,000, at from \$8 to \$12 a ton, to ports on the Gulf of Mexico and to the islands and neighboring coasts of the three Americas and Australia; and English coal and iron are supplied to steamers and railways along the whole Pacific coast, from San Francisco to Cape Horn. The cost to consumers is enormous, but it would be cut down to about one-third the present rate if enterprises of United States citizens in Central and South America were encouraged.

ARKANSAS. (a)

Total production in 1887, 150,000 short tons; spot value, \$252,500.

The coal beds in Arkansas are contained in the Carboniferous system, and are found in the western part of the State; the coal area adjoins the Indian Territory coal field. Coal is found in twelve counties in the State, and the estimated area of the field is about 9,000 square miles, though some estimates put this total at 12,000 square miles. Most of the coal outcrops have been found south of the Arkansas river. The coal beds vary in thickness from 4 to 7 feet; they have been reported to be included within or to lie underneath the Millstone Grit. Much of the coal which is mined is of a semi-bituminous character. In the neighborhood of Fort Smith a coal classed as semi-anthracite has been found; this coal contains from 74 to 84 per cent. of fixed carbon. The bed has been explored over a considerable area by drilling, and varies in thickness from 4 to 6½ feet. The three principal mining districts in the State are: (1) in the vicinity of the Ouita mine, near Russellville, about 75 miles from Little Rock; (2) in the region of the Spadra openings, 25 miles farther up the valley; and (3) in the district surrounding the Coal Hill openings, 15 miles still farther up the valley.

The Ouita Coal Company operates the Coal Hill mines in Johnson county and the Ouita mines in Pope county. The total production of these mines in 1887 was as follows: Coal Hill mines 51,616 tons, and the Ouita mines 3,500 tons; total, 55,116 tons. This production is an increase over that for 1886 of 9,024 tons. The coal from the Ouita mines, near Russellville, is classed as a semi-anthracite; it is an excellent coal for domestic purposes.

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a This report has been made from returns reported direct to the Survey.

The following analysis, made by Messrs. Chauvenet and Blair, of Saint Louis, shows the character of this coal:

Analysis of Ouita coal, Arkansas.

	Per cent.
Ash	5.11
Fixed carbon	80.46
Volatile matter	12.66
Water	1.77
Total	100.00
Sulphur	0.78

This coal commanded a price of $2 per ton at the mines during 1887. The mines were operated nine months of the year and employed 30 men. The coal bed, which is 32 inches in thickness, is reached by a slope.

The Coal Hill mines, in Johnson county, were operated during 1887 throughout the entire year and gave employment to 225 men. At these mines 80 to 90 cents per ton is paid for mining the coal; at the Ouita, wages are $1 per ton. The coal bed mined at Coal hill is 3 feet 4 inches in thickness; the coal is used principally for steam purposes, but it also makes an excellent domestic fuel; it is known locally as the "smokeless" coal. This coal during 1887 sold at the mouth of the mines for $1.50 per ton. It is largely used by the railroads in this part of the State and also shipped to Little Rock for steam purposes.

The Kansas and Texas Coal Company has opened two shafts near Hackett City, in Sebastian county. The capacity of these mines is said to be 60 cars per day. The coal is a semi-anthracite, containing 80 to 84 per cent. of fixed carbon, and underlying two-thirds of the county; the thickness of the bed varies from 3 to 6 feet. No detailed returns were received from this company for 1887.

Towards the end of 1886 Mr. M. R. Shinn opened a mine in the vicinity of Russellville, which was worked on a small scale during 1887. This coal was all hauled to market by wagons, the principal markets being Russellville and Dardanelle. During 1887 the amount of this coal sent to market was 250 tons.

Mr. A. J. Lamborne, local auditor of the Arkansas Valley route, reports the total tonnage carried by the Little Rock and Fort Smith Railway during the year 1887 as 62,572 short tons; the total shipped by the Ouita Coal Company he reports as 54,460 tons; and by Messrs. Stiewel & Co., 18,100 tons. The entire output of all the mines on the road is used by the locomotives of the various roads in this part of the State, with the exception of what is consumed locally at Little Rock and other points on the line of the road.

CALIFORNIA.

Total production 50,000 short tons; spot value, $150,000.

Although repeated claims are made for the existence of coal beds of commercial importance throughout California, no mines, with the exception of those in Amador, Contra Costa, Fresno, Alameda, and Los Angeles counties, have been worked on a commercial scale. The most important mines have been those in the Mount Diablo coal field, in Contra Costa county, east of San Francisco bay. The most productive bed in this field has been the Clark bed, which ranges in thickness from 2 feet to 4 feet 6 inches; this bed has been more extensively mined by the Black Diamond Coal Company than any other bed. A second coal bed known as the Black Diamond has a thickness of 3 feet 6 inches; this bed was also mined by the Black Diamond Coal Company from the "750-foot" shaft. The mines of this company were abandoned in the early part of 1885 on account of it being found unprofitable to compete with the better coals brought into the San Francisco market from Washington Territory and British Columbian fields. It is of interest to note the production of the mines of the Black Diamond Coal Company from 1871 to the time when they were closed in 1885:

Production of the Black Diamond Coal Company's mines, California.

	Quantity.		Quantity.
	Short tons.		*Short tons.*
1877	75,094	1883	55,965
1878	63,373	1884	52,529
1879	71,451	1885	6,262
1880	80,130		
1881	60,173	Total	526,699
1882	61,722		

This company has been the largest single producer of coal in the Mount Diablo field. Mr. Charles G. Yale, editor of the *Mining and Scientific Press*, reports that the mines of Contra Costa county during 1887 produced about 60,000 tons. From returns made to the survey the production was only 27,600 tons, 20,100 tons for the Sommerville mines, and 7,500 tons for the mines more immediately in the vicinity of Mount Diablo. This coal was not sent to San Francisco, but was consumed almost entirely by the river boats.

In Iona valley, in Amador county, several small mines have been opened to supply coal to the Southern Pacific Company; the production of these mines during the year was about 15,500 tons.

At Livermore, in Alameda county, three distinct beds of coal are reported to have been opened by the Livermore Coal Company; these are known as the Summit, Richards, and Eureka beds, having thicknesses, respectively, of 4, 6, and 8 feet. The Richards bed has been worked to a depth of 120 feet, and the Eureka to a depth of 60 feet. The mines produced about 3,000 tons, which were sold in small lots at Livermore, San José, Stockton, Oakland, and Santa Clara.

The following are two analyses of these coals reported by Professor Price:

Analyses of coal from Livermore, California.

	Summit bed.	Richards bed.
	Per cent.	*Per cent.*
Water	18.08	20.78
Volatile matter	39.30	31.00
Fixed carbon	35.61	42.46
Ash	7.01	5.70
Total	100.00	99.94

Several coal beds have been opened in Fresno county, chiefly by the Southern Pacific Company. A small amount of coal was produced during the year.

In Mendocino county a coal bed 14 to 15 feet in thickness has been found. This coal seems to be of good quality, being in fact rather better than that from the Mount Diablo mines. The distance of this coal bed from the market and its almost inaccessible position in the mountains render it very unlikely that it will be worked to any extent for some time at least. In Shasta county a thick bed of mixed coal and slate has been found, the total thickness of which is 12 feet; the coal and slate occur in thin seams almost impossible to separate from each other; this coal was opened but never worked to any considerable extent. At several other places, as in the Sacramento valley in Placer county, at the American cañon in Solano county, in the hills east of Santa Rosa valley in Sonoma county, and at several places in the vicinity of the exploited areas at Mount Diablo, coal beds have been reported, but probably not of commercial value.

During the past year coal has been discovered in a number of places in southern California, but no coal of any great value has been found. Coal is being worked to a small extent in San Diego county, the coal bed being reported 6 feet thick. This coal is all consumed in the vicinity of the mines. These coal deposits are at Elsinore, and are the first in this county from which coal has been shipped to market. Analyses of this coal are given in the table below. None of these southern California coals will make coke.

The following analyses of southern California coals are compiled from the report of the State mineralogist for 1887:

Analyses of southern California coals.

Coals analyzed.	Water.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Analyst.
Dolbeer & Hoff, bituminous shale	2.65	44.25	7.40	45.70	3.43	T. Price, 1887.
Dolbeer & Hoff, coal	17.50	41.00	28.65	12.85	5.6	Do.
Cheney mine coal	19.00	46.50	21.90	12.60	......	W. D. Johnston, 1887.
Coal, section 14, township 22 south, range 13 east.	4.10	43.40	40.25	12.25	......	Do.
Robinson & Rawlins	15.50	40.00	29.50	15.00	......	Do.
Dolbeer & Hoff, near Elsinore, poorest.	9.00	38.50	19.25	34.25	......	Do.
Dolbeer & Hoff, best coal	15.40	43.60	27.90	13.10	......	Do.
Dolbeer & Hoff, face of gangway	16.25	43.75	28.15	11.85	......	Do.

None of the coals of California are of as good quality as those of Oregon and Washington Territory or the foreign coals with which these California coals come in competition in the San Francisco market. A comparison of the relative values of these different coals for steam purposes may be found in the following table, which is taken from the report of Mr. W. A. Goodyear, published in the report of the State mineralogist of California for 1887:

Relative values of different coals for steam.

Kinds of coal.	Value.	Remarks.
Mount Diablo	1.000	
Seattle	1.171	Experiments at Spring Valley water-works.
Sydney	1.502	Do.
Welsh	1.472	Do.
Bellingham Bay	1.148	Do.
Nanaimo	1.277	Do.
Anthracite	1.546	Do.
Wellington	1.407	Do.
Nanaimo	1.335	Experiments at Garratt's foundry.
Wellington	1.295	Do.
Seattle	1.177	Experiments on ferry-boat.
Seattle	1.330	Probable result of tests on Central Pacific railroad.

In these tests the Mount Diablo coal has been assumed as unity.

The following table, compiled from the report of Mr. I. Steuart, of San Francisco, shows the total receipts of coal at San Francisco, San Pedro, and San Diego, California, for 1887:

Receipts of coal at San Francisco, San Pedro, and San Diego in 1887.

	Short tons.
Australian	156,729
English and Welsh	94,028
Scotch	12,108
Eastern anthracite and Cumberland	21,709
British Columbia	252,810
Seattle, Franklin, Green river, Cedar river, Washington Territory	292,179
Carbon Hill, Washington Territory	181,267
South Prairie, Washington Territory	48,163
Coos Bay, Oregon, and Mount Diablo, California	96,000
Total at San Francisco	1,154,993
British Columbia and other foreign	138,000
Washington Territory	10,000
Total at San Pedro	148,000
British Columbia and other foreign	50,099
Washington Territory	6,000
Total at San Diego	56,099
Total California	1,359,092

The average prices of the various coals received at San Francisco in 1887 were generally higher than those for 1886; these prices varied greatly from January to December, being highest at the end of the year. This was largely owing to the fact that there was a scarcity of coal in California towards the end of the year. These prices with their variations from month to month are shown in the following table:

Prices of foreign coals in San Francisco in 1887.

Months.	Australian.	English Steam.	Scotch Splint.	West Hartley.
January	$6.25	$6.00	$6.50	$7.00
February	6.12	6.00	6.50	7.00
March	6.25	6.00	6.50	7.00
April	6.70	6.50	6.70	7.00
May	6.90	6.70	6.80	7.00
June	7.25	7.00	7.20	7.30
July	7.50	7.25	7.25	7.37
August	7.70	7.50	7.55	7.75
September	7.87	7.87	7.87	8.25
October	8.00	8.00	8.30	8.50
November	8.00	8.00	8.50	8.50
December	9.00	9.00	9.50	9.50

COLORADO. (a)

Total production in 1887, 1,791,735 short tons; spot value, $3,941,817.

The year 1887 has been one of great activity in coal mining in Colorado, and is marked by the development of one new and extensive coal field, the Glenwood, in Garfield county, and the opening of mines in the Yampah field, in Routt county, which promise to be of great importance.

In the Glenwood field a large number of new mines have been opened up and equipped with machinery. The completion of the Denver and Rio Grande and Colorado Midland railways past the outcrops of the coal beds where mines have been opened, rendered it possible to ship the product of these mines to the various Colorado markets easily, but owing to the fact that this railway communication was only effected during the last quarter of 1887 the production from these mines was not very large. Within the boundaries of the Glenwood field all grades of coal are found, from the best anthracite to lignite. The beds of coking coal are of great importance, since they will supply the smelters of Leadville and Salt Lake City with a purer and stronger coke than any western coke which has been obtained. Although the principal coal beds in this district have been described in the reports for 1885 and 1886, brief reference is made here to the new mines developed. Near the town of Glenwood Springs, and on a branch of the Roaring fork are the Four-mile or Sunshine mines. A bed from 6 to 9 feet in thickness is opened and coal of an excellent non-coking variety has been taken out. The coal is especially adapted to domestic use, and is very popular among consumers. (See analysis in Mineral Resources, 1886, p. 246.)

To the south of Four-mile creek, and about 10 miles from Glenwood Springs, are located the Jerome Park mines. The Marion is the principal mine in the Park; the prospect openings show 6 feet of clear coking coal. The coal and coke have been examined by Mr. John Fulton,

a Reported by F. F. Chisolm.

general manager of the Cambria Iron Company, of Johnstown, Pennsylvania, and some of the statements in his report are furnished below as showing the purity of the coke made from the Marion coal.

Comparative analyses, of Cardiff, Connellsville, and Marion, Colorado, coke.

	Cardiff, Wales.	Connellsville.	Marion.
	Per cent.	*Per cent.*	*Per cent.*
Fixed carbon	95.	87.46	93.75
Ash	4.26	11.32	5.49
Volatile matter	0.74	1.22	0.76

These mines and those on Four-mile creek are worked in the interest of the Colorado Midland railway. Immediately above these mines are located those of the Colorado Coal and Iron Company, from which no coal has yet been shipped to market. That these mines will probably produce as good coking and non-coking coals as those in Jerome Park can not be doubted.

Above these mines, and on Rock creek, the Colorado Fuel Company has a large number of mines in which have been opened beds of anthracite, coking, and non-coking coals. These mines still lack railway communication, so that they have not yet been very extensively developed.

Below Glenwood Springs, on small tributaries of the Grand river, beds of excellent coal have been opened up. On South Cañon creek, on Piñon creek, and to the north of Elk creek, near the town of New Castle, numerous beds of strong non-coking bituminous coal have been opened, but not developed for the want of railway communication. When these beds are opened they will be reached by the extensions of the Denver and Rio Grande and Colorado Midland railways en route to Utah.

Claims containing numerous coal beds near Meeker and on the branches of the upper White river have been generally taken up, but the beds have not as yet been developed.

Upon the north slope of Mount Orno, in Routt county, a seam of good coking coal has been opened by private parties. The openings are very high up on the mountain side, and this will probably prevent the development of the mine for a long time. At various points along the Yampah river, in Routt county, excellent beds of bituminous non-coking coal "have been filed upon" by the Colorado Coal and Iron Company and opened sufficiently to indicate their prospective value.

In the spring of 1887 a party was sent out by the Union Pacific Railway, under Mr. F. F. Chisolm, to explore the anthracite seams found at the foot of Anita peak in the Elk Head mountains. These beds were partially described on pages 243–245 of Mineral Resources, 1886, after a brief examination, which was greatly interfered with by snow. Careful exploration under favorable more circumstances showed that the coal beds were very unreliable. At one point they contained a good clean anthracite, while at another, perhaps not more than 1,000 feet away, the same coal beds contained only poor bituminous coal. The area of good anthracite is too small to render mining for coal alone profitable. In the immediate neighborhood are coal beds of free-burning anthracite of prospective value, and also large beds of non-coking bituminous coal which will eventually be opened when railway communication with eastern markets is established.

The greatest activity in coal mining has been shown in the southern part of the State.

In Fremont county two new mines of large productive capacity have been opened in the interest of the Atchison, Topeka and Santa Fé Railway, and in Las Animas county, near Trinidad, the Denver Fuel Company and the Denver, Texas and Fort Worth Railway have opened new mines on the well known coal bed near the Colorado Coal and Iron Company's property. The Fort Worth company expects to furnish Texas and southern points with fuel upon the completion of railway connection with Galveston in February or March, 1888.

The anthracite mine near Crested Butte reached its maximum production in 1887, while the coking industry at the same place was greater than ever before.

The principal supply of fuel for the Denver and Rio Grande Railway comes from the mines owned and operated by the Colorado Coal and Iron Company.

The following table shows the production of this company in past years to January, 1888:

Production of coal by the Colorado Coal and Iron Company.

Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*
1873	12,187	1882	511,239
1874	18,092	1883	602,396
1875	15,278	1884	450,808
1876	20,816	1885	562,660
1877	44,410	1886	605,956
1878	82,140	1887	750,790
1879	120,102		
1880	221,378	Total production	4,369,196
1881	350,944		

The production of this company's various mines in 1887 was:

Statement of the production of the Colorado Coal and Iron Company's mines in 1887.

Name and location.	Quantity.
	Short tons.
Coal Creek and Oak Creek mines, Fremont county	154,520
El Moro mines, Las Animas county	303,070
Walsenburgh mines, Huerfano county	131,810
Crested Butte mines, Gunnison county	161,390
Total	750,790

Coke is made at Crested Butte and El Moro.

The production of the Union Coal Company in the interest of the Union Pacific Railway shows but very little increase. This is due to the partial neglect of the mines, inferior facilities for hauling the product of the Baldwin mine, and the irregularity in the occurrence of the bed in the Como mine.

The production by this company in 1887 was:

Production of the Union Coal Company's mines in 1887.

Name and location.	Quantity.
	Short tons.
Como mines, Park county	23,421
Baldwin mines, Gunnison county	42,732
Total	66,153

Production of mines operated by or in the interest of railway companies in 1887.

Railways.	Quantity.
	Short tons.
Denver and Rio Grande Rai way	750,790
Union Pacific Railway	66,153
Atchison, Topeka, and Santa Fé Railway	433,834
Burlington and Missouri River Railway	36,000
Denver, Texas, and Gulf Railway	47,017
Denver. Utah, and Pacific Railway	31,288
Denver Land and Coal Company	16,000
Colorado Midland Railway	20,000
Total	1,401,082

The anthracite production of the State in 1887 was 36,000 short tons from the Anthracite-Mesa mine near Crested Butte, in Gunnison county.

The total production of coal by private persons and by companies not allied with railways was 390,653 short tons, or about 22 per cent. of the State's entire production.

The railway production shows an increase in 1887 over 1886 of 285,815 short tons, or about 25 per cent.

Production of coal in Colorado, by counties, in 1887.

Counties.	Quantity.	Counties.	Quantity.
	Short tons.		*Short tons.*
Las Animas	506,540	Park	23,421
Fremont	417,326	La Plata	22,880
Boulder	288,218	Arapahoe	16,000
Gunnison	243,122	Jefferson	12,000
Huerfano	131,810	Douglas	3,500
Weld	48,401	Dolores	1,000
El Paso	47,517		
Garfield	30,000	Total	1,791,735

Coal production of Colorado from 1864 to 1887.

Years.	Localities.	Production.	
		Short tons.	
1864....	Jefferson and Boulder counties	....	500
1865....	......do	....	1, 200
1866....	......do	....	6, 400
1867....	......do	....	17, 000
1868....	......do	....	10, 500
1869....	......do	....	8, 000
1870....	......do	....	13, 500
1871....	......do	....	15, 600
1872....	......do	14, 200	
	Weld county	54, 340	
			68, 540
1873....	Jefferson and Boulder counties	14, 000	
	Weld county	43, 790	
	Las Animas and Fremont counties	12, 187	
			69, 977
1874....	Jefferson and Boulder counties	15, 000	
	Weld county	44, 280	
	Las Animas and Fremont conuties	18, 092	
			77, 372
1875....	Jefferson and Boulder counties	23, 700	
	Weld county	59, 860	
	Las Animas and Fremont counties	15, 278	
			98, 838
1876....	Jefferson and Boulder counties	28, 750	
	Weld county	68, 600	
	Las Animas and Fremont counties	20, 316	
			117, 666
1877....		....	160, 000
1878....	Northern division	87, 825	
	Central division	73, 137	
	Southern division	39, 668	
			200, 630
1879....	Northern division	182, 630	
	Central division	70, 647	
	Southern division	69, 455	
			322, 732
1880....	Northern division	123, 518	
	Central division	136, 020	
	Southern division	126, 403	
	Northwestern division	1, 064	
	Unreported mines	50, 000	
			437, 005
1881....	Northern division	156, 126	
	Central division	174, 882	
	Southern division	269, 045	
	Northwestern division	6, 691	
	Unreported mines	100, 000	
			706, 744
1882....	Northern division	300, 000	
	Central division	243, 694	
	Southern division	474, 285	
	Northwestern division	43, 500	
			1, 061, 479
1883....	Northern division	243, 903	
	Central division	396, 401	
	Southern division	501, 307	
	Northwestern division	87, 982	
			1, 229, 593
1884....	Northern division	253, 282	
	Central division	296, 188	
	Southern division	483, 865	
	Northwestern division	96, 689	
			1, 130, 024
1885....	Northern division	242, 846	
	Central division	416, 373	
	Southern division	571, 684	
	Southwestern division	125, 159	
			1, 356, 062
1886....	Northern division	260, 145	
	Central division	408, 857	
	Southern division	537, 785	
	Southwestern division	161, 551	
			1, 368, 338
	Northern division :		
1887....	Mines near Erie and Canfield	180, 053	
	Louisville	30, 000	
	Langford	126, 566	
	Golden	12, 000	
	Denver	16, 000	
			364, 619

Coal production of Colorado from 1864 *to* 1887—Continued.

Years.	Localities.	Productions.	
		Short tons.	
	Central division:		
1887.	Mines near Sedalia	3,500	
	Franceville	47,517	
	Cañon City	417,326	
	Como	23,421	
			491,764
	Southern division:		
	Mines near Trinidad and El Moro	506,540	
	Walsenburgh	131,810	
	Durango	23,880	
			662,230
	Southwestern division:		
	Mines near Crested Butte	197,390	
	Baldwin	45,732	
	Glenwood	30,000	
			273,122
			1,791,735

The increase in the total production over 1886 was 423,397 short tons, or 31 per cent. The average value of the coal on the cars at the mines was $2.20 per ton, making the value of the State's production in 1887 $3,941,817. The average number of persons employed was about 5,000. The State inspector of coal mines estimates that the average thickness of the coal beds worked in Colorado is 5 feet 7 inches; the thickest bed worked is 14 feet and the thinnest 3 feet. The average price paid miners for digging and loading the coal and timbering rooms is 89½ cents per ton of screened coal. The average cost of producing the coal on the cars at the mines (including royalties) is $1.73 per ton. Many of the above figures have been furnished through the courtesy of the State inspector, Mr. John McNeil.

The following description of the Coal Measures and mines in a number of the counties has been compiled by Mr. A. P. Brown from the report of Mr. John McNeil, State inspector of coal mines.

The Coal Measures of Park county are badly broken and faulted, and the coal beds are locally spoken of as being "much troubled with hitches and dykes." About four years ago the Union Coal Company at the Como No. 4 mine made extensive mining improvements in order to work the mine on a large scale. A fault was discovered, however, on each side of the slope. The indications were that these faults converged and would meet at a point about 1,500 feet from the outcrop of the coal bed. After the coal in sight had been nearly mined out, explorations were made for the bed beyond the faults, but it was not found. A diamond drill hole sunk to a depth of 800 feet failed to throw any light on the system of rock faults. A somewhat similar experience was had in the same coal field, about one mile northwest of Como, by the Denver and South Pueblo Railroad Company, where after an expenditure of about $80,000 in mine improvements, coke ovens, etc., the work had to be abandoned. The coal bed was semi-bituminous and dipped at all angles ranging from 16° to 55°. The most extensive coal deposit in this county so far developed is that worked by the Union Coal Company.

In Fremont county the Cañon City Coal Company is working a coal bed 3 feet 3 inches thick at the bottom of mine No. 1, the shaft of which is 300 feet deep. At mine No. 3 the coal bed is 5 feet thick and occurs 60 feet above what is considered to be the Rockdale bed. At mine No. 4, the same bed is mined as at No. 1. At mine No. 5 of the same company, situated 1½ miles southeast of Como, the coal bed is 8 feet thick and dips 8°. A number of small mines have been opened in the vicinity of Cañon City, which supply coal to the State penitentiary and a number of local consumers.

In Boulder county the Star Coal Company works a seam 5 feet thick from a shaft in the vicinity of Canfield. The Fox and Patterson mine, 4 miles from Boulder, is opened in a bed of lignite 9 feet thick, which compares in quality with the best northern lignite. At the Mount McGregor mine, in the Erie coal field, a bed 4 feet 6 inches thick is worked from a shaft 100 feet deep; these are practically the same conditions that exist at the Cleveland mines in the same district. The Marshall mines, which are located 6 miles from Boulder, are opened in a bed 8 feet thick which dips 6°.

In Gunnison county the Crested Butte mine No. 2, of the Colorado Coal and Iron Company, is opened by a drift which is driven into a 6-foot coal bed which produces what is generally considered to be the best coke manufactured in the State. A considerable quantity of explosive gases are encountered in this mine, but not in as great abundance as at mine No. 1. At the Ohio Creek Anthracite Coal Company's mine, which is situated west of Mount Carbon, distant about 20 miles from Gunnison, a bituminous coal bed is mined 4 feet 6 inches thick and dips at an angle of 35°. The coal bed is opened by a rock crosscut 1,150 feet long. This company is building 20 coke ovens, and will build more should the coking of this coal prove a success.

The Union Coal Company is working a seam of semi-bituminous coal at its Baldwin mine, 18 miles from Gunnison, on the Denver, South Park and Pacific railroad. This coal lies nearly level, dipping only about 4°. The mine produced 42,732 tons of coal in 1887. The Anthracite-Mesa mine of the Colorado Fuel Company is working in a 5-foot bed of anthracite coal at the terminus of the Crested Butte branch of the Denver and Rio Grande railroad. This mine is opened on the mountain about 800 feet above the railroad and breaker, and 10,000 feet above sea level.

The coal beds in Jefferson county all dip at angles varying from 50° to 80°; their outcrops are found generally along the mountain slopes. Passing southward through Douglas county to El Paso county the dip gradually decreases, so that in El Paso county it is only 6° to 8°. The beds are lignite, and vary much both in thickness and quality throughout the county. In the White Ash mine, at Golden, Jefferson county, the quality of the lignite was found much better at a depth of 600 feet than at the surface. Lignite is also worked in Weld county, several small mines being reported for 1887. The Mitchell mine, on the Denver, Utah and Pacific railroad, is the largest in the county, producing in 1887 a total of 31,288 tons of coal. The lignite beds vary in thickness at different localities throughout the county, ranging from 5 feet 6 inches to 10 feet in thickness.

The greater part of La Plata county has been found to be underlaid by extensive coal beds, which dip at all angles from 0° to 40°.

The Coal Measures in this county belong to the Fox Hill group, and in places are over 1,000 feet in thickness. The coal is of a bituminous character and in some cases makes a very good coke; this has been determined from tests made of the coals in the vicinity of Durango by the San Juan Smelting Company. The coal bed worked by the San Juan Coal Company is 3 feet 6 inches in thickness, and dips regularly at an angle of 5°. No explosive gases have been detected in this mine, possibly on account of the elevation of the coal above water level (800 feet). The Carbonaria mines are situated 2 miles south of Durango, in La Plata county. These mines are working in the Mammoth bed of the Durango coal field. This Mammoth coal bed is 90 feet in thickness, but so badly broken up by seams of slate, fire-clay, and "bone," that the thickest workable bench is only 7 feet in thickness. This coal bed crops out along the base of the mountain near Carbonaria, on the east side of the Animas river, and is found to dip at an angle of 35°. A number of the benches of this bed have been opened by a cross cut and the coal is worked from several of them. Large quantities of explosive gases have been encountered in this mine, the gases seeming to come from the floor of the coal bed.

The area in the State where coal has been developed covers at least 1,000,000 acres. It has been estimated that the entire coal-bearing area of the State is over 26,000,000 acres. Good anthracite and coking coals are found in the area embraced between Slate river and Rock creek, north of Crested Butte, Gunnison county. In this vicinity much prospecting has been done, especially during the last two years, and the locality will probably become a prominent coal-producing center in the near future. A new field of lignite, 17 miles east of Denver, was opened by the Denver Railroad and Land Company during 1887; this lignite is not of very good quality.

Production of Colorado coal

Names of mines.	Location, county.	Operators.	Kind of opening.
Starkville	Las Animas	T. C. & C. Co	Drift
El Moro	....do	C. C. & I. Co	....do
C. & J	....do	Chapelle & John	
Rockvale No. 1	Fremont	C. C. C. Co	Shaft
Rockvale No. 3	....do	....do	....do
Rockvale No. 4	....do	....do	....do
Rockvale No. 5	....do	....do	Slope
Coal Creek No. 1	....do	C. C. & I. Co	....do
Coal Creek No. 2	....do	....do	....do
Oak Creek	....do	....do	....do
Small mines	....do	Several operators	....do
Louisville	Boulder	Marshall Consolidated Coal Company	Shaft
Marshall	....do	M. C. C. M. Co	Slope
Cleveland	....do	Cleveland Coal Company	Shaft
Star	....do	Star Coal Company	....do
Jackson	....do	Jackson Coal Company	Slope
Fox	....do	Fox Coal Company	Shaft
Garfield	....do	Garfield Coal Company	....do
McGregor	....do	McGregor Coal Company	....do
Stewart	....do	Stewart Coal Company	....do
Wise and others	....do	Wise Coal Company and others	....do
Crested Butte	Gunnison	C. C. & I. Co	Drift
Baldwin	....do	Union Coal Company	Shaft
Anthracite Mesa	....do	Colorado Fuel Company	Drift
Small mines	....do	Several operators	....do
Walsen	Huerfano	C. C. & I. C	Slope
Cameron	....do	....do	....do
Mitchell	Weld	Mitchell C. & L. Co	Shaft
Baker	....do	D. W. Davis	Slope
Four small mines	....do	Various operators	
Franceville	El Paso	Franceville Coal Company	Slope
McFerran	....do	J. H. B. McFerran	Shaft
Como No. 1	Park	Union Coal Company	Slope
Como No. 4	....do	....do	....do
San Juan	La Plata	S. S. Coal Company	Drift
Carbonaria	....do	G. D. Jackson	....do
Porter	....do	Porter Coal Company	....do
Small mines	....do	Various operators	
Scranton	Arapahoe	D. R. & L. Co	Slope
White Ash	Jefferson	Paul Lanius	Shaft
Golden Star	....do	G. C. S. Co	....do
Other small mines	....do	Several operators	
Grand View	Dolores	Grand View Mining Company	
Douglas	Douglas		
Grand River	Garfield	Grand River Coal Company	
Small mines	....do	Various operators	
Total			

mines in 1886 *and* 1887.

Character of coal.	Thickness of coal bed. *Ft.*	*In.*	Production, 1886.	Coke produced, 1886.	Production, 1887.
Bituminous	6	0	143, 403	28, 314	181, 270
....do	7	6	286, 303	82, 845	303, 070
					22, 200
Lignite	3	3			
....do	4	6	205, 212		252, 564
....do	3	4			
....do	7	0			
....do	5	0			
....do	3	6	126, 812		154, 520
....do	4	6			
....do	3	0			10, 242
....do	8	0	55, 896		28, 347
....do	8	0	64, 934		130, 000
....do	4	6	6, 100		11, 548
....do	5	0	7, 946		11, 000
....do	5	0	21, 000		29, 273
....do	9	0	24, 652		26, 566
....do	4	10	6, 942		10, 022
....do	4	6	5, 657		7, 516
....do	4	6	20, 973		25, 110
			3, 000		8, 836
Bituminous	6	0	102, 918	29, 003	161, 390
Semi-bituminous			37, 405		42, 732
Anthracite			19, 628		36, 000
					3, 000
Lignite	6	0	89, 913		89, 100
....do	3	6			42, 710
....do	5	6	18, 840		31, 288
....do	10	0	3, 187		9, 120
....do			1, 610		7, 993
....do	8	0	50, 000		47, 017
....do	8	0	3, 000		500
Semi-bituminous	10	0	23, 823		23, 421
... do	10	0			
Bituminous	3	6	14, 000		14, 000
....do	7	0	2, 256		
....do			1, 910		2, 880
....do					6, 900
			11, 000		16, 000
Lignite	8	0	9, 020		
....do			908		12, 000
....do					
					1, 000
					3, 500
					20, 000
					10, 000
			1, 368, 338	140, 162	1, 791, 735

DAKOTA. (a)

Total production in 1887, 21,470 short tons; spot value, $32,205.

The production of coal in Dakota in 1887 shows a material decrease from the production in 1886, due to the decrease of mining operations at Sims by the Northern Pacific Coal Company. The coal beds wherever opened so far appear to be an inferior lignite, which will not stand transportation. The dry coal contains from 4 to 8 per cent. of water, impairing its value greatly. Analyses made from samples taken by Mr. George H. Eldridge were published in the volume of the Mineral Resources for 1886. From these a fair idea of the general character and composition of the Dakota coals can be obtained.

Mr. C. W. Thompson, who is the largest operator in the territory, reports the following analysis of the coal from his mine at Sims:

Analysis of coal from Sims, Dakota.

	Per cent.
Water	12.01
Volatile matter	27.54
Fixed carbon	58.05
Ash	2.40
Total	100.00

As will be seen from a comparison of this analysis with others the coal is far better than any examined by Mr. Eldridge.

Much coal is mined in small quantities by farmers and ranchmen of which it is impossible to obtain any statistics, only an approximate estimate being possible.

The production of the Territory in 1887 was:

Coal production in Dakota in 1887.

	Short tons.
Northern Pacific Coal Company, at Sims	8,470
C. W. Thompson, at Sims	10,000
Unreported small lots	3,000
Total	21,470

The value of the product at the mines was not more than $1.50 per ton, making the total value of the Territory's production in 1887 $32,205. The bed worked at Sims by Mr. Thompson is 7 feet in thickness. Coal has been recently reported as occurring in the Black Hills, 10 miles southwest of Hot Springs. This deposit covers about 12 square miles, and contains coal of a bituminous character, associated with thin seams of a harder coal, which is very black and bright, and breaks with a cubical fracture. No developements of these coals have been made.

a Reported by Mr. F. F. Chisolm.

GEORGIA.

Total production in 1887, 313,715 short tons; spot value, $470,573.

The coal field of Georgia occupies about 200 square miles in the extreme northwestern corner of the State, it being the smallest portion of the Appalachian coal field which is contained in any one State.

There is only one producing company, the Dade Coal Company. There are, however, several small country banks whose production is very small and is not reported. The Dade coal bed in which the mines are worked is considered by Mr. A. P. Buck, general manager of the company, to lie below the Pottsville Conglomerate (Millstone Grit) No. XII. It varies in thickness from 1 foot 6 inches to 14 feet, with an average workable thickness of about 4 feet. The character of the coal is semi-bituminous, and it makes a fair coke, although rather high in ash.

The Dade mines are located at Cole City, in Dade county. During 1887 these mines produced 49,537 tons of lump coal and 158,483 tons for coke, which was manufactured from the nut and slack. This estimate does not include the colliery consumption, of which no record is kept by the company. The lump coal is shipped principally to the Western and Atlantic Railroad, while the coke is consumed in the company's furnaces. The coal commands a price of $1.50 per ton on the cars. The company employs about 500 men in and about the mines and 130 more at the coke ovens. Mining is paid at the rate of 30 to 35 cents per "corve," the corve containing 16 bushels of 80 pounds each. The cost of mining the coal and putting it on the cars for shipment is estimated at 3.64 cents per bushel of 80 pounds.

IDAHO.

Total production in 1887, 500 short tons; spot value, $2,000.

The existence of bituminous coal and lignite, in deposits of considerable extent, has been reported at a number of localities in the Territory. Some of these localities are mentioned in Mineral Resources, 1886. The developments of the coal areas have thus far been confined to prospecting and locating claims. No coal has yet been produced, except for local consumption. In speaking of these developments, Hon. E. J. Curtis, secretary of the Territory, says: "Since February, 1888, the executive department of Idaho has sent circulars to every part of the Territory where coal has been reported to exist, requesting information in regard to it. We have only thus far been successful in getting reports of supposed discoveries of coal in workable quantities, but as yet we have not been able to obtain any data whatever of coal production. The miners and locators of many of these coal claims are still at work making explorations and carrying forward developments with the hope and expectation of finding coal beds. We are therefore compelled to report that there is at present no commercial production of coal in Idaho." The entire amount of coal mined by these prospectors throughout the year would probably not exceed 500 tons.

ILLINOIS. (a)

Total production in 1887,(b) 10,278,890 short tons; spot value, $11,152,596.

The Illinois coal field occupies the greater portion of the central coal field of the United States, the smaller portions constituting the Indiana field and the western Kentucky field.

The productive coal area of the State, according to the late Prof. A. H. Worthen, State geologist, covers about 37,000 square miles, although the actual extent of the area has been questioned, since no general survey has been made with sufficient accuracy to permit of a reliable statement. Dr. Theo. B. Comstock, in a recent article on the fossil fuels of Illinois, says: "It is generally conceded that the actual area underlaid by coal which can be mined at a profit will all be included within the range of 10,000 to 25,000 square miles."

The number of counties which produced coal during 1887 was 49, out of a total in the State of 102. There are 52 counties in all from which the production of coal has been reported at some time and in greater or less quantities, but three of them did not contribute to the output of the State during the year. These are Edgar, Jasper, and Calhoun counties. Edgar county has only one mine, located at Illiana, on the Indiana State line, and this has not been in operation during the year, though there is still an abundance of mineral in sight. The coal and coke plant at Thomas's landing, on the Mississippi river, in Calhoun county, has been idle for a number of years, and is apparently abandoned. Jasper county also fails this year to contribute its small quota of coal, owing to the suspension of its one unimportant mine.

According to the reports of the State mine inspectors, the most prolific, accessible, and easily worked seam of coal in the State is found in the Belleville district, in the four or five counties east of the Mississippi river, at Saint Louis. The seam is from 6 to 8 feet in thickness, and lies usually 100 feet under cover; seldom less than 50, and rarely more than 250 feet.

A summary of the statistics of the Illinois field for 1887 and a comparison with those for 1885 and 1886 respectively, is shown in the following table:

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a Compiled principally from reports made by Col. J. S. Lord, secretary of the State Bureau of Labor Statistics; notes were also furnished by mine inspectors and by Mr. H. A. Bischoff.

b Commercial coal, not including nut and slack; latter sizes have not been reported for the individual mines. Colonel Lord estimates that if the nut and slack coal were included, the total output of the mines would be about 13,000,000 short tons.

Statistics of the Illinois coal field.

	1885.	1886.	1887.
Counties producing coal	50	50	49
Mines and openings of all kinds	778	789	817
Employés of all kinds	25,446	25,846	26,804
Mining machines employed	....	235	....
Tons of coal mined	9,791,874	9,246,435	10,278,890
Aggregate value of the same at the mines	$11,456,493	$10,263,543	$11,152,596
Average value per ton at the mines	$1.17	$1.11	$1.085
Average number of days of active operation	225	206	213.2
Average price paid per ton for mining	$0.725	$0.616	$0.727
Kegs of powder used	140,382	127,099	152,627
Mules employed underground	....	1,344	1,474
Men killed	39	52	41
Men injured so as to lose time	176	169	180
Tons mined for each life lost	251,073	177,816	244,735
Employés for each life lost	652	497	409

The whole number of coal mines and openings of all kinds is somewhat larger this year than heretofore, though the numerical increase is largely in mines of trifling importance. The summary shows a total of 817 places at which coal is produced, but of these 9 are so-called "strip-plings" and 7 are mines at which, for various reasons, no coal has been mined during the year. Omitting these, there remain 801 from which a definite product has been reported. Of these, 64 have produced 50,000 tons or more during the year, 139 have produced from 10,000 to 50,000 tons, 278 from 1,000 to 10,000 tons, and 320 less than 1,000 tons.

The following table exhibits a classification of the mines of the State upon the above basis for the past five years:

Classification of the coal mines of Illinois.

Years.	Mines producing—				Total.
	Less than 1,000 tons.	1,000 to 10,000 tons.	10,000 to 50,000 tons.	Over 50,000 tons.	
1883	209	233	135	62	639
1884	262	273	146	60	741
1885	286	290	139	63	778
1886	316	280	136	57	789
1887	320	278	139	64	801

This division is made not upon the capacity but the actual output of the mines as reported for the several years, and it follows that a plant of larger capacity may appear in a lower class than it should if it has not for any reason been worked approximately to its capacity. In general, however, these arbitrary divisions upon the basis of output afford a very good indication of the relative importance of the whole number of mines.

It is of course noticeable that the first class, consisting of those whose product has been 50,000 tons or more, make a very small proportion of the whole number. An examination, however, of the actual business of the 64 mines reported in this class for 1887 shows that their aggregate product was more than half the whole, or 5,949,894 tons, which gives an average of 160,608 tons to each. Similarly, it is found that the 139 mines of the second class, producing from 10,000 to 50,000 tons in the year, show a total output of 3,270,681 tons. Thus the two classes, numbering 203 mines, produce an aggregate of 9,220,575 tons; or, in round numbers, one-fourth of the whole number of mines delivers 90 per cent. of the entire product of coal.

The largest output of any one mine for the year is that of the Chicago, Milwaukee and Saint Paul shaft No. 2, at Braceville, which raised 274,711 tons. The No. 1 shaft of the Chicago, Wilmington and Vermilion Coal Company, at Streator, is next in rank, with an output of 241,508 tons, and this is followed by the Saint Louis Ore and Steel Company's mine at Murphysborough, which shows a total of 215,690 tons.

The relative magnitude of the business of the great coal companies is as follows: The Consolidated Coal Company of Saint Louis, which owns and controls 71 mines in Illinois, reports as the product of 54 of them 2,008,341 tons. This, however, does not represent a full year's operations in point of time, as the organization of the company was not completed until September, and 17 of their acquired mines were not operated at all. So that the above output may be regarded as the work of three-fourths of their mines for ten months of the year.

The Chicago, Wilmington and Vermilion Coal Company has 4 mines at Braidwood and 3 at Streator, and reports as the product of these seven establishments a total of 851,308 tons.

The Spring Valley Coal Company, near La Salle, has had 3 mines in operation during the year, with a total output of 351,985 tons. Another mine will shortly be opened by this company, and still others as rapidly as the work can be advanced. Among the smaller companies may be mentioned the Wilmington Star Coal Company, with 2 mines and an output of 115,645 tons; the La Salle County Carbon Coal Company, with 2 mines, producing 107,250 tons; the Sangamon Coal Company, Springfield, 3 mines, producing 140,182 tons; the Grape Creek Coal Company, 4 mines, producing 82,320 tons; and the Coal Valley Coal Company, Rock Island, with 2 mines, and a product of 73,469 tons, though this is practically the output of only one of them.

Mr. Taylor Williams, a large individual owner, has had 5 mines in operation during the year, whose product has been as follows: At Clark City, 87,000 tons; Gardner, 43,000 tons; Saint David, 24,039 tons; Rapids City, 36,199 tons; Cleveland, 9,968 tons; the total being 200,206 tons.

There are, of course, new mines being opened each year and mines being exhausted or, for other reasons, abandoned. An enumeration of these show that numerically they have nearly offset each other, the whole number of new mines for the year being 60, and the number of mines closed being 54.

The mines of the State are divided into five inspection districts. The detailed statistics for the mines in these districts have been reported by the inspectors as follows: First district, Alexander Ronald; second district, Thomas Hudson; third district, James Freer; fourth district, Walton Rutledge; fifth district, Robert Winning.

Statistics of Illinois coal inspector's districts for 1887.

Counties.	Number of mines.	Miners (summer).	Miners (winter).	Other employés.	Average number of days worked.	Average price paid per ton for mining.		Number of tons of coal produced.	Average value per ton at the mines.
						Summer.	Winter.		
FIRST DISTRICT.									
Grundy	21	1,799	2,093	452	148	$0.9523	$0.9564	792,954	$1.347
Kankakee	2	220	220	62	173	.95	.95	97,000	1.35
La Salle	27	1,577	2,221	809	180	.8447	.8489	1,125,235	1.324
Livingston	13	827	1,024	227	181	.797	.797	387,600	1.24
Will	5	660	711	96	164	.95	.95	284,040	1.293
Total	68	5,083	6,269	1,646				(*a*)2,686,829	
Average					169	.8893	.8922		1.316
SECOND DISTRICT.									
Bureau	22	692	1,008	199	196	.901	.901	429,680	1.40
Hancock	6	10	33	6	157	1.021	1.069	6,208	1.653
Henry	27	(*b*)174	(*c*)396	57	170	.817	.87	117,533	1.506
Knox	39	101	263	42	151	.91	.809	64,234	1.298
Marshall	20	138	194	31	125	.898	.898	73,928	1.485
McDonough	63	350	532	37	125	1.096	1.33	110,103	1.637
Mercer	21	233	413	204	152	.869	.914	127,608	1.68
Rock Island	24	163	295	65	167	.831	.854	85,282	1.723
Schuyler	7	39	71	11	140	.722	.714	22,686	1.11
Stark	23	34	104	13	141	.803	.80	17,865	1.446
Warren	23	21	88	7	132	1.166	1.166	13,810	1.84
Total	275	1,955	3,397	672				(*d*)1,069,027	
Average					150	.904	.938		1.496
THIRD DISTRICT.									
Cass	4	8	14	2	166	.95	.95	2,325	1.399
Fulton	73	477	819	134	166	.6907	.733	337,215	1.069
Logan	3	160	235	71	260	.621	.621	159,000	1.143
McLean	2	200	336	94	233	.70	.815	141,700	1.235
Menard	10	125	284	56	221	.598	.608	155,621	.967
Peoria	87	545	990	164	164	.6935	.6965	452,123	1.046
Tazewell	10	87	132	21	177	.68	.68	51,847	1.063
Vermilion	45	571	891	257	182	.6225	.6540	359,119	1.125
Woodford	2	215	290	113	270	.85	.85	122,445	1.268
Total	236	2,388	3,991	912				(*e*)1,781,395	
Average					204	.6752	.6942		1.095
FOURTH DISTRICT.									
Bond	2	40	58	16	250	.50	.55	36,076	1.00
Calhoun (*f*)	1								
Christian	1	(*g*)85	(*g*)130	36	293	(*h*)	(*f*)	149,973	.83
Coles	1	75	100	24	260	.75	.75	34,612	1.50
Edgar (*f*)	1								
Greene	9	36	55	10	178	.75	.75	12,578	1.50
Jasper (*f*)	1								
Jersey	5	10	11		192	1.00	1.00	2,684	1.75
Macon	3	169	260	61	282	.696	.696	118,183	1.274

a 274,953 tons not included in averaging prices for mining.
b 40 working with machines not included in this average.
c 30 working with machines not included in this average.
d 54,550 tons not included in averaging prices for mining.
e 360 tons not included in averaging prices for mining.
f Mines not operated.
g Not included in averaging prices for mining.
h Paid by the day.

Statistics of Illinois coal inspector's districts for 1887—Continued.

Counties.	Number of mines.	Miners (summer).	Miners (winter).	Other employés.	Average number of days worked.	Average price per ton paid for mining.		Number of tons of coal produced.	Average value per ton at the mines.
						Summer.	Winter.		
FOURTH DISTRICT—continued.									
Macoupin	22	994	1,277	328	243	.5094	.5094	926,588	.809
Madison	29	426	632	175	212	.554	.587	521,705	.802
Montgomery	1	13	22	8	190	.75	.75	10,220	1.35
Morgan	4	25	20	10	148	.687	.70	6,669	1.452
Sangamon	16	722	1,222	376	232	.581	.58	730,391	.9217
Scott	5	31	45	7	240	1.125	1.125	9,802	1.60
Shelby	10	21	45	6	167	2.00	2.00	8,810	2.50
Total	111	2,647	3,877	1,057	......	......	......	2,568,291	......
Average	......	......	......	......	222	(a).5707	.5785	......	.8873
FIFTH DISTRICT.									
Clinton	2	75	75	12	144	.50	.50	55,238	.75
Jackson	10	411	500	66	188	.567	.57	375,718	.8927
Marion	5	160	252	95	206	.551	.551	98,915	.8859
Perry	13	452	571	191	227	.522	.595	319,552	.8777
Randolph	10	139	184	47	211	.452	.525	74,263	.7812
Saline, Gallatin, Johnson	6	79	202	40	214	.627	.627	78,955	.95
Saint Clair	63	1,512	1,610	838	180	.4922	.4922	1,018,149	.7681
Washington	3	49	78	24	208	.545	.545	40,220	.9995
Williamson	6	116	153	4	152	.387	.50	112,338	.8237
Total	118	2,993	3,625	1,317	......	......	......	(b)2,173,348	......
Average	......	......	......	......	192	.5183	.5452	......	.8248

a 631,411 tons not included in averaging prices paid for mining.
b 937,997 tons not included in averaging prices paid for mining.

The relative output of the several districts and the aggregate for the State for a term of years is shown in the following table:

Coal product by districts in Illinois.

Years.	First district.	Second district.	Third district.	Fourth district.	Fifth district.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1870	....	....	....	....	....	2,624,163
1880	1,631,440	696,046	1,185,189	1,022,718	1,579,984	6,115,377
1882	2,540,532	710,526	1,350,020	2,075,244	2,412,321	9,088,643
1883	2,495,072	831,522	1,585,108	3,128,368	1,990,921	10,030,991
1884	2,507,370	728,341	1,932,881	2,804,183	2,128,230	10,101,005
1885	2,519,397	723,077	1,811,405	2,615,992	2,122,003	9,791,874
1886	2,326,742	704,723	1,518,445	2,749,813	1,946,712	9,246,435
1887	2,686,829	1,069,027	1,781,395	2,568,291	2,173,348	10,278,890

The total production for 1887 shows a marked increase over the output of any recent year, it was in fact a larger total by 177,885 tons than the State has ever before produced in one year. In both the years 1883 and 1884 the total exceeded ten millions of tons, but in the following year, 1885, the output declined to 9,791,874 tons, and in 1886 to 9,246,435 tons. The increase over last year is consequently somewhat more than a million tons. It is made up in the following districts: In the first district, including the Streator, La Salle, and Braidwood fields, there has been a gain of 360,087 tons; in the second district a gain of 364,304 tons, chiefly arising from the further development of the Spring Valley fields; in the third district, embracing Peoria, Fulton, Vermilion, and intermediate counties, the gain has been 262,950 tons, and in the fifth district, which takes in Saint Clair and the southern fields, the increase has been 226,636 tons. But in the fourth district, including among others the great coal counties of Sangamon, Macoupin, and Madison, there has been a decline in output of 181,522 tons. This has occurred principally in Macoupin county, where ten of the mines recently acquired by the Consolidated Coal Company show a falling off of 165,017 tons as compared with their output for the preceding year. For the last four years the fourth district has stood at the head of the list in its coal product, though its tonnage has been declining each year since 1883, when it had attained a maximum of 3,128,368 tons. Now it yields the first place to the first district, which shows the largest output it has ever had. There is, moreover, every probability that this supremacy will be maintained in the future, as the new branch of the Chicago, Burlington and Quincy railroad, already referred to, as being constructed across this prolific territory, affords a new and direct outlet to the Northwest; it is already stimulating new coal companies, and will doubtless continue to do so. This will especially add to the magnitude of the industry in La Salle county.

There is naturally a greater variance between counties as to the richness of their coal deposits, and the extent to which they are developed, than between districts. Three counties have alternately enjoyed the distinction of being the greatest producers of coal; these are La Salle, Saint Clair, and Macoupin. For a period of six years the aggregate of coal raised in each of these counties has not varied greatly from a million tons. In 1882 La Salle county was foremost with an output of 1,169,030 tons; in 1883 and 1884 Macoupin county produced the most, the totals being 1,233,200 and 1,164,509 tons, respectively; in 1885 Saint Clair county took the lead with a total of 1,202,549 tons; in 1886 Macoupin county again acquired the ascendency with 1,085,539 tons, and this year La Salle county has the precedence with 1,125,235 tons.

The six counties which rank next to these are Grundy, with 792,954 tons; Sangamon, with 730,391; Madison, with 521,705; Peoria, with 452,123; Jackson, with 375,718, and Vermilion, with 359,119.

The average number of men employed may be arrived at by an examination of the reported numbers for summer and winter for four years:

Total number of employés in the Illinois coal mines.

Years.	Miners.		Other employés.
	Summer.	Winter.	
1884	13,961	20,610	4,965
1885	14,194	20,273	5,174
1886	14,129	20,973	4,873
1887	15,066	21,158	5,646
Total	57,350	83,014	20,658

The average deducible from these figures is 22,710 for both miners and other employés.

In 1886 the number of miners employed in summer was 14,129, in winter, 20,973, and of other employés, 4,873, making a total in the winter, or busy season, usually conceded to be about eight months in the year, of 25,846; and the year before that the total was about the same; this year we have for the summer 15,066 miners, for the winter, 21,158, and of others, 5,646, making a maximum number of 26,804. In this summary the men engaged in operating machines are reported as miners, though many of them are not and never have been practical miners, capable of cutting, drilling, blasting, and timbering with the ordinary implements of the craft.

In mining, perhaps more than any other industry, there is a tendency to congregate a surplus of men about every establishment. This is important to the proprietor because coal can not be mined and stored profitably in anticipation of future demands, but must be produced daily in quantities to supply the current need. It thus happens that there are frequent emergencies requiring the services of many more men than can be employed continually, and while it is well that the operator should be able to command men for such occasions, it is not well for the miners, who must remain more or less idle for long intervals in the dull season. An illustration of what a given number of miners can accomplish when kept continuously and regularly at work is found at the mine of the Matthiessen and Hegeler Zinc Works, at La Salle. This establishment consumes the entire product of its mine in the manufacture of zinc; and the quantity required is substantially uniform for every working day in the year. Under these conditions 46 miners deliver from a 5-foot seam an average of 240 tons a day, or 74,310 tons in a year of 310 working days, which gives an average of 1,615 tons a year to each man. At 55 cents a ton this gives to each an average annual income of $888.25, or $74 a month.

On the other hand an average of 1,713 miners is reported from 12 other mines in La Salle county, working from 3 to 5 feet of coal by hand, whose aggregate product is 893,078 tons, or 521 tons to the man, which at 84 cents a ton gives them an average of $437.64 per annum. This also shows how the smaller sum per ton may be the better pay. The coal at the zinc works is not screened, and the gross weight of the contents of each pit car is credited to the miner, while at the other mines, with one exception, the coal is screened first and weighed afterward. This of itself would not, however, make the whole difference between 55 cents and 84 cents a ton to the miner. At a neighboring mine 77½ cents a ton is paid for coal from a 3-foot seam weighed before screening, indicating that the gain from that source is equivalent to 12½ cents a ton. But the great advantage enjoyed by a miner at the works of Matthiessen and Hegeler consists in the regularity of the work, and if this firm was disposed to take the utmost advantage of its situation it could doubtles fill the mine with men at 45 cents a ton, while others offering less regular work were paying 90 cents.

In ten large hand-mines in Grundy county, 1,919 men on an average produce 776,762 tons, or an average of 405 tons each, for which they receive 95 cents a ton, or $384.75 each per annum. This is for work in a 3-foot seam. In Sangamon county an average of 1,055 men working in a 5-foot seam mine 730,391 tons, or 692 per man, which at 55 cents a ton would give the miner an average of $380.60. In Saint Clair county the reported number of men compared with the tons mined shows a product of about 600 tons to the man, at 50 cents a ton. At Spring Valley 633 men mine 351,985 tons, or 556 to each in a 3-foot seam, and at 90 cents a ton, making average earnings of $500.

These cases are given not so much for the purpose of showing the average earnings at different places, for the enumeration of employés is not accurate enough for predicating anything more than a generalization, but more especially to emphasize the paramount importance to the miner of steady work. It appears that with full opportunities a miner can make 1,600 tons of coal per annum in a 5-foot seam, working pillar-and-room by hand, while with such opportunities as they can get in ordinary shipping mines, dependent upon a fluctuating market, they average at most 600 or 700 tons per annum. In other words the number of men actually engaged in and dependent upon the industry is about twice as great as the number really required to produce the present output if they could work all the time.

Working time.—This leads to the subject of average working time for the year as derived from the reports of the number of days in active operations at each mine. In the subsequent table of summaries, a level average of days worked by each of the mines, of all sizes, is given as 183.8 days in the year. But, as already shown, much the larger number of mines are of comparatively trifling capacity, and their operations are confined to the winter months. In order, therefore, to arrive at the average working time of those mines which are operated both summer and winter, a division is made upon the class known as shipping mines. We thus obtain a list of 292 mines, the whole number being 297, and these we find have in fact given employment to 23,146 men, or 86 per cent. of the whole, and have brought to the surface 9,655,811 tons of coal, or 94 per cent. of the entire product. Applying the calculation to these, as truly representing the industry as a permanent and continuous business, we find that these mines have been in active operation during the year an aggregate of 62,248 days, from which we deduce the average of 213.2 days as the average working time of each, and 68.7 per cent. as the proportion of full time which has been devoted to the active prosecution of this business. The average working time similarly computed for last year was 206 days. Carried somewhat further these figures indicate an average daily product of 4,529 tons, and an annual product per miner of 523 tons.

The average value of this staple product at the mines, for the State at large and for the year, is found to have been $1.085 per ton. The basis for this deduction is the average value given by each proprietor for his coal on track at the mine. Being an average it does not purport to indicate exact prices received, which in some localities vary very widely, as between contracts for large amounts, and the prices charged to private consumers. But for purposes of comparison and general deduction the average reported from year to year affords a relatively true index of real values. The average for the State as deduced for the year past is somewhat less than the preceding year, or for any other year. Computations for this average for a series of years gives the following tabular statement:

Average value of coal per short ton at the mines in Illinois since 1882.

Districts.	1882.	1883.	1884.	1885.	1886.	1887.	Percentage decline since 1882.
							Per cent.
First	$1.75	$1.59	$1.49	$1.41	$1.321	$1.316	24.8
Second	1.87	1.97	1.79	1.71	1.57	1.497	19.9
Third	1.43	1.45	1.31	1.25	1.161	1.095	23.4
Fourth	1.33	1.32	1.09	.985	.969	.887	33.3
Fifth	1.31	1.26	.961	.894	.862	.823	37.2
The State	1.51	1.48	1.26	1.17	1.11	1.085	28.0

The somewhat remarkable fact is here developed that the operators of mines are now receiving from one-quarter to one-third less for their product than they were in 1882, the decline by districts being from 20 to 37 per cent. with an average of 28 per cent. for the whole State. This decline has moreover been continuous during the term, each year showing a smaller average than its predecessor, though the variation this year is slighter than in former years. This, and the further fact that there has been during the year a slight improvement in the prices paid to operative miners, indicates that the limit of depression must have been reached. The following is the record of average prices paid for hand-mining in this State for a period of five years:

Average prices paid for mining in each district in Illinois for the years 1883 *to* 1887 *inclusive.*

Districts.	1883.		1884.		1885.		1886.		1887.		Percentage decline in five years.
	Summer.	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	Winter.	
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	
First	88.4	93.4	85.4	93.2	84.5	87.8	80.3	88.8	88.93	89.22	3.
Second	95.4	99.8	95.0	103.0	90.7	95.8	89.3	94.4	90.40	93.80	6.
Third	80.3	91.1	81.4	90.3	78.5	82.9	69.9	74.5	67.52	69.42	21.5
Fourth	65.8	73.6	63.5	72.4	59.8	63.1	55.6	58.2	57.07	57.85	19.
Fifth	58.6	63.5	54.0	63.0	47.9	52.8	43.8	53.3	51.83	54.52	13.
The State	75.9	82.4	72.6	81.2	68.1	74.3	59.5	71.7	70.82	72.12	6.4
The year	80.2		78.3		72.5		67.6		72.7		

As shown in a former table the average value of coal at the mines for the State at large has declined somewhat during the year, though but slightly, and has declined continuously for six years, the total decline amounting to 28 per cent. The following table shows the relative movements of the prices of coal and the prices of mining for a period of five years:

Average values of coal and average prices for mining for five years in five districts and for the State as a whole.

Districts.	1883.		1884.		1885.		1886.		1887.		Percentage decline in—	
	Average value of coal.	Average price for mining.	Average value of coal.	Average price for mining.	Average value of coal.	Average price for mining.	Average value of coal.	Average price for mining.	Average value of coal.	Average price for mining.	Coal.	Mining.
First	$1.59	$0.917	$1.40	$0.906	$1.41	$0.867	$1.32	$0.859	$1.316	$0.891	17	3
Second	1.97	.983	1.79	1.00	1.71	.941	1.57	.927	1.497	.927	24	6
Third	1.45	.875	1.31	.873	1.25	.814	1.16	.729	1.095	.688	25	21.5
Fourth	1.32	.71	1.09	.694	.985	.62	.969	.573	.887	.576	33	19
Fifth	1.26	.619	.961	.60	.894	.511	.862	.501	.823	.537	35	13
The State	1.48	.802	1.26	.783	1.17	.725	1.11	.676	1.085	.727	26.5	9.4
Ratio of value of coal to price of mining.	54 per cent.		61 per cent.		62 per cent.		61 per cent.		66 per cent.			

This shows an average decline in the selling price of coal, or in its reported value on track at the mines, of 26.5 per cent., and a decline in the prices paid for mining, as reported by proprietors of mines, of 9.4 per cent. The ratio which the price paid for mining sustains to the value of product is also here brought out, and it appears that an increasing portion of the value of the coal is being paid to miners. That proportion has increased from 54 per cent. in 1883 to 66 per cent. in 1887. In other words, the average price paid per ton to hand-miners for reducing the mineral to merchantable form is now two-thirds of the average value of the coal on track.

At the average price paid for mining, 72.7 cents per ton, we should have as the gross sum paid out for the delivery of 10,278,890 tons of coal on pit cars at the face of the workings, $7,472,753.75. At the reported average value of the same per ton on track, or ready for market, viz., $1,085, we have as the aggregate value of the entire product the sum of $11,152,596, leaving $3,679,843, or 35.8 cents per ton to cover all the expenses, profits, and hazards of the business. Both the expenses, however, and the risks of mining vary so widely, owing to natural conditions, locations, and methods that a mathematical conclusion of this kind may have only a general, and in no case a specific application.

The year 1887 has been marked by greater activity in the coal trade than the previous year; but while trade has been more active prices have remained low, and hence profits small. The tendency has been, therefore, to curtail expenses as much as possible; hence improvements have not been very rapid. During the year, 328 miles of new railroad have been laid in Illinois, distributed among twelve railroad lines. Much of this construction was in the coal regions, thus encouraging the opening of new mines. In the first inspection district the construction of the Indianapolis, Vincennes and Northern railroad from Streator to Walnut, a distance of 65 miles, has stimulated the development of the coal lands near Streator, so that during the summer of 1887 these fields have been opened sufficiently to increase the daily production of this region by from 1,500 to 2,000 tons. This railroad furnishes the most direct route to the Northwest and will probably stimulate the opening of other mines along the route. Probably the most complete mining plant in the State is the new shaft of the Chicago, Wilmington and Vermilion Coal Company, recently opened 1½ miles north of Streator. Mining machines will be employed throughout this mine, the workmen being paid by the day. In this district eight new mines were opened and twelve permanently abandoned during the past year. Eight new fans were erected, while furnace ventilation in those and natural ventilation in five mines was done away with.

In the second district the most marked improvement during the year was the opening of twenty-two new escapements. These were mostly confined to local mines, and were comparatively inexpensive, ranging from drift openings to shafts 50 to 60 feet in depth. All the principal mines in the district are now equipped with ventilating fans, but two mines, employing over thirty men, being supplied with furnaces. Four new shafts have been sunk and one new mine opened, while four mines have been permanently abandoned.

In the third district thirty-seven new mines have been added to the list, while twenty-five have been permanently abandoned. Eighteen new fans have been erected, replacing six smaller fans and four furnaces, the remaining eight being placed at new openings. One of the most marked improvements has been the increase in the number of furnaces and the decrease in natural ventilation throughout the district. This increase in the number of furnaces amounted to forty-seven, while the decrease in naturally ventilated mines was forty-one. The number of escapement shafts completed during the year was fifty-two.

In the fourth district eight new mines were opened and seven permanently abandoned. The greatest improvements have been in regard to ventilation, all the shipping mines, with two exceptions, are now equipped with fans, work the coal by the double-entry system, and split the air currents. Most of the large mines are now using steel ropes for hoisting, and are adopting mining machines where the nature of the coal seam admits of them.

In the fifth district five new mines have been opened and six permanently abandoned during 1887. Statistics show an increase of six fans in the district, with a decrease of twenty furnaces, as compared with 1886. Mines employing single and double-entry systems of mining are now about equal in number, those employing the double-entry system showing an increase of nearly 30 per cent. over last year.

The following table exhibits in condensed form the increase and decrease in number of mines, and kinds of ventilation employed in 1887, as compared with 1886, for the five inspection districts of the State:

Increase and decrease in number of mines and in kinds of ventilation employed in 1887, *as compared with* 1886.

Districts.	Number of mines.		Fan ventilation.		Furnace ventilation.		Steam-jet ventilation.		Natural ventilation.	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
First	....	1	7	....	....	3	....	....	....	5
Second	13	....	....	1	4	....	....	2	13	....
Third	13	....	5	....	45	....	....	1	....	39
Fourth	2	....	4	....	9	....	....	4	....	7
Fifth	....	8	6	....	....	20	7	....	....	1
Total	28	9	22	1	58	23	7	7	13	52

The following statistics connected with the Chicago coal market are reproduced from the *Black Diamond*, and are significant, showing the movement of coal as affecting the production of Illinois coal mines:

Yearly receipts of coal at Chicago since 1882.

Kinds of coal.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Anthracite by lake	663,785	738,723	820,002	741,866	768,164	853,158
Anthracite by rail	447,636	506,688	627,806	613,054	616,997	845,386
Eastern bituminous coal by lake	287,794	214,488	243,188	206,817	166,762	123,221
Eastern bituminous coal by rail	390,212	630,914	612,462	790,169	888,771	1,196,324
Illinois coal	1,167,844	1,490,515	1,467,989	1,287,995	1,175,001	1,375,759
Indiana coal	542,760	500,925	469,079	659,634	732,191	1,154,681
Coke	467,633	464,529	553,860	558,963	540,204	592,980
Total	3,967,664	4,546,782	4,794,386	4,858,498	4,888,090	6,141,509

The following table shows the relative percentage which each kind or division bears of the aggregate receipts for each year:

Kinds of coal.	1882.	1883.	1884.	1885.	1886.	1887.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Anthracite	27.46	27.39	30.20	27.89	28.35	27.65
Eastern bituminous	17.22	18.59	17.85	20.52	21.59	21.48
Illinois coal	29.67	32.78	30.62	26.51	24.03	22.40
Indiana coal	13.78	11.02	9.78	13.58	14.98	18.96
Coke	11.87	10.22	11.55	11.50	11.05	9.51
Total	100.00	100.00	100.00	100.00	100.00	100.00

The following tables give the receipts of bituminous coal at Chicago from 1884 to 1887:

Yearly receipts of bituminous coal at Chicago since 1883.

Eastern bituminous coal.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Hocking	81,224	165,463	211,984	317,933
Ohio Central	165,022	115,951	193,732	220,470
Shawnee	40,940	54,717	75,558	95,222
Jackson Hill	11,999	9,520	10,023	45,245
Pittsburgh	190,764	249,684	133,260	136,744
Youghiogheny	133,353	173,944	256,515	294,666
Erie and Brier Hill	137,899	145,096	71,245	74,160
Cumberland	19,515	50,289	25,161	31,452
Miscellaneous	....	....	....	103,653
Total	780,716	964,664	977,478	1,319,545
Western bituminous coal.				
Wilmington	931,945	909,854	791,337	734,456
Indiana Block	300,035	500,458	575,301	964,388
Mount Olive	99,519	88,447	112,497	151,729
Streator	107,898	80,878	92,758	208,052
Norton Creek and Clinton	32,661	53,185	66,325	87,601
Grape Creek	229,994	155,863	89,654	178,276
Fountain County	96,597	89,411	90,565	63,496
Miscellaneous	....	....	....	138,542
Total	1,798,649	1,878,096	1,818,437	2,526,540

Receipts, consumption, and shipments of anthracite coal at and from Chicago since 1883.

RECEIPTS.

	1883.	1884.	1885.	1886.	1887.
Stock on hand in docks and yards (January 1)	271,638	265,645	324,289	223,518	118,059
Receipts by vessel (January 1 to December 31)	738,723	820,002	741,866	768,164	853,158
Receipts by rail (January 1 to December 31)	506,688	627,806	613,054	616,997	845,386
Total	1,517,049	1,713,453	1,679,209	1,608,679	1,816,603

CONSUMPTION AND SHIPMENTS.

	1883.	1884.	1885.	1886.	1887.
Shipments to the country (January 1 to December 31)	493,860	585,753	632,274	451,869	559,560
Local consumption (January 1 to December 31)	757,544	803,411	823,417	1,038,751	1,079,443
Balance stock carried over (January 1 to December 31)	265,645	324,289	223,518	118,059	177,600
Total (December 31)	1,571,049	1,713,453	1,679,209	1,608,679	1,816,603

The average nominal prices quoted free on board for the various kinds of coal coming into the Chicago market are given in the following table:

Kinds of coal.	1885.	1886.	1887.	Kinds of coal.	1885.	1886.	1887.
Anthracite	$5.82½	$5.56	$6.40	Sunday Creek	2.98	2.92	3.23
Kanawha cannel	......	4.75	4.75	Shawnee	3.02½	2.92	3.23
Buckeye cannel	4.17½	4.31	4.48	Wellston	......	......	3.28
Brush Creek cannel	......	......	4.75	Jackson Hill	3.04	3.15	3.28
Blossburg	3.77	3.56	3.99	Indiana Block	2.38	2.45	2.70
Sonman	3.64	3.53	3.84	Peacock	......	......	2.50
Cumberland	3.40	3.48	3.84	Wilmington	2.12	2.04	2.18
Mount Vernon	......	......	3.90	Mount Olive	2.12	2.04	2.18
Fire Creek	......	3.50	3.50	Norton Creek	1.95	1.95	2.15
Erie and Briar Hill	4.40	4.18	4.69	Grape Creek	2.07	2.04	2.15
Raymond	......	......	3.67	Minonk	2.12	2.04	2.18
Winifride	......	3.50	3.50	Fountain county	2.03	2.02	2.15
Black Band	......	......	4.38	Streator	2.12	2.04	2.15
Youghiogheny	3.36	3.20	3.50	Morris	1.96	2.04	2.15
Pittsburgh	3.30	3.18	3.41	Summit semi-block	......	......	2.50
Hocking Valley	3.02½	2.92	3.23				

INDIANA.(a)

Total production in 1887, 3,217,711 short tons; spot value, $4,324,604. The coal field of this State is confined to the southwestern part, being part of the Illinois coal field. The eastern boundary crosses the Indiana-Illinois State line in Warren county, 4 miles west of Williamsport, then passes near Greencastle, in Putnam county, and Freedom, in Owen county. It touches the western boundary and passes between the Huron and Shoales, and the Ohio and Mississippi rivers in Lawrence and Martin counties, and passing through Orange county to the mouth of Deer creek in Perry county, where it crosses the Ohio River into Kentucky.

The counties of Posey, Vanderburg, Warrick, and Spencer are wholly within the Coal Measure limits, and a large area in the west part of Perry and Crawford, with all of Gibson, Pike, Dubois, Knox, Daviess, Martin, Sullivan, Green, and Clay, together with the west part of Owen, and large areas in Vigo, Parke, Vermillion, Fountain, and Warren counties are more or less rich in deposits of remarkably pure, hard, and clean-burning bituminous coals.

The Coal Measures are usually divided into the Lower, Middle, and Upper Coal Measures; the area covered by them is nearly 7,000 square miles, while the actual workable coal fields cover more than 6,000 square miles.

The coal beds are designated by the letters A to N, inclusive. No beds have, however, been discovered to represent the letters C, D, and E. The vertical thickness of the strata is about 260 feet, and the aggregate thickness of the remaining eleven beds in the general section of the State would be between 25 and 30 feet, the bed having the minimum thickness being bed G, about 6 inches thick, and the bed having the maximum thickness being bed L, or the Staunton bed, having a thickness of about 7 feet.

a For complete list of the coal mines of Indiana see Mineral Resources, 1886.

The production given above for 1887 is the estimate of Mr. Thomas McQuade, State mine inspector, who says in this connection: "I have succeeded in obtaining some figures on the production of coal for the year 1887 that have enabled me to calculate the total coal production for the State more accurately than in previous years. The total coal production for the year 1887 is estimated at 3,217,711 short tons, which is an increase of 217,711 tons over the production for 1886. I believe the coal production of the State in 1887 would have reached 4,000,000 tons had the strikes been as few as in 1886. These difficulties have arisen in different parts of the State and have seriously lessened the general output. In estimating capital invested in coal mines this year, according to the best figures obtainable, I find the amount to be $2,192,000. This does not include investments made in coal lands; if they were added to these figures it would amount to several hundred thousand dollars more. The above amount covers only money actually invested in new mines, and improvements of various kinds that have been made in mines in the State during 1887."

The Survey corresponded with every operator in the State with a view of obtaining more complete statistics, and though the returns were incomplete, much information was collected from which the following facts were compiled:

The largest coal company in the State is the Brazil Block Coal Company, which operates eleven mines in Clay county and three in Parke county. Returns were received from this company giving the gross production of their mines, classified according to the kind of coal produced. Block coal for use in iron and steel making and for rolling-mills is mined by this company at the Abby, Campbell, Chicago, Gartsherrie Nos. 1 and 2, Hancock, mines Nos. 5, 6, 7, 8, and 9, in Clay county, and the Otter Creek mine in Parke county. The aggregate production of these mines, exclusive of colliery consumption, of which no record is kept, reached 550,384 tons in 1887. This output was distributed among the different sizes of coal, as follows: Lump coal, 462,045 tons; nut and smaller sizes, exclusive of slack, 1,014 tons; slack, 5,125 car loads, estimated at 87,325 tons. The coal beds worked, I and J, vary in thickness from 2 feet to 4 feet 6 inches; the coal lies in local basins, and the deposit is of limited extent. An analysis of this block coal made by Mr. E. T. Cox, late State geologist, is as follows:

Analysis of block coal from beds I and J in Indiana.

	Per cent.
Ash	2.50
Fixed carbon	56.50
Volatile matter	32.50
Water	8.50
Total	100.00
Sulphur	1.43
Specific gravity	1.285

This coal commanded an average price of $1.47 on board cars at the mines in 1887. The price paid for mining varied from 80 cents per ton at the beginning of the year to 90 cents per ton at the close; the average for the entire year was about 84 cents per ton. This coal is shipped principally to Chicago for rolling-mill use. The average number of days worked at these mines during 1887 was 250, the number of men employed in and about the mines being 1,500.

The coal produced by the Brazil Block Coal Company's mines, Nos. 1 and 2, at Coxville, Parke county, on the Chicago and Indiana Coal railroad, is a steam coal, its principal use being for locomotive fuel. The production of these mines for 1887 was 42,624 tons, including 311 carloads of slack, estimated at 5,280 tons. The colliery and local consumption is not included in the above figures, no record being kept of it. The coal bed worked at these mines is bed I, the thickness ranging from 4 feet to 5 feet 6 inches. An analysis of this coal, made by Mr. G Gibbs, is as follows:

Analysis of coal from bed No. 1, Indiana.

	Per cent.
Ash	3.46
Fixed carbon	50.70
Volatile matter	40.98
Sulphur	1.88
Water	2.98
Total	100.00

The average selling price during 1887 was $1.18 per ton on cars at the mines; the coal was all shipped to the railroads for locomotive use. The price paid for mining varied from 70 cents at the beginning of the year to 75 cents at the end of the year. The average number of days worked at these mines was 250 in 1887, the number of men employed being 300.

The Crawford Coal Company operates two mines near Brazil, in Clay county. The Crawford shaft, located 3 miles northeast of Brazil, produced during 1887 a total of 110,379 tons, and the Potter slope, opened in July, 1887, produced 9,284 tons, making a total of 119,663 tons for the entire production of this company. This company is also sinking another shaft, which will have sufficient hoisting capacity to handle 500 tons per day. During 1887 the shaft worked 215 days and the slope 110 days, from July to the end of the year. The company employs at the two mines a total of 250 men. The miners earn on an average about $2 per day. The coal bed worked at these mines is J; the coal is found in local basins, the bed varying from 2 to 4 feet 6 inches in thickness and averaging 3 feet 6 inches. This coal is shipped to Indianapolis, Terre Haute, and Chicago for use in iron-making. The coal is quite free from sulphur, and may be used in blast furnaces in the raw state instead of being previously coked. The average selling price during 1887 was $1.60 per ton.

The Zeller & Sigler Coal and Mining Company operates the Vandalia and Diamond mines in Clay county. In 1887 this company produced 125,000 tons of coal, of which 1,000 tons were consumed at the mines and the remainder shipped to Chicago for domestic and furnace use. The beds worked are I and J, the same as those worked by the Brazil Block Coal Company, described above. The company employs 375 men, and the mines were operated 270 days in 1887.

The Gartsherrie Coal and Mining Company operates two mines located, respectively, 2½ miles west and 3½ miles south of Brazil, Clay county. The former, known as Burgherville, produced in 1887 a total of 34,997 tons, and the latter, or Watson No. 1, produced 49,682 tons. The coal bed mined at the Burgherville mine is bed L, bituminous coal, the thickness varying from 6 feet 6 inches to 8 feet. It is a steam coal. The bed mined at the Watson No. 1 shaft is I, block coal, with a thickness of 3 feet 6 inches to 4 feet 6 inches. It is employed for iron making. The coal from these mines is shipped to Chicago and points in Wisconsin. The average number of days worked in 1887 was 240, the total number of men employed at both mines being 164. Mining is paid for at the rate of 85 to 90 cents per ton for block coal and 65 to 75 cents per ton for steam coal; the average selling prices for 1887 were, block coal, $1.60 per ton, and steam coal, $1.05 per ton, at the mines.

The other operators in Clay county from whom reports were received are as follows: Mr. Joseph Somers, operating the Staunton shaft, produced in 1887, 27,843 tons; Mr. Benjamin Simpson, operating Simpson's mine, produced in 1887, 4,000 tons; Messrs. Morgan & Powel, operating the Morgan-Powel mine, produced in 1887, 7,448 tons; and Mr. Charles B. Reddie, operating the Centennial mine, produced in 1887, 8,100 tons. The latter operator gives an analysis of the block coal worked at his mine, as follows:

Analysis of coal from the Centennial mine, Indiana.

	Per cent.
Ash	3.
Fixed carbon	52.
Volatile matter	40.
Sulphur	1.
Water	4.
Total	100
Specific gravity	1.211
Color of ash	White.

The Mutual Mining Company is operating a mine in Daviess county, the bed worked being coal bed I, which here shows a thickness of 5 feet, of which the upper 4 feet are cannel, and the lower 1 foot bituminous coal. This cannel coal is used for gas enriching, and for open stove and grate purposes. During 1887 this mine produced 12,000 tons, of which 1,000 tons were consumed at the mines or sold to the local trade. Thirty miners were employed, the number of days worked during 1887 being 175. An analysis made by Prof. E. T. Cox is as follows:

Analysis of coal from bed I, Daviess county, Indiana.

	Per cent.
Ash	6.
Fixed carbon	40.
Volatile matter	51.
Water	3.
Total	100.

Another mine, larger than the above, is operating this cannel coal; the rest of the mines in Daviess county work bed L, the steam coal.

Dubois county contains two small mines, the operator of one of which, Alexander Barrowman, reported a production of 10,500 tons for 1887. The coal bed worked at this mine is 4 feet 6 inches thick. The other mine is in bed L, which is here 4 feet thick. They are operated largely to supply the local trade, though considerable coal is shipped to outside markets. The coal makes a good steam or domestic fuel. The mines are located at Huntingburgh.

Coal bed L is operated exclusively in Pike county. The thickness varies from 4 to 9½ feet at the different mines reported on. At Stephen Biederman's mine the thickness averages 7 feet. This mine produced during 1887 a total of 30,000 tons of coal, of which 1,000 tons were consumed locally, and the remainder shipped to Evansville, Indiana. This is a coking coal, and the average price for it at the mines in 1887 was 75 cents per ton. J. C. Townsend & Co. produced 44,000 tons of coal in 1887 in Pike county, the average selling price of which at the mines was 87½ cents per ton. This coal bed is reported as 4 feet 6 inches in thickness on the average. The coal is adapted for steam and fuel purposes. An analysis made by Mr. J. T. Elsom is as follows:

Analysis of coal from Pike county, Indiana.

	Per cent.
Ash	1.59
Fixed carbon	56.13
Volatile matter	40.01
Water	2.27
Total	100.00
Specific gravity	1.275

Rogers Brothers & Co. produced in 1887 a total of 60,000 tons of coal, all of which was shipped to Evansville and the Evansville and Indianapolis Railroad Company. This coal was sold for $1 per ton on cars at the mines in 1887. The bed varies in thickness from 7 to 9 feet 6 inches, and will average about 8 feet. The coal is adapted for steam and domestic purposes. The following tests, made by Mr. James Somerville, of the Indianapolis Gas Company, show the quality of the coal as compared with standard Pittsburgh coal as 100:

Comparison of Indiana gas coal with Pittsburgh coal.

	Per cent.
Yield of gas	88.3
Specific gravity	103.8
Candle-power	103.8
Coke	81.7

In Sullivan county, also, bed L is the one exclusively worked. The bed varies from 5 to 6 feet in thickness; the coal, which is bright bituminous, is employed for domestic and steam purposes. Two companies reported their productions for 1887 as follows: Curriesville Coal Company, 44,000 tons; Lyonton Coal Company, 10,600 tons. The average selling price for lump coal at the mines in 1887 was about $1.20 to $1.25 per ton.

In Vigo county, this same coal bed, L, is worked quite extensively by the Coal Bluff Mining Company, which operates 5 mines in this county. The bed here averages about 7 feet thick, and is found in deposits of from 50 to 500 acres in extent. The production of the mines of this company in Vigo county, as reported to the Survey, are given below:

Coal product of the coal Bluff Mining Company in Vigo county, Indiana.

Coals.	Location.	Production.
Lump coal:		
Hercules	Fontanet	94,134
Fontanet, No. 1	Fontanet	16,766
Edgar	Coal bluff	39,047
Spring Valley	Coal bluff	20,987
Slope	Coal bluff	25,893
Total lump coal		196,827
Slack coal		96,443
Total		293,270

This company employs 435 men, the miners receiving 70 to 75 cents per ton for mining, and day laborers $2 to $2.50 per day. The coal is supplied to the different railroads within the State for use in locomotives, for which purpose it is especially adapted.

In Vermillion county the Norton Creek Coal and Mining Company is operating two mines in bed L, which here averages 5 feet in thickness. As at other localities, this coal bed furnishes here an excellent steam and locomotive fuel. In 1887 the production of this company was 92,271 tons, all of which was shipped to Chicago and the Northwest for steam and locomotive purposes. This coal is sold for $1.25 per ton at the mines. About 200 men were employed in 1887. The number of days worked was about 230. The only other operation in the county is that of Shirkie & Co. This firm operates the same bed as the Norton Creek Coal and Mining Company. The coal bed at Shirkie & Company's mine is 5 feet in thickness, and with the same general characteristics as that of the Norton Creek Company. During 1887 the mine of Shirkie & Co. was operated 75 days. The production during that time was 33,560 tons. The company employed 225 miners and 150 laborers, a total of 375 men, in 1887.

Coal bed K is mined at five places in the vicinity of Evansville, in Vanderburgh county. It averages about 4 feet in thickness, and is a steam and domestic coal. The Sunnyside Coal and Coke Company operates two mines on the outskirts of Evansville. During 1887 the total production for these two mines was 41,302 tons. About two-thirds of this coal is consumed at Evansville, the remainder being shipped to Mattoon, Illinois. From 80 to 100 men are employed during the summer and 160 to 175 in winter. The First Avenue Coal Mining Company operates a mine within the city limits of Evansville. The production in 1887 was 17,738 tons, a small portion of which was shipped to small towns in Indiana and Illinois, and the remainder consumed locally at Evansville.

The same coal bed, K, is mined at six places in Warrick county. The thickness at these mines is greater than in Vanderburgh, being from 4 to 6 feet, and averaging over 5 feet. Only two mines sent reports to the Survey—Robert Lander & Sons, who produced 14,171 tons in 1887, and Robert Gough, who produced 4,089 tons in 1887. The coal is consumed at local points in Indiana, being used for steam and domestic purposes.

As will be seen from the above statements, the wages vary in the different counties, being higher where block coal is mined and lower where steam coal is mined. This variation depends on the difficulty of mining the coal and the thickness of the coal bed. The average selling price for the State was $1.344 per net ton at the mines, the extreme being 75 cents and $1.85 per ton.

The total production of the Indiana coal fields for the past fifteen years is shown in the following table:

Annual production of coal in Indiana for fifteen years.

Years.	Quantity.	Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*		*Short tons.*
1873	1,000,000	1878	1,000,000	1883	2,560,000
1874	812,000	1879	1,196,490	1884	2,260,000
1875	800,000	1880	1,500,000	1885	2,375,000
1876	950,000	1881	1,771,536	1886	3,000,000
1877	1,000,000	1882	1,976,470	1887	3,217,711

INDIAN TERRITORY.

Total production in 1887, 685,911 short tons; spot value, $1,286,692.

The only coal produced in the Territory on a commercial scale is mined along the line of the Missouri Pacific railroad in the Choctaw Nation, in the southeastern part of the Territory. There are eight mines in the Territory, two at Lehigh, a few miles west of Atoka, two at Savannah, and four at McAlester. During 1887 the production reached 685,911 tons of merchantable coal, of which 37,818 tons were manufactured into coke at McAlester.

The Atoka Coal and Mining Company operates the mines at Lehigh and Savannah. During 1887 the production of these mines was 289,850 tons, of which 286,669 tons were shipped to points in Texas, the remaining 3,181 tons being consumed at the mines. The average selling price for this coal on cars at the mines was $1.8234 in 1887. The coal is especially adapted to steam purposes. The company employs 630 men in and about the mines. The number of days worked during 1887 was 276. The two mines at Savannah were abandoned in April, 1877, and no work has been done there since. The coal bed worked at these mines varies from 3 feet 11 inches to 4 feet 2 inches in thickness. Sufficient explorations have not been made to determine the area of workable coal, but it is very extensive. An analysis of this coal shows as follows:

Analysis of coal from Atoka, Indian Territory.

	Per cent.
Ash	10.49
Fixed carbon	45.74
Volatile matter	39.16
Water	4.61
Total	100.00
Sulphur	0.370

The mines at McAlester are operated by the Osage Coal and Mining Company, which also operates mines in Missouri. There were four mines in operation at McAlester during 1887, and three others were being opened. It is estimated that during 1888, with these new mines in operation, the daily capacity will be increased to 2,500 tons per day at McAlester. During 1887 the production of these mines was 396,061 tons, of which 37,818 tons were made into coke. The coal is shipped to various points in Texas, Mexico, New Mexico, and Arizona, the average selling price during 1887 being $1.91 per ton. The company gives employment to 700 men, and the mines were operated quite steadily during 1887, the number of days worked being 258. The coal bed worked varies from 3 feet 6 inches to 4 feet in thickness; its extent has never been determined exactly, but the bed is known to extend northeast and southwest from the present workings a distance of many miles. This coal is particularly adapted for gas and coke making; it is also an excellent domestic coal. The analyses of McAlester coal and coke are as follows:

Analyses of coal and coke from McAlester, Indian Territory.

	Coal.	Coke.
	Per cent.	*Per cent.*
Ash	5 52	10.975
Fixed carbon	62.67	87, 140
Volatile matter	29.71	1, 560
Water	2.10	0.325
Total	100.00	100, 00

The Atoka Coal and Mining Company and the Osage Coal and Mining Company are under the general management of Mr. R. M. McDowell, of Saint Louis, Missouri, with Mr. S. W. Kniffin as assistant to the general manager, from whom the above statistics were obtained.

The following table shows the production of the individual mines of these companies during 1887:

Production of the individual mines of Indian Territory for 1887.

Names of companies and mines.	Location.	Production.
Atoka Coal and Mining Company:		*Tons.*
No. 4	Lehigh	204, 487
No. 5	....do	34, 397
No. 1	Savannah	14, 419
No. 2	....do	36, 547
Osage Coal and Mining Company:		
No. 7	McAlester	153, 719
No. 8	....do	1, 149
No. 9.	....do	113, 376
No. 10	....do	127, 817
Total		685, 911

(a) IOWA.

Production in 1887, 4,473,828 short tons; spot value, $5,991,735.

The coal fields of the State form the northern part of the Western bituminous field of the United States. The State is divided into three inspection districts, comprising the southern, northeastern, and northwestern portions of the State, respectively. The production of coal by inspection districts for the past five years is shown in the following table:

Total production of coal in Iowa by districts from 1883 *to* 1887.

Districts.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
First	1, 099, 503	1, 040, 859	1, 156, 224	1, 264, 433	1, 426, 841
Second	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978
Third	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671
Total	3, 979, 946	3, 902, 255	3, 582, 656	3, 853, 374	3, 994, 490

a Compiled from special reports made to the Survey by the mine inspectors.

It will be noticed that there has been a progressive increase in production in the first two districts, and a progressive decrease in the third district, since 1884. In speaking of the decrease, Mine Inspector James E. Stout says: "The large decrease during the last three years in the production of this district is due to the exhaustion of mines in different localities, and the drowning out of a number of others." The first inspection district comprises the following counties: Appanoose, Adams, Davis, Jefferson, Lucas, Marion, Monroe, Page, Taylor, Van Buren, Wapello, Warren, and Wayne; total production in 1887, 1,426,841 tons. Mine Inspector Binks says of this district: "During 1887 the mines in the first district have enjoyed a very good trade, and although there has been no great advance in the price of coal, it has been a prosperous year, all things considered, and the outlook for the future is very encouraging. There has been more coal shipped to western markets than at any time for some years, and there have been no strikes or labor troubles for some time. The selling price of coal varies in the district, being from $1.25 to $1.75 per ton. The miners are paid 80 cents per ton for coal mined from beds in the Lower, $1 in the Middle, and $1.25 in the Upper Coal Measures."

The coal bed mined in Appanoose county belongs to the Middle Coal Measures, and averages about 3 feet thick. During 1887 there were 33 mines in operation in the county, employing 638 men and producing 160,351 tons; the coal beds lie at depths of from 25 to 160 feet from the surface and are usually reached by shafts. But few of the mines ship their coal by rail, most of them being operated to supply the local trade. This county reached its maximum production in 1885, but the production for 1887 showed an increase of 10,351 tons over 1886, though still 85,545 tons below 1885.

The mines in Adams county are all working in the Upper Coal Measures; the beds are, on an average, only about one and a half feet thick. Fifteen mines were in operation during 1887, employing 162 men; and they produced 19,851 tons. The mines are located in the vicinity of Carbon, and supply the local trade among the farmers and others in the northern part of the county. The coal beds are found at depths ranging from 45 to 95 feet.

Davis county contains 5 small mines, which supply the local trade. The mines work the beds of the Middle Coal Measures, and they show an average thickness of 3 feet 6 inches, and a depth of 40 feet from the surface. These mines in 1887 employed 26 men and produced 1,800 tons of coal.

About three-fourths of Jefferson county is underlaid with the Lower Coal Measures; the bed worked averages about 3 feet thick. But little coal has been mined since 1883, when the production reached 38,887 tons; at present all the coal is consumed by the local trade. Ten small mines were operated; they employed 44 men, and produced 10,397 tons during 1887. The coal bed is reached at depths ranging from 28 to 48 feet. The development of the thicker coal beds to the west of Jefferson county, in Wapello, Monroe, Lucas, and Appanoose counties, was the cause of the decline in the production of Jefferson county.

The most important coal producing county in the first district is Lucas, where the coal beds of both the Upper and the Lower Coal Measures are worked; the beds of the Upper Measures show a thickness of 2 feet 6 inches, while the second bed is 5 feet thick. All the important mines are working this lower coal bed, which is here found at from 225 to 339 feet below the surface. The largest operator is the White Breast Coal Company, which has three mines located at Cleveland, and employs 550 men. The shafts of this company have each a hoisting capacity of 1,000 tons per day, and they employ steam-power for hauling inside the mines. The Chariton Coal Company, formerly large operators in this county, have worked out and abandoned their mine, which was worked by a shaft about 1 mile northwest of the White Breast mines. This Chariton shaft is 342 feet deep, being the deepest in the State. The production of coal in Lucas county has not varied much for the past five years; the production in 1887 was 472,998 tons, which is a little below the average for the past five years.

Marion county is one of the important coal producing counties of this district, having produced during 1887 a total of 212,695 tons, which is about two and one-third times the production of 1883. The beds of the Lower Coal Measures are mined; they are from 3 feet 6 inches to 6 feet in thickness, and are reached at depths varying from 50 to 90 feet. The largest mine is the White Breast, No. 7, shaft, worked by the White Breast Coal Company and the Union Coal Company. The coal bed at these mines is from 5 to 6 feet thick. There are 44 mines in the county, and the product of most of them supplies the local trade.

Monroe county has kept very close to Marion, as regards production, for the past five years. Both counties have about doubled their production since 1883. In 1887 this county produced 183,505 tons of coal, while in 1883 the production was only 93,435 tons. The coal beds worked in this county belong to the Middle and Lower Coal Measures. The beds vary from 3 to 5 feet in thickness; the average for the beds in the Middle Coal Measures is 3 feet, and for the Lower Coal Measures 4 feet 6 inches; the depths of the beds from the surface varies from 50 to 160 feet. The majority of the mines in this county ship their coal by rail, in some cases the coal being hauled by wagons to the railroad. Over 400 men are employed in the 18 mines that were in operation in this county during 1887.

The mines in Page county are all located along the Nodaway river, and are of little importance. During 1887 three mines were in operation. The coal bed is only 1 foot 6 inches thick; 22 men were employed, and the production for the year was 1,780 tons.

The production of Taylor county has steadily increased since mines were first opened, in 1883. The production in 1887 was 12,180 tons.

There are 9 mines in the county, employing an aggregate of 72 men, and the coal is used mostly to supply the local trade. The coal bed worked averages from 16 to 18 inches. The coal is found at depths ranging from 13 to 120 feet from the surface.

Van Buren county lies in the southeastern corner of the Iowa coal field, three-fourths of the county being underlaid by the Coal Measures; not more than one-half of this area, however, is underlaid by workable coal beds. Two coal beds are found in the county, both belonging to the Lower Coal Measures; their thickness ranges from 2 to 4 feet. The entire Coal Measures are not over 130 feet in thickness in this county, and being overlaid by 60 feet of drift it follows that a bore-hole 200 feet deep will test the coal in any portion of the county. There are 15 mines in the county, the majority of which are only worked to supply the local trade. Until 1886 the annual production scarcely rose above 1,000 tons, but in 1886 it increased to 8,038 tons, and in 1887 was 26,331 tons.

The coal beds worked in Wapello county belong to the Lower Coal Measures; they are well exposed in the valley of the Des Moines river and along the tributary creeks from 6 to 10 miles back from the river. Three beds of coal occur, ranging in thickness from a few inches up to 6 or 7 feet; the thickness of any single bed is not uniform, hence the workable areas of coal are quite local. From this cause it seems probable that not more than one-fourth of the county is underlaid by workable coal beds; the lower bed is too thin to be worked profitably in any portion of the county, while the upper bed rarely exceeds 2 feet 6 inches in thickness. The second seam averages over 4 feet in thickness and sometimes reaches 7 feet, it is the one principally worked. During 1887 the production of coal reached 272,073 tons. The largest operator is the Wapello Coal Company, which works three mines and employs 550 men. The coal lies at varying depths from the surface, ranging from 25 to 115 feet in different parts of the county.

The coal beds worked in Warren county are 1½ to 3½ feet thick; they belong to the Upper and Middle Coal Measures. Twenty-seven mines were in operation during 1887, the production for the year being 24,796 tons, a slight increase over last year, and about double the production of 1883. About 140 men are employed in the mines of the county.

Wayne county contains nine operating mines, all working beds of the Middle Coal Measures, which range from 2½ feet to 3 feet thick, and are reached at depths of from 50 to 240 feet. The production during 1887 was 28,084 tons, somewhat less than last year. The most important company now operating mines in the county is the Occidental Coal Company, which employs about 40 men. The coal bed is 2½ feet thick, and lies at a depth of 240 feet.

The following table shows the production of coal in the first inspection district for the past five years:

Production of coal in the first inspection district of Iowa, from 1883 *to* 1887.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Appanoose	128, 896	158, 986	245, 896	150, 000	160, 351
Adams	3, 891	3, 981	3, 896	9, 581	19, 851
Davis	527	1, 207	33, 655	1, 000	1, 800
Jefferson	38, 887	8, 172	1, 116	1, 083	10, 397
Lucas	487, 821	410, 729	439, 956	530, 759	472, 998
Marion	90, 985	97, 085	100, 011	141, 694	212, 695
Monroe	93, 435	98, 427	101, 517	117, 700	183, 505
Page	748	1, 009	1, 819	1, 550	1, 780
Taylor	94	127	617	8, 585	12, 180
Van Buren'	1, 678	1, 778	1, 193	8, 038	26, 331
Wapello	237, 821	240, 720	187, 911	237, 111	272, 073
Warren	12, 828	13, 727	12, 825	23, 332	24, 796
Wayne	1, 892	4, 947	25, 812	34, 000	28, 084
Total	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841

The second inspection district includes the coal producing counties of Hardin, Jasper, Keokuk, Mahaska, Marshall, Muscatine, and Scott. This is the largest producing district in the State. The production for 1887, according to Inspector J. A. Smith, was 1,775,978 tons of coal. The largest number of men employed in the district at one time during 1887 was 4,800 per day.

The three beds of coal belonging to the Lower Coal Measures are found in Hardin county. They constitute the extreme northeastern portion of the Iowa coal field. Much of the coal will only average 2 feet thick, though at one locality a thickness of 6 feet was found. The irregularity of the beds and the trouble from water make the mining operations very expensive, but the coal commands a higher price at the mines than at any other locality in the State. During 1887 there were three mines in the county in operation, and the production was only 450 tons against 2,000 tons in 1886. The coal is all consumed by the local trade.

The coal beds worked in Jasper county vary in thickness from 3 feet 8 inches to 7 feet; the beds that are worked most extensively average about 5 feet in thickness. In 1883 the production was 45,883 tons, but the maximum was reached in 1886, when the production was 286,034 tons. In 1887 it had fallen off about one-half, being 142,039 tons. There are 21 mines in the county, of which more than half are country banks, worked only to supply the local trade.

Nearly the entire area of Keokuk county is underlaid by the Coal Measures, but probably not more than one-fourth of this area contains workable coal beds. Skunk river runs through the county from west to east, and the concretionary limestone, the base of the Coal Measures, is exposed in several places, thus encouraging the belief that the county had very little coal. The most important coal basin in the county, and one of the best yet developed in the State, is that at What

Cheer. Of the 20 mines in the county, 11 are situated at this point. During 1887 Keokuk county produced 599,007 tons of coal.

The largest producing county in the district, as well as in the State, is Mahaska county, which during 1887 produced 1,025,548 tons of coal, more than one-fourth of the entire production of the State. The county is traversed by the Skunk and Des Moines rivers, which have cut through the drift and the Coal Measures in many places, exposing the beds of coal along their banks. The shafts vary from 45 to 90 feet in depth. The thickness of the coal beds varies from 4 to 7 feet, though the average is about 5½ feet. This county is fortunate in having railroad connection with the north, giving the operators a market for their coal in a region entirely destitute of mineral fuel. During 1887 there were 29 mines in operation in the county, a large number of which are operated simply to supply the local demand.

The coal deposits in Marshall, Muscatine, and Scott counties are not of very great importance, being rather thin and their extent uncertain. During 1887 Marshall county produced 200 tons, Muscatine 100 tons, and Scott 8,634 tons of coal. The coal mined in these three counties is mainly consumed by the local trade, though some coal has been shipped from Scott county on the Mississippi river.

The following table shows the production of coal in the second district by counties since 1883:

Production of coal in the second inspection district of Iowa, from 1883 *to* 1887.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mahaska	927, 387	932, 714	762, 785	851, 362	1, 025, 548
Keokuk	500, 040	430, 940	372, 816	545, 304	599, 007
Jasper	45, 883	46, 336	90, 425	286, 034	142, 039
Scott	3, 714	3, 821	5, 937	3, 000	8, 634
Marshall				400	200
Hardin				2, 000	450
Muscatine				100	100
Total	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978

The third inspection district of Iowa includes the coal-producing counties of Boone, Dallas, Greene, Guthrie, Hamilton, Polk, Webster, and Story. The inspector is Mr. James E. Stout. Mines have been abandoned at Angus and Moingona, in Boone county; Coalville, in Webster county; and near Des Moines, in Polk county, where several large mines have been drowned out during the last three years. The mines were worked quite steadily during 1887, but especially during the winter months. The selling price of coal is much lower than a few years ago, so that operators who were then receiving \$2.25 to \$3 per ton now only get from \$1.35 to \$2.17; the latter being the highest price reported in the district.

The mining operations in Boone county have been confined chiefly to the localities of Angus, Moingona, and Boonesborough. In 1884 the production for the county was 473,073 tons, while in 1887 the production was 167,068 tons.

The mines in Dallas county, with two exceptions, are working on beds in the Middle Coal Measures, the beds ranging from 2 to 3 feet thick. The coal beds in the Middle Coal Measures lie at depths varying from 3 to 100 feet, while the bed worked in the Lower Measures is found at a depth of from 165 to 275 feet. The mines operating in the Middle Coal Measures are worked to supply the local trade, while the two working in the Lower Coal Measures ship their coal by rail. The production for 1887 was 40,420 tons.

Greene county, to the northwest of Dallas county, contains 14 mines; these are all located in the southeastern portion of the county, and are mostly railroad shippers, the coal being taken to the Chicago, Milwaukee and Saint Paul railroad, and to the Minneapolis and Saint Louis railroad. During 1887 the production of the county reached 105,894 tons. The Keystone Coal Company, employing 280 men, and the Standard Coal Company, employing 220 men, are the most important operators in the county.

Guthrie county, lying to the south of Greene county, and adjoining Dallas on the west, contains 24 mines, all being operated in a coal bed of the Middle Coal Measures which varies in thickness from 1 foot 6 inches to 2 feet 6 inches, and will average about 2 feet wherever worked. The coal is of a good quality for domestic purposes, for which it is mainly consumed. All the mines are operated to supply the local trade. The most western mines in the county are at the rapids of the Middle Coon river. During 1887 the county produced 18,305 tons of coal, 148 men being employed in the mines.

The coal in Hamilton county is found usually in local basins of uncertain extent. This characteristic is common to the entire northern edge of the coal field, of which the Hamilton area forms a part. There are 18 mines in the county, all operated to supply the local trade, which is good during the winter months. There being no coal north of this county in the State. The mines are all small operations, worked only during the winter months. They employ an aggregate of about fifty men. During 1887 the production was 6,669 tons.

Polk county is the largest coal-producing county in the district, though its production has fallen off very much during the last few years, being now only half of what it was during 1884. Three coal beds are worked in this county belonging to the Upper, Middle, and Lower Coal Measures, respectively. The average thickness of each is over 4 feet, though the lowest bed worked is found in some places only 3 feet thick, while at others it increases to 6 feet. Nineteen mines were in operation in this county during 1887, the production being 305,094 tons. An aggregate of 990 men are employed in the mines of this county. The mines were opened mostly by shafts, the depths varying from 40 to 240 feet.

Webster county, lying to the north of Boone and Greene counties, and west of Hamilton county, is on the northern edge of the coal field. The coal-producing areas are nearly all small detached portions of the coal field, which have been cut off from the main body by erosion before the deposition of the drift which covers all this portion of the State. The coal beds were easily opened when railroad facilities were supplied, and the output of the county was quite large for a time; but, the deposits becoming exhausted, the production fell off, and in 1887 was only about one-half of what it was in 1883. During 1887 the production was 146,221 tons; an increase of about 40,000 tons over 1886, but 100,000 tons less than the production for 1883.

There is but one mine in Story county, employing 25 men. The coal bed worked belongs to the Lower Coal Measures, and is 3 feet in thickness. During 1887 the prodution was 2,000 tons.

The following table shows the production of coal in the third district since 1883:

Production of coal in the third inspection district of Iowa from 1883 *to* 1887.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Boone	466, 981	473, 073	458, 191	294, 970	167, 068
Dallas	38, 208	37, 185	32, 986	21, 986	40, 420
Greene	88, 851	96, 327	89, 587	117, 538	105, 894
Guthrie	....	5, 187	4, 596	17, 194	18, 305
Hamilton	1, 998	1, 878	918	3, 312	6, 669
Polk	558, 821	619, 921	462, 895	337, 964	305, 094
Webster	248, 560	214, 014	145, 296	107, 777	146, 221
Story	....	....	....	....	2, 000
Total	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671

The number of mines, production, thickness of coal bed worked, and number of employés in the three inspection districts for 1887 is shown in the following table:

General statistics of coal mining in Iowa in 1887.

Counties.	Number of mines.	Production, 1887.	Average thickness of coal beds worked.			Number of employés.
			Upper.	Lower.	Middle.	
FIRST DISTRICT.		*Long tons.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	
Appanoose	33	160, 351	....	3 0	....	638
Adams	15	19, 851	1 6	....	....	162
Davis	5	1, 800	....	3 6	....	26
Jefferson	10	10, 397	....	....	3 0	44
Lucas	15	472, 998	2 6	....	5 0	906
Marion	44	212, 695	....	....	4 2	600
Monroe	18	183, 505	....	3 0	4 6	463
Page	3	1, 780	1 6	....	....	22
Taylor	9	12, 180	1 6	....	....	72
Van Buren	15	26, 331	....	....	3 8	122
Wapello	20	272, 073	....	....	4 2	756
Warren	27	24, 796	1 6	3 6	....	140
Wayne	9	28, 084	....	2 7	....	80
Total	223	1, 426, 841	1 8	3 2	4 0	4, 041

General statistics of coal mining in Iowa in 1887—Continued.

Counties.	Number of inches.	Production, 1887.	Average thickness of coal beds worked.						Number of employés.
			Upper.		Lower.		Middle.		
SECOND DISTRICT.		*Long tons.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	
Hardin	3	450			4	0			....
Jasper	21	142, 039			4	8			....
Keokuk	20	599, 007			5	2			....
Mahaska	29	1, 025, 548			5	6			....
Marshall	1	200			4	0			....
Muscatine	2	100			2	0			....
Scott	8	8, 634			2	8			....
Total	84	1, 775, 978		4		0			4, 800
THIRD DISTRICT.									
Boone	22	167, 068	....		2	8	4	2	700
Dallas	9	40, 420	....		2	5	3	6	157
Greene	14	105, 894	4	2	4	0	4	0	747
Guthrie	24	18, 305	....		2	0	....		148
Hamilton	18	6, 669	....		....		....		50
Polk	19	305, 094	4	0	4	1	4	6	990
Webster	38	146, 221	4	4	3	9	....		491
Story	1	2, 000	....		....		3	0	25
Total	145	791, 671	4	2	3	3	4	2	3, 308
The State	452	3, 994, 490	....		....		....		12, 149

KANSAS.

Total production in 1887, 1,596,879 short tons; spot value, $2,235,631.

The coal fields of Kansas lie in the eastern part of the State; they extend from the northern to the southern boundaries and from the eastern boundary west to a central line extending through Emporia. This area has been estimated by Professor Swallow to contain 17,000 square miles.

The Cherokee and Crawford County coal field contains the thickest and most valuable deposit of coal yet discovered in the State. This coal bed is known as the Cherokee bed. It ranges in thickness from 3 feet 2 inches to 3 feet 9 inches, and attains its greatest thickness in the vicinity of Weir City and Scammonville, in Cherokee county, where in some cases it has a uniform thickness of 4 feet, and occasionally even reaches 5 feet. The coal from this seam is an excellent quality of bituminous coal and makes fair coke; it is also largely used as gas coal by many gas companies within the State. This bed is mined by shaft, slope, drift, and strip-bank openings all along its eastern outcrop for a distance of 30 miles, from Mulberry to Columbus. There are also other small coal beds above this Cherokee bed, which are mined largely by stripping. In Cherokee and Crawford counties some of these beds attain a thickness of 26 inches. Throughout Osage, Shawnee, and Coffey counties a coal bed is being mined which ranges in thickness from 12 to 20 inches. This coal is mined from shafts or by stripping. Some of the largest mines in the State are in this bed. In the Neosho County coal field a bed 14 inches thick is mined. The mining operations in this county are confined to the small area about 2 miles south of Thayer. The coal is largely mined by stripping, and is consumed by the local trade. A coal bed of 18 inches in thickness is mined in Franklin county, principally in the vicinity of Ransomville, which seems to be different from the one mined in Linn, Bourbon, and Neosho counties. This coal is largely mined by shafts, the coal being worked on the long-wall system. The coal bed which is mined in Bourbon and Lynn counties is probably the same as that mined in Leavenworth county. This bed ranges from 18 inches to 3 feet in thickness, but the average thickness is about 1 foot 10 inches. All the above coals are of a bituminous character, and are largely used for heating and steam purposes.

In the center of the State, in the counties of Russell, Ellsworth, Mitchell, Cloud, Republic and Jewell, an inferior grade of lignite or brown coal is found. This coal burns freely, but has a very high percentage of ash. The average thickness of the bed is about 22 inches, though it varies from 8 inches to 3 feet in thickness. This coal is mined by drifts and shafts usually; in some localities it may be mined by stripping. It can not compete in the market with the coals from Colorado or with those from the eastern part of the State; but away from the railroad lines it may be mined with profit. The coal statistics of Kansas for 1887 were furnished by Mr. George W. Findlay, State inspector of mines. The following table gives the production of coal and other interesting statistics for the several counties in the State for the year 1887:

Production of coal in Kansas in 1887 by counties.

Counties.	Production, 1887.	Number of miners.	Number of day hands.	Total employés.	Average wages of day hands per day.	Total amount paid for mining.	Total amount paid for mining and dead work.	Total amount paid day hands.
	Bushels of 80 pounds.							
Crawford	7, 451, 225	755	260	1, 015	$2. 00	$282, 407. 53	$327, 188. 03	$73, 726
Cherokee	9, 631, 553	839	251	1, 090	2. 00	357, 794. 32	413, 987. 67	88, 142
Osage	9, 840, 189	2, 044	198	2, 242	2. 00	633, 309. 95	648, 417. 40	76, 616
Linn	310, 000	45	22	67	2. 00	13, 985. 00	....	6, 032
Leavenworth	2, 737, 000	290	197	487	2. 00	109, 480. 00	118, 459. 00	20, 094
Penitentiary shaft, Leavenworth	2, 150, 000	.....	.....	.....	.....	....	....	....
Franklin	452, 000	.....	.....	.....	.....	....	....	....
Bourbon	1, 000, 000	.....	.....	.....	.....	....	....	....
Neosha	750, 000	.....	.....	.....	.....	....	....	....
Cloud	200, 000	.....	.....	.....	.....	....	....	....
Shawnee	600, 000	.....	.....	.....	.....	....	....	....
All other counties	300, 000	.....	.....	.....	.....	....	....	....
Strip coal	4, 500, 000	.....	.....	.....	.....	....	....	....
Total	39, 921, 967	.....	.....	.....	.....	....	....	....

NOTE.—With the exception of the first five counties mentioned above no county statistics were obtained other than the total production.

The Penitentiary shaft mentioned above is in Leavenworth county, and is worked entirely by convicts, most of the product being furnished to State institutions and the remainder sold. Of the above output 95 per cent. was shipped from the mine and the remainder consumed locally. In this estimate of the production of the State no account was taken of the slack. During the year 5 fatal and 21 non-fatal accidents are reported by the mine inspector. These accidents all occurred in the three counties: Crawford, Cherokee, and Osage. The production for 1887, as reported by the mine inspector, is 196,879 short tons in excess of that for 1886.

Mr. A. J. Vanlandingham, assistant general freight agent of the Kansas City, Fort Scott and Gulf Railroad, and of the Kansas City, Clinton and Springfield Railway Company, reports the following shipments of coal mined in Missouri and Kansas and carried by these lines of railroad during 1886 and 1887:

Shipments of coal over lines of Kansas City, Fort Scott and Gulf railroad, and Kansas City, Clinton and Springfield railway in 1886 *and* 1887 *in short tons.*

Railroads.	Mined in Kansas.		Mined in Missouri.		Total.	
	1886.	1887.	1886.	1887.	1886.	1887.
Kansas City, Fort Scott and Gulf R. R	424, 372	449, 884	223, 685	267, 695	648, 057	717, 579
Kansas City, Clinton and Springfield Rwy	....	....	50, 768	59, 282	50, 768	59, 282
	424, 312	449, 884	274, 453	326, 977	698, 825	776, 861

The following table gives a statement of the coal and coke shipment by the coal companies situated along the Atchison, Topeka and Santa Fé railroad during the year 1887:

Shipments of coal over the Atchison, Topeka and Santa Fé railroad in 1887.

Names of companies.	Location of mines.	Coal.	Coke.
		Short tons.	*Short tons.*
The Cherokee and Pittsburgh Coal and Mining Company.	Frontenac, Crawford county, Kansas.	74, 234	....
The Osage Carbon Company	Osage county, Kansas.	268, 513	....
The Cañon City Coal Company	Fremont county, Colorado	253, 594	....
The Trinidad Coal and Coking Company	Las Animas county, Colorado.	141, 016	17, 807
Raton Coal and Coke Company	Colfax county, New Mexico.	154, 875	....
The San Pedro Coal and Coke Company	Carthage, New Mexico	58, 707	13, 700
Total		950, 939	31, 507

During 1887 there was considerable activity in the opening of new mines in Kansas, especially in the vicinity of Leavenworth, Osage City, and Cherokee. The exact number of mines in the State was not reported by the inspector for 1887. The following table shows the number of mines and character of the coal worked at the close of 1885. With the exception of the localities mentioned above, the number of mines during 1887 would probably not vary very much from that given in the table:

Number of mines and strippings and thickness of coal beds worked in Kansas.

Counties.	Number of operators.	Number of mines.	Average thickness of coal bed.		Character of coal.	Coal mined by stripping.	
			feet.	*inches.*		*Operators.*	*Strippings.*
Crawford	13	22	3	4	Bituminous	37	37
Cherokee	16	23	3	3	Bituminous	2	2
Osage	4	24	1	4	Bituminous	24	24
Shawnee	7	7	1	0	Bituminous		
Coffey	2	2	1	1	Bituminous	19	19
Franklin	6	7	1	6	Bituminous		
Douglas	1	1	1	3	Bituminous		
Cloud	6	6	2	0	Lignite		
Republic	4	5	2	0	Lignite		
Ellsworth	8	8	1	7	Lignite		
Lincoln	7	7	1	8	Lignite		
Russell	4	4	1	1	Lignite		
Neosho	5	5	1	2	Bituminous		
Linn	6	6	2	5	Bituminous		
Leavenworth	2	2	1	10	Bituminous		
Bourbon	6	6	1	6	Poor bituminous	17	17
Labette	3	3	1	6	Bituminous		
Jewell	1	1	1	5	Lignite		
Total	104	139				99	99

KENTUCKY.

Total production in 1887, 1,933,185 short tons; spot value, $2,223,163. This State is the only one which includes within its boundaries portions of both the Appalachian and the Illinois or Central coal fields. According to Prof. John R. Procter, State geologist, the Appalachian coal field in Kentucky covers about 10,000 square miles in the eastern part of the State, and the Illinois about 4,000 square miles in the western part of the State. The former area lies east of a line drawn from Portsmouth, on the Ohio river, southwest through Irvine, on the Kentucky river, and Albany, in Clinton county, south of the Cumberland river. The western coal field covers ten counties and parts of fifteen counties lying in the northwestern part of the State immediately south of the Mississippi river, between the Rolling Fork and the Cumberland rivers. The following description of these coal fields is taken from a recent article on the "Mineral Resources of Kentucky," by Professor Procter:

"Resting upon the southeastern slope of the great anticline of central Kentucky, the Coal Measure rocks dip gently to the southeast until interrupted by the Great Pine mountain fault, extending from the 'breaks' of Big Sandy to near Jellico, on the Tennessee line. As the hills increase in height, the thickness of the measures and the number of coal beds increase to the southeast, until we have north of Pine mountain the following coals, counting from the western outcrop upwards; Two coal beds below the conglomerate, one a reliable bed from 36 to 48 inches thick; Combs coal, first coal above conglomerate, 12 to

36 inches thick, not given a number; Sand Lick coal, 36 to 60 inches thick (coal No. 1); Wright's coal, 12 to 42 inches; Elkhorn coal (coking seam), 40 to 108 inches (coal No. 3); Upper splint coal, 36 to 80 inches; Kiser's 72-inch coal (Letcher); Bear Fork cannel (Pike); coal with many partings; Ambergy's 80-inch coal (Knott); Sycamore Creek 92-inch coal (Pike); Flat Woods coal, Pike county, reported as a thick bed.

"In the Big and Little Black and Log mountains, in the synclinal trough between the Pine and Cumberland mountains, through the counties of Letcher, Harlan, Bell, and Knox, the above section is not only present but additional coals in higher measures. The mountains reach an altitude of 4,000 feet above sea, and the vertical thickness of Coal Measures is probably greater here than is found at any one place in the United States. Two claims may be made for the Kentucky coal field: (1) That it contains the largest known area of rich and thick cannel coal beds, and (2) it contains the largest known area of thick and pure coking coals. The main coking coal of eastern Kentucky has been named the Elkhorn, from the stream of that name in Pike county where it was first found and proved to be a coking coal. Since its discovery a few years since, this bed has been identified and traced as a thick coal bed over an area of more than 1,600 square miles and has been proved by tests to produce an excellent coke over an area of more than 1,000 square miles. This coal attains its greatest thickness in Letcher, Pike, and Harlan counties, Kentucky, and in Wise county, Virginia; but it is sufficiently thick for profitable mining, when trans portation is secured, in all of the following counties: Pike, Letcher, Harlan, Floyd, Knott, Leslie, Perry, and Bell. For over 1,000 square miles it is found as coking coal with a thickness of from 6 to 9 feet and most favorably located for cheap mining."

The following analyses of eastern Kentucky cannel and coking coals and cokes have been made by the Kentucky geological survey:

Analyses of Kentucky coals, made by the geological survey of Kentucky.

Counties.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Character of coal.
Johnson	49.130	41.920	7.150	0.802	Cannel.
Pike	43.400	46.300	8.300	0.689	do.
Perry	44.160	49.400	6.000	0.766	do.
Breathitt	66.280	29.730	3.640	0.830	do.
Breathitt	53.800	45.000	5.540	0.722	do.
Morgan	50.060	40.140	8.400	1.650	do.
Letcher	34.30	58.10	6.50	0.890	Elkhorn coking.
Pike	26.80	67.60	3.80	0.967	do.
Pike	33.50	60.54	3.96	0.429	do.
Wolfe	37.50	55.70	4.40	0.895	do.
Bell	37.90	57.78	3.12	1.030	do.
Bell	38.60	57.30	2.70	0.629	do.
Harlan	36.70	58.86	2.24	0.277	do.
Harlan	35.30	58.24	3.36	1.290	do.

Analyses of cokes, made by the geological survey of Kentucky.

Counties.	Fixed carbon.	Ash.	Sulphur.	Total.
Pike	94.14	4.66	1.484	100.284
Pike	95.40	3.50	.517	99.417
Wolfe	91.00	4.60	.503	97.103
Bell	95.80	4.00	1.710	100.510
Bell	94.00	5.60	.629	100.229
Harlan	93.10	6.30	.546	99.946
Harlan	93.60	6.00	1.068	100.668

"The western coal field is a broad synclinal, having its axis almost parallel with the general direction of Green river, and crossed by gentle undulations running slightly north of east and south of west. The conglomerate sandstone at the base of the Coal Measures is not so thick as in eastern Kentucky. Above this conglomerate 12 workable coals are present. Some of these coals are of excellent quality, but the percentage of ash and sulphur is greater than in the best of eastern Kentucky coals. A strong coke has been made from at least one of the Upper coals, having, however, in the coke from unwashed coal, a higher percentage of sulphur than is desirable. Recent experiments lead to the hope that a furnace coke may be made from the first coal above the conglomerate (No. I). This field has now excellent transportation facilities. Green river traverses the entire field from south to north, giving reliable slack-water navigation from Bowling Green to the Ohio river. One railway traverses the center of the field from east to west, and two railways from north to south, and two important new roads are being completed now and others are projected."

The coal statistics for the year 1887 were furnished by Mr. C. J. Norwood, the State mine inspector. The total production of the State for 1887 was 413,185 short tons in excess of that for 1886, the most notable increase being in the southeastern coal field, the production of which in 1887 nearly doubled that for 1886. The State is divided into three districts, namely: Western, southeastern, and northeastern districts. The following list of the mines in these districts, with their location and production in 1887, is reported by the State mine inspector:

Production of coal in the western district of Kentucky in 1887, by individual mines.

Names of mines.	Post offices.	Counties.	Production, 1887.
			Bushels of 80 pounds.
Robinson	Island	McLean	341,321
Hecla	Earlington	Hopkins	1,153,201
Co-operative	do	do	452,066
Crabtree	Dawson	do	906,675
Reinecke	Madisonville	do	420,110
Diamond	Earlington	do	8,830,853 (Diamond, Saint Charles, Earlington No. 11, Earlington No. 9)
Saint Charles	Saint Charles	do	
Earlington No. 11	Earlington	do	
Earlington No. 9	do	do	

Production of coal in the western district of Kentucky, etc.—Continued.

Names of mines.	Post offices.	Counties.	Production, 1887.
			Bushels of 80 pounds.
Clifton	Mannington	Hopkins	435,000
Dovey's Kentucky	Mercer	Muhlenberg	793,843
Mud River	Mud River	...do	744,290
Memphis	Bevier	...do	1,297,640
Central	Central City	...do	1,867,000
McDougall	Paradise	...do	25,000
Airdrie	...do	...do	10,000
Davidson's Uniontown	Uniontown	Union	115,000
Davis Bros. & Wardlaw	Caseyville	...do	108,639
Shotwell	Dekover	...do	822,999
Lehman	Commercial Point	...do	52,006
John Tate	Caseyville	...do	50,000
Eight small mines		...do	30,000
James M. Lamb's	Weston	Crittenden	70,800
Taylor	Beaver Dam	Ohio	160,000
Emporia	McHenry	...do	367,451
Render	...do	...do	1,062,000
McHenry	...do	...do	1,800,000
Echols	Echols	...do	375,000
Zion	Zion	Henderson	60,000
Peoples	Henderson	...do	135,000
Corydon	Corydon	...do	90,000
Spottsville	Spottsville	...do	612,800
Henderson	Henderson	...do	375,000
Nall's	Owensboro	Daviess	165,073
R. Patrick's	...do	...do	31,000
M. Mattingly	...do	...do	15,000
G. S. Helm	...do	...do	10,000
Sixteen small mines		...do	160,000
Empire	Empire	Christian	612,682
Total			24,557,449

Production of the individual mines in the southeastern district of Kentucky in 1887.

Names of mines.	Post offices.	Counties.	Production, 1887.
			Bushels of 80 pounds.
Happy Hollow	Sloan's Valley	Pulaski	480,000
Barren Fork	Flat Rock	...do	1,024,741
Beaver Creek	Greenwood	...do	1,248,645
Greenwood	...do	...do	956,227
Dowlais	Jellico, Tenn	Whitley	2,242,749
Main Jellico Mountain	Kensee	...do	3,340,637
Union Coal Company		Laurel	73,079
Litton	East Bernstadt	...do	181,002
Pitman	Pittsburgh	...do	1,210,397
Highland (Wood's Creek)	...do	...do	22,500
Aetna	...do	...do	248,620
Altamont	Altamont	...do	558,131
Queen City	East Bernstadt	...do	540,000
Peacock	Pittsburgh	...do	559,950
Laurel	...do	...do	853,878
Victoria	...do	...do	217,913
Guy City	East Bernstadt	...do	200,000
Black Diamond	...do	...do	
Star	...do	...do	
Buckeye	...do	...do	1,000,000
T. Jeffrey's	Pittsburgh	...do	
Livingston		...do	
Garrard's	Manchester	Clay	50,000
Total			15,008,469

Production of the individual mines in the northeastern district of Kentucky in 1887.

Names of mines.	Post-offices.	Counties.	Production, 1887.
			Bushels of 80 pounds.
Ashland Coal and Iron Railway	Geigerville	Boyd	3, 648, 625
Great Western Mining and Manufacturing Company	Peach Orchard	Lawrence	1, 164, 956
Lexington and Carter Coal Mining Company, Nos. 1 and 2	Music	Carter	1, 052, 575
Strait Creek	Denton	do	650, 000
Mary	do	do	629, 958
Star Furnace	Geigerville	do	1, 618, 000
Total			8, 764, 114

For convenience of comparison the following summary of the production of these three districts since 1884 is given in short tons below:

Production of coal in Kentucky from 1884 *to* 1887.

	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Western coal field	875, 593	860, 000	855, 000	982, 282
Southeastern coal field	384, 031	400, 000	390, 000	600, 339
Northeastern coal field	278, 630	280, 000	275, 000	350, 564
Total	1, 538, 254	1, 540, 000	1, 520, 000	1, 933, 185

The production as given in the above tables is for all classes of coal, that is the production of lump, nut, and slack were not reported separately. The cost of mining the coal and placing it on board the cars at the mine varied in the several districts during 1887, as shown in the following table:

Cost of mining coal and preparing it for market in Kentucky in 1887.

Districts.	Average cost per 100 bushels.	Variation of cost per 100 bushels.
Northeastern	\$3. 37½	....
Southeastern	3. 20	\$3. 13¾ to 3. 26¼
Western	3. 764	3. 704 3. 824

The Northeastern district includes the counties of Boyd, Carter, and Lawrence. The coal beds worked in this district are the Peach Orchard coal bed worked in Lawrence county and the Coalton coal bed worked in Carter and Boyd. The Peach Orchard coal bed varies greatly in thickness; at Peach Orchard it is 6 feet thick. The Coalton bed furnishes an excellent fuel for using raw in blast furnaces and other uses connected with iron mills. The thickness of this bed varies from $3\frac{1}{2}$ to 6 feet.

The Southeastern district includes the counties of Clay, Laurel, Pulaski, and Whitley. The coal beds worked belong to the lower members of the Lower Productive and Conglomerate series. The thickness of these beds varies from 3 to 4 feet. The celebrated Jellico coals are worked in Whitley county. There are twenty-three mines in the Southeastern district, the largest number being in Laurel county.

The Western district, which is a part of the Illinois coal field, includes the counties of Crittenden, Daviess, Henderson, Hopkins, McLean, Muhlenberg, Ohio, and Union. Twelve coal beds are known to occur in this district, of which, however, but five are worked to any considerable extent. Various attempts have been made to locate an equivalent for the Pittsburgh bed in Kentucky, but thus far they have not been successful. Running in an irregular east and west direction across this western coal field is a disturbance which has divided the basin into two parts; north of this disturbance the Upper coals are in place while south of it the Upper coals have disappeared and only the Lower coal beds, from numbers 1 to 5, are found.

The most important coals in the northern Upper field are numbers 12, 11, and 9 of the Geological Survey. According to Mr. J. H. Allen, of Mannington, Kentucky, the coal from No. 1 bed, after being crushed and washed, makes a very good coke. At present there are 95 coke ovens in the State, distributed as shown in the following table:

Coke ovens in Kentucky at the end of 1887.

Names of companies.	Location of ovens.	Number of ovens.
Byrne & Speed	Louisville	4
O'Neil & Co	do	4
Blick & Phillips Coal Co	Covington	6
A. Montgomery & Co	do	6
Swift's Iron and Steel Works	Newport	12
Dovey Brothers	Mercer's Station	7
Clifton Coal Company	Mannington	34
St. Bernard Coal Company	Earlington	22

The cokes made from these coals have, in all cases, a bright silvery luster and a clear metallic ring with good physical structure; in most cases, however, the percentage of sulphur in the coke is high, though not higher than the majority of Alabama and Tennessee cokes. The yield of coke compares very favorably with that in the adjoining fields, being 54 per cent. of the coal charged into the ovens. Mr. Allen reports the following analyses of unwashed and washed coal, and coke made from the washed coal at the Clifton mine in Hopkins county:

Analyses of washed and unwashed Clifton coal and coke.

	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.	Analyst.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Washed coal, No. 1, bed (L)	35.24	52.53	1.92	10.31	100	Stutz.
Unwashed coal, No. 1, bed (L)	33.32	47.45	3.21	16.02	100	do.
Coke No. 1, bed (L)	1.28	83.14	1.98	13.60	100	do.
Do	1.62	83.42	2.02	12.94	100	Safford.

The Mud River coal can be used in a raw state in blast-furnaces; the Coalton coal is also noted for its excellence as an iron-making fuel in the raw state, containing more ash, but a little less sulphur than is yielded by the Mud River seam; neither of these coals, however, will make good coke. The analyses of these coals and a number of others reported by Mr. C. J. Norwood, are shown in the following table:

Analyses of Kentucky coals from the report of Mr. C. J. Norwood, State mine inspector.

Localities.	Counties.	Fixed carbon.	Volatile matter.	Water.	Sulphur.	Ash.	Character of coal analyzed.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Peach Orchard	Lawrence	49.24	36.56	3.24	....	11.56	Peach Orchard.
Manchester	Clay	60.70	38.10	1.20	1.793	5.80	No. 1 bed.
Pittsburgh	Laurel	59.58	37.12	....	0.895	3.30	Coking.
Flat Rock	Pulaski	58.26	33.80	1.54	1.540	6.40	Inter-conglomerate.
Kensee	Whitley	63.10	32.86	1.90	0.700	2.14	Jellico bituminous.
Mining City	Butler	54.24	34.36	8.00	0.876	3.40	
Coaltown	Christian	55.03	32.22	4.85	1.373	7.90	Coaltown.
Hawesville	Hancock	50.50	39.00	3.30	3.373	7.20	Main Hawesville.
(Middle seam)	....do	49.30	34.80	5.40	2.398	10.50	Middle bed.
Lewisport	....do	45.56	43.40	3.50	4.155	7.54	Lewisport.
Coalton	Carter	54.90	39.00	....	1.312	6.10	Iron smelting.
Mud River	Muhlenberg	58.60	36.50	....	1.923	4.90	do.
Clifton	Hopkins	47.45	33.32	....	3.210	16.02	Unwashed coking.
Earlington	....do	48.77	39.26	6.85	2.911	5.690	Washed slack.
Clifton	....do	52.53	35.24	....	1.92	10.31	Washed coking.
Pryse's Tunnel	Lee	55.50	35.50	4.00	1.041	5.00	

The number of mines and the production in these three districts, by counties, are shown in the following table:

Number of mines in operation and production of coal in Kentucky during 1887, by counties.

Districts.	Counties.	Number of mines.	Production, 1887.
			Short tons.
Western	Christian	1	24,507
	Crittenden	1	2,832
	Daviess	20	15,243
	Henderson	5	50,912
	Hopkins	9	487,916
	McLean	1	13,653
	Muhlenberg	6	189,511
	Ohio	5	150,578
	Union	13	47,130
	Total	61	982,282
Southeastern	Clay	1	2,000
	Laurel	16	226,617
	Pulaski	4	148,385
	Whitley	2	223,337
	Total	23	600,339
Northeastern	Boyd	1	145,945
	Carter	5	158,021
	Lawrence	1	46,598
	Total	7	350,564
The State		91	1,933,185

The increase in the coal output of Kentucky since 1880 has been great. In that year the total production was about 1,000,000 short tons; in 1887 the total production was 1,933,185 short tons, or practically double the production for 1880. In the fiscal year ended July 1, 1887, the number of persons engaged in the eighty-six mines, which come under the supervision of the inspector, was 4,903. Including in all mines, large and small, there are probably not less than 6,500 miners employed in Kentucky. The following table shows the production of coal in Kentucky from 1873 to the present time:

Production of coal in Kentucky.

Years.	Short tons.	Years.	Short tons.
1873	300,000	1881	1,100,000
1874	360,000	1882	1,300,000
1875	500,000	1883	1,650,000
1876	650,000	1884	1,550,000
1877	850,000	1885	1,600,000
1878	900,000	1886	1,550,000
1879	1,000,000	1887	1,933,185
1880	1,000,000		
		Total for fifteen years.	16,243,185

MARYLAND.

Total production in 1887, 3,278,023 short tons; spot value, $3,114,122. The coal fields of the State are composed of the Cumberland and the Frostburg or George's Creek basin. These are parts of the Appalachian field, and are situated in Alleghany and Garrett counties. The continuation of the field to the north into Somerset county, Pennsylvania, is known as the Wellersburgh basin. The great bed of the Cumberland region is geologically identical with the Connellsville coking coal bed and the Pittsburgh gas coal bed; the area underlaid by this bed in Maryland is about 20 miles long, northeast and southwest, with an average width of about 4½ miles; the original area underlaid by the bed before mining was commenced was, however, only about 27 square miles. The bed is popularly called the "14-foot bed," although it rarely has a workable thickness over any considerable area of more than 10 feet, and seldom produces more than 6,000 tons of merchantable coal to the acre.

This coal field has connections with the tidewater as follows:

Via Baltimore and Ohio railroad to Baltimore, 178 miles from Cumberland and 206 miles from Piedmont.

Via Chesapeake and Ohio canal to Georgetown 184 miles, and to Alexandria 191 miles.

Via Pennsylvania State Line branch, which connects with Cumberland and the Pennsylvania railroad near Mount Savage.

Via George's Creek and Cumberland railroad from Lacount to Cumberland, where connections can be made with railroad or canal.

The shipments made by these routes for 1887, compiled from official sources, are shown in the following table:

Shipments from the Cumberland coal field, Maryland and West Virginia, (a) in 1887.

Names of companies or mines.	1887.					Compared with 1886.	
	To Baltimore and Ohio Railroad.	To Chesapeake and Ohio Canal.	To Pennsylvania Railroad.	Surplus and local.	Total.	Increase.	Decrease.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	766, 306	137, 760	197	32, 536	936, 799	262, 147	......
Maryland Coal Company	221. 179	2, 607	87, 709	5, 023	316, 518	27, 776	......
George's Creek Coal and Iron Company	302, 577	86, 246	1, 350	3, 839	394, 012	128, 070	......
American Coal Company	173, 342	2, 255	65, 522	18, 513	259, 632	48, 327	......
Potomac Coal Company	207, 620	......	108	2, 065	209, 793	53, 036	......
New Central Coal Company	171, 139	......	8, 274	2, 493	181, 906	32, 345	......
Borden Mining Company	8, 184	33, 065	139, 805	11, 582	192, 636	54, 889	......
Maryland Union Coal Company	137, 014	......	10, 326	1, 183	148, 523	31, 752	......
Blaen Avon Coal Company	11, 606	103	......	225	11, 934	......	53, 896
National Coal Company	92, 045	......	10, 948	14, 782	117, 775	55, 138	......
Davis & Elkins' mine	74, 462	......	4, 660	3, 545	82, 667	34, 485	......
Swanton Mining Company	52, 708	......	572	8, 330	61, 610	18, 922	......
Atlantic and George's Creek Consolidated Coal Company (Pekin mine)	......	......	......	......	......	......	7, 321
Union Mining Company	......	......	......	7, 500	7, 500	676	......
Piedmont Coal and Iron Company (Empire mine)	......	......	......	......	......	......	1, 678
Local mines	......	......	......	5, 597	5, 597	5, 597	......
North Potomac basin.							
Elk Garden mines	179, 701	15, 960	58, 297	5, 396	259, 354	48, 975	......
Atlantic and George's Creek Consolidated Coal Company	107, 605	......	......	......	107, 605	46, 031	......
Big Vein Coal Company	59, 801	......	......	......	59, 801	8, 801	......
Davis and Thomas mines	15, 178	......	......	6, 883	22, 061	1, 384	......
Total	2, 580, 467	277, 996	387, 768	129, 492	3, 375, 723	846, 151 62, 895	62, 895
Increase	......	......	......	......	......	783, 256	......

Recapitulation.

From—	To Baltimore and Ohio Railroad.	To Chesapeake and Ohio canal.	To Pennsylvania railroad.	Local.	Total.
Cumberland and Pennsylvania Railroad	1,490,863	131,869	276,240	80,480	1,879,552
Cumberland Branch	332,798	125,305	....	....	458,103
George's Creek and Cumberland Railroad	394,521	4,862	53,231	23,636	576,150
West Virginia Central and Pittsburgh Railway	362,285	15,960	58,297	12,279	448,821
Local sales from mines	....	....	....	13,097	13,097
Total	2,580,467	277,996	387,768	129,492	3,375,723

a. This table includes the shipment from the Elk Garden, Atlantic and George's Creek, Big Vein, Davis and Thomas mines, all of which are included in the North Potomac basin situated in West Virginia.

In the above table the small shipment of 129,492 tons is credited to surplus and local consumption, and in the following table, showing the coal shipment at the different mines and the transportation for forty-six years, from 1842 to 1887, inclusive, the surplus and local consumption is included in the shipments of the Baltimore and Ohio railroad.

Total shipments from the Cumberland coal field in

Years.	Frostburgh region.						
	Cumberland and Pennsylvania Railroad.				Cumberland Coal and Iron Company's Railroad.		
	By Baltimore and Ohio Railroad.	By Chesapeake and Ohio Canal.	By Pennsylvania Railroad.	Total.	By Baltimore and Ohio Railroad.	By Chesapeake and Ohio Canal.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1842	757			757	951		951
1843	3,661			3,661	6,421		6,421
1844	5,156			5,156	9,734		9,734
1845	13,738			13,738	10,915		10,915
1846	11,240			11,240	18,555		18,555
1847	20,615			20,615	32,325		32,325
1848	36,571			36,571	43,000		43,000
1849	63,676			63,676	78,773		78,773
1850	73,783	3,167		76,950	119,023	875	119,898
1851	70,893	51,438		122,331	103,808	31,540	135,348
1852	128,534	46,357		174,891	139,925	19,362	159,287
1853	150,381	84,060		234,441	155,278	70,535	225,813
1854	148,953	63,731		212,684	173,580	92,114	265,694
1855	93,691	77,095		170,786	97,710	100,691	198,401
1856	86,994	80,387		167,381	121,945	105,149	227,094
1857	80,743	55,174		135,917	88,573	54,000	142,573
1858	48,018	166,712		214,730	66,009	87,539	153,548
1859	48,415	211,639		260,054	72,423	86,203	158,626
1860	70,669	232,278		302,947	80,500	63,600	144,100
1861	23,878	68,303		92,181	25,983	29,296	55,279
1862	71,745	75,206		146,951	41,096	23,478	64,574
1863	117,796	173,269		291,065	111,087	43,523	154,610
1864	287,126	194,120		481,246	67,676	64,522	132,198
1865	384,297	285,295		669,592	104,651	57,907	162,558
1866	592,938	291,019		883,957	52,251	52,159	104,410
1867	623,031	385,249		1,008,280	40,106	72,904	113,010
1868	659,115	424,406		1,083,521	100,345	57,919	158,264
1869	1,016,777	573,243		1,590,020	130,017	78,908	208,925
					2,092,660	1,192,224	3,284,884
					Cumberland Branch.		
1870	909,511	520,196		1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085		1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641,220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,646	170,884	1,399,808	63,181	111,350	174,531
1878	823,801	486,038	145,864	1,455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76,140	275,323
1883	851,985	302,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	289,884	124,718	414,602
1885	1,091,904	171,460	206,227	1,469,591	289,407	117,829	407,236
1886	1,131,949	115,531	141,520	1,389,000	243,321	113,791	357,112
1887	1,584,114	132,177	176,241	1,892,532	332,798	125,305	458,103
Total	24,324,959	10,849,486	2,366,084	37,540,529	2,807,545	2,428,573	5,236,118

a Of this amount 35,149 long tons were shipped to the Chesapeake and Ohio Canal via Piedmont,
b Includes 78,045 long tons used on line of Cumberland and Pennsylvania Railroad and its branches, pany in locomotives, rolling-mills, etc.
c The total shipments of the Cumberland coal field reported by the railroads is 63 long tons greater company.

Maryland and West Virginia for forty-six years.

Frostburgh region.				Piedmont region.		Total.			
George's Creek and Cumberland Railroad.									
By Chesapeake and Ohio Canal.	By Pennsylvania Railroad.	Local and Baltimore and Ohio.	Total.	George's Creek Railroad.	Hampshire Railroad, by Baltimore and Ohio Railroad.	Baltimore and Ohio Railroad and local.	Chesapeake and Ohio Canal.	Pennsylvania Railroad.	Aggregate.
Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
......	......	......	......	......	......	1, 708	......	......	1, 708
......	......	......	......	......	......	10, 082	......	......	10, 082
......	......	......	......	......	......	14, 890	......	......	14, 890
......	......	......	......	......	......	24, 653	......	......	24, 653
......	......	......	......	......	......	29, 795	......	......	29, 795
......	......	......	......	......	......	52, 940	......	......	52, 940
......	......	......	......	......	......	79, 571	......	......	79, 571
......	......	......	......	......	......	142, 449	......	......	142, 449
......	......	......	......	......	......	192, 806	4, 042	......	196, 848
......	......	......	......	......	......	174, 701	82, 978	......	257, 679
......	......	......	......	......	......	268, 459	65, 719	......	334, 178
......	......	......	......	73, 725	......	376, 219	157, 760	......	533, 979
......	......	......	......	181, 303	......	503, 836	155, 845	......	659, 681
......	......	......	......	227, 245	65, 570	478, 486	183, 786	......	662, 002
......	......	......	......	269, 210	42, 765	502, 330	204, 120	......	706, 450
......	......	......	......	252, 368	51, 628	465, 912	116, 574	......	582, 486
......	......	......	......	218, 318	63, 060	395, 405	254, 251	......	649, 656
......	......	......	......	257, 740	47, 934	426, 512	297, 842	......	724, 354
......	......	......	......	289, 298	52, 564	493, 031	295, 878	......	788, 909
......	......	......	......	85, 554	36, 660	172, 075	97, 599	......	269, 674
......	......	......	......	69, 482	36, 627	218, 950	98, 684	......	317, 634
......	......	......	......	266, 430	36, 240	531, 553	216, 792	......	748, 345
......	......	......	......	......	44, 552	399, 354	258, 642	......	657, 996
......	......	......	......	......	71, 345	560, 293	343, 202	......	903, 495
......	......	......	......	......	90, 964	736, 153	343, 178	......	1, 079, 331
......	......	......	......	......	72, 532	735, 669	458, 153	......	1, 193, 822
......	......	......	......	......	88, 658	848, 118	482, 325	......	1, 330, 443
......	......	......	......	......	83, 724	1, 230, 518	652, 151	......	1, 882, 669
				(*a*)2, 190, 673					
				Empire and West Virginia mines.					
......	......	......	......	28, 035	60, 988	1, 112, 938	604, 137	......	1, 717, 075
......	......	......	......	81, 218	96, 453	1, 494, 814	850, 339	......	2, 345, 153
......	......	......	......	85, 441	121, 364	1, 517, 347	816, 103	22, 021	2, 355, 571
......	......	......	......	77, 582	103, 793	1, 780, 710	778, 802	114, 589	2, 674, 101
......	......	......	......	57, 492	109, 194	1, 576, 160	767, 064	67, 671	2, 410, 895
......	......	......	......	63, 537	90, 800	1, 302, 237	879, 838	160, 698	2, 342, 773
......	......	......	......	108, 723	7, 505	1, 070, 775	632, 440	131, 866	1, 835, 081
......	......	......	......	......	......	818, 459	584, 996	170, 884	1, 574, 339
......	......	......	......	......	998	924, 254	609, 204	145, 864	1, 679, 322
......	......	......	......	......	51	1, 075, 198	501, 247	154, 264	1, 730, 709
......	......	......	......	66, 573	......	1, 319, 589	603, 125	213, 446	2, 136, 160
83, 136	125, 097	4, 947	213, 180	88, 722	......	1, 478, 502	504, 818	278, 598	2, 261, 918
78, 298	93, 861	31, 436	203, 595	277, 929	......	1, 085, 249	269, 782	185, 435	1, 540, 466
215, 767	202, 223	77, 829	495, 819	338, 001	......	1, 444, 766	680, 119	419, 288	2, 544, 173
69, 765	156, 959	283, 336	510, 060	466, 928	......	2, 233, 928	344, 954	356, 097	2, 934, 979
79, 455	214, 518	291, 685	585, 658	403, 489	......	2, 076, 485	368, 744	420, 745	2, 865, 974
53, 480	98, 371	348, 196	500, 047	346, 308	......	(*b*)2, 069, 774	282, 802	239, 891	2, 592, 467
4, 863	153, 230	418, 057	576, 150	449, 011	......	2, 724, 347	262, 345	389, 104	*c*3, 375, 796
584, 764	1, 044, 259	1, 455, 486	3, 084, 509	2, 938, 989	1, 475, 969	37, 172, 000	15, 110, 380	3, 470, 461	55, 752, 671

Baltimore and Ohio Railroad, to Cumberland.
by Cumberland and Piedmont; also 280,850 long tons used by the Baltimore and Ohio Railroad Com-

than the total shipments shown in the table already given exhibiting the shipments of each coal

In deducing the total production of the Maryland mines for any one year referred to above, care must be taken to exclude the production of the West Virginia mines. This has not been done in the coal shipment tables, since, for all practical uses, the West Virginia mines which are included are as essential a part of the Cumberland district as those within the State of Maryland.

The total production of the Maryland mines for each year from 1883 to 1887, inclusive, is shown in the following table:

Production of coal in Maryland.

Companies.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	456, 238	689, 212	710, 064	675, 652	936, 799
New Central Coal Company	210, 850	210, 140	203, 814	149, 561	181, 906
George's Creek Coal and Iron Company	257, 490	266, 042	257, 343	265, 942	394, 012
Maryland Union Coal Company	137, 105	117, 180	98, 095	116, 771	148, 523
Borden Mining Company	151, 665	162, 057	179, 537	137, 747	192, 636
Maryland Coal Company	235, 854	295, 736	365, 319	288, 742	316, 518
American Coal Company	190, 055	194, 330	220, 339	211, 305	259, 632
Potomac Coal Company	139, 723	169, 463	196, 280	156, 757	209, 793
Hampshire and Baltimore Coal Company	194, 534	36, 416	....	....	....
Atlantic and George's Creek Coal Company (Pekin mine)	69, 000	75, 467	64, 938	7, 321	....
Swanton Mining Company	34, 905	28, 620	52, 862	42, 688	61, 610
Blæn Avon Coal Company	84, 721	100, 961	69, 192	65, 830	11, 934
Piedmont Coal and Iron Company	4, 619	1, 250	32	1, 678	....
Union Mining Company	5, 024	5, 310	5, 641	6, 824	7, 500
National Coal Company	38, 998	42, 680	48, 307	62, 637	117, 775
Davis & Elkins mine	....	74, 437	58, 002	58, 382	82, 667
James Ryan	....	....	....	....	3, 608
George M. Hansel	....	....	....	....	1, 989
Totals	2, 210, 781	2, 469, 301	2, 529, 765	2, 247, 837	2, 926, 902

The following are the average prices for Cumberland coal at Baltimore for the past sixteen years:

Prices of Cumberland coal.

Years.	Prices.	Years.	Prices.
1872	$4. 52	1880	$3. 75
1873	4. 83	1881	3. 75
1874	4. 70	1882	3. 50
1875	4. 35	1883	2. 90
1876	3. 87	1884	2. 40
1877	3. 15	1885	2. 25
1878	2. 86	1886	2. 10
1879	2. 75	1887	2. 45

Mr. C. H. Hamill, State mine inspector, in his report to the governor of Maryland, in speaking of the output of coal for the year 1887, says:

"The output of this coal-field for the year just closing is 2,926,902 tons, a sum largely in excess of any previous year. This immense total required an expenditure in the State of Maryland of $6,700,000 for labor, supplies and transportation.

"The year has been, therefore, one of unprecedented prosperity so far as our working people are concerned. I regret, however, that I am unable to say as much for the employers. It is true there was a small advance during the year in the price of coal, but that improvement was nearly, if not quite all, distributed between labor and transportation. On the first of March last the coal companies operating in this region advanced their miners' wages 25 per cent., the largest voluntary addition, perhaps, ever made to the pay of any industry in this State. This, with the increased cost of transportation, absorbed about all the advantage there was gained in the market from the increased demand for the product of the region, leaving no adequate return to the owners for the capital invested and the depletion of their property. On December 30, this year, the companies advanced the drivers' wages 12 per cent. This voluntary act on the part of the companies has not only been appreciated by the drivers, but by the miners and the general public as well.

"By referring to the accompanying tables it will be found that we have 2,382 miners, whose aggregate earnings for the year were $1,436,426.14, or a fraction over $600 per capita. At some of the mines, however, this latter sum was largely exceeded. The entire amount disbursed in the region to this industry for labor and supplies was $2,341,521.60, all of which is paid monthly, in cash.

"There have been improvements made at nearly all the mines during the year, with a view to a largely increased production of coal during the coming year. Prominent among these may be mentioned the George's Creek Coal and Iron Company, which has made a new opening called the "Pine Hill mine," with double siding, incline, and all necessary buildings for large operations.

"The New Central Coal Company and Consolidation Coal Company have also made extensive improvements at their mines during the past year. During 1887 a new company, the Barton and George's Creek Valley Coal Company, has been organized. This company has a splendid coal property, and already has erected a plant second to none in the region; it will have a working capacity in 1888 of at least 250,000 tons per annum, which amount will, no doubt, stand to the credit of the mine at the end of the year.

"For the twelve years ending with this date, there have been seventy-two fatal accidents, or one for each 342,000 tons of coal produced. For the last two years—the period covered by this report—there have been thirteen fatal accidents, or one for each 398,000 tons of coal produced."

Mr. Hamill reports the following table, giving an analysis of the operation of the coal mines in his district for the year 1887:

Statistical analysis of the operations of the mines of Alleghany and Garrett counties, Maryland, for the year 1887.

Names of companies.	Output of each company.	Number of miners employed by each company.	Amount paid miners by each company.	Number of other employés.	Number of days worked.	Amount paid other employés.	Amount paid for supplies and improvements.	Total amount paid by each company.
	Long tons.							
Consolidation Coal Co	936, 799	826	$463, 715. 50	257	255	$131, 727. 92	$153, 995. 78	$749, 439. 20
George's Creek Coal and Iron Co	394, 012	256	195, 035. 94	89	283	45, 840. 34	74, 333. 32	315, 209. 60
Maryland Coal Co	316, 518	279	156, 676. 41	64	243	28, 304. 64	68, 233. 35	253, 214. 40
American Coal Co	259, 632	190	128, 517. 84	49	280	24, 000. 00	55, 177. 76	207, 705. 60
Potomac Coal Co	209, 793	168	103, 847. 53	48	290	24, 360. 00	39, 626. 87	167, 834. 40
Borden Mining Co	192, 636	180	95, 354. 82	40	231	16, 354. 80	42, 399. 18	154, 108. 80
New Central Coal Co.	181, 906	160	90, 043. 47	54	198	18, 283. 32	37, 198. 01	145, 524. 80
National Coal Co	117, 775	89	58, 298. 62	19	291	9. 675. 75	26, 245. 63	94, 220. 00
Swanton Mining Co.	61, 610	50	30, 496. 95	13	270	5, 616. 00	13, 175. 05	49, 288. 00
Maryland Union Coal Co	148, 523	123	73, 518. 93	54	260	24, 570. 00	20, 729. 47	118, 818. 40
Davis and Elkins *a*	82, 667	61	40, 920. 16					66, 133. 60
James Ryan *b*	3, 608							2, 886. 40
Union Mining Co. *b*	7, 500							6, 000. 00
Blane Avon Coal Co. *c*	11, 934							9, 547. 20
George M. Hansel *c*.	1, 989							1, 591. 20
	2, 926, 902	2, 382	1, 436, 426. 17	687	2, 601	328, 732. 77	531, 114. 42	2, 341, 721. 60

a Owing to sickness, the clerk could not give full returns in time for this report.
b Local operators; unable to get returns in time for this report.
c Went out of existence the beginning of the year.

MICHIGAN.

Total production in 1887, 71,461 short tons; spot value, $107,191.

The coal field of Michigan is detached from that of any other State. Its area is about 6,700 square miles, and is embraced principally by the counties of Saginaw, Shiawassee, Clinton, Ionia, Montcalm, Gratiot, Isabella, and Midland. Large areas also of Tuscola, Genesee, Ingham, Eaton, and Bay counties are underlaid by the coal formation, making, in all, thirteen counties in addition to small portions of Livingston and Jackson counties, and probably several counties to the north, which are also underlaid by the coal formation. (See "Mineral Resources," 1886.)

Mr. Charles D. Lawton, commissioner of mineral statistics of Michigan, in speaking of the coals of the State says:

"Michigan coal beds are usually poor in quality, being light and friable, sometimes slaty, and making considerable slack. They are thin, exceeding nowhere 3 to 4 feet in thickness; the roof is frequently poor and the ground wet. Some of the best coal shafts that have been opened have proved too wet to work with any profit. The formation is liable to be curved and faulted, thus adding to the difficulty of getting rid of the water. The coal is said to be excellent for making steam and is liked for locomotive boilers, but the difficulty in making contracts with the railroad companies has been due to uncertainty as to the product; this uncertainty arises mainly from the difficulty which the coal companies have of securing and holding their laborers. The seams being so low and wet, the men do not like to work in them, and hence also the miners must understand how to work to advantage or they can not make good wages."

Jackson and Corunna are the only coal mining localities of any importance in the State. At the latter several new shafts were opened during 1887. A new shaft was sunk in 1887 at Trumbull station, 5 miles west of Jackson, by R. H. Emerson & Co., the first coal being taken out in July. This company had previously worked out and abandoned the Merrill shaft one-half mile west of the city. The output during 1887 was 13,230 tons.

The Bennett Sewer Pipe Company operates a shaft near Jackson; the company also opened a new slope near the city during 1887. The coal is used in the sewer pipe works. From 10 to 15 men are employed at these mines, and the output for 1887 was 3,939 tons, including 1,344 tons of slack. About 72 tons were consumed at the mines. The largest establishment reported in the State is that of the Standard Mining Company, located 1 mile from Jackson. The coal bed here varies from 3 to 4 feet thick, the coal being adapted for steam purposes. The company employs about 50 men, and worked 306 days during 1887. The total production for 1887 was 27,792 tons, including 9,725 tons of slack coal. The Spring Arbor Coal Company, also in the vicinity of Jackson, produced 500 tons during 1887. At Corunna, in Shiawassee county, about 18,000 tons were produced, and at Ground Ledge, in Ingham county, about 2,000 tons.

The following table gives the production of coal in the State to date:

Production of coal in Michigan.

	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Williamston mine	......	......	......	......	......	10, 454	884	......	......	500	......
Jackson mine	67, 697	61, 785	65, 000	......	......	......	......	......	......	......	......
Corunna Coal Co	......	22, 537	16, 115	12, 252	7, 000	8, 624	9, 000	8, 000	10, 000	15, 976	18, 000
Other mines	1, 500	1, 000	800	......	......	......	......	......	......	1, 500	......
Jackson Coal Co	......	......	......	66, 780	61, 666	60, 103	40, 412	13, 712	15, 553	21, 368	......
Eureka Coal Co	......	......	......	30, 000	37, 477	25, 000	......	......	......	......	......
Michigan Coal Co	......	......	......	20, 021	23, 987	25, 000	......	......	......	......	......
Porter Coal Co	......	......	......	......	......	6, 158	21, 000	15, 000	13, 000	......	......
Star Coal Co	......	......	......	......	......	......	......	......	5, 125	5, 820	6, 000
Standard Coal Co	......	......	......	......	......	......	......	......	1, 500	15, 270	27, 792
R. H. Emerson	......	......	......	......	......	......	......	......	......	......	13, 230
Spring Arbor Coal Co	......	......	......	......	......	......	......	......	......	......	500
Bennett Sewer Pipe Co	......	......	......	......	......	......	......	......	......	......	3, 939
Ground Ledge	......	......	......	......	......	......	......	......	......	......	2, 000
Total (*a*)	69, 197	85, 322	82, 015	129, 053	130, 130	135, 339	71, 296	36, 712	45, 178	60, 434	71, 461

a Years previous to 1877, 350,000 short tons.

MISSOURI.

Total production in 1887, 3,209,916 short tons; spot value, $4,298,954.

The outcrop of the Coal Measures in Missouri extends from the Des Moines river on the Iowa line south through Clark and into Lewis county, west into Scotland county, then in a general southerly direction to Audrain county, where it bends to the east, forming a loop, and thence extends west and south to Jefferson City on the Missouri river. The southern outcrop follows the Missouri river west to the mouth of Grand river, where it crosses the Missouri and extends in a general southerly direction to the northwest corner of Jasper county.

All of the State north and west of this line is included in the Coal Measures; and they underlie a large part of Saint Louis county south of the Missouri river. The most productive coal areas in the State are in the central portion along the Missouri river and in the western part of the State west of the Osage and Sac rivers. Thirty-five counties in all have produced coal; of these, sixteen produced coal for shipment in 1887.

According to the estimate of Professor Swallow, late State geologist, the total area underlaid by coal beds in the State is about 27,000 square miles. Previous to 1887 the statistics of production of Missouri coal have been collected by agents of the bureau of labor statistics, of which Hon. Oscar Kochtitzky is commissioner.

In 1887 the office of State mine inspector was created, and the statistics for 1887 were collected by Mr. Marshall Lea Wolfe, the present inspector. The time in which to inspect and report was limited to four months, and, therefore, the report was somewhat incomplete, but contained a great deal of very valuable information. Direct returns were not received from all the mines in the State by the inspector, but the total production for 1887 was estimated at 2,865,996 long tons. The average selling price at the mines was about $1.50 per long ton in 1887. The following table, showing the production and number of mines and other interesting statistics for the year 1887, is compiled from the report of the State mine inspector:

Production, number of mines, price, wages, etc., in 1887.

Counties.	Production.	Number of mines reported on.	Average price of coal at mines per ton.	Average wages of miners, per ton.	Number of employés.	Average thickness of coal seam worked.	
	Long tons.					*Feet.*	*Inch.*
Audrain	91, 100	10	\$1. 50	\$1. 00	238	2	10
Barton	118, 103	4	1. 40	. 65	360	3	4
Bates	956, 345	9	1. 25	. 51½	2, 027	3–5	......
Caldwell	26, 000	2	....	. 87½	140	2	4
Carroll	8, 000	10	....	....	44	......	......
Cooper	7, 000	1	....	....	35	*a*35+	......
Grundy	32, 306	2	2. 06	1. 18¾	200	1	6
Henry	178, 372	13	1. 50	. 87½	666	3	6
Johnson	8, 910	7	1. 25	....	49	2	6
Lafayette	315, 078	21	1. 75	1. 12½	1, 166	1	8
Linn	650	3	2. 00	1. 50	10	2	3
Macon	568, 832	9	1. 45	. 70	1, 496	4	......
Putman	105, 000	1	1. 40	. 80	760	2	10
Randolph	249, 470	15	1. 45	. 94	734	4	......
Ray	180, 880	7	1. 60	1. 00	611	2	......
Vernon	19, 950	5	1. 15	. 75	64	2–8	......
	2, 865, 996	119	1. 50	. 87½	8, 600		

a Pocket of cannel coal.

It will be noticed that the production for 1887 is more than 1,400,000 tons in excess of that for 1886, or an increase of nearly 80 per cent. Reports of production for 1886 were received from only 8 counties; for 1887 reports were received from 16 counties. The largest producing county in the State is Bates county, which produced during 1887, 957,345 long tons. The most important coal fields in Bates county are those at Rich Hill, in the southern part of the county. These coal fields are considered the most valuable and extensive in the State. No extended surveys have been made in this field, so that the exact extent of this field is unknown; but new coal-producing territory is constantly being discovered in localities where formerly no coal was supposed to exist. The coal bed is found at various depths from the surface, the deepest shaft yet sunk being about 60 feet. The thickness of the bed varies from 3½ to 5½ feet, though in places it is found 9 feet thick. The roof over this coal is a solid slate. The coal is excellent for steam and heating purposes, being but little inferior to Pittsburgh or McAlester coal. Two large companies are operating in the district, and during 1887 their average shipments amounted to about 3,500 cars per month; a number of private operators are also working mines in this district and shipping from 1 to 15 cars per day. This coal deposit extends over the entire southern portion of Bates county and the northern portion of Vernon county. The second largest producing county in the State is Macon; the production of this county for 1887 was estimated at 568,832 tons; there are 9 mines shipping coal; the average thickness of the coal bed worked is 4 feet. Of the other counties in the State, the following are the most important: Audrain, Barton, Henry, Lafayette, Putnam, Randolph, and Ray. In Putnam county the coal field is found in the eastern part, extending over several thousands of acres. There are 3 coal beds found in this region. The first is 18 inches thick and lies close to the surface; it is largely mined by stripping. The second bed averages about 3 feet 9 inches in thickness and is usually mined by drifts; it yields an excellent bituminous coal and is largely used for smithing purposes. The third bed is found at depths varying from 50 to 100 feet below the surface and must be mined by shafts; it is said to be the most valuable coal of the three. In several of the counties in the central part of the State large deposits of cannel coal are found. In Moniteau county, about 125 miles from Saint Louis, a cannel coal bed has been found which varies from 12 to 72 feet in thickness; in some localities this coal may be mined by stripping. Cannel coal is also mined in Cooper county, where the bed has been entered for the depth of 35 feet without passing through it; 7,000 tons of this coal were produced in 1887. These cannel coal deposits are usually enlargements of the coal bed in the form of pockets. The mines under the general supervision of Mr. R. H. McDowell made returns direct to the Survey; these returns are given in the following table:

Production by coal companies from which the Survey has received returns.

Names of companies.	Number of mines.	Production, 1887.
		Short tons.
Lexington Coal Mining Company	6	130,165
Western Coal and Mining Company	4	143,470
Johnson County Coal Mining Company	2	7,105
Rich Hill Coal Mining Company	8	556,353
Osage Coal and Mining Company	1	48,632
Total	21	885,725

The same gentleman has reported analyses of the coals mined at these localities. These analyses are given in the following table:

Analyses of Missouri coals reported to the Survey in 1887.

Names of companies.	Ash.	Fixed carbon.	Volatile matter.	Water.	Total.	Sulphur.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Osage Coal and Mining Company, Elliott	2.34	47.54	41.90	8.22	100.00	1.81
Rich Hill Coal Mining Company, Rich Hill	13.70	41.14	42.62	2.54	100.00	4.51
Johnson County Coal Mining Company, Montserrat	26.90	34.69	32.25	6.16	100.00	14.71
Lexington Coal Mining Company	7.71	45.32	36.34	10.63	100.00	2.93

The shipments over the Missouri Pacific Railroad Company are shown in the following table. This company controls the Osage Coal and

Mining Company in the Indian Territory; it owns the Montana mines in Crawford and Cherokee counties, Kansas; and mines in Baxter county, Missouri, and possesses the controling interest in the Lexington and Rich Hill Coal Company. Of the total coal mined along its lines during 1887, 1,608,544 tons were mined by these companies in which the railroad has the controlling interest. A total of 12.061 tons of coke were made along the lines of this railroad in 1887.

Coal shipments of the Missouri Pacific Railroad Company in 1884, 1885, 1886, *and* 1887.

Years.	Coal mined on line.	Received from connection.	Total.	Commercial coal carried.	For company use.	Cost per ton.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
1884	1,002,972	514,287	1,517,259	601,820	915,439	$2.24
1885	1,031,180	468,817	1,499,997	629,551	870,446	1.80
1886	1,172,052	544,796	1,716,848	877,510	839,338	1.74
1887	1,816,213	569,625	2,385,838	1,255,510	1,125,328	1.69

MONTANA TERRITORY. (a)

Total production in 1887, 10,202 short tons; spot value, $35,707. In Montana but little was done in the mining of coal in 1887. The effects of the prolonged strikes in 1886 at the Bozeman or Timberline mines were felt all through the year, causing the rapid development of the Roslyn coal mines in Washington Territory, owned by the Northern Pacific Coal Company, which also owns the Timberline mines. Hence the Timberline mines were neglected until the latter part of the year, when they were re-opened, the production being 7,802 tons of coal, of which the estimated value was $19,995. It is probable that the mines will be worked quite extensively in 1888 in order to supply the large and growing demand for fuel in Montana.

The production of the Timberline mines to the end of 1887 has been:

Production of the Timberline coal mines, Montana.

Years.	Short tons.
1883	10,489
1884	55,664
1885	83,156
1886	45,446
1887	7,802
Total	202,557

The activity in railway building in Montana will undoubtedly lead to the opening of new mines in 1888 or the greater development of mines already opened; the Montana Central railway being now under process of construction near the Sand Coulée, Belt Creek, and Smith River mines.

a Report by F. F. Chisolm.

As to the character and quantity of these coals some doubt seems to be entertained. Mr. E. V. Smalley states that officials of the Northern Pacific have examined this district and report that the coal is only a fair quality of lignite and that it lies in small pockets. Opposed to this is the statement of Mr. O. C. Mortson, of Great Falls, who states that the coal at Sand Coulée and Belt creek cokes well.

The branch of the Montana Central, 12 miles long, from Great Falls to Sand Coulée, is already completed, awaiting only rails.

No work was done on the Deep Creek mines in 1887.

At the Belt Creek mines very little was done beyond making tests of the coking qualities of the mines, with very satisfactory results.

The Sand Coulée mines have been largely developed by the Montana Central railway. The production in 1887 was small, as almost all of the work was directed toward running main entries and preparing the mine for a large production as soon as the Montana Central is completed.

The mines at Smith river, Maxey, Red Rock, and other points were worked in 1887.

Recapitulation.—Coal production of Montana.

Year.	Timber-line.	Boseman and Maxey.	Sand Coulée.	Belt Creek.	Lignite.	Other mines.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1883	10,489	9,306					19,795
1884	55,664	8,006			16,221	485	80,376
1885	83,156	100	700	1,200		1,284	86,440
1886	45,446		800	600		3,000	49,846
1887	7,802		2,200			200	10,202
Total	202,557	17,412	3,700	1,800	16,221	4,969	246,659

The value of the Territory's output in 1887 at $3.50 per ton was $35,707. It is impossible to estimate the number of men employed in coal mining in the Territory.

For more complete description of the Montana coal field reference should be made to report in Mineral Resources, 1886.

NEBRASKA. (a)

Total production in 1887, 1,500 short tons; spot value, $3,000.

Some coal or lignite occurs in each of the three principal formations in this State, the Carboniferous, the Cretaceous, and the Tertiary. Carboniferous rocks underlie 3,200 square miles of southeastern Nebraska, including the counties of Richardson, Pawnee, Johnston, Nebraska, Otoe, most of Cass, and portions of Gage, Lancaster, Sarpy, and Douglas. Thin seams of coal have been observed in nearly all of these counties, none of them exceeding 2 feet in thickness. The only one which is regularly mined is near Du Bois, in Pawnee county. The product of

a Reported by Prof. L. E. Hicks, University of Nebraska.

this for the year ending December 31, 1886, was 1,300 tons. Mining in this county is mostly done by farmers at odd times when they would otherwise be idle. None of the product is shipped away from the county. It is probable that similar operations are carried on in some of the other counties, but no authentic information is at hand of the fact, or the amount of the product. The total product for 1887 has been estimated at 1,500 tons.

The roof of the Du Bois coal bed is shale and the working easy, considering the thinness of the seam. A specimen block of this coal in the cabinet of the State University, representing the whole thickness of the seam at the point from which it was taken, is 18 inches thick. It is bituminous coal of fair quality. The seam lies near the surface (the greatest depth yet reached in mining operations is 65 feet), and belongs to the Upper Coal Measures. The Lower Coal Measures were penetrated by the test well at Brownville, Nemaha county, and a seam of tolerably good bituminous coal 30 inches in thickness was found at a depth of 821 feet. (Further details may be found in the proceedings of the American Association for the Advancement of Science, Buffalo meeting, 1886, pp. 217, 218.)

Permian rocks underlie 450 square miles of Nebraska, mostly in Gage county, and in this formation no coal has been observed.

Near the top of the Colorado group of the Cretaceous period occurs a thin seam of the lignite, nowhere more than 1 foot in thickness. It is often associated with much black shale, and thus produces a very promising coal blossom, though it is in fact entirely worthless. Its outcrops occur both in northern and southern Nebraska (Dakota and Jefferson counties), and it has been reached by borings in Dodge and Cedar counties.

A seam of lignite probably belonging to the Eocene Tertiary has been struck at the depth of 500 feet at Chadron, Dawes county, in northwestern Nebraska. It is reported to be 4 feet in thickness. Specimens of it were analyzed in the laboratory of the State University with the following result:

Analysis of Nebraska coal.

	Per cent.
Moisture	11.38
Volatile matter	43.71
Coke	40.62
Ash	4.29
Total	100.00
Specific gravity	1.318

This deposit strengthens the supposition that the lignitic coals of Wyoming and Dakota extend into northwestern Nebraska beneath the newer Tertiary formations which appear at the surface.

NEW MEXICO.(a)

Total production in 1887, 508,034 short tons; spot value, $1,524,102.

In 1887 the coal production of New Mexico grew steadily, but with no unusual features.

The production at the Raton mines by the Raton Coal and Coking Company was greater than ever before, reaching 154,875 tons. The mines here have been described in previous volumes of the "Mineral Resources." The coal from this section is used for fuel by the Atchison, Topeka and Santa Fé railway, and is sold along the line for commercial purposes.

The production of the mines of the Gallup and Defiance district reached its highest point in 1887. Exact statements from all the mines of this district were not obtainable, but the estimates furnished were very conservative and approximately accurate.

The coal from the San Pedro mine is largely coked for use by the smelters of New Mexico and Arizona.

More coal was mined from the Cerillos field near Santa Fé than ever before. The coal produced is mainly for local consumption in Santa Fé. The owners of the mines here claim that if fair rates of transportation were afforded them they would be able to ship largely.

The mine at Monero changed ownership twice in 1887, which prevented any large output. The production of the Territory to date has been as follows:

Coal production of New Mexico from 1881 *to* 1887.

Localities.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Raton district	91,798	112,089	102,513	135,833	87,708	154,875
Gallup district	33,373	42,000	62,802	97,755	106,530	275,952
Monero	12,000	17,240	11,203	14,958	7,000	11,000
Los Cerrillos	3,600	3,000	3,000	1,000	1,000	7,500
San Pedro	16,321	37,018	41,039	56,656	69,047	58,707
Total	157,092	211,347	220,557	306,202	271,285	508,034

The value of the Territory's production in 1887 was $1,524,102. The number of men employed averaged about 995.

Governor Edmund G. Ross, in his report for 1887 to the Secretary of the Interior, makes the following statements relative to the coal fields of New Mexico:

"The Blossburg mines include several thousand acres of coal land, underlaid with a seam 5½ feet in thickness. The seam is a true bituminous coal, of first-rate steam-producing qualities, and is largely consumed by railroads and other steam users.

"The San Pedro mines are located at Carthage, Socorro county. The coal is high-grade coking and steam coal. These mines, as well as the Blossburg mines, are operated by the Atchison, Topeka and Santa Fé Railroad Company, which has also seventy coke ovens at San Antonio,

a Reported by Mr. F. F. Chisolm.

where a large portion of the San Pedro coal is converted into coke, and finds a ready market in New Mexico, Arizona, and Mexico.

"The Gallup mines embrace a group of several known deposits, 5 feet to 6 feet in thickness, and represent a large section in that portion of the Territory underlaid with coal, known to include several hundred square miles. The coal is lignite, excellently adapted to domestic uses as well as steam, is clean, and burns down to a white ash, with little or no residuum. These three districts are the only ones in the Territory which can be said to be fairly developed. Their extent, with the exception of San Pedro, is as yet practically unknown.

"The Amargo mines have been in operation but a short time. These and the Monero mines are in the same general section of country, and represent a very large and important coal district. In the Amargo three seams have been opened, each about 4 feet in thickness, the lowest 150 feet below the surface, and each apparently belonging to a different stratum. This is excellent coal for gas, steam, and domestic purposes, and its development, now assured, will add very largely to the wealth of the Territory.

"The output of the White Oaks mines represents simply the local demand of a community isolated from railroad transportation. The seams vary from 3 to 4 feet in thickness.

"In San Juan county, in the northwest corner of the Territory, coal is mined for domestic purposes only, there being no transportation or demand for other purposes. The outcroppings in that county range from 1 to 20 feet in thickness, and the deposit is evidently very extensive; but there can be no development without the facilities for reaching a market, now 150 miles distant. In the Cerrillos district, while the mining is somewhat of a desultory character, the extent of the deposits is very large, covering some hundreds of square miles, and the seams average 4 feet in thickness.

"The Ortis mines in this district are said to consist of a high-grade anthracite, pronounced by experts to be equal to the average anthracite of Pennsylvania."

NORTH CAROLINA.

For some years, examination of the coal deposits of North Carolina has been carried on under the direction of the State board of agriculture with a view to determining their commercial value. The examinations made by Dr. H. M. Chance were described in the report for 1885; since Dr. Chance's examinations, prospecting has been carried on under direct supervision of the Commissioners of Agriculture. There are two isolated Triassic areas in North Carolina in which coal beds have been opened, one at Deep river and the other on the Dan river. Mr. John Robinson, Commissioner of Agriculture, in speaking of the coal fields of North Carolina, says: "The only actual mining at present carried on in the State is on the line of the Cape Fear and Yadkin railroad in the Deep River district. This coal is being taken to Greensborough, where it is used in the manufacture of gas and other purposes. The Department of Agriculture is aiding in the exploration of the Dan River coal fields." The following description of the results of this exploration is compiled from the *Bulletin of the Department of Agriculture:* Two coal beds have been found of workable thickness in the Dan River field. The explorations of these coal beds have been conducted by Mr. H. B. Robson, as follows: Coal bed No. 1 has been followed 120 feet into the hill on a water level and found to have an extended thickness of from 5 to 5½ feet; the coal is bright, soft, and friable as far as it has been explored, but may become harder where it is found under more cover. The work of exploring is now being extended on the dip to greater depth, when it is expected that the coal will be found harder and better in quality. No. 2 bed has been similarly opened for a distance of 90 feet and has been found to be much disturbed by rock intrusions, but presents about 3 or 3½ feet of harder coal of the same general character as No. 1. On the opposite side of the same valley a bed of soft coal was opened, which for 20 feet into the hill carried a constant thickness of 8½ to 9 feet, almost entirely free from slaty matter or other impurities. From other localities in the same region a harder coal, which breaks with a cubical fracture, has been found. Near Stokesburgh a bed of soft coal was opened from 7 to 7½ feet in thickness, and 40 feet below this is found a bed of hard coal of variable thickness from a few inches up to 2 feet. Explorations in the Dan River district will be continued with the diamond drill in the centre of the valley. Mr. H. B. Robson, the engineer who is conducting these explorations, in his report to the Department of Agriculture, says: "From a careful observation of the coal areas encountered hitherto, I think I have found rapid transformation from soft to hard crystalline coal in the hill slope beds. I hope to find this latter condition in the deposits of the valley. This result will be of vast importance to the State as well as to the district; adding to the coal resources not less than 40,000,000 tons of accessible coal." Mr. Robson further states in regard to the Dan River coal field: "The Dan River coal deposits may be taken as available for fuel supplies between Leaksville and Germantown, a distance of about 50 miles, the width of the basin between outcrops being about 3½ miles. No coal has been found on the northwestern edge of the basin, but on the southeastern edge two available coal seams are found, which reach their maximum thickness (3 and 7 feet) southwest of the Dan river, and within 10 miles of the southwestern end of the deposit. Since October last, when I began to explore this basin, I have driven over 800 feet of adits in length from 30 feet down to 20 feet, and have ascertained with certainty the existence of persistent seams of coal and coally matter over 5 feet in thickness. Some very fine crystalline hard and hot burning anthracite coal which we are now stocking will certainly show the excellent character of some of this coal. Much of the coal that we have mined hitherto has shown an excess of sulphur." Mr. Robson has leased 4,000 acres of coal lands in the vicinity of Walnut Cove, Stokes county, and expects to mine in this district at a recent date.

Col. J. A. Gray, of Greensborough, president of the Cape Fear and Yadkin Railway Company, reports that on Deep river, in Moore and Chatham counties, a considerable amount of coal was mined during the late war to supply the arsenal at Fayetteville, and for the use of the blockade runners at Wilmington. Since that time but little has been done in this district, except in the way of exploration. Some of the coal, however, has been raised, from time to time, and is used in the manufacture of gas at Greensborough, with very satisfactory results. In 1887 the Egypt Coal Company was organized, with a capital stock of $250,000, to mine coal from the old Egypt shaft, at Egypt, in Chatham county. This shaft is 463 feet in depth, and has 12,000 feet of gangway. There are two beds of coal opened by this shaft, the upper 45 feet and the lower 2 feet in thickness, the interval between them, which is 18 inches, being composed of "blackband." The coal is superior for gas, steam, and domestic uses and is also fine coking coal. The company expects to work the mine on an extensive scale, the intention being to supply Raleigh and other towns in North Carolina. During the late war 50,000 tons were taken from these mines for the use of the Confederate Government.

The Richmond coal field is of the same age and the same general character as the Deep River deposit, and it is a notable fact that during the past year extensive operations have been started in both of these fields.

OHIO. (*a*)

Total production in 1887, 10,301,708 (*b*) short tons; spot value $9,096,848.

The Ohio coal field is situated in the northwestern part of the Appalachian coal field and embraces within the State between 10,000 and 12,000 square miles (generally stated as 10,000 square miles), more than one-fourth of the area of the State being underlaid by productive Coal Measures. The western margin of the Ohio portion of the Appalachian field runs through the counties of Trumbull, Geauga, Portage, Summit, Medina, Wayne, Holmes, Knox, Licking, Perry, Hocking, Vinton, Jackson, Pike, and Scioto, and the Coal Measures are spread over all the territory lying east of this line of outcrop to the State line at the Ohio river.

All the beds of coal at present worked are located in the Upper and Lower Coal Measures; the Barren Measures, as the name indicates, containing little coal of sufficient thickness for the immediate purposes of the miner.

The product of the State by counties for the years 1885, 1886, and 1887 is given in the following table:

a Compiled from the report by Mr. Thos. B. Bancroft.

b Includes lump, nut, pea, and slack coal.

Coal produced in Ohio by counties in 1885, 1886, *and* 1887.

Counties.	1885.			1886.			1887.			
	Lump.	Nut.	Total.	Lump.	Nut.	Total.	Lump.	Nut.	Pea and slack.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	677, 487	145, 652	823, 139	766, 411	132, 635	899, 046	884, 622	141, 900	57, 021	1, 083, 543
Belmont	650, 640	93, 806	744, 446	462, 252	111, 527	573, 779	494, 974	108, 363	118, 430	721, 767
Columbiana	398, 703	64, 030	462, 733	268, 465	67, 598	336, 063	393, 617	74, 985	47, 455	516, 057
Coshocton	78, 351	21, 258	99, 609	43, 361	9, 573	52, 934	88, 367	17, 412	19, 012	124, 791
Carroll	121, 125	29, 570	150, 695	184, 095	32, 535	216, 630	186, 624	39, 137	67, 567	293, 328
Guernsey	336, 366	60, 991	297, 267	349, 503	84, 297	433, 800	360, 340	100, 475	92, 798	553, 613
Gallia	13, 477	2, 906	16, 383	14, 862	2, 562	17, 424	13, 000	....	2, 365	15, 365
Holmes	9, 716	1, 743	11, 459	10, 491	2, 179	12, 670	7, 407	2, 283	836	10, 526
Hocking	574, 086	82, 355	656, 441	637, 224	104, 347	741, 571	693, 097	116, 914	43, 052	853, 063
Harrison	....	....	....	5, 132	377	5, 509	3, 643	72	317	4, 032
Jackson	641, 419	150, 189	791, 608	717, 516	139, 224	856, 740	863, 047	194, 888	76, 770	1, 134, 705
Jefferson	245, 492	25, 837	271, 329	442, 051	33, 615	275, 666	222, 277	40, 328	31, 270	293, 875
Lawrence	111, 453	34, 463	145, 916	139, 173	27, 760	166, 933	113, 790	22, 272	7, 497	143, 559
Medina	136, 121	16, 600	152, 721	223, 747	28, 664	252, 411	178, 772	30, 425	16, 290	225, 487
Meigs	199, 584	35, 172	234, 756	165, 627	26, 636	192, 263	153, 444	23, 051	8, 710	185, 205
Muskingum	75, 511	11, 355	86, 846	85, 011	11, 590	96, 601	127, 353	9, 442	35, 133	171, 928
Mahoning	257, 561	18, 483	275, 944	251, 515	61, 525	313, 040	210, 294	18, 999	43, 056	272, 349
Morgan	5, 536	....	5, 536	4, 370	....	4, 370	3, 500	....	600	4, 100
Noble	....	....	....	3, 342	....	3, 342	4, 000	1, 320	1, 000	6, 320
Perry	1, 055, 500	204, 092	1, 259, 592	1, 346, 131	261, 535	1, 607, 666	1, 535, 911	179, 414	155, 515	1, 870, 840
Portage	67, 683	9, 388	77, 071	61, 273	9, 066	70, 339	48, 649	4, 442	12, 072	65, 163
Scioto	2, 440	....	2, 440	....	....	....	....	....	....	....
Stark	341, 859	49, 559	391, 418	519, 992	73, 430	593, 422	586, 014	81, 973	116, 177	784, 164
Summit	129, 069	16, 065	145, 134	70, 221	12, 004	82, 225	76, 110	5, 700	14, 005	95, 815
Tuscarawas	225, 530	60, 015	285, 545	212, 362	55, 304	267, 666	363, 094	81, 554	61, 818	506, 466
Trumbull	234, 654	29, 863	264, 517	162, 331	26, 200	188, 531	132, 829	27, 058	8, 102	167, 989
Vinton	67, 604	9, 523	77, 127	49, 392	10, 621	60, 013	69, 043	11, 702	8, 982	89, 727
Wayne	74, 062	7, 445	81, 507	99, 174	9, 883	109, 057	84, 906	8, 436	11, 808	105, 150
Washington	4, 000	1, 000	5, 000	4, 000	1, 500	5, 500	1, 480	400	....	1, 880
Total	6, 635, 029	1, 181, 150	7, 816, 179	7, 099, 024	1, 336, 187	8, 435, 211	7, 900, 204	1, 342, 945	1, 057, 658	10, 300, 807

Increase and decrease in product, time made, and miners employed.

Counties.	In 1886 compared with 1885.						In 1887 compared with 1886.					
	Tonnage.		Weeks worked.		Miners employed.		Tonnage.		Weeks worked.		Miners employed.	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
Athens	75, 907		3		86		184, 497				276	
Belmont		170, 667	5		280		147, 988		8		143	
Columbiana		126, 670		1		273	179, 994		8		355	
Coshocton		46, 675		19		93	71, 857		27		73	
Carroll	65, 935			2	189		76, 698		7		118	
Guernsey	136, 533		8		132		119, 813			6	10	
Gallia								2, 059	4			5
Holmes								2, 144	6			25
Harrison								1, 477				20
Hocking	85, 130		3		293		111, 492			5	224	
Jackson (*a*)	65, 132				283		278, 865		1		218	
Jefferson	4, 337		11			9	18, 209				42	
Lawrence	21, 017		2		93			23, 374		3		140
Medins	99, 690		7		376			26, 924	4			180
Meigs		42, 403		10	144			7, 058				108
Muskingum	9, 755		17		16		75, 327			2	98	
Mahoning (*a*)	37, 096				44			40, 691	5			339
Morgan								270				4
Noble							2, 978					4
Perry	348, 074		5		596		263, 175			1	405	
Portage		6, 732	1			35		5, 176	3			27
Stark	202, 004		6		139		190, 742		2		151	
Summit		62, 909		9		103	13, 590		17			155
Tuscarawas		17, 879	1			3	238, 800		6		237	
Trumbull		75, 986	2			499		20, 542	2			53
Vinton		17, 114		6	8		29, 714		9			20
Wayne	27, 550		7		241			3, 907	1			119
Washington								3, 620				9
Total	1, 178, 160	567, 125	78	47	2. 920	1, 015	2, 003, 739	137, 242	110	17	2, 350	1, 208

a The time made in Jackson and Mahoning counties was the same in 1886 as in 1885.

It will be observed in the first table that with but few exceptions the relative output of the counties during 1887 varies but little from the output during 1885 and 1886, respectively. In the eleven counties of Perry, Jackson, Athens, Hocking, Stark, Belmont, Guernsey, Columbiana, Tuscarawas, Jefferson, and Carroll a largely increased product is shown, and reference to the second table given will show an increased force of employés in each, and an increased average time made by them, with the exception of Athens and Jefferson, whose time was the same as in 1886. Conspicuous among the counties mentioned above is Tuscarawas, whose product is nearly double that of 1886. This is accounted for by the number of new mines of large capacity that have been opened within her borders during the year, and the increased force and time worked by all. It will be observed that the Hocking valley (Perry, Athens, and Hocking counties) furnishes more than one-third of the entire tonnage of the State, and that of these three counties, Perry's output is almost equal to the other two combined, and is nearly one-fifth of the gross production of the State.

The average time made for the year (computed from the time worked by the commercial mines only) is two hundred and twenty-eight days, being twenty-two days more than was made in 1886. The returns made show an increase of 1,142 miners and 658 outside hands over the previous year, and that the total number of men engaged in the industry in the State was 22,237, or an increase over 1886 of 1,800. The number of new mines opened during the year was seventy-five, while the mines worked out or abandoned were twenty-three, showing an increase of fifty-two commercial mines in the State as compared with last year's report. These facts are sufficient to account for the largely increased tonnage, and at the same time go to show a constantly improving condition of affairs consequent upon the harmonious relations existing between employers and employed, and the satisfactory basis upon which these relations rest.

The only counties showing a decided decrease in their tonnage are Mahoning, Trumbull, Medina, and Lawrence. The first two of these show a large decrease of men employed and (in Trumbull) of time worked. It is possible that the introduction of natural gas in Youngstown and vicinity may have had some effect in this direction, and it is certain that the large mines of these two counties are being worked out faster than new ones take their places. The decrease in Medina arises from a lessened force, while this cause and a shorter average time brought about the decrease in Lawrence.

The following table gives a summary, in a condensed form, of the tonnage, time worked, employés, and casualties in each county:

Table of tonnage, time worked, number of men, etc., in each county in Ohio in 1887.

Counties.	Tonnage.	Number of commercial mines.	Number of country banks.	Total number of mines.	Number of miners.	Number of outside men.	Total employés.	Accidents.	Fatalities.	Average weeks worked.
Athens	1,083,543	38	6	44	2,080	318	2,398	2	6	35
Belmont	721,767	27	27	54	1,092	241	1,333	6	3	43
Columbiana	516,057	22	35	57	872	185	1,057	1	1	44
Coshocton	124,791	12	8	20	219	33	252	1	....	47
Carroll	293,328	10	17	27	533	87	620	5	....	44
Guernsey	553,613	11	4	15	795	104	893	5	1	31
Gallia	15,365	2	......	2	30	3	33	....	....	40
Holmes	10,526	1	11	12	31	6	37	....	....	40
Hocking	853,063	17	......	17	1,389	253	1,642	2	3	31
Harrison	4,032	......	7	7	16	1	17	....	1	....
Jackson	1,135,605	49	15	64	2,213	291	2,504	5	3	35
Jefferson	293,875	9	11	20	495	94	589	3	....	40
Lawrence	143,559	5	17	22	306	52	358	1	2	42
Medina	225,487	7	2	9	550	61	611	3	....	41
Meigs	185,205	11	4	15	495	118	613	....	1	28
Muskingum	171,928	23	50	73	385	91	476	2	....	38
Mahoning	272,349	13	18	31	642	98	740	3	1	43
Morgan (estimated)	4,100	......	......	......	10	2	12	....	....	....
Noble	6,320	1	......	1	8	4	12	....	....	....
Perry	1,870,841	63	7	70	3,008	633	3,641	7	5	34
Portage	65,163	3	......	3	138	35	173	....	....	34
Stark	784,164	25	32	57	1,561	253	1,814	17	6	35
Summit	95,815	5	6	11	156	28	184	3	....	38
Tuscarawas	506,466	22	25	47	852	149	1,001	3	2	37
Trumbull	167,989	14	12	26	533	96	629	4	....	33
Vinton	89,727	6	13	19	200	51	251	1	....	44
Wayne	105,150	2	3	5	261	71	332	1	1	36
Washington	1,880	1	......	1	7	2	9	....	....	....
Total	10,301,708	399	330	729	18,877	3,360	22,237	75	36	913

The average selling price of coal in the Hocking valley would probably be a fair estimate of the average selling price of coal throughout the State. These prices were: Lump, $1.03; nut, 88 cents; pea, 29 cents, and slack, 11 cents. In the table giving the amount of pea and slack produced in each county during 1887 one-third of the tonnage may be considered pea coal and two-thirds slack coal.

The output of the State for 1887 exceeds that reported for 1886 by 1,866,497 tons. The amount for 1887 includes the pea coal and slack sold and shipped during the year; these coals were not taken into consideration in last year's report of product; they amount to 1,057,658 tons, which, deducted from the total product of the year, would still leave an increased output on the basis of the reports for previous years of 808,839 tons. The demand for pea and slack in the past has gradually grown, and the shipment of these sizes assumed such proportions in 1887 that it was deemed advisable to include them in the report for this year in order that a full and accurate statement of the tonnage of the State might be made. The output for 1887 was phenomenal, and, when considered in connection with the introduction of natural gas as a fuel in 1885, it will be observed that the product has increased regularly ever since this new fuel competitor entered the field.

The steady and continuous growth (except during 1883 and 1884) in the coal production of the State since 1872 is exhibited by the following table:

Annual coal production of Ohio from 1872 *to* 1887.

Years.	Short tons.	Years.	Short tons.
1872	5,315,294	1880	7,000,000
1873	4,550,028	1881	8,225,000
1874	3,267,585	1882	9,450,000
1875	4,864,259	1883	8,229,429
1876	3,500,000	1884	7,640,062
1877	5,250,000	1885	7,816,179
1878	5,500,000	1886	8,435,211
1879	6,000,000	1887	10,301,708

The product for 1882 was no doubt in excess of that for 1883, 1884, and 1885, but not necessarily in excess of that reported for 1886, since up to 1884 there was no statutory provision for the collection of these statistics, and the product was estimated (from the best data procurable, no doubt), and was liable to inaccuracies that it was not possible to detect.

There are a few mines in Belmont and Jefferson counties where the product was consumed in iron and glass works belonging to their owners that have ceased operations owing to substitution of natural gas. These mines are not enumerated as abandoned, as it is possible that their suspension may be but temporary. At the end of the year there were 399 mines in the State employing more than 10 men each, and 330 that do not give employment to that number, making a total of 729 coal mines, large and small, in the State.

As mine improvement progresses, the number of improvements made should decrease from year to year. This is not the case, however, with the present year, as its record of improvements is largely in excess of that of 1886, and serves to show that during profitable seasons mine owners are more willing, as they are better able, to put and keep their mines in good condition. Since the last report 39 furnaces have been built, 9 fans erected, 50 air-shafts sunk, 7 second openings made, and 8 stairways, as means of escape, put in. This is certainly a good showing for the year, and if to this be added the record of improvements previously reported, we find that in the last three years and a half there have been 128 air-shafts sunk, 25 second openings made (in addition to such air-shafts as can be used for this purpose), 30 stairways or ladders put into shaft mines, 140 furnaces built, 44 fans erected, and 33 safety-catches put upon cages. When it is considered that there are to-day but 399 mines in the State coming directly under the law, and that these improvements have been made, generally, in mines where they did not previously exist, it will be seen that much good has been accomplished, and it is upon its face proof that the mines of the State are in good condition.

New markets which opened up in the Northwest took most of the excess in the production during 1887, and the demands in that direction are still increasing. It is a noticeable fact that the coals of this State are able to hold their own and compete successfully with those of States much nearer these markets. This is conspicuously shown in the large amount of Ohio coal sold on the Chicago market, where it comes in direct competition with the nearer coal of Illinois and Indiana.

During the year Ohio coal has penetrated into Wisconsin, Iowa, Minnesota, Colorado, and Dakota. The Columbus and Hocking Coal and Iron Company has erected at Ashland, Wisconsin, at the head of lake navigation, a large and complete dock system, with a storage capacity of 100,000 tons, and with the most improved machinery for elevating and transferring coal from vessels to cars. Coal from the Hocking Valley mines is now taken in cars to Toledo, and from there shipped by vessels to Ashland, where it is again loaded into cars and sent on its journey to markets distant hundreds of miles west of that point. This investment would indicate a faith that these new markets will continue to be held by Ohio, and demonstrates that the coal of the State will stand transfer and long haulage.

It would seem that the introducton of natural gas, so far from having had a baneful effect upon Ohio's coal trade, has, on the contrary, proved beneficial by forcing the coal product upon localities hitherto undreamed of, and which have proved of consumptive capacity beyond expectation. The future outlook for the trade is good; and the opening of new mines in the State during the year has been in excess, it is believed, of any previous year in its history. The development of new fields or the extension of old ones has also followed the improved condition of trade, and will be noticed in another part of this report.

The high price of foreign coke for furnace use, and the rise in price of anthracite for domestic purposes, together with the substitution of crushed coke for the now generally adopted base-burner heating stoves, have stimulated inquiry into the feasibility of coking our coals, and considerable progress has been made in this direction, which is elsewhere noticed.

During the past year developments have been made in Muskingum county that give promise of opening up a large and profitable coal field in the near future. Until lately the mines have been small, their product being consumed locally, but the recent extension of the Columbus and Eastern railroad into Brush Creek township and the building of the Zanesville and Ohio railroad along the Muskingum river from Zanesville to Malta, have furnished outlets for large bodies of coal that have hitherto been neglected. The result is that in this county where a year ago there were but 9 mines employing over 10 men each, there are now 24 regularly shipping mines of large capacity. The coal area opened up by the branch of the Columbus and Eastern railroad contains in sections 5, 6, 25, 26, and 27 of Brush Creek township a deposit of cannel coal varying from nothing to 12 feet in thickness and underlaid by from 1 foot 6 inches to 4 feet of bituminous coal. Along the line of the Zanesville and Ohio railroad, in section 13, Brush Creek township, the same coal bed (No. 7) is opened showing 6 feet of excellent bituminous coal without the cannel.

Extensive developments of the Massillon coal field, in comparatively new territories, have also been made during 1887, which go far to explode the theory that the deposits of this celebrated coal are about exhausted, and from what is shown by these explorations it may be assumed that the supply of this coal will be kept up for years to come. In the Sippo Valley, near Massillon, there are in all 6 mines opened or being opened. The Anderson mine, owned by the Howells Coal Company, has a shaft 178 feet deep, and when in complete working order will have a capacity of 300 tons per day. The coal seam varies from 4 feet 6 inches to 5 feet thick, and the drillings made by this company show that the basin is large and the seam quite uniform in thickness. The West Massillon Coal Company and the Pigeon Run Coal Company have also opened new and extensive mines in the Massillon district during the year 1887.

In Lawrence township, Stark county, near the Wayne county line, a large deposit of coal has been discovered that was not known to exist. It occurs at a depth of 150 feet and the seam varies from 4 to 5 feet in thickness. A company is about to open a mine of large capacity here.

In the Mahoning valley, the celebrated Brier Hill, or block coal, has long been supposed to be exhausted; but it has been redeveloped recently. Messrs. Morris and Stambaugh have been prospecting in Liberty township, Trumbull county, near the Mahoning line, and found at a depth of 190 to 215 feet a coal seam, which is beyond doubt the Brier Hill coal, and which is from 3 feet 6 inches to 4 feet 6 inches in thickness. Coal has been found in eight out of thirteen holes, and the indications are favorable for an extensive basin, although the full area is not yet known. A mine will soon be opened at this locality.

OREGON.

Total production in 1887, 31,696 short tons; spot value, $70,000.

But little is known of the economic geology of the State, or of the exact distribution of the coal-bearing formations within its borders. The present developments are confined to the coal basin in Coos county, though recent discoveries of lignite are reported from Washington and Columbia counties. The extent and thickness of these latter beds are yet to be determined. The Coos county basin covers several hundred square miles, and extends from the Umpqua river north into Douglas county, south to the Coquille river, and back from the Pacific coast line 15 or 20 miles. The only mines from which coal was shipped in 1887 are located in the vicinity of Marshfield, in Coos county. Direct returns were received from the two companies who operate these mines. In securing these returns valuable assistance was rendered by Mr. H. A. Biddle, of Portland, Oregon.

The Oregon Coal and Navigation Company of Marshfield, Coos county, operates the Newport mine, the largest in the State. During 1887 this mine produced 31,360 short tons of coal; this small output was owing to a strike among the miners, which lasted from the beginning of 1887 until June. The following section is reported for this coal bed as worked at the Newport mine:

Section of coal bed worked at the Newport mine, Coos County, Oregon.

	Ft.	In's.
Coal	2	0
Mining (slate ?)	0	4
Coal	1	6
Mining (slate ?)	0	4
Coal	1	0
Total	5	2

The coal from this seam, which is at present supposed to be included in the Tertiary formation, is black and handsome when first mined; it is usually classed as a lignite. It will not coke, and is used principally for domestic purposes. The following analyses, made by Mr. Thomas Price, of San Francisco, California, are given by the company:

Analyses of Coos county coal, Oregon.

	Upper bench.	Lower bench.
Ash	8.05	6.18
Fixed carbon	34.95	32.40
Volatile matter	41.55	44.15
Sulphur	2.53	1.37
Water	15.45	17.27
Total	102.53	101.37

This coal is shipped principally to San Francisco. The selling price at the mines varied in 1887 from $2.50 to $3 per long ton. The mines were operated for seven months of 1887 beginning June 1. Eighty miners and twenty-five laborers are employed in and about the mines. The average wages were $1.12½ per ton for mining and $2.75 per day for laborers. The total shipments of coal in 1887 amounted to 30,240 short tons, and 1,120 tons were consumed at the mines or sold locally.

The firm of Hougard, Davis & Sons operates the Caledonia mine, situated on Isthmus slough, in Coos county, 4 miles above Marshfield. But 336 tons of coal were produced at this mine in 1887. Of this total, 224 short tons were shipped to San Francisco and the remainder consumed at the mine or by the local trade. The coal commanded a price of $3 per ton at the mines during 1887. This mine was only operated for the first three months of 1887, being idle from the end of March. But four miners were employed. The coal bed worked at these mines is 3 feet 6 inches in thickness; its extent has never been satisfactorily determined. The coal is particularly adapted to domestic and steam uses. According to Mr. Biddle these two mines were the only ones operated in the State during 1887. A number of new localities for coal have been reported during 1887 in different parts of the State, but no development of these new deposits has as yet been attempted.

PENNSYLVANIA.

The total production in 1887 was 70,372,857 short tons; spot value, $107,172,185.

Anthracite: Total shipments, 39,506,255 short, or 35,273,442 long tons; spot value, $79,365,244.

Bituminous: Total production, 30,866,602 short tons; spot value, $27,806,941.

ANTHRACITE.

The anthracite region of Pennsylvania is the most important coal district in the United States, and its product is the most desirable coal for general domestic uses found in the world.

The region is confined to the following counties in the northeastern part of the State: Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, Sullivan, and Susquehanna. It is grouped into five principal divisions, as follows:

(1) Southern or Pottsville field, extending from the Lehigh river, at Mauch Chunk, in Carbon county, southwest to within a few miles of the Susquehanna river, north of Harrisburg, in Dauphin county. The central part of the field is contained in Schuylkill county. Total production in 1887, 3,265,974 long tons.

(2) Western Middle or Mahanoy and Shamokin field lies between the easternmost headwaters of the Little Schuylkill river and the Susquehanna river, and within the counties of Schuylkill, Columbia, and Northumberland. Total production in 1887, 9,382,422 long tons.

(3) Eastern Middle or Upper Lehigh field, lying between the Lehigh river and Catawissa creek, and principally in Luzerne county, with small areas extending into Carbon, Schuylkill, and Columbia counties. Total production in 1887, 3,831,335 long tons.

(4) Northern or Wyoming and Lackawanna field lies in the two valleys from which it derives its geographical name, and is embraced almost entirely by Luzerne and Lackawanna counties. A small area in the extreme northeastern end of the field extends into Wayne and Susquehanna counties. Total production in 1887, 21,006,337 long tons.

(5) Western Northern or Loyalsock and Mehoopany field lies within the area drained by the Loyalsock and Mehoopany creeks, and is contained in Sullivan and Wyoming counties. Total production in 1887, 92,679 long tons.

The anthracite coal beds have a varied geological structure occurring under all degrees of dip, being practically horizontal in the Loyalsock field and within very small areas in the other fields. Within large areas of the Eastern Middle, Western Middle, and Southern fields, especially, the coal beds and associated strata are highly plicated, in some cases they are inverted beyond the perpendicular. In the Northern field the strata have comparatively low dips. A general idea of the topographic relief and geological structure of the four principal fields were shown in the last report.

Topographic and geologic levels in anthracite fields.

	Feet.
Northern field, Wilkes-Barre basin.	
Wilkes-Barre (Lehigh Valley Railroad depot)	+549
Mammoth bed outcrop on north side of basin, at Kingston Coal Company's slope No. 2	+778
Mammoth bed outcrop on south side of basin, at Hollenback slope No. 2	+774
Bottom of Mammoth bed basin under flat, north of Wilkes-Barre (estimated)	(*a*)—800
Width of basin (4.4 miles)	23, 200
Eastern Middle field.	
Drifton basin:	
Drifton (Lehigh and Susquehanna Railroad depot)	+1, 633
Buck Mountain bed outcrop on north side of basin, at Drifton slope No. 2	+1, 692
Buck Mountain bed outcrop on south side of basin	+1, 645
Bottom of Buck Mountain bed basin	+1, 150
Width of basin (.4 mile)	2, 250
Hazleton basin:	
Hazleton (Lehigh Valley Railroad depot)	+1, 612
Mammoth bed outcrop on north side of basin	+1, 660
Mammoth bed outcrop on south side of basin, at Hazleton slope No. 6	+1, 672
Bottom of Mammoth bed basin	+ 850
Width of basin along line through slope No. 6 (.7 mile)	3, 800
Western Middle field.	
Mahanoy basin:	
Gilberton (Philadelphia and Reading Railroad depot)	+1, 133
Mammoth bed outcrop on north side of basin, at Gilberton slope	+1, 223
Mammoth bed outcrop on south side of basin, at Draper slope	+1, 275
Width of basin along line through Gilberton slope (.6 mile)	3, 050
Southern field, Panther Creek basin (near Tamaqua).	
Tamaqua (Philadelphia and Reading Railroad depot)	+ 803
Mammoth bed outcrop on north side of basin	+1, 250
Mammoth bed outcrop on south side of basin	+1, 300
Bottom of Mammoth bed basin (estimated)	−1, 000

a Depth attained by workings in Prospect colliery is now over 330 feet below ocean level.

The approximate areas of the anthracite fields and the production of each for the past four years, together with the growth and decline in production, are shown in the following table:

Area and total production of individual anthracite coal fields.

Field.	Square miles (approximated).	1884.		1885.	
		Long tons.	*Per ct.*	*Long tons.*	*Per ct.*
Northern	200	16, 411, 277	50. 28	17, 215, 066	50. 29
Eastern Middle	40	5, 098, 684	15. 62	5, 329, 607	15. 57
Western Middle	90	7, 896, 049	24. 19	8, 152, 937	23. 82
Southern	140	3, 149, 471	9. 65	3, 455, 927	10. 10
Loyalsock	Unknown.	86, 018	0. 26	75, 011	0. 22
Total	470+	32, 641, 499	100. 00	34, 228, 548	100. 00

Area and total production of individual anthracite coal fields—Continued.

Field.	Square miles (approximated).	1886.		1887.	
		Long tons.	*Per ct.*	*Long tons.*	*Per ct.*
Northern	200	18, 247, 875	52. 36	21, 006, 337	55. 90
Eastern Middle	40	4, 993, 361	14. 33	3, 831, 335	10. 19
Western Middle	90	8, 122, 639	23. 30	9, 382, 422	24. 97
Southern	140	3, 427, 435	9. 83	3, 265, 974	8. 69
Loyalsock	Unknown.	61, 767	0. 18	92, 679	. 25
Total	470+	34, 853, 077	100. 00	37, 578, 747	100. 00

The county boundaries of that portion of the State in which the anthracite region is located are not recognized by the coal trade in the classification of either the coal fields or the coals which they produce; neither are they recognized as distinct counties in the division of the field into inspectors' districts. The production of coal, however, in the individual counties is of interest in showing the relative importance of the anthracite mining industry to the counties in which it is located. This production is shown in the following table:

Total production of Pennsylvania coal fields, by counties.

Counties.	1884.		1885.		1886.		1887.	
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*
Susquehanna	77, 058	0. 24	84, 459	0. 24	97, 072	0. 28	176, 422	. 47
Lackawanna	7, 093, 190	21. 73	7, 174, 294	20. 96	7, 275, 853	20. 88	8, 772, 510	23. 34
Luzerne	13, 382, 912	41. 00	14, 329, 645	41. 86	14, 928, 206	42. 83	15, 003, 722	39. 92
Sullivan	86, 018	. 26	75, 011	. 22	61, 767	. 17	92, 679	. 26
Carbon	1, 155, 916	3. 54	1, 210, 284	3. 53	1, 304, 114	3. 74	1, 332, 027	3. 54
Schuylkill	7, 165, 532	21. 96	7, 700, 005	22. 49	7, 915, 650	22. 71	7, 994, 462	21. 27
Columbia	745, 826	2. 28	610, 552	1. 81	601, 729	1. 73	741, 845	1. 97
Northumberland	2, 331, 108	7. 14	2, 482, 644	7. 25	2, 260, 822	6. 49	2, 839, 372	7. 56
Dauphin	603, 939	1. 85	561, 654	1. 64	407, 864	1. 17	625, 708	1. 67
Total	32, 641, 499	100. 00	34, 228, 548	100. 00	34, 853, 077	100. 00	37, 578, 747	100. 00

The region is divided into seven inspection districts, as follows:

First. That portion of the Wyoming coal field included in the counties of Lackawanna, Wayne, and Susquehanna.

Second. The county of Sullivan and that portion of the Wyoming coal field situated in Luzerne county east of and including Plains and Kingston townships.

Third. The remaining portion of the Wyoming coal field west of Plains and Kingston townships, including the city of Wilkes-Barre and the boroughs of Kingston and Edwardsville.

Fourth. That part of Luzerne county lying south of the Wyoming coal field, together with Carbon county.

Fifth. That part of the Schuylkill coal field in Schuylkill county lying north of the Broad mountain and east of a meridian line through the center of the borough of Girardville.

Sixth. That part of the Schuylkill coal field in Schuylkill county lying north of the Broad mountain and west of a meridian line through the center of the borough of Girardville, together with Columbia, Northumberland, and Dauphin counties.

Seventh. All that part of the Schuylkill coal field in Schuylkill county lying south of the Mahanoy valley and the county of Lebanon.

Total production and shipment from the inspectors' districts for the years 1885, 1886, *and* 1887, *with the colliery and local consumption.*

District (under law of June 30, 1885).	Inspectors.	1885. Shipment.	1885. Colliery and local consumption.	1885. Total production.
		Long tons.	*Long tons.*	*Long tons.*
First	Patrick Blewett	6, 829, 977	428, 776	7, 258, 753
Second	Hugh McDonald	3, 686, 695	161, 854	3, 848, 549
Third	G. M. Williams	6, 036, 884	145, 891	6, 182, 775
Fourth	James E. Roderick	5, 055, 407	528, 209	5, 583, 616
Fifth	William Stein	4, 493, 075	276, 005	4, 769, 080
Sixth	James Ryan	3, 965, 959	238, 663	4, 204, 622
Seventh	Samuel Gay	2, 197, 424	183, 729	2, 381, 152
Total production of all anthracites		32, 265, 421	1, 963, 127	34, 228, 548
		1886.		
First	Patrick Blewett	6, 631, 226	481, 033	7, 112, 259
Second	Hugh McDonald	4, 143, 575	116, 498	4, 260, 073
Third	G. M. Williams	6, 692, 552	244, 758	6, 937, 310
Fourth	James E. Roderick	4, 916, 310	441, 060	5, 357, 370
Fifth	William Stein	4, 570, 145	402, 356	4, 972, 501
Sixth	James Ryan	3, 462, 265	261, 252	3, 724, 517
Seventh	Samuel Gay	2, 347, 637	141, 410	2, 489, 047
Total production of all anthracites		32, 764, 710	2, 088, 367	34, 853, 077
		1887.		
First	Patrick Blewett	7, 855, 987	606, 626	8, 462, 613
Second	Hugh McDonald	4, 882, 527	160, 989	5, 043, 516
Third	G. M. Williams	7, 334, 139	206, 615	7, 540, 754
Fourth	James E. Roderick	3, 537, 192	424, 402	3, 961, 594
Fifth	William Stein	5, 005, 858	390, 587	5, 396, 445
Sixth	James Ryan	4, 359, 230	378, 392	4, 737, 622
Seventh	Samuel Gay	2, 298, 509	137, 694	2, 436, 203
Total production of all anthracites		35, 273, 442	2, 305, 305	37, 578, 747

The shipment of coal from the three prominent districts into which the region has been divided by the transportation companies, from the commencement of mining in 1820, has been carefully recorded by Mr. P. W. Sheafer, and subsequently by Mr. John H. Jones. From these records the following table has been compiled, and is interesting in showing the history of the development of the region:

Annual shipments of anthracite coal in Pennsylvania since 1820, *with the number of tons and percentage shipped from each region.*

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*
1830			365				365
1821			1,073				1,073
1822	1,480	39.79	2,240	60.21			3,720
1823	1,128	16.23	5,823	83.77			6,951
1824	1,567	14.10	9,541	85.90			11,108
1825	6,500	18.60	28,393	81.40			34,893
1826	16,767	34.90	31,280	65.10			48,047
1827	31,360	49.44	32,074	50.56			63,434
1828	47,284	61.00	30,232	39.00			77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.54	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471
1853	2,665,110	51.30	1,054,309	20.29	1,475,732	28.41	5,195,151
1854	3,191,670	53.14	1,207,186	20.13	1,603,478	26.73	6,002,334
1855	3,552,943	53.77	1,284,113	19.43	1,771,511	26.80	6,608,567
1856	3,603,029	52.91	1,351,970	19.52	1,972,581	28.47	6,927,580
1857	3,373,797	50.77	1,318,541	19.84	1,952,603	29.39	6,644,941
1858	3,273,245	47.86	1,380,030	20.18	2,186,094	31.96	6,839,369
1859	3,448,708	44.16	1,628,311	20.86	2,731,236	34.98	7,808,255
1860	3,749,632	44.04	1,821,674	21.40	2,941,817	34.56	8,513,123
1861	3,160,747	39.74	1,738,377	21.85	3,055,140	38.41	7,954,264
1862	3,372,583	42.86	1,351,054	17.17	3,145,770	39.97	7,869,407
1863	3,911,683	40.90	1,894,713	19.80	3,759,610	39.30	9,566,006
1864	4,161,970	40.89	2,054,669	20.19	3,960,836	38.92	10,177,475
1865	4,356,959	45.14	2,040,913	21.14	3,254,519	33.72	9,652,391
1866	5,787,902	45.56	2,179,364	17.15	4,736,616	37.29	12,703,882
1867	5,161,671	39.74	2,502,054	19.27	5,325,000	40.99	12,988,725
1868	5,330,737	38.52	2,502,582	18.13	5,968,146	43.25	13,801,465
1869	5,775,138	41.66	1,949,673	14.06	6,141,369	44.28	13,866,180
1870	4,968,157	30.70	3,239,374	20.02	7,974,660	49.28	16,182,191
1871	6,552,772	41.74	2,235,707	14.24	6,911,242	44.02	15,699,721
1872	6,694,890	34.03	3,873,339	19.70	9,101,549	46.27	19,669,778
1873	7,212,601	33.97	3,705,596	17.46	10,309,755	48.57	21,227,952
1874	6,866,877	34.09	3,773,836	18.73	9,504,408	47.18	20,145,121
1875	6,281,712	31.87	2,834,605	14.38	10,596,155	53.75	19,712,472
1876	6,221,934	33.63	3,854,919	20.84	8,424,158	45.53	18,501,011
1877	8,195,042	39.35	4,332,760	20.80	8,300,377	39.85	20,828,179
1878	6,282,226	35.68	3,237,449	18.40	8,085,587	45.92	17,605,262
1879	8,960,829	34.28	4,595,567	17.58	12,586,293	48.14	26,142,689
1880	7,554,742	32.23	4,463,221	19.05	11,419,279	48.72	23,437,242
1881	9,253,958	32.46	5,294,676	18.58	13,951,383	48.96	28,500,017
1882	9,459,288	32.48	5,689,437	19.54	13,971,371	47.98	29,120,096
1883	10,074,726	31.69	6,113,809	19.23	15,604,492	49.08	31,793,027
1884	9,478,314	30.85	5,562,226	18.11	(*a*)15,677,753	51.04	30,718,293
1885	9,488,426	30.01	5,898,634	18.65	(*a*)16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	(*a*)17,031,826	52.82	32,136,362
1887	9,431,621	26.95	6,019,162	17.20	(*a*)19,546,624	55.85	34,997,407
Total	231,178,166	36.65	118,237,528	18.81	279,553,415	44.54	628,969,109

a Includes Loyalsock field.

The total shipments reported in this table for each year cover the shipments made by the railroads and canals, and are less than the total shipments reported by the mine inspectors, which cover the shipments by wagon to near points.

Under the head of Lehigh region in the above table is included the eastern end of the Southern or Pottsville coal basin between Tamaqua and Mauch Chunk. In this district, which is known as the Panther Creek coal basin, the development of the region first commenced, and until 1828 more than one-half of the anthracite production of the entire region came from this basin.

From 1828 to 1857, inclusive, the Schuylkill region, including the Southern coal field west of Tamaqua and the Western Middle coal field, produced more than one half of all the coal mined, and until 1867 this same region produced more than either one of the other two regions. In 1868 the Wyoming region took its rank as the greatest producer of the three regions, and has maintained it until the present time.

Since 1883 the Wyoming region, which in the above table is made to include the Lackawanna district, has produced more than one-half of the total anthracite mined in the State.

The shipment and production (including colliery consumption) of coal for each colliery during 1886 and 1887, as reported to the Survey by the seven anthracite mine inspectors, are shown in the following tables. The numbers in the first column designate the character of the coal produced by each colliery according to an arbitrary trade classification; the following table gives the significance of the numbers, the character of the coals having been more fully explained in the last report (see Mineral Resources):

Explanation of numbers used to designate the character of the coal.

1. Hard white ash.
2. Free-burning white ash.
3. Schuylkill red ash.
4. Shamokin.
5. Lorberry red ash.
6. Lykens Valley red ash.
7. Trevorton.
8. Wyoming red ash.
9. Lehigh red ash.

NORTHERN COAL FIELDS.

1. *Carbondale district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
2	1	Olyphant, No. 2, shaft	Olyphant borough
2	1	Eddy Creek	do
2	1	Grassy Island	do
2	1	White Oak	Archbald
2	1	Jermyn slope	Jermyn
2	1	Jermyn shaft	do
2	1	Racket Brook	Carbondale
2	1	Coalbrook	do
2	1	No. 1	do
2	1	No. 3	do
2	1	Erie shaft	Glenwood
2	1	Keystone	do
2	1	Forest City	Clifford township, Susquehanna county.
2	1	Jermyn, No. 4	Priceville
2	1	Filer slope	Winton borough
2	1	Grassy Island	do
2	1	Powderly	Carbondale
2	1	Edgarton	Archbald borough
2	1	Eaton	do
2	1	Pierce	do
2	1	Lackawanna	Blakely borough
2	1	Dolph	Winton borough
2	1	Belmont	Carbondale
2	1	Blanc'd (Simpson)	Fell township
2	1	Brennan	do
2	1	Marshwood	Olyphant borough
2	1	S. V. White	Winton borough

2. *Scranton district.*

2	2	Sibley	Old Forge township, Lackawanna county.
2	2	Greenwood shaft and tunnel	Lackawanna township
2	2	Dunn shaft and slope	Old Forge township
2	1	Meadow Brook	Scranton, Twentieth ward
2	1	National shaft and slope, and Meadow Brook tunnel	Lackawanna township
2	1	Bridge	Scranton, Fourteenth ward
2	1	Mount Pleasant	do
2	1	Green Ridge	Dunmore borough
2	1	Church	Scranton, Second ward
2	1	Archbald shaft	Lackawanna township
2	1	Sloan	do
2	1	Pyne	do
2	1	Taylor	do
2	1	Oxford	Scranton, Fifth ward
2	1	Dodge	Lackawanna township
2	1	Bellevue shaft	do
2	1	Bellevue slope	do
2	1	Hampton shaft	do
2	1	Continental	do
2	1	Central shaft	Scranton, Fifth ward
2	1	Hyde Park	Scranton, Fifteenth ward
		Diamond:	
2	1	Shaft No. 2	Scranton, Twenty-first ward
2	1	Slope No. 2	do
2	1	Tripp slope	do
2	1	Tripp shaft	do
2	1	Brisbin	Scranton, Third ward
2	1	Cayuga	do
2	1	Dunmore shaft, No. 1	Dunmore borough
2	1	Dunmore shaft, No. 2	do
2	1	Gypsy Grove shaft, No. 3	do
2	1	Gypsy Grove shaft, No. 4	do
2	1	Dunmore shaft No. 5	do

NORTHERN COAL FIELDS.

1. *Carbondale district.*

Operators.	1886.		1887.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	....	....	107,741	115,254
......do	143,625	163,573	174,505	185,944
......do	100,903	112,417	35,587	45,627
......do	109,168	115,453	123,170	129,365
......do	31,724	35,734	....	....
......do	150,353	167,895	197,387	217,811
......do	182,257	184,948	204,725	206,916
......do	235,880	239,502	279,628	283,010
......do	27,165	30,295	51,759	54,889
......do	....	....	4,113	8,808
Hillside Coal and Iron Company	123,275	125,008	121,816	123,389
......do	118,793	118,952	173,085	176,421
......do	92,149	97,072	173,085	176,421
John Jermyn	161,883	163,252	71,568	173,304
Griffiths, Thomas & Co	43,262	45,207	34,094	43,996
Grassy Island Coal Company (limited)	85,215	87,501	67,861	70,049
Delaware and Hudson Canal Company	77,598	82,293	86,265	91,586
Edgarton Coal Company (limited)	112,577	113,797	160,142	160,547
Jones, Simpson & Co	94,997	95,246	126,625	127,105
Pierce Coal Company (limited)	83,496	84,921	148,846	151,657
Lackawanna Coal Company (limited)	153,329	155,016	170,705	173,212
Dolph Coal Company (limited)	61,627	62,195	67,934	68,433
Andrew Langdon	10,695	11,907	28,444	29,689
Northwestern Coal Company	22,225	23,225	105,087	105,782
Frisbie & Co	2,790	2,940	....	20,857
Moosic Mountain Coal Company	....	475	....	220
Winton Coal Company	44,758	45,671	58,698	60,609
	2,269,744	2,364,495	2,872,870	3,000,901

2. *Scranton district.*

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
Elliott, McClure & Co	65,394	65,394	122,900	132,875
Pennsylvania Anthracite Coal Company	32,173	34,433	101,900	103,386
......do	117,541	118,597	74,467	79,828
William Connell & Co	140,927	176,500	132,647	182,254
......do	98,992	98,992	167,505	167,505
Bridge Coal Company (limited)	78,649	102,902	79,551	107,291
William T. Smith	125,282	133,582	137,031	146,017
O. S. Johnson & Co	130,850	135,486	136,186	141,357
Church Coal Company (limited)	2,700	10,340	6,000	16,500
Delaware, Lackawanna and Western Railroad Company.	157,557	167,657	166,720	172,808
......do	165,843	176,956	207,776	207,949
......do	166,997	174,134	197,346	206,477
......do	175,732	186,713	183,241	190,119
......do	120,007	127,241	122,140	124,182
......do	148,053	153,068	148,931	154,057
......do	168,863	184,243	184,203	199,229
......do				
......do	40,376	44,498	174,646	181,836
......do	22,328	26,508	26,066	30,236
......do	205,450	227,956	263,632	287,742
......do	136,565	142,321	112,071	116,700
......do	213,429	232,753	221,017	241,899
......do				
......do				
......do				
......do	16,716	22,408	46,585	57,252
......do	159,771	170,416	161,225	172,918
......do	....	....	....	1,055
Pennsylvania Coal Company	66,212	66,652	58,589	58,980
......do	....	....	....	65,586
......do	122,231	122,231	70,112	70,112
......do	107,020	109,212	....	114,280

NORTHERN COAL FIELDS—Continued.

Scranton district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
2	1	Legitt's Creek shaft	Scranton, First ward
2	1	Marvine	do
2	1	Von Storch	Scranton, Second ward
2	1	Capouse	Scranton, Twenty-first ward
2	1	Pine Brook shaft	Scranton, Seventh ward
2	1	Fairlawn	do
2	1	Manville	Scranton, Thirteenth ward
2	2	Holstead	Marcy township
2	1	Pancoast shaft	Dickson City borough
2	1	Dickson shaft	Scranton, Second ward
2	1	Holden	Taylorville, Lackawanna township
2	1	Glendale	Lackawanna township
2	1	Richmond shaft	Scranton, Twenty-first ward
2	1	Spencer	Dunmore
......	1	Storr's shaft	
......	1	Walkins	
......	1	Tripp's	
......	1	Peckville tunnel	
......	1	Clark's tunnel	
2	1	Local sales mines	

3. *Pittston district.*

2	2	Exeter	West Pittston
2	2	Heidelberg shaft	Pittston township
2	2	Everhart	Jenkins township
2	2	Tompkins shaft	Pittston borough
2	2	Spring Brook	Lackawanna township
2	2	Twin shaft	Pittston borough
2	2	Beaver slope	do
2	2	Columbia	Marcy township
2	2	Fairmount	Pittston township
2	2	Butler	do
2	2	Mosier	Hughestown borough
2	2	Schooley	Wyoming
2	2	Consolidated	Pleasant Valley
		Central:	
2	2	Shaft No. 12	do
2	2	Shaft No. 13	Old Forge township
2	2	Law shaft	Pittston township
2	2	Barnum	Marcy township
2	2	Stark	Lackawanna township
		Breaker No. 6:	
2	2	Shaft No. 5	Jenkins township
2	2	Shaft No. 6	do
2	2	Shaft No. 11	do
		Breaker No. 8: (a)	
2	2	Shaft No. 1	Hughestown borough
2	2	Shaft No. 8	do
2	2	Shaft No. 14	do
		Breaker No. 10:	
2	2	Shaft No. 9	Pittston borough
2	2	Shaft No. 10	Hughestown borough
2	2	Shaft No. 7.. Ewen breaker	Jenkins township
2	2	Slope No. 4.. Ewen breaker	do
2	2	Shaft No. 4.. Ewen breaker	do
2	2	Tunnel No. 1 Ewen breaker	Pittston township
2	2	Old Forge	Old Forge township, Lackawanna county.
2	2	Eagle	Jenkins township
2	2	Elmwood	Pittston township

a Closed 1887; coal from shafts goes to Ewen breaker.

NORTHERN COAL FIELDS—Continued.

Scranton district—Continued.

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	152, 675	165, 462	179, 105	193, 041
.....do	144, 555	157, 075	189, 555	202, 075
.....do	214, 030	236, 991	246, 065	268, 182
Lackawanna Iron and Coal Company	380, 052	390, 600	318, 831	327, 791
.....do	4, 363	8, 575	138, 861	145, 904
Fairlawn Coal Company (limited)	40, 685	54, 776	47, 191	57, 846
Delaware, Lackawanna and Western Railroad Company and Delaware and Hudson Canal Company.	147, 118	159, 478	217, 095	231, 174
Delaware, Lackawanna and Western Railroad Company.	174, 211	182, 474	203, 583	215, 157
Pancoast Coal Company	121, 314	136, 449	164, 268	178, 436
Delaware and Hudson Canal Company	158, 636	169, 347	202, 271	213, 169
Amity Coal Company (limited)	114, 072	117, 923	146, 371	150, 741
Glendale Coal Company	14, 743	15, 627		
Elk Hill Coal and Iron Company	37, 597	39, 347	18, 469	19, 419
Spencer Coal Company	75, 829	83, 132	110, 437	117, 510
Delaware, Lackawanna and Western Railroad Company.				3, 000
Walkins & Son			219	427
Tripp & Co			319	10, 642
Peckville Coal Company			802	1, 802
Clark Tunnel Coal Company				5, 965
		35, 840		15, 600
	4, 765, 548	5, 164, 289	5, 485, 929	6, 088, 311

3. *Pittston district.*

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
Lehigh Valley Coal Company			9, 968	10, 033
......do	109, 700	110, 000	113, 786	114, 007
Dininny & Cowan	31, 350	31, 350		
A. Tompkins	26, 340	26, 615		
W. E. Colburn	62, 293	62, 293		
Deninny & Co			47, 615	51, 129
Waterman & Beaver				
Old Forge Coal Company			56, 942	58, 540
H. W. Harris & Co	7, 000	7, 300	23, 896	25, 577
Butler Colliery Company	18, 051	20, 936	29, 000	30, 150
......do	92, 834	92, 834	95, 838	98, 130
Dininny & Cowan	140, 598	140, 598	96, 203	103, 138
Hillside Coal and Iron Company	95, 973	97, 172	117, 912	118, 823
Pennsylvania Coal Company				
......do			85, 052	85, 052
......do	202, 447	202, 447	86, 643	86, 643
......do	207, 942	207, 942	189, 067	189, 067
......do				
......do				
......do	108, 725	108, 725	139, 726	139, 726
......do				
......do				
......do	71, 249	71, 249	75, 404	75, 404
......do	52, 567	52, 567		
......do	170, 815	170, 815	188, 843	188, 843
......do				
......do	93, 853	93, 853		
......do			290, 010	290, 010
......do				
......do				
......do	152, 015	152, 015	160, 241	160, 241
......do				
Florence Coal Company (limited)	74, 171	77, 633	161, 637	169, 024

NORTHERN COAL FIELDS—Continued.

Pittston district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
2	2	Clearspring	West Pittston
2	2	Hunt	Wyoming
2	2	Katydid	Moosic
2	2	Keystone	Plains township

4. *Wilkes Barre district.*

		Susquehanna Coal Company:	
2	3	Colliery No. 1	Nanticoke
2	3	Colliery No. 2	......do
2	3	Colliery No. 5	......do
2	3	Newport, No. 6	Glen Lyon
8	3	Maffet	Sugar Notch
2	3	Alden	Alden
2	3	Warrior Run	Warrrior Run
2	3	Franklin	Wilkes Barre
2	2	Hillman	Plains township
2	3	Hillman Vein	Wilkes Barre
2	2	Enterprise	Plains township
2	2	Henry	......do
2	2	Midvale	......do
2	2	Mineral Spring	......do
2	2	Prospect	......do
2	3	Dorrance	Wilkes Barre
2	2	Wyoming Colliery	Plains township
2	2	Bennett	......do
2	2	Mill Creek	......do
2	2	Pine Ridge	......do
2	2	Laurel Run	......do
2	3	Baltimore slope and shaft	Wilkes Barre township
2	3	Baltimore tunnel	......do
2	3	Conyngham	Wilkes Barre
8	3	Red Ash, No. 1	Wilkes Barre township
8	3	Red Ash, No. 2	......do
2	3	Diamond, No. 1	Wilkes Barre
2	3	Hollenback, No. 2	......do
8	3	Empire, No. 4	......do
2	3	Jersey, No. 6	Ashley
2	3	Stanton, No. 7	Wilkes Barre
2	3	Sugar Notch, No. 9	Sugar Notch
....	3	South Wilkes Barre	Wilkes Barre
2	3	Wanamie, No. 18	Newport township
8	3	West End, No. 1	Conyngham township
2	3	West End, No. 2	......do

5. *Plymouth district.*

....	3	Salem	Salem township
2	3	Susquehanna, No. 3	West Nanticoke
....	3	Avondale	Plymouth township
....	3	Chauncey	......do
....	3	Gaylord	Plymouth
....	3	Dodson	......do
....	3	Parrish	......do
....	3	Lance, No. 11	......do
....	3	Nottingham, No. 15	......do
....	3	Reynolds, No. 16	......do
....	3	Plymouth, No. 2	......do
....	3	Plymouth, No. 3	Plymouth township
....	3	Plymouth, No. 4	Plymouth

NORTHERN COAL FIELDS—Continued.

Pittston district—Continued.

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Clearspring Coal Company	124, 777	132, 125	149, 171	159, 426
Delaware, Lackawanna and Western Railroad Company.	55, 222	62, 342	52, 812	59, 151
John M. Robertson	14, 574	15, 487	11, 459	13, 032
Keystone Coal Company	2, 457	2, 607	89, 600	89, 786
	1, 914, 953	1, 938, 905	2, 270, 825	2, 314, 932

4. *Wilkes Barre district.*

Susquehanna Coal Company	1, 581, 286	219, 161	1, 444, 591	188, 454
......do		504, 441		460, 403
......do		547, 677		514, 805
......do		214, 195		279, 983
Hanover Coal Company	119, 643	120, 618	136, 068	136, 658
Alden Coa Company	193, 248	199, 909	255, 444	263, 074
A. J. Davis	63, 564	76, 774	80, 855	92, 389
Franklin Coal Company	115, 292	128, 336	156, 862	169, 337
H. Baker Hillman	37, 678	37, 679	60, 000	60, 000
Hillman Vein Coal Company	25, 084	40, 471	75, 032	97, 407
A. Langdon	90, 035	95, 704	106, 126	112, 418
Lehigh Valley Coal Company	177, 094	187, 627	175, 818	186, 259
......do	....	....	....	....
......do	71, 589	76, 235	84, 536	90, 306
......do	304, 286	304, 431	317, 707	317, 853
......do	33, 128	42, 905	40, 017	51, 650
......do	151, 364	159, 074	135, 187	143, 187
Waddell & Walter	93, 970	97, 193	107, 823	112, 362
Delaware and Hudson Canal Company	129, 167	129, 167	102, 814	102, 814
......do	146, 014	150, 635	198, 591	202, 016
......do	114, 609	114, 609	130, 125	130, 125
......do	61, 071	61, 071	69, 645	69, 645
......do	108, 701	110, 942	130, 419	132, 854
......do	89, 292	91, 303	83, 150	84, 657
Red Ash Coal Company	115, 820	115, 820	145, 781	145, 781
......do	129, 781	131, 957	175, 120	177, 712
Lehigh and Wilkes Barre Coal Company	136, 607	136, 607	94, 144	94, 526
......do	190, 756	207, 881	232, 037	254, 566
......do	255, 640	258, 322	246, 792	249, 373
......do	141, 307	145, 173	119, 039	123, 119
......do	212, 926	217, 955	266, 476	273, 473
......do	164, 413	166, 732	182, 723	184, 840
......do	....	....	5, 870	5, 870
......do	138, 022	139, 735	149, 215	151, 051
West End Coal Company	128, 732	141, 196	152, 861	172, 260
......do	....	....	....	....
	5, 320, 119	5, 371, 535	5, 660, 858	5, 831, 237

5. *Plymouth district.*

Salem Coal Company	10, 491	13, 832	....	....
Susquehanna Coal Company	....	146, 386	117, 855	117, 885
Delaware, Lackawanna and Western Railroad Company.	148, 830	172, 011	166, 168	172, 589
T. P. Macfarlane	15, 228	15, 628	....	....
Gaylord Coal Company	173, 012	179, 356	239, 726	248, 277
Plymouth Coal Company	136, 855	149, 189	139, 091	154, 041
Parrish Coal Company	205, 102	209, 053	185, 744	187, 957
Lehigh and Wilkes Barre Coal Company	182, 452	182, 452	193, 623	193, 689
......do	436, 922	444, 519	489, 480	498, 015
......do	142, 994	144, 994	149, 468	149, 631
Delaware and Hudson Canal Company	115, 236	115, 236	177, 307	177, 307
......do	164, 839	166, 982	222, 092	223, 939
......do	124, 099	124, 099	173, 802	173, 802

NORTHERN COAL FIELDS—Continued.

Plymouth district—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
....	3	Plymouth, No. 5	Plymouth
....	3	Boston	Plymouth township
....	3	Kingston, Nos. 1 and 4	Edwardsville borough
....	3	Kingston, Nos. 2 and 3	do
....	2	East Boston	Kingston township
....	2	Black Diamond	do
....	2	Raubville	Luzerne borough
....	2	Harry E	Kingston township
....	2	Forty Fort	do
....	2	Woodward, No. 1	Plymouth township

EASTERN MIDDLE COAL FIELD.

6. *Green Mountain district.*

9	4	Upper Lehigh, No. 2	Upper Lehigh
9	4	Upper Lehigh, No. 4	do
9	4	Pond Creek	Pond Creek

7. *Black Creek district.*

9	4	Sandy Run	Sandy Run
9	4	Cross Creek, No. 1	Drifton
9	4	Cross Creek, No. 2	do
9	4	Cross Creek, No. 3	do
1	4	Tomhicken	Tomhicken
1	4	Derringer	Derringer
1	4	Gowen	Gowen
9	4	Highland, No. 1	Highland
9	4	Highland, No. 2	do
1	4	Oakdale, No. 1	Jeddo
1	4	Oakdale, No. 2	do
9	4	Council Ridge, No. 10	Eckley
9	4	Council Ridge, No. 5	do
1	4	Ebervale	Ebervale
1	4	Black Ridge	Conyngham
1	4	Harleigh	Harleigh
1	4	Lattimer, No. 1	Lattimer
1	4	Lattimer, No. 2	do
1	4	Lattimer, No. 3	do
1	4	Milnesville, Nos. 6 and 7	Milnesville
1	4	Hollywood	Hollywood

8. *Hazleton district.*

1	4	East Sugar Loaf, No. 1	Stockton
1	4	East Sugar Loaf, No. 2	do
1	4	East Sugar Loaf, No. 3	do
1	4	East Sugar Loaf, No. 5	do
1	4	Humboldt	Humboldt
1	4	Hazlebrook	Lumber Yard
1	4	South Sugar Loaf	Hazleton
1	4	Laurel Hill	do
1	4	Hazleton, No. 1	do
1	4	Hazleton, No. 3	do
1	4	Hazleton, No. 6	do

NORTHERN COAL FIELDS—Continued.

Plymouth district—Continued.

Operators.	1886.		1887.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Delaware and Hudson Canal Company	166, 087	168, 692	200, 129	203, 732
......do	126, 516	126, 516	39, 609	40, 209
Kingston Coal Company	205, 780	217, 627	234, 387	249, 763
......do	333, 796	341, 557	363, 507	371, 559
W. G. Payne & Co	99, 546	101, 655	152, 092	154, 124
Haddock & Steel	107, 965	121, 160	120, 448	135, 450
Thomas Waddell & Co	51, 912	57, 007	57, 750	62, 913
Wyoming Valley Coal Company	62, 000	74, 000	128, 700	140, 850
......do	128, 000	136, 700	100, 600	110, 750
Delaware, Lackawanna and Western Railroad Company.	....	....	....	4, 464
	3, 137, 662	3, 408, 651	3, 651, 578	3, 770, 956

EASTERN MIDDLE COAL FIELD.

6. *Green Mountain district.*

Upper Lehigh Coal Company	170, 789	194, 138	145, 056	163, 683
......do	183, 950	190, 942	119, 828	124, 935
M. S. Kemmerer	46, 332	49, 466	....	....
	401, 070	434, 546	264, 884	288, 618

7. *Black Creek district.*

M. S. Kemmerer & Co	135, 078	146, 344	109, 965	118, 561
Coxe Bros. & Co				
......do	453, 258	492, 582	308, 706	345, 329
......do				
......do	75, 354	82, 460	67, 184	77, 823
......do	276, 022	388, 185	252, 074	273, 894
......do				
G. B. Markle & Co	128, 397	138, 688	83, 925	92, 217
......do	126, 265	136, 366	85, 790	94, 367
......do	113, 298	122, 360	62, 870	79, 155
......do	104, 815	113, 200	85, 668	93, 168
Coxe Bros. & Co	33, 012	36, 499	74, 031	84, 836
......do	125, 574	137, 637	73, 874	89, 155
Ebervale Coal Company	....	....	....	....
J. S. Wentz & Co	52, 522	56, 723	28, 981	31, 879
Kemmerer & Co	5, 780	6, 460	....	....
Pardee Bros. & Co	75, 855	98, 784	58, 090	69, 164
......do				
......do	94, 025	100, 497	80, 117	84, 749
Stout Coal Company	100, 015	108, 016	70, 061	75, 043
C. Pardee & Co	110, 393	119, 394	86, 258	93, 528
	2, 009, 663	2, 184, 182	1, 627, 594	1, 702, 868

8. *Hazleton district.*

Linderman, Skeer & Co	4, 545	7, 818	24, 743	27, 227
......do	80, 395	85, 219	60, 323	66, 342
......do	104, 648	110, 926	....	....
......do	94, 814	100, 503	71, 144	77, 043
......do	76, 220	80, 794	52, 827	56, 886
J. S. Wentz & Co	36, 065	38, 965	33, 886	37, 185
A. Pardee & Co	52, 038	55, 278	33, 446	36, 686
......do	39, 671	46, 584	48, 882	55, 794
......do	113, 426	118, 691	87, 976	93, 241
......do	65, 791	71, 726	39, 877	45, 811
......do	116, 459	117, 809	50, 168	51, 515

EASTERN MIDDLE COAL FIELD—Continued.

8. *Hazleton district*—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
1	4	Sugar Loaf	Hazleton
1	4	Cranberry	do
1	4	Crystal Ridge	do
1	4	Mount Pleasant	Mount Pleasant

9. *Beaver Meadow district.*

1	4	Beaver Meadow	Beaver Meadow
1	4	Coleraine, Nos. 1 and 2	do
1	4	Spring Mountain, No. 1	Jeansville
1	4	Spring Mountain, Nos. 4 and 7	do
1	4	Beaver Brook, Nos. 1 and 2	Frenchtown
1	4	Spring Brook, No. 5	Yorktown
1	4	Spring Brook, No. 6	do
1	5	Honey Brook, No. 1	Audenried
1	4	Audenried, No. 2	Tresckow
1	5	Audenried, No. 4	Audenried
1	5	Audenried, No. 5	do
1	5	Silver Brook	do

WESTERN MIDDLE COAL FIELD.

10. *East Mahanoy district.*

1	5	Ellangowan	Maple Dale
1	5	Knickerbocker	Yatesville
1	5	Saint Nicholas	Saint Nicholas
1	5	Tunnel Ridge	Mahanoy City
1	5	Elmwood	do
1	5	Mahanoy City	do
1	5	North Mahanoy	do
1	5	Schuylkill	do
2	5	Suffolk	Saint Nicholas
1	5	Glendon	Mahanoy City
1	5	Primrose	do
1	5	Park, No. 1	do
1	5	Park, No. 2	do
1	7	Middle Lehigh	New Boston
1	5	Buck Mountain	Mahanoy City

11. *West Mahanoy district.*

2	6	Alaska shaft	Alaska Station
2	6	Reliance	Mount Carmel
2	6	Locust Spring	Locust Gap
2	6	Merriam	Locust Summit
2	6	Potts	Locust Dale
2	6	Keystone	do
1	6	Tunnel	Ashland
1	6	Bast	Big Mine Run
1	6	North Ashland	Dark Corner
1	6	Preston, Nos. 1 and 2	Girardville
1	6	Preston, No. 3	do
1	5	Girard	do
1	5	Hammond	do
1	5	Connor	do
1	5	Girard Mammoth	Raven Run
1	5	Turkey Run	Shenandoah
1	5	West Shenandoah	do

EASTERN MIDDLE COAL FIELD—Continued.

8. *Hazleton district*—Continued.

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
A. Pardee & Co				
......do	124, 053	133, 299	85, 302	94, 548
......do				
Pardee Sons & Co	132, 925	149, 136	89, 352	104, 150
	1, 041, 050	1, 116, 748	677, 926	746, 428

9. *Beaver Meadow district.*

Coxe Bros. & Co	181, 373	189, 324	116, 894	129, 292
W. T. Carter & Co	88, 030	94, 846	72, 428	77, 031
Lehigh Valley Coal Company	101, 148	112, 273	81, 612	94, 108
......do	125, 793	139, 768	82, 124	94, 827
Charles M. Dodson & Co	162, 281	178, 012	115, 095	126, 540
George H. Meyers & Co	56, 069	71, 069	28, 509	35, 406
......do	95, 225	107, 260	83, 130	92, 157
Lehigh and Wilkes Barre Coal Company	21, 414	27, 414	....	....
......do	70, 055	71, 025	58, 729	71, 360
......do	112, 902	122, 902	106, 689	116, 193
......do	122, 492	135, 492	145, 111	161, 690
Silver Brook Coal Company	5, 500	8, 500	90, 317	94, 817
	1, 142, 312	1, 257, 885	980, 638	1, 093, 421

WESTERN MIDDLE COAL FIELD.

10. *East Mahanoy district.*

Philadelphia and Reading Coal and Iron Co	384, 603	405, 603	435, 336	459, 336
......do	228, 214	240, 214	230, 157	242, 157
......do	....	....	....	....
......do	....	....	24, 585	26, 585
......do	128, 661	140, 661	105, 244	111, 244
......do	129, 006	145, 006	153, 827	163, 827
......do	146, 825	161, 825	161, 898	169, 898
......do	116, 946	124, 946	96, 180	102, 180
......do	150, 869	161, 869	154, 181	163, 181
J. C. Hayden & Co	100, 709	109, 763	69, 099	76, 979
Nevills & Co	71, 079	80, 079	97, 343	104, 883
Lentz, Lilly & Co	2, 405	2, 740	....	....
......do	151, 316	171, 793	228, 856	246, 372
Mill Creek Coal Company	120, 560	127, 793	231, 000	244, 860
Buck Mountain Coal Company	90, 296	90, 945	83, 746	89, 534
	1, 821, 489	1, 963, 237	2, 071, 452	2, 201, 036

11. *West Mahanoy district.*

Philadelphia and Reading Coal and Iron Company.	70, 408	74, 632	192, 109	202, 636
......do	97, 120	102, 947	116, 691	123, 693
......do	117, 866	124, 938	125, 032	132, 534
......do	161, 974	171, 692	171, 052	181, 315
......do	4	4	....	....
......do	47, 567	50, 421	87, 987	93, 266
......do	59, 127	62, 675	74, 438	78, 904
......do	78, 728	83, 451	85, 409	90, 534
......do	67, 627	71, 684	152, 940	162, 116
......do	....	....	....	....
......do	88, 555	93, 868	101, 001	107, 061
......do	10, 149	12, 149	....	....
......do	124, 173	132, 173	163, 731	183, 731
......do	68, 494	70, 494		
......do	75, 433	75, 284	61, 667	68, 667
......do	150, 007	162, 007	160, 743	170, 743
......do	134, 262	142, 262	140, 032	149, 032

WESTERN MIDDLE COAL FIELD—Continued.

11. *West Mahanoy district*—Continued.

Character of coal.	No. of inspector's district.	Name of collieries.	Location.
1	5	Shenandoah City	Shenandoah
1	5	Plank Ridge	do
1	5	Indian Ridge	do
1	5	Gilberton	Gilberton
1	5	Boston Run	Saint Nicholas
1	5	Bear Run	do
2	6	Locust Gap	Locust Gap
2	6	Monitor	do
1	5	Kohinoor	Shenandoah
1	5	East Bear Ridge	Mahanoy Plane
1	5	West Bear Ridge	do
1	5	Stanton	Maizeville
2	6	Mount Carmel	Mount Carmel
2	6	Black Diamond	do
2	6	Morris Ridge	Centralia
2	6	Bellmore	Mount Carmel
2	6	Big Mine Run	Big Mine Run
2	6	Hazel Dell	Centralia
2	6	Centralia	do
1	6	Logan	do
2	6	Continental	do
1	5	Packer, No. 1	Colorado
1	5	Packer, No. 2	Lost Creek
1	5	Packer, No. 3	Brownsville
1	5	Packer, No. 4	Lost Creek
1	5	Packer, No. 5	Rapahannock
1	5	William Penn	Shaft post-office
2	5	Springdale	
1	5	Kehley Run	Shenandoah
....	5	Cambridge	do
1	5	North Laurel Ridge	Gilberton
1	5	South Laurel Ridge	do
1	5	Lawrence	Mahanoy Plane
1	5	Draper	Gilberton
....	5	South Shenandoah	
....	5	Furnace	

12. *Shamokin district.*

7	6	North Franklin, No. 1, Red Ash	Trevorton
7	6	North Franklin, No. 2, White Ash	do
4	6	Bear Valley	Shamokin
4	6	Burnside	Carbon Run
4	6	Peerless	Shamokin
4	6	Buck Ridge	do
4	6	Greenback	Greenback
4	6	Cameron	Shamokin
4	6	Luke Fidler	do
4	6	Hickory Ridge	Coal Run
4	6	Hickory Swamp	Green Ridge
4	6	Pennsylvania	do
4	6	Lancaster	Coal Run
4	6	Royal Oak	Shamokin
4	6	Sterling	Carbon Run
4	6	Henry Clay, No. 1	Shamokin
4	6	Big Mountain	do
4	6	Excelsior	Excelsior
4	6	Enterprise	do
4	6	Garfield	Shamokin
....	6	Big Mountain, No. 2	Centralia
....	6	Pioneer	Ashland
....	6	Neilson Shaft	Shamokin

WESTERN MIDDLE COAL FIELD—Continued.

11. *West Mahanoy district*—Continued.

Operators.	1886.		1887.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Philadelphia and Reading Coal and Iron Company.	241, 886	261, 886	259, 321	274, 321
......do	....	....	....	....
......do	198, 523	212, 523	227, 823	247, 823
......do	70, 284	108, 709	100, 924	112, 924
......do	96, 237	104, 237	120, 716	127, 716
......do	132, 114	138, 114	156, 229	166, 229
......do	91, 865	97, 377	139, 611	147, 988
......do	142, 279	150, 815	132, 440	140, 286
......do	170, 170	182, 170	240, 587	252, 587
......do	....	....	....	....
......do	....	....	....	....
......do	67, 809	75, 809	73, 473	73, 473
T. M. Righter & Co	117, 310	124, 582	145, 971	153, 269
Schwenk, Robertson & Co	....	....	....	....
Isaac May & Co	94, 934	97, 634	87, 906	90, 906
S. S. Bickel & Co	39, 403	40, 299	92, 306	93, 482
Jeremiah Taylor	159, 526	163, 687	156, 781	160, 933
L. A. Riley & Co ......do	160, 524	174, 467	175, 949	189, 425
......do	201, 356	217, 641	194, 607	205, 916
Lehigh Valley Coal Company	....	....	....	....
......do	....	....	....	....
......do	....	2, 906	....	245
......do	170, 391	182, 613	102, 068	109, 186
......do	212, 074	227, 726	124, 575	138, 645
......do	63, 112	73, 056	61, 097	71, 424
William Penn Coal Company	235, 000	255, 000	310, 000	340, 000
Lentz, Lilly & Co	....	....	67, 825	76, 212
Thomas Coal Company	116, 418	119, 849	132, 889	136, 190
Cambridge Coal Company	6, 753	6, 953	9, 949	10, 039
S. H. Barrett	39, 689	31, 039	33, 031	33, 048
......do	11, 655	11, 805	19, 721	19, 721
Lawrence & Brown	105, 699	125, 379	119, 982	149, 182
Oliver Ditson	115, 606	128, 606	132, 655	146, 621
Harry Reese	....	....	1, 388	1, 388
O. Zerbe & Co	....	....	2, 425	2, 425
	4, 403, 111	4, 745, 564	5, 055, 081	5, 415, 836

12. *Shamokin district.*

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
Philadelphia and Reading Coal and Iron Company	....	....	....	....
......do	111, 852	118, 563	95, 104	100, 810
......do	84, 307	89, 366	135, 995	143, 759
......do	101, 910	108, 025	108, 583	115, 098
......do	62, 307	66, 045	(*a*)	....
......do	....	....	....	....
......do	....	....	....	....
Mineral Railroad and Mining Company	176, 461	193, 931	104, 681	116, 909
......do	104, 448	115, 728	113, 701	122, 951
......do	39, 302	43, 252	44, 549	48, 944
W. L. Scott & Co	63, 502	67, 842	81, 623	87, 544
......do	217, 976	226, 976	291, 127	386, 127
Smith & Keiser	7, 413	7, 623	21, 118	21, 968
Tillett & Brother	1, 071	1, 135	147	246
Philadelphia and Reading Coal and Iron Company. ......do ......do	18, 314 62, 063	19, 413 65, 787	258, 620	275, 461
Excelsior Coal Mining Company	161, 424	171, 109	177, 467	177, 467
Baumgardner & Co	103, 094	110, 726	116, 349	124, 520
Garfield Coal Company	7, 998	8, 317	26, 101	26, 491
John Q. Williams	....	....	....	....
David Vaughan	....	....	....	....
J. Langdon & Co	....	....	15, 316	19, 255
	1, 323, 442	1, 413, 838	1, 590, 681	1, 765, 550

a The production of Peerless for 1887 is included in that of Sterling, Henry Clay, and Big Mountain.

SOUTHERN COAL FIELD.

13. *Panther Creek district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
1	4	Colliery, No. 3	Nesquehoning
1	4	Colliery, No. 4	Jamestown
1	4	Colliery, No. 5	Andrewsville
1	4	Colliery, No. 6	do
....	7	Colliery, No. 8	Coaldale
....	4	Colliery, No. 9	do
....	7	Colliery, No. 10	Bull Run
....	7	Colliery, No. 11	do
....	7	Colliery, No. 12	Coaldale
....	7	Colliery, No. 13	Tamaqua
....	7	Leased mines	do
		Total	

14. *East Schuylkill district.*

2	7	Beechwood	Mount Laffee
2	7	Wadesville shaft	Wadesville
2, 3	7	Pottsville	Pottsville
1	7	Eagle Hill shaft	New Philadelphia
....	7	Eagle	Saint Clair
1	7	Schuylkill Valley	New Castle
....	7	Monitor	Wadesville
3	7	Cumdee	do
....	7	Hooker	Saint Clair
3	7	Palmer vein	New Philadelphia
....	7	Kaska William	Middleport
....	7	Coal Hill	Blythe township
1	7	East Lehigh	Tamaqua
3	7	Pine Dale	Middleport
1	7	Ebony	New Castle
3	7	Peach Orchard	Saint Clair
....	7	Sharp Mountain	Pottsville
....	7	Oak Hill	Mount Laffee
....	7	Vulcan	Wadesville
....	7	Tamaqua	Tamaqua
....	7	Shelly	
....	7	Chamberlain	Saint Clair
....	7	Milford	Middleport
		Total	

15. *West Schuylkill district.*

2	7	Otto	Branchdale
3	7	Phœnix Park, No. 3	Phœnix Park
2	7	Forestville	Forestville
2	7	Glendower	Glen Carbon
2	7	Richardson	do
2	7	Thomaston	Heckschersville
2	7	Wood	Swatara
2	7	Peach Mountain	Wolf creek
2	7	Herbine	do
3	7	Wolf Creek Big Diamond	do
2	7	Little Diamond	Minersville
2	7	Ellsworth	New Castle
2	7	Black Valley	Minersville
....	7	Jugular	New Castle
2	7	Crystal	do
2	7	Kirkline	Thomaston
3	7	Newtown	Newtown
....	7	Mine Hill Gap	Minersville

SOUTHERN COAL FIELD.

13. *Panther Creek district.*

Operators.	1886.		1887.	
	Shipment.	Production.	Shipment.	Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Lehigh Coal and Navigation Company	143,778	170,318	73,149	117,905
......do	146,477	160,194	120,929	130,602
......do }	134,805	155,588	80,863	87,332
......do }				
......do	135,896	144,049	93,413	99,018
......do	159,462	172,217	119,554	127,941
......do	164,760	174,645	121,029	128,289
......do	112,053	118,776	70,834	75,084
......do	96,204	101,976	62,736	66,500
......do	20,193	21,404	22,135	23,463
......do	....	....	....	....
	1,113,628	1,219,167	764,642	856,134

14. *East Schuylkill district.*

Philadelphia and Reading Coal and Iron Company.	60,442	64,068	70,986	75,245
......do	....	....	....	....
......do	....	....	....	....
......do	215,175	228,657	203,861	216,093
......do	40,319	42,738	40,662	43,102
Quinn & Winnons	1,070	1,134	3,706	3,928
John Denning & Bro	6,580	6,974	4,471	4,739
John Mullin & Co	....	....	....	....
Thomas Wren & Co	8,650	9,169	13,646	14,465
Alliance Coal Mining Company	425	450	5,408	5,732
......do	159,083	168,628	122,072	129,396
William Basler	....	....	....	....
Mitchell & Shepp	4,683	4,964	4,157	4,406
Slemmer & Co	11,148	11,816	....	....
Bowman & Co	....	....	....	....
Evans & Geisweit	....	....	....	....
Thomas Wren	....	....	....	....
......do	....	....	....	....
William L. Williams	....	....	10,026	10,628
Draper & Wittich	....	....	....	....
Shelly & Confair	....	....	....	....
Thompson & Co	21,102	22,368	7,793	8,261
Docker & Bowman	1,081	1,145	....	....
	529,758	562,111	486,788	515,995

15. *West Schuylkill district.*

Philadelphia and Reading Coal and Iron Company.	69,301	73,459	53,718	56,941
......do	47,073	49,897	59,860	63,452
......do	....	....	....	....
......do	77,800	82,468	78,819	83,548
......do	99,048	104,990	111,490	118,179
......do	107,515	113,965	140,396	148,820
C. Wood	....	....	....	....
W. H. Harris	....	....	....	....
J. K. Seigfried	35,506	37,636	38,943	41,280
J. F. Donahue	....	....	....	....
J. A. Lawrence	2,490	2,639	3,600	3,816
John R. Davis	8,062	8,545	12,282	13,019
Edward Hoskins	....	....	....	....
J. S. Hepner	....	....	....	....
Joseph Brady & Co	5,344	5,664	9,596	10,172
P. O'Connor	3,500	3,710	2,225	2,359
Miesse & Diggles	3,000	3,180	....	....
Philadelphia and Reading Coal and Iron Company.	....	....	....	....

SOUTHERN COAL FIELD—Continued.

15. *West Schuylkill district*—Continued.

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
....	7	Swatara, No. 2	Swatara
....	7		
		Total	

16. *Lorberry district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
5	7	Colket	Donaldson
5	7	East Franklin	Upper Rausch creek
5	7	Middle Creek shaft	Middle creek
5	7	Rausch Creek	Tremont township
		Total	

17. *Lykens Valley district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
6	7	Brookside	Porter township
6	7	Kalmia	Orwin
6	7	Lincoln	Tremont township
6	7	New Lincoln	do
0	6	Williamstown	Williamstown
6	6	Short Mountain	Lykenstown
6	6	Lykens Valley	do
6	6	Big Run Gap	Williams valley
		Total	

LOYALSOCK FIELD.

18. *Loyalsock district.*

Character of coal.	No. of inspector's district.	Names of collieries.	Location.
....	2	Bernice	Bernice, Sullivan county

SOUTHERN COAL FIELD—Continued.

15. *West Schuylkill district*—Continued.

Operators.	1886. Shipment.	1886. Production.	1887. Shipment.	1887. Production.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
John D. Felty	....	....	....	....
Dix & Edwards	....	....	....	....
....	458, 639	486, 153	510, 929	541, 586

16. *Lorberry district.*

Philadelphia and Reading Coal and Iron Company.	....	....	....	....
......do	7, 195	7, 626	....	....
......do	73, 077	77, 461	109, 154	115, 703
......do	....	....	....	....
....	80, 272	85, 087	109, 154	115, 703

17. *Lykens Valley district.*

Philadelphia and Reading Coal and Iron Company.	274, 817	291, 306	312, 817	331, 586
......do	74, 302	78, 760	2, 423	2, 568
......do	125, 617	133, 154	112, 754	119, 519
Levi Miller and Co.	154, 566	163, 833	148, 268	157, 175
Summit Branch Railroad Company	167, 817	193, 799	338, 927	388, 291
Lykens Valley Coal Company ......do	175, 833	214, 065	197, 494	237, 417
James Fennell	....	....	....	....
....	972, 952	1, 074, 917	1, 112, 683	1, 236, 556

LOYALSOCK FIELD,

18. *Loyalsock district.*

State Line and Sullivan Railroad Company....	59, 331	61, 767	90, 018	92, 679

The number of tons of coal and the percentage of the entire product mined by each of the different operating coal companies and individuals in each field, and the number of tons and the percentage of the entire production handled by the different transportation companies in these same fields, are shown in the following table:

Railroad and colliery division of production of individual coal fields for 1885, 1886, *and* 1887.

NORTHERN COAL FIELD.

	1885.		1886.		1887.	
Railroad division.	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*
Delaware, Lackawanna and Western, main line	2, 593, 180	36. 51	2, 568, 525	37. 68	3, 073, 875	37. 14
Delaware, Lackawanna and Western, Lackawanna and Bloomsburgh division	3, 688, 617		4, 307, 516		4, 720, 217	
Delaware and Hudson Canal Company	2, 584, 907	15. 02	2, 797, 648	15. 33	3, 425, 857	16. 31
Delaware and Hudson Canal Company and Lackawanna and Bloomsburgh division of Delaware, Lackawanna and Western railroad	795, 395	4. 62	765, 645	4. 20	889, 959	4. 23
Delaware and Hudson Canal Company and Lehigh and Susquehanna	253, 745	1. 47	280, 807	1. 54	443, 711	2. 11
Delaware and Hudson Canal Company and Lehigh Valley	52, 996	0. 31	77, 633	0. 42	169, 024	0. 80
Lehigh and Susquehanna	2, 436, 495	14. 15	2, 442, 697	12. 39	2, 625, 572	12. 49
Lehigh and Susquehanna and North and West branch	128, 899	0. 75	141, 196	0. 77	172, 260	0. 82
Lehigh Valley	1, 452, 254	8. 43	1, 754, 870	9. 62	1, 707, 930	8. 13
North and West branch (Pennsylvania)	1, 275, 765	7. 41	1, 485, 474	8. 14	1, 443, 645	6. 87
Pennsylvania Coal Company	1, 304, 932	7. 58	....	......	....	......
Erie and Wyoming Valley	517, 718	3. 00	1, 454, 880	7. 97	1, 642, 767	7. 81
New York, Lake Erie and Western (Jefferson branch)	96, 629	0. 56	135, 144	0. 74	332, 749	1. 58
Local sales (shipped by wagon and unclassified)	33, 534	0. 19	35, 840	0. 20	358, 771	1. 71
Total	17, 215, 066	100. 00	18, 247, 875	100. 00	21, 006, 337	100. 00
Colliery division.						
Delaware, Lackawanna and Western	2, 168, 017	12. 60	2, 453, 699	13. 45	2, 798, 820	13. 32
Delaware and Hudson Canal Company	3, 048, 237	17. 70	3, 220, 237	17. 65	3, 756, 777	17. 88
Delaware and Hudson, and Delaware Lackawanna and Western	192, 176	1. 12	159, 478	0. 88	231, 174	1. 11
Lehigh and Wilkes Barre Coal Company	1, 716, 682	9. 97	2, 044, 370	11. 20	2, 178, 153	10. 36
Susquehanna Coal Company	1, 466, 735	8. 51	1, 631, 860	8. 94	1, 561, 530	7. 44
Lehigh Valley Coal Company	830, 755	4. 83	1, 016, 972	5. 57	913, 289	4. 35
Pennsylvania Coal Company	1, 711, 379	9. 94	1, 357, 708	7. 44	1, 523, 944	7. 26
Hillside Coal and Iron Company	371, 867	2. 16	438, 204	2. 40	595, 054	2. 83
Individual operators	5, 709, 218	33. 17	5, 925, 347	32. 47	7, 447, 606	35. 46
Total	17, 215, 066	100. 00	18, 247, 875	100. 00	21, 006, 347	100. 00

EASTERN MIDDLE COAL FIELD.

Railroad division.						
Lehigh Valley	2, 991, 416	56. 12	2, 938, 706	58. 85	2, 168, 470	56. 60
Lehigh and Susquehanna	1, 282, 109	24. 06	946, 223	18. 95	845, 577	22. 07
Lehigh Valley and Lehigh and Susquehanna	728, 979	13. 67	737, 787	14. 78	465, 571	12. 15
Sunbury, Hazleton and Wilkes Barre	327, 103	6. 15	370, 645	7. 42	351, 717	9. 18
Total	5, 329, 607	100. 00	4, 993, 361	100. 00	3, 831, 335	100. 00
Colliery division.						
Lehigh and Wilkes Barre Coal Company	500, 391	9. 39	356, 833	7. 15	349, 243	9. 12
Individual operators	4, 829, 216	90. 61	4, 636, 528	92. 85	3, 482, 092	90. 88
Total	5, 329, 607	100. 00	4, 993, 361	100. 00	3, 831, 335	100. 00

Railroad and colliery division of production of individual coal, etc.—Continued.

WESTERN MIDDLE COAL FIELD.

	1885.		1886.		1887.	
Railroad division.	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*	*Long tons.*	*Per cent.*
Philadelphia and Reading	5,525,749	67.78	5,461,415	67.24	6,141,766	65.46
Philadelphia and Reading and Northern Central	330,272	4.05	281,835	3.47	301,987	3.22
Lehigh Valley	1,523,256	18.68	1,599,455	19.69	2,001,957	21.34
Northern Central	619,271	7.60	655,352	8.07	783,443	8.35
Lehigh Valley and Northern Central	24,455	0.30	....	......	....	.....
Philadelphia and Reading, Northern Central, and Lehigh Valley	129,934	1.59	124,582	1.53	153,269	1.63
Total	8,152,937	100.00	8,122,639	100.00	9,382,422	100.00
Colliery division.						
Philadelphia and Reading Coal and Iron Company	4,417,421	54.18	4,609,645	56.75	5,361,114	57.14
Lehigh Valley Coal Company	460,814	5.65	486,301	5.99	319.500	3.40
Mineral Railroad and Mining Company	437,167	5.36	352,911	4.35	288,804	3.08
Individual operators	2,837,535	34.81	2,673,782	32.91	3,413,004	36.38
Total	8,152,937	100.00	8,122,639	100.00	9,382,422	100.00

SOUTHERN COAL FIELD.

Railroad division.						
Philadelphia and Reading	1,669,805	48.33	1,800,404	52.53	1,784,132	54.63
Lehigh and Susquehanna	1,224,468	35.44	1,219,167	35.57	856,134	26.21
Northern Central	561,654	16.23	407,864	11.90	625,708	19.16
Total	3,455,927	100.00	3,427,435	100.00	3,265,974	100.00
Colliery division.						
Philadelphia and Reading Coal and Iron Company	1,249,503	36.15	1,348,549	39.35	1,374,756	42.09
Lehigh Coal and Navigation Company	1,224,468	35.43	1,219,167	35.57	856,134	26.21
Summit Branch Railroad Company	344,480	9.97	193,799	5.65	338,291	10.36
Lykens Valley Coal Company	217,174	6.28	214,065	6.25	237,417	7.27
Individual operators	420,302	12.17	451,855	13.18	459,376	14.07
Total	3,455,927	100.00	3,427,435	100.00	3,265,974	100.00

WESTERN NORTHERN COAL FIELD.

Railroad division.						
Lehigh Valley (*a*)	75,011	100.00	61,767	100.00	92,679	100.00

(*a*) Operator: State Line and Sullivan Railroad Company.

The number of tons of coal and the percentage of the total product shipped by the different transportation companies individually and by two or more companies combined are shown in the following table. These statistics are generally published in the coal trade journals in a table in which a fixed tonnage is assigned to each independent company. This is not strictly correct since a number of railroads collect from the collieries a certain amount of coal which goes to market by short lines in the coal fields belonging to other transportation companies. With this explanation the following table will be perfectly understood.

Railroad division of the production of anthracite coal fields for 1885, 1886, *and* 1887.

Names of railroads.	1885.		1886.		1887.	
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*
Philadelphia and Reading railroad	7,195,554	21.02	7,261,819	20.84	7,925,898	21.08
Delaware, Lackawanna, and Western railroad	6,281,797	18.36	7,822,264	22.44	7,794,092	20.74
Lehigh Valley railroad	6,041,937	17.66	6,354,798	18.23	5,971,036	15.89
Central railroad of New Jersey	4,943,072	14.44	3,661,864	10.51	4,327,283	11.51
Pennsylvania railroad	2,783,793	8.13	2,919,335	8.38	3,204,513	8.53
Delaware and Hudson Canal Company	2,584,907	7.55	2,797,648	8.03	3,425,857	9.12
Pennsylvania Coal Company	1,304,932	3.81	....	......	....	......
Delaware and Hudson Canal Company and Delaware, Lackawanna and Western railroad	795,395	2.32	765,645	2.20	889,959	2.37
Lehigh Valley railroad and Central railroad of New Jersey	728,979	2.13	737,787	2.12	465,571	1.29
Erie and Wyoming Valley railroad	517,718	1.51	1,454,880	4.17	1,642,767	4.34
Philadelphia and Reading railroad and Pennsylvania railroad	330,272	.97	281,835	.81	301,987	.80
Delaware and Hudson Canal Company and Central railroad of New Jersey	253,745	.74	280,807	.80	443,711	1.18
Philadelphia and Reading railroad, Pennsylvania railroad, and Lehigh Valley railroad	129,934	.38	124,582	.36	153,269	.41
Central railroad of New Jersey and Pennsylvania railroad	128,899	.37	141,196	.40	172,260	.46
Jefferson Branch, New York, Lake Erie and Western railroad	96,629	.28	135,144	.39	332,749	.88
Delaware and Hudson Canal Company and Lehigh Valley railroad	52,996	.16	77,633	.22	169,024	.45
Lehigh Valley railroad and Pennsylvania railroad	24,455	.07	....	......	....	......
Local sales (shipped by wagon)	33,534	.10	35,840	.10	358,771	.95
Total	34,228,548	100.00	34,853,077	100.00	37,578,747	100.00

All the transportation companies in the region, however, have relations with coal operating companies or with individual operators by which the shipment of coal from the collieries of these companies and individual operators is shipped exclusively over the respective lines controlled by the different transportation companies. The total production of coal from these collieries is given in the following table:

Colliery division of production of the anthracite coal fields for 1885, 1886, *and* 1887.

Operating companies.	1885.		1886.		1887.	
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*
Individual operators	13,796,271	40.31	13,687,512	39.27	14,802,068	39.31
Philadelphia and Reading Coal and Iron Company	5,666,924	16.56	5,958,194	17.07	6,735,870	17.92
Delaware and Hudson Canal Company	3,048,237	8.90	3,220,237	9.24	3,756,777	9.99
Pennsylvania Railroad Coal Companies	2,465,556	7.20	2,392,635	6.87	2,426,042	6.51
Lehigh and Wilkes-Barre Coal Company	2,217,073	6.48	2,401,203	6.90	2,527,396	6.78
Delaware, Lackawanna and Western Railroad Company	2,168,017	6.33	2,453,699	7.04	2,798,820	7.45
Pennsylvania Coal Company	1,711,379	5.00	1,357,708	3.90	1,523,944	4.06
Lehigh Valley Coal Company	1,291,569	3.77	1,503,273	4.31	1,232,789	3.28
Lehigh Coal and Navigation Company	1,224,468	3.58	1,219,167	3.50	856,134	2.28
Hillside Coal and Iron Company	371,867	1.09	438,204	1.26	595,054	1.55
Delaware and Hudson Canal Company and Delaware, Lackawanna and Western Railroad Company	192,176	.56	159,478	.46	231,174	.62
State Line and Sullivan Railroad Company	75,011	.22	61,767	.18	92,679	.25
Total	34,228,548	100.00	34,853,077	100.00	37,578,747	100.00

The following table shows the amount of the different kinds of coal produced in the different fields, the number of producing collieries in each field, from which the different varieties of coals come, and the proportion produced, both in tons and per cent. of total production, in 1885, 1886, and 1887:

Production of the different classes of coal during the last three years.

Coal fields.	Character of coal.	1885. Number of collieries.	Production.	Percentage of total production.
			Long tons.	
Northern	Free-burning white ash	131	15,485,033	45.24
	Wyoming red ash	14	1,730,033	5.05
Total		145	17,215,066	50.29
Eastern Middle	Hard white ash	39	3,715,897	10.85
	Lehigh red ash	11	1,613,710	4.72
Total		50	5,329,607	15.57
Western Middle	Hard white ash	46	4,780,671	13.97
	Free-burning white ash	17	1,807,961	5.28
	Shamokin	16	1,452,596	4.24
	Trevorton	1	111,709	.33
Total		80	8,152,937	23.82
Southern	Lykens Valley red ash	6	1,219,030	3.56
	Hard white ash	12	1,289,023	3.77
	Free-burning white ash	17	619,213	1.81
	Schuylkill red ash	8	236,360	.69
	Lorberry red ash	4	92,301	.27
Total		47	3,455,927	10.10
Western Northern	Lykens Valley red ash	1	75,011	.22
Grand total		323	34,228,548	100.00
		1886.		
Northern	Free-burning white ash	128	16,266,201	46.67
	Wyoming red ash	14	1,981,674	5.69
Total		142	18,247,875	52.36
Eastern Middle	Hard white ash	38	3,470 719	9.96
	Lehigh red ash	11	1,522,642	4.37
Total		49	4,993,361	14.33
Western Middle	Hard white ash	40	5,123,309	14.70
	Free-burning white ash	15	1,585,492	4.55
	Shamokin	15	1,295,275	3.72
	Trevorton	1	118,563	.34
Total		71	8,122,639	23.31
Southern	Lykens Valley red ash	6	1,074,917	3.08
	Hard white ash	14	1,563,312	4.48
	Free-burning white ash	11	547,041	1.57
	Schuylkill red ash	8	157,078	.45
	Lorberry red ash	2	85,087	.24
Total		41	3,427,435	9.82
Western Northern	Lykens Valley white ash	1	61,767	.18
Grand total		304	34,853,077	100.00

Production of the different classes of coal, etc.—**Continued.**

Coal fields.	Character of coal.	1887. Number of collieries.	Production.	Percentage of total production.
			Long tons.	
Northern	Free-burning white ash	145	20, 302, 062	54. 05
	Wyoming red ash	5	704, 275	1. 87
Total		150	21, 006, 337	56. 92
Eastern Middle	Hard white ash	35	2, 718, 251	7. 20
	Lehigh red ash	11	1, 113, 084	2. 96
Total		46	3, 831, 335	10. 16
Western Middle	Hard white ash	43	5, 563, 147	14. 80
	Free-burning white ash	16	2, 053, 725	5. 46
	Shamokin	16	1, 520, 981	4. 05
	Trevorton	2	244, 569	. 66
Total		77	9, 382, 422	24. 97
Southern	Lykens Valley red ash	7	1, 236, 556	3. 29
	Hard white ash	19	1, 286, 746	3. 42
	Free-burning white ash	10	551, 020	1. 39
	Schuylkill red ash	4	75, 949	. 22
	Lorberry red ash	1	115, 703	. 38
Total		41	3, 265, 974	8. 70
Western Northern	Lykens Valley red ash	1	92, 679	. 25
Grand total		315	37, 578, 747	100. 00

Number of collieries producing each kind of coal, the amount in tons and percentage of each, in 1885, 1886, *and* 1887.

Character of coal.	Number of collieries.	Production.	Percentage of total production.
1885.		*Long tons.*	
Free-burning white ash	165	17, 912, 207	52. 33
Hard white ash	97	9, 785, 591	28. 59
Wyoming red ash	14	1, 730, 033	5. 05
Lehigh red ash	11	1, 613, 710	4. 72
Shamokin	16	1, 452, 596	4. 24
Lykens Valley red ash	6	1, 219, 030	3. 56
Schuylkill red ash	8	236, 360	. 69
Trevorton	1	111, 709	. 33
Lorberry red ash	4	92, 301	. 27
Bernice white ash	1	75, 011	. 22
Total	323	34, 228, 548	100. 00
1886.			
Free-burning white ash	154	18, 398, 734	52. 79
Hard white ash	92	10, 157, 340	29. 14
Wyoming red ash	14	1, 981, 674	5. 69
Lehigh red ash	11	1, 522, 642	4. 37
Shamokin	15	1, 295, 275	3. 72
Lykens Valley red ash	6	1, 074, 917	3. 08
Schuylkill red ash	8	157, 078	. 45
Trevorton	1	118, 563	. 34
Lorberry red ash	2	85, 087	. 24
Bernice white ash	1	61, 767	. 18
Total	304	34, 853, 077	100. 00

Number of collieries producing each kind of coal, etc.—Continued.

Character of coal.	Number of collieries.	Production.	Percentage of total production.
1887.		*Long tons.*	
Free-burning white ash	171	22, 906, 807	60. 90
Hard white ash	97	9, 568, 144	25. 42
Wyoming red ash	5	704, 275	1. 87
Lehigh red ash	11	1, 113, 084	2. 96
Shamokin	16	1, 520, 981	4. 05
Lykens Valley red ash	7	1, 236, 556	3. 29
Schuylkill red ash	4	75, 949	. 22
Trevorton	2	244, 569	. 66
Lorberry red ash	1	115, 703	. 38
Bernice white ash	1	92, 679	. 25
Total	315	37, 578, 747	100. 00

A comparative idea of the value of the different kinds of anthracite may be had from the following table:

Prices of anthracite at New York City in 1883, 1884, 1885, 1886, *and* 1887.

Year.	Grades.	Lump.		Grate.		Egg.		Stove.		Nut.	
		Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.
1883	Free-burning	3. 90	4. 30	3. 90	4. 30	4. 00	4. 55	4. 20	4. 85	4. 20	4. 75
	Hard white ash	4. 85	5. 15	4. 10	4. 50	4. 10	4. 70	4. 35	4. 90	4. 10	4. 70
1884	Free-burning	3. 80	3. 30	3. 80	3. 80	3. 80	3. 80	4. 15	4. 40	4. 00	4. 15
	Hard white ash	4. 75	4. 75	4. 10	4. 10	4. 10	4. 10	4. 15	4. 40	4. 00	4. 15
1885	Free-burning	3. 30	3. 45	3. 00	3. 25	3. 00	3. 40	3. 50	4. 10	3. 10	3. 60
	Hard white ash	4. 25	4. 75	3. 35	3. 50	3. 25	3. 40	4. 00	4. 25	3. 40	3. 75
1886	Free-burning	3. 25	3. 45	2. 80	3. 55	2. 85	3. 80	3. 00	4. 15	3. 00	3. 85
	Hard white ash	4. 25	4. 25	3. 35	3. 75	3. 35	4. 00	3. 65	4. 15	3. 00	3. 65
1887	Free-burning	3. 40	4. 25	3. 40	4. 60	3. 70	4. 75	4. 00	5. 25	3. 75	5. 25
	Hard white ash	4. 25	4. 75	3. 75	4. 75	3. 85	4. 75	4. 00	5. 00	3. 75	4. 75

It is found in practice that after the coal is passed through the breaker and screened into different sizes for shipment the purity of the different sizes, as regards fixed carbon and ash, is very different. This is indicated by the following analyses of specimens collected from the Hauto screen-building of the Lehigh Coal and Navigation Company:

Analyses of different sizes of coal.

Kind of coal.	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.	Color of ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	
Egg	1. 722	3. 518	88. 489	. 609	5. 662	100	Light cream.
Stove	1. 426	4. 156	83. 672	. 572	10. 174	100	Cream.
Chestnut	1. 732	4. 046	80. 715	. 841	12. 666	100	Cream.
Pea	1. 700	3. 894	79. 045	. 697	14. 664	100	Cream.
Buckwheat	1. 690	4. 058	76. 918	. 714	16. 620	100	Cream.

The coal is separated into different sizes, according to the mesh of the screen over which it passes. The sizes noted in the above table passed over and through sieve meshes of the following dimensions:

Sizes of coal-sieve meshes.

	Through.	Over.
	Inches.	*Inches.*
Broken or grate	4	2.5
Egg	2.5	1.75
Stove	1.75	1.25
Chestnut	1.25	.75
Pea	.75	.50
Buckwheat	.50	.25

PENNSYLVANIA BITUMINOUS. (*a*)

The Bituminous coal region of Pennsylvania occupies the extreme northeastern end of the Appalachian field, which extends from the southern line of New York west of south for a distance of about 900 miles, ending in the coal region of Alabama. Although the largest portion of the Appalachian coal field contained in any one State is included in West Virginia (about 16,000 square miles), yet Pennsylvania contains over 9,000 square miles. When the Pennsylvania field is considered in respect to the thickness and purity of its coal beds and the extent to which these beds have been developed, it is by far the most important of any of the bituminous fields in the United States.

Although coal beds have been known to exist in the Pocono or Vespertine sandstone No. X at the base of the Carboniferous rocks and between the top of the Catskill sandstone No. IX (Old Red Sandstone) and the Mauch Chunk Red Shale and Limestone No. XI (Mountain Limestone), yet the commercially valuable beds have all been found until within a few years included in the strata lying above the Pottsville Conglomerate No. XII (Millstone Grit). Recently, however, coal beds included in the Pocono Sandstone and Pottsville Conglomerate have been profitably mined. The only mining operations carried on in coal beds in the Pocono Sandstone is that of the Tipton Run Coal Company, on the Pennsylvania railroad, not far from Altoona. During 1887 this company produced 30,000 tons of coal from its two mines. The author made a careful survey and report on this property in 1885. (See "Annual Report Geological Survey of Pennsylvania;" also "Mineral Resources of the United States, 1886."

The Productive Coal Measures of Pennsylvania are divided into the following easily recognized groups:

(1) The Upper Barren Measures are included between the Permo-Carboniferous strata of the extreme southwestern corner of the State, above, and the Waynesburgh sandstone below. This major group is subdivided into two minor groups; the Greene county group above, and the Washington county group below. The principal coal bed con-

a In the collection of these statistics special assistance was rendered by the State mine inspectors in the Second, Third, Fourth, Fifth, Sixth, and Eighth districts.

tained is known as the Washington bed, ranging from 3 to 3½ feet thick; this bed in Washington county is estimated to contain 672,000,000 tons of merchantable coal.

(2) The Upper Productive or Monongahela River Coal Measures include the strata from the Waynesburgh sandstone, down to and embracing the Pittsburgh coal bed. The principal beds included in the group are the Waynesburgh (average thickness, 3 to 5 feet); Uniontown (2 to 3 feet); Sewickley (3 feet); Redstone (2 to 3 feet), and finally, the Pittsburgh coal bed (6 to 12 feet). This last bed is the most valuable bituminous coal bed which has ever been discovered, not only in Pennsylvania, but in the United States. These coal beds are estimated to contain together over 13,635,000,000 tons of merchantable coal, of which about 80 per cent. is contained in the Pittsburgh bed alone, principally in the counties of Allegheny, Westmoreland, Fayette, Washington, and Greene.

(3) The Lower Barren Measures extend from the Pittsburgh bed down to the base of the Mahoning sandstone. There is included in this group a number of thin sporadic coal beds, which are workable in places; among these are the Brush Creek, Coleman, etc., beds, which are estimated to contain nearly 1,000,000,000 tons of merchantable coal, although it is highly improbable that these beds will ever produce coal which can compete with the purer coal from other beds; they will certainly never be mined for many generations.

(4) The Lower Productive or Allegheny River Coal Measures have been divided into three sub-groups; Freeport at the top, Kittanning in the middle, and Clarion at the bottom, each with three principal coal beds. Of these nine beds, not more than two, or at the most three, have been found workable in one locality, one directly above the other. It has been estimated that all of these beds contain in the aggregate over 17,000,000,000 tons of merchantable coal; they can be mined either from their outcrops, or at easily accessible depths.

(5) The Pottsville Conglomerate Measures (No. XII) have been recognized as divided into three distinct sandstone and conglomerate formations, designated as the Upper, Middle, and Lower; these are separated by shales and slates intercalated with thin beds of coal workable in places, impure siliceous limestones, and poor ironstones, generally so lean in iron as to be commercially valueless. Beneath the conglomerate lies the Sharon coal bed, from which valuable coal is mined in Ohio, and parts of Mercer county, Pennsylvania; the Sharon bed has proved elsewhere worthless. A small area of the coal bed caps the conical hill north of the Pennsylvania railroad station at Ridgway, in Elk county. The workable area of all the coal beds above mentioned has been estimated to contain about 1,000,000,000 tons of merchantable coal.

(6) The Mauch Chunk and Mountain Limestone Barren Coal Measures (No. XI) have generally been considered to form the top of the sub-Carboniferous formation; the Mauch Chunk strata in Pennsylvania have never been found to contain workable coal beds. But from

the fact that there exist workable beds in the Pocono Sandstone below the Mauch Chunk, there seems to be sufficient reason for dropping the term sub-Carboniferous from our geological scale, except where it is used to apply generally to the Devonian, Silurian, etc., formations beneath the Pocono Sandstone.

(7) The Pocono or Allegheny Mountain Coal Measures (No. X) include numerous thin sporadic coal beds, which number as many as nineteen in the Sideling Hill (East Broad Top railroad) tunnel in Huntingdon county. The beds there range in thickness from an inch to a foot, and are worthless; but in the vicinity of Altoona, on Tipton run, as many as six coal beds have been located, any of which may prove workable, although only two up to the present time have actually been mined, having thicknesses ranging from 3 to 4½ feet.

Within the Coal Measures proper which must be considered those existing above the Pottsville Conglomerate (Millstone Grit) there are probably 100 different individual coal beds which in special localities have a thickness of over 1 foot. Not more than one-fifth of these beds, however, can be considered workable in a commercial sense, that is, have a thickness of over 2 feet, which is the minimum thickness, under the most favorable circumstances at which any of the Pennsylvania beds may be worked. At the present time, under ordinary circumstances, a bed of 3 feet in thickness is about as thin as can be profitably worked.

Estimated tonnage of available bituminous coal in Pennsylvania, by Dr. H. M. Chance.

Classification of coal beds.	Thickness.		Available tonnage.
	Feet.		
Upper Barren Measures:			
Washington bed	3 to 3½		787, 200, 000
Upper Productive Measures:			
Waynesburgh bed	3	5	2, 126, 400, 000
Uniontown bed	2	3	312, 000, 000
Sewickley bed	3		432, 000, 000
Redstone bed	2	3	326, 400, 000
Pittsburgh bed	6	12	10, 438, 800, 000
			13, 635, 600, 000
Lower Barren Measures:			
Brush Creek, Coleman beds, etc	....		878, 400, 000
Lower Productive Measures:			
In Westmoreland, Fayette, and Allegheny counties	....		2, 064, 000, 000
Millerstown bed	3		28, 800, 000
Freeport upper bed	3	5	3, 764, 800, 000
Freeport lower bed	2	6	2, 385, 600, 000
Kittanning upper bed	2	4	1, 596, 000, 000
Kittanning middle bed	2	3	829, 800, 000
Kittanning lower bed	2	6	4, 225, 200, 000
Clarion coals	2	3	696, 000, 000
Brookville bed	2	4	1, 627, 200, 000
			17, 217, 400, 000
Conglomerate series:			
Mercer coals	2	3	932, 600, 000
Quakertown bed	2		57, 600, 000
Sharon coal horizon	2	3	38, 400, 000
			1, 028, 600, 000
Total	....		33, 547, 200, 000

ALLEGHENY COUNTY.

(Coal produced in 1887, 4,680,924 short tons.)

The greatest amount of coal mined in Allegheny county is taken from the Pittsburgh coal bed, which at the city of Pittsburgh is 350 feet above low-water level. The only other coal bed of any importance that is mined is the Upper Freeport, which is the topmost bed in the Lower Productive Coal Measures. This bed outcrops in the Allegheny river, in East Deer township.

The New York and Cleveland Gas Coal Company produced a greater amount of coal during the year than any one company in the county.

Although there has been a notable increase in the amount of natural gas consumed in the county during the year, yet the coal mines produced, during the year 1887, 478,838 tons of coal more than in 1886, being an increase in production of 11 per cent. The average price per ton at the mines was $1.03, being an increase over 1886 of 10½ per cent. The increase in the production is due to the greater demand for Pittsburgh bed coal in distant markets, and not to any increase in the local consumption.

What is popularly known as the Monongahela River coal region is located in the counties of Allegheny, Westmoreland, Fayette, Washington, and Greene. The bulk of coal shipped from this region passes either down the Monongahela or Allegheny and the Ohio rivers. The production of the region is generally spoken of by the coal trade as an integral part of the production of the Pittsburgh mines, although the mines are not exclusively located in Allegheny county, around the city of Pittsburgh. The small amount of coal which is consumed at the present time in the Pittsburgh district proper is taken chiefly by the iron blast furnaces in the form of coke, or by manufacturers for special uses to which natural gas is not so well adapted as coal. This local consumption is supplied almost exclusively by railroad shipments. On account of the exceptionally low stage of water in the Monongahela river during the year, especially after June, the shipments for 1887 were much less than in 1886, as shown by the following table:

Shipments of Pittsburgh coal by slackwater navigation since 1860.

Years.	Quantity.	Years.	Quantity,
	Short tons.		*Short tons.*
1860	1, 517, 909	1874	2, 503, 504
1861	834, 630	1875	2, 275, 265
1862	743, 358	1876	2, 495, 800
1863	1, 134, 150	1877	2, 677, 460
1864	1, 402, 828	1878	2, 797, 530
1865	1, 580, 791	1879	2, 623, 232
1866	1, 704, 212	1880	3, 361, 934
1867	1, 202, 908	1881	3, 450, 186
1868	1, 812, 040	1882	4, 057, 384
1869	2, 100, 504	1883	4, 339, 492
1870	2, 303, 856	1884	3, 170, 900
1871	1, 944, 852	1885	3, 298, 200
1872	2, 291, 220	1886	4, 123, 945
1873	2, 094, 312	1887	3, 065, 240

The operators and the number of mines worked by each, together with the number of tons produced by each operating company during 1887, are shown in the following table:

Allegheny county mines, operators, and production in 1887.

Names of collieries.	Operators.	Number of mines.	Production.
			Short tons.
Allaquippa	Bailey, Wilson & Co	1	77,539
Alpsville	Thomas Hackett & Co., limited	1	20,801
Amity	J. C. Risher & Co	1	83,719
Atlantic	Lake Erie Gas Coal and Coke Company	1	32,873
Beck's Run	Jas. H. Hay's estate	1	39,520
Beechmont	Beechmont Coal Company	1	5,772
Bellwood	Munhall Brothers	1	47,500
Boyd	Edward Fisher	1	9,000
Bellevue	Gumbert & Huey	1	71,000
Bridgeville	A. J. Schulte	1	74,436
Buena Vista	Youghiogheny River Coal Company	1	49,485
Camden	George Lysle & Sons	1	83,600
Camp Hill	David Steen	1	74,802
Castle Shannon	Pittsburgh and Castle Shannon Railroad Company.	1	31,109
Cherry	Morris McCue	1	21,648
Coal Ridge	Gray & Bell	1	23,289
Corey	Corey Coal Company	1	20,052
Diamond	Baines Coal Company	1	6,300
Dravo	Lake Shore Gas Coal Company	1	38,000
Duquesne	New York and Cleveland Gas Coal Company.	1	44,736
Enterprise	Hartley & Marshall	1	181,850
Enterprise	O'Neil & Co	1	40,000
Essen	Sanford & Co	1	75,000
Federal Spring	W. J. Steen	1	20,000
First Pool	First Pool Monongahela Gas Coal Company.	1	1,000
Fort Pitt	The Fort Pitt Coal Company	1	40,660
Fox	Thomas Fox	1	121
Fulton	George Jones & Co	1	14,560
Glendale	J. V. N. & R. Cook	1	14,598
Glenshaw	Glenshaw Coal Company	1	17,500
Grant	Grant Coal Company	1	82,311
Graver	New York and Cleveland Gas Coal Company.	1	34,061
Hampton	Hampton Coal Company	1	86,900
Harrison	Beadling Brothers	1	30,000
Hasting Slope	Pennsylvania Coal Company, limited	1	48,311
Horner & Roberts	Horner & Roberts	2	44,346
Idlewood	Stewart, Lewis & Dickson	1	2,500
Imperial	Imperial Coal Company	3	160,248
Jefferson	Foster, Clark & Wood	1	79,955
Keeling	Birmingham Coal Company	1	18,684
Keystone	W. H. Brown Sons	2	19,166
Laurel Hill	W. P. Rend	1	350,000
Leesdale	Gregg Brothers	1	30,000
Lovedale	John A. Wood & Sons	1	49,231
Mansfield	Mansfield Coal and Coke Company	2	225,000
Milesville	Robert Jenkins, sr	1	34,003
National	National Coal Company, limited	1	30,000
Natrona	Pennsylvania Salt Manufacturing Company.	2	11,782
Nikon	Chartiers Valley Coal Company	1	40,109
Ocean	The Youghiogheny River Coal Company	3	147,426
Oak Ridge	Oak Ridge Coal Company	1	57,687
Old Eagle	W. H. Brown Sons	1	45,000
H. D. O'Neil	H. D. O'Neil	1	46,000
Osceola	Osceola Coal Company	1	70,500
Pacific	Lake Erie Gas Coal and Coke Company	1	87,659
Penney	Penney Coal Company	1	29,122
Pittsburgh Union	Joseph McConnel	1	30,000
Plum Creek	New York and Cleveland Gas Coal Company.	1	110,353
Powers	Chartiers Block Coal Company	1	60,000
Rankin	William Rankin	1	8,984
Robbins	W. M. Robbins & Co	1	45,582
Rock Run	W. J. Snodgrass & Co	1	29,754
Sandy Creek	New York and Cleveland Gas Coal Company.	2	145,281
Sanford No. 2	Sanford & Co.	1	36,004
Six Mile Ferry	J. H. Hays' estate	1	71,440

Allegheny county mines, operators, etc.—Continued.

Names of collieries.	Operators.	Number of mines.	Production.
			Short tons.
Snowden	Pittsburgh and Chicago Gas Coal Company.	1	65,000
Spring Hill	Spring Hill Gas Coal Company	2	33,000
Star	Francis Mankedick	1	18,000
Stone	William Stone's estate	1	75,000
Street's Run	J. D. Risher	1	55,156
Summer Hill	Frank Armstrong	1	96,835
Turtle Creek	New York and Cleveland Gas Coal Company.	1	126,841
Venture	Gray & Bell	1	8,000
Walton's	Joseph Walton & Co	3	300,000
Weinman & Co	Weinman & Co	2	12,960
Winona	William Skillen	1	4,000
Willow Grove	Willow Grove Mining Company	2	133,263
Youghiogheny	W. H. Brown Sons	2	92,000
Total		93	4,680,924

ARMSTRONG COUNTY.

(Coal produced in 1887, 235,221 short tons.)

The coal beds mined in the county belong exclusively to the Lower Productive Measures. Most of the surface of the county is immediately underlaid by the Lower Barren and the Lower Productive Coal Measures. There is a small area of the Pittsburgh coal bed in Kiskiminetas township, in the extreme southeastern part of the county. The principal coal beds which are mined are those of the Freeport and Kittanning groups. The largest mine in the county, that of the Oak Ridge Mining Company, is opened in the Lower Freeport coal bed. This company produced during the year 126,833 tons. The next largest mine is that of the Kittanning Iron Company, which is opened in the Upper Freeport bed. All the product of the latter mine is coked for the company's consumption. The coal from the Oak Ridge Company's mine is shipped principally to the Buffalo market. These two companies produced during the year 71 per cent. of the entire output of the county, and the production of both for 1887 was very much in excess of that for 1886. The aggregate amount of coal produced in the county during 1887 was 24,365 tons more than in 1886, being an increase of 10 per cent. The average price which the coal commanded at the mines increased during the latter year 6 per cent. The details of production in the county for 1887 are shown in the following table:

Armstrong county mines, operators, and production in 1887.

Names of collieries.	Operators.	Number of mines.	Production.
			Short tons.
Glen	J. R. Smith	1	13,848
Gosford	W. W. Acheson	2	27,947
International	International Coal Mining Company	1	6,286
Kittanning	Kittanning Iron Company	2	40,729
Oak Ridge	Oak Ridge Mining Company	1	126,833
River View	River View Coal Mining Company	1	19,578
Total		8	235,221

BEAVER COUNTY.

(Coal produced in 1887, 197,863 short tons.)

A very small area in the southern part of Hanover township is underlaid by the Pittsburgh coal bed, which however, is nowhere mined. All the active coal mines in the county are opened in the coal beds of the Lower Productive series, principally in the Upper Freeport and the Middle and Lower Kittanning beds, the most important being the Middle Kittanning, which attains the wonderful thickness of 20 feet in the vicinity of Darlington; the upper portion of the bed is cannel coal. The entire production of the county during the year was 197,863 tons, being a decrease from 1886 of 10,957 tons, or 5 per cent. The State Line Coal Company produced 80 per cent. of this. The shipments of this county are sent principally to points along the lake shore and to eastern Ohio. The average price at which Beaver county coal was sold during the year was $1.12 cents per ton, being an increase of 14 cents.

Beaver county mines, operators, and production in 1887.

Name of mines.	Operators.	Number of mines.	Production.
			Short tons.
Cannel	Ira F. Mansfield	1	18,700
Clayton	Will J. Clayton	1	3,000
Hulmes	James Clayton	1	2,217
Scott & Co.	Scott & Co	1	47,313
State Line	State Line Coal Company	1	126,633
Total		5	197,863

BEDFORD COUNTY.

(Coal produced in 1887, 311,452 short tons.)

The coal beds of this county belong to the Lower Productive series and are located in the southwestern part of the Broad Top semi-bituminous coal fields in Broad Top township, in the northeastern corner of the county. The coal beds themselves are locally known throughout the western portion of the Broad Top coal field as the Kelly, Barnet, and Fulton beds. Sweet & Brown, the largest operators in the county, and the Kimble Iron Company, the second largest operators, mine their product from the Kelly bed. R. B. Wigton Sons mine coal from the Barnet beds, although openings have been made in the Fulton bed, which lies below the other beds. The exceptionally large increase in the mines for 1887 over that for 1886 (55 per cent.) is due, not so much to the opening of new mines within the county, but to greater activity in coal mining, and to imperfect returns which were received during 1886. The average price which the coal commanded at the mines during the year was 16½ cents greater than during 1886.

Bedford county mines, operators, and production in 1887.

Names of collieries.	Operators.	No. of mines.	Production.
			Short tons.
Brown	Sweet & Brown	1	96,000
Cambria	Clearfield Consolidated Coal Company	1	35,000
Chevington	do	1	23,000
Coaldale	Roda, Maher & Co	1	22,000
Cunard	R. B. Wigton Sons	2	60,000
Duval	E. P. Jenkins & Co	1	8,831
Mount Equity	Kemble Iron Company	1	66,621
Total		8	311,452

BLAIR COUNTY.

(Coal produced in 1887, 287,367 short tons.)

The coal beds which are mined in this county belong to the Lower Productive Coal Measures which outcrop along the western boundary of the county along the Allegheny mountain crest, and to the Pocono or Allegheny Coal Measures which lie east of and below the Allegheny mountain crest. The Blair Iron and Coal Company (Cambria Iron Company), which is operating the Bennington slope and the Lemon drift, produced in the aggregate 50 per cent. of the entire production of the county, the remaining 50 per cent. being produced by five independent operating companies. The Bennington slope, which is the largest individual mine, takes its coal from the Lower Kittanning bed, and the Lemon mine takes its coal from the Upper Freeport. There were mined from the Lower Productive coal beds 257,367 tons, and but 30,000 tons from the Pocono beds. The successful operations of the Tipton Run Coal Company in the Pocono coal beds have had a tendency to enhance the value of the lands located in the county in front of the Allegheny mountains wherever the Pocono formation has been known to outcrop. These enhanced values must be considered fictitious until the coal beds, which have been proved valuable on the Tipton Run Coal Company's property, shall have been actually developed on other lands. Although the Tipton Run Coal Company has actually worked out twelve acres of its property underlaid by commercially valuable Pocono coal beds, yet this fact does not of itself establish a persistent character to these beds. The geological studies which have been made of these beds by Professor Lesley for thirty-five years subsequent to 1840, and by myself since 1875, conclusively prove that these beds have a most sporadic character both as to their thickness and the character of coal which they contain; and none of the lands in the State upon which the Pocono strata outcrop can be considered commercial coal lands until the actual existence of the coal beds and their commercial thickness and purity is established by practically developed mines.

Blair county mines, operators, and production in 1887.

Names of collieries.	Operators.	No. of mines.	Production.
			Short tons.
Beech grove	Beech Grove Coal Company	2	17,100
Bennington slope	Blair Iron and Coal Company	1	66,554
Glenwhite	Glenwhite Coal and Lumber Company	1	52,666
Horseshoe	Altoona Coal Company	1	27,232
Lemon	Blair Iron and Coal Company	1	53,380
Porter shaft	Dennison, Porter & Co.	1	40,435
Tipton run	Tipton Run Coal Company	2	30,000
Total		9	287,367

BRADFORD COUNTY.

(Coal produced in 1887, 167,416 short tons.)

The most northeastern workable coal beds in the Appalachian region are located in this county. The entire product of the county is mined by the Towanda and the Long Valley Cóal Companies, which are closely affiliated with the interests of the New York, Lake Erie and Western railroad. The production of the Towanda Coal Company, the largest operator in the county, since 1865 is shown by the following table:

Production of the Towanda Coal Company, 1865 *to* 1887.

Years.	Short tons.	Years.	Short tons.
1865	6,886	1877	164,344
1866	3,881	1878	165,025
1867	27,668	1879	237,608
1868	67,080	1880	246,064
1869	176,307	1881	223,172
1870	196,310	1882	210,917
1871	239,240	1883	226,806
1872	263,960	1884	181,786
1873	252,329	1885	246,397
1874	215,572	1886	145,208
1875	200,424	1887	99,416
1876	160,343		

The production of this county has steadily decreased for a number of years, due to the exhaustion of the coal areas. Between 1856 and 1857 the Barclay Coal Company mined 412,640 tons of coal from its property, which was subsequently leased and worked by the Towanda Coal Company.

The Schrader Coal Company's property adjoins that of the Towanda Coal Company. It is now exhausted, the mines having been abandoned in 1884. The total production of these mines from 1874 to 1884 inclusive was 1,696,042 tons.

The Long Valley Coal Company, which operates the Long Valley mines produced during the year 1887 68,000 tons. The average price for production of this county for the year 1887 was 7 cents greater than for the year 1886.

BUTLER COUNTY.

(Coal produced in 1887, 161,764 short tons.)

The entire area of the county is underlaid by coal-bearing strata belonging to the Lower Barren, Lower Productive, and the Pottsville Conglomerate series. The only coal beds which are mined in the county are those of the Kittanning group. The Union Coal and Coke Company and the Mahoning Valley Iron Company are the two largest operators in the county; they mine the Lower Kittanning bed. The coal from this bed makes an excellent coke and a good steam fuel, the greater proportion of the production of the county being consumed for the latter use at points along the Lake Erie shore, and by consumers between the Lake and the mines. The product of the mines commanded about the same price during 1887 as during 1886.

Butler county mines, operators, and production in 1887.

Names of collieries.	Operators.	No. of mines.	Production.
			Short tons.
Acbarr	Acbarr Mining Company	1	4,974
Allegheny	Allegheny Coal Company	1	25,759
Barnes	Mercer Coal Company	1	25,000
Boyce	Hamilton Cannel Coal Company	1	240
Chisholm	Mercer Coal Company	1	15,000
Gomersal	Mahoning Valley Iron Company	1	35,007
Karns	W. C. Mobley & Co	1	10,000
Keisters	Union Coal and Coke Company, limited	1	35,232
Kelly	Kelly Coal Company	1	8,392
Keystone	Pittsburgh and Fairport Coal and Coke Company.	1	2,160
Total		10	161,764

CAMBRIA COUNTY.

(Coal produced in 1887, 1,421,980 short tons.)

The principal coal beds mined in this county are the Freeport and Lower Kittanning beds. The two largest operators in the county during the year were the Gallitzin Coal and Coke Company, and Messrs. Taylor & McCoy, who operate the Mitchell slope and the Gallitzin shaft respecively; 25 per cent. of the entire production of the county coming from these two mines, which are worked on what is locally known as the Lemon coal bed. Probably the most important coal developments made in the county during the year were those along the Trout Run branch of the Pennsylvania railroad, which runs from Portage. There were four new mines opened in this district in 1887, and a large output may be expected for 1888. A considerable portion of this coal will be manufactured into coke, thirty-seven ovens having already been erected. What is popularly known by the trade as Mountain coke is manufactured from the coal produced from the Lemon seam. Twenty per cent of the entire product of the county is manufactured into coke. The mines produced in the aggregate 199,852 tons or 16 per cent. more coal during 1887 than during 1886, the increase in the value of the product at the mouth of the mines being 16½ cents per ton. This increase both in the tonnage and the price is a very notable one in view of the large amount of natural gas which is brought from the Grapeville natural gas field by the Westmoreland and Cambria Natural Gas Company, and supplied to the Cambria Iron Company and smaller consumers.

Cambria county mines, operators, and production in 1887.

Names of collieries.	Operators.	No. of mines.	Production.
			Short tons.
Anchor	Clearfield Consolidated Coal Company	1	20,196
Argyle	Huff & Coulter	1	115,337
Aurora	Heist & Luke	1	21,861
Ben's Creek Plane	E. W. Mentzer	1	34,703
Black Diamond	J. H. Miller	1	36,000
Conemaugh	Cambria Iron Company	1	16,663
Cushon	do	1	19,965
Delaney	J. H. Haywood	1	55,439
Diamond	Haywood Coal Company	1	9,000
Dysart No. 1	Caron Leahy	1	14,500
Dysart No. 2	D. Laughman	1	48,200
Eagle	J. Gwin & Son	1	7,294
Eldorado	Wray & Co	1	10,000
Euclid	Euclid Coal Company	1	21,298
Gallitzin Shaft	Taylor & McCoy	1	165,214
Great Bend	Great Bend Coal Company	1	65,000
Griffiths	Fend & Cover	1	8,020
Lower Gautier	Cambria Iron Company	1	10,448
Martindale Slope	J. C. Martin & Co	1	60,000
Miller	Miller Coal Company	1	20,000
Mitchell Slope	Gallitzin Coal and Coke Company	1	171,525
Mount Hope	Cambria Iron Company	1	130
Moshannon	Felix Toole & Co	1	20,000
Rolling Mill	Cambria Iron Company	1	15,704
Rubins		1	7,510
Smittle	Smittle & Co	1	18,086
Sonman 1 and 2	W. H. Piper & Co	2	100,000
Sonman Shaft	Hughes & Shoemaker	1	46,378
South Fork	South Fork Coal Works Company	1	16,649
Standard	Standard Coal Company	1	40,000
Stineman	J. C. Stineman	1	76,860
Webster No. 3	John C. Scott & Son	1	150,000
Total		33	1,421,980

No returns were received from Cameron county; its total production has been estimated at 3,000 tons.

CENTRE COUNTY.

(Coal produced in 1887, 508,255 short tons.)

The Upper and Lower Kittanning coal beds are extensively mined in this county, the principal mine opened in the latter being that of the Clearfield Bituminous Coal Corporation, opposite the town of Peale, in Clearfield county. The largest establishment in the county is that of the Lehigh Valley Coal Company, which operates the Sugar Camp mines, opened in the Upper Kittanning coal bed. A large amount of the coal mined by these two companies is manufactured into a superior grade of coke. The coal region of Centre county is generally known as the Snow

Shoe region. The shipments of coal from this region over the Pennsylvania railroad since 1883 are shown in the following table:

Shipments of coal from the Snow Shoe region over the Pennsylvania railroad.

Years.	Shipments.	Years.	Shipments.
	Short tons.		*Short tons.*
1873	95,257	1881	128,263
1874	63,540	1882	233,708
1875	62,426	1883	257,230
1876	51,399	1884	183,271
1877	42,985	1885	148,500
1878	29,168	1886	113,967
1879	56,654	1887	165,091
1880	56,020		

The Lehigh Valley Coal Company had on January 1, 1887, 165 coke ovens; during the year 100 additional ovens were added. The Clearfield Bituminous Coal Corporation constructed 100 ovens during 1887. The Lehigh Valley Coal Company reports the following analysis of its coke, made by Messrs. Booth, Garrett & Blair, of Philadelphia, from a sample selected by the analysts to show the composition of the marketable product of the ovens:

Analysis of coke from the Snow Shoe region, Centre county, Pennsylvania.

	Per cent.
Moisture, 212	.36
Volatile matter	.46
Fixed carbon	90.27
Ash	8.91
	100.00

The mines in the Snow Shoe region are shown in the following table:

Centre county mines, operators, and production in 1887.

Collieries.	Operators.	No. of mines.	Production.
			Short tons.
Black Diamond	W. J. Jackson & Co	1	47,554
Central	Thomas C. Heims & Co	1	69,218
Elizabeth No. 3	Elizabeth Coal Company	1	41,000
Etna	James Passmore	1	700
Irvona	Irvona Coal Company	1	2,400
Sommerville's	J. L. Sommerville & Co	2	57,312
Sugar Camp	Lehigh Valley Coal Company	4	206,907
Tunnel	Clearfield Bituminous Coal Corporation	2	83,164
Total		13	508,255

CLARION COUNTY.

(Coal produced in 1887, 593,758 short tons.)

The highest coal measures in this county belong to the Lower Barren series, which caps the hills in the southern townships east of the Allegheny river and north of Red Bank creek. The principal mines are located in the southwestern corner of the county, along the Allegheny river, in the vicinity of East Brady, and in the southern part of the county, near Fairmount, north of Red Bank creek. The princiapl beds which are mined are the Lower Freeport and Lower Kittanning. The bulk of the coal comes from the Lower Freeport bed. The Northwestern Coal and Iron Company, which produced during the year nearly 25 per cent. of the entire production of the county, mines all its coal from the Lower Freeport bed, while the Fairmount Coal and Iron Company, the largest operator in the county, which mines 35 per cent. of the entire production of the county, takes probably two-thirds from the Lower Freeport bed. The coal beds in the county range from 3 to 6 feet in thickness, the latter being characteristic more especially of the Lower Freeport bed. The shipments are made principally to Buffalo and other Lake points.

Clarion county mines, operators, and production in 1887.

Collieries.	Operators.	No. of mines.	Production.
			Short tons.
Acme	Acme Coal Company	1	9,897
Catfish	Pittsburgh Coal and Mining Company	1	8,715
Church Hill	J. McCollum	1	5,000
Diamond	Thomas Mitchell & Sons	1	33,227
Fairmount	Fairmount Coal and Iron Company	2	178,472
Hardscrabble	Brady's Bend Mining Company	1	69,773
Keystone	George E. & John Henry	1	10,492
Mineral Ridge	Mineral Ridge Coal Company	1	42,430
Pine Run	Stephenson & Mitchell	1	68,863
Red Bank	David & John D. Reynolds	1	40,000
Star	Northwestern Coal and Iron Company	2	126,889
Total		13	593,758

CLEARFIELD COUNTY.

(Coal produced in 1887, 5,180,311 short tons.)

The coal beds which have been mined in this county belong exclusively to the Lower Productive Measures. The bed which has given so much fame to this region, particularly during the past twelve years, when the development has been more phenomenal than in any one region in the State, is the Lower Freeport bed, which is locally known as the Moshannon. Although the bulk of the coal produced in the county comes from this bed, the Upper Freeport and the Lower Kittanning beds are also worked in a number of localities, the latter, however, to a much greater extent than the former. Much of the coal which is mined from the latter bed, particularly in the vicinity of Coalport, in the southern part of the county, is manufactured into an excellent coke, and a considerable amount of coke is also made from the Lower Freeport bed in the Moshannon basin.

The entire production in this county for 1887 was 1,591,542 tons, or 42 per cent. in excess of the production for 1886; this increase is the most notable of any one county. It will be observed from the table already given that the percentage increase is not as great as in a number of other counties, yet it is far in excess of all the other large producing counties, and is over 900,000 tons in excess of the increase of production in Westmoreland and Jefferson counties, which rank next below Clearfield in the increase for the year. The Clearfield increase, however, can only be legitimately compared with the increase in Westmoreland county, since the increase in Jefferson county is due to the opening up of virgin fields. A general idea of the development of the industry in Clearfield county may be had from the following tables:

Coal carried over the Tyrone and Clearfield branch railroad during the last twenty-six years.

Years.	Short tons.	Years.	Short tons.
1862	7,239	1875	928,297
1863	24,330	1876	1,281,861
1864	65,380	1877	1,374,927
1865	60,629	1878	1,295,201
1866	107,878	1879	1,631,120
1867	166,364	1880	1,739,873
1868	170,335	1881	2,401,987
1869	259,994	1882	2,838,970
1870	379,863	1883	2,857,710
1871	542,896	1884	3,173,363
1872	431,915	1885	2,901,613
1873	592,860	1886	2,273,147
1874	639,630	1887	3,256,328

Beech Creek railroad tonnage.

Years.	Short tons.	Years.	Short tons.
1882	....	1885	774,055
1883	....	1886	1,050,238
1884	234,751	1887	1,351,579

The largest single establishment in the State is that of the Berwind-White Coal Mining Company, which produced 1,512,897 tons during the year, nearly 200,000 tons in excess of the amount produced by the next largest establishment, that of the H. C. Frick Coke Company. The coal from this county is a favorite for steam purposes, and is shipped principally to eastern markets, from which a large proportion is again shipped to distant points by water. Clearfield county coal is more widely distributed than any other coal mined in the United States. During 1887 the average selling price at the mines was 19½ cents higher than for 1886, the advance in the average price being greater than in any other county in the State. The aggregate value at the mines of the coal produced was $4,543,6)9, being a greater value than in any other county, with the exception of Allegheny and Westmoreland.

Clearfield county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Alexander	Madera Coal Company	1	6,568
Alder Run	Alder Run Coal and Coke Company	1	3,800
Ashland	Berwind-White Coal Mining Company	1	36,712
Ashman	J. Swires & Co	1	9,595
Atalanta	Atalanta Coal Company	2	62,729
Atlantic	Berwind-White Coal Mining Company	2	79,239
Baltic	Baltic Coal Company	1	41,747
Cataract	Berwind-White Coal Mining Company	1	118,052
Coaldale	Holt & Chipman	4	359,310
Columbia, Nos. 1 and 2	Mitchell, Lazzar & Co	2	125,312
Columbia, No. 3	do	1	31,980
Colorado	Jackman & Ellsworth	1	81,000
Cuba	Cuba Coal Company	1	15,580
Cunard and Shoff	R. B. Wigton Sons	2	39,000
Decatur	John Nuttall & Co	1	36,000
Derby	T. Barnes & Brother	1	36,971
Dixon	H. C. Springer & Co	1	60,000
Drane	T. C. Heems & Co	1	58,762
Elizabeth	Elizabeth Coal Company	2	55,000
Empire	Empire Coal Company	1	110,500
Eureka	Berwind-White Coal Mining Company	6	493,729
Excelsior	H. G. Fisher	4	155,562
Franklin	Berwind-White Coal Mining Company	2	163,307
Ferndale	Ferndale Coal Company	1	9,500
Gazzam	Clearfield Bituminous Coal Corporation	1	79,155
Glenwood, No. 1	Williams, Morris & Co	1	101,179
Glenwood, No. 2	Ruse & Long	1	38,000
Grassflat	Clearfield Bituminous Coal Corporation	3	11,500
Hawk Run	Jones, Mull & Co	1	24,000
Hudson	R. B. Wigton Sons	1	6,000
Irvona, No. 1	Irvona Coal and Coke Company	1	79,000
Karthaus	Berwind-White Coal Mining Company	1	70,000
Keystone	Keystone Coal Company	1	8,884
Kyler	R. C. Fishburn	1	51,800
Lancashire	T. Barnes & Brother	2	89,632
Laurel Run	J. M. Bacon	2	46,157
Logan	H. Liveright & Co	1	90,479
Logan Ridge	A. H. Smith	1	8,979
Loraine	Reakirt Brothers	1	45,081
Lueder Slope	A. B. & G. V. Lueder	1	3,074
Mapleton	Berwind-White Coal Mining Company	1	34,762
Moshannon	Clearfield Consolidated Coal Corporation	1	32,000
Mount Vernon	do	3	134,000
Morrisdale	R. B. Wigton Sons	3	120,000
National	National Coal and Coke Company	2	38,296
Oakland	Samuel Hegarty	1	35,000
Ocean	Berwind-White Coal Mining Company	3	134,423
O'Shanter	O'Shanter Coal Company	1	16,803
Pacific	Berwind-White Coal Mining Company	2	316,510
Pardee	W. P. Duncan & Co	1	217,601
Reading	H. Liveright	1	22,658
Rothrock	R. B. Wigton Sons	1	175,000
Rochester	The Bell, Lewis & Yates Coal Mining Company.	3	363,594
Sobieski	Alice Wilkinson	2	40,092
Spring Hill	Walton & Ganoe	1	7,370
Sterling	Robert Hare Powel & Co	2	283,206
Victor	Victor Coal Company	3	107,129
Vulcan	R. B. Wigton Sons	1	50,000
Webster, No. 4	Beulah Coal Company	1	60,000
Wills Run	J. L. Somerville & Co	1	33,492
Yorkshire	T. Barnes & Co	1	7,500
Estimated production of new mines unreported			8,000
Total		94	5,180,311

On account of the opening of a great many new mines in Clearfield county during the year, I have estimated that there must have been produced at least 8,000 tons of coal from such new mines, of which no reports could be obtained.

ELK COUNTY.

(Coal produced in 1887, 609,757 short tons.)

This county contains the most northern coal operations of any considerable magnitude in the western part of the State. The coal beds which have been mined belong to the Lower Productive and the Pottsville Conglomerate series. There is a greater geological range of coal beds mined here and also a greater variety of coal contained in the beds than in any other county in the State. The early operations which were made in this county were started on geologically lower and poorer coal beds, so that this fact has served to establish a questionable reputation for all Elk county coals. There is, however, a great development of the Kittanning and the Freeport coal beds in the southern part of the county, especially in the Meade Run coal basin, which is destined to support a large coal industry. There are but four active establishments in the county, the largest being that of the Northwestern Mining and Exchange Company, which produced during the year 404,907 tons. The recent lititigation between this company and the Commonwealth, places the future working of the lands controlled by the company in a very doubtful position. That much good coal is contained on this land, which can be as profitably mined as any in the county, admits of no doubt, and that these lands, and more especially those in the Meade Run basin, on account of their close proximity to the markets of southern and western New York, as well as to competing lines of railroads, which form an easy outlet to these markets, are destined to become important coal fields in the near future, is equally certain. The principal bed which has been worked in the past in the county is the Lower Kittanning, locally known as the Dagus bed; this bed varies in thickness from 2½ to 5 feet, although the average thickness would not range far from 3 feet. These operations are shown in the following table; the work carried on by Mr. D. Eldridge was discontinued at the end of 1887.

Elk county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Cascade	Kaul and Hall	1	74, 310
Dagus	Northwestern Mining and Exchange Company.	17	404, 907
Eureka slope	D. Eldridge	1	32, 996
St. Mary's	St. Mary's Coal Company	3	81, 002
Tannerdale	do	1	16, 542
Total		23	609, 757

FAYETTE COUNTY.

(Coal produced in 1887, 4,540,322 short tons.)

This county is popularly known as the coke-producing county of the State, and the statistics bear out such a statement. Of the total production of the county for the year, 98 per cent. was manufactured into coke. The great coal bed of the county is the Pittsburgh or Connellsville coal bed, although there are a number of other valuable coal beds in the county which can be profitably mined, and which are of exceptional quality. But the extensive area of the Pittsburgh bed within the county has prevented a practical development of the other coal beds.

The following tables give a number of analyses of the Connellsville coal. They were reported by the H. C. Frick Coke Company.

Analyses of Connellsville coal from the H. C. Frick Coke Company's mines in Fayette county, Pennsylvania.

Mines.	Location.	Fixed carbon.	Volatile matter.	Ash.	Sulphur.	Total.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Henry Clay....	Broad Ford.......	61.49	32.40	5.10	1.01	100.00
Frick..........	....do	60.92	32.60	5.40	1.08	100.00
Valley.........	Valley Works	63.78	30.60	4.50	1.12	100.00
Trotter	Trotter Station	63.34	30.20	5.40	1.06	100.00
Eagle..........	Sherrick..........	62.68	27.90	7.50	1.92	100.00
Summit........	Summit............	59.80	33.80	5.40	1.00	100.00
Tip Top	Tinshnan.........	60.90	32.10	5.60	1.40	100.00
Morgan........	Morgan...........	58.10	33.60	7.10	1.20	100.00
Foundry.......	Sherrick	65.36	28.40	4.90	1.34	100.00
White	....do............	63.30	28.80	6.80	1.10	100.00

The increase in the production of coal in Fayette county during the past year over that for 1886 was only 1 per cent. The increase in the estimated value of the coal at the mouth of the mines was 6 cents. This small increase in production is to be attributed to extensive strikes which occurred during the year, and which resulted in no benefit either to the coal operators or the coal miners, and more especially the latter. The total production by the H. C. Frick Coke Company for all the mines was 1,317,600 tons. Of this amount Fayette produced 896,000 tons.

The following table contains the production of the individual operators;

Fayette county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Albany	Snowden & Hogg	1	70,300
Anchor	Pennsylvania Manufacturing, Mining, and Supply Company.	1	28,000
Atlas	Atlas Coke Company (limited)	1	48,376
Carondelet	E. C. Furlong	1	12,000
Cedar Hill	Bradford & Lynch	1	14,440
Clarissa	James Cochran, Sons & Co	1	58,520
Climax	Eli Leonard & Sons	1	20,000
Clinton	B. F. Keister & Co	1	17,072
Coalbrook	Rafferty & Donnelly	1	42,247
Cora	J. S. Newmeyers & Sons	1	21,418
Dexter	Joseph R. Stauffer & Co	1	16,524
Diamond	Rafferty & Donnelly	1	35,399
Eagle	H. C. Frick Coke Company	1	45,000
Fairchance	Fairchance Furnace Company	1	48,254
Fayette	Fayette Coke and Furnace Company	1	73,748
Ferguson	Dunbar Furnace Company	1	41,042
Fort Hill	W. J. Rainey	1	83,200
Foundry	H. C. Frick Coke Company	1	63,000
Fountain	E. A. Humphries	1	25,293
Franklin	B. F. Keister & Co.	1	22,500
Frick	H. C. Frick Coke Company	1	63,000
Furnace	E. A. Humphries	1	2,600
Grace	W. J. Rainey	1	171,649
Great Bluff	Isaac Taylor	1	5,652
Germania	John W. Hall & Sons	1	32,566
Henry Clay	H. C. Frick Coke Company	1	60,000
Hill Farm	Dunbar Furnace Company	1	88,422
Home	Stauffer & Wiley	1	11,303
Jackson	Jackson Mines Company	1	27,000
Kyle Farm	Bliss & Marshall	2	48,435
Leisenring	The Connellsville Coke and Iron Company	3	376,204
Luth	Chicago and Connellsville Coke Company	1	120,000
Lemont	R. Hogsett & Co	1	78,000
Little Alps	John Underwood	1	5,000
Little Pittsburgh	R. E. Schmertz & Co	1	7,348
Little Redstone	Joseph Rutherford	1	4,560
Mahoning	Cambria Iron Company	1	69,228
Merchant	David Bowdler	1	198
Moreland	W. J. Rainey	1	14,021
Morrell	Cambria Iron Company	1	239,512
Mount Braddock	R. Hogsett & Co	1	17,000
Nellie	Broun & Cochran	2	100,050
Paul	W. J. Rainey	1	7,067
Pinnsville	Pinnsville Coke Company	1	38,683
Painter	Rafferty & Donnelly	1	119,192
Percy	Percy Mining Company	1	37,782
Plummer & Davidson	Pittsburgh and Connellsville Gas, Coal and Coke Company.	2	180,000
Rainbow	Rainbow Coal and Coke Company	1	33,000
Redstone	J. M. Schoonmaker Coke Company	3	215,000
Rist	H. C. Frick Coke Company	1	112,500
Snow Hill	Alps Coal Company	1	51,563
Sterling	J. M. Schoonmaker Coke Company	2	195,000
Stewart	Stewart Iron Company (limited)	1	86,357
Stony Hill	Stony Hill Coal Company	1	28,500
Summit	H. C. Frick Coke Company	2	102,000
Tip Top	do	1	75,000
Tremont	John A. Wood & Son	1	4,000
Trotter	H. C. Frick Coke Company	1	337,500
Tyrone	Laughlin & Co. (limited)	2	94,018
Umpire	C. L. Snowden & Co	1	41,800
Union	J. D. Boyd & Co	1	24,381
Uniondale	Reid Brothers	1	26,619
Valley	H. C. Frick Coke Company	1	105,000
Wheeler	Cambria Iron Company	1	64,070
White	do	1	114,000
Wynn	Wynn Coke and Mining Company	1	11,850
Youngstown	Youngstown Coke Company (limited)	1	107,399
Total		78	4,540,322

GREENE COUNTY.

(Coal produced in 1887, 3,002 short tons.)

Geologically the highest coal strata of the Coal age are found in this county, which occupies the extreme southwestern corner of the State. The strata which immediately underlie the surface of the county are as barren of workable coal beds as any other part of the Carboniferous system, and the Pittsburgh coal bed and the beds of the Lower Productive Measures exist at such depths beneath the surface of the county that it will be many years before they can be mined in order to compete with the coals mined above water level in the counties farther north. Professor Lesley has estimated that at the point where Aleppo, Jackson, Gilmore, and Spring Hill townships join the surface is so high geologically that it would be necessary to sink a shaft 1,200 feet deep to reach the Waynesburg coal bed, and 1,700 feet deep to reach the Pittsburgh coal bed.

The entire production of the county during the year was 3,002 tons. Messrs. Johnson & Leonard produced the entire amount. The production was so small as only to require the employment of ten miners. The coal is consumed in the local market.

HUNTINGDON COUNTY.

(Coal produced in 1887, 265,479 short tons.)

This county, together with Bedford, contains all the active coal mines situated in the Broad Top semi-bituminous coal field. The operations are about equally divided between the two counties, although the production of Bedford was slightly in excess of that of Huntingdon. There was, however, more activity in the coal operations in Bedford county than in Huntingdon; in the former there was a large increase in production over that of 1886, while in the latter there was a corresponding decrease over that of 1886. All the coal beds which occur in the Lower Productive Coal Measures, and which are contained between the bottom of the Mahoning sandstone and the top of the lowest member of the Pottsville conglomerate are mined to a greater or less extent; some of the beds, however, send no coal to market, and are only worked by the farmers for home consumption. The principal establishment in the county is that of the Rockhill Iron and Coal Company, situated in what is usually designated as the East Broad Top district. The total production of this company for the year was 153,289 tons. Of this amount only 48,581 tons of coal were shipped to outside markets and 104,707 tons were consumed locally, the principal consumption being by the iron furnaces of the company situated at Orbisonia midway between the mines and the junction of the company's railroad (East Broad Top) with the Pennsylvania railroad at Mount Union. A number of improvements were made at the company's mines during the year which have increased their productive capacity.

The Broad Top semi-bituminous coal is shipped over the Huntingdon and Broad Top and East Broad Top railroads. The shipments by the former road since 1873 and by the latter road since it was opened in 1875 are shown by the following tables:

Coal carried by the Huntingdon and Broad Top railroad to the Pennsylvania railroad at Huntingdon.

Years.	Short tons.	Years.	Short tons.
1873	350, 245	1881	204, 819
1874	226, 693	1882	271, 216
1875	204, 921	1883	196, 534
1876	159, 779	1884	192, 706
1877	140, 143	1885	176, 075
1878	150, 204	1886	385, 796
1879	141, 594	1887	357, 438
1880	174, 736		

Coal carried by the East Broad Top railroad to the Pennsylvania railroad at Mount Union.

Years.	Short tons.	Years.	Short tons.
1875	43, 567	1882	99, 095
1876	66, 104	1883	44, 737
1877	54, 738	1884	43, 514
1878	63, 068	1885	51, 878
1879	67, 929	1886	51, 050
1880	72, 450	1887	48, 581
1881	91, 745		

In this connection it is interesting to note the shipments of Cumberland (West Virginia portion) coal over the former railroad and the Pennsylvania railroad from Huntingdon junction:

Shipments of Cumberland coal over the Pennsylvania and Huntingdon and Broad Top railroads.

Years.	Short tons.	Years.	Short tons.
1873	114, 589	1881	313, 600
1874	67, 671	1882	208, 031
1875	175, 154	1883	471, 785
1876	145, 796	1884	394, 114
1877	187, 488	1885	460, 289
1878	163, 598	1886	266, 153
1879	171, 930	1887	438, 145
1880	242, 593		

Huntingdon county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Benedict	Reed Brothers	1	15, 000
Fisher	Sweet & Brown	1	7, 000
Huntingdon	E. F. Gould	1	2, 000
Moredale	E. P. Jenkins & Co.	1	11, 015
Ocean	William H. Sweet	1	30, 000
Prospect	Robert Hare Powel, Sons & Co.	2	47, 175
Robertsdale	Rockhill Iron and Coal Company	2	153, 289
Total		9	265, 479

INDIANA COUNTY.

(Coal produced in 1887, 207,597 short tons.)

The production of this county is small in comparison with the amount of coal which it contains; the entire area of the county is underlaid by Coal Measures with the exception of nine spots, five of which are in the prominent gaps in the mountains and four over anticlinal axes. The want of proper transportation facilities and the fact that a large amount of the coal lands in the county can only be developed by shaft have operated against this field. All the mining operations in the county are confined to the vicinity of Blairsville as noted in the following table:

Indiana county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Blairsville	Blairsville Coke Company, limited	1	16,000
Foster	Saltsburgh Coal Company	1	160,800
Smith	Robert Smith	1	16,000
Turner	J. M. Turner	1	14,797
Total		4	207,597

JEFFERSON COUNTY.

(Coal produced in 1887, 1,693,492 short tons.)

There has been a rapid development of the coal industry in Jefferson county during the past three years. The coal beds of the Lower Productive Measures are found in most parts of the county with the exception of the extreme northwestern corner, adjoining Forest, and a small area adjoining Clearfield in the eastern part of the valley of the Clarion river. The coal bed at present most extensively mined is the Lower Freeport; this is the noted bed of the Reynoldsville basin. It has a workable thickness in all parts of the county. This bed is the representative of the Moshannon bed of the Clearfield region.

The three beds of the Kittanning group and the Clarion-Brookville bed are found in many parts of the county of workable thickness and contain good coal, although they are not generally desirable beds to mine, due to their lack of persistency both as to thickness and quality.

There were more new coal lands opened up in Jefferson county during the year than in any other county in the State. This is due to the extension of the Bell's Gap railroad from its former terminus at Coalport, in Clearfield county, to Punxsutawney, in Jefferson county, thus making direct eastern connections with the Pennsylvania railroad for Punxsutawney coal; and also to the fact of the close proximity of this county to the increasing demand for coal in the northern markets, principally in western and central New York. The increased production for 1887 over 1886 was 65 per cent., and there was an increase of

15 cents in the average price which the coal commanded at the mines. The largest single establishment in the county is that of the Rochester and Pittsburgh Coal and Iron Company, which produced 946,584 tons, making this company the third largest coal producer in the bituminous fields of Pennsylvania. The different varieties of the Jefferson county coal are adapted to steam, gas, and coking purposes; 25 per cent. of the entire production of the county was made into coke, the bulk of which was manufactured at the Walston mines in the vicinity of Punxsutawney. The coal, which was used for steam and gas purposes, is shipped principally to New England, New York, and intermediate markets.

Jefferson county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Adrian	Rochester and Pittsburgh Coal and Iron Company.	2	136,613
Beechtree	do	1	225,836
Clarion	Northwestern Mining and Exchange Company.	6	210,305
Coal Glen	Jefferson Coal Company	1	123,778
Hamilton	The Bell, Lewis and Yates Coal Mining Company.	1	77,599
Pleasant Valley	do	1	4,068
Soldier Run	do	2	205,296
Sprague	do	1	125,862
Walston	Rochester and Pittsburgh Coal and Iron Company.	3	584,135
Total		18	1,693,492

LAWRENCE COUNTY.

(Coal produced in 1887, 125,361 short tons.)

The most northern workable coal areas along the western State line are in Lawrence county. In the southern part of the county, on the hill tops, occur the lowest strata of the Barren Coal Measures. The Upper Freeport coal bed, which is locally known as the "five and four foot" bed, is over 6 feet thick in several mines near the northern line of Little Beaver township. The Darlington or Kittanning bed varies from 2 to 4 feet in thickness and produces a good coal at several mines in the Beaver valley. In the Slippery Rock valley this bed, however, is very sulphury. In Plain Grove township the same bed is block coal.

The production of the county for 1887 was 23 per cent. greater than for 1886. There were only three establishments in this county, the Beaver mines, operated by the Beaver Coal and Coke Company, which produced 57,764 tons; the Clinton mines, operated by the Clinton Coal Company, produced 38,000 tons, and the Penn mine, operated by the Penn Coal Company, limited, which produced 29,597 tons, making an aggregate of 125,361 tons. There was an increase in the average price at which the coal was sold during the year over that of 1886, of 11½ cents.

The Lawrence county coal is used for steam and gas purposes, principally to supply the local trade.

McKEAN COUNTY.

(Coal produced in 1887, 9,214 short tons.)

In this county occur only the lowest coal beds of the Lower Productive Coal Measures. The Lower Kittanning coal bed occurs in some localities under very small areas, but is too thin and contains coal too impure to be commercially valuable. The Alton bed, which is included in the Pottsville conglomerate series, was mined for many years at the Alton and Buttsville mines, in Lafayette township, and the Clarion coal bed has been mined for a number of years to a greater or less extent at Claremont, by the Buffalo Coal Company. The only operator in the county during the year was this company, the total amount of coal shipped being only 8,761 tons, and the amount locally consumed 453 tons. The entire production was consumed on the Claremont branch of the Buffalo, New York and Philadelphia railroad. The maximum production of coal from the county was attained in 1881. The shipments since 1875 are shown in the following table:

Shipments of coal from McKean county, Pennsylvania.

Years.	Short tons.	Years.	Short tons.
1875	33,501	1882	73,834
1876	81,830	1883	84,899
1877	73,222	1884	78,870
1878	72,098	1885	44,312
1879	85,745	1886	617
1880	100,046	1887	8,761
1881	110,099		

The opening of the Bradford branch of the New York, Lake Erie and Western railroad across McKean county and the introduction of natural gas for fuel, and of the better coals from Elk, Jefferson, and Clearfield counties, have practically closed the McKean county mines.

MERCER COUNTY.

(Coal produced in 1887, 539,721 short tons.)

The production was practically the same as during 1886. In this county extensive mining operations are carried on in the lowest coal beds of the Lower Productive series.

The Brookville or Pardoe coal bed is mined in many places in Pine, Findley, Jackson, and Lake townships, where it ranges from 3½ to 4 feet thick. These coal beds occur immediately on top of the Homewood sandstone, underneath which lie the two Mercer coal beds. Farther down in the series occurs the Quakerstown coal, and still lower the Sharon block coal. All these beds produce coals which are highly prized by special consumers, the product being shipped to points as far north as Buffalo and as far west as Chicago. The coal from the Pardoe bed is especially adapted for steam purposes and locomotive use, while the Sharon coal, which is identical with the Briar Hill coal of Ohio, is highly prized for domestic and furnace purposes.

The largest producing company is the Mercer Iron and Coal Company. The mines are located at Stoneboro. Their total production during the year was 93,189 tons. Most of the coal from this county goes to lake points, with the exception of the Sharon block coal, which is also shipped to points in Ohio and west to Chicago.

Mercer county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Bethel	Bethel Coal Company	1	16,260
Black Diamond	Filer, Sutliffe & Co	1	41,104
Carver	Carver Coal Company	1	50,409
Chestnut Ridge	Westerman, Filer & Co	1	45,088
Hickory Slope	Hazzard, Wood & Co	1	47,910
Jackson	Jackson Coal Company	1	2,000
Lackawannock	Pierce Coal Company, limited	2	23,171
New Virginia	Virginia Coal Company	1	14,900
Ormsby Shaft	Ormsby Coal Company	1	33,335
Ormsby Slope	L. M. Ormsby & Co., limited	1	48,100
Pardoe	Mercer Coal Company	1	55,000
Pine Grove	Pine Grove Coal Company	1	30,000
Sharon	Sharon Coal Company	1	39,255
Stoneboro	Mercer Iron and Coal Company	3	93,189
Total		17	539,721

SOMERSET COUNTY.

(Coal produced in 1887, 416,240 short tons.)

The northeastern end of the Cumberland semi-bituminous coal basin, the coal of which has so long been favorably known throughout the United States, and in fact beyond the capes, is located in this county, although what is generally designated as the Cumberland basin proper is located in the State of Maryland. All the coal beds in the Lower Productive, Barren, and the Upper Productive Measures have been opened and worked to a greater or less extent in this county; some of the poorer and more insignificant beds have been opened, however, by the farmers.

The greatest bed of the county is the Pittsburgh; the thickness of that portion of the bed which is worked ranges from 5 to 9 feet. Next to the Pittsburgh bed, the Middle Kittaning coal bed is one which is principally mined. The Berlin mine is opened on the Price seam, which occurs in the Lower Barren Measures. The largest individual establishment in the county is that of the Fair View Coal Company, which operates three mines. The aggregate production by this company for the year was 100,800 tons. A number of new mines have been opened in the Pittsburgh bed during the year, although none of them have assumed any considerable proportions. The increase of production for 1887 over 1886 was 19½ per cent., and the increase in the average price per ton at the mouth of the mines was 14½ cents. Most of the coal produced in Somerset county is shipped to Baltimore and other points along the Baltimore and Ohio railroad.

Somerset county mines, operators, and production in 1887.

Collieries.	Operators.	No. of mines.	Production.
			Short tons.
Berlin	B. D. Morgan & Co	1	6,500
Casselman	Casselman Coal Company	1	39,200
Cochrane	James Cochrane & Co	1	13,440
Co-operative	Co-operative Coal Company	1	14,560
C. & E. L	Cumberland and Elk Lick Coal Company	1	81,814
Cumberland	Cumberland Coal and Mining Company	1	67,000
Fair View	Fair View Coal Company	1	21,280
Flog Hill	do	1	32,480
Grassy Run	Grassy Run Coal Company	1	14,112
Hamilton	Hamilton & Cochrane	1	25,760
Hocking	Hocking Coal Company	1	8,038
Keystone	Keystone Coal Company	1	17,808
Statler	Emanuel Statler	1	13,440
Thomas	Benjamin Thomas	1	8,561
Tree Forest	Buffalo Creek Coal Company	1	5,207
Tub Mill Run	Fair View Coal Company	1	47,040
Total		16	416,240

TIOGA COUNTY.

(Coal produced in 1887, 1,328,963 short tons.)

The coal areas of this county are smaller in proportion to the amount of the coal production than any other county in the State. On account of the limited extent of these coal areas the amount of valuable coal contained in the county is rapidly diminishing. The "B" or Blossburgh coal bed is the largest bed known in the county, and from this almost the entire production is mined. The aggregate production of the Tioga mines decreased 4 per cent. during 1887; the coal commanded, however, at the mines an average of 25 cents a ton more than during 1886. The coal from this county, known as the Blossburgh coal, is a favorite for blacksmithing. It is shipped principally to Canada and New York, but much of it is sent as far west as Chicago and other lake points.

The production of the Blossburgh region since 1872 has been as follows:

Years.	Short tons.	Years.	Short tons.
1872	849,262	1880	921,555
1873	991,057	1881	1,178,581
1874	796,388	1882	1,165,604
1875	581,782	1883	1,217,870
1876	616,984	1884	1,018,342
1877	602,245	1885	1,074,581
1878	652,597	1886	1,388,611
1879	874,010	1887	1,329,239

Tioga county mines, operators, and production in 1887.

Collieries.	Operators.	No. of mines.	Production.
			Short tons.
Antrim	Fall Brook Coal Company	3	403,592
Arnot	Blossburgh Coal Company	3	341,294
Fall Brook	Fall Brook Coal Company	2	97,320
Gaines	Gaines Coal Company	2	10,856
Morris Run	Morris Run Coal Mining Company	3	475,901
		13	1,328,963

VENANGO COUNTY.

(Coal produced in 1887, 2,296 short tons.)

In the hill tops in the southern part of this county are included very small areas underlaid by the lower strata of the Lower Productive Coal Measures. These areas are confined principally to Irwin, Clinton, Scrubgrass, Dotters, and Potterfield townships.

In the eastern part of Cranberry township, about 8 miles southeast of Oil City, are two small areas reported to be underlaid by the bottom of the Lower Productive Coal Measures. In all of these townships there have been enumerated twenty-six patches underlaid by coal strata. The amount of coal which has been mined in the county has been very small, and has been consumed principally for steam purposes at oil wells drilled in the immediate vicinity. There was but one operation in the county in 1887 which mined coal for shipment. This was the Maple Grove mine of Mr. S. P. McCalmont, which is working one of the Mercer coal beds. The coal is shipped for locomotive use.

WASHINGTON COUNTY.

(Coal produced in 1887, 1,751,615 short tons.)

This county, on account of the great amount of coal which it contains, is destined to be one of the greatest coal producing counties in the State. On account, however, of the fact that most of the workable coal beds in the county are situated below water level, and will have to be mined by shafts, no development has been made commensurate with the amount of coal which it contains. According to the estimates made by Dr. H. M. Chance, this county contains nearly as much coal as Fayette, which ranks first, containing more coal than any other county in the State. The Pittsburgh coal bed at the present time supplies nearly the entire product of the county, which is shipped principally to Chicago, Cleveland, Columbus, and minor points in Illinois, Indiana, and Ohio. A large shipment is also made by boats, down the Monongahela, Ohio, and Mississippi rivers. The aggregate production of the county during 1887 was 9 per cent. greater than 1886. The increase in the average price per ton at the mouth of the mines was only 2½ cents. The largest individual establishment in the county during the year was that of the Jumbo Coal and Coke Company, which produced 183,035 tons.

Washington county mines, operators, and production in 1887.

Collieries.	Operators.	No. of mines.	Production.
			Short tons.
Alex. Hays	W. S. B. Hays	1	26, 256
Acme	Stockdale Coal Company	1	52, 545
Allison's	Hon. Jonathan Allison	1	48, 000
American	Washington Coal Company	1	41, 208
Banner	J. M. Risher	2	92, 100
Black Diamond	W. H. Brown Sons	1	50, 000
Boon	Stoner & Co	1	33, 000
Bowman	Eli Leonard	1	5, 000
Brier Hill	Patterson & Sauters	1	100, 524
Buffalo	Youghiogheny Coal Company, limited	1	90, 000
Caledonia	Caledonia Coal Company	3	157, 000
Catsburg	Louis Staib	1	48, 506
Cincinnati	Jordan S. Neel	1	37, 000
Cliff	J. M. Risher	1	57, 300
Clipper	Allenport Coal Company	1	25, 000
Coal Bluff	Monongahela and Peters Crk. Gas Coal Co.	1	87, 898
Cook's	J. V. N. Cook	1	7, 000
Courtney	Courtney Coal Company	1	46, 000
Eclipse	Jordan S. Neel	1	50, 000
Floersheim	Henry Floersheim	2	54, 571
Garfield	Jordan S. Neel	1	26, 000
Gastonville	Pittsburgh and Chicago Gas Coal Co	1	88, 000
Globe	Globe Coal Company	1	60, 000
Greenfield	Jordan S. Neel	1	20, 000
Hilldale	Hilldale Coal Company	1	40, 000
Ivill	James Jones	1	75, 889
Jumbo	Jumbo Coal and Coke Company	1	183, 035
Knob	Knob Coal Company	1	43, 114
Midway	Midway Block Coal Company	2	17, 242
Robbins	Robbins Block Coal Company	1	61, 000
Venetia	D. M. Anderson	1	38, 427
Woods Run	W. A. Stone & Co	1	50, 000
Total		37	1, 751, 615

WESTMORELAND COUNTY.

(Coal produced in 1887, 6,074,486 short tons.)

This county produces more coal than any one county in the State The production for 1887 was 11 per cent. greater than for 1886. The increase in the average price per ton at the mouth of the mines was 5½ cents. The proportion of the large producing mines of this county is also in excess of any other county. Allegheny in 1887 had twenty more producing mines than Westmoreland, and yet produced one million tons of coal less. The principal bed which is mined is the Pittsburgh. The characteristics of this bed within this county which make it a most desirable bed to mine are its great thickness, the small amount of ash, and the high amount of carbon contained, which makes the coal one especially adapted for manufacturing a high grade of illuminating gas and coke.

What is frequently designated by the coal trade as the Westmoreland region comprises that portion of the county from which the gas coals are principally shipped. The shipments over the Pennsylvania railroad from this region for the past fourteen years are shown in the following table:

Shipments of Westmoreland county coal over the Pennsylvania railroad.

Years.	Short tons.	Years.	Short tons.
1874	952, 971	1881	982, 293
1875	796, 968	1882	1, 278, 121
1876	906, 139	1883	1, 399, 702
1877	786, 039	1884	1, 320, 186
1878	692, 586	1885	1, 293, 813
1879	816, 302	1886	1, 305, 732
1880	943, 177	1887	1, 636, 974

The largest individual operator in the county is the Westmoreland Coal Company, which operated during the year three mines, producing in the aggregate 725,793 tons. Fifty per cent. of the entire product of the county was manufactured into coke, and only 142,665 tons were consumed at the mines for raising steam for the operation of the mine machinery; this latter fact of itself is an indication of the small cost at which this coal can be mined. It may be added here that coal mining is generally more skillfully conducted in Westmoreland county than, possibly, in any other group of bituminous coal mines in the United States.

Westmoreland county mines, operators, and production in 1887.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Alexandria	Alexandria Coal Company	3	138, 483
Alice	J. M. Schoonmaker Coke Company	1	125, 000
Amieville	N. J. Bigley	1	55, 500
Bagdad	Bagdad Coal Company	3	21, 506
Buckeye	A. C. Cochran	2	101, 727
Bessemer	McClure & Co	2	141, 700
Central	Central Connellsville Coke Company	1	70, 000
Columbia	J. T. Jones	1	33, 000
Derry	Derry Coal and Coke Company	1	2, 000
Dilworth	Sellers & Dillworth	1	12, 400
Donelly & Dellinger	McClure & Co	2	103, 818
Emma	Maria F. Overholt	1	16, 786
Enterprise	McClure & Co	1	27, 859
Eureka	Stoner & Co., limited	1	40, 000
Fairbank	Saltsburgh Coal Company	1	150, 000
Gilmore	Altmeyer & Molsberger	1	28, 500
Greensburgh	Greensburgh Coal Company	1	115, 124
Hazlett	McClure & Co	2	142, 500
Hecla	Hecla Coke Company	1	155, 652
Hempfield	Hempfield Coal Company	1	156, 356
Isabella	Isabella Furnace Company	1	156, 000
Larimer	Westmoreland Coal Company	1	240, 148
Latrobe	Latrobe Coal and Coke Company	1	135, 165
Leechburgh	Leechburgh Coal and Coke Company	4	84, 367
Loyalhanna	Loyalhanna Coal and Coke Company	1	82, 316
Lockport	Bolivar Coal and Coke Company	1	1, 000
Mammoth	J. W. Moore	2	226, 920
Manor	New York and Westmoreland Gas Coal and Coke Company.	2	19, 000
Manor Valley	Manor Gas Coal Company	1	90, 031
Mayfield	McClure & Co	1	32, 310
Millwood shaft	Millwood Coal Company	1	59, 614
Monastery	H. C. Frick Coke Company	1	135, 000
Morewood	Southwest Coal and Coke Company	2	300, 160
M. Saxman	M. Saxman, jr., & Co	1	85, 000
Mullin	McClure & Co	1	43, 052
Mutual	Mutual Mining and Manufacturing Company.	3	91, 116
Ohio and Pennsylvania.	Ohio and Pennsylvania Coal Company	1	5, 000
Ocean No. 1	The Youghiogheny River Coal Company	1	125, 229

Westmoreland county mines, operators, and production in 1887—Continued.

Collieries.	Operators.	Number of mines.	Production.
			Short tons.
Penn. gas	Penn Gas Coal Company	4	557, 227
Pittsburgh and Kiskiminitas.	Pittsburgh and Kiskiminitas Coal and Coke Company.	1	28, 269
Port Royal	Port Royal Coal and Coke Company	3	67, 297
Republic	Republic Coal Company	1	34, 000
Ridge View	D. C. George & Co	1	40, 000
Rostraver	William Schrader	1	25, 000
Shaner	Shaner Gas-Coal Company, limited	2	72, 000
Smithton	Waverly Coal and Coke Company	2	89, 700
South Side	Westmoreland Coal Company	1	211, 462
Southwest, 2, 3, and 4	Southwest Coal and Coke Company	3	122, 346
Standard	H. C. Frick Coke Company	2	390, 000
Saint Clair	Saint Clair Coal and Coke Company	1	80, 000
Union	McClure & Co	1	34, 212
United	United Coal and Coke Company	1	177, 333
West Overton	A. C. Overholt & Co	1	54, 940
West Newton	West Newton Coal Company	2	128, 252
Westmoreland shaft	Westmoreland Coal Company	1	274, 183
Youghiogheny slope	Youghiogheny Slope Gas Coal Company	1	42, 426
Youghiogheny Valley	Youghiogheny and Ashtabula Coal and Coke Company.	1	96, 500
Total		85	6, 074, 486

Comparative statistics of the Pennsylvania bituminous mines for 1886 *and* 1887.

Counties.	Number of mines.				Production.				Average price per ton at mines.		
	1886.	1887.	Increase.	Decrease.	1886.	1887.	Increase.	Decrease.	1886.	1887.	Increase.
					Short tons.	*Short tons.*	*Short tons.*	*Short tons.*			
Allegheny	85	93	8	....	4, 202, 086	4, 680, 924	478, 838	....	.925	1. 03	.105
Armstrong	7	8	1	....	210, 856	235, 221	24, 365	....	.68	.74	.06
Beaver	6	5	....	1	208, 820	197, 863	....	10, 957	.98	1. 12	.14
Bedford	5	8	3	....	173, 372	311, 452	138, 080	....	.685	.85	.165
Blair	11	9	...	2	305, 695	287, 367	....	18, 328	.755	.76	.005
Bradford	6	3	....	3	206, 998	167, 416	....	39, 582	1. 17	1. 24	.07
Butler	8	10	2	....	162, 306	161, 764	....	542	.830	.80	.....
Cambria	28	33	5	....	1, 222, 028	1, 421, 980	199, 952	....	.645	.81	.165
Cameron	1	1	....	....	3, 200	3, 000	....	200	1. 25	.....	.....
Centre	9	13	4	....	313, 383	508, 255	194, 872	....	.632	.90	.268
Clarion	14	13	....	1	429, 544	593, 758	164, 214	....	.675	.73	.055
Clearfield	61	94	33	....	3, 753, 986	5, 180, 311	1, 426, 325	....	.655	.85	.195
Elk	6	23	17	....	526, 036	609, 757	83, 721	....	.78	.91	.13
Fayette	61	78	17	...	4, 494, 613	4, 540, 322	45, 709	....	.69	.75	.06
Greene	2	1	....	1	5, 600	3, 002	....	2, 598	.92	.92	.00
Huntingdon	8	9	1	....	313, 581	265, 479	....	48, 102	.655	.80	.145
Indiana	3	4	1	....	103, 615	207, 597	103, 982	....	.89	.95	.06
Jefferson	10	18	8	....	1, 023, 186	1, 693, 492	670, 326	....	.68	.83	.15
Lawrence	4	3	....	1	101, 154	125, 361	24, 207	....	.915	1. 03	.115
McKean	1	2	1	....	617	9, 214	8, 597	....	.90	.....	.....
Mercer	17	17	....	....	537, 712	539, 721	2, 009	....	1. 23	1. 02	.....
Somerset	14	16	2	....	349, 926	416, 240	66, 314	....	.56	.706	.146
Tioga	7	13	6	....	1, 384, 800	1, 328, 963	....	55, 837	1. 00	1. 25	.25
Venango	1	1	....	....	2, 500	2, 296	....	204	.70	1. 00	.30
Washington	35	37	2	....	1, 612, 407	1, 751, 615	139, 208	....	.885	.91	.025
Westmoreland	66	84	18	....	5, 446, 480	6, 074, 486	....	....	.88	.935	.055
Unreported mines, estimated	....	....	....	....	....	200, 000	....	....	....	....	....
Totals and averages	476	596	120	....	27, 094, 481	31, 516, 856	4, 398, 725	176, 350	.80	.90	.10

This table has been compiled from statistics received from individual operators, or where a number of mines are controlled by one operating company, from those received from the superintendents of the individual mines or groups of mines. The facts contained in the individual reports were not homogeneous throughout the whole series, due to the imperfect mine records kept by many companies, so that a number of apparent inconsistencies exist in the table, although it is believed that the total production of coal from each mine and that compiled for each county is as complete as can be made except by a personal canvass of the mines.

In the column of local consumption there is no tonnage assigned to Blair, Cameron, Centre, Indiana, and Venango counties. This does not indicate that the local tonnage reported does not cover the local consumption, but that no division has been made of the amount of coal locally consumed and that shipped to distant points. The total production of each county, therefore, in every case is believed to include the amount locally consumed; other inconsistencies might be mentioned.

In the reports received from coal operators whose mines are large enough to be examined by the State inspectors a large amount of information was obtained relative to smaller mines, which are worked by their owners during a portion of the year for the supply of their own mills and manufacturing establishments or the domestic market immediately around the mines. It was impossible to obtain the exact amount of coal produced by these mines in each county, but it is safe to estimate that for the entire bituminous region of the State it amounted during the year to at least 200,000 tons, which has been classified in the above table as 196,000 tons for shipment, or that used outside and independently of the amount of coal required for steam or ventilating purposes at the mines, and 4,000 tons for the latter purposes.

The total shipment of the State (30,866,602 short tons) reported in the summary for the States, includes both the amount noted as shipped in the above table and that reported as manufactured into coke.

The average value per ton of the total production was a fraction *less* than 90 cents per ton, making the total value at the mines of all the coal produced (31,516,856 short tons) $28,339,455. The average value per ton at the mines of coal shipped and coked was a little *over* 90 cents per ton, making the aggregate value of the coal classified as shipped (30,866,602 short tons), as reported in the summary table for the States, $27,806,941. A comparison of the statistics for 1886 with 1887 is shown in the following table:

Statistics of the Pennsylvania bituminous mines for 1887.

Counties.	Number of operators.	Number of mines.	Shipment.	Local consumption.	Coked.	Total production.	Average price per ton at mines.	Total value at mines.	Average number of days worked.	Number of employés.
			Short tons	*Short tons*	*Short tons*	*Short tons*				
Allegheny	69	93	4, 472, 924	125, 000	83, 000	4, 680, 924	$1. 03	$4, 821, 352	201	10, 000
Armstrong	6	8	184, 100	14, 764	36, 357	235, 221	. 74	174, 064	215	416
Beaver	5	5	189, 846	8, 017	....	197, 863	1. 12	221, 607	223	513
Bedford	6	8	235, 182	4, 000	72, 270	311, 452	. 85	264, 734	235	530
Blair	6	9	78, 796	....	208, 571	287, 367	. 76	281, 398	255	610
Bradford	2	3	162, 419	4, 997	....	167, 416	1. 24	207, 023	248	381
Butler	9	10	147, 622	1, 237	12, 905	161, 764	. 80	129, 411	156	412
Cambria	28	33	971, 969	170, 621	279, 390	1, 421, 980	. 81	1, 151, 803	230	2, 500
Cameron	1	1	3, 000	....	....	3, 000	1. 25	3, 750	....	......
Centre.........	8	13	362, 527	....	145, 728	508, 755	. 90	457, 429	240	950
Clarion	11	13	537, 401	10, 000	46, 357	593, 758	. 73	433, 443	175	1, 144
Clearfield	44	94	4, 998, 735	15, 387	166, 189	5, 180, 311	. 845	4, 378, 782	204	8, 039
Elk............	4	23	596, 492	2, 000	11, 265	609, 757	. 91	554, 879	245	1, 545
Fayette........	46	78	320, 147	32, 883	4, 187, 292	4, 540, 322	. 75	3, 405, 241	210	7, 600
Greene	1	1	....	3, 002	....	3, 002	. 92	2, 762	270	10
Huntingdon ...	7	9	112, 296	1, 300	151, 883	265, 479	. 80	212, 383	182	538
Indiana.........	4	4	191, 597	....	16. 000	207, 597	. 95	197, 217	301	190
Jefferson	4	18	1, 263, 515	11, 977	418, 000	1, 693, 492	. 83	1, 405, 598	250	5, 160
Lawrence......	3	3	124, 761	600	....	125, 361	1. 028	128, 871	205	256
McKean	1	2	8, 761	453	....	9, 214	......	9, 214	....	10
Mercer	14	17	513, 110	26, 611	....	539, 721	1. 02	550, 515	202	1, 240
Somerset	14	16	363, 643	14, 442	38, 155	416, 240	. 706	293, 865	250	528
Tioga..........	4	13	1, 044, 995	12, 968	271, 000	1, 328, 963	1. 25	1, 661, 204	238	2, 652
Venango.......	1	1	2, 296	....	....	2, 296	1. 00	2, 296	160	8
Washington ...	28	37	1, 698, 275	43, 340	10, 000	1, 751, 615	. 91	1, 593, 970	189	3, 900
Westmoreland.	48	84	2, 930, 197	142, 655	3, 001, 634	6, 074, 486	. 935	5, 679, 644	238	10, 000
Unreported mines, estimated	....	....	196, 000	4, 000	....	200, 000	. 90	180, 000	....	......
Total	374	596	21, 710, 606	650, 254	9, 155, 996	31, 516, 856	. 90	28, 339, 455	222	59, 132

BOUNDARIES OF INSPECTION DISTRICTS.

The bituminous regions of the State are divided into eight mine inspection districts, as follows:

First district.—Greene county, Washington county, that part of Westmoreland county west of the Youghiogheny river, and that part of Fayette county which lies along the Monongahela river.

Second district.—That part of Allegheny county east of the Allegheny, Monongahela, and Youghiogheny rivers; Westmoreland county, except the mines along the West Pennsylvania railroad, and those mines along the main line of the Pennsylvania railroad west of Brinton station.

Third district.—That part of Beaver county north of the Ohio river; Lawrence county; Butler county; Armstrong county; the mines in Westmoreland county which lie along the West Pennsylvania railroad; Mercer county; Venango county, and Clarion county.

Fourth district.—Bradford, Sullivan, Tioga, Lycoming, Clinton, McKean, Cameron, Elk, and Jefferson counties, and that part of Clearfield county along the Allegheny Valley railroad.

Fifth district—Somerset and Fayette counties, except mines along the Monongahela river.

Sixth district.—Huntingdon, Bedford, Blair, Cambria, and Indiana counties, Clearfield along the Bell's Gap railroad to Irvona, and Westmoreland county along the main line of the Pennsylvania railroad east of Brinton station.

Seventh district.—Allegheny county west of the Allegheny, Monongahela, and Youghiogheny rivers.

Eighth district.—Centre and Clearfield counties, except the parts along the Allegheny Valley railroad and along the Bell's Gap railroad to Irvona.

The following table gives a summary of the mine inspectors' statistics for the year 1887:

Inspectors' returns by districts in Pennsylvania for 1887.

Districts.	Mines in district.	Persons employed in the mines.	Persons employed outside.	Tons of coal mined to each fatal accident.	Tons of coal mined to each non-fatal accident.	Employés to each fatal accident.	Employés to each non-fatal accident.
First	72	4, 782	436	487, 966	71, 409	869	127
Second	70	7, 058	2, 686	217, 437	118, 172	389	212
Third	54	3, 865	613	....	112, 565	....	236
Fourth	68	6, 441	1, 069	321, 069	143, 927	577	259
Fifth	76	4, 589	3, 313	570, 457	134, 225	988	232
Sixth	81	4, 887	1, 191	477, 340	278, 448	868	506
Seventh	80	8, 320	838	374, 223	95, 732	832	213
Eighth	96	7, 147	633	344, 929	10, 452	556	236
Totals and averages	597	47, 089	10, 779	256, 153	83, 723	689	225

Total production, local consumption, and shipment of coal from the inspectors' districts for 1887.

Districts.	Inspectors.	Shipment.	Local consumption including amount coked.	Total production.
		Long tons.	*Long tons.*	*Long tons.*
First	Henry Louttit (*a*)	2, 089, 879	(*b*) 837, 920	2, 927, 799
Second	William Jenkins	2, 804, 854	2, 631, 069	5, 435, 923
Third	Thomas K. Adams	2, 024, 119	114, 619	2, 138, 738
Fourth	Roger Hampson	3, 684, 663	489, 246	4, 173, 909
Fifth	J. T. Davis	406, 001	4, 157, 656	4, 563, 657
Sixth	J. T. Evans	2, 114, 843	1, 226, 538	3, 341, 381
Seventh	James Blick (*a*)	3, 906, 452	210, 000	4, 116, 452
Eighth	John M. Watt	4, 678, 815	150, 202	4, 829, 017
		21, 707, 606	9, 809, 250	31, 516, 856

a No returns received from inspectors; these figures are compiled from returns from the individual operators in these districts made directly to the survey.

b Includes surplus on hand at end of year.

The Pennsylvania Railroad Company is the largest single carrier of bituminous coal in the State, the tonnage of coal (bituminous and anthracite) and coke originating on the main line and branches of this road between Harrisburg and Pittsburgh is shown in the following table:

Pennsylvania railroad shipments of coal and coke.

Districts.	1885. Coal.	1885. Coke.
	Short tons.	*Short tons.*
Originating on the Pennsylvania Railroad division:		
Snow Shoe, semi-bituminous	148, 500	25, 643
Karthaus	120, 969	....
Tyrone and Clearfield	2, 873, 876	....
Gallitzin and Mountain	550, 244	193, 091
West Pennsylvania	219, 750	64, 901
Southwest Pennsylvania	102, 689	1, 999, 923
Westmoreland region	1, 293, 813	252, 397
Monongahela region	267, 502	108, 706
Pittsburgh region	236, 703	....
North and West branch	1, 294, 334	....
Sunbury, Hazleton, and Wilkes-barre	321, 192	....
Other localities	....	....
Originating off the Pennsylvania Railroad division:		
Anthracite	3, 087, 831	....
Bituminous	1, 062, 193	57, 652
Total	11, 579, 596	2, 702, 313
	1886.	
Originating on the Pennsylvania Railroad division:		
Snow Shoe, semi-bituminous	113, 967	29, 036
Karthaus	154, 086	....
Tyrone and Clearfield	2, 273, 147	24
Gallitzin and Mountain	672, 564	201, 868
West Pennsylvania	318, 493	110, 168
Southwest Pennsylvania	158, 185	2, 715, 895
Westmoreland region	1, 305, 733	339, 965
Monongahela region	414, 611	157, 061
Pittsburgh region	278, 671	628
North and West branch	1, 388, 340	....
Sunbury, Hazleton, and Wilkes Barre	359, 384	....
Other localities	9, 451	....
Originating off the Pennsylvania Railroad division:		
Anthracite	2, 965, 124	....
Bituminous	1, 327, 740	70, 466
Total	11, 739, 496	3, 620, 111
	1887.	
Originating on the Pennsylvania Railroad division:		
Snow Shoe, semi-bituminous	165, 091	59, 325
Karthaus	196, 289	....
Tyrone and Clearfield	3, 256, 328	1, 763
Gallitzin and Mountain	793, 550	260, 118
West Pennsylvania	312, 928	110, 538
Sounthwest Pennsylvania	118, 690	2, 819, 856
Westmoreland region	1, 636, 974	385, 542
Monongahela region	431, 925	125, 564
Pittsburgh region	217, 201	73
North and West branch	1, 374, 454	....
Sunbury, Hazelton, and Wilkes Barre	341, 729	....
Other localities	120, 207	....
Originating off the Pennsylvania Railroad division:		
Anthracite	....	....
Bituminous	....	....
Total	....	....

RHODE ISLAND. (a)

Total production in 1887, 6,000 short tons; spot value, $16,250.

The New England basin has been estimated to contain 500 square miles of coal-producing territory. The original coal beds in this basin have been metamorphosed into graphite and graphitic coal, of which a considerable quantity has been mined at various times in the past. The area includes eastern Rhode Island and the counties of Bristol and Plymouth, Massachusetts. The graphitic character of the coal has resulted from the metamorphic action which the beds and their associated strata have undergone; this action has expelled all the volatile matter originally contained in the coal, and the bulk of the carbon has been converted into graphite. The product mined from the beds requires a considerable degree of heat for combustion, and can only be used in connection with other combustible material or under intense draught or blast. Prof. N. S. Shaler, of Cambridge, Massachusetts, who has recently examined the coal fields about Narragansett bay, says: "This field contains a large and essentially unexplored coal basin, which gives promises of great value. I have found that this basin contains several coal beds of workable thickness underlying a large area. The coal is exceedingly anthracitic, but has a heat-giving power of 80 per cent. of the best Pennsylvania anthracite. The beds lie in strata much dislocated, and they are in part rendered useless by the crumbling and cracking which have accompanied the foldings to which they have been subjected; still there are large areas where the beds lie in altitudes which will render mining not difficult. The field has peculiar advantages for making water gas, and smelting iron and copper, as the coal will not fill up a furnace to the extent of other anthracites, and will remain a long time in combustion. The percentage of sulphur is slight and the proportion of ash is not greater than that of several coals extensively used in this country. This is the only coal field on the United States Atlantic coast which is actually on tidewater. Nearly the whole basin is covered by a thick coating of rearranged glacial drift, which often makes it impossible to get any knowledge of the geology of the bed rock. There are no exposures of the underlying strata."

The statistics of the production of coal in Rhode Island for 1887 were furnished by the governor of the State, having been obtained through the Bureau of Labor Statistics. The most important mine that is being worked at the present time is the Cranston mine, operated by the Carbon Iron Company, of New York. This mine is about 2½ miles from Narragansett Pier, on Sockanosset hill, in Kingston township; it is opened by two shafts, each 75 feet deep; the bed varies in thickness from 10 to 35 feet, but averages about 28 feet. It consists of graphitic coal and has a black slate roof; the dip is 15° in a southeast direction.

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a The product of the Rhode Island mines does not enter into competition with coals for fuel purposes; on account of its peculiar graphitic character it has a special use of its own, and is generally classed by the trade as graphite.

The production of this mine in 1887 was 5,500 tons, of which 3,000 tons were shipped to the steel works of the Carbon Iron Company, in Pittsburgh, leaving a surplus of 2,500 tons on hand at the end of 1887. The coal is used in the reduction of high-grade iron ores to a metallic sponge, for the direct manufacture of steel. For this purpose the Carbon Iron Company mixes 30 per cent. of graphite with the pulverized ore. About twenty men are employed on an average at this mine, wages being about $1.60 per day.

The Blackstone Coal Mining Company is operating a mine on Cumberland hill, in the northeastern corner of the State. During 1887 this mine produced 500 tons, all of which was shipped for molders' use in making furnace and stove facings. The product of the mine, which is known as graphite, is shipped in the pulverized state, being ground at the mines before shipment. The present workings are about 200 feet from the surface, though the mine extends to a depth of 500 feet. The value ot this product when prepared for shipment is about $5 per ton at the mine. The Portsmouth mine of anthracite coal was probably the first mine worked in this region. The graphitic coal was discovered in 1809, and was worked on a small scale until 1840. For forty years subsequent to 1840 two mines were working this coal bed quite extensively, the production previous to 1870 being about 16,000 tons per year. It has been estimated that there is in this deposit 38,000,000 tons of coal, analyzing at its best 90 per cent. of carbon, but containing very little sulphur. This deposit has remained unworked for the past six years. There has lately been considerable discussion as to whether this coal and graphite in the New England basin could be profitably mined for the manufacture of fuel gas, and for use in the blast furnace for iron making. Associated with the coal and graphite are extensive deposits of iron ore, limestone, and fire clay. The Rhode Island iron ores are of rather a low grade, but they can be cheaply mined and are very low in phosphorous and sulphur. It has been proposed to use these ores in connection with rich foreign ores for the manufacture of a high-grade Bessemer steel.

TENNESSEE.

Total production in 1887, 1,900,000 short tons; spot value, $2,470,000.

The coal field of Tennessee is part of the Appalachian coal field. The workable coal area is confined to what is known as the Cumberland table land, an elevated and sharply outlined plateau which is a prolongation of the southern end of the Kentucky field. Its area is about 1,500 square miles, and it is embraced within the following counties: Scott, Morgan, Cumberland, Fentress, Van Buren, Grundy, Bledsoe, Sequatchie, Marion, Overton, Putnam, White, Warren, Franklin, Claiborne, Campbell, Anderson, Rhea, and Hamilton. At its northern boundary the coal field is 71 miles broad, and at its southern boundary 50 miles.

For convenience of description the Coal Measures have been divided into the Upper and Lower series. The Upper series has an average thickness, in the Sequatchie section, of about 200 feet, and the lower series about 225 feet. The Upper series is capped by a conglomerate 50 feet thick, and the Lower series rests on top of the mountain limestone. The two series are separated by a conglomerate 70 feet thick. In the upper series are included what have been known locally as coal beds A, B, and C, and in the lower series coal beds D, E, F, and G.

Previous to 1887 the statistics for the State were collected by the State mine inspector. In 1887 no special appropriation was made by the State for carrying on this work of collecting statistics, and hence they had to be collected directly from the several operating companies in the State by the Survey. Detailed returns were not received from all of the mines in the State, and hence the exact production for 1887 can not be given. Mines are being operated in Tennessee in the following counties: Grundy, Marion, Hamilton, Rhea, Roane, Anderson, Scott, and Campbell. The largest operator in the State is the Tennessee Coal, Iron and Railroad Company, which operates mines at Tracy City and Whitwell, in Grundy county, in Tennessee, and the Pratt mines in Alabama. The total production of the mines of this company in Tennessee in 1887 was 428,014 tons, and of the mines in Alabama 711,606 tons, making a total for both of the States of 1,139,620 tons. A considerable amount of this coal is manufactured into coke in Tennessee, but the returns from the company did not give the amount manufactured into coke in each State separately. The following, however, will show the total amount manufactured into coke and shipped from the mines in Alabama and Tennessee combined:

Coal produced by the Tennessee Coal, Iron and Railroad Company in 1887.

	Short tons.
Total consumed at the mines, including the amount made into coke	509,288
Total shipped to outside markets	630,332
Total production	1,139,620

The Tracy City mines in Tennessee produced 415,485 tons and the Whitwell mines in Tennessee produced 12,529 tons; this coal is used principally for coking and steam purposes, and is shipped to various points in the South from Nashville to New Orleans. The Etna Coal Company is operating a mine in Marion county; these mines were first opened in 1882 and have been operated since that time by several companies with varying success; the coal is excellent for blacksmithing purposes and makes a very good foundry coke. No details were received from this mine for 1887. The Consolidated Coal and Iron Company is opening a mine at Kelley's Ferry in Marion county, and expects to coke a portion of the coal at the mine. This company is a successor to the McNabb Coal and Iron Company, and took charge of the mine at the beginning of 1888. The McNabb Coal Company mined very little coal in

1887. The principal work done at the mines was constructing and opening new areas preparatory to commencing active work in 1888. This company owns 18,000 acres of land, the greater part of which is underlaid by a coal seam 2½ to 3½ feet in thickness; the coal is adapted for use as a blacksmithing, steam, and coking coal. The following analyses of the coal and coke are reported by the company:

Analyses of coal and coke from the McNabb Company, Tennessee.

Coal.	Ash.	Fixed carbon.	Volatile matter.	Sulphur.	Water.	Analyst.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
McNabb coal	2.46	71.85	23.32	1.32	1.05	University of Cincinnati.
Do	5.550	69.550	22.70	2.200	....	W. Dickerson.
Oak Hill coal	11.600	67.120	19.30	1.980	....	Do.
McNabb coke....	3.29	95.83	....	0.88	....	University of Cincinnati.

The Soddy Coal, Iron and Railway Company is operating the following mines in Hamilton county: No. 1 Gulch mine, and Africa mine. This company produced, during 1887, a total of 112,694 tons of coal, which commanded at the mines an average price of $1.25 per ton. Of this total 68,232 tons were lump coal and 44,462 tons slack coal. The coal bed worked averages about 3 feet 4 inches in thickness, and extends over 8,000 acres. The coal is used for steam and coking purposes.

The following analysis made by the Roane Iron Company will show the quality of this coal:

Analysis of coal from Hamilton county, Tennessee.

	Per cent.
Ash	6.64
Fixed carbon	64.39
Volatile matter..	27.82
Sulphur	Trace.
Water..	1.15
Total..	100.00

The company employs about 250 miners and 100 laborers; mining is paid at the rate of 60 cents per ton for run of the mine on an average, payments being regulated by a sliding scale. The average wages of the day hands is about $1 per day. This coal is shipped to Chattanooga, Tennessee, and Athens, Macon, and Augusta, Georgia.

The Walden Ridge Coal Company is operating a mine at Sale creek in Hamilton county, 28 miles from Chattanooga on the Cincinnati Southern railroad. This company produced 60,000 tons of coal in 1887, of which 36,000 tons were manufactured into coke. The coal bed worked varies in thickness from 3 feet to 4½ feet, the average being 3 feet 6 inches. The coal is soft and specially adapted for coking purposes, though it is also an excellent steam coal. These mines were operated steadily throughout 1887, 200 men being employed. The coal was shipped to Chattanooga and other points; it sold at the mines for an average of $1.25 per ton. This company enlarged its plant considerably during 1887, increasing the capacity so that the production for 1888 will probably be largely in excess of that for 1887. A new mine has been opened in this locality by the Fox Coal and Coke Company. The Daisy Coal Company is operating a mine at Daisy station, on the Cincinnati Southern railway, 18 miles from Chattanooga. This mine during 1887 produced 20,000 tons of coal, of which 2,400 tons were consumed at the mines or made into coke. The coal bed worked is 3 feet 10 inches in thickness; the coal is specially adapted for steam and coking purposes. The mine was operated two hundred days in 1887, 100 men being employed. The Daisy Coal Company took charge of this mine on December 1, 1887, since which time the capacity of the mine has been nearly doubled, so that a much larger output may be expected for 1888. This coal was shipped principally to Atlanta, Georgia. The average selling price at the mines for the year being $1.15 per ton. On this same property are several other workable coal beds, which may be opened in the near future. The Dayton Coal and Iron Company, limited, is operating two mines in the vicinity of Dayton, Rhea county. The Richland mine is 3 miles west of Dayton and the Nelson 1½ miles from Dayton. Both of these mines are located on Walden's ridge. During 1887 the production of these mines was as follows:

Production of coal on Walden's ridge in 1887.

	Long tons.
Richland	75, 988
Nelson	78, 663
Total	154, 651

The total production of these mines is manufactured into coke for use in the Iron Company's furnaces at Dayton. The coal bed worked at Richland mine is 23 inches thick, and that at the Nelson mine 5 feet in thickness. The following analyses, made by Mr. H. S. Fleming, will show the quality of these coals:

Analyses of coal and coke from Dayton, Tennessee.

	Richland coal.	Richland coke.	Nelson coal.
	Per cent.	*Per cent.*	*Per cent.*
Ash	10. 32	19. 36	7. 38
Fixed carbon	64. 39	77. 38	64. 38
Volatile matter	25. 29	1. 43	28. 34
Sulphur	2. 48	1. 83	....

Descriptions of both of these mines may be found in the report for 1886. The mines were operated throughout the entire year 1887, having worked three hundred and thirteen days; 550 men were employed at the mines. Mining is paid for at the Richland mine at the rate of 60 cents per ton of 2,100 pounds and at the Nelson mines at the rate of 40 cents per ton of 2,100 pounds. The Roane Iron Company is operating a mine at Rockwood, in Roane county, 70 miles north of Chattanooga. The entire production of this mine during 1887 was 123,043 tons, all of which was manufactured into coke for use in the company's furnaces. The coal bed dips into the mountain at an angle of 45°, and is mined from three different levels. The coal is particularly adapted for coking and steam purposes, for which uses it is employed by the Roane Iron Company. The mines were operated every day in the year with the exception of Sundays, 80 miners and 100 laborers being employed. Mining was paid for at the rate of 1¾ cents per bushel; drivers receiving $1.25 per day.

The Jellico Mountain Coal and Coke Company is operating a mine at Newcomb, in Campbell county. This mine produced 95,000 tons of lump coal in 1887, of which 94,000 tons were shipped to Atlanta, Macon, Rome, and other points in Georgia, Alabama, and Tennessee. The price of this coal, delivered on the cars at Newcomb during 1887, was $1.35 per ton. The coal bed worked at this mine is 4 feet 6 inches in thickness, and extends over an area 8 miles long by 6 miles wide. The coal, which is known as "Jellico Mountain" coal, is used for domestic and steam purposes. It is very hard, and may be stocked in yards without loss.

The following analysis of the Jellico Mountain coal, made by Professor Peters, of Lexington, Kentucky, is given by the company:

Analysis of coal from Jellico mountain, Tennessee.

	Per cent.
Ash	1.60
Fixed carbon	60.60
Volatile matter	35.44
Sulphur	Trace.
Water	2.36
Total	100.00

These mines were operated about two hundred and fifty days during 1887, 250 miners and laborers being employed at the mines. Miners' wages average 75 cents per ton for lump coal; day laborers, $1.25 to $1.75 per day. There are seven different coal beds in the Jellico Mountain district, including a fine bed of cannel coal. The Standard Coal Company has recently opened a mine in this cannel coal bed at Newcomb, 3 miles south of the Kentucky line, on the Knoxville and Ohio railroad. This cannel coal bed is 400 feet above the Jellico bed, and ranges in thickness from 3 feet to 3 feet 4 inches. It is free from sulphur, slate, and other impurities. It is estimated that there are

1,200 acres of this cannel coal in this deposit. An analysis of this coal is as follows:

Analysis of cannel coal from the Jellico Mountain district, Tennessee.

	Per cent.
Volatile matter	49.85
Fixed carbon	35.03
Ash	15.12
Sulphur	.74
Candle-power of gas	40.00

This mine was brought up to a capacity of 100 tons per day at the end of 1887, having shipped 1,000 tons up to December 31, 1887. The Standard Coal and Coke Company has mines of bituminous coal at Newcomb, which produced during 1887 a total of 60,000 tons, of which about 57,000 tons were shipped to points on the East Tennessee, Virginia and Georgia railroad. This coal commanded a price of $1.65 per ton at the mine during 1887. The coal bed worked is 4 feet thick on an average. The quality of the coal varies, in some places becoming almost semi-anthracite. It is used especially for grate and steam purposes; the sales for domestic purposes being very large. This coal shows the same composition as that given by the Jellico Mountain Coal and Coke Company.

One hundred and seventy-five men were employed at these mines during 1887, the average wages of miners being about $2 per day and of laborers about $1.50 per day. The company expects to make a large output of cannel coal in 1888. This cannel coal is used especially as a gas enricher; the percentage of volatile hydro-carbons being very large. Several other new mines were opened in this vicinity during the year.

The number of miners and others employed at the different mines in the State during 1887 was probably more than 3,500. Of this total about 800 are convicts, who are largely employed in the mines at Tracy City and Coal Creek. Reference was made in last report to the coke supply for Tennessee. Some of the coke made in this State makes a very fair furnace fuel. The Etna Coal Company shipped coke as far west as Arizona, but most of the Tennessee coke is used at local points in the State.

TEXAS.

Total production in 1887, 75,000 short tons; spot value, $150,000.

No reliable statistics of the amount of coal mined in this State are available. In fact, very little is known in regard to the geology of the coal and lignite beds and their associated strata. As far as known the coal area can be divided into three prominent groups: (1) Eolignitic area, (2) Central area, and (3) the Mountainous area. Descriptions of these areas, and especially the first, can be found in the report for 1886.

Returns were received from three mines in the State during 1887. In this work valuable assistance was rendered by Mr. E. W. Parker of Austin. Most of the mines in the State are operated on a small scale to supply the local demand. Heretofore no provision has been made by the State legislature for collecting coal statistics; at their last session, however, all county collectors were instructed to submit full and comprehensive reports of all mining and minerals in their several counties to the legislature at its next meeting, which occurs in January, 1889; more complete returns of these mines may therefore be expected for 1888.

The Black Diamond Coal Company is operating a small mine near Rockdale, in Milam county, on the main line of the International and Great Northern railroad. This company is working a seam of lignite 5 feet 4 inches thick, under a cover of 20 feet. Forty feet below this bed is found another coal bed 6 feet 8 inches in thickness; while 25 feet deeper is a third coal bed 4 feet 8 inches in thickness. This latter coal bed is said to be cannel coal of excellent quality. The second and third beds have only been explored by drilling. The coal mined from the upper bed is sold locally at Austin, and is used also near the mines for brick-making, the brick clay occurring in beds associated with the coal. This coal burns readily, giving a strong and steady heat, leaving no clinkers and but little ash. The production of this mine during 1887 was very small. The coal sells at the mine at $1.50 per ton.

John Crosby, of Bexar county, is operating the Kirkwood colliery. This mine produced 1,428 tons of lignite during 1887, which was sold at San Antonio, Bexar county, for steam purposes. This coal commanded $1.35 per short ton at the mines in 1887. The coal bed worked varies from 5½ to 7 feet in thickness. During 1887 from three to six men were employed at this mine, the miners being paid 50 cents per ton for lump coal, and laborers $1.50 per day of ten hours.

The largest mine in the State from which returns were received by the Survey was that operated by Mr. R. H. Hartz, at Eagle Pass, Maverick county. This mine produced during the year 22,700 tons, including nut and slack coal. Of this production 17,400 tons were shipped to San Antonio or supplied to the Southern Pacific Company for locomotive use. This coal commanded in 1887 a price of $2.25 per ton at the mines. The coal is used for stationary engines and locomotives. The bed worked is 6 feet 4 inches in thickness and is interstratified with a streak of slate, which reduces the workable thickness to 4 feet 3 inches. The coal is hard and has to be blasted with powder. The coal field in this vicinity is very large; its exact dimensions have never been established, but the outcropping of coal beds can be seen for miles up and down the Rio Grande river in the vicinity of Eagle Pass. The mine operated by Mr. Hartz is about 5 miles northwest of Eagle Pass. During 1887 this mine was worked 250 days; 20 miners and 10 laborers being employed at the mine, and 30 teamsters to haul the coal to the railroad at Eagle Pass. The miners received $1.25 for digging coal, and laborers' wages were $1.50 to $1.75 per day. In various parts of the State coal has been reported as occurring in workable quantities during 1887.

Mr. W. M. Chandler, of El Paso, states that the Eagle Springs mines, in El Paso county, have been leased to Dr. John Arthur of Kansas City, who has contracted to mine 30 tons of coal per day. No coal was produced at these mines in 1887. Mr. Chandler states that he does not consider that there is any very large amount of coal in El Paso county. The total production of coal and lignite in the State for 1887 would probably not exceed 75,000 tons.

UTAH TERRITORY.

Total production in 1887, 180,021 short tons; spot value, $360,042.

Very limited coal developments have been made in this Territory. The first operations were started in the vicinity of Coalville, in Summit county, northwest of Salt Lake City, in 1864, at mines which are now being operated by the Home Coal Company. The present coal mines are confined to Summit, San Pete, and Emery counties.

At the Winter Quarters mine of the Pleasant Valley Coal Company, which is situated at Scofield, Emery county, the production during the year 1887 was 94,610 tons, divided among the different sizes of coal as follows: Lump 84,072, nut 2,278, slack 8,260 tons. This coal is a good steam and stove coal, and is shipped for these purposes to various points in Utah, western Colorado, and Nevada. The greater part is shipped to points in Utah, only a small quantity going out of the Territory. The average selling price of this coal in 1887 was $1.98 per ton at the mines. Mining is paid at the rate of 80 cents per ton in winter and 70 cents in summer. In the winter months 130 men are employed, but in summer this number is reduced to 70 men. During 1887 the mine was operated 280 days. The coal bed is 11 feet in thickness; the following recent analysis of the coal is given by Mr. W. F. Colton, the secretary of the company:

Analysis of lignite from Winter Quarters mine, Utah.

	Per cent.
Ash	5.55
Fixed carbon	47.30
Volatile matter	39.85
Water	7.30
Total	100.00

The Utah Central Railway Company's mine at Scofield, Emery county, produced in 1887 a total of 44,465 tons of coal, which was shipped principally to Salt Lake City and towns on the line of the Utah Central Railway. This coal commanded a price of $2 per ton at the mines. In summer 41 men are employed, and in winter 85 men. The mines were operated 232 days in 1887. The wages paid at this mine are the same as those paid at the Pleasant Valley Coal Company's mine. The coal bed at the Utah Central Railway Company's mine is 28 feet thick.

The Home Coal Company now operates two mines in the vicinity of Coalville; in 1887 these mines produced about 30,000 tons of coal. About two-thirds of the entire product is consumed at Park City, Utah. The mines have hitherto been connected by narrow gauge track with the railroad, thus necessitating a transfer of the coal from the narrow to the broad gauge cars, but, with the third rail making broad gauge connections with the mines, the output in 1888 will doubtless be very much increased. The coal bed is 12 feet thick, the coal is tender, and makes 40 to 50 per cent. of slack. It is used principally for steam purposes and for domestic fuel. An analysis of this coal is as follows:

Analysis of coal from Coalville, Utah.

	Per cent.
Ash	4.30
Fixed carbon	46.37
Volatile matter	38.90
Water	10.32
Total	99.89

The Grass Creek mines, near Coalville, were only worked to a limited extent during 1887, only 4,946 tons of coal being mined. Messrs. Hill & Snyder are drawing the pillars of these mines, having a lease from the Grass Creek Coal Company. The coal bed worked at the Grass Creek mines is about 10 feet in thickness.

The total production of the Territory, including that given above, and that from small mines from which no direct returns were obtained, is estimated at 180,021 short tons, distributed as shown in the following table:

Coal production of Utah, by companies, in 1887.

Companies.	Short tons.
Pleasant Valley Coal Company	94,610
Utah Central Coal Company	44,465
San Pete Coal and Coke Companies	3,000
Grass Creek Coal Company	4,946
Home Coal Company	30,000
Small mines	3,000
Total	180,021

VIRGINIA.

Total production in 1887, 825,263 short tons; spot value, $773,360.

The coal fields of Virginia may be divided into: First, the Richmond coal field, situated in the Triassic sandstone areas in the vicinity of Richmond. Second, the Middle or sub-Carboniferous coal fields, situated in the western part of the State along the frontier of that division of the State which is generally known as "Appalachia." The coal beds of this division are geologically in the Pocono, or Vespertine, formation, which is now generally considered to be the bottom member of the Carboniferous group, instead of being designated as the Lower sub-Carboniferous as formerly. Third, the Pocahontas coal field, which spreads over parts of Tazewell, Dickenson, Wise, and Lee counties; the workable coal beds within this area being assigned to the Lower Productive and Pottsville Conglomerate Coal Measures, respectively. The largest and most important developments are situated within the latter field and in Tazewell county, which is the only county within the Pocahontas field which now ships any coal to market.

The production of coal in the State for the year is exhibited in the following table:

Total production of coal in Virginia in 1887, by counties.

Counties.	Names of companies.	Total production.	Local consumption.	Manufactured into coke.	Total shipped.
		Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Tazewell	Southwest Virginia Improvement Company.	781, 155	2, 782	160, 941	617, 432
Chesterfield .	Brighthope Railway Company.	30, 000	3, 000	....	27, 000
Montgomery.	Hugh Price...........	67	....	....	67
	Jas. B. Price..........	560	....	....	560
	J. M. Cronen	1, 008	336	....	672
	Kanode Bros..........	525	455	....	70
	Smith & Bell..........	470	336	....	134
	Jno. H. Kipps	1, 008	560	....	448
	W. C. G. Myers	336	336	....	....
	Myers Bros...........	3, 024	336	....	2, 688
	Brush Mountain Coal Company.	896	....	....	896
	Hoge Tyler...........	3, 360	....	....	3, 360
	Kinzer & Shaeffer ...	1, 232	336	....	896
	Sam'l Smith's heirs...	42	....	....	42
	J. P. Linkons.........	997	....	....	997
	Moore & Co	583	58	....	525
	Total for State...	825, 263	8, 535	160, 941	655, 787

During 1887 there was an increase in the production of coal over 1886 in Tazewell county of 141,404 tons, in Chesterfield county an increase of 2,000 tons, and in Montgomery county a decrease of 3,092 tons; this apparent decrease in Montgomery county is probably largely due to the fact that some of the estimates in this county for 1886 were too large. During the year there was a slight decrease in the amount of coal locally consumed, and the amount of coal manufactured into coke in Tazewell county was 67,000 tons in excess of that manufactured into coke during 1886. The shipments over the Norfolk and Western railroad during the year were reported by Mr. Charles G. Eddy, vice-president, as follows:

Shipments of coal over the lines of the Norfolk and Western railroad during 1887.

Localities from which coal is shipped.	Coal.	Coke.
	Long tons.	*Long tons.*
Flat Top Mines, Virginia	503,071	103,209
Flat Top Mines, West Virginia	471,976	47,962
Back Creek, Tyler's, and Belmont stations	2,646	....
Vicker's and Pulaski City stations	8,584	....
Total	986,277	151,171

Mr. Eddy, in referring to the shipments of coal and the coal fields along the line of the Norfolk and Western railroad, says:

"The Pocahontas coal field is in Virginia and West Virginia. All that portion of the coal field lying north of the Bluestone river is in West Virginia. There were shipped from the Pocahontas Flat Top coal field, from mines in Virginia, during the year 1887, 503,071 tons of coal; from the Pocahontas Flat Top coal field, from mines in West Virginia, during the same period, 471,976 tons. At New River Division stations—Back Creek, Tyler's, and Bellspring—a semi-anthracite coal is mined on a small scale, and from those three points during the year 1887, 2,646 tons were shipped.

"This same class of coal is also mined and shipped from Vicker's station, on our main line, and a bituminous coal of inferior quality is also produced at the Altoona mines, near Pulaski City. From Vicker's and Pulaski, during the year 1887, 8,584 tons were shipped.

"The coke shipments from the Pocahontas Flat Top field, during the year 1887, of coke manufactured in Virginia, were 103,209 tons; from the Pocahontas Flat Top field in West Virginia, 47,962 tons. One and two-thirds tons of coal are required to make 1 ton of coke, so the calculation can readily be made, and this amount of coal should be added to the coal tonnage from the Pocahontas Flat Top field in both Virginia and West Virginia.

"It is calculated that there were mined and consumed in the vicinity of the Pocahontas Flat Top field, not shipped by rail, at least 5,000 tons of coal, and for territory along the main line and the New River Division 3,000 tons would cover the total amount consumed locally, which was furnished direct from the mines and not shipped in cars."

It will be found that the figures given by Mr. Eddy are slightly different from those recorded elsewhere, which were obtained from separate and independent sources. The closeness of the agreement between these independently reported statistics testifies to the general value of both. The annual shipments of coal over the Norfolk and Western railroad since 1883 have been reported by Mr. F. J. Kimball, president of the company, as follows:

Shipments of coal over the Norfolk and Western railroad from 1883 *to* 1887.

Years.	Tons.
1883 (from month of June)	105, 805
1884	272, 173
1885	651, 987
1886	924, 361
1887	1, 169, 700

Mr. Talcott Williams, in referring to the recent developments of the coal and coke industries of Virginia, but more particularly the Pocahontas region, says:

"The two Virginias in 1880 produced 1,500,000 short tons of coal, of which 100,000 were from Virginia; in 1884 they produced 3,450,000, of which 250,000 tons were from the larger State; and in 1887 the product reported and estimated rose to 5,200,000 tons, of which considerably over a tenth was from Virginia. The mines of the recently developed coal field of this section and on the Chesapeake and Ohio were playing an inconsiderable part among the bituminous coals east of the Alleghanies three years ago. Last year the seaboard percentage allotted these two lines was 21 per cent., and it is likely to reach a full fourth in 1888; for while the Chesapeake and Ohio output fell off from 656,760 in 1885 to 510,301 in 1887, the mines here advanced 44 per cent. of their output. These mines had their first great opportunity during the Clearfield strike in 1886, and they gained a position which they are likely to maintain in spite of the great distance their product must be taken. Half their shipments reach the seaboard at Norfolk before they find a purchaser, and the minimum price of coal at tidewater under the pool is $2.60, against 85 cents paid here at the mines. This is equally true of coke shipments, which reached 9,603 cars in 1887; only 5,987 of them went to points on the Norfolk and Western and Shenandoah Valley railroads, to be consumed at Lynchburg, Roanoke, and points still more distant. The South took 1,275 cars; for in Alabama the building of furnaces has outstripped the construction of coke ovens, and the coke produced is far from equaling that made here. Chicago, East Saint Louis, and other points in Illinois took 1,263 tons, and the real future of this district will only begin when it has a direct western connection, already surveyed; an opening to the southeast to Wilmington, and lastly to furnaces in its immediate neighborhood. Meanwhile 1888 promises to increase very considerably over 1887, the output of the mines of the Pocahontas region being 81,000 tons for January, against 41,000 in January of last year.

"The cost of production in a level seam of this thickness is low—far below the general average—which in 1880 was $1.22 per ton for bituminous coal and $1.39 for coke. The production per miner is not apparently as great here as in Connellsville. The average in the Pocahontas mines would not, I judge, run over four wagons per man in a day of ten hours, and where, in the narrower seam on the Bluestone river a man and a boy or laborer generally work together, the average is about the same for both. Here, as in Connellsville, there is no waste and no slate, and while a floor and roof of coal are left above and below, a large part of this is saved when the supports are removed. The cost of handling the coal is at its lowest possible figure. Donkey engines bring the cars out of the mine, and once out it is inspiriting to see the speed and facility with which the cars are handled on a gravity line to the tipple by a negro foreman and his mixed gang of negroes and Hungarians. Ventilation in the Pocahontas mines since the terrible explosion of four and a half years ago is provided by 25-foot fans. Aside from the labor account the expenses of operation are not heavy. Timber as yet is abundant and close at hand, and the timbering is less expensive than in Northern mines. The expense per ton of timbering and track laying falls as low, under favorable circumstances, as 1¼ cents a ton, and it rises to 2½ and 3 cents per ton for each of these items in smaller mines or where the seam is in a less advantageous situation.

"A graded royalty is paid by operators to the Trust of 12½ cents per ton for the first 10,000 tons mined, 11 cents above that to 25,000 tons, and over this output 10 cents. The cost of coal at the pit mouth is placed at 65 cents, but it may fall as low as 60 cents. The first figure is generally taken as the safest basis of calculation. The cost of making coke, coal and all, is placed at $1.35 per ton. Of the coke made at Pocahontas all but the Sunday drawing is forty-two hour coke; that is seventy-two hour; and this is the normal practice.

"If the mines run on full time, this would be a paradise for the miners. The company opens the ways and chambers, timbers and lays the tracks, brings the cars up to the breast and takes them away, and pays 75 cents a car for 2-ton cars holding from 80 to 85 cubic feet. The miner provides oil and powder and pays 50 cents a month for tools. 'It is a poor man,' said Mr. William Moody, the mine boss, 'who can not mine four cars a day, and a good man makes five.' Colonel Dodds told me of negro miners who make $120 and $130 a month, nor does this seem surprising from the number of men coming out with five cars as their day's work. The net sum received for a car varies from 50 to 60 cents, and Colonel Dodds placed the average wages at $45 a month. The boy drivers receive 90 cents to $1.06 a day; timber and trackmen, $1.85 to $2.20; men on the dumps, $1.40, and laborers from $1.40 to $1.27. Coke drawers receive from 53 to 55 cents an oven."

The following tables give analyses by Mr. A. S. McCreath of Pocahontas coal, and of a number of coal beds recently examined in the Big Stone Gap, in Wise county, Virginia, lying between Stone and Little Black mountains:

Average analysis of ten samples of coal from the Pocahontas field, Virginia.

	Per cent.
Water	6.940
Volatile matter	18.832
Fixed carbon	74.066
Sulphur	761
Ash	5.647

Analyses of coals from Big Stone Gap area, Virginia.

Locality.	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.	Color of ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
J. H. Huff, Black creek	1.160	34.075	54.798	1.717	8.250	100.000	Reddish gray.
Virginia coal and Iron Company, Preacher creek.	1.096	34.684	58.143	.662	5.415	100.000	Cream.
Virginia cannel, Preacher creek.	1.716	43.069	48.252	.738	6 225	100.000	Light red.
Virginia Imboden seam, Mud lick.	2.008	31.437	57.704	.651	8.200	100.000	Reddish gray.
Virginia Imboden seam, Looney creek.	1.400	33.660	58.365	.705	5.870	100.000	Do.
Imboden seam, Looney creek, No. 1.	.924	35.971	58.436	.579	4.090	100.000	Red.
Imboden seam, Looney creek, No. 2.	1.154	35.346	60.107	.643	2.750	100.000	Salmon.
Virginia coal and Iron Company, Pigeon creek.	1.464	36.266	59.741	.799	1.730	100.000	Pink.
Splint coal, Preacher creek.	.880	37.580	58.059	.406	3.075	100.000	....

The above analyses are reproduced from a series of geological reports recently published by Messrs. A. S. McCreath and E. V. d'Invilliers. These reports have been valuable aids toward the proper understanding of the geology of southwestern Virginia, and of great economical value for the development of the coal beds found in this section.

The Richmond or Triassic coal basin ranks next in the State to the Pocahontas coal field as a coal producer. For a number of years previous to 1887 but one mine was operated in this basin, that of the Brighthope Railway Company. This mine produced 30,000 tons of coal during the year 1887. Toward the close of the year 1887 a number of new companies were organized to develop the coal lands in this Richmond basin; the most important of these are the Virginia Tidewater Coal Company, S. S. Murphy, and the Richmond Coal Mining and Manufacturing Company. The Virginia Tidewater Coal Company and S. S. Murphy are opening mines near Midlothian. The Carbon Hill mine of the Richmond Mining and Manufacturing Company is working the natural coke and semi-anthracite in the vicinity of Carbon hill, but they expect also to sink shafts to the bituminous coal beds below. Mr. William Clifford, of Manchester, England, who has recently made an examination of this coal field, states that the basin extends from 12 miles northwest of Richmond to about 24 miles southwest, including parts of the counties of Goochland, Henrico, Powhatan, Chesterfield, and Amelia. Traces of the coal have also been found in Hanover and Dinwiddie counties. Although this coal field was the first one to be worked in the United States, less than 2 square miles out of 180 contained in its boundaries have been worked over. The former developments have been confined to small areas and to the edge of the field, leaving the greater part of the basin untouched.

The following description is taken from Mr. Clifford's report on the Richmond coal field: "The Coal Measures in this basin are deposited in a huge hollow about 3,000 feet deep over an area 30 miles long, and from 4 to 10 miles wide, with a number of hollows on each flank, all scooped out of the granite rock. In the main trough, upon the granite floor, is now found a variable thickness of Triassic rocks, sometimes over 500 feet thick. These form the bed upon which lie the Coal Measures, consisting of coal seams, carbonaceous shales, and sandstones. The rocks thin out towards the sides of the basin as though, during their disposition, the rock material had slid somewhat down the steep sides on which it was thrown.

"In the outlying basins there is found only one coal seam, usually of great thickness and separated from the granite by a thin bed of shale, sometimes only a few inches thick.

"The beds contained in this formation are composed of bright black bituminous coal, varying considerably in hardness, the hard coal being usually freer from impurities than the softer coal. In some localities trap has intruded into the immediate vicinity of the seam, when the curious phenomenon of natural coke extending over a large area appears. This natural coke is found principally in that part of the field lying north of the James river, but it has also been found at Midlothian. Two varieties of this natural coke are obtained in the same seam, one heavy and close-grained, strongly charged with sulphur and unequally, imperfectly carbonized. The other variety, found higher up in the seam, is more fully carbonized and somewhat resembles artificial coke. This natural coke lies in the upper part of the Coal Measures, and has been chiefly worked in the north end of the field, where, instead of one thick seam, as at Midlothian and farther south, the coal is split up into beds of moderate size, divided by shales and sandstones. A number of analyses have been made of these coals and cokes from time to time. These analyses are shown in the following table:"

Analyses of Richmond, Virginia, coals and natural cokes.

Collieries.	Authorities.	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Coke.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Clover Hill (Coxe's)	Professor Johnson.	1.339	30.984	56.831	10.132	0.514	66.963
Do	W. B. Rogers	....	29.12	66.52	5.36	....	70.88
Do	G. W. Andrews	....	38.50	55.00	6.50	....	61.50
Stonehedge	W. B. Rogers	....	36.50	58.70	4.80	....	63.50
Creek Company's shaft	Professor Johnson.	1.450	26.788	60.30	8.57	2.89	68.872
Mills, Reid & Co., Creek shaft.	W. B. Rogers	....	38.60	57.80	3.60	....	61.40
Greenhole shaft	...do	....	31.17	67.83	2.00	....	69.83
Midlothian, average	Professor Johnson.	2.455	29.73	53.01	14.73	0.058	67.75
Midlothian, new shaft	...do	0.67	31.20	56.40	9.44	2.286	65.84
Midlothian, screened	...do	1.785	34.29	54.06	9.65	0.202	63.71
Midlothian, 900-foot shaft	.. do	1.172	27.27	61.08	10.46	....	71.55
Do	Silliman and Hubbard.	2.000	31.62	58.26	7.67	....	66.31
Midlothian, screened, 1875	A. S. McCreath	1.03	38.23	54.27	6.47	1.52	60.74
Midlothian, average	.. do	1.05	36.49	46.70	15.75	2.23	62.46
Maidenhead pits	W. B. Rogers	....	32.83	63.97	3.20	....	67.17
English Company, old shaft	.. do	....	35.82	53.36	10.82	....	64.18
English Company, middle bench.	...do	....	28.40	66.50	5.10	....	71.60
English Company, top bench	...do	....	28.40	61.68	9.52	....	71.20
Chesterfield Mining Company.	Professor Johnson.	1.896	28.719	58.794	8.634	1.957	67.42
Wills', Ætna shaft	Clemson	....	28.80	66.60	4.60	....	71.20
Powhatan pits (Colonel Finney's).	W. B. Rogers	....	32.33	59.87	7.80	....	67.67
Scott's pits	...do	....	33.70	60.86	5.66	....	66.52
Jewett & Bro., Midlothian natural coke, "Lustrous."	Dr. T. M. Drown	0.69	11.10	81.52	6.68	1.60	......
Natural coke, "Dull"	...do	2.00	15.47	79.33	3.20	4.08	......
Carbon Hill Bituminous, upper seam.	O. J. Henwich	0.40	20.60	60.80	17.20	....	78.00
Carbon Hill Bituminous, second seam.	...do	0.40	18.60	71.00	10.00	....	81.00
Carbon Hill Bituminous, natural coke.	...do	1.57	9.64	79.03	8.86	....	88.79
Carbon Hill Bituminous, average.	Professor Johnson.	1.785	23.95	59.97	14.28	....	74.25
Carbon Hill Bituminous, natural coke.	...do	1.116	11.94	75.081	11.82	....	86.90
Anderson's pits (Dover)	W. B. Rogers	....	28.30	66.78	4.92	....	71.70
Do	Clemson	....	26.00	64.20	9.80	....	74.00
Coalbrookdale, first seam	W. B. Rogers	....	24.00	70.80	5.20	....	76.00
Coalbrookdale, second seam	...do	....	22.83	54.97	22.20	....	77.17
Coalbrookdale, third seam	...do	....	24.70	65.50	9.80	....	75.30
Coalbrookdale, fourth seam	...do	....	21.33	56.07	22.60	....	78.67
Cranches, upper seam	...do	....	30.00	64.60	5.40	....	70.00
Waterloo	...do	....	26.80	55.20	18.00	....	73.20
Deep Run Basin	...do	....	26.16	69.86	5.00	....	74.86
Carbon Hill, natural coke	Dr. Wallace, Glasgow.	1.56	14.26	81.61	0.224	....	83.85

WASHINGTON TERRITORY.

Total production in 1887, 772,601 short tons; spot value, $1,699,746.

The occurrence of coal in Washington Territory was very fully described in the report for 1886, to which reference should be made. In several parts of the field extensive developments have been made during 1887, greatly increasing the output of several of the mines; some new mines have also been opened during the year. The coal statistics for 1887 were largely collected by Mr. H. J. Biddle. Valuable assistance was also rendered by the governor of the Territory, the inspector of mines, and the territorial treasurer. The production of the mines in the Territory during 1887, by counties, is shown in the following table:

Production of coal in Washington Territory, by counties, in 1887.

Counties.	Names of mines.	Operators.	Production.
			Long tons.
King	New Castle	Oregon Improvement Company ..	136,473
	Franklin..............	......do......................	80,703
	Black Diamond.......	Black Diamond Coal Company ...	86,900
	Cedar River	Cedar River Coal Company	35,885
Total	....	....	339,961
Pierce	Carbon Hill...........	Pacific Improvement Company ..	173,808
	South Prairie.........	South Prairie Coal Company	52,524
	Wilkeson	Tacoma Coal Company...........	3,453
Total	....	....	229,785
Thurston	Bucoda	Northwestern Coal and Transportation Company.	15,295
Kittitass	Roslyn................	Northern Pacific Coal Company..	104,782
Total	....	....	120,077
Total from the Territory......			689,823

Coal was first discovered in this Territory in the vicinity of Bellingham bay near the northern boundary of the Territory. The mines in this vicinity were worked for a number of years until coal of a better quality was found; these mines are now abandoned, although the field is not exhausted. East of Seattle and Lake Washington is what is known as the Washington coal field; a number of the most important mines in the Territory are located in this field. The coal is lignite, and is used for steam and domestic purposes. Thirty-three miles southeast of Seattle lies the Green River coal field; the coal in this field is semi-bituminous, and the field is doubtless an extension of the Puyallup coal field, which extends along the Carbon river up the south fork of Puyallup, and on Flett and South Perry creeks. In this Puyallup region the coal beds are quite numerous and vary in character, from lignite to bituminous; most of them are coking coals and can be used for gas, forge, and coking as well as for domestic and steam purposes. The latest discovered and one of the most valuable coal fields is that known as the Raging River, which lies about 10 miles east of Squak; most of the beds in this region are coking coals. Besides these fields coal is also found in the basin of lake Cle-elum and the Skagit river, which will probably be important fields at some future date.

The New Castle mines of the Oregon Improvement Company are situated on the Columbia and Puget Sound railway, 20 miles from Seattle; the coal is a good quality of lignite, locally known as Seattle coal. The production of this mine during 1887 was 136,473 long tons; this coal is shipped principally to San Francisco and Portland, Oregon. The following table shows the annual output of these mines for fiscal years ending June 30, from 1879 to 1887, inclusive:

Production of New Castle mines, Washington Territory, since 1879.

Fiscal years.	Production.
	Long tons.
1879	127,381
1880	128,853
1881	149,602
1882	158,340
1883	218,742
1884	149,948
1885	149,050
1886	85,561
1887	140,701
Total	1,308,178

The Franklin mine, also owned by the Oregon Improvement Company, is situated about 33 miles from Seattle on the Columbia and Puget Sound railroad; the output of this mine is being rapidly increased. The coal is semi-bituminous and is used for domestic purposes; the output during 1887 was 80,703 tons. Coal was first shipped from this mine in July, 1883, but regular shipments were only commenced in the latter part of 1885. The average capacity during 1887 was about 300 tons per day; but owing to the improvements made during the year this capacity will probably be increased during 1888. The annual shipments for the year ending June 30 in 1886 and 1887 were as follows: 1886, 8,350 tons; in 1887, 37,922 tons; total 46,272 tons.

The Black Diamond mines are situated on the same railroad as the Franklin, 3 miles nearer Seattle; these mines are owned and operated by the Black Diamond Coal Company. The daily capacity of this mine was about 700 tons in 1887; the production during the year was 86,900 tons. The coal is semi-bituminous and is shipped principally to the San Francisco market for steam coal. The annual shipments for fiscal years ending June 30, since April, 1885, are shown in the following table:

Shipments from the Black Diamond mines since 1885.

Fiscal years.	Production.
	Long tons.
1885	10,562
1886	71,356
1887	66,500
Total	148,418

The Cedar River mine, operated by the Cedar River Coal Company, is located 20 miles from Seattle on the Columbia and Puget Sound railroad. The first shipment of coal from this mine was made in 1884. The production for 1887 was double that for 1886. Extensive improvements were made at these mines during 1887, which will largely increase the output during 1888, making the capacity about 5,000 tons per month. The production in 1887 was 35,885 tons.

The above four mines were the only ones which produced coal in King county in 1887, their total production being 339,961 long tons. The Seattle Coal and Iron Company is opening several mines in King county, and the production of this county at Squak and Raging river in 1888 will probably be largely increased.

The principal mines in Pierce county are the Carbon Hill, South Prairie, and Wilkeson; these mines during 1887 produced 229,785 tons of coal. The Carbon Hill mines are on the Northern Pacific railroad about 34 miles from Tacoma. The mines are situated on Carbon Hill river in a cañon 400 to 500 feet deep. The coal is chiefly mined by drifts above water level. Four coal beds are worked at these mines: 3½, 4½, 5, and 10 to 12 feet in thickness, respectively. A number of other coal beds have been opened, but not worked to any considerable extent. The coal is a soft bituminous and makes a fair quality of coke; it is used chiefly for steam purposes by railroads in California.

The shipments from these mines since 1885 for fiscal years ending June 30 are shown in the following table:

Shipments from the Carbon Hill mines since 1885.

Fiscal years.	Long tons.
1885	135, 926
1886	120, 965
1887	145, 316
Total	402, 207

The total production of the Carbon Hill mines for the year ending December 31, 1887, was 173,808 long tons.

The South Prairie mine is situated on the Northern Pacific railroad, 28 miles from Tacoma; operations were commenced at this mine in 1881. The coal is mined from a water level drift, but during 1887 a slope 450 feet deep has been sunk and the mines will be worked from this opening in 1888. The average output per day during 1887 was 250 tons; the total production for the year was 52,524 long tons. The shipments from this mine for years ending June 30, since 1885, are as follows:

Shipments from South Prairie mine since 1885.

Fiscal years.	Long tons.
1885	34, 314
1886	45, 653
1887	59, 815
Total	139, 782

The Wilkeson mine, operated by the Tacoma Coal Company, is situated on the Northern Pacific railroad 32 miles from Tacoma. The mine was originally opened in 1877, but was abandoned and not re-opened until 1884, since which time the company has built a number of coke ovens and erected a crushing and washing plant, and is now manufacturing a very excellent coke. This is the only coke made in the Northwest at the present time. The production of the mines is about 100 tons of coke per day. The total production of coal in 1887 was 3,453 tons. The shipments of coke from this mine since 1885, for fiscal years ending June 30, are given in the following table:

Shipments of coke from Tacoma since 1885.

Fiscal years.	Long tons.
1885	5,402
1886	2,837
1887	2,134
Total	10,373

The only mine worked to any extent in Thurston county is the Bucoda mine, operated by the Northwestern Coal and Transportation Company. This mine is situated on the Pacific branch of the Northern Pacific railroad 45 miles from Tacoma and 90 miles from Portland, Oregon; it is the only mine opened in the Chehalis coal field. This mine commenced shipment in March, 1887, and at the close of the year had produced 15,295 tons; the coal is a lignite and is marketed at Tacoma, Portland, and intermediate points; it is not shipped as yet to San Francisco. This coal is easily and cheaply mined, having a good roof and bottom and dipping at an angle of about 5°.

The Roslyn mine of the Northern Pacific Coal Company, is situated in Kittitass county, and is the only mine that is now being operated east of the Cascade mountains. It is on a branch of the Northern Pacific railroad, which leaves the main line at Cle-Elum. This mine supplies the Northern Pacific railroad with fuel, but the company soon intends to ship to the California and Oregon trade. The quality of this coal is semi-bituminous and resembles the coal from the Green River field; it is excellent for steam and domestic purposes and makes a fair quality of coke. The mine commenced shipment in November, 1886, and during 1887 it had already become the third producing mine in the Territory. Its capacity is 400 tons daily. During 1887 the production was 104,782 long tons.

The Seattle Coal and Iron Company's mines are situated at Squak and Raging River. The completion of the Seattle, Lake Shore and Eastern railroad through Squak has enabled the mines there to begin shipping coal and they will probably furnish a considerable production during 1888. Five beds of coal have been opened, 5½, 6, 6½, 7½, and 12 feet thick respectively. The quality of the coal is the same as that from the New Castle mines. At Raging River, 10 miles east of Squak, on the line of the same railroad, are the company's Raging River bituminous coal mines. The railroad is not yet completed to these mines, so that shipments have not yet begun. The number of men employed in the coal mines of the Territory in 1887 was 1,571. The cost of mining the coal and transportation to tidewater during the year was estimated at from $2 to $2.30 per ton, for the region west of the Cascade range. Several railroads are expected to be built in the Territory during 1888, and as many of these railroads intend to reach already discovered coal fields, a decided development of the coal-mining industry will doubtless follow their completion. The important coal fields of the Territory are all within a radius of 40 miles of tidewater and afford facilities for rapid shipment. The principal markets are those of California and Oregon. The approximate acreage of the developed coal lands in the Territory is shown in the following table:

Acreage of developed coal lands in Washington Territory.

Counties.	Acreage.
King	70, 000
Pierce	40, 000
Kittitass	50, 000
Lewis	5, 000
Thurston	5, 000
Whatcom	10, 000
Total	180, 000

An estimate of the total output of coal in the Territory since the first developments up to June 30, 1887, is given in the following table:

Total production of coal in Washington Territory to June 30, 1887.

	Production.
	Long tons.
Newcastle	1, 308, 178
Franklin	46, 272
Black Diamond	148, 418
Renton	85, 015
Talbot	10, 000
Cedar River	64, 816
Carbonado	402, 207
South Prairie	130, 782
Wilkeson	10, 373
Bucoda	4, 550
Roslyn	40, 987
Bellingham Bay	250, 000
Clallam Bay	500
Total	2, 452, 098

Mr. James H. Watson, mine inspector of the Territory, reports the following analyses of the coal of different mines in the Territory:

Analyses of Washington Territory coals.

Coal bed.	Per cent. of coke.	Ash.	Fixed carbon.	Volatile matter.	Sulphur.	Water.	Total.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Newcastle, No. 2	52.04	6.04	46.00	35.50	.04	11.70	99.28
Newcastle, No. 4	56.45	2.65	53.80	36.91	....	6.64	100.00
Newcastle, Bagley	50.43	5.56	44.86	42.36	....	7.22	100.00
Franklin, No. 10	62.75	5.07	57.68	33.92	....	3.33	100.00
Franklin, No. 12	61.71	10.93	50.78	34.63	....	3.66	100.00
Franklin, No. 14	55.92	4.10	51.82	40.07	....	4.01	100.00
Andrews, S. C. & I. Co	55.73	3.08	52.65	31.91	....	12.36	100.00
Cedar River	55.03	5.28	49.75	32.68	....	12.29	100.00
Talbot bed	53.46	2.49	50.97	34.65	....	11.89	100.00
Mammoth	61.69	7.71	53.98	35.56	....	2.75	100.00
South Prairie	62.92	3.03	59.89	34.49	....	2.59	100.00
Carbonado (average 9 beds)	67.56	9.26	58.30	30.70	....	1.74	100.00
Roslyn, No. 1	70.35	13.36	56.69	27.37	.16	2.42	100.00
Roslyn, No. 2	66.51	6.80	59.71	32.10	.06	1.33	100.00
Roslyn, No. 3	64.35	4.00	60.35	19.71	.38	15.56	100.00
Wellington, B. C	57.58	3.95	53.63	39.56	....	2.86	100.00
Skagit Conner bed	89.12	11.22	77.90	9.96	....	.92	100.00
Wilkeson	72.57	9.70	62.87	25.56	....	1.87	100.00

WEST VIRGINIA.

Total production in 1887, 4,836,820 short tons; spot value, $4,594,979.

The coal regions of this State are located within the boundaries of the Appalachian coal fields, of which they form one of the most important integral parts, the present annual production of the State being only exceeded by the other two bituminous regions in the same field, those of Pennsylvania and Ohio. Although active mining developments are carried on in only fourteen counties, yet several others are included within the field the boundaries of which are clearly defined in the 1886 report.

The Coal Measures of West Virginia have been generally grouped the same as those of southwestern Pennsylvania, of which they are an extension toward the south. The topmost group is known as the Upper Barren Measures, which are composed of sandstone and shale, but are nearly destitute of workable coal beds; next below occur the Upper Productive Coal Measures, containing several important workable coal seams, of which the Pittsburgh or Cumberland big seam lies at the base of the formation. Prof. I. C. White has made a careful study of the coal beds in different sections of the State, and has constructed a section along the Baltimore and Ohio Railroad tunnel in Preston county.

The following is the section reported by Professor White of the Pittsburgh coal bed in this region.

Section of the Pittsburgh coal bed in West Virginia.

	Ft.	*In.*
Coal, slaty	0	8
Shale	0	9
Coal	0	10
Shale	2	0
Main bench, good coal	9	0
Slate parting	0	3
Bottom coal, slaty	1	6
Total	15	0

Although the Pittsburgh coal bed is found to vary greatly from this section, yet it illustrates the general structure. Next below occur the Lower Barren Measures, which are composed of reddish and bluish shales and slates interstratified with sandstone and limestone, but really containing no beds of workable thickness. This group in the sections just referred to is over 600 feet thick. The Lower Productive Coal Measures, which are separated from the Lower Barren Measures by the Mahoning sandstone in the same section, are 225 feet thick. In these measures can be recognized the Freeport and Kittanning coals. Although these beds, as well as the Pittsburgh, are better known by local names, a comparison of the Pennsylvania and West Virginia, names, particularly those in the Kanawha field, as determined by Professor White, is as follows:

Comparison of Pennsylvania and West Virginia coal beds.

Kanawha coal field (local names).	Pennsylvania (local names).
1. Raymond, Plymouth, etc. (hard splint)	Pittsburgh.
2. Lower Cannelton (cannel and splint)	Upper Freeport.
3. Coalburgh (hard block splint)	Lower Freeport.
4. Winifrede (splint)	Upper Kittanning.
5. Cedar Grove (steam and gas coal)	Middle Kittanning.
6. Campbell's Creek (block splint)	Lower Kittanning.
7. Eagle Kanawha coke (gas and steam)	Clarion.
8. Upper Kanawha or New River (No. XII)	

Below the Lower Productive Coal Measures occurs the Pottsville conglomerate, the thickness of which within the State is variously reported in different localities from 100 to 1,000 feet. This latter group is here, as in Pennsylvania, composed of alternating beds of conglomerate and sandstone, including beds of shale and slate, and, in a number of localities, several valuable workable coal beds.

On account of the change in the mining laws of the State, the production of the coal mines is no longer reported by the mine inspectors for the calendar year ending December 31, but for the year ending June 30. In consequence of this fact the statistics from the individual mines in the State were collected directly by the Survey, instead of being reported by the mine inspectors as formerly. In collecting the statistics, however, valuable assistance has been rendered by Messrs. H. J. Tucker and Henry Cunningham, the present inspectors of the first and second districts respectively. These districts include the following counties:

First district.—The counties of Barbour, Berkeley, Brooke, Calhoun, Doddridge, Gilmer, Grant, Hampshire, Hancock, Hardy, Harrison, Jackson, Jefferson, Lewis, Marion, Marshall, Mason, Mineral, Monongalia, Morgan. Ohio, Pendleton, Pleasants, Preston, Putnam, Randolph, Ritchie, Roane, Taylor, Tucker, Tyler, Upshur, Wetzel, Wirt, and Wood.

Second district.—The counties of Boone, Braxton, Cabell, Clay, Fayette, Greenbrier, Kanawha, Lincoln, Logan, McDowell, Mercer, Monroe, Nicholas, Pocahontas, Raleigh, Summers, Wayne, Webster, and Wyoming.

There are fifty-four counties included within the inspection districts, but only fourteen actually produced coal for shipment during 1887, although coal was mined in a number of the other counties at country banks to supply a very local demand in the farming communities. No returns were received from these mines; they would not probably exceed 1,000 tons. The production by counties, together with other special statistics, for 1887, is shown in the following table:

Statistics of coal production in West Virginia in 1887.

Counties.	Number of mines.	Total production.	Number of employés.	Average number days worked.	Average price at mines.
		Short tons			*Per short ton.*
Brooke	3	40, 366	50	256	$0. 94
Ohio	9	131, 936	211	221	1. 10
Marshall	3	92, 368	125	230	. 76
Marion	6	365, 844	590	280	. 80
Preston	3	276, 224	348	250	....
Mineral	4	478, 636	475	190	. 80
Tucker	2	24, 707	100	230	. 80
Taylor	2	168, 000	225	....	....
Harrison	6	154, 220	263	253	. 65
Mason	10	140, 968	368	209	1. 00
Putnam	2	53, 200	200	....	....
Kanawha	28	1, 126, 839	2, 496	194	1. 25
Fayette	25	1, 252, 427	3, 030	233	. 90
Mercer	5	575, 885	965	210	. 76
Total	108	4, 836, 820	9, 446	230	. 95

During 1887 there were only one hundred and eight individual mines operated, as against one hundred and twelve during 1886, although the production during 1887 was over 830,000 tons in access of that for 1886, the spot value of the coal mined during 1887 being over $700,000 in excess of that for 1886.

There was an increase of production in the following counties: Brooke, Marion, Preston, Mineral, Tucker, Taylor, Harrison, Mason, Putnam, Kanawha, and Mercer. In the following counties there was less coal produced in 1887 than in 1886: Ohio, Marshall, and Fayette. The most notable increase was in Kanawha county and the most notable decrease was in Fayette. There was an increase in the production of coke during the year in Preston, Marshall, Mercer, and Fayette counties. The average wages received for mining coal throughout the State was 46.6 cents per ton, while the average price which the coal netted at the mines was 95 cents. The difference between the cost of mining and the selling price permitted of a small profit to the operators after deducting royalties and general expenses.

Mr. Addison M. Scott, the resident engineer on the United States improvement of the Great Kanawha river, in a report to Col. William P. Craighill, the officer in charge, gives the following table, showing the increase of coal exports from the Kanawha Coal basin, both river and rail, for the years 1875 to 1887 inclusive. It is as follows:

Coal shipments from the Kanawha basin from 1875 to 1887.

Years.	Shipments by river.	Shipments by railroad.	Total shipments.	Number of mines in operation.	Number of tow-boats in use.	Approximate number of coal barges in use.
	Bushels.	*Bushels.*	*Bushels.*			
1875	4,048,300	5,792,925	9,841,225	8	5	150
1876	5,024,050	6,609,650	11,633,700	10	5	....
1877	5,183,650	7,758,800	12,942,450	10	5	....
Year ending June 30, 1881	9,628,696	6,631,660	16,260,356	13	6	....
Year ending June 1, 1883	15,370,458	13,290,255	28,660,713	26	14	430
Year ending June 1, 1884	18,421,084	12,059,172	30,480,256	28	14	....
Year ending June 1, 1885	17,812,323	12,972,217	30,784,540	32	22	....
Year ending June 1, 1886	17,861,613	13,953,745	31,815,353	36	24	854
Year ending June 1, 1887	23,233,374	19,160,896	42,394,270	37	......	....

From the above table it may be seen that the total output of Kanawha coal in 1887 is 42,394,270 bushels (or about 1,750,000 tons), being an increase from 1875 to 1887, twelve years, of 336 per cent., showing the increased demand for Kanawha coals.

Again, the increase in coal and coke tonnage over the Newport News and Mississippi Valley railway for the year ending December 31, 1884, was 863,313 tons; for the year ending December 31, 1885, 1,157,851 tons, a gain of 34.12 per cent; for the year ending December 31, 1886, 1,267,954 tons, a gain of 9.5 per cent., and a gain in two years of 46.8 per cent.

A large amount of the West Virginia coal, especially that from the Kanawha region, is shipped by boat to Ohio and Mississippi river points. A comparison of Kanawha and other coals received in Cincinnati, as given in the report of the secretary of the Cincinnati Chamber of Commerce, is as follows, in fiscal years:

Annual receipts at Cincinnati of various coals in seven years, bushels of 80 pounds.

Kinds.	1886.	1885.	1884.	1883.	1882.	1881.	1880.
Kanawha	17,329,349	14,588,573	15,926,743	13,260,347	13,950,802	10,715,459	8,912,801
Pittsburgh	34,933,542	32,286,133	32,239,473	33,895,064	37,807,961	23,202,084	31,750,968
Ohio river	939,746	3,007,078	2,956,688	3,309,534	3,560,881	3,151,934	4,268,214
Cannel	205,717	314,774	293,010	180,621	77,336	67,684	202,489
Anthracite	1,287,925	1,257,900	1,085,350	977,250	779,925	770,525	712,075
Other kinds	2,720,250	2,683,864	3,910,795	2,997,216	3,090,715	2,336,752	2,351,699
Total	57,416,529	54,138,322	56,412,059	54,620,032	59,267,620	40,244,438	48,198,246

An examination of the above table with reference to the rate of increase of Kanawha coals in the Cincinnati market shows that in 1879–'80 Kanawha coal receipts in Cincinnati were about one-fourth of Pittsburgh coal receipts, and that in 1885–'86 Kanawha had increased to about one-half of Pittsburgh coal receipts; showing that in 1879–'80 Kanawha coal receipts were about one and one-fifth times all other coal receipts, beside Pittsburgh; in 1885–'86 Kanawha coal receipts were three and one-third times as much; that while in 1879–'80 Kanawha equalled one-fifth of all coal received in Cincinnati, and that in 1885–'86 (eight years) Kanawha had grown to be about one-third of all.

Kanawha coal receipts have increased eight and one-half times as fast as Pittsburgh, and Kanawha coal has driven out and replaced two-fifths of all coals received from sources other than Pittsburgh; further, Kanawha coal receipts (increasing demand and consumption) have increased four times as fast as coal receipts from other sources. Mr. Scott, in referring to the Government improvements, says:

"After the slackwater improvement is completed the coal mined for river shipment during the low stages (*i. e.*, when the movable dams are up) will be locked down to the mouth about as fast as the barges are loaded (with smaller towboats and at less expense than now), and held there ready to go down the Ohio as the water in the stream admits. In short, the continuance of the locks and dams to the mouth of the river will not only nearly or quite double the time for shipping coal, but will, in effect, put the Great Kanawha coal fields about 300 miles nearer to the markets of the lower Ohio and Mississippi valleys. The slack-water will be of great advantage, too, in affording reliable navigation for the return of empty barges. Not considering the controlling effect of river navigation on freight rates, which in the case of the Great Kanawha connection with the Ohio river is of great importance, it might, in a narrow sense, be said that the completed improvement of the Great Kanawha would not directly affect the railroad charges, from the fact that the roads can not compete with the river in carying freight. This is particularly true in reference to the main interest of the valley, namely, coal. The rates for towing by river are so much lower than it is possible for railroads to carry that this traffic of the roads is necessarily confined almost entirely to interior points. In this connection a comparison of the rates on coal by rail and river will be interesting.

"The distance from Charleston to Cincinnati by river is 263 miles. The charge for towing to Cincinnati, as stated before, is about 1 cent per bushel, or 25 cents for 2,000 pounds. This covers the return of the empty barges. Operators who have barges pay a boat a half a cent barge rent. The total additional expenses, including the care of barges, pumping, wharfage, lines, etc., may be taken at a quarter of a cent a bushel, making a total charge to Cincinnati of 1¾ cents per bushel, or 43¾ cents per ton of 2,000 pounds. This is a little less than one-sixth of a cent per ton per mile. For longer distances, to points on the Ohio and Mississippi below Cincinnati, the rate per mile is much less than this. This rate, it will be noticed, is for operators who hire everything, and includes, of course, a profit on barges and towing. For operators who own their barges and towboats, as several of the largest shippers do, the total cost, including wear and tear, of taking a ton of coal to Cincinnati is estimated at about 28 cents per ton. This, it will also be remembered, embraces 58 miles of the interior and expensive navigation (as compared with the proposed slackwater) in the Great Kanawha.

"The rate on coal to the Great Kanawha operators during the past season, to Winchester, Kentucky, and other points on the Kentucky Central railroad—between Winchester and Covington—has been $2.70 per ton of 2,000 pounds; to Covington, $2. The distance from Charleston to Winchester is 171 miles; to Covington, 266 miles. It may also be stated that the rate to Chicago, 425 miles, is the same as from Pittsburgh. The rate to Lexington, Kentucky (190 miles), where the Chesapeake and Ohio comes in competition with the Cincinnati Southern, is $1.82 for 2,000 pounds," showing the advantage of a competing waterway.

The following table shows the location of the locks and dams on the Great Kanawha river, described in the last report, and their condition at the end of the year 1887:

Table showing the location, etc., of locks and dams on the Great Kanawha river already constructed, and same for those yet to be built.

No. of lock.	Location.	Kind of dam.	When completed.
2	1 mile below Cannelton and 84¼ miles from mouth of river.	Fixed.....	Finished in 1887.
3	1 mile below Paint Creek and 79¼ miles from mouth of river.	....do	Finished in 1882.
4	1½ miles below Coalburgh and 73 miles from mouth of river.	Movable..	Finished in 1880.
5	9 miles above Charleston and 67¼ miles from mouth of river.	....do	Do.
6	4½ miles below Charleston and 54 miles from mouth of river.	....do	Finished in 1886.
7	1¼ miles below St. Albans and 44 miles from mouth of river.	....do	Yet to be built.
8	2½ miles below Raymond City and 35¾ miles from mouth of river.	....do	Do.
9	6 miles below Winfield and 26½ miles from mouth of river.	....do	Do.
10	2¾ miles below Buffalo and 18¼ miles from mouth of river.	....do	Do.
11	Foot Three Mile Bar and 1¾ miles from mouth of river.	....do	Do.

A number of analyses of the coals and cokes have been reported to the Survey during the past year. These are contained in the following table:

Analyses of West Virginia coals and coke.

Names of coal and coke.	Counties.	Fixed carbon.	Volatile matter.	Water.	Sulphur.	Ash.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Bed No. 6, Wellsburgh	Brooke	65.90	30.90	1.40	0.98	1.80
Manchester steam	Ohio	50.67	39.65	1.73	4.518	7.95
Wheeling	....do	46.02	43.29	1.61	1.98	7.10
Boggs Run	Marshall	46.30	43.29	1.20	3.48	9.21
Gaston gas coal	Marion	65.40	32.50	....	....	2.10
Lower Freeport	Preston	58.67	26.77	1.48	3.00	10.04
Despard gas coal	Harrison	53.30	40.00	....	....	6.70
Black Band	Kanawha	57.48	38.58	2.24	....	1.70
Cedar Grove coal	....do	60.67	34.08	2.10	0.65	2.50
Crown Hill splint	....do	62.61	33.26	2.14	0.18	1.81
Lovell's Campbell Creek	....do	61.07	35.64	....	0.37	1.21
Peabody gas coal	....do	56.00	40.42	0.50	....	3.00
Blacksburgh steam coal	....do	59.144	38.350	2.506	....	....
Robinson's Coalburgh	....do	62.00	32.50	4.00	0.45	1.50
Steven's Coalburgh	....do	57.43	38.65	1.95	....	1.97
Winifrede	....do	58.73	36.33	1.86	0.36	2.72
Beury's Stone Cliff	Fayette	71.00	26.50	0.50	0.50	1.50
Elmo steam coal	....do	72.67	23.62	1.05	0.76	2.20
Great Kanawha	....do	58.43	38.48	0.62	....	2.47
Lawton steam coal	....do	75.02	22.345	0.610	0.560	1.463
Mount Carbon coking coal	....do	61.75	34.91	....	0.16	2.40
Mount Carbon coke	....do	92.00	1.45	0.20	0.10	6.35
New River coal	....do	70.659	26.642	0.668	0.498	1.535
New River coke	....do	96.141	0.140	0.290	0.569	2.860
Fire Creek coal	....do	75.499	22.425	0.735	0.536	0.805
Fire Creek coke	....do	91.940	0.492	0.105	0.538	6.928
Nuttallburgh coal	....do	70.67	25.35	1.35	0.57	2.10
Eagle seam coke	....do	90.48	....	....	0.50	9.00
Flat Top, Freeman's	Mercer	74.256	18.812	1.011	0.730	4.10
Flat Top coke, Buckeye	....do	92.816	1.059	0.664	0.548	4.913
Montana coke	Marion	91.85	0.43	0.42	0.48	6.82

In addition to the above the Charleston Industrial Development Association has recently reported the following analyses, which present a comparison of the West Virginia cokes, manufactured from both New river and Kanawha coals, and a further comparison of these with coke made from coals mined in different localities:

Comparative analyses of Kanawha, New River and other cokes.

Localities.	Mines or seams.	Carbon.	Ash.	Sulphur.	Authority.
		Per ct.	*Per ct.*	*Per ct.*	
Connellsville	Bradford	89.576	9.113	0.821	McCreath.
Do	Coketon	89.150	9.650	1.200	B. Crowther.
Irwins	Pennsylvania Gas Company.	88.240	9.414	0.962	Carnegie Bros. & Co.
Allegheny mountains.	Bennington B.	87.580	11.360	1.060	McCreath.
Blossburgh	Arnot Seymour vein.	84.760	13.345	0.998	Do.
Allegheny river	Lower Freeport	85.777	11.463	2.107	Do.
Beaver county	Hulmes & Bro.	84.727	12.636	1.994	Do.
New river, Upper Kanawha.	Quinnimont	93.850	5.850	0.300	J. B. Britton.
Do	Fire Creek	92.180	6.680	0.618	Do.
Do	Longdale	93.000	6.730	0.270	C. E. Dwight.
Do	Nuttallburgh	92.220	7.530	0.910	Do.
Kanawha (middle)	Powellton	92.000	6.500	0.105	Hy. Froeling.
Do	Great Kanawha colliery.	89.920	8.605	0.216	Do.
Do Do	Saint Clair Eagle	90.48	9.00	0.500	Porter & Going.
Do	East Bank C. G. seam.	89.95	9.13	0.378	H. V. C. & I. Co.
EUROPEAN COKES.					
English Durham	Bromney	91.580	6.86	....	I. L. Bell.
Belgian	Mons. Boein	91.300	6.20	....	M. de Maisilly.
Germany	Westphalia	85.000	0.400	....	Dr. F. Muck.

WYOMING.(a)

Total production 1887, 1,170,318 short tons; spot value, $3,510,954.

The rapid increase of population in the adjoining States, Nebraska and Kansas, the growth of railway interests in Wyoming, and the demands of this Territory for fuel for manufacturing, all combine to render the Wyoming coal mines extremely important. The production of the mines has steadily increased until at length the output in 1887 exceeded a millon tons of coal. Most of the coal mined is consumed by the railways, but about 33 per cent. is sold for commercial purposes. There have been no new fields opened, and the increase has been due simply to the increased capacity of the mines. The coal fields of the Territory have been fully described in past volumes of the Mineral Resources. The production of the Territory in 1887 has been as follows: The production of the mines at Carbon in 1887 was 288,358 short tons, of which 265,377 tons were sold to the Union Pacific Railway Company; 21,260 tons were sold for commercial use, and 1,721 tons were used at the mine. The total past production of the mine is as follows:

Product of the Carbon mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1878	62,418
1869	30,482	1879	75,424
1870	54,915	1880	100,433
1871	31,748	1881	156,820
1872	59,237	1882	200,123
1873	61,164	1883	248,380
1874	55,880	1884	319,883
1875	61,750	1885	226,863
1876	69,060	1886	214,233
1877	74,343	1887	288,358

At the Rock Spring mines the output in 1887 was 465,444 short tons, of which 187,634 tons were sold to the Union Pacific Railway Company, 275,420 tons were sold for commercial use, and 2,390 tons used at the mine. The total past production of the mine has been as follows:

Product of the Rock Spring mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	365	1878	154,282
1869	16,933	1879	193,252
1870	20,945	1880	244,460
1871	40,566	1881	270,425
1872	34,677	1882	287,510
1873	44,700	1883	304,495
1874	58,476	1884	318,197
1875	104,664	1885	328,601
1876	134,952	1886	359,234
1877	146,494	1887	465,444

The production of the mines at Almy, which are worked in the interest of the Union Pacific railway, was 196,913 tons, of which 134,933 tons were sold to the railway; 60,739 tons were sold for commercial use,

a Reported by Mr. F. F. Chisolm.

and 1,221 tons were used at the mines. The total production of the mines is as follows:

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1,967	1879	71,576
1870	12,454	1880	100,234
1871	21,171	1881	110,157
1872	22,713	1882	117,211
1873	22,847	1883	111,713
1874	23,006	1884	150,880
1875	41,805	1885	164,441
1876	60,756	1886	155,547
1877	54,643	1887	196,913
1878	59,096		

The product of the mines at Almy, owned and operated by the Rocky Mountain Coal and Iron Company, is sold almost entirely to the Central Pacific Railway Company, and the mines are for convenience called the Central Pacific mines. The production of these mines to date has been:

Product of the Central Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1870	16,981	1879	60,739
1871	53,843	1880	82,684
1872	105,118	1881	90,779
1873	130,989	1882	94,065
1874	181,699	1883	78,450
1875	92,589	1884	68,471
1876	69,782	1885	70,216
1877	67,373	1886	100,341
1878	57,404	1887	164,510

The Twin Creek mines were not operated in 1887.

RECAPITULATION.

Years.	Carbon.	Rock Spring.	Almy.		Twin Creek.	Fremont, Elkhorn and Missouri Valley Railroad Company.	Private mines at Rock Springs.	Total.
			Union Pacific mines.	Central Pacific mines.				
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1868	6,560	365	......	......	......	......	......	6,925
1869	30,482	16,933	1,967	......	......	......	......	49,382
1870	54,915	20,945	12,454	16,981	......	......	......	105,295
1871	31,748	40,566	21,171	53,843	......	......	......	147,328
1872	59,237	34,677	22,713	105,118	......	......	......	221,745
1873	61,164	44,700	22,847	130,989	......	......	......	259,700
1874	55,880	58,476	23,006	81,699	......	......	......	219,061
1875	61,750	104,664	41,805	92,589	......	......	......	300,808
1876	69,060	134,952	60,756	69,782	......	......	......	334,550
1877	74,343	146,494	54,643	67,373	......	......	......	342,853
1878	62,418	154,282	59,096	57,404	......	......	......	333,200
1879	75,424	193,252	71,576	60,739	......	......	......	400,991
1880	100,433	244,460	100,234	82,684	......	......	......	527,811
1881	156,820	270,425	110,157	90,779	......	......	......	628,181
1882	200,123	287,510	117,211	94,065	8,855	......	......	707,764
1883	248,380	304,495	111,713	78,450	36,651	......	......	779,689
1884	319,883	318,197	150,880	68,471	45,189	......	......	902,620
1885	226,863	328,601	164,441	70,216	17,207	......	......	807,328
1886	214,233	359,234	155,547	100,341	......	......	......	829,355
1887	288,358	465,444	196,913	164,510	......	5,093	50,000	1,170,318

The number of employés in the coal mines varies greatly from summer to winter; the greatest number at any time being about 1,300. The wages paid vary from 90 cents to $1.10 per ton of coal. The value of the product of the Territory in 1887, at $3 per ton, is $3,510,954.

A new mine, Central Pacific No. 6, was being opened at Almy by the Rocky Mountain Coal and Iron Company during 1887. A bed of coal 7 feet in thickness was discovered near Douglas, in Albany county; during 1887 a shaft and slope were started into this bed, and it was expected that coal would be shipped from this mine early in 1888.

Wyoming coal is shipped to widely separated points in the West, going to Salt Lake, Virginia City, San Francisco, Denver, and points in Nebraska as far east as the Missouri river.

THE MANUFACTURE OF COKE.

BY JOSEPH D. WEEKS.

In this report, as in previous ones of the series, the word "coke" is used to denote only that coke made from bituminous coal in ovens, pits, ricks, or "on the ground," and which for convenience may be termed "oven coke." Having in the report for last year discussed the statistics of coke made in connection with illuminating gas, which for convenience may be termed "gas coke," this product of bituminous coal will not be considered in the report for the present year.

The unit of quantity throughout this chapter is the short ton of 2,000 pounds. The year, unless otherwise stated, is the calendar year ending December 31.

Production of coke in the United States in 1887.—In the following table are consolidated by States and Territories the statistics of the production of coke in the United States for the year 1887:

Manufacture of coke in the United States, by States and Territories, in 1887.

States and Territories.	Number of establishments.	Ovens, December 31.		Coal used.	Coke produced.	Yield of coal in coke.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				Tons.	*Tons.*	*Per ct.*		
Alabama	15	1,555	1,362	550,047	325,020	59	$775,090	$2.39
Colorado	7	532	0	267,487	170,698	64	682,778	4.00
Georgia	2	300	0	158,482	79,241	50	174,410	2.20
Illinois	8	278	0	16,596	9,198	55⅓	19,594	2.13
Indiana	4	119	0	35,600	17,658	50	51,141	2.81
Indian Territory	1	80	0	20,121	10,060	50	33,435	3.33
Kansas	4	39	0	27,604	14,950	54	28,575	1.91
Kentucky	6	98	0	29,129	14,565	50	31,730	2.18
Missouri	1	4	0	5,400	2,970	55	10,395	3.50
Montana	2	27	0	10,800	7,200	66⅔	72,000	10.00
New Mexico	1	70	0	22,549	13,710	61	82,260	6.00
Ohio	15	585	223	164,974	93,004	56	245,981	2.65
Pennsylvania	151	18,294	802	8,938,438	5,832,849	65¼	10,746,352	1.84
Tennessee	11	1,560	165	655,857	396,979	61	870,900	2.19
Virginia	2	350	300	235,841	166,947	70.8	417,368	2.50
Washington	1	30	0	22,500	14,625	65	102,375	7.00
West Virginia	39	2,080	742	698,327	442,031	63.3	976,732	2.21
Total	270	26,001	3,594	11,859,752	7,611,705	64.2	15,321,116	2.01

It will be noted from the above table, as compared with 1886, that Texas and Utah drop out entirely; they were only carried in the table of last year as having establishments and ovens. Montana, which produced no coke in 1886, re-appears as a coke producer in 1887, while Missouri, which has not appeared in the tables in previous reports, appears this year with a production of 2,970 tons.

The same fact as to the origin of the larger part of the coal made into coke that has been noted in previous volumes of "Mineral Resources" is again evident in the above table, viz, that by far the largest proportion of coal manufactured into coke in the United States comes from the various coal measures of the Appalachian basin, and, as an analysis of the statistics of the different districts will show, chiefly from the great Pittsburgh coal bed. Of the 11,859,752 tons of coal made into coke in the United States in 1887 only 446,986 tons, or between 3 and 4 per cent., were from other coal fields. This, however, is an increase of 126,000 tons in round numbers from the coal fields outside of the Appalachian field as compared with 1886. This 446,986 tons was burned in ten of the seventeen States in which coke was made in 1887, or in other words, these ten States burned but about 3 per cent. of the coal, and made only about 3 per cent. of the coke produced in the United States. Of this 446,986 tons of coal made into coke that came from the coal fields outside of the Appalachian basin, 290,036 tons were from the coal fields of Colorado and New Mexico; 53,125 tons from the Missouri basin, which would include the coal used in Kansas, Indian Territory, and Missouri; 45,725 tons from the Illinois fields, including that used in Illinois and western Kentucky; 35,600 tons were from the Indiana coal measures, and 22,500 tons from Washington Territory.

As is noted above, most of the coal burned into coke in the United States came from the great Pittsburgh coal bed. This includes all that was burned in the Connellsville district, all in the Upper Connellsville district, all in the Pittsburgh district, some of that burned in Ohio, West Virginia, and other States. Ranking next to this is the Pratt seam in Alabama, most of the coal coked in that State being from this seam. Third in point of consumption in the manufacture of coke is the Sewanee seam of Tennessee. Fourth, the New River coking coal of West Virginia, and if in this is included the coal from the Flat Top region, it would rank second in point of consumption.

In the production of coke Pennsylvania still outranks all the other States, producing 5,832,849 tons out of 7,611,705 tons, or nearly 76⅔ per cent.

Statistics of coking in the United States.—In the following table are consolidated the statistics of coking in the United States for the year 1887. These statistics relate not only to the production of coal and coke, but also to the consumption of coal and its percentage yield in coke, as well as the number of establishments making coke and the number of ovens built and building at the close of each year.

Statistics of the manufacture of coke in the United Stat , 1881 to 1887, inclusive.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1881	197	14, 119	1, 005	6, 546, 662	4, 113, 760	$7, 725, 175	$1. 88	63
1882	215	16, 356	712	7, 577, 648	4, 793, 321	8, 462, 167	1. 77	63
1883	231	18, 304	407	8, 516, 670	5, 464, 721	8, 121, 607	1. 49	64
1884	250	19, 557	812	7, 951, 974	4, 873, 805	7, 242, 878	1. 49	61
1885	233	20, 116	432	8, 071, 126	5, 106, 696	7, 629, 118	1. 49	63
1886	222	22, 597	4, 154	10, 688, 972	6, 845, 369	11, 153, 366	1. 63	64
1887	270	26, 001	3, 584	11, 859, 752	7, 611, 705	15, 321, 116	2. 01	64. 2

From this table it appears that the number of establishments in the United States has increased from 222 in 1886 to 270 in 1887. As is explained elsewhere, part of this increase is more seeming than real, it being due to reporting in 1887 as separate works several establishments under one management which were reported as one works in 1886.

The number of ovens built has increased from 22,597 to 26,001. The production of coke has increased from 6,845,369 tons in 1886 to 7,611,705 tons in 1887. The coal consumed in the manufacture of coke has increased from 10,688,972 in 1886 to 11,859,752 tons in 1887; the total value of the coke from $11,153,366 in 1886 to $15,321,116 in 1887, and the average value per ton from $1.63 in 1886 to $2.01 in 1887; while the average yield of coal in coke increased from 64 per cent. in 1886 to 64.2 in 1887. In other words, with the single exception of the number of ovens building at the close of the year, every item of this table shows an increase, and also makes the year 1887 show in all these particulars the largest figures of any year since the establishment of the industry in the United States.

In the eight years that have been covered by these reports, *i. e.*, from 1880 to 1887, both inclusive, the number of ovens has increased from 12,372 to 26,001, or more than 100 per cent; the coke produced from 3,338,300 tons to 7,611,705 tons or 128 per cent.; the average value of the coke has increased from $1.99 per ton to $2.01 per ton.

Total number of coke works in the United States.—The following table gives the number of establishments manufacturing coke in the United States in each year from 1880 to 1887, by States:

Number of establishments in the United States manufacturing coke from 1880 *to* 1887.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Alabama	(*a*) 4	4	5	6	8	11	14	15
Colorado	1	2	5	7	8	7	7	7
Georgia	1	1	1	1	1	2	2	2
Illinois	6	6	7	7	9	9	9	8
Indiana	2	2	2	2	2	2	4	4
Indian Territory	1	1	1	1	1	1	1	1
Kansas	2	3	3	4	4	4	4	4
Kentucky	5	5	5	5	5	5	6	6
Missouri	0	0	0	0	0	0	0	1
Montana	0	0	0	1	3	2	4	2
New Mexico	0	0	2	2	2	2	2	1
Ohio	15	15	16	18	19	13	15	15
Pennsylvania	124	132	137	140	145	133	108	151
Tennessee	6	6	8	11	13	12	12	11
Texas	0	0	0	0	0	0	1	0
Utah	1	1	1	1	1	1	1	0
Virginia	0	0	0	1	1	1	2	2
Washington	0	0	0	0	1	1	1	1
West Virginia	18	19	22	24	27	27	29	39
Total	186	197	215	231	250	233	222	270

a The number of establishments on December 31 of each year.

From the above it will be noted that the number of establishments at which coke is made in the United States has increased from 222 in 1886 to 270 in 1887. The total number of establishments is greater than during any previous year. A part of this increase is more seeming than real, the increase in the number of establishments in Pennsylvania from 108 to 151 being due, in part, to the different methods of reporting the number of establishments. In 1886 several proprietors of coke works owning a number of establishments reported them as one, they being under one general management. This year, at the request of the special agent, they have been reported as separate works, corresponding in this respect to the practice prior to 1886.

The number of establishments in the country for each year since 1850, for which there are any returns, is as follows:

Number of coke establishments in the United States since 1850.

Years.	Number.	Years.	Number.
1850 (census year)	4	1882, December 31	215
1860 (census year)	21	1883, December 31	231
1870 (census year)	25	1884, December 31	250
1880 (census year)	149	1885, December 31	233
1880, December 31	186	1886, December 31	222
1881, December 31	197	1887, December 31	270

Number of coke ovens in the United States.—The following table gives the total number of coke ovens in the United States on December 31 of each year from 1880 to 1887. In addition to the coke made in ovens some has been made in pits and on the ground; but as the number of pits varies greatly at different times, no attempt has been made to give their total number.

Number of coke ovens in the United States on December 31 *of each of the years from* 1880 *to* 1887.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Alabama	316	416	536	767	976	1,075	1,301	1,555
Colorado	200	267	344	352	409	434	483	532
Georgia	140	180	220	264	300	300	300	300
Illinois	176	176	304	316	325	320	335	278
Indiana	45	45	37	37	37	37	100	119
Indian Territory	20	20	20	20	20	40	40	80
Kansas	6	15	20	23	23	23	36	39
Kentucky	45	45	45	45	45	33	76	98
Missouri	0	0	0	0	0	0	0	4
Montana	0	0	0	2	5	2	16	27
New Mexico	0	0	0	12	70	70	70	70
Ohio	616	641	647	682	732	642	560	585
Pennsylvania	9,501	10,881	12,424	13,610	14,285	14,553	16,314	18,294
Tennessee	656	724	861	992	1,105	1,387	1,485	1,560
Texas	0	0	0	0	0	0	0	0
Utah	20	20	20	20	20	20	20	0
Virginia	0	0	0	200	200	200	350	350
Washington	0	0	0	0	0	2	11	30
West Virginia	631	689	878	962	1,005	978	1,100	2,080
Total	12,372	14,119	16,356	18,304	19,557	20,116	22,597	26,001

With three exceptions, viz., Georgia, New Mexico, and Virginia, every State in the Union in which coke was made in 1887 has shown an increase in the number of ovens. The total increase is from 22,597 to 26,001, an increase of 3,404 ovens, or 15 per cent. In 1885 but three States, Pennsylvania, Tennessee, and Alabama, had over 1,000 ovens; in 1886 four States were credited with over 1,000 ovens, and the same is true of 1887. Ranking the four States in this respect, Pennsylvania is first, with 18,294 ovens, or 70 per cent.; West Virginia second, with 2,080 ovens, or 8 per cent.; Tennessee third, with 1,560 ovens, or 6 per cent., and Alabama fourth, with 1,555 ovens, or nearly 6 per cent.

As has already been stated, most of the ovens in the United States are of the bee-hive or solid wall type; by far the larger number being of the regular bee-hive shape. Others are a modified shape of the bee-hive or solid wall oven, the oven being long or muffle shaped. Notwithstanding the repeated experiments that have been made to produce coke successfully from American coals in a flue oven, they have been almost universally a failure, for reasons that need not be discussed here. Works at which most earnest efforts have been made to use the flue ovens have finally been compelled to abandon the attempt, and the flue ovens have either been torn down and bee-hive ovens erected in their stead, or new constructions and extensions of these works have been with the bee-hive oven.

Number of ovens building in the United States.—In the following table is given the number of ovens that were actually in course of construction in the United States at the close of each year from 1880 to 1887:

Number of coke ovens building in the United States at the close of each of the years from 1880 to 1887.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Alabama	100	120	0	122	242	16	1,012	1,362
Colorado	50	0	0	0	24	0	0	0
Georgia	40	40	44	36	0	0	0	0
Illinois	0	0	0	0	0	0	0	0
Indiana	0	0	0	0	0	0	18	0
Indian Territory	0	0	0	0	0	0	0	0
Kansas	0	0	0	0	0	0	0	0
Kentucky	0	0	0	0	0	0	2	0
Missouri	0	0	0	0	0	0	0	0
Montana	0	0	0	0	12	0	0	0
New Mexico	0	0	12	28	0	0	0	0
Ohio	25	0	0	0	0	0	0	223
Pennsylvania	836	761	642	211	232	317	2,558	802
Tennessee	68	84	14	10	175	36	126	165
Virginia	0	0	0	0	0	0	100	300
Washington	0	0	0	0	0	0	21	0
West Virginia	40	0	0	0	127	63	317	742
Total	1,159	1,005	712	407	812	432	4,154	3,594

There is no attempt in this table to indicate the increase in the total number of coke ovens during the year. This is shown under the previous subject, total number of coke ovens in the United States. In this table is given only the number of ovens reported as being in course of construction at the close of 1887; as compared with the total number of ovens in course of construction at the close of 1886, which was the year that showed the greatest total since the beginning of these reports, there is a decided falling off, the number in course of construction at the close of 1886 being 4,154, and 3,594 at the close of 1887, a reduction of 560. Notwithstanding this falling off, however, the report indicates the greatest activity in the building of ovens at the close of 1887, and the probabilities are that the increase in the number of ovens in existence at the close of 1888 will be considerably in excess of the number building at the close of 1887. The greatest number in course of construction in any one State is in Alabama, where 1,362 ovens were building; Pennsylvania comes second, with 802; West Virginia third, with 742; Virginia fourth, with 300; Ohio fifth, with 223; and Tennessee sixth, with 165. It will be noticed, therefore, that all of the chief coke producing States, with the exception of Colorado, had ovens in course of construction at the close of the year.

Total production of coke in the United States.—The production of coke in the United States for the years 1880 to 1887, inclusive, was as follows:

Amount of coke produced in the United States, 1880 *to* 1887, *inclusive, by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	60, 781	109, 033	152, 940	217, 531	244, 009	301, 180	375, 054	325, 020
Colorado	25, 568	48, 587	102, 105	133, 997	115, 719	131, 960	142, 797	170, 698
Georgia	38, 041	41, 376	46, 602	67, 012	79, 268	70, 669	82, 680	79, 241
Illinois	12, 700	14, 800	11, 400	13, 400	13, 095	10, 350	8, 103	9, 198
Indiana	0	0	0	0	0	0	6, 124	17, 658
Indian Ter	1, 546	1, 768	2, 025	2, 573	1, 912	3, 584	6, 351	10, 060
Kansas	3, 070	5, 670	6, 080	8, 430	7, 190	8, 050	12, 493	14, 950
Kentucky	4, 250	4, 370	4, 070	5, 025	2, 223	2, 704	4, 528	14, 565
Missouri	0	0	0	0	0	0	0	2, 970
Montana	0	0	0	0	75	175	0	7, 200
New Mexico	0	0	1, 000	3, 905	18, 282	17, 940	10, 236	13, 710
Ohio	100, 596	119, 469	103, 722	87, 834	62, 709	39, 416	34, 932	93, 004
Pennsylvania	2, 821, 384	3, 437, 708	3, 945, 034	4, 438, 464	3, 822, 128	3, 991, 805	5, 406, 597	5, 832, 849
Tennessee	130, 609	143, 853	187, 695	203, 691	219, 723	218, 842	368, 139	396, 979
Utah	1, 000	0	250	0	0	0	0	0
Virginia	0	0	0	25, 340	63, 600	49, 139	122, 352	166, 947
Washington	0	0	0	0	400	311	825	14, 625
West Virginia	138, 755	187, 126	230, 398	257, 519	223, 472	260, 571	264, 158	442, 031
Total	3, 338, 300	4, 113, 760	4, 793, 321	5, 464, 721	4, 873, 805	5, 106, 696	6, 845, 369	7, 611, 705

From this it will be seen that the maximum production of coke was reached in 1887, the product for that year being 7,611,705 tons, as compared with 6,845,369 tons in 1886. Pennsylvania still remains the great producing State of the Union; it was the only State producing over half a million tons, its product being 5,832,849 tons.

The following table gives the relative rank of the States and Territories in the production of coke in the years 1884 to 1887, inclusive:

Rank of the States and Territories in production of coke in 1884, 1885, 1886, *and* 1887.

States and Territories.	1884.	1885.	1886.	1887.	States and Territories.	1884.	1885.	1886.	1887.
Pennsylvania	1	1	1	1	Illinois	10	10	11	15
Alabama	2	2	2	4	Kansas	11	11	9	10
West Virginia	3	3	4	2	Indiana	......	......	13	9
Tennessee	4	4	3	3	Kentucky	12	13	14	12
Colorado	5	5	5	5	Indian Territory	13	12	12	14
Georgia	6	6	7	8	Washington	14	14	15	11
Virginia	7	7	6	6	Montana	15	15	......	16
Ohio	8	8	8	7	Missouri	......	......	......	17
New Mexico	9	9	10	13					

From the above table it will be seen, as compared with 1886, that Pennsylvania retains the first place; Alabama has dropped to fourth, while West Virginia has risen from fourth to second; Tennessee still remaining the third; Colorado is fifth; Georgia and Ohio have changed places, Virginia remaining the sixth, as in 1886.

Value and average selling price of coke.—In the following table is given the total value of the coke produced in the United States for each year from 1880 to 1887:

Total value at the ovens of the coke made in the United States in the years from 1880 *to* 1887, *by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Alabama	$183,063	$326,819	$425,940	$598,473	$609,185	$755,645	$993,302	$775,090
Colorado	145,226	267,156	476,665	584,578	409,930	512,162	569,120	682,778
Georgia	81,789	88,753	100,194	147,166	169,192	144,198	179,031	174,410
Illinois	41,950	45,850	29,050	28,200	25,639	27,798	21,487	19,594
Indiana	0	0	0	0	0	0	17,953	51,141
Indian Ter	4,638	5,304	6,075	7,719	5,736	12,902	22,229	33,435
Kansas	6,000	10,200	11,460	16,560	14,580	13,255	19,204	28,575
Kentucky	12,250	12,630	11,530	14,425	8,760	8,499	10,082	31,730
Missouri	....	....	....	....	....	.....	....	10,395
Montana	0	0	0	0	900	2,063	0	72,000
New Mexico	0	0	6,000	21,478	91,410	89,700	51,180	82,260
Ohio	255,905	297,728	266,113	225,660	156,294	109,723	94,042	245,981
Pennsylvania	5,255,040	5,898,579	6,133,698	5,410,387	4,783,230	4,981,656	7,664,023	10,746,352
Tennessee	316,607	342,585	472,505	459,126	428,870	398,459	687,865	870,900
Utah	10,000	0	2,500	0	0	0	0	0
Virginia	0	0	0	44,345	111,300	85,993	305,880	417,368
Washington	0	0	0	0	1,900	1,477	4,125	102,375
West Virginia	318,797	429,571	520,437	563,490	425,952	485,588	513,843	976,732
Total	6,631,267	7,725,175	8,462.167	8,121,607	7,242,878	7,629,118	11,153,366	15,321,116

While this table gives the totals of the values as returned in the schedules, the figures do not always represent the same thing. A statement as to the actual selling price of the coke was asked for, and in most cases, including possibly 80 per cent. of all the coke produced, the figures are the actual selling price. In some cases, however, the value is an estimate. Considerable of the coke made in the United States is produced by proprietors of blast furnaces for consumption in their own furnaces, none being sold. The value, therefore, given for this coke would be an estimate based, in some instances where there are coke works in the neighborhood selling coke for the general market, upon the price obtained for this coke. In other cases the cost is estimated at the cost of the coke at the furnace, plus a small percentage for profit on the coking operation, while in still other cases the value given is only the actual cost of the coke at the ovens.

It will be noted that the value of the coke made in the United States has increased from $11,153,366 in 1886 to $15,321,116 in 1887, an increase of about 37 per cent., though the increase in the production of coke was only a little over 10 per cent.; indeed the demand for coke in 1887 was so great that, not only was there a large increase in production, but considerable increase in price.

The preceding table gives the total value of the coke by States and Territories, and also for the United States.

In the following table is given the value per short ton:

Average value per short ton, at the ovens, of the coke made in the United States in the years from 1880 *to* 1887, *by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Alabama	$3.01	$3.00	$2.79	$2.75	$2.50	$2.50	$2.65	$2.39
Colorado	5.68	5.29	4.67	4.36	3.45	3.88	3.99	4.00
Georgia	2.15	2.15	2.15	2.20	2,13	2.04	2.17	2.20
Illinois	3.30	3.10	2.55	2.10	1.96	2.68	2.65	2.13
Indiana	0	0	0	0	0	0	2.93	2.81
Indian Territory	3.00	3.00	3.00	3.00	3.00	3.60	3.50	3.33
Kansas	1.95	1.80	1.70	1.96	2.02	1.65	1.54	1.91
Kentucky	2.88	2.89	2.83	2.87	3.94	3.14	2.23	2.18
Missouri	......	......	......	......	......	......	.....	3.50
Montana	0	0	0	0	12.00	11.72	0	10.00
New Mexico	0	0	6.00	5.50	5.00	5.00	5.00	6.00
Ohio	2.54	2.49	2.57	2.57	2.49	2.78	2.69	2.65
Pennsylvania	1.86	1.70	1.55	1.22	1.25	1.25	1.42	1.84
Tennessee	2.42	2.33	2.52	2.25	1.95	1.31	1.87	2.19
Utah	10.00	0	10.00	0	0	0	0	0
Virginia	0	0	0	1.75	1.75	1.75	2.50	2.50
Washington	0	0	0	0	4.75	4.75	5.00	7.00
West Virginia	2.30	2.30	2.26	2.19	1.19	1.86	1.94	2.22
Total average	1.99	1.88	1.77	1.49	1.49	1.49	1.63	2.01

An increase in the average value of coke was noted in the report for 1886 over the values for the three preceding years, *i. e.*, 1883, 1884, and 1885; an increase is also noticeable in the average value of the present year, it being greater than that for any preceding year since these figures have been collected, the nearest approach being in 1880, when the average value was $1.99. It seems hardly necessary to say that this average value was obtained, not by taking the average of the prices given in this table, but by dividing the total value of the coke produced by the total number of tons of coke—in other words, $2.01 is a true average price, not an average of prices.

Amount of coal consumed in the manufacture of coke.—In the following table is given the total number of tons of coal which entered into the manufacture of coke in the United States for the years 1880 to 1887:

Amount of coal used in the manufacture of coke in the United States from 1880 *to* 1887, *by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	106,283	184,881	261,839	359,699	413,184	507,934	635,120	550,047
Colorado	51,891	97,508	180,549	224,089	181,968	208,069	228,060	267,487
Georgia	63,402	68,960	77,670	111,687	132,113	117,781	136,133	158,482
Illinois	31,240	35,240	25,270	31,370	30,168	21,487	17,806	16,596
Indiana	0	0	0	0	0	0	13,030	35,600
Indian Ter	2,494	2,852	3,266	4,150	3,084	5,781	10,242	20,121
Kansas	4,800	8,800	9,200	13,400	11,500	15,000	23,062	27,604
Kentucky	7,206	7,406	6,906	8,437	3,451	5,075	9,055	29,129
Missouri	0	0	0	0	0	0	0	5,400
Montana	0	0	0	0	165	300	0	10,800
New Mexico	0	0	1,500	6,941	29,990	31,889	18,194	22,549
Ohio	172,453	201,145	181,577	152,502	108,164	68,796	59,332	164,974
Pennsylvania	4,347,558	5,393,503	6,149,179	6,823,275	6,204,604	6,178,500	8,290,849	8,938,438
Tennessee	217,656	241,644	313,537	330,961	348,295	412,538	621,669	655,857
Utah	2,000	0	500	0	0	0	0	0
Virginia	0	0	0	39,000	99,000	81,899	200,018	235,841
Washington	0	0	0	0	700	544	1,400	22,500
West Virginia	230,758	304,823	366,653	411,159	385,588	415,533	425,002	698,327
Total	5,237,741	6,546,762	7,577,646	8,516,670	7,951,974	8,071,126	10,688,972	11,859,752

In this statement is included all of the coal charged into the ovens, without any reference to its condition when so charged. A large proportion of the coal used is "run of the mine;" that is, all of the coal as it comes from the pit—lump, nut, and slack—is charged, without screening, into the ovens, the coal in these cases being mined only for the purpose of being made into coke. This is especially true of the Connellsville, Allegheny Mountain, and Reynoldsville-Walston districts in Pennsylvania, the New River district in West Virginia, and the Warrior district in Alabama, as well as several others. On the other hand, a large amount of coking, as will appear from the statement made in connection with the industry in different districts, is for the purpose of utilizing the slack coal produced in mining. This is true of the Pittsburgh district in Pennsylvania, as well as of many of the localities producing but a small amount of coke. It is not found practicable, however, as suggested above, to distinguish between the coal which was used as "run of the mine" and that which was used as "slack."

The amount of coal necessary to produce a ton of coke in 1887 was 1.56 tons, or 3,120 pounds; in 1886, 1.56 tons, or 3,120 pounds; in 1885, 1.58 tons, or 3,160 pounds; in 1884, 1.63 tons, or 3,260 pounds,

Yield of coal in coke.—The table given below shows the average yield of the coal coked in the United States for the seven years covered by this report. By the yield is meant the percentage of the constituents of the coal that remained in the coke after the process of coking.

Percentage yield of coal in the manufacture of coke in the United States in the years 1880 *to* 1887, *by States and Territories.*

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Alabama	57	59	58	60	60	59	59	59
Colorado	49	50	57	60	64	63	62.6	64
Georgia	60	60	60	60	60	60	60	50
Illinois	41	42	45	43	43	48	46	$55\frac{1}{2}$
Indiana	0	0	0	0	0	0	47	50
Indian Territory	62	62	62	62	62	62	62	50
Kansas	64	64.4	65	62.9	$62\frac{1}{4}$	$53\frac{3}{8}$	54.2	54
Kentucky	60	60	59	60	64	53	50	50
Missouri	......	......	......	......	......	......	......	55
Montana	0	0	0	0	46	$58\frac{1}{2}$	0	$66\frac{2}{3}$
New Mexico	0	0	$66\frac{2}{3}$	$57\frac{1}{4}$	$57\frac{1}{2}$	$56\frac{1}{4}$	56	61
Ohio	58	59	57	58	58	57	59	56
Pennsylvania	65	64	64	65	62	64.6	65.2	$65\frac{1}{4}$
Tennessee	60	60	60	62	63	53	59	61
Texas	......	......	......	......	......	......	50	......
Utah	50	0	50	0	0	0	0	......
Virginia	0	0	0	$64\frac{1}{2}$	$64\frac{1}{4}$	60	61.1	70.8
Washington	0	0	0	0	$57\frac{1}{2}$	57	58.7	65
West Virginia	60	61	63	63	62	63	62	63.3
Total average	63	63	63	64	61	63	64	64.2

Some of the percentages of this table are in part estimates. As has been stated, a great deal of the coal coked is slack, and this is frequently charged into the ovens without weighing. In such cases only an estimate of the amount used could be given.

There has been an increase of two-tenths of one per cent. in the average yield of coal in coke in 1887 as compared with 1886, that is, the yield in 1886 was 64 per cent., and in 1887 it was 64.2.

A great deal of attention has been paid to an endeavor to arrive at the actual yield of coal in coke. There is considerable question as to the accuracy of the figures of yield. It is believed, however, that in each year, especially in large coking districts, the figures are approaching absolute accuracy.

In connection with the report on Pennsylvania, a statement is given as to some very careful experiments made in that State during the year as to the amount of coal charged and the coke produced from the same. It is hoped that in the report for 1888 we shall be able to give similar reports of actual yield through the whole year from other States.

Imports and exports of coke.—The following table gives the quantities and value of coke imported and entered for consumption in the United States from 1869 to 1887, inclusive. In the statement is included, not only that coke which is entered for consumption through the custom houses, but the withdrawals from warehouses for consumption. The years are the Government fiscal years ending June 30. In the reports of the Treasury Department the quantities are long tons; these have been reduced to short tons to make the table commensurate with the other tables in this chapter.

Coke imported and entered for consumption in the United States, 1869 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869	....	$2,053	1879	6,035	$24,748
1870	....	6,388	1880	5,047	18,406
1871	....	19,528	1881	15,210	64,987
1872	9,575	9,217	1882	14,924	53,244
1873	1,091	1,366	1883	20,634	113,114
1874	634	4,588	1884	14,483	36,278
1875	1,046	9,648	1885	20,876	64,814
1876	2,065	8,657	1886	27,222	78,678
1877	4,068	16 686	1887	34,863	91,757
1878	6,616	24,186			

The coke imported into the United States goes chiefly to the Pacific coast, where it is used in smelting argentiferous lead ores of the Rocky Mountain region. The coke imported is chiefly English and Welsh. Some coke from Nova Scotia is imported into New England.

The exports of coke, which have always been insignificant, seem to have ceased entirely in 1886 and 1887.

ALABAMA.

Notwithstanding the notable development in the blast-furnace industry in Alabama it is a remarkable fact that the production of coke in this State in 1887 was less than it was in 1886, the production for 1887 in the three districts noted below being but 325,020 tons, against 375,054 tons in 1886. Every important coke works in the Warrior district, with the exception of the Coalburg Coal and Coke Company's works at Coalburg, and the Pratt Mines' Works of the Tennessee Coal, Iron and Railroad Company, report a reduced output in 1887, as compared with their output in 1886; but the increase at these two works, though it is a notable one (the increase at the Pratt mines being from 79,220 tons in 1886 to 101,438 tons in 1887), was not sufficient to balance the decreased output at the other works, and as a consequence the production in the Warrior district has fallen from 336,054 tons in 1886 to 279,520 in 1887. The extension of coke works that were in progress, however, at the close of 1887, will probably make the production during the present year greater than that of 1886.

At the close of 1887 there were 15 coke works in Alabama—10 in the Warrior district, 3 in the Cahaba, and 2 in the Coosa. Two works in the Warrior district and 2 in the Cahaba, made no coke in 1887.

There were built in the State at the close of 1887, 1,555 coke ovens, an increase in the year of 254 ovens. There were building at the close of 1887, 1,362 ovens. Most of the ovens built and building were the old-fashioned bee-hive, but a number of the so-called "Thomas oven," which is an oblong oven with mechanical discharger, are in course of construction, experiments having shown that it is quite well adapted to coking some of the coals of Alabama. At the close of the year a large number of the ovens that were building were almost finished and ready to operate. The 276 ovens of the De Bardeleben Coal and Iron Company at Bessemer, near Birmingham, were to have been completed in February. Of the 365 ovens of the Tennessee Coal, Iron and Railroad Company, reported as building on December 31, some 240 were finished early in February, and ready to be charged.

The total production of coke in Alabama in 1887 was 325,020 tons, as compared with 375,054 tons in 1886, a decrease of 50,034 tons, or about 13 per cent. Of the 325,020 tons produced, 279,520 were produced in the Warrior district, 35,500 tons in the Cahaba district, and 10,000 tons in the Coosa district.

There were used in the production of this 325,020 tons of coke 550,047 tons of coal, the yield of coke at the various establishments ranging, as reported, from 57½ to 66⅔ per cent.; the average yield being 59 per cent.

The total value of the coke at the works was $775,090, an average value of $2.39 per ton; the value at the different works ranging from $2.25 to $3 per ton.

The following are the statistics of the manufacture of coke in Alabama from 1880 to 1887, inclusive:

Statistics of the manufacture of coke in Alabama, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	4	316	100	106, 283	60, 781	$183, 063	$3. 01	57
1881	4	416	120	184, 881	109, 033	326, 819	3. 00	59
1882	5	536	....	261, 839	152, 940	425, 940	2. 79	58
1883	6	767	122	359, 699	217, 531	598, 473	2. 75	60
1884	8	(*a*)976	242	413, 184	244, 009	609, 185	2. 50	60
1885	11	(*a*)1, 075	16	507, 934	301, 180	755, 645	2. 50	59
1886	14	(*a*)1, 301	1, 012	635, 120	375, 054	993, 302	2. 65	59
1887	15	1, 555	1, 362	550, 047	325, 020	775, 090	2. 39	59

a One establishmant made coke on the ground.

As in previous years, the chief supply of coal for coking was obtained from the Pratt seam of the Warrior field. The character of the coal and of the deposits has been so thoroughly described, however, in previous volumes of "Mineral Resources of the United States" that it is unnecessary to repeat the description here.

COLORADO.

Colorado still retains the position it has occupied since 1884 as the fifth in the list of coke-producing States. Its production of coke for 1887 was 170,698 tons, the largest in its history, being 27,901 tons greater than in 1886, when 142,797 tons were produced. The total value of the coke produced was $682,778, as against $569,120 in 1886. The average value in 1887 was $4, as compared with $3.99 in 1886, and $3.80 in 1885. There were 267,487 tons of coal used in the production of this 170,698 tons of coke, the yield of coal in coke being, therefore, 64 per cent. The range of yield was 60 per cent. in the Durango district, 63 per cent. in the Crested Butte district, and 64 per cent. in the El Moro. The number of ovens built at the close of 1887 was 532, as compared with 483 at the close of 1886. Of these, 336 were in the El Moro district, 180 in the Crested Butte district, and 16 in the Durango district. There was no increase in the number of ovens built in the El Moro district, but the number of ovens in the Crested Butte district increased fifty. No coke, however, was made in these ovens during the year, as they were finished about the beginning of 1888.

Of the 170,698 tons of coke made in Colorado in 1887, 127,602 tons were made in the El Moro district, 40,901 tons in the Crested Butte district, and 2,195 tons in the Durango district.

The statistics of the production of coke in Colorado for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in Colorado, 1880 to 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	1	200	50	51, 891	25, 568	$145, 226	$5. 68	49
1881	2	267	0	97, 508	48, 587	267, 156	5. 29	50
1882	5	344	0	180, 549	102, 105	476, 665	4. 67	57
1883	7	352	0	224, 089	133, 997	584, 578	4. 36	60
1884	8	409	24	181, 968	115, 719	409, 930	3. 45	64
1885	7	434	0	208, 069	131, 960	512, 162	3. 88	63
1886	7	483	0	228, 060	142, 797	569, 120	3. 99	62. 6
1887	7	532	0	267, 487	170, 698	682, 778	4. 00	64

The coals and cokes of this region have been fully described in previous volumes of "Mineral Resources of the United States." The character of the coals and cokes of the El Moro and Crested Butte fields are well known. The value of the coal, and of the coke made from the same, of the Durango district is not so widely understood. It has been claimed that this coal was high in ash and sulphur. Through the courtesy of Mr. G. C. Hewitt, general superintendent of the Grand River Coal and Coke Company, whose works are located in Garfield county, we are enabled to give the result of a very careful series of experiments made upon the coals of this section. At these works fifty drag ovens have been built. Samples of the coke made in the bee-hive ovens at these works were submitted to Mr. John Fulton, of Johnstown, Pennsylvania, for a report as to the physical characteristics, as compared with Cardiff and Wales coke, and with Connellsville coke. These analyses were from a hand sample of Welsh coke, and three samples from the coke made in the bee-hive ovens. This report is as follows:

Fulton's table exhibiting the physical and chemical qualities of coke.

[Revised series.]

	Standard coke, Connellsville.	Cardiff coke (Wales).	Grand River coke.
Grammes in 1 cubic inch:			
Dry	15. 47	12. 9	13. 23
Wet	23. 67	22. 27	4. 07
Pounds in 1 cubic foot:			
Dry	58. 98	49. 16	50. 27
Wet	87. 34	84. 86	80. 06
Percentage by volume:			
Coke	49. 96	42. 76	50. 21
Cells	50. 04	57. 24	49. 79
Compression strength per cubic inch, one-fourth ultimate strength	301.	231.	226.
Height of furnace charge supported without crushing	120.	92.	90.
Order in cellular space	1.	1.	1.
Hardness	3. 5	3.	3.
Specific gravity	1. 89	1. 84	1. 55
Chemical analysis:			
Fixed carbon ... per cent	87. 46	95.	93. 75
Moisture ... do	. 49	. 01	....
Ash ... do	11. 32	4. 26	5. 49
Sulphur ... do	. 69	. 68	. 76
Phosphorus ... do	. 029	. 018	. 1
Volatile matter ... do	. 011	....	....

Fifty ovens at these works, as stated above, are Welsh drag ovens, 16 feet deep, 5 feet wide at the back to 5½ feet wide in front, 3½ feet high on the sides to the spring line arch, with two tunnel heads for the admission of coal. For the purpose of securing greater heat the least depth of the filling on top of the arch is 2 feet. The result has been very satisfactory, the ovens keeping hotter than the average bee-hive ovens. The intention in building the drag ovens was to discharge mechanically. Three and one-half ton charges were used, burning forty-eight hours. With larger charges the tendency of the coke to become what is termed "reedy" is more marked, though the coke is harder.

The coal, as will be seen from the analyses, does not differ materially from the typical coking coals, except in the lower percentage of ash. The coal in appearance somewhat resembles the Broad Top, and like it is soft. It is a remarkable fact that within 4 miles of the point from which this coking coal appears, and on the same outcrop, the corresponding seams in the same Coal Measures are of coal entirely dry and hard.

No analyses of the coke have been made since the drag ovens have been used, but consumers to whom large quantities have been shipped say that the average of several analyses from car-load lots was less than 8 per cent. ash, "and the coke superior to Connellsville, or any other coke produced in this country, for lead smelting."

GEORGIA.

In Georgia there has been no increase in the number of coke works or ovens since 1884, all the ovens in the State being owned by one company, though there are two distinct works, one with 286 ovens, and the other, some 2 miles distant, with 14 ovens. This latter bank of ovens has not been in operation for the past three years. The coke reported as made was all made at the works of 286 ovens. Little or none of this coke is sold in the general market, the company which makes it using most of it at its own two furnaces, the Rising Fawn furnace, at Rising Fawn, near the coke ovens, and the Chattanooga furnace, in Chattanooga, Tennessee.

The statistics of the manufacture of coke in this State for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in Georgia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880..........	1	140	40	63,402	38,041	$81,789	$2.15	60
1881..........	1	180	40	68,960	41,376	88,753	2.15	60
1882..........	1	220	44	77,670	46,602	100,194	2.15	60
1883..........	1	264	36	111,687	67,012	147,166	2.20	60
1884..........	1	300	0	132,113	79,268	169,192	2.13	60
1885..........	2	300	0	117,781	70,669	144,198	2.04	60
1886..........	2	300	0	136,133	82,680	179,031	2.17	60
1887..........	2	300	0	158,482	79,241	174,410	2.20	50

In the above statement it will be noted that there has been a decided falling off in the yield of coal in coke. This comes from the fact that slack was largely used in the production of coke in 1887. With run of mine, coal yields about 63 per cent. coke, but with slack the yield is only some 50 per cent.

ILLINOIS.

During the year 1887 the number of coke ovens in Illinois has decreased from 335, the number at the close of 1886, to 278. One establishment has dropped out, but eight remaining. There has been a slight increase in the production of coke, however, the production for 1886 being 8,103 tons, and for 1887, 9,198 tons.

Of the 278 ovens in the State, but 41 were operated during the year, the others being idle. In the production of the 9,198 tons of coke, 16,596 tons of coal were used, the yield of coal in coke being 55½ per cent. This coke was valued at $19,594 at the oven, or $2.13 per ton.

Nothing need be added to the statements that have already been made in previous volumes of "Mineral Resources of the United States" relative to the character of the coals and cokes of this State, and the causes of the continual want of success in the attempts to produce coke in Illinois.

The following are the statistics of the manufacture of coke in Illinois for the years 1880 to 1887:

Statistics of manufacture of coke in Illinois, 1880 to 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	176	0	31,240	12,700	$41,950	$3.30	41
1881	6	176	0	35,240	14,800	45,850	3.10	42
1882	7	304	0	25,270	11,400	29,050	2.55	45
1883	7	316	0	31,170	13,400	28,200	2.10	43
1884	9	325	0	30,168	13,095	25,639	1.96	43
1885	9	320	0	21,487	10,350	27,798	2.68	48
1886	9	335	0	17,806	8,103	21,487	2.65	46
1887	8	278	0	16,596	9,198	19,594	2.13	55.5

INDIANA.

Considerable success has attended the recent attempts to utilize the coals of Indiana for the purpose of manufacturing coke. The two new establishments referred to in the last report have been in successful operation during the past year, and Indiana again takes its place among the coke-producing States.

At the close of 1887 there were four establishments in Indiana engaged in the manufacture of coke, though but three of them were in operation during the year. At these establishments there are 119 ovens. The production of coke in 1887 was 17,658 tons, an increase from 6,124 tons in 1886. The value of this coke was $51,141, or $2.81 per ton. The coal yielded 50 per cent. in coke.

In our last report we referred at length to the operations of the Laclede Coal and Coke Company at Ayrshire, Pike county. The work has been pushed at the ovens of the company. The coal used is slack, which is crushed in a Scaife crusher made at Pittsburgh, and washed in the Osterspey washer. If the lump or run of the mine is used it is crushed to 1-inch cubes or smaller. The coke is dense and hard, with a good luster. The market is principally west of Saint Louis, though the coke has been used in steel-making, silver-smelting, and iron cupola practice with good success. It had not, at the time this report was made, been used in blast furnaces.

For the following very interesting table of analyses, showing improvements made in the manufacture of this coke, we are indebted to Mr. George A. McCord, secretary of the company. The last analysis, I am informed, was of a 60-pound lot selected by a party not connected with the company, the pieces being taken from cars, oven and the waste-pile.

Analyses of Ayrshire (Indiana) coke.

Date of analysis.	Nov., 1884.	Apr. 15, 1885.	Aug. 12, 1885.	Sept. 9, 1885.	Sept. 12, 1885.	Feb. 9, 1887.	Apr. 10, 1887.	Oct. 20, 1887.	Jan. 30, 1888.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Water	0.36	0.31	0.59	0.34	0.20	0.14	0.09	0.09	0.11
Volatile	3.10	2.92	2.33	1.73	3.17	1.00	1.81	1.62	1.04
Fixed carbon	84.79	84.80	85.00	88.93	86.00	87.15	85.77	86.85	87.68
Ash	10.47	10.55	10.89	7.87	9.45	10.98	11.46	10.60	10.41
Sulphur	1.28	1.42	1.19	1.13	1.18	0.73	0.87	0.84	0.76
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The first sample was made in a crucible; the second in an oven not fully heated; the fourth was a selected sample; the remainder are regarded as fair samples of the product of these works.

At Blackburn, Pike county, is a block of nine ovens operated by the Petersburg Coal and Coke Company. These works were in operation about six months during the year. Buildings, machinery, etc., are erected for 150 ovens. Unwashed slack is burned, the charge being 6 tons. At present there are no arrangements for screening or washing the coal.

The second largest coke works in the State is that of the New Pittsburgh Coal and Coke Company, at Alum Cave. At these works the coke is crushed and a portion sold to the gas companies of Chicago for making water gas.

The statistics of the manufacture of coke in Indiana for the years 1886 and 1887 are as follows. No coke was made in Indiana from 1879 to to 1886:

Statistics of manufacture of coke in Indiana for 1886 and 1887.

	1886.	1887.
Number of establishments	4	4
Ovens built	100	119
Ovens building	18	....
Coal used, short tons	13,030	35,600
Coke produced, short tons	6,124	17,658
Total value of coke at ovens	$17,953	$51,141
Value of coke at ovens, per ton	$2.93	$2.81
Yield of coal in coke, per cent	47	50

INDIAN TERRITORY.

The coke works of the Osage Coal and Mining Company, located at McAlester, still continues to be the only one in Indian Territory. The coal used at these works and the coke made have been fully described in previous volumes of "Mineral Resources of the United States." The coke is made entirely from slack. The following analyses, however, made in 1887, may be interesting for comparison with analyses given in previous reports.

Analyses of McAlester (Indian Territory) coke.

	Per cent.
Carbon	82.50
Volatile matter	4.53
Ash	11.60
Phosphorus	.01
Sulphur	1.06
Total	99.70

During the year the number of ovens at the works in this Territory has been doubled, and the production of coke increased from 6,351 tons in 1886 to 10,060 tons in 1887. As showing how great has been the increase in the production of coke in this Territory since the beginning of the collection of statistics for these reports, it may be mentioned that the production in 1880 was but 1,546 tons, and in 1887, 10,060 tons.

The statistics of the manufacture of coke in the Territory for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in Indian Territory, 1880 to 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	20	0	2,494	1,546	$4,638	$3.00	62
1881	1	20	0	2,852	1,768	5,304	3.00	62
1882	1	20	0	3,266	2,025	6,075	3.00	62
1883	1	20	0	4,150	2,573	7,719	3.00	62
1884	1	20	0	3,084	1,912	5,736	3.00	62
1885	1	40	0	5,781	3,584	12,902	3.60	62
1886	1	40	0	10,242	6,351	22,229	3.30	62
1887	1	80	0	20,121	10,060	33,435	3.33	50

KANSAS.

The production of coke in Kansas in 1887 shows a slight increase over the figures for 1886, the production being 14,950 tons in 1887, and 12,493 tons in 1886. There has also been an increase of three in the number of ovens during the year, the number at the close of 1887 being 39.

The statistics of the manufacture of coke in Kansas from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in Kansas, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	2	6	0	4,800	3,070	$6,000	$1.95	64.0
1881	3	15	0	8,800	5,670	10,200	1.80	64.4
1882	3	20	0	9,200	6,080	11,460	1.70	65.0
1883	4	23	0	13,400	8,430	16,560	1.96	62.9
1884	4	23	0	11,500	7,190	14,580	2.02	62.5
1885	4	23	0	15,000	8,050	13,255	1.65	53⅔
1886	4	36	0	23,062	12,493	19,204	1.54	54.2
1887	4	39	0	27,604	14,950	28,575	1.91	54.0

Some of the coke reported made in 1880 and 1881 was produced at one establishment in pits.

KENTUCKY.

The experiments in connection with coking the coals of western Kentucky have given importance to the production of coke in this State. A most important paper on this subject has been written by Mr. Joseph H. Allen, of the Clifton Coal Company, of Mannington, Kentucky. This paper contains not only an admirable statement of the coals of western Kentucky, and the methods adopted in coking them, and the experiments connected with the same, but also an interesting series of analyses of the coals and cokes. From this paper we condense the following statement:

The coal used at Mannington is coal L of the Kentucky Geological Survey. The coal is extensively developed in Edmonson, Grayson, and Butler counties, where it runs from three to seven feet in thickness, and contains less sulphur than it does in Mannington, in Hopkins county, and cokes well.

Relative to his connection with the coking of the Clifton Coal Company's coal, Mr. Allen says:

"In January of 1886 I was requested by the president of the Clifton Coal Company to make an examination of their mine, located in Hopkins county, to advise them as to the value of the property, and to suggest what should be done to make it profitable. The coal had become known as the poorest domestic coal on the market, and the property had been worked for several years at a loss. Upon examination I found that the vein was No. 1 or L, and had been opened on its eastern outcrop, which readily accounted for the immense quantities of sulphur and slate found in the coal. The shaft at this point had been sunk in a bottom, where the covering did not exceed 30 feet. The vein averaged in thickness 5 feet 10 inches, with several slate and shale partings and a band of sulphur (iron pyrites) near the top. In the main entry, running west from the shaft and under the hills, I found the slate partings to be fewer in number and the band of sulphur to diminish in size. No systematic plan of mining had been followed, and both ventilation and drainage were imperfect.

"From this examination I was satisfied that as the mine was opened westward the character of this coal as a domestic fuel would greatly improve, and (provided the sulphur and slate could be taken out) a fair coking coal could be obtained. With this end in view we began a series of experiments. A correspondence was opened with Mr. Stutz, of Pittsburgh, Pennsylvania, the patentee of the Stutz coal-washer, and a sample of the coal was forwarded to him for his examination and test. Mr. Stutz reported the result of his experiments in the following analyses of the unwashed and washed coals, and the resultant coke:

Analysis of coal and coke from Mannington, Kentucky.

	Unwashed coal.	Washed coal.	Coke.
	Per cent.	*Per cent.*	*Per cent.*
Volatile matter	33.32	35.24	1.28
Fixed carbon	47.45	52.53	83.14
Sulphur	3.21	1.92	1.98
Ash	16.02	10.31	13.60
Totals	100.00	100.00	100.00

and added in his report, 'I believe that a good and strong furnace coke for smelting iron, capable of bearing any burden, can be manufactured from this coal, provided it is properly treated and prepared. The coal in its chemical composition comes near to the Pittsburgh coal and possesses life enough to get the heat up.' An analysis by Dr. Safford, of Vanderbilt University, made about the same time from coke made at the mines, gave the following results:

Analysis of coke from Mannington, Kentucky.

	Per cent.
Carbon	83.42
Volatile matter	1.62
Sulphur	2.02
Ash	12.94
Total	100.00

"The ash analyzed as follows:

Analysis of ash.

	Per cent.
Iron	2.74
Silica	4.45
Alumina, lime, and magnesia	5.75

Arrangements were made to put up a crushing and washrng plant and to erect coke ovens. The new work was commenced on June 17, 1886, and finished on September 19. It was originally intended that the block of ovens should comprise 50, but the conformation of the ground and the lateness of the season compelled the stoppage with 34. On December 19 the whole battery was put in operation. At first considerable difficulty was experienced in operating the works, the chief difficulty being in crushing the coal to the proper size, and adjusting the washing machinery to the coal, an analysis of the coke in June showing 17 per cent. ash. Changes were made, the difficulties overcome in part, and better coke was produced, and the percentage of ash decreased to between 12 and 13 per cent. The coking is done in 48 hours, except the charges which are put in on Friday and Saturday, these being drawn Monday and Tuesday. The loss in washing is estimated at 12 per cent.; the yield of coal in coke is about 54 per cent.

Relative to the quality of the coal, Mr. Allen states: "From time to time I have made various tests of nearly all the coals in the western Kentucky field, and in all cases the coke has a bright silvery luster, a clear metallic ring, and good physical structure; sulphur seems to be the only drawback, and I am fully persuaded that this difficulty will in the end be overcome. In a great many cases, even now, the sulphur is much less than in some of the Alabama and Tennessee cokes, which are extensively used by the furnaces of Chattanooga and Birmingham. A comparative statement of analyses, with the names of the chemists, is appended.

Comparative analyses of southern cokes.

No.	Name of coke.	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Pratt	1.92	7.58	88.875	1.182	8.993
2	......do	.130	1.130	86.478	1.049	11.213
3	......do	.180	.640	89.164	.670	9.346
4	Coalburgh mine	.128	.685	84.678	1.879	12.630
5	Etna	.856	1.160	85.45	1.451	11.08
6	Daisy	.218	1.055	79.83	2.132	16.75
7	Soddy	.172	1.098	80.82	2.127	15.78
8	Dade	.542	1.091	75.94	.670	21.75
9	Saint Bernard, No. 9	....	.615	87.275	2.21	12.110
10	Saint Bernard, No. 11	....	.34	90.69	2.37	8.96
11	Tar Lick, Kentucky	.40	....	79.70	2 27	19.90
12	Nells Fork, Kentucky	1.74	.06	81.60	1.56	16.60
13	Sycamore, Kentucky	.80	.30	82.00	1.67	16.90
14	Airdrie furnace, No. 12	7.50	....	82.90	.64	5.40
15	Clifton Coal Company	....	1.28	83.14	1.98	13.60
16	......do	....	1.62	83.42	2.02	12.94

Comparative analyses of southern cokes—Continued.

No.	Place from which coke was obtained.	Name of chemist.
1	Mary Pratt stock pile	A. S. McCreath.
2	Sloss Furnace ovens	Do.
3	Woodward Iron Company	Do.
4	Williamson Furnace Company	Do.
5	Citico Furnace Company	Do.
6	......do	Do.
7	......do	Do.
8	Chattanooga Iron Company	Do.
9	Saint Bernard ovens	Mr. Morrell.
10	......do	Do.
11	Made at Clifton Coal Company's ovens	Dr. Peter, of Kentucky Survey.
12	......do	Do.
13	......do	Do.
14	Stock pile at furnace	Kentucky Geological Survey.
15	Made at Clifton Coal Company's ovens	Mr. Stutz.
16	......do	Professor Safford.

At the Dovey "Kentucky" mines, located at Mercer Station, in the county of Muhlenberg, no coke was made in 1887. The coke made, however, is of an excellent structure, but contains sulphur in such quantities as to render it practically worthless for smelting purposes. The coal used was the lower portion of the vein (coal D, of Owen, No. 9, of Shaler). The three center ovens of the block of seven at these works were fired and the test was made in the middle one of these three, using the ones on either side as heaters. After some weeks of tests with unwashed slack from the mines, and when the ovens had arrived at a good heat, the cuttings from the lower portion of the vein above referred to were introduced into the ovens. The preliminary stages of firing were satisfactory, and it looked as though the result would be all that was wished, as for a time the charge "boiled" nicely and fired well; but it did not burn, and there was an absolute absence of smoke coming from the tunnel head. The charge seemed dead and only smoldered. Various draughts were tried, but after burning the charge thirty-nine hours it was cooled and drawn, with the result that the coke was utterly worthless.

The second largest coke works in the State is that of the Saint Bernard Coke Company, at Earlington, in Hopkins county. These ovens were not put in operation until December 10, nor were all of them in full blast during the month. The amount of coke produced was only 202 tons, the yield being 50 per cent. At these works only slack from the mines is used, the weight of the charge being 4 tons. We have already given analyses of coal at these mines, and of the coke made from it.

The statistics of the manufacture of coke in Kentucky from 1880 to 1887 are as follows:

Statistics of the total manufacture of coke in Kentucky, 1880 *to* 1887.

Years.	Number of establishments	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	45	0	7,206	4,250	$12,250	$2.88	60
1881	5	45	0	7,406	4,370	12,630	2.89	60
1882	5	45	0	6,906	4,070	11,530	2.83	59
1883	5	45	0	8,437	5,025	14,425	2.87	60
1884	5	45	0	3,451	2,223	8,760	3.94	64
1885	5	33	0	5,075	2,704	8,489	3.14	53
1886	6	76	2	9,055	4,528	10,082	2.23	50
1887	6	98	0	29,129	14,565	31,730	2.18	50

From the above table it will be seen that the production of coke increased from 4,528 tons in 1886 to 14,565 tons in 1887.

MISSOURI.

In the last report reference was made to the fact that the Excelsior Coal Company, of Higginsville, Missouri, had erected ovens to test the coking quality of its coal. We have not received any further information relative to these experiments.

In this report, however, Missouri appears for the first time as a producer of coke, the Southwest Lead and Zinc Company, of Rich Hill, Bates county, Missouri, having erected four ovens and produced 2,970 tons of coke from 5,400 tons of coal. Nothing was learned as to the character of the deposit from which the coal for making the coke is drawn, nor as to the character of the coke. All of the coke made is used in the furnaces of the company. They estimate that the coke is worth $3.50 per ton at the ovens.

The following are the statistics of the manufacture of coke in Missouri for the year 1887:

Statistics of the manufacture of coke in Missouri in 1887.

	1887.
Number of establishments	1
Ovens built	4
Ovens building	0
Coal used, short tons	5,400
Coke produced, short tons	2,970
Total value of coke at ovens	$10,395
Value of coke at ovens, per ton	$3.50
Yield of coal in coke, per cent	55

MONTANA.

Coke was made at but one works in this Territory in 1887, that of the Livingston Coal and Coke Company. The coal deposit from which this coke is made has been described in previous volumes of Mineral Resources of the United States, and need not be repeated here. It is claimed that the coke is equal to the Connellsville. At these works there are twenty-seven ovens. No value was given for the coke, but on the basis of the cost of Connellsville coke delivered in this section it has been estimated at $10 per ton.

The statistics of the manufacture of coke in Montana from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in Montana, 1880 to 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	0	0	0	0	0	0	0	0
1881	0	0	0	0	0	0	0	0
1882	0	0	0	0	0	0	0	0
1883	1	2	0	0	0	0	0	0
1884	3	5	12	165	75	$12	$900	46
1885	2	2	0	300	175	11.72	2,063	58.5
1886	4	16	0	0	0	0	0	0
1887	2	27	0	10,800	7,200	10.00	72,000	66⅔

NEW MEXICO.

There was no change in the number of works or of ovens built in New Mexico in 1887. The San Pedro Coal and Coke Company, at San Antonio, on the Rio Grande river, still remains, so far as could be learned, the only coke works with ovens in the Territory. This is also the only works at which, so far as could be learned, any coke was made in 1887.

It will be noted that there was some increase in the production of coke in this Territory in 1887, but it is still below that of 1884 and 1885. As in previous years, the company making this coke declines to give the value of the coke at the ovens; consequently the estimate, as in previous years, putting the price, in view of the higher price of Connellsville coke in 1887, at $6 per ton.

The statistics of the manufacture of coke in New Mexico from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in New Mexico, 1880 to 1887.

Years.	Number of establishments.	Ovens built. (*a*)	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	0	0	0	0	0	0	0	0
1881	0	0	0	0	0	0	0	0
1882	2	0	12	1,500	1,000	$6	$6,000	66⅔
1883	2	12	28	6,941	3,905	5.50	21,478	57¼
1884	2	70	0	29,990	18,282	5	91,410	57¼
1885	2	70	0	31,889	17,940	5	89,700	56¼
1886	2	70	0	18,194	10,236	5	51,180	56
1887	1	70	0	22,549	13,710	6	82,260	61

a At one works there are ten stone pits, with an average capacity of 10 tons each.

OHIO.

The production of coke in Ohio in 1887 shows a marked increase over the previous year, the production being 93,004 tons, the largest production since 1882, the production of that year being 103,722 tons. This increase has shown itself in all districts, the production of the Hocking Valley having increased from nothing to 3,491 tons, the Steubenville district from 4,351 tons to 21,588, the Washingtonville district from 20,015 tons to 35,031 tons, and the Cincinnati district from 10,566 to 32,894 tons. This increase is probably ascribable to the high price of Connellsville and West Virginia coke during a portion of the year. When prices in the chief producing districts are high it is economical to mix, in the blast furnace, coke from other districts with a portion of the native coke.

Coking districts.—The coke industry of Ohio is comparatively of so little importance that it has not been considered necessary to retain the division into four districts that was observed in previous volumes of Mineral Resources of the United States. The State is divided into two districts, one, the Cincinnati, including the ovens in Ohio in and near that city, and the other including all the ovens of the State not included in the Cincinnati district. Since nearly, if not quite, all of the coke made in the Cincinnati district is from coal produced outside of the State, the Ohio district alone will give the production of coke from Ohio coal.

Cincinnati district.—As stated above, all the coke made in this district is from the dust and screenings of the coal yards of Cincinnati, and of the coal boats and barges that bring the coal from the upper Ohio, chiefly from Pittsburgh and the Kanawha region of West Virginia. The largest block of ovens in this district is that at North Bend, on the Ohio river, a short distance below Cincinnati. These had been idle up to the close of 1886. They were fired late in December of that year, using Youghiogheny and Monongahela river slack. During the year the number of ovens at these works has been increased from 50 to 110. Most of the production of the Cincinnati district is in these ovens.

The statistics of the manufacture of coke in the Cincinnati district from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Cincinnati district, Ohio, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	32	0	16,141	10,326	$4.09	$42,255	64
1881	4	32	0	20,607	13,237	4.11	54,439	64
1882	4	32	0	19,687	12,545	3.78	47,437	64
1883	5	57	0	33,978	20,106	3.28	65,990	59
1884	5	57	0	32,134	18,840	3.24	61,072	59
1885	5	82	0	17,480	10,962	3.27	35,873	63
1886	5	82	0	17,015	10,566	2.99	31,633	62.1
1887	5	150	20	56,733	32,894	2.91	95,754	56

Ohio district.—This district, as stated above, includes all of the ovens that have been classified in the reports prior to the last under the Washingtonville, Steubenville, and Hocking Valley districts—that is, all the ovens coking Ohio coal.

In the Washingtonville district the number of works has been reduced, one by the practical abandonment of the coke ovens at the Grafton Iron Company's works, no coke having been made in these ovens since 1882.

In the Steubenville district the number of works remains the same (seven), but no coke was made at two of the seven. The total production of coke in this district was 60,110 tons in 1887, against 24,366 tons in 1886, the production being the largest since 1883.

The most important development in connection with the coke industry of Ohio for some years has been in the Hocking valley during the year covered by this report. The ovens of the Nelsonville Coal and Coke Company, to which reference has been made in several previous reports, were put in operation in March, 1887. The coal used is Bayley's Run vein No. 7 and is remarkably free from sulphur. The slack is used mainly, and when this is insufficient to keep the ovens in operation, of which there are 20, of the beehive pattern, the nut and pea coal is added. The coal is crushed and washed and coked in forty-eight hours. The product is used chiefly for domestic purposes.

The most important development in the State, however, was on the land of the Federal Valley Coal Company, in Berne township, Athens county. The vein worked is No. 8 Pittsburgh, and runs from 9 to 12 feet thick, with a fireclay parting 8 inches to a foot in thickness. The seam both above and below the parting shows a coal remarkably free from impurities. In 1875 some coke was made here in ricks, but no thorough tests were made with the coal until early in 1887.

After a thorough test of the coal 24 beehive ovens were erected, 6 at the No. 1 mine and 18 at the No. 2. At No. 1 slack only is used, while at No. 2 the run of the mine is utilized. The coal is burned forty-eight hours at both works. It is the intention to crush and wash the coal.

There is no doubt as to the coking properties of this vein. Sulphur seems to be the greatest difficulty in the way of successful coking. The coke now being made in density and appearance is fair, and with the improvements in cleaning the coal before coking that are contemplated it is probable that a good merchantable coke will be produced. It is at these works that 200 of the 223 ovens reported as in process of construction in Ohio at the close of the year are being built.

The statistics of the manufacture of coke in Ohio from Ohio coal from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Ohio district, Ohio, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	11	584	25	156, 312	90, 270	$213, 650	$2. 37	57
1881	11	609	0	180, 438	106, 232	243, 289	2. 39	59
1882	12	615	0	161, 890	91, 677	218, 676	2. 39	57
1883	13	625	0	118, 524	67, 728	159, 670	2. 36	57
1884	14	675	0	76, 030	43, 869	95, 222	2. 17	58
1885	8	560	0	51, 316	28, 454	73, 850	2. 60	55
1886	10	478	0	42, 317	24, 366	40, 899	1. 68	57¾
1887	10	435	203	108, 251	60, 110	130, 227	2. 12	55½

Total coke statistics for Ohio.—In the following table the statistics of the coke made in the several districts of Ohio for the years 1880 to 1887 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	15	616	25	172, 453	100, 596	$255, 905	$2. 54	58
1881	15	641	0	201, 045	119, 469	297, 728	2. 49	59
1882	16	647	0	181, 577	103, 722	266, 113	2. 57	57
1883	18	682	0	152, 502	87, 834	225, 660	2. 57	58
1884	19	732	0	108, 164	62, 709	156, 294	2. 49	58
1885	13	642	0	68, 796	39, 416	109, 723	2. 78	57
1886	15	560	0	59, 332	34, 932	94, 042	2. 69	59
1887	15	585	223	164, 974	93, 004	245, 981	2. 65	56

The figures of 1887, it will be noticed, show a great increase over those for 1886, as already pointed out, the production being greater than any year since 1882.

PENNSYLVANIA.

The same division into districts that was observed in the last volume of "Mineral Resources of the United States" is continued in this; the "Irwin-Latrobe" district of the early reports now being called the "Upper Connellsville," while what was known as the "Snow Shoe" district is now called the "Clearfield-Centre," from the two counties in which the ovens are located. These divisions into districts are based in part upon geographical and topographical distinctions and in part upon the routes to market of the coke produced.

Total coke production in Pennsylvania.—Consolidating the statistics of the different districts given below, the following are the statistics of the production of coke in Pennsylvania from 1881 to 1887:

Statistics of the manufacture of coke in Pennsylvania, 1881 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke.
				Short tons	*Short tons.*			*Per cent.*
1881	132	10,881	761	5,393,503	3,437,708	$5,898,579	$1.70	64
1882	137	12,424	642	6,149,179	3,945,034	6,133,698	1.55	64
1883	140	13,610	211	6,823,275	4,438,464	5,410,387	1.22	65
1884	145	14,285	232	6,204,604	3,822,128	4,783,230	1.25	62
1885	133	14,553	317	6,178,500	3,991,805	4,981,656	1.25	64.6
1886	108	16,314	2,558	8,290,849	5,406,597	7,664,023	1.42	65.2
1887	151	18,294	802	8,938,438	5,832,849	10,746,352	1.84	65¼

Pennsylvania, as will be seen from the above table, still retains its pre-eminence as the greatest coke manufacturing State in the Union, 5,832,849 tons of the 7,611,705, or 76.6 per cent. of the amount produced in the United States, having been made in ovens in Pennsylvania. There are also 18,294 of the 26,001 ovens, or 70.4 per cent. of the ovens in the United States. It will thus appear that as the percentage of ovens in this State is less than the percentage of production, the production per oven in Pennsylvania in 1887 was greater than in the rest of the country.

The number of establishments in Pennsylvania has increased from 108 in 1886 to 151 in 1887; the number of ovens from 16,314 to 18,294; the coke produced from 5,406,597 to 5,832,849 tons; while the coal used increased from 8,290,849 to 8,938,438 tons. The value of the coke produced increased from $7,664,023 to $10,746,352. The value of the coke increased from $1.42 to $1.84, and the average yield of coal in coke from 65.2 to 65.25.

The Connellsville district.—The Connellsville district, which still remains the most important coke producing center in the United States, and one of the most important in the world, has been so thoroughly described in previous volumes of "Mineral Resources of the United States" as to require only the briefest reference here. It may be well to say, however, that the Connellsville coal basin is in the southwestern part of Pennsylvania, some 50 or 60 miles from Pittsburgh. It is a slender prong, separated from the Upper Coal Measures, and may be regarded as extending from south of Latrobe, on the Pennsylvania railroad, in a southwesterly direction, to the Virginia line, forming a basin some 3 miles wide and 50 miles long, almost without a fault, the beds yielding from 8 to 10 feet of workable coal. The same trough that contains the Connellsville coal extends northwesterly from Latrobe, but the Connellsville region proper is regarded as extending no further north than the vicinity of Latrobe. We have designated the district north of the Connellsville proper as the "Upper Connellsville." It is known locally as the "washed coal district."

In this Connellsville district there were produced 4,146,989 tons in 1887, or 71 per cent. of the 5,832,849 tons made in Pennsylvania. As 7,611,705 tons of coke were produced in the United States, it will appear that the Connellsville region produced 54.4 per cent. of all made in the country. This decrease of the percentage of the total amount made, as compared with previous years, is due to the decreased production in this district, owing to stoppages from strikes and other causes.

In 1886 the production was 4,180,521 tons. The reduction in production in 1887, notwithstanding the fact of all the stoppages for the reasons before mentioned, was 33,532 tons, or only about three-quarters of 1 per cent.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1887:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	$65\frac{1}{2}$
1881	70	8,208	654	4,018,782	2,639,002	4,301,573	1.63	$65\frac{2}{3}$
1882	72	9,283	592	4,628,736	3,043,394	4,473,789	1.47	$65\frac{3}{4}$
1883	74	10,176	101	5,355,380	3,552,402	4,049,738	1.14	$66\frac{1}{3}$
1884	76	10,543	200	4,829,054	3,192,105	3,607,078	1.13	$66\frac{1}{10}$
1885	68	10,471	48	4,693,831	3,096,012	3,776,388	1.22	$66\frac{1}{10}$
1886	36	11,324	1,895	6,305,460	4,180,521	5,701,086	1.36	$66\frac{3}{10}$
1887	73	11,923	98	6,182,846	4,146,989	7,437,669	1.79	67

These figures need but little comment. The most important fact, next to the total production, is the percentage yield of coal in coke, the statistics of this year showing the largest yield given for any year covered by these reports, and it is probable that these figures are very nearly correct. At three works in this region during the past year all of the coal charged into the ovens and the coke produced have been carefully weighed, with the following results:

Coal charged and coke produced.

	Coal charged.	Coke produced.	Percentage yield.
No. 1 works	230,585	157,070.40	68.118
No. 2 works	60,943	40,947.00	67.188
No. 3 works	63,893.2	42,927.24	67.2
Total	355,421.2	240,944.64	67.8

It would thus seem that a yield of 67 per cent. in coking Connellsville coal is not a high average.

Prices of Connellsville coke.—The price of Connellsville coke on January 1, 1887, was $1.50 free on board cars at the oven. This was also the price for the previous eight months. On February 1 the price was raised to $2, at which figure it remained until the close of the year. The demand was very heavy during the entire year, and cars scarce. On the first week in May the coke workers struck for 12½ per cent. advance in wages, and nearly all the works in the region were idle until June 11, when the Frick Coke Company, the largest in the region, granted the advance, and their men went to work; the other operators refused to grant the advance and their men continued the strike until the latter part of June, when a few of them returned to work at the old wages. In the last week in July the remainder resumed work. It was not, however, until nearly the middle of August that the region began producing its usual quota of coke. It will thus be seen that for six weeks practically the entire region was idle. For six weeks more the production could not have been more than 40 per cent. of the average output.

The average selling price of the coke for the year, as shown in the table above, was $1.79 free on board at the ovens.

The quoted price of blast furnace coke free on board at the ovens during the past seven years has been as follows:

Monthly prices of Connellsville blast-furnace coke, free on board at ovens.

Months.	1881.		1882.		1883.		1884.	1885.	1886.	1887.
January	$1.50 to	$1.75	$1.70 to	$1.80	$1.15 to	$1.20	$1.00	$1.10	$1.20	$1.50
February	1.50	1.75	1.70	1.80	1.20	1.10	1.00	1.10	1.20	2.00
March	1.50	1.75	1.70	1.75		1.05	1.00	1.10	1.35	2.00
April	1.60	1.75	1.70	1.75		1.05	1.10	1.20	1.35	2.00
May	1.60	1.65	1.65	1.70	.95	1.05	1.10	1.20	1.50	2.00
June	1.60	1.65	1.50	1.65		.90	1.10	1.20	1.50	2.00
July	1.50	1.60	1.35	1.50		.90	1.10	1.20	1.50	2.00
August		1.60		1.35		.90	1.10	1.20	1.50	2.00
September		1.60	1.25	1.35		1.00	1.10	1.20	1.50	2.00
October	1.60	1.65		1.25		1.00	1.10	1.20	1.50	2.00
November	1.60	1.65	1.25	1.35		1.00	1.10	1.20	1.50	2.00
December	1.60	1.70	1.15	1.35		1.00	1.10	1.20	1.50	2.00

These prices, it should be noted, are open rates. In many cases, especially in times of advance, it will be found that contracts have been made for deliveries covering the year, so that as a rule the actual price received for the coke is less than the open rates.

The Upper Connellsville district.—This district, as already stated, includes that portion of the trough or basin in which the Connellsville coke is found that is located northerly from a point just below Latrobe. The coal differs somewhat from that found in the lower part of the basin, and as stated previously, the district is known as the "washed coal district." It is one of the most important coking districts in the amount of production in the country, second only to the Connellsville. Its production for several years prior to 1887 was in excess of that of any State except Pennsylvania, and among the districts of Pennsylvania it is surpassed only by the Connellsville.

This district includes not only the ovens in the upper part of the Connellsville basin, but also the others along the line of the Pennsylvania railroad from Larimer to Blairsville. These ovens are situated in three of the coal basins of western Pennsylvania, the Upper Connellsville, the detached Greensburgh basin, and the upper part of the Irwin basin. The lower part of the Irwin basin, or the ovens along the line of the Baltimore and Ohio railroad, are included with the ovens of the Pittsburgh district. In this district most of the coke made is from washed slack, and at most ovens the coal used, whether slack or run of mines, is washed before coking.

The following are the statistics of the manufacture of coke in the Upper Connellsvil le region for the years 1880 to 1887:

Statistics of the manufacture of coke in the Upper Connellsville district, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	757	0	319, 927	229, 433	$1. 73	$397, 945	59
1881	10	986	0	588, 924	343, 728	1. 60	548, 362	58
1882	11	1, 118	0	650, 174	375, 918	1. 43	536, 503	58
1883	11	1, 118	0	668, 882	389, 053	1. 08	422, 174	58
1884	11	1, 118	0	496, 894	294, 477	1. 06	311, 665	59
1885	11	1, 168	40	555, 735	319, 297	1. 08	346, 168	57
1886	12	1, 337	29	691, 331	442, 968	1. 29	572, 073	64. 1
1887	16	1, 442	87	717, 274	470, 233	1. 79	840, 144	65. 6

It will be noted that the number of ovens has increased from 1,337 to 1,442, an increase of 105, while 87 were in course of construction. The production of coke has also increased from 442,968 tons to 470,233 tons; and this notwithstanding the fact that three works in this district made no coke during any part of the year, a fourth was idle, owing to repairs during the early part of the year, and a fifth made no coke during the latter part of the year. It will also be noted that there has been some increase in the yield of coal in coke.

A recent analysis of coke made by the Latrobe Coal Company, in Unity township, near Latrobe, in this district, is as follows:

Analysis of Latrobe (Pennsylvania) Coal Company's coke.

	Per cent.
Fixed carbon	89. 119
Ash	9. 392
Sulphur	1. 183
Volatile matter	. 202
Water	. 104
Total	100. 000

Allegheny Mountain district.—The third in importance of the coke districts of Pennsylvania is the Allegheny Mountain. In this district are included not only the ovens along the line of the Pennsylvania railroad east of Blairsville, including those on both sides of the Alleghenies in Cambria and Blair counties, but those of Somerset county. The number of establishments in this district remains the same as in 1886, viz, 10; but there has been an increase of 115 in the number of ovens, and 150 others were in course of construction at the close of 1887. The production of coke has materially increased during the year, it having advanced from 227,369 tons in 1886 to 297,724 tons in 1887; an increase of 70,355 tons, or nearly 31 per cent.

The importance of this locality as a coke-producing district is rapidly increasing. The coke made is an excellent fuel, and the region being somewhat nearer the eastern market than the Connellsville, is in great demand in that section. The Gallitzin coke works, at which there are 173 ovens, and which produced the largest amount of coke of any works in the district, may be taken as typical of the coke works on the western slope of the Allegheny mountains in this region.

The vein operated here is geologically equivalent to the celebrated Moshannon coal bed mined at Houtzdale, being commonly known in Cambria county as the "Lemon vein." Its uniform height in the Gallitzin mine is 4 feet of workable coal, there being about 12 inches of bone in the roof, and 12 inches in the bottom, which is not removed, making in all at least 6 feet of vein. The coal from this mine is well adapted to coking, being purely bituminous, and yielding a high percentage of carbon. The coal yields nearly 6,000 tons per acre, the net being 6,543⅓ tons per acre, including wastage. The ovens are 12 feet in diameter by 7 feet in height; the heats are 48 and 72 hours; the charge for the latter is about 31 inches of coal. It has been demonstrated that the long heat of 72 hours is the most economical with this coal, and produces the most satisfactory result. This 72-hour coke is more uniform in cell and structure, and it also appears that the elimination of sulphur and volatile matter is more complete than in the shorter heat.

An analysis of coke made at the Gallitzin works is as follows:

Analysis of Gallitzin, Allegheny mountain, Pennsylvania, coke.

	Per cent.
Fixed carbon	90.687
Ash	7.488
Sulphur	.927
Volatile matter	.790
Moisture	.180
Total	100.072

At one of the works in this district a very careful weighing of the charge and the coke produced was made during the whole year with a resultant yield of 64.01 per cent.

The following are the statistics of the manufacture of coke in the Allegheny mountain and Somerset district of Pennsylvania for the years 1880 to 1887:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	291	0	201,345	127,525	$2.27	$289,929	63
1881	9	371	0	225,563	144,430	2.28	329,198	64
1882	10	481	0	284,544	179,580	2.10	377,286	63
1883	10	532	0	200,343	135,342	1.78	240,641	68
1884	12	614	0	241,459	156,290	1.30	203,213	65
1885	11	523	82	327,666	212,242	1.30	286,539	65
1886	10	579	14	351,070	227,369	1.64	374,013	64.8
1887	10	694	150	461,922	297,724	2.25	671,437	64.4

Clearfield-Centre district.—In the volumes of "Mineral Resources of the United States" previous to that of 1886, this district has been known as the "Snow Shoe district." The year 1887 shows the same notable increase in the importance of this district as a coke-producing region that was noted in last year's report; the production of coke in 1887 being 97,852 tons, as compared with 55,810 tons in 1886, and 48,103 tons in 1885. During the year the number of coke works in the district has increased from three to six, and the number of ovens from 299 to 523.

The coke made in this district is remarkably free from phosphorus, is a most excellent furnace fuel, and is in great demand at the eastern furnaces, especially in the Lehigh district.

The statistics of the manufacture of coke in the Clearfield-Centre district for the years 1880 to 1887 are as follows:

Statistics of manufacture of coke in the Clearfield-Centre district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	0	0	200	100	$2.00	$200	50
1881	2	50	0	20,025	13,350	1.70	22,695	67
1882	1	50	0	25,000	17,160	1.60	27,406	69
1883	1	60	0	26,500	18,696	1.50	28,044	71
1884	1	60	0	33,000	23,431	1.40	32,849	71
1885	2	245	0	69,720	48,103	1.46	70,331	69
1886	3	299	20	84,870	55,810	1.70	94,877	66
1887	6	523	10	154,566	97,852	2.02	198,095	63.3

The Broad Top district.—In this district are included all the ovens in what is known as the Broad Top coal fields, the ovens being situated in

Bedford and Huntingdon counties. There has been a notable increase in the production of this district in 1887 over the production for 1886; indeed the production of coke during the last year is the greatest in the history of this district, there being produced 164,535 tons, as compared with 108,294 tons in 1886, and 151,959 tons in 1884, the year of the largest production prior to the present. There has been a slight increase in the number of ovens, the number at the close of 1887 being 581, as compared with 562 at the close of 1886. At the close of the year other establishments contemplated the erection of ovens in this district, but as no work had been begun upon them, they are not included in this report.

The statistics of the manufacture of coke in the Broad Top region, Pennsylvania, for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Broad Top region, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	188	105	92,894	51,130	2.40	$123,748	55
1881	5	188	105	111,593	66,560	2.51	167,074	59
1882	5	293	50	170,637	105,111	2.05	215,079	62
1883	5	343	110	220,932	147,154	1.84	271,692	66
1884	5	453	0	227,954	151,959	1.74	264,569	66
1885	5	537	0	190,836	112,073	1.65	185,656	58
1886	5	562	100	171,137	108,294	1.73	187,321	63.3
1887	5	581	0	262,730	164,535	2.11	347,061	62.6

The values given in the above table are in some cases the cost at the ovens; in others, an assumed price over cost. So little of the coke is sold, most of it being used by the owners of the coke works, that no market price can be given.

Pittsburgh district.—This district, which has for so many years been of little moment, is rapidly becoming one of the most important coke districts in the United States, chiefly by reason of the Carrie Furnace Company's, the Imperial Coal Company's, Laughlin and Company's, and the Moorehead-McCleane Company's works. Three of these works have over 100 ovens each; and there are three others with over 50 ovens. There are also in process of erection in this district 235 ovens. This makes a total in the district, therefore, of 880 ovens; a larger number than the total for any State except Pennsylvania, Alabama, and West Virginia.

The experiments in connection with the Belgian ovens in this State which were conducted at so much expense, with so much intelligence, and through such a lengthy period of time, have at last been abandoned, and there are no ovens now in western Pennsylvania except the bee-hive ovens.

The statistics of the manufacture of coke in the Pittsburgh district, Pennsylvania, for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Pittsburgh district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	21	534	0	194, 393	105, 974	$2. 40	$254, 500	55
1881	21	538	0	178, 509	96, 310	2. 15	206, 965	54
1882	21	557	0	114, 956	64, 779	2. 07	134, 378	61
1883	20	542	0	119, 310	66, 820	1. 89	126, 020	56
1884	20	535	0	97, 367	53, 357	1. 87	99, 911	55
1885	17	416	4	91, 101	46, 930	1. 55	72, 509	51. 5
1886	18	730	0	228, 874	138, 646	1. 88	221, 617	60. 6
1887	20	880	235	366, 184	177, 097	1. 78	315, 546	48. 4

It will be noted that the number of establishments in this district has increased by 2, the number of ovens 150, while there are 235 building at the close of 1887, as against none building at the close of 1886. The production of coke has increased from 138,646 tons in 1886 to 177,097 tons in 1887, the largest production in the history of this district.

One of the most interesting features in connection with the above statement is the low percentage yield of coal in coke, this report making it 48.4 as against 60.6 a year ago. It is probable that the 48 per cent. is correct, as the coal used in these works is chiefly slack; the coal being weighed before it is washed would probably decrease the yield. At one works making a large proportion of the coke produced in this district the yield is given as only 43 per cent. In cases where the weight of the coal after being washed is taken, the yield would be considerably higher, and under such conditions it is probable that the 60 per cent. yield is not too great.

Beaver district.—The coke industry in this district is of but little moment; the ovens in Beaver and Lawrence counties only are included. There, however, has been a material increase in the coke produced in this district during the past year, the production being the largest in any one year included in this report. The largest production in any previous year was in 1883, when 12,395 tons were made. In 1887, 13,818 tons were produced.

The following are the statistics of the manufacture of coke in the Beaver district, Pennsylvania, for the years 1880 to 1887:

Statistics of the manufacture of coke in the Beaver district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	106	0	8,013	4,880	$10,150	$2.08	61
1881	5	106	0	6,887	4,333	9,013	2.08	63
1882	5	106	0	11,699	7,960	15,124	1.90	68
1883	5	107	0	.19,510	12,395	21,062	1.70	64
1884	4	89	0	2,250	1,390	2,168	1.56	62
1885	4	89	0	686	438	696	1.59	63
1886	3	87	0	698	411	646	1.57	59
1887	3	65	0	25,207	13,818	24,137	1.75	55

Allegheny Valley district.—In this district are included the coke works in Armstrong and Butler counties, and one of those in Clarion county, the other ovens in the latter county being included in the Reynoldsville-Walston district.

As will be noted from the returns, the production has largely increased during the year, the increase being from 28,948 in 1886 to 44,621 tons in 1887. This makes 1887 the year of the largest production since the beginning of these statistics.

The statistics of the manufacture of coke in the Allegheny Valley district for the years 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Allegheny Valley district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	97	0	45,355	23,470	$49,068	$2.10	52
1881	5	109	0	55,676	29,650	64,664	2.18	53
1882	6	159	0	76,000	41,897	80,294	1.92	55
1883	6	159	0	64,810	34,868	62,982	1.81	54
1884	7	209	0	55,110	31,430	54,859	1.75	57
1885	5	208	0	28,630	15,326	30,151	1.97	53.5
1886	5	208	0	51,580	28,948	44,422	1.54	56
1887	5	288	88	77,766	44,621	84,913	1.90	57.1

Reynoldsville-Walston district.—This has become among the most important of coking districts in the United States. In it are included all the ovens on the Rochester and Pittsburgh railroad, as well as those on the Low Grade Division of the Allegheny Valley railroad and the Dagus mines of the Lake Erie and Western. This district has been thoroughly described in previous volumes of Mineral Resources of the United States, and to these those desiring further information are referred.

The following are the statistics of the manufacture of coke in this district for the years 1880 to 1887:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880..........	3	117	0	45, 055	28, 090	$46, 359	$1.65	62
1881..........	4	125	2	99, 489	44, 260	80, 785	1.85	44
1882..........	5	177	0	87, 314	44, 709	80, 339	1.80	51
1883..........	6	229	0	76, 580	37, 044	65, 584	1.77	48
1884..........	7	321	0	159, 151	78, 646	113, 155	1.44	49
1885..........	8	600	143	183, 806	114, 409	153, 795	1.34½	62
1886..........	9	783	500	271, 037	161, 828	217, 834	1.35	59.7
1887..........	11	1, 492	134	507, 320	316, 107	592, 728	1.88	62.3

From the above statement it will be seen that the Reynoldsville-Walston district now has a larger number of ovens than any district in Pennsylvania, except the Connellsville, surpassing the Upper Connellsville by 50. The production of this district, however, did not equal the production of the Upper Connellsville region, owing to the fact that quite a number of the ovens were not in operation until late in the year. This region also has a larger number of ovens than any State in the Union, except Pennsylvania, Alabama, and West Virginia.

Blossburg district.—In this district are included the two establishments making coke from the coal of the Blossburg coal field. The returns for 1887 show a marked increase in production during the year, the amount of coke having increased from 81,801 tons in 1886 to 103,873 tons in 1887, the number of ovens being 1 more than were reported in 1886. It is probable that the great increase in this region, as in several other regions, is due to the increased demand for coke for various metallurgical purposes in the eastern States.

The following are the statistics of the manufacture of coke in the Blossburg, Pennsylvania, district from 1880 to 1887:

Statistics of the manufacture of coke in the Blossburg district, Pennsylvania, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880..........	1	200	0	72, 520	44, 836	$134, 500	$3.00	62
1881..........	1	200	0	88, 055	56, 085	168, 250	3.00	64
1882..........	1	200	0	100, 119	64, 526	193, 500	3.00	64
1883..........	2	344	0	71, 028	44, 690	122, 450	2.74	63
1884..........	2	344	32	62, 365	39, 043	93, 763	2.40	63
1885..........	2	296	0	46, 489	26, 975	59, 423	2.17	58
1886..........	2	405	0	136, 136	81, 801	174, 532	2.13	60
1887..........	2	406	0	182, 623	103, 873	234, 622	2.26	56.9

Statistics of coke production in Pennsylvania, by districts.—In the following table is given in a consolidated form the statistics of coke production in Pennsylvania, by districts, for 1887:

Coke production in Pennsylvania in 1887, *by districts.*

Districts.	Number of establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Connellsville	73	11,923	98	6,182,846	4,146,989	$7,437,669	$1.79	67
Upper Connellsville	16	1,442	87	717,274	470,233	840,144	1.79	65.6
Allegheny mountain	10	694	150	461,922	297,724	671,437	2.25	64.4
Clearfield-Centre	6	523	10	154,566	97,852	198,095	2.02	63.4
Broad Top	5	581	0	262,730	164,535	347,061	2.11	62.6
Pittsburgh	20	880	235	366,184	177,097	315,546	1.78	48.4
Beaver	3	65	0	25,207	13,818	24,137	1.75	55
Allegheny valley	5	288	88	77,766	44,621	84,913	1.90	57.1
Reynoldsville-Walston	11	1,492	134	507,320	316,107	592,728	1.88	62.3
Blossburg	2	406	0	182,623	103,873	234,622	2.26	56.9
Total	151	18,294	802	8,938,438	5,832,849	10,746,352	1.84	65.25

TENNESSEE.

In the number of ovens and the total coke production Tennessee ranks as the third State in the Union, being surpassed only by Pennsylvania and West Virginia. The number of ovens, however, is but five greater than the number built at the close of the year in Alabama, while the number of ovens building in Alabama is nearly 1,200 greater than the number building in Tennessee at the close of the year. The production of coke in Tennessee was 71,959 tons greater than in Alabama.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1887:

Statistics of the manufacture of coke in Tennessee, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	656	68	217,656	130,609	$316,607	$2.42	60
1881	6	724	84	241,644	143,853	342,585	2.38	60
1882	8	861	14	313,537	187,695	472,505	2.52	60
1883	11	992	10	330,961	203,691	459,126	2.25	62
1884	(*a*)13	1,105	175	348,295	219,723	428,870	1.95	63
1885	12	1,387	36	412,538	218,842	398,459	1.82	53
1886	12	1,485	126	621,669	368,139	687,865	1.87	59
1887	11	1,560	165	655,857	396,979	870,900	2.19	61

a One works made coke in pits.

While there has been an increase in the production of coke in this State in 1887 over 1886, it has been a small one, less than 10 per cent. Its production will be easily surpassed in 1888 by Alabama.

TEXAS.

The experiments referred to in the last report as in progress by the Rio Grande and Eagle Pass Railway Company have not as yet resulted in anything definite. There are no ovens in the State, nor was any coke made in 1887.

VIRGINIA.

A reproduction of the remarks in the report on Virginia in the last volume of "Mineral Resources of the United States" will answer for the report of the present year. Only the coke made in this State during the year is covered by this report; the coal mined in the State was produced at Pocahontas, in Tazewell county, from Flat Top coal, by the Southwest Virginia Improvement Company. In addition to the ovens of this company there is at Low Moor, in Alleghany county, just across the border from West Virginia, a bank of 150 ovens, drawing their supplies of coal from the New River district of West Virginia, the ovens being, for convenience, located at Low Moor, near the blast furnaces in which their product is consumed. As coking is regarded as a manufacture of coal, the production of these ovens is reported in the State in which they are situated, and not in the State from which the coal is drawn.

The following are the statistics of the manufacture of coke in Virginia from 1880 to 1887:

Statistics of the manufacture of coke in Virginia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	0	0	0	0	0	$0	$0	0
1881	0	0	0	0	0	0	0	0
1882	0	0	0	0	0	0	0	0
1883	1	200	0	39,000	25,340	44,345	1.75	65
1884	1	200	0	99,000	63,600	111,300	1.75	64.25
1885	1	200	0	81,899	49,139	85,993	1.75	60
1886	2	350	100	200,018	122,352	305,880	2.50	61.2
1887	2	350	300	235,841	166,947	417,368	2.50	70.8

The notable feature of this report is the high yield of coal in coke, which seems almost incredible. The published statement as to the production of coke at one of these works would, on the basis of the coal reported as consumed, give an average yield of coal in coke of 61.5 per cent., which is probably more nearly correct. However, the figures are allowed to stand as reported.

WASHINGTON TERRITORY.

The coke works of the Tacoma Coal and Coke Company at Wilkeson, Pierce county, Washington Territory, is still the only one, so far as has been ascertained, on the Pacific coast.

These works and the coal and coke have been fully described in previous volumes of "Mineral Resources of the United States," and the description need not be repeated here.

The following are the statistics of the manufacture of coke in Washington Territory for the years 1884 to 1887, the only years in which coke has been made:

Statistics of the production of coke in Washington Territory, 1884 *to* 1887.

	1884.	1885.	1886.	1887.
Number of establishments	1	1	1	1
Number of ovens built	0	2	11	30
Number of ovens building	0	0	21	0
Coal used in the production of coke, short tons	700	544	1,400	22,500
Coke produced, short tons	400	311	825	14,625
Total value of coke at ovens	$1,900	$1,477	$4,125	$102,375
Value of coke at ovens, per ton	$4.75	$4.75	$5.00	$7.00
Yield of coal in coke, per cent	57½	57	58.9	65

It will be noted that there has been a very great increase in the production of coke in the Territory, the increase being from 825 tons in 1886 to 14,625 tons in 1887, the greatest percentage of increase in any of the States.

WEST VIRGINIA.

The localities in which coke is made in West Virginia are in this report divided into five districts, instead of four, as in the report for 1886, and three as in the reports prior to 1886. The district added the present year has been termed the "Upper Potomac" district, and includes the ovens on the line of the West Virginia Central and Pittsburgh railway. These districts are known as the Kanawha, the New River, the Flat Top, the Northern, and the Upper Potomac. The first two are compact and continuous. They include the ovens along the line of what was formerly known as the Chesapeake and Ohio railroad from Low Moor, in Virginia, to the Kanawha valley. The Flat Top region includes the ovens in the new Flat Top district, which are located in West Virginia. The ovens in this district which are located in Virginia are reported under that State. This Flat Top district is in reality a part of the New River district. The fourth district, the Northern, is a scattered one, including, in this report, the ovens in Preston, Taylor, Harrison, and Marion counties, and in previous volumes those in Wheeling, West Virginia. Most of the coke made in Wheeling in previous years has been used in glass manufacture. The advent of natural gas has entirely stopped the production of coke in Ohio county, in which Wheeling is situated. The Fifth district, the Upper Potomac, as already stated, includes the ovens along the line of the West Virginia Central and Pittsburgh railway, in what may be called the Upper Potomac basin.

With the exception of the Upper Potomac district these sections have been thoroughly described in previous volumes of "Mineral Resources," and need not be referred to here in detail; such statements as are required will be given under the heading devoted to each district.

Production of West Virginia by districts.—In the following table will be found the statistics of the production of coke in West Virginia in 1887 by districts:

Production of coke in West Virginia in 1887, *by districts.*

Districts.	Total number of establishments.	Number of ovens built.	Number of ovens building.	Coal used.	Coke produced.	Total value coke produced.	Average price of coke per ton.	Yield of coal in coke.
								Per ct.
Kanawha	7	548	0	153, 784	96, 721	$201, 418	$2. 08	63
New River	11	518	50	253, 373	159, 836	401, 164	2. 51	63
Flat Top	5	348	642	76, 274	51, 071	100, 738	1. 97	67
Northern	15	646	0	211, 330	132, 192	268, 990	2. 03	62. 5
Upper Potomac	1	20	50	3, 566	2, 211	4, 422	2. 00	62
	39	2, 080	742	698, 327	442, 031	976, 732	2. 21	63. 3

The Kanawha district.—In this district are included the ovens from Ansted down the Kanawha, all drawing their coal from the formations described in the volume of Mineral Resources for 1886.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	18	0	6, 789	4, 300	$9, 890	$2. 30	63⅓
1881	4	18	0	11, 516	6, 900	16, 905	2. 45	60
1882	5	(*a*) 138	0	40, 782	26, 170	62, 808	2. 40	64
1883	5	(*a*) 147	0	58, 735	37, 970	88, 090	2. 32	64⅔
1884	6	(*a*) 177	15	60, 281	39, 000	76, 070	1. 95	64⅔
1885	7	(*b*) 181	63	65, 348	37, 551	63, 082	1. 68	57
1886	7	302	170	89, 410	54, 329	117, 649	2. 17	60. 7
1887	7	548	0	153, 784	96, 721	201, 418	2. 08	63

a Eighty of these ovens are Coppée, the balance beehive.
b Sixty of these ovens are Coppée, the balance beehive.

There are two features in this statement that are of interest; one is the great increase in the number of ovens during the year, the number of ovens at the close of 1886 being 302, and 548 at the close of 1887.

This increase has been chiefly at the works of the Mount Carbon Coke Company, limited, these works beginning the year 1887 with but 30 beehive ovens and ending it with 202, consequently the present plant was not at work during the entire year. This indicates that the production of this district for 1888 will be considerably in excess of what it was for 1887. One works, the Hawk's Nest at Ansted, was entirely idle during the year. The number of coke works in the Kanawha district is now greater than that in the New River district, though the production is much less.

The second notable feature is the great increase in production during the year, the production of 1886 being 54,329 tons, and that of 1887 96,721 tons. For many years the Kanawha district was of but little importance as a coke-producing region. The present outlook indicates that it is assuming an importance second to none in the State.

Coke from the Eagle seam, of coal which is used entirely by the Saint Clair Coke Company, and by Mr. William Wyant, gives the following analysis:

Analysis of Eagle seam, West Virginia, coke.

	Per cent.
Carbon	10.48
Ash	9.001
Sulphur	.500

The coke made by Mr. Stewart M. Buck at Hampton, Kanawha county, is made from the slack of what is known as the Chestnut Point seam, which is regarded as the equivalent of the Middle Kittanning of Pennsylvania.

New River district.—The New River coking district includes the ovens along the line of what was formerly known as the Chesapeake and Ohio railroad from Quinnimont to Nuttalsburg.

The statistics of the manufacture of coke in the New River district from 1880 to 1887 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per. ct.*
1880	6	468	40	159,032	98,427	$239,977	$2.44	62
1881	6	499	0	219,446	136,423	334,652	2.45	62
1882	6	518	0	233,361	148,373	352,415	2.38	64
1883	6	546	0	264,171	167,795	384,552	2.29	64
1884	8	547	12	219,829	135,335	274,988	2.03	62
1885	8	519	0	244,769	156,007	325,001	2.08	63¾
1886	8	513	5	203,621	127,006	281,778	2.22	62
1887	11	518	50	253,373	159,836	401,164	2.51	63

The production of coke in this district in 1887 has been surpassed but once in its history. That was in 1883, when 167,795 tons were made, as against 159,836 tons in 1887. The production for 1886 was but 127,006 tons. It will be noticed that there has been an increase of three works in this district. One of these, and the largest with the exception of the Longdale Iron Company, which has the same number of ovens, viz, 150, made no coke in 1887, having begun production in January, 1888. The Central Coke Company will build 50 ovens during the present year.

Flat Top district.—The statistics of the manufacture of coke in the Flat Top district for the years 1886 and 1887 are as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia for 1886 *and* 1887.

	1886.	1887.
Number of establishments	2	5
Ovens built	10	348
Ovens building	38	642
Coal used, short tons	1,075	76,274
Coke produced, short tons	658	51,071
Total value of coke at ovens	$1,316	$100,738
Value of coke at ovens, per ton	$2.00	$1.97
Yield of coal in coke, per cent	61.2	67

Coke was made in this district for the first time in 1886, consequently the table only covers the operations of 1886 and 1887.

It is unnecessary to point out the remarkable increase in importance of this district and its promise for the future. No district in the United States shows such remarkable development. It has been so thoroughly described in previous volumes of Mineral Resources that only the briefest description need be given here. Nearly, if not quite all the coal lands in the Flat Top region, including the lands in Tazewell county, Virginia, and Mercer and McDowell counties, West Virginia, are controlled by an organization known as the Flat Top Land Trust, which leases these lands on a royalty. The great seam, 11 feet thick, from which the coal is taken, underlies 320,000 acres, and it is calculated that of this immense tract 60 per cent. is underlaid with working coal, whose yield is 10,000 tons per acre. This land trust was organized on April 1, 1887, and bought out the lands of the Southwest Virginia Improvement Company, the Flat Top mountain group, the Blue Stone Coal Company, and others.

The cost of production in the level seam of this coal is low, far below the general average. The average output of the Pocahontas mines per day of 10 hours is some four wagons. In the narrow seam on the Blue Stone river a man and a boy helper generally work together, and the output there is about the same. Here, as at Connellsville, there is no waste and no slate, and while a floor and roof of coal are left above and below in mining, a large part of this is saved when the supports are removed. The cost of handling the coal is at the lowest possible figures.

Donkey engines bring the cars out of the mines. Aside from the labor account, the expenses of operation are not heavy. Timber as yet is abundant and close at hand. Timbering is less expensive than in northern mines. The expense per ton of timbering and track laying falls as low, under favorable circumstances, as 1¼ cents a ton; and it rises to 2½ and 3 cents per ton in smaller mines or where the seam is in a less advantageous situation.

A graded royalty is paid to the proprietors of the trust; the royalty being 12½ cents per ton for the first 10,000 tons mined; above 10,000 to 25,000 tons, 11 cents, and over this, 10 cents. The cost of the coal at the pit mouth is placed at 65 cents, but it may fall as low as 60 cents. The cost of making coke, coal and all, at the close of the year was $1.35 per ton.

The company opens the ways and chambers, lays the track, brings the cars up to the breast and takes them away, and pays 75 cents a car for two-ton cars, holding from 80 to 85 cubic feet. The miner provides oil and powder, and pays 50 cents a month for tools. At the close of the year the average wages of miners per month were $45, some miners making from $120 to $130 a month. The boy drivers receive 90 cents to $1.06 a day, timber and trackmen, $1.85 to $2.20; men on the dumps, $1.40; laborers from $1.27 to $1.40; coke drawers from 53 to 55 cents an oven.

The following is an analysis of the coke made at the works of Stephenson, Mullin & Co.:

Analysis of Flat Top, West Virginia, coke.

	Per cent.
Fixed carbon	92.816
Ash	4.913
Sulphur	.548
Volatile matter	1.059
Water	.664
Total	100.000

An average of three samples of coke from the Pocahontas mine, Flat Top region, is as follows:

Analysis of Pocahontas coke.

	Per cent.
Fixed carbon	92.550
Ash	5.749
Sulphur	.597
Volatile matter	.757
Water	.347
Total	100.000

Northern district.—In this district are included the ovens in the group of counties lying along the line of the Baltimore and Ohio railroad, near the headwaters of the Monongahela river in Preston, Taylor, Harrison, and Marion counties. This district, with the other districts of West Virginia, has assumed considerable importance within the last two or three years.

The statistics of the production of coke in the Northern district of West Virginia from 1880 to 1887, are as follows:

Statistics of the manufacture of coke in the Northern district, West Virginia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	145	0	64,937	36,028	$68,930	$1.91	55
1881	9	172	0	73,863	43,803	78,014	1.78	59
1882	11	222	0	92,510	55,855	105,214	1.88	60
1883	13	269	0	88,253	51,754	90,848	.76	59
1884	13	281	100	78,468	49,139	74,894	1.52	63
1885	12	278	0	105,416	67,013	97,505	1.45	63.5
1886	12	275	104	131,896	82,165	113,100	....	62.3
1887	15	646	0	211,330	132,192	268,990	2.03	62.5

The report for 1887 shows a remarkable increase over that of previous years, the number of ovens having more than doubled and the production of coke increased over 50 per cent. There has been a large increase in the number of ovens at several coke works. The Montana Coal and Coke Company has 158 ovens at their works at Fairmont, while the Newburg-Orrel Coke Company of Baltimore has 130 at their two works. Colgate & Co. has at their Austen works 77, and the Howard Coal and Coke Company 55. Quite a number of ovens that have been built during the past year were in operation but a very small portion of the time, and the indications are that the production of 1888 will be greater than for 1887. Quite a number of new ovens will be built during the coming year.

My attention has been called to an error in the report for 1886. It is stated there that the coke made by the Newburg-Orrel Coal and Coke Company at Newburg is from a 10 to 11 foot vein of gas coal, and is liable to contain an excess of sulphur. I am informed that some years since the company owning these works did operate a gas-coal mine at Newburg located on the mountain top, and reached by an incline 2,100 feet long. At that time a few ovens were operated to utilize the screenings. In 1884, however, the company sunk a shaft in the valley near the Baltimore and Ohio railroad track to a depth of 380 feet, and have since that time been making coke from this coal exclusively. In sinking, the shaft passed through what is known as the Austen vein at a depth of 168 feet and was carried on to a lower seam, which is a bright clean coal from 5 feet 8 inches to 6 feet in thickness, and said to be the Connellsville seam. The company is now operating 105 ovens, using the coal from this seam exclusively.

The largest works in this district is that of the Montana Coal and Coke Company, located at Montana Mines, in Marion county. At this works 20 ovens were put in blast in October, 1886; the other 138 ovens were built in the summer of 1887, and only completed on December 1, of that year; hence the report includes practically only the production of 20 ovens. In the beginning of 1888 the output of coke was 7,000 tons a month, and the plant was to be increased 225 ovens in the spring of 1888. The coke is used both for foundry and furnace purposes; the market being in the West, chiefly Chicago, Milwaukee, and Columbus.

The following is an analysis of coke from these mines:

Analysis of Montana (West Virginia) coke.

	Per cent.
Fixed carbon	91.85
Ash	6.82
Sulphur	.48
Volatile matter	.43
Water at 225°	.42
Total	100.000

Color of ash, brown. Phosphorus, trace.

The sample was bright and hard, and as will be seen its composition is better than the average Connellsville coke.

Upper Potomac district.—Notwithstanding the fact that the first successful production of coke pig iron in the United States was in a furnace in Maryland, using coke made from a coal from what may be termed the Upper Potomac basin, it has been many years since any coke has been made on a commercial scale in this district. In 1837 the Georges Creek Coal Company built the Lonaconing furnace, 8 miles northwest of Frostburg, Maryland, and in June, 1839, it was making about 70 tons per week of good foundry iron, using coke as a fuel. In 1840 two large blast furnaces were built by the Mount Savage Company to use the same fuel. The coke used at these furnaces was from the seam of coal known as the Mount Savage Fawn Ash coal, containing about 78 per cent. of fixed carbon, and 7 per cent. ash; it also carried quite a large percentage of sulphuret of iron, which greatly injured its value, both for furnace and foundry purposes. This coke was made in open pits. From 1840 to 1850, between 59,000 and 75,000 tons of coke were made at the Mount Savage works, most of which was used at the furnace, and some in foundries. In the decade between 1860 and 1870 a portion of the coke used was from what is known as the big vein, Alleghany county, but the coke was unsatisfactory. From 1860 to 1870 all the coke made was from another portion of the big vein, which produced good coke. These furnaces have not been in blast for some years, consequently the manufacture of coke has been suspended.

In 1845 the Antietam furnace, which was built as a charcoal furnace, was built and blown in with half coke and half charcoal, and run in this way until 1848, when all coke was used. From this time until 1857 short blasts were made, using the coke entirely; the coke being chiefly from the Frostburg Coal Company's and the Cumberland Coal and Iron Company's mines. However, in the last three or four years' blasts, part of the coke was made at the furnace. From 1867 to 1879 all the coke used at the furnace was made at the furnace. After 1879 Connellsville coke was used.

The last company making coke in Cumberland prior to the operations of the West Virginia Central and Pittsburgh Railroad Company was the Cumberland Coal and Iron Company, which made some as late as 1878 and 1879.

For some time the West Virginia and Pittsburgh Railroad Company has been experimenting for the purpose of utilizing the slack produced at its mines in the manufacture of coke. These experiments were so encouraging that early in 1887 a number of ovens were built, the first shipment of coke being made in July of that year. At the close of the year there were 20 ovens in operation, and 50 to 100 additional ones were to be built early in 1888. The total production of coke to December 31 was 2,211 tons. No price has been given, nor yield. It is assumed that the yield is 62 per cent., and the price $2 per ton. In the coal lands on the line of the Central Virginia railroad there are several veins of coking coal, the best known of which is the 11 foot vein of the Upper Potomac region. Both the 8 foot and 11 foot veins of this region make excellent coke, but that from the lower vein is the purest and gives the best results.

The following is an analysis of coke from this region:

Analysis of coke from Potomac (West Virginia) region.

	8-foot vein.	11-foot vein.
	Per cent.	*Per cent.*
Fixed carbon	87.14	89.23
Ash	10.00	8.28
Sulphur	.721	.645
Volatile matter	2.39	2.24
Water	.47	.25
Totals	100.721	100.645

From a report on these coals and cokes made by Prof. I. C. White, of the West Virginia University, Morgantown, we extract the following:

"The Upper Freeport coal is one of the regular, persistent, and valuable beds of the Coal Measures, and it nearly always furnishes a quality of fuel that makes excellent coke. This is the coking bed in the Preston county basin which has been so successfully coked at Austen, Irondale, and other points in that region for a long time. It has also long been coked successfully in the Broad Top, Clearfield, and other regions of Pennsylvania. It has a thickness of nearly 8 feet from roof to floor in the Upper Potomac field, but a bony coal and slate just above the center of the bed render a portion of this thickness unavailable, so that seldom more than 6 feet of merchantable coal can be obtained from this seam. The upper portion of this bed comes out in good-sized lumps, and will make a good shipping coal, while the lower bench is softer and will make good coke. This bed goes under the Potomac near Bayard, and underlies the entire basin from that point to Thomas, a distance of 15 miles, while the width across from one outcrop to the other varies from 3 to 4 miles.

"At a vertical distance of 170 feet below the floor of the Upper Freeport coal we come to the roof of the most valuable coal in the basin, the one which has been referred to under the name of Lower Kittanning, or 'Davis seam.' The entire thickness of this bed is about 11 feet, but as the bottom bench is separated from the middle or main one by a slate of considerable thickness, the lowest ply of coal, which is nearly 3 feet thick, is not usually mined, since there is 6 feet of clean coal above this after it has been freed from all slates, of which there are two streaks in the upper portion of the bed, but they both come out without trouble, taking with them of coal, slate, and all, only 8 inches from the thickness of the bed, leaving, as just stated, exactly 6 feet of coal free from impurities.

"This Lower Kittanning coal in the Upper Potomac region is one of the purest beds with which the writer is acquainted anywhere in the country, being singularly free from sulphur, so much so in fact that it already has a great reputation as a smithing coal, being as highly prized for this purpose as the celebrated Blossburg coal of Pennsylvania, with which bed, strange to say, it seems to be exactly identical.

"The following analyses of these cokes made from the Upper Freeport and Lower Kittanning coal beds, by Prof. Hugo Blanck, of the College of Pharmacy, Pittsburgh, Pennsylvania, serve to show the excellent character of the product and the special freedom from impurities that would be injurious in the manufacture of iron, or for its use in metallurgical processes. The cokes were manufactured in a small plant of ovens which the railroad company has erected for experimental purposes near Thomas, and as the coal for these specimens was taken entirely across the merchantable portion of the two beds the analyses should be fairly representative in character.

Analysis of coke from Upper Freeport and Lower Kittanning coal.

	1.	2.	3.	4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	0.590	0.440	0.840	1.200
Volume carbon	0.870	1.300	2.020	1.380
Fixed carbon	93.060	86.400	88.000	90.900
Ash	5.480	5.480	9.140	6.520
Sulphur	0.116	0.105	0.191	0.147
Phosphorus	0.001	0.020	0.030	0.0192
Totals	100.117	93.745	100.221	100.1662

(1) Lower ply of Upper Freeport coke ("Thomas" bed).
(2) Upper ply of the Upper Freeport coke ("Thomas" bed).
(3) Lower ply of the Lower Kittanning coke ("Davis" bed).
(4) Upper ply of the Lower Kittanning coke ("Davis" bed).

Mr. White adds that the physical structure of the Upper Potomac cokes is very much in their favor, and there is not the least doubt that for every purpose for which coke is used they would prove to be perfectly successful. The great freedom from sulphur and other impurities ought to render these cokes especially desirable for metallurgical purposes, and all others in which a pure fuel is necessary.

The statistics of the manufacture of coke in the Upper Potomac district of West Virginia for 1887 are as follows:

Statistics of the manufacture of coke in the Upper Potomac district of West Virginia, 1887.

Number of establishments	1
Ovens built	20
Ovens building	50
Coal used, short tons	3,566
Coke produced, short tons	2,211
Total value of coke at ovens	$4,422
Value of coke at ovens, per ton	$2
Yield of coal in coke, per cent	62

Statistics of the production of coke in West Virginia.—Consolidating the statistics of the five different districts given below, the following is a statement of the production of coke in West Virginia for the years 1880 to 1887:

Statistics of the manufacture of coke in West Virginia, 1880 *to* 1887.

Years.	Number of establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	18	631	40	230,758	138,755	$318,797	$2.30	60
1881	19	689	0	304,823	187,126	429,571	2.30	61
1882	22	878	0	366,653	230,398	520,437	2.26	63
1883	24	962	0	411,159	257,519	563,490	2.19	63
1884	27	1,005	127	385,588	223,472	425,952	1.91	62
1885	27	978	63	415,533	260,571	485,588	1.86	63
1886	29	1,100	317	425,002	264,158	513,843	1.94	62
1887	39	2,080	742	698,327	442,031	976,732	2.21	63.3

From a comparison of these figures it will be seen that the year 1887 has been one of remarkable progress in this State, the number of works having increased 10 since 1886, from 29 to 39; the number of ovens being nearly doubled, there being 2,080 at the close of 1887, as compared with 1,100 at the close of 1886. This number of ovens is the largest in any State except Pennsylvania, it being 520 larger than the number of ovens in Tennessee, which comes next to it, and 525 larger than the number of ovens built in Alabama.

The production of coke during the year has increased some 75 per cent., or from 264,158 tons in 1886 to 442,031 in 1887. This places West Virginia second in the rank of coke-producing States in the Union.

COKING IN GERMANY.

In a recently published work by M. Simmerbach, of Bochum, there is a statement (unofficial) of the production of coke in Germany in 1886.

The following is a recapitulation of the figures of the production of metallurgical coke in Germany in 1886:

Production of metallurgical coke in Germany in 1886.

Mining districts.	Coke works.	Ovens working.	Production.	Selling price.	Years.	Remarks.
			Short tons.			
Dortmund	60	5, 242	2, 819, 107	1. 83	1886	Price of the coke syndicate.
Breslau:						
Upper Silesia	19	1, 831	881, 225	2. 07	1885	Approximate price.
Lower Silesia	.....	314	147, 443	2. 79	1885	
Bown:						
Saar	8	967	637, 963	3. 12	1885–'86	
Aix-la-Chapelle	2	343	127, 569	2. 40	1885	
Clausthal	1	......	25, 247	3. 60	1886	
Freiberg in Saxony	.....	338	103, 133	3. 48	1883	
Munich	1	......	11, 025	......	....	Approximate quantity.
Total	.....	......	(*a*)4, 752, 712	......	....	

a Amounting in value to about $9,360,000.

This table is but an epitome of a series of investigations on the production of coke in different provinces. We will confine ourselves to the principal ones in or out of work in 1885.

Number of coke works in Westphalia (Dortmund).

Districts.	Works.	Coke ovens.
Dortmund	24	2, 194
Bochum	32	3, 048
Essen	14	1, 470
Total	70	6, 712

A distinction is made between coke ovens connected with mines and those which are distinct coke enterprises.

Official statistics are given of the coke ovens connected with mines, and are as follows:

Years.	Works.	Ovens.	Consumption of coal.	Production of coke.
			Short tons.	*Short tons.*
1885	53	4, 724	4, 140, 908	2, 645, 420
1886	55	4, 906	3, 634, 102	2, 581, 634

In order that the figures may be less approximate he falls back upon the statistics of the coke syndicate, which give the following statements:

Statistics of the German coke syndicate.

Years.	Works in activity.	Ovens.		Production of coke.
		Constructed.	At work.	
				Short tons.
1885	68	6,464	....	3,128,933
1886	60	6,712	5,242	2,819,106

The coke sales in 1885 were distributed as follows:

	Short tons.	Per cent.
Sales in Westphalia	1,050,467	41.11
Sales in northeast Germany	355,479	13.91
Sales in center and south Germany	176,885	6.93
Sales in Alsace-Lorraine	380,880	14.91
Total in Germany	1,963,711	76.86
Exports to Belgium and Luxemburg	331,400	12.97
Exports to France	151,142	5.92
Exports to Austria and Italy	68,927	2.70
Exports to other countries	39,865	1.55
Total exports	591,334	23.14
General total	2,555,045	100.00

While the production of coal in the basin of Saarbruck is entirely in the hands of the Prussian Government, the manufacture of coke is almost exclusively confined to private industry.

The production of coke in 1883 is as given below:

Production of coke in Saarbruck in 1883.

	Short tons.
Under the control of the Government	70,232
Under the control of private parties	588,515

The situation practically remains as it was at that date. The production of coke in 1885–'86 was distributed as follows:

Distribution of the sales of German coke in 1885–'86.

	Short tons.	Per cent.
Sales in Prussia	293,433	46.00
Sales in the South of Germany	38,584	6.00
Sales in Alsace-Lorraine	212,582	33.37
Total in Germany	544,599	85.37
Exports to France	64,920	10.17
Exports to other countries	28,443	4.46
Total exports	93,363	14.63
General total	637,962	100.00

The production of the Aix-la-Chapelle district in 1885 was distributed as follows:

Production of coke in Aix-la-Chapelle in 1885.

	Short tons.
Sales in Germany	66, 358
Exports to Lorraine	34, 348
Exports to Belgium and Luxemburg	26, 862
Total	127, 568

Production of coke in Upper and Lower Silesia in 1885.

	Upper Silesia.	Lower Silesia.
	Short tons.	*Short tons.*
Production in 1885	881, 225	147, 444
Sales in 1885—		
Sales in Germany	823, 320	79, 054
Exports to Russia	30, 452	21, 304
Exports to Austria-Hungary	27, 453	47, 859
Total	881, 225	148, 217

On the whole, therefore, Germany consumed nearly 3,858,750 tons of coke and exported nearly 882,000 tons of coke. Finally, the author gives an approximate estimate of the production of metallurgical coke in the world:

Simmerbach's estimate of the production of coke in the world.

Countries.	Years.	Production.	Remarks.
		Short tons.	
England	1885	12, 127, 500	Estimated.
United States of America	1885	5, 622, 750	
Germany	1885	4, 740, 750	
Belgium	1885	1, 874, 250	
France	1885	1, 653, 750	Estimated.
Austria-Hungary	1884	496, 125	
Other countries	1885	55, 125	Estimated.
Approximate production of the world	......	26, 570, 250	

Official statistics (statistisches Jahrbuch für das deutsche Reich) give separately the difference between the exports and the imports. By their showing the exports exceeded the imports in 1884 by 739,343 short tons, in 1885 by 698,871 short tons.

These net exports in 1885 were distributed as below:

Exports of coke from Germany in 1885.

	Short tons.
France	463, 123
Austria-Hungary	75, 918
Holland	48, 300
Switzerland	45, 092
Russia	42, 583
Belgium	28, 615
In German districts (exempt from custom)	23, 100
Other countries	12, 657
Total	739, 388

COKE IN FRANCE.

It is difficult to procure correct statistics of the total production of coke in France. The statements made are usually estimates based on the estimated consumption. The most complete statement that it has been possible to obtain is as follows:

Consumption of coke in France in 1885.

	Metric tons.
By railroads	84, 000
By blast furnaces	1, 874, 000
By steel works	12, 150
By lead, copper, and similar smelting	8, 220
Total	1, 978, 370

No estimate was secured of the consumption at foundries.

The importation of coke into France in 1885 and the countries from which it was imported were as follows:

Importation of coke into France in 1885.

From—	Metric tons.
Belgium	853, 000
England	11, 000
Germany	268, 000
Total	1, 132, 000

Production of coke in Nova Scotia.—The production of coke in Nova Scotia in 1886 was 31,604 tons, and in 1887, 28,748 tons.

PETROLEUM.

BY JOSEPH D. WEEKS. (*a*)

The noticeable features in connection with the production of petroleum in 1887 were: First, the great reduction in the production of the Pennsylvania and New York fields, growing out of the agreement among the producers to restrict drilling, and the great increase in the new Ohio field; second, the great reduction in the prices of petroleum during the summer months; third, the shut down in production and the consequent increase in price; fourth, the slight increase in the amount of exports and the marked increase in the amount of home consumption; fifth, the great depression and low prices of oil in the Lima region.

The production in the New York and Pennsylvania oil fields declined from 25,798,000 barrels in 1886 to 22,356,193 barrels in 1887. Notwithstanding this the production in the whole country in 1887 has shown a slight advance over the production of 1886, the total for 1887 being 28,249,597 barrels, as compared with 28,110,115 barrels in 1886, an increase of 139,482 barrels. This compensation for the decrease in the production of the Pennsylvania and New York fields is, of course, due to the increased production of the Ohio field, which in 1887 reached 5,018,015 barrels, as compared with 1,782,970 barrels in 1886. There has also been some increase in the production in West Virginia, and considerable increase in the production of California, the production of the latter State increasing from 377,145 barrels in 1886 to 678,572 barrels in 1887.

Localities in which petroleum is found in the United States.—For convenience we reproduce here the statement published in the report for 1886 as to the localities in which petroleum is found in the United States.

Petroleum has been found in nearly if not quite all of the States lying entirely or in part in the great Mississippi basin, as well as in several of the Rocky Mountain States and in California. The localities, however, in which it is produced on a commercial scale are few, in view of the great extent of territory in which it has been discovered. These producing localities are the well-known oil regions of western New York and western Pennsylvania, Macksburgh, and the recently devel-

a In the preparation of this report, in addition to the special credit given in the body of the same, I beg to acknowledge my constant indebtedness to *Stowell's Petroleum Reporter*, and the *American Manufacturer and Iron World*, of Pittsburgh, the *Oil City Derrick*, the *Petroleum Age*, of Bradford, Pennsylvania, and the *Bradford Era*, of Bradford, Pennsylvania.

oped northwestern or Lima field of Ohio, the Volcano and other oil districts of West Virginia, and the oil producing portions of California.

The oil fields of Tennessee and Kentucky, where some oil was produced shortly after the great discoveries in the Pennsylvania region, as well as the Wyoming oil fields, did not produce sufficient oil in 1886 or 1887 to be considered in speaking of the localities that produced oil in those years. What their possibilities may be is as yet uncertain, and can only be determined by more extensive explorations.

Several of these districts are subdivided into smaller fields, which are known by some geographical name in the field. There are also other divisions of these districts based upon the character of the oil, or the sand from which the oil of these districts is produced.

TOTAL PRODUCTION OF PETROLEUM IN THE UNITED STATES AND CANADA.

In the following table will be found consolidated the statistics of the production of petroleum in the various fields of the United States and Canada, from the beginning of operations in these fields, so far as the same could be ascertained:

Production of crude petroleum in the United States and Canada from 1859 *to* 1887, *inclusive.*

Years.	Pennsylvania and New York.	West Virginia.	Ohio.	Kentucky, Tennessee, and other States.	California.	Total United States.	Canada. (*a*)
	Barrels. (*b*)	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1859 ...	2,000	....	....	....	....	2,000	....
1860 ...	500,000	....	....	....	....	500,000	....
1861 ...	2,113,609	....	....	....	....	2,113,609	....
1862 (*c*)	3,056,690	....	....	....	....	3,056,696	11,775
1863 ...	2,611,309	....	....	....	....	2,611,309	82,814
1864 ..	2,116,109	....	....	....	....	2,116,109	90,000
1865 ...	2,497,700	....	....	....	....	2,497,700	110,000
1866 ...	3,597,700	....	....	....	....	3,597,700	175,000
1867 ...	3,347,300	....	....	....	....	3,347,300	190,000
1868 ...	3,646,117	....	....	....	....	3,646,117	200,000
1869 ...	4,215,000	....	....	....	....	4,215,000	220,000
1870 ...	5,260,745	....	....	....	....	5,260,745	250,000
1871 ...	5,205,234	....	....	....	....	5,205,234	269,397
1872 ...	6,293,194	....	....	....	....	6,293,194	308,100
1873 ...	9,893,786	....	....	....	....	9,893,786	365,052
1874 ...	10,926,945	....	....	....	....	10,926,945	168,807
1875 ...	8,787,514	(*d*) 3,000,000	(*d*) 200,000	....	(*d*) 175,000	12,162,514	220,000
1876 ...	8,968,906	120,000	31,763	....	12,000	9,132,669	312,000
1877 ...	13,135,475	172,000	29,888	....	13,000	13,350,363	312,000
1878 ...	15,163,462	180,000	38,179	....	15,227	15,396,868	312,000
1879 ...	19,685,176	180,000	29,112	....	19,858	19,914,146	575,000
1880 ...	26,027,631	179,000	38,940	....	40,552	26,286,123	350,000
1881 ...	27,376,509	151,000	33,867	....	99,862	27,661,238	275,000
1882 ...	30,053,500	128,000	39,761	....	128,636	30,349,897	275,000
1883 ...	23,128,389	126,000	47,632	....	142,857	23,444,878	250,000
1884 ...	23,772,209	90,000	90,081	....	262,000	24,214,290	250,000
1885 ...	20,776,041	91,000	650,000	....	325,000	21,842,041	250,000
1886 ...	25,798,000	102,000	1,782,970	(*e*) 225,000	377,145	(*e*) 28,285,115	250,000
1887 ...	22,356,193	145,000	5,018,015	51,817	678,572	28,249,597	868,345
Total ..	330,312,443	4,664,000	8,030,208	276,817	2,289,709	345,573,177	6,940,290

a. There are no reliable statistics of production for Canada. Those given are the estimates of parties intimately connected with the industry.

b. All barrels in this table are of 42 gallons.

c. In addition to the above it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania and Canada fields; also a large amount from West Virginia and Tennessee.

d. Including all production prior to 1876.

e. This includes the 175,000 barrels produced in Kentucky and Tennessee prior to 1886.

In the above table it appears that the total production of all the oil fields known since the discovery of oil in Pennsylvania in 1859 has been 345,573,177 barrels. Of this amount Pennsylvania and New York have produced 330,312,443 barrels; the production of all the other States being 15,220,734 barrels. West Virginia has produced 4,664,000 barrels, Ohio 8,030,208 barrels. The value of this oil, based on the value of petroleum in Pennsylvania since 1860, ranged from $19.25 in January, 1860, to 10 cents per barrel during October, November, and December, 1861, and January, 1862. In view of the monthly and yearly average prices given elsewhere, it is believed that $1 a barrel would not exceed the average price of oil for these years, which would make the total value of crude petroleum produced in the United States since 1859, $345,573,177.

TOTAL PRODUCTION AND VALUE OF PETROLEUM IN THE UNITED STATES IN 1887.

The total production of oil in the United States in 1887, arranged by States, so far as the production of the individual States could be ascertained. was as follows, the barrel being uniformly 42 gallons:

Production of petroleum in the United States in 1887.

States.	Production.
	Barrels.
Pennsylvania and New York	22,356,193
Ohio	5,018,015
California	678,572
West Virginia	145,000
Colorado	1,817
Elsewhere	50,000
Total	28,249,597

As compared with 1886 this shows an increase of production in the year of 139,482 barrels. The Pennsylvania-New York region shows a decrease, the production of 1886 being 25,798,000, and that of 1887 22,356,193 barrels. Ohio shows a remarkable increase, the production advancing from 1,782,970 barrels in 1886 to 5,018,015 barrels in 1887, an increase of very nearly 300 per cent. There has also been a remarkable increase in California, the production being nearly doubled, having advanced from 377,145 barrels in 1886 to 678,572 barrels in 1887. West Virginia shows an increase of about 45 per cent.

It is nearly impossible to arrive at the actual value of this oil. The average value of pipe-line certificates in Pennsylvania during the year 1887 was 66¾ cents. Heavy oil like the Franklin, of which, however, but a small quantity was produced, was worth four times this, and even some of the Pennsylvania oils, because of their superior value in making illuminating oils, are rated a certain number of cents per barrel above the average price. California oil, it is estimated, was worth $2 per barrel. On the other hand, Lima oil sold in 1887 as low as 15 cents a barrel, and the production was equal to one-fifth the production of Pennsylvania. It is fair to assume that the average value of the pipe-line certificates would be the average value of all the oil produced. On the basis then of 66¾ cents per barrel, the value of the oil produced in 1887 would be $18,856,606. The value of the oil produced in 1886 was given as $20,028,457, and that for 1885 as $19,193,694.

THE PENNSYLVANIA AND NEW YORK FIELDS.

As has been stated in previous reports, the intimate connection in a commercial way is such as to render it almost impossible to make an exact separation between the oil produced in New York and that from the wells in Pennsylvania. Latterly the oil produced in what is known as the Allegany field has been reported separately, and, in order to arrive at a correct statement of the production of New York, to this oil should be added that produced in the outlying districts of this State. Concerning the latter amount, however, it is difficult to give even an estimate, as the returns from these wells are reported with those in Pennsylvania. If 5 per cent. of the production of the Bradford district is added to the total production of the Allegany field, it is believed that this will represent the total production of New York. The production of the Allegany field in 1887 is estimated at 1,700,000 barrels; add to this 5 per cent. of the Bradford district, say 375,000 barrels, and we would have, as the production of New York in 1887, 2,075,000 barrels, which would leave as the production of Pennsylvania 20,281,193 barrels.

The Pennsylvania and New York oil fields.—There are five general divisions of the Pennsylvania and New York oil field, one, the Washington, being added to the four divisions last reported. These are the Allegany, Bradford, Middle, Lower, and Washington districts.

The several Pennsylvania fields, with the exception of the Washington, have been fully described in previous reports. It may be well to say, however, that the Allegany field lies wholly in Allegany county, New York, and is of an irregular shape, with an average length of some 20 miles. Outlying this district, in the same county, are four smaller fields, of which one, about a mile north of the town of Niles, and bearing its name, has a few small wells and produces dark oil; it is the farthest north of any of the petroleum developments of the two States of Pennsylvania and New York. The Wirt field, midway between the Niles and the Allegany fields, has a few small wells, but produces more gas than oil. The Waugh and Porter field, near the Pennsylvania State line, and lying southwestwardly from the most southerly point of the eastern limit of the Allegany field, produces an amber-colored oil from small wells. Southeastwardly of the eastern limit of the Allegany field proper is the Harding-O'Connor territory, in which there are a few small wells.

The second district, Bradford, lies chiefly in Pennsylvania, in McKean county, but the main field extends some 5 miles into the State of New York, and an outlying basin of oil rocks, which properly belongs to the Bradford basin, is situated for the greater part in Carrollton township, in Cattaraugus county, New York. This field also includes the small outlying district of Kinzua, which lies southwestwardly from the main district, and contains large and long-lived wells, and the Windfall Run field, lying in Pennsylvania, near Eldred, which has only small wells.

The lower field covers a large extent of territory from Sugar Run, in McKean county, just across the border from Warren county, down through Forest to Beaver county, including, in addition to Warren and Forest, all the oil-producing territory in Venango, Clarion, Butler, Lawrence, and Beaver counties, with the Pleasant Unity district in Westmoreland county.

In the Washington field are included the wells in Washington and Green counties, Shoustown, in Allegheny, and other small districts in the neighborhood.

Production in the several districts of Pennsylvania and New York.— Without giving in detail the production of all the fields in Pennsylvania and New York, it may be said in general that the production of all of the older fields has declined steadily during the year. The falling off of the average daily production of the Bradford region has been about 6,000 barrels. The Allegany has declined about 1,600 barrels. Cherry Grove, Cooper, and Ball Town all show some reduction in daily average production. It is estimated that Cogley has declined from about 2,800 barrels a day, average production, to somewhere near 700. Red Valley has fallen off about half. Tarkill, it is estimated, has fallen off a little more than half. Pontius has declined from 2,600 barrels a day to an average of about 1,600 barrels, and Kane from 3,500 to 1,950 barrels. On the other hand, the Bald Ridge district has increased from 2,000 barrels a day to 5,500; Washington, from 6,600 to 7,800 barrels. Shannopin has increased from 1,600 to 1,900 barrels, while the new Saxonburgh district has come in with 266 barrels a day.

The estimate of the production of the different fields of Pennsylvania and New York in 1887, as given in the *Petroleum Age*, is as follows:

The Petroleum Age's estimate of the production of Pennsylvania and New York in 1887.

Districts.	Barrels.
Bradford	7, 563, 452
Allegany	1, 662, 661
Cherry Grove	73, 546
Cooper	141, 155
Ball Town	192, 333
Bald Ridge, etc	2, 028, 728
Cogley	262, 020
Red Valley	172, 003
Tarkill	342, 221
Pontius	588, 370
Kane	708, 464
Washington	2, 859, 344
Shannopin	690, 500
Saxonburgh	96, 977
Other fields	4, 986, 551
Total	22, 368, 325

It will be noted that this makes the total production of the Pennsylvania and New York fields 22,368,325 barrels, while the figures given in this report are 22,356,193. This is a difference of 12,132 barrels, which is due to the fact that in both cases estimates have been made as to the production of certain districts, and the estimate of this by the author of this report differs from that of the *Petroleum Age*.

Total production of the Pennsylvania and New York oil fields.—In the following table will be found a statement of the total production of crude petroleum as shown by pipe-line runs in the Pennsylvania and New York oil fields, by months, for the past five years:

Total production of crude petroleum in the Pennsylvania and New York oil fields for the years 1882 *to* 1887, *by months.*

Months.	1882.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	2, 353, 551	1, 948, 319	1, 825, 838	1, 652, 176	1, 748, 958	1, 990, 851
February	2, 131, 332	1, 756, 188	1, 880, 650	1, 437, 884	1, 604, 848	1, 827, 924
March	2, 482, 170	1, 830, 674	2, 052, 262	1, 638, 133	1, 928, 448	2, 007, 196
April	2, 402, 790	1, 816, 530	2, 065, 860	1, 780, 290	1, 938, 360	1, 960, 860
May	2, 486, 572	1, 962, 052	2, 381. 854	1, 771, 371	2, 178, 773	1, 993, 517
June	2, 825, 940	1, 977, 900	1, 862, 190	1, 767, 210	2, 335, 380	1, 912, 860
July	3, 258, 162	2, 020, 394	2, 059, 950	1, 775, 804	2, 418, 961	1, 89[illegible], 525
August	3, 104, 495	1, 879, 437	2, 099, 165	1, 705, 961	2, 413, 206	1, 84[illegible], 877
September	2, 620, 380	1, 913, 370	1, 948, 260	1, 712, 790	2, 418, 540	1, 779, 930
October	2, 297, 658	2, 076, 659	1, 961, 866	1, 874, 105	2, 408, 111	1, 843, 291
November	2, 192, 940	1, 958, 340	1, 811, 700	1, 761, 660	2, 222, 790	1, 125, 450
December	1, 897, 510	1, 988, 526	1, 822, 614	1, 898, 657	2, 181, 625	1, 288, 602
Total	30, 053, 500	23, 128, 389	23, 772, 209	20, 776, 041	25, 798, 000	21, 478, 883

To the above statement of production, which practically represents only the pipe-line runs, must be added dump oil from the various fields and that shipped by private lines. This is estimated to amount to 877,310 barrels, which, added to 21,478,883, would make the total production of the Pennsylvania and New York oil fields 22,356,193 barrels. This, with the exception of 1885, is the smallest total production since 1879.

Average daily production.—In the following table will be found the average daily production of all wells in the Pennsylvania and New York districts for the years 1882 to 1887:

Average daily production of crude petroleum in the Pennsylvania and New York oil fields for the years 1882 *to* 1887, *by months.*

Months.	1882.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	75, 921	62, 849	58, 898	53, 296	56, 418	64, 221
February	76, 119	62, 721	64, 850	51, 353	57, 316	65, 283
March	80, 070	59, 054	66, 202	52, 843	62, 208	64, 716
April	80, 093	60, 551	68, 862	59, 343	64, 612	65, 372
May	80, 212	63, 292	76, 834	59, 141	70, 283	64, 307
June	94, 198	65, 930	62, 073	58, 907	77, 846	63, 762
July	105, 102	65, 174	66, 450	57, 284	78, 031	61, 275
August	100, 145	60, 627	67, 71[illegible]	55, 031	78, 426	59, 641
September	87, 346	63, 779	64, 942	57, 093	80, 618	59, 321
October	74, 118	66, 989	63, 286	60, 455	77, 681	61, 822
November	73, 098	65, 278	60, 390	58, 722	74, 093	37, 515
December	61, 210	64, 146	58, 794	61, 247	70, 375	41, 568
Yearly averages	82, 338	63, 365	65, 129	56, 921	70, 679	58, 846

The yearly averages in this table were computed by dividing the total production for each year by 365.

The above table gives the average daily production as indicated by the pipe-line runs. The year 1887 began with a daily production of 64,221, and closed with a production of 41,568 barrels; the lowest average of daily production in any one month in the year was November, when it was 37,515 barrels. The production for this month (November) was less than half the highest average daily production in 1886.

This average daily production is based, as is stated above, on the runs, which is the only criterion we have for ascertaining approximately the monthly averages. Taking the basis of production given under the preceding subhead, that is, 22,356,193, which is found by adding to the pipe-line runs the dump oil and that transported in private lines, the average daily production would be 61,250 barrels instead of 58,846. In other words, the dump oil and that of private lines were equal to a production of 2,404 barrels per day.

Total shipments.—In the following table will be found a statement of the number of barrels of crude petroleum and of refined reduced to crude equivalent shipped out of the Pennsylvania and New York oil regions, whether by pipe or by railroad, for the years 1882 to 1887. A considerable portion of this oil is shipped as refined; this is reduced to its equivalent in crude, a barrel of refined being regarded as equal to 1⅓ barrels of crude.

Shipments of crude petroleum and of refined petroleum reduced to crude equivalent out of the Pennsylvania and New York oil regions for the years 1882 *to* 1887.

Months.	1882.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	1, 657, 067	1, 357, 815	1, 686, 961	1, 804, 028	1, 991, 561	2, 312, 067
February	1, 787, 909	1, 250, 824	1, 723, 261	1, 895, 021	2, 032, 794	1, 995, 757
March	1, 718, 956	1, 641, 899	1, 873, 890	1, 887, 034	2, 055, 750	2, 332, 324
April	1, 678, 134	1, 908, 379	1, 643, 336	1, 823, 726	2, 070, 468	1, 938, 278
May	1, 827, 356	1, 995, 634	1, 899, 329	2, 097, 099	2, 032, 672	2, 328, 564
June	2, 172, 685	1, 747, 789	1, 827, 553	2, 034, 025	2, 117, 489	2, 165, 439
July	2, 402, 970	1, 634, 407	1, 740, 021	1, 961, 152	2, 418, 961	2, 000, 173
August	2, 047, 545	2, 086, 478	2, 000, 371	2, 049, 099	2, 059, 299	2, 220, 768
September	1, 992, 171	2, 325, 574	2, 292, 087	2, 116, 659	2, 157, 323	2, 342, 227
October	2, 089, 428	2, 215, 421	2, 510, 283	2, 050, 150	2, 441, 848	2, 573, 008
November	1, 404, 640	2, 065, 602	2, 078, 261	1, 857, 080	2, 724, 796	2, 462, 082
December	1, 121, 453	1, 749, 547	2, 382, 244	2, 138, 253	2. 550, 891	2, 608, 341
Total	21, 900, 314	21, 979, 369	23, 657, 597	23, 713, 326	26, 653, 852	27, 279, 028

To the above statement of shipments, in order to arrive at consumption, must be added the dump oil and the shipments of private lines, amounting to, say roughly, 700,000 barrels, which would make the total shipments out of the oil regions 27,979,028 barrels. As the average daily export for the year was 46,699 barrels, and the average total shipment, based upon the above statement, 76,654, the daily average of home consumption must have been about 29,955, a most gratifying increase.

It will also be noticed that these shipments are the largest of any year in the history of the trade.

Total stocks.—In the following table will be found a statement of the total stocks held in the Pennsylvania and New York oil regions at the close of each month for the years 1882 to 1887. In addition to the net stocks held by the pipe-lines, the term net stocks meaning the stocks after making a certain deduction for surplus and sediment, these stocks include an estimate of field oil which in the tables of Stowell's Petroleum Reporter, from which these tables are taken, is carried as surplus.

Total stocks of crude petroleum in the Pennsylvania and New York oil regions at the close of each month for the years 1882 *to* 1887.

Months.	1882.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	26, 716, 188	35, 187, 116	35, 384, 509	37, 214, 274	34, 186, 238	33, 835, 389
February	27, 059, 611	35, 692, 480	36, 041, 898	36, 757, 137	34, 082, 775	33, 288, 630
March	27, 822, 825	35, 881, 255	36, 220, 270	36, 508, 236	33, 954, 493	32, 932, 502
April	28, 547, 481	37, 789, 406	36, 642, 794	36, 464, 800	33, 823, 385	32, 955, 084
May	29, 206, 697	35, 755, 824	38, 631, 203	36, 139, 072	33, 969, 486	32, 642, 330
June	29, 859, 952	35, 985, 935	38, 665, 838	35, 872, 257	34, 187, 377	32, 389, 750
July	30, 715, 144	36, 371, 922	38, 985, 767	35, 686, 909	34, 428, 490	32, 289, 269
August	31, 772, 094	36, 164, 881	39, 084, 561	35, 343, 771	34, 800, 397	32, 003, 536
September	32, 400, 303	35, 752, 677	38, 740, 734	34, 939, 902	35, 061, 614	31, 340, 939
October	32, 608, 533	35, 613, 915	38, 192, 317	34, 763, 857	35, 027, 877	30, 662, 583
November	33, 728, 555	35, 506, 653	37, 925, 756	34, 668, 437	34, 525, 871	29, 325, 951
December	34, 596, 612	35, 745, 632	37, 366, 126	34, 428, 841	34, 156, 605	28, 006, 211
Average	30, 419, 500	35, 953, 975	37, 698, 481	35, 732, 291	34, 350, 467	31, 806, 015

The stocks at the close of December, 1887, were only 28,006,211, the lowest stocks reported since March, 1882. This reduction is due to two causes: First, the increased shipments out of the region; and, secondly, the reduction of production in accordance with the agreement reached by the producers. The average stock held at the close of each month during the year was 31,806,015, the lowest for any year since 1882.

Prices.—In the following table will be found a statement of the monthly and yearly average price of pipe-line certificates for the years 1882 to 1887.

Monthly and yearly average price of pipe-line certificates or crude petroleum at the well for the years 1882 *to* 1887.

Months.	1882.	1883.	1884.	1885.	1886.	1887.
January	$0. 83⅛	$0. 93¾	$1. 11	$0. 70⅞	$0. 88⅜	$0. 70
February	. 84½	1. 01	1. 04⅜	. 72⅜	. 79⅞	. 64⅝
March	. 81⅜	. 97⅝	. 98⅛	. 80⅛	. 77¼	. 63⅜
April	. 78⅜	. 92⅜	. 94	. 78½	. 74⅛	. 64⅞
May	. 71½	1. 00⅛	. 85⅝	. 79	. 70	. 64⅛
June	. 54⅜	1. 16⅜	. 68⅝	. 82	. 66½	. 62⅝
July	. 57$\frac{4}{10}$	1. 05⅞	. 63½	. 92½	. 66	. 59¼
August	. 58⅝	1. 08½	. 81⅛	1. 00¼	. 62⅛	. 60⅛
September	. 72⅛	1. 12½	. 78	1. 00¾	. 63⅜	. 67
October	. 93¾	1. 11⅛	. 71⅛	1. 05½	. 65⅛	. 70⅞
November	1. 14	1. 14½	. 72½	1. 04⅜	. 71⅝	. 73⅞
December	. 96	1. 14¾	. 74⅜	. 89⅞	. 70⅝	. 80¾
Average	. 78⅞	1. 05¾	. 83½	. 88	. 71¼	. 66¾

These averages, it is understood, are not true average prices, that is, averages that consider both price and quantity sold at that price, but they are the averages of prices obtained. This, under the circumstances, is the only average that can be ascertained, and does not vary greatly from the average of the prices. It is also to be understood that the oil of certain districts brings a price in excess of the average of pipe-line certificates.

The average price of pipe-line certificates for 1886 is the lowest since 1861, the average for that year being 49 cents. The lowest price reached during the year was in July, when it touched 54⅛ cents; the highest in December, when it reached 90⅛ cents.

Prices of refined oil.—In the following table will be found a statement of the highest and lowest prices of refined oil at New York, by months, the price being cents per gallon:

Highest and lowest prices of refined oil in New York for the year 1887.

Months.	Highest.	Lowest.
	Cents.	*Cents.*
January	6¾	6⅝
February	6¾	6⅜
March	6⅝	6⅝
April	6¾	6⅝
May	6¾	6⅝
June	6¾	6⅝
July	6⅝	6⅜
August	6⅝	6⅜
September	6⅞	6⅝
October	6⅞	6⅝
November	7	6⅞
December	7⅛	7

Wells completed.—In the following table will be found a statement of the number of wells completed in each district in the Pennsylvania and New York oil fields during each month of 1887. This table shows the total number completed, the number of those completed that produced oil, and the number of dry holes in each district, together with the totals of these several items for the entire year:

Number of wells completed during each month of the year 1887 *in the Pennsylvania and New York oil fields, by districts.*

Months.	Allegany district.			Bradford district.			Middle district.		
	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.
January	3	3	0	15	12	3	37	32	5
February	4	2	2	12	11	1	39	33	6
March	7	5	2	10	8	2	41	32	9
April	3	3	0	15	13	2	49	40	9
May	3	2	1	16	13	3	61	54	7
June	8	7	1	19	19	0	60	52	8
July	5	4	1	8	6	2	58	50	8
August	5	5	0	10	9	1	58	46	12
September	6	4	2	13	12	1	40	31	9
October	2	1	1	5	2	3	36	30	6
November	3	1	2	13	2	11	23	11	12
December	3	3	0	3	2	1	25	16	9
Total	52	40	12	139	109	30	527	427	100

Number of wells completed during each month of the year, 1887, *etc.*—Continued.

Months.	Lower district.			Washington district.			Totals.		
	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.	Total number.	Productive.	Dry holes.
January	68	48	20	35	28	7	158	123	35
February	80	62	18	29	24	5	164	132	32
March	60	44	16	20	15	5	138	104	34
April	66	47	19	27	19	8	160	122	38
May	59	40	19	9	7	2	148	116	32
June	64	41	23	9	6	3	160	125	35
July	79	47	32	9	7	2	159	114	45
August	55	35	20	14	13	1	142	108	34
September	63	44	19	12	12	0	134	103	31
October	54	42	12	3	0	3	100	75	25
November	57	33	24	5	2	3	101	49	52
December	62	44	18	3	2	1	96	67	29
Total	767	527	240	175	135	40	1,660	1,238	422

The following table shows the total number of drilling wells completed in the Pennsylvania and New York oil fields, by months, for each of the years from 1882 to 1887. In this table are included not only those completed wells which produced oil, but also the dry holes:

Number of drilling wells completed in the Pennsylvania and New York oil fields each month from 1882 *to* 1887, *by years and months.*

Months.	1882.	1883.	1884.	1885.	1886.	1887.
January	347	125	229	64	270	158
February	340	126	227	62	280	164
March	385	142	256	82	291	138
April	432	209	298	116	328	160
May	469	231	311	213	343	148
June	340	228	244	242	365	160
July	185	261	268	217	357	159
August	253	309	145	283	313	142
September	164	321	89	356	253	134
October	117	321	59	397	272	100
November	150	302	73	384	221	101
December	122	272	66	345	185	96
Total	3,304	2,847	2,265	2,761	3,478	1,660

The above table shows but 1,660 wells completed in the Pennsylvania and New York oil fields in the year 1887. This is the smallest number reported since 1874, the number for that year being 1,317. The largest number in any one year was 4,217, in 1880.

Average daily production of new wells.—The average daily production of the new wells completed in the years from 1882 to 1887, by months, is shown in the following table:

Average daily production of the new wells in the Pennsylvania and New York oil fields from 1882 to 1887, by years and months.

Months.	1882.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
January	19.5	22.4	13.7	40.0	13.5	25.5
February	19.4	14.9	15.0	41.3	13.4	44.75
March	22.25	22.5	17.0	23.3	22.9	29.75
April	22.0	21.0	12.0	40.0	32.0	43.5
May	21.3	17.5	18.0	23.0	38.6	22.
June	36.8	15.0	17.5	10.6	25.0	38.51
July	108.8	15.0	59.3	10.3	31.1	18.14
August	84.2	13.8	22.6	10.6	51.9	49.3
September	25.75	14.4	41.7	13.2	62.4	57.7
October	15.9	14.2	165.5	14.0	28.0	25.98
November	12.9	13.8	87.4	10.9	28.0	19.69
December	20.4	11.8	92.6	10.9	23.0	11.4

PRODUCTION STATISTICS.

Total production of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340	456, 475	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130	517, 762	549, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	632, 617	608, 300	665, 291	641, 520	776, 364	793, 470	867, 473	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 893, 786
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	921, 750	1, 033, 447	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	852, 159	719, 824	789, 539	675. 060	696, 508	696, 210	788, 361	718, 766	698, 940	731, 073	700, 200	720, 874	8, 787, 514
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600	763, 623	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	842, 890	783, 216	901, 697	972, 810	1, 127, 594	1, 130, 790	1, 189, 005	1, 273, 759	1, 214, 910	1, 269, 326	1, 173, 420	1, 256, 058	13, 135, 475
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250	1, 283, 865	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650	1, 637, 767	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 685, 176
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440	2, 248, 430	2, 341, 027	2, 346, 300	2, 385, 636	2, 274, 420	2, 238, 634	26, 027, 631
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860	2, 372, 678	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940	3, 258, 162	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 053, 500
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900	2, 020, 394	1, 879, 437	1, 913, 370	2, 076, 659	1, 958, 340	1, 988, 526	23, 128, 389
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190	2, 059, 950	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210	1, 775, 804	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041
1886	1, 748, 958	1, 604, 848	1, 928, 448	1, 938, 360	2, 178, 773	2, 335, 380	2, 418, 961	2, 413, 206	2, 418, 540	2, 408, 111	2, 222, 790	2, 181, 625	25, 798, 000
1887	1, 990, 851	1, 827, 924	2, 007, 196	1, 960, 860	1, 993, 157	1, 912, 860	1, 899, 525	1, 848, 877	1, 779, 930	1, 843, 291	1, 125, 450	1, 288, 602	21, 478, 883

Shipments of crude petroleum, and refined petroleum reduced to crude equivalent, out of the Pennsylvania and New York oil fields, for the years 1871–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1871	437, 691	347, 718	383, 890	389, 147	587, 375	501, 754	541, 137	528, 134	551, 075	505, 071	480, 977	410, 822	5, 664, 791
1872	476, 966	407, 606	276, 220	428, 512	510, 417	529, 228	591, 238	621, 954	541, 607	607, 468	477, 945	430, 786	5, 899, 947
1873	573, 124	527, 440	668, 374	708, 191	768, 176	696, 414	814, 449	864, 768	952, 955	1, 010, 852	959, 589	955, 443	9, 499, 775
1874	843, 663	501, 220	518, 246	803, 409	899, 027	815, 413	940, 281	793, 865	1, 014, 570	543, 341	546, 117	602, 348	8, 821, 500
1875	453, 095	327, 776	693, 918	729, 581	681, 679	745, 986	904, 537	882, 089	1, 109, 392	871, 917	671, 066	871, 902	8, 942, 938
1876	677, 289	519, 193	623, 762	603, 037	646, 150	921, 862	1, 228, 539	1, 203, 402	1, 154, 549	524, 190	871, 496	1, 190, 983	10, 164, 452
1877	743, 461	484, 904	913, 919	993, 526	1, 234, 324	1, 391, 124	1, 096, 951	1, 425, 943	1, 563, 797	1, 268, 971	1, 205, 634	600, 019	12, 832, 573
1878	775, 791	774, 234	741, 512	846, 632	960, 894	1, 135, 119	1, 330, 454	1, 655, 651	1, 434, 225	1, 747, 390	1, 281, 410	992, 688	13, 676, 000
1879	663, 998	702, 729	973, 879	1, 136, 188	1, 331, 469	1, 369, 314	1, 625, 035	1, 808, 239	1, 627, 120	1, 662, 269	1, 453, 645	1, 532, 585	15, 886, 470
1880	1, 650, 409	1, 395, 151	1, 613, 371	842, 268	1, 095, 259	975, 083	1, 231, 611	1, 394, 129	1, 252, 635	1, 665, 933	1, 226, 030	1, 335, 613	15, 677, 492
1881	1, 061, 617	915, 028	1, 276, 746	1, 348, 398	1, 563, 436	1, 729, 697	1, 925, 532	2, 214, 877	2, 131, 950	2, 080, 467	2, 066, 906	1, 969, 581	20, 284, 235
1882	1, 657, 067	1, 787, 909	1, 718, 956	1, 678, 134	1, 827, 356	2, 172, 685	2, 402, 970	2, 047, 545	1, 992, 171	2, 089, 428	1, 404, 640	1, 121, 453	21, 900, 314
1883	1, 357, 815	1, 250, 824	1, 641, 899	1, 908, 379	1, 995, 634	1, 747, 789	1, 634, 407	3, 086, 478	2, 325, 574	2, 215, 421	2, 065, 602	1, 749, 547	21, 979, 369
1884	1, 686, 961	1, 723, 261	1, 873, 890	1, 643, 336	1, 899, 329	1, 827, 553	1, 740, 021	2, 000, 371	2, 292, 087	2, 510, 283	2, 078, 261	2, 382, 244	23, 657, 597
1885	1, 804, 028	1, 895, 021	1, 887, 034	1, 823, 726	2, 097, 099	2, 034, 025	1, 961, 152	2, 049, 099	2, 116, 659	2, 050, 150	1, 857, 080	2, 138, 253	23, 713, 326
1886	1, 991, 561	2, 032, 794	2, 055, 750	2, 070, 468	2, 032, 672	2, 117, 489	2, 418, 961	2, 059, 299	2, 157, 323	2, 441, 848	2, 724, 796	2, 550, 891	26, 653, 852
1887	2, 312, 067	1, 995, 757	2, 332, 324	1, 938, 278	2, 328, 564	2, 165, 439	2, 000, 173	2, 220, 768	2, 342, 227	2, 573, 008	2, 462, 082	2, 608, 341	27, 279, 028

Number of drilling wells in the Pennsylvania and New York oil fields at the close of each month for the years 1871–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly averages.
1871	140	173	240	279	356	303	329	330	439	486	477	394	329
1872	363	369	313	302	386	391	359	392	301	311	354	318	347
1873	361	349	227	177	228	395	340	267	197	163	137	60	242
1874	37	55	99	213	225	210	180	128	107	82	57	54	121
1875	40	40	45	64	127	162	118	96	132	170	179	168	112
1876	142	151	230	267	307	340	353	374	511	565	618	493	363
1877	457	463	395	448	512	395	365	417	535	573	565	426	463
1878	334	326	379	409	376	266	188	185	240	282	297	218	292
1879	265	323	406	468	460	384	329	258	270	313	372	440	357
1880	540	535	577	580	460	440	452	515	491	469	475	408	495
1881	383	420	437	446	470	408	379	352	388	445	475	468	423
1882	422	438	408	405	381	226	240	194	177	184	154	138	276
1883	126	151	205	199	216	228	262	315	314	341	301	263	243
1884	270	273	260	284	244	123	123	91	79	100	86	78	168
1885	97	109	139	190	228	209	242	308	382	355	359	277	241
1886	320	337	356	318	358	403	349	290	322	272	285	238	324
1887	201	177	155	155	157	142	135	137	107	104	114	88	139

Number of drilling wells completed in the Pennsylvania and New York oil fields each month for the years 1872–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1872	37	120	89	121	135	84	128	118	82	100	64	105	1, 183
1873	93	94	100	105	102	130	114	120	106	101	100	98	1, 263
1874	102	104	110	113	109	101	121	107	104	120	106	120	1, 317
1875	190	187	195	186	172	190	200	210	201	220	217	230	2, 398
1876	240	231	242	200	202	261	248	270	209	273	272	272	2, 920
1877	281	241	291	269	320	403	317	255	322	467	391	382	3, 939
1878	274	226	211	409	470	269	203	186	174	229	248	165	3, 064
1879	136	132	238	270	402	330	327	283	210	232	227	261	3, 048
1880	320	230	367	500	426	310	338	368	356	364	336	302	4, 217
1881	222	220	271	316	406	374	336	332	312	322	363	406	3, 880
1882	347	340	385	432	469	340	185	253	164	117	150	122	3, 304
1883	125	126	142	209	231	228	261	308	321	321	302	272	2, 847
1884	229	227	256	298	311	244	268	145	89	59	73	66	2, 265
1885	64	62	82	116	213	242	217	283	356	397	384	345	2, 761
1886	270	280	291	328	343	365	357	313	253	272	221	185	3, 478
1887	158	162	138	160	148	157	159	142	134	100	90	96	1, 640

Average daily production of crude petroleum in the Pennsylvania and New York oil fields each month for the years 1872–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly averages.
1872	18,825	15,965	14,890	15,403	17,326	16,371	16,702	17,739	16,681	4,272	21,287	20,825	17,194
1873	20,407	21,725	21,461	21,384	25,044	26,449	27,983	30,198	31,809	30,403	33,049	34,980	27,106
1874	37,653	29,839	28,598	25,958	28,895	30,725	33,337	30,049	28,021	29,669	28,702	27,682	29,937
1875	27,489	25,708	25,469	22,502	22,468	23,207	25,431	23,186	23,298	23,583	23,340	23,254	24,075
1876	22,975	23,065	23,167	23,383	23,721	24,120	24,633	25,233	26,020	26,102	26,216	25,390	24,505
1877	27,190	27,979	29,087	32,427	36,374	37,693	38,335	41,089	40,497	40,946	39,114	40,518	35,988
1878	38,816	39,102	38,980	39,863	40,802	40,575	41,415	43,288	43,857	44,187	44,965	42,538	41,544
1879	44,191	43,515	48,365	51,015	53,062	55,855	56,057	61,042	61,890	59,238	57,016	57,076	54,206
1880	61,423	64,552	65,032	67,190	71,901	71,948	72,530	75,517	78,210	76,956	75,814	72,214	71,114
1881	72,390	68,326	73,372	73,526	77,203	79,262	76,538	75,217	73,114	74,941	75,561	80,000	75,004
1882	75,921	76,119	80,070	80,093	80,212	94,198	105,102	100,145	87,346	74,118	73,098	61,210	82,338
1883	62,849	62,721	59,054	60,551	63,292	65,930	65,174	60,627	63,779	66,989	65,278	64,146	63,365
1884	58,898	64,850	66,202	68,862	76,834	62,073	66,450	67,715	64,942	63,286	60,390	58,794	65,129
1885	53,296	51,353	52,843	59,343	59,141	58,907	57,284	55,031	57,093	60,455	58,722	61,247	56,921
1886	56,418	57,316	62,208	64,612	70,283	77,846	78,031	78,426	80,618	77,681	74,093	70,375	70,679
1887	64,221	65,283	64,716	65,372	64,307	63,762	61,275	59,641	59,321	61,822	37,515	41,568	58,846

[Yearly average is total production divided by the number of days in year, *not* average of monthly averages.]

Total stocks of crude petroleum in the Pennsylvania and New York oil fields for the years 1871–'87, by years and months.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1871	537,751	587,021	642,000	771,000	605,000	554,000	511,220	530,146	541,300	495,102	502,960	532,000	567,458
1872	532,971	579,793	662,497	877,832	950,803	1,010,302	990,229	997,166	951,410	914,423	886,909	1,084,423	869,896
1873	1,183,728	1,265,373	1,244,657	1,178,643	1,192,541	1,324,493	1,433,620	1,513,890	1,521,185	1,452,777	1,493,875	1,625,157	1,369,161
1874	1,948,919	2,283,032	2,648,210	2,623,534	2,594,286	2,701,625	2,279,479	2,932,444	2,758,504	3,134,902	3,449,845	3,705,639	2,755,035
1875	4,011,703	4,546,188	4,592,364	4,537,843	4,552,672	4,502,896	4,386,720	4,223,397	3,812,945	3,672,101	3,701,235	3,550,207	4,174,189
1876	3,585,143	3,734,835	3,829,250	3,900,703	3,989,904	3,791,642	3,326,726	3,304,405	2,930,456	3,040,108	2,955,092	2,551,199	3,411,622
1877	2,604,128	2,860,636	3,210,454	3,279,731	3,173,008	2,912,674	3,004,728	2,852,544	2,503,657	2,504,012	2,471,798	3,127,837	2,875,434
1878	3,555,342	3,875,964	4,342,832	4,692,090	4,996,058	5,078,189	5,031,600	4,717,877	4,599,362	4,221,769	4,289,309	4,615,299	4,501,308
1879	5,321,222	5,813,663	6,318,099	6,689,111	6,980,064	7,263,150	7,353,382	7,114,195	7,620,525	7,794,634	8,051,469	8,470,490	7,065,834
1880	8,724,194	9,004,062	9,606,683	10,780,153	11,916,577	13,099,934	14,116,753	15,063,651	16,157,316	16,887,019	18,025,409	18,928,430	13,541,682
1881	20,110,903	21,108,003	22,105,789	22,963,171	23,793,028	24,441,191	24,888,337	25,005,187	25,066,657	25,309,361	25,509,285	26,019,704	28,860,051
1882	26,716,188	27,059,611	27,822,825	28,547,481	29,206,697	29,859,952	30,715,144	31,772,094	32,400,303	32,608,533	33,728,555	34,596,612	30,419,500
1883	35,187,116	35,692,480	35,881,255	37,789,406	35,755,824	35,985,935	36,371,922	36,164,881	35,752,677	35,613,915	35,506,653	35,745,632	35,953,975
1884	35,884,509	36,041,898	36,220,270	36,642,794	38,631,203	38,665,838	38,985,767	39,084,561	38,740,734	38,192,317	37,925,756	37,366,126	37,698,481
1885	37,214,274	36,757,137	36,508,236	36,464,800	36,139,072	35,872,257	35,686,909	35,343,771	34,939,902	34,763,857	34,668,437	34,428,841	35,732,291
1886	34,186,238	34,082,775	33,954,493	33,823,385	33,969,486	34,187,377	34,428,490	34,800,397	35,061,614	35,027,377	34,525,871	34,156,605	34,350,467
1887	33,835,389	33,288,630	32,932,502	32,955,084	32,642,330	32,389,750	32,289,269	32,003,536	31,340,939	30,662,583	29,325,951	28,006,211	31,806,015

Monthly and yearly average price of pipe-line certificates or crude petroleum at well for the years 1860–'87.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1860	$19.25	$18.00	$12.62½	$11.00	$10.00	$9.50	$8.62½	$7.50	$6.62½	$5.50	$3.75	$2.75	$9.59
1861	1.00	1.00	1.00	.62½	.50	.50	.50	.25	.20	.10	.10	.10	.49
1862	.10	.15	.22½	.50	.85	1.00	1.25	1.25	1.25	1.75	2.00	2.25	1.05
1863	2.25	2.50	2.62½	2.87½	2.87½	3.00	3.25	3.37½	3.50	3.75	3.85	3.95	3.15
1864	4.00	4.37½	5.50	6.56	6.87½	9.50	12.12½	10.12½	8.87½	7.75	10.00	11.00	8.06
1865	8.25	7.50	6.00	6.00	7.37½	5.62½	5.12½	4.62½	6.75	8.12½	7.25	6.50	6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	2.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82½	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	5.70	5.35	4.95	5.37½	5.57½	5.50	5.50	5.80	5.12½	5.63¾
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22½	3.40	3.86
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.80	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.64
1873	2.60	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.83
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	.95	.95	.85	.55	.61½	1.17
1875	1.03	1.52½	1.75	1.36½	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.35
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.37½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅝	2.07½	2.51	2.38	2.56¾	1.91	1.80	2.42
1878	1.43	1.65¼	1.59	1.37½	1.35¼	1.14	.98¾	1.01	.86⅝	.82⅛	.89⅜	1.16	1.19
1879	1.03	.98	.86¼	.78½	.76	.68⅜	.69⅞	.67⅛	.69⅜	.88⅛	1.05⅝	1.18⅛	.85⅞
1880	1.10¼	1.03⅛	.88¾	.78	.80	1.00	1.06¼	.91	.96	.96⅞	.91⅞	.91⅝	.94½
1881	.95⅛	.90⅜	.83⅜	.86¼	.81⅞	.81¼	.76⅞	.78⅛	.97$\frac{3}{16}$	.91¼	.85¼	.84⅜	.85⅞
1882	.83⅛	.84½	.81⅜	.78⅜	.71½	.54⅜	.57$\frac{4}{10}$	.58⅝	.72⅛	.93¾	1.14	.96	.78⅞
1883	.93¾	1.01	.97⅝	.92⅜	1.00⅛	1.16⅜	1.05⅞	1.08½	1.12½	1.11⅛	1.14½	1.14¾	1.05¾
1884	1.11	1.04⅜	.98⅛	.94	.85⅝	.68⅝	.63½	.81⅛	.78	.71⅛	.72½	.74⅜	.83½
1885	.70⅞	.72⅜	.80⅛	.78⅛	.79	.82	.92½	1.00¼	1.00¾	1.05⅛	1.04⅜	.89⅞	.88
1886	.88⅜	.79⅞	.77¼	.74⅛	.70	.66½	.66	.62⅛	.63⅜	.65⅛	.71⅝	.70⅝	.71¼
1887	.70	.64⅝	.63⅜	.64⅞	.64⅛	.62⅝	.59¼	.60⅛	.67	.70⅞	.73⅞	.80¾	.66¾

OHIO.

The producing fields of this State have been so thoroughly described in previous volumes of Mineral Resources that it is unnecessary to more than refer to them here.

The two chief sources of oil in Ohio are the Trenton limestone and the Berea grit. The old and well-known fields of Mecca and Grafton derive their oil from the Berea grit; at Macksburgh, the only important oil district at present in the eastern part of Ohio, there are four productive sand rocks, interest, however, centers in the Berea grit. In Athens and Morgan counties a little shallow oil is produced from the coal measures, and some oil is found in the Waverly conglomerate. The chief producer of oil in Ohio at present, however, is the Trenton limestone.

The important producing fields in Ohio are the Macksburgh and the Lima or Northwestern, the latter of which includes, in addition to the Lima field proper, the Findlay and North Baltimore.

The northwestern Ohio or Lima oil fields.—The pipe-line runs in this district for 1887, by months, were as follows:

Production of petroleum in the Lima field, Ohio.

	Barrels.		Barrels.
January	131, 011	August	490, 862
February	206, 026	September	465, 743
March	303, 084	October	444, 941
April	352, 798	November	458, 612
May	449, 062	December	483, 704
June	474, 535		
July	389, 997	Total	4, 650, 375

Owing to the great production and the difficulty experienced in refining oil from this field it has rapidly dropped in price. Early in 1886 the price was 40 cents a barrel. This was reduced near the close of the year to 35 cents, and in 1887 it was reduced rapidly to 30 cents, then to 25, and again to 20 cents; July 14, from 20 to 17½ cents, and on July 21, to 15 cents per barrel.

The Macksburgh oil field.—There are various figures given for the production of this field in 1887. The production has been estimated, from various returns received, at 372,257 barrels.

WEST VIRGINIA.

There is nothing to add to the statements that have already appeared in previous volumes of "Mineral Resources of the United States" relative to the production of petroleum in West Virginia. The search for natural gas in this State has resulted in a discovery of some small amounts of petroleum, but no field of any importance has been opened, nor indeed do discoveries thus far made give any indication of future prominence in petroleum production.

KENTUCKY AND TENNESSEE.

Nothing can be added to the statements contained in previous volumes of the "Mineral Resources of the United States" relative to the petroleum fields or production of Kentucky and Tennessee. Some explorations for oil and gas have been prosecuted in these States during the past year, but the results have been of no importance commercially. The wells near Glasgow, in Kentucky, still yield a small quantity of oil, and possibly some few barrels have been produced in Tennessee, but the amount of production in either State is not of sufficient importance to justify its tabulation.

CALIFORNIA.

Quite full statements have been made regarding the history and production of the California oil fields, and the use of petroleum in this State as a fuel, in previous volumes of Mineral Resources, but little can be added to these statements. These fields are exhaustively treated also in the report of the State mineralogist of California for 1887.

The counties in which petroleum is produced in commercial quantities are almost exclusively in the southern part of the State. While oil has been found in other sections, it has not been in sufficient quantities to warrant much expenditure in production. The chief localities are in Los Angeles county, at Petrolia, Puente, and Pico cañon. In Ventura county, the oil region lies in the mountains north of the Santa Clara river, and stretches from the easterly boundary of the county to the west as far as San Buenaventura river; the wells are mostly situated from 3 to 6 miles north of the edge of the Santa Clara river, in and about a series of cañons, which reach southerly to the Santa Clara river. At the close of July, 1887, in Adams cañon there were six wells in operation, producing 197 barrels a day; one of these, No. 8, drilled in 1886, producing 125 barrels. At the close of 1887 three others were producing. One of them, No. 13, which was brought in in August, was producing, at the close of September, 125 barrels; and No. 14, finished in August, was pumping about 50 barrels.

From the report of Mr. William A. Goodyear, found in the report of the State mineralogist of California for 1887, we extract the following statement relative to the quantity of oil handled by the Mission Transfer Company during a period of thirteen months. The barrels are 42 gallons each.

California petroleum handled by the Mission Transfer Company in thirteen months.

Months.	From Adams cañon.	From Wheeler cañon.	From Scott wells, Santa Paula cañon.	From Ojai ranch.	From Sespe region.	Distillate.	Total.
1886.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
June	2, 562. 38	320. 62	331. 38	373. 69	....	218. 86	3, 806. 93
July	5, 102. 55	312. 86	178. 83	201. 40	....	134. 12	5, 929. 76
August	4, 018. 45	302. 00	232. 14	....	....	501. 55	5, 054. 14
September	4, 172. 87	143. 66	165. 82	....	....	156. 32	4, 638. 67
October	4, 375. 73	588 26	194. 63	56. 12	....	792. 04	6, 006. 78
November	3, 406. 43	468. 02	220. 88	66. 31	....	441. 80	4, 603. 44
December	2, 855. 10	171. 70	178. 84	50. 00	....	581. 23	3, 836. 87
1887.							
January	3, 215. 69	319. 76	176. 21	....	....	581. 21	4, 292. 87
February	3, 287. 47	474. 14	52. 60	....	....	347. 14	4, 161. 35
March	5, 004. 47	327. 09	228. 52	27. 97	....	....	5, 588. 05
April	2, 988. 51	332. 32	268. 19	....	....	....	3, 589. 02
May	3, 707. 06	340. 90	261. 74	....	....	....	4, 309. 70
June	4, 229. 27	480. 63	273. 22	....	5, 514. 29	....	10, 497. 41
Total	48, 925. 98	4, 581. 96	2, 763. 00	775. 49	5, 514. 29	3, 754. 27	66, 314. 99

In order to obtain from this table the actual quantity of crude petroleum produced, the 3,754.27 barrels of distillate, which were returned to the tanks from the refinery at San Buenaventura, must be deducted from the total as given. Bearing this in mind, we find the average daily product for the year, from June 1, 1886, to June 1, 1887, to have been as follows:

Average daily product of petroleum in California from June 1, 1886, *to June* 1, 1887.

	Barrels.
From Adams cañon	122. 46
From Wheeler cañon	11. 24
From Santa Paula (Scott wells)	6. 82
From Ojai ranch	2. 12
Total	142. 64

But a portion of the 5,514.29 barrels credited to the Sespe region for the month of June, 1887, is really due to the previous months of February, March, April, and May, since the Sespe well No. 1 finished drilling on February 12, and No. 2 was drilled in April.

The average gravity of the oils from various cañons is stated to be as follows: From Adams cañon, 26° to 27° B.; from Santa Paula cañon, 23° B.; from Ojai ranch, 19° to 20° B., from Sespe region, 31° B.

The following are the results of the investigation of some petroleum oils of California, obtained by Dr. W. D. Johnson, chemist to the State Mining Bureau. The degrees are centigrade.

Percentage yield of distillates from California petroleum.

	Boiling points.	Yield.	Specific gravity.	Or in Baumé degrees approximately.
SAN MATEO COUNTY.				
Lane's well, Purissima cañon:	*Degrees centigrade.*	*Per cent.*		
Crude oil			0.855	34
Distillate	Below 150	18	.759	54
Do	150 to 300	44	.817	41
Tunitas well:				
Crude oil			.799	45
Distillate	Below 100	9.90	.707	68
Do	100 to 125	17.30	.739	59
Do	125 to 150	19.50	.761	54
Do	150 to 200	17.20	.795	46
Do	200 to 250	11.80	.837	37
Do	250 to 300	6.00	.858	33
SANTA CLARA COUNTY.				
Well No. 4, Moody's gulch:				
Crude oil			.812	44
Distillate	Below 100	9.40	.716	65
Do	100 to 150	24.40	.756	57
Do	150 to 200	17.10	.798	47
Do	200 to 250	14.80	.836	39
Do	250 to 300	3.60	.860	34
VENTURA COUNTY.				
Tar Creek, pumping well:				
Crude oil			.833	28
Distillate	Below 100	10.00	.720	64
Do	100 to 125	6.80	.755	55
Do	125 to 150	5.50	.777	50
Do	150 to 200	9.70	.809	43
Do	200 to 250	11.00	.856	33
Do	250 to 300	7.10	.889	27
Sespe, No. 2:				
Crude oil			.859	33
Distillate	Below 100	9.10	.700	70
Do	100 to 125	9.20	.734	61
Do	125 to 150	8.80	.762	54
Do	150 to 200	11.80	.798	45
Do	200 to 250	9.00	.822	40
Do	250 to 300	8.00	.876	30
Green oil well, Adams cañon:				
Crude oil			.853	34
Distillate	100 to 125	7.80	.740	59
Do	125 to 150	9.00	.762	54
Do	150 to 200	18.00	.795	46
Do	200 to 250	14.40	.832	38
Do	250 to 300	10.00	.861	33
Wild Bill well, Adams cañon:				
Crude oil			.915	23
Distillate	Below 150	9.20	.732	61
Do	150 to 200	10.80	.813	42
Do	200 to 250	8.00	.846	35
Do	250 to 300	7.70	.880	29
LOS ANGELES COUNTY.				
Pico well, No. 2:				
Crude oil			.865	32
Distillate	Below 150	10.60	.781	49
Do	150 to 200	20.60	.800	45
Do	200 to 250	16.20	.833	38
Do	250 to 300	11.30	.858	33
H. & S. well, No. 3, Pico cañon:				
Crude oil			.846	35
Distillate	Below 100	11.20	.723	62
Do	100 to 125	9.30	.752	56

Percentage yield of distillates from California petroleum—Continued.

	Boiling points.	Yield.	Specific gravity.	Or in Baumé degrees approximately.
LOS ANGELES COUNTY—continued.				
H. & S. well, No. 3, Pica cañon—Continued.	*Cegrees centigrade.*	*Per cent.*		
Distillate	125 to 150	9.50	.775	51
Do	150 to 200	13.60	.802	44
Do	200 to 250	13.40	.841	36
Do	250 to 300	8.80	.870	31
Pico well, No. 4:				
Crude oil			.825	40
Distillate	Below 100	9.10	.702	69
Do	100 to 125	10.40	.739	59
Do	125 to 150	9.30	.762	54
Do	150 to 200	13.40	.787	48
Do	200 to 250	13.90	.819	41
Do	250 to 300	8.30	.847	35
Pico well, No. 9:				
Crude oil			.836	37
Distillate	Below 100	13.10	.710	67
Do	100 to 125	6.50	.743	58
Do	125 to 150	10.00	.764	53
Do	150 to 200	13.60	.794	46
Do	200 to 250	12.40	.829	39
Do	250 to 300	7.20	.856	34
Pico well, No. 13:				
Crude oil			.832	38
Distillate	Below 100	9.70	.713	66
Do	100 to 125	8.80	.742	58
Do	125 to 150	6.00	.761	54
Do	150 to 200	12.00	.783	49
Do	200 to 250	11.20	.812	42
Do	250 to 300	13.00	.840	37
San Fernando well, Pico cañon:				
Crude oil			.830	38
Distillate	Below 100	17.30	.720	64
Do	100 to 125	11.00	.753	56
Do	125 to 150	9.40	.776	50
Do	150 to 200	13.30	.803	44
Do	200 to 250	10.60	.839	37
Do	250 to 300	6.80	.865	32
Puenta tank, from wells 3, 4, 5, 6:				
Crude oil			.822	28
Distillate	Below 100	10.60	.717	65
Do	100 to 125	8.70	.747	57
Do	125 to 150	7.70	.771	51
Do	150 to 200	10.20	.803	44
Do	200 to 250	7.20	.845	36
Do	250 to 300	6.00	.881	29
Little Moore cañon, No. 1:				
Crude oil			.910	24
Distillate	Below 150	6.60	.757	55
Do	150 to 200	11.20	.787	47
Do	200 to 250	7.00	.821	40
Do	250 to 300	8.80	.846	35
MONTEREY COUNTY.				
Cholame Valley Oil Company:				
Crude oil				
Distillate	180 to 200	9.40	.840	37
Do	200 to 250	18.00	.867	31
Do	250 to 300	10.40	.895	26

COLORADO.

In Colorado the Florence oil field is the only one developed. Its location has been described in previous volumes of "Mineral Resources."

The oil occurs in a shale bed of unknown thickness, and appears to lie in small reservoirs. The general belief in the neighborhood seems to be that the oil has been forced up into the shale from the underlying sandstones, but for this belief no conclusive reasons have been adduced. The wells are in and around the Cañon City coal basin. The productive tracts are in some cases so small that, of wells 40 feet apart, sometimes one will yield oil and the other not. The pressure in none of the wells is sufficient to bring the oil to the surface, and hence pumping in all cases is resorted to. The total number of wells sunk is now about thirty, the deepest being 3047 feet; half of these wells are unproductive. The oil is refined by two companies, the United Oil Company and the Florence Oil Company.

The production of crude oil in Colorado in 1887.

[Barrels of forty-two gallons.]

	Barrels.
United Oil Company	56,295
Florence Oil Company	20,000
Total	76,295

The crude oil yields 35 per cent. of illuminants, making the total production of illuminating oil 1,122,539 gallons. The residue is made into lubricants, and is also quite extensively used as fuel in steam making at points in Colorado to which freight rates permit its being shipped.

CANADA.

The oil-producing territory of Canada is situated in the county of Lambton, Ontario, the paying wells being confined to a belt running northeast and southwest for about 20 miles, with a width varying from 1 to 4 miles. This belt is situated some 16 miles easterly of Port Sarnia, running nearly parallel with the St. Clair river. In this territory are two districts, Petrolia and Oil Springs.

Petrolia, which is the center of the Canadian oil district, was settled in 1839. It is about 160 miles from Toronto, on Bear creek, a tributary of the Sydenham river.

From the *Petrolia Advertiser's Almanac* for 1888 we extract the following figures relative to the extent of the oil district at the close of 1887:

Partial statistics of oil production in Canada in 1887.

Number of wells pumping oil	3,860
Number of engines used	480
Approximate number of wells drilled in 1887	400
Number of hands employed in oil pumping, about	3,000
Number employed in refineries	500
Average cost per well	$400.00
Average price of crude for 1887	$0.80

There are eight large refineries in the vicinity of Petrolia, the output of which, in full blast, would be between 5,000 and 6,000 barrels of refined per week. The Crude Oil and Tanking Company affords ample facilities for storing crude oil in underground tanks, as also does the Crown Producers Company. The total amount of capital invested in the oil industry is estimated to be but little short of $3,000,000.

Another estimate of the capital invested in the oil business in this district is $2,750,000, divided as follows: Cost of wells, exclusive of the value of land, $1,500,000; cost of engines, derricks, and other machinery to run the wells, $300,000; storage tanks, $150,000; 60 miles of pipe line with forcing machinery, $150,000; the cost of refineries is placed at $500,000; and the cooper shops, barrels, chemicals, etc., $250,000. The cost of sinking wells, which are put down some 475 feet, is about $500. The yield is from 3 to 10 barrels per day.

The largest refining establishment in Petrolia is that of the Imperial Oil Company. The works of this company extend over 45 acres, embracing stills, repair shops, tin works, cooper shops, etc., with eight steam boilers used in driving the machinery. The process of distillation is carried on in two banks or benches, one containing sixteen and the other five stills, the total capacity of which is 8,000 barrels of crude at a run. They have also a paraffin bank of six stills. Their cooper shops are furnished with machinery, so that every step in the process, from the cutting of the staves out of the block to the completing of the barrels, is taken through the medium of a machine. Their tin works have been fitted with a plant at a cost of $10,000. The cans are almost entirely 5-gallon measures, and are put up two in a case, for transportation chiefly to the Northwest, British Columbia, and the lower provinces.

The output of petroleum for the last six months of 1887, measured by shipments, which is the only basis for estimating the production in Canada, was the largest ever known in the same length of time, aggregating 510,352 barrels. Below we give a statement of the shipments of crude and refined oil, and the refined reduced to crude equivalent, for each month of 1887 and 1877:

Petroleum shipments from Canada in 1887 and 1877.

Months.	1887.			1877.		
	Crude.	Refined.	Crude equivalent.	Crude.	Refined.	Distillate.
January	14,331	15,697	51,524	31,389	1,567	12,369
February	15,152	14,282	50,858	30,622	2,293	8,628
March	16,079	15,102	53,834	29,139	1,121	3,958
April	17,617	6,400	33,617	19,335	872	2,772
May	15,045	10,063	40,227	20,974	1,080	6,600
June	11,611	6,129	27,933	20,554	579	5,016
July	11,477	16,006	51,492	16,208	87	792
August	14,357	24,003	74,334	18,731	1,080	3,280
September	19,923	35,605	108,935	22,461	1,847	4,350
October	25,220	34,923	112,526	19,965	2,530	5,239
November	23,953	26,932	91,383	28,764	2,569	198
December	18,867	21,130	71,682	26,984	2,658	2,304

On December 28, 1877, crude was quoted in Petrolia at $2.08 per barrel; in 1887 it sold at 74½ cents per barrel. On December 28, 1877, refined brought 13½ cents; on December 28, 1887, it was quoted at 9½ and 10 cents.

The production of petroleum in Canada since 1862 is estimated as follows:

Production of crude petroleum in Canada from 1862 *to* 1887.

Years.	Barrels.	Years.	Barrels.	Years.	Barrels.
1862	11,775	1871	269,397	1880	350,000
1863	82,814	1872	308,100	1881	275,000
1864	90,000	1873	365,052	1882	275,000
1865	110,000	1874	168,807	1883	250,000
1866	175,000	1875	220,000	1884	250,000
1867	190,000	1876	312,000	1885	250,000
1868	200,000	1877	312,000	1886	250,000
1869	220,000	1878	312,000	1887	868,345
1870	250,000	1879	575,000		

There are no reliable statistics of production in Canada. The above are the estimates of parties intimately connected with the industry.

RUSSIAN PETROLEUM.

No statement relative to Russian petroleum can be complete without reference to the admirable reports of Consul Chambers, of Batoum, to the State Department. These are the most complete, correct, and intelligent statements that have been made relative to the condition of the petroleum industry in Russia. From Consul Chambers's report to the State Department, dated February, 1888, published in Consular Report No. 92, we condense the following statement relative to Russian petroleum in 1887:

"The production of crude petroleum in Russia in 1887 shows a large increase over any former year. No attempt is made to keep any accurate record of crude production at Baku, but the amount of production is estimated from the output of refined oil and illuminating distillate, of which fairly correct statistics are obtainable, upon a basis of 3½ gallons crude for every gallon of the aforesaid products, to which is added the crude oil shipped. In this manner it is ascertained that the crude oil production in 1887 was over 45,000 barrels, of 40 gallons, for every day in the year, *i. e.*, the amount of crude used was over 45,000 barrels per day, and no one knows how much was lost, but there is no doubt that the loss was at least 20 per cent., and that the actual amount of crude taken from the ground during the year was nearer 55,000 barrels per day than 45,000. Of course, 20 per cent. allowance for oil wasted will seem to an American to be very liberal; but if the manner in which oil is conducted to reservoirs from wells, the construction of reservoirs, and the great number of flowing wells are considered or understood, this estimate will not appear so liberal. In 1887 the amount of crude oil wasted was undoubtedly much greater than in any previous year, because of the number of flowing wells, and the great productiveness of some of them. From one well it is said that more than 1,000,000 barrels were lost.

This well, called the Mining Company well, was struck in August at a depth of 790 feet, and flowed the full size of the pipe (12 inches) to a height of 200 feet above the derrick for sixty-nine days. It was some days before the oil from it could be directed into reservoirs, and then there were no reservoirs of sufficient capacity to hold its production, and notwithstanding that nearly all the Baku refiners connected their pipe lines to the reservoirs into which the oil was going, and kept their pumps going day and night, the whole country seemed to be overflowed with the oil, and there is no doubt that at least half its production was lost. The lowest estimate I have heard of the production of this well for the sixty-nine days is 3,000,000 barrels, and had the well flowed only oil this would be very reasonable, but it produced much more sand proportionately than the average Baku well, although all wells there throw out immense quantities of sand with the oil. Some one-story stone buildings about 15 feet high, within 100 yards of the well, were completely buried out of sight in sand from the well, and an area of probably 10 acres around the well was covered from 1 to 15 feet with sand. The production of the well, after sixty-nine days, declined to 200 or 300 barrels per day, and all the efforts to make it produce profitably again have been unsuccessful.

"There has been no new territory discovered in the past year, and very little effort has been made to find any, notwithstanding the fact that the theory advanced by some of Baku's eminent scientists, that the complete exhaustion of the present developed territory is very near at hand, seems to be gaining supporters. One of these scientific gentlemen now says that the Balakhani-Sabunchi territory will not last more than three years, in which opinion it is said he is backed by some of the people having the heaviest financial interests in the trade.

"But the support given to this idea by those financially interested is apparently not strong, costing nothing, and the sincerity of it is open to doubt; because, notwithstanding that the exhaustion of this territory before new territory is discovered may mean financial ruin to all the refiners, they make no effort to find other territory. The Baku geologists who prophesy the early exhaustion of the territory make a very plausible showing of figures, basing their estimates upon past production, increasing depth of drilling, etc. But the depth of the last oil-bearing stratum and the number of such wells as that of the Mining Company that may be found are unknown quantities in the very interesting and important problem of the future production of petroleum in Russia.

"Owing to the large production the price of crude at wells was very low the whole of the past year, the extremes being $1\frac{3}{4}$ to $7\frac{1}{4}$ cents per barrel of 40 gallons, but the average for the year was not more than $3\frac{1}{2}$ cents per barrel. At present, February, 1888, the price is between 6 and 7 cents per barrel, which is rather high for midwinter, when more than half the demand is shut off, owing to Volga navigation being closed, but does not seem to be due to a scarcity of oil, because there are many good wells at Balakhani and Sabunchi, although no very large ones according to native ideas.

"The refining capacity at Baku, owing to the fact that the business was very profitable, was materially increased during the year. The limited transportation facilities of the railway to Batoum maintained a heavy premium upon tank-car capacity for Batoum shipment, and a syndicate formed for the purpose of controlling home markets insured a fair price for Caspian Sea shipments. These circumstances, together with the low price of crude, gave the refiners a margin of ¼ to ½ cent per gallon on Caspian Sea shipments, and from 1 to 1¼ cents per gallon upon refined shipped to Batoum. The last allotment of tank cars to refiners (made regularly by a committee formed for that purpose to secure equal distribution) is for the first three months in 1888, and shows 149 refineries, with an aggregate annual capacity of 625,000,000 gallons refined oil. This estimate of capacity was made for the distribution of tank cars for Batoum shipment, the refiners receiving tank cars in proportion to their capacity; and as the heavy premium upon tank cars accrues to refiners' benefit, they naturally made the best possible showing, so that there is little doubt that it is greatly exaggerated. But as the shipment of refined oil and distillate from Baku in 1887 did not exceed 200,000,000 gallons, there is also no doubt whatever that the refining possibilities of Baku are very much in excess of present requirements.

"With an apparently unlimited supply of crude oil, so great a refining capacity and a profitable market for refined, it is clear that the limited transportation facilities of the railway are the chief obstruction to a rapid increase of export. Since December, 1886, railway transportation has entirely governed the price of oil at Batoum. Refined oil for Caspian Sea shipment during the past year has brought an average price f. o. b. Baku of about 1.3 cents per gallon, while the same quality of oil f. o. b. cars for Batoum averaged 2.3 cents per gallon. At the beginning of 1887 the railway company had 1,250 tank cars in service, and there were no private tank cars on the road. The price for refined f. o. b. cars at Baku then reached $3\frac{1}{5}$ cents per gallon, a premium of almost 2 cents per gallon on tank-car capacity. This encouraged refiners to put cars of their own upon the railway, and permission was granted refiners by the Government railway control to place over 4,000 private tank cars upon the road. Notwithstanding the protests of the railway management that they could not move promptly and regularly more than 500 or 600 private tank cars, over 1,000 were put in service before December 1; 500 more are due before March 1, and owing to a great decline in the volume of grain freights (due to depressed condition of the grain market) the additional cars have been satisfactorily handled, and the railway is now delivering 3,500 to 4,000 tank cars per month at Batoum, against 2,000 per month a year ago. As the possibilities of export from Batoum have not kept pace with the increase in railway transportation, the situation here is exactly the opposite of a year ago, when there was no oil here, and a demand for much more than the railway could deliver; for now the Batoum tankage, aggregating about 23,000,000 gallons, is about full, and the monthly receipts here are probably 3,000,000 to 4,000,000 gallons in excess of the shipments, with little prospects of an early increase in export facilities, and a certainty of increased rail deliveries from the new tank-cars daily coming into use. Under such circumstances it is not at all surprising that the market seems weak, with a steady downward tendency; that sales a few days ago show a difference of less than three-fourths cent between Caspian Sea and Batoum shipment at Baku, and that all talk of pipe lines over the Suram Pass for refined oil has ceased, notwithstanding permission was granted by the Government ten months ago for five such lines, and all were to be constructed immediately. The increase in the oil-carrying capacity of the railway might seem only temporary were it not for the fact that the work upon the Suram tunnel (the railway grade at this point, being 238 feet to the mile, has been the great obstruction to a greatly-increased traffic) is progressing very rapidly, and I am assured upon the best possible authority that the tunnel and accompanying improvements can be completed by September or October, 1889. This will not only insure the permanency of the present carrying capacity of the railway, but will still further increase it.

"There are now regularly in the Batoum trade eleven tank steamers, with an aggregate annual carrying capacity to ports for which they are chartered of about 70,000,000 gallons. The can and case manufacturing capacity of the port is at present not more than 30,000,000 gallons per year. The railway cars, apparently, deliver about 150,000,000 gallons per year, so that the tankage being full the difference, or 50,000,000 gallons, will have to be exported in barrels to keep up with receipts, and with present facilities that is impossible. It is reported that many new tank steamers are being built for the trade, and there is no doubt that the can and case manufacturing capacity will be doubled soon, so that it is quite possible that by the end of the year the exports will be fully up to rail receipts. Any one who has seen the progress made by the Russian petroleum trade in the past two years, in the face of such difficulties as high freights, limited markets, and losing prices abroad can not doubt that these people will progress more rapidly now under circumstances equally as favorable as they were then unfavorable. Now tank steamers have reduced their freights to the minimum, and the recent shut-down movement among American producers, or other cause, has advanced prices all over Europe to such a figure that any one in commercial matters should be able to do a very profitable export business in Russian oil. The exporter has everything in his favor at present, for in addition to an advancing market abroad, he has a declining market to purchase upon, as it is not believed that the export from Batoum can be increased soon enough to prevent the wiping out of the tank-car premium, which means very cheap refined here. At present refined is quoted f. o. b. Batoum nominally at about $3\frac{2}{5}$ cents per gallon in bulk, and seven-tenths of a cent of this price is premium on tank-car capacity."

The following are the statistics of the export and home trade of Russia for the years 1886 and 1887.

Shipments of petroleum products from Batoum in 1886 *and* 1887.

To—		Illuminating oil and distillate.	Crude, residuum, lubricating oil and distillate.	Total.	Decrease.	Increase.
		Gallons.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
Austria-Hungary	1886			13,290,970		
	1887	21,206,590	175,500	21,382,090		8,091,120
Belgium	1886	2,037,750	1,377,800	3,415,550		
	1887	4,042,500	2,351,400	6,393,900		2,978,350
Bulgaria	1886	49,000		49,000		
	1887	265,300		265,300		216,300
Burmah	1886					
	1887	738,000		738,000		738,000
China	1886			500		
	1887	620,620		620,620		620,120
Egypt	1886	1,678,460	500	1,678,960		
	1887	4,322,570		4,322,570		2,643,610
England	1886	1,907,500	1,980,185	3,887,685		
	1887	6,012,170	661,650	6,673,820		2,786,135
France	1886	1,708,400	1,649,135	3,357,535		
	1887	246,000	2,394,100	2,640,100	717,435	
Germany	1886	1,490,000	1,300,850	2,790,850		
	1887	2,003,535	1,721,700	3,725,235		934,385
Greece	1866	418,500	1,750	420,250		
	1887				420,250	
Holland	1886		120,000	120,000		
	1887	315,000	326,500	641,500		521,500
India	1886	1,250,000	100	1,250,100		
	1887	7,743,350	5,000	7,748,350		6,498,250
Italy	1886	2,181,000	1,078,200	3,259,200		
	1887	2,009,600	342,850	2,352,450	906,750	
Malta	1886					
	1887	120,000		120,000		120,000
Roumania	1886	4,604,410	81,150	4,685,560		
	1887	869,250	54,200	923,450	3,762,110	
Spain	1886	308,000		308,000		
	1887		285,000	285,000	23,000	
Turkey	1886	10,476,290	7,905	10,484,195		
	1887	9,061,000	76,550	9,137,550	1,346,645	
Tunis and Algiers	1886	372,000		372,000		
	1887				372,000	
Denmark	1886	300,750		300,750		
	1887				300,750	
Other countries	1886	3,469,065	1,096,950	4,566,015		
	1887				4,566,015	
Total export	1886			54,236,120		
	1887			67,969,935	12,414,955	26,147,770
Russia	1886			13,523,330		
	1887	9,661,200	102,850	9,764,050	3,759,280	
Total shipments	1886			67,759,450		
	1887			77,733,985	16,174,235	26,148,570

Total increase in shipments in 1887 over 1886, 9,974,535; increase of export 1887 over 1886, 13,733,815 gallons.

Shipments of petroleum products from Baku via Caspian Sea in 1886 and 1887.

Products.		To Russia.	Increase.	Decrease.	To Persia.	Increase.	Decrease.	Totals.
		Gallons.	*Gallons.*	*Galls.*	*Gallons.*	*Galls.*	*Galls.*	*Gallons.*
Illuminating	1886	88,744,725	....	....	955,024	....	....	89,699,749
	1887	112,196,875	23,452,150	....	938,450	....	16,574	113,135,325
Residuum	1886	161,973,930	....	....	319,720	....	....	162,293,650
	1887	197,821,515	35,847,585	....	208,290	....	111,430	178,029,805
Crude	1886	12,369,380	....	....	30,185	....	....	12,399,565
	1887	14,848,070	2,478,690	....	635,250	605,065	....	15,483,320
Lubricating	1886	1,755,575	....	....	....	....	....	1,755,575
	1887	4,553,125	2,797,550	....	125	125	....	4,553,250
Other products	1886	1,114,285	....	....	188	....	....	1,114,473
	1887	873,130	....	241,155	7,815	7,627	....	880,945
Totals	1886	265,957,895	....	....	1,305,117	....	....	267,263,012
	1887	330,292,715	64,334,820	....	1,789,930	484,813	....	312,082,645

"The prospects of the Batoum petroleum exporters for 1888 were never brighter, with greatly increased railway transportation, declining prices at Baku, a steady downward tendency in the value of Russian paper money, and high and advancing prices in the markets of the world. If they do not reach a rich harvest this year they will have lost a golden opportunity, such as is rarely seen in any business. It is expected here that the Batoum exports this year will be over 150,000,000 gallons, almost double those of 1887, but it is not believed possible for them to exceed 120,000,000 gallons. A very good beginning has been made, however, as the January shipments were over 10,000,000 gallons, and the steamer charters for cases January, February, and March, loading for India alone, are nearly 6,000,000 gallons."

NATURAL GAS

BY JOSEPH D. WEEKS.

The excitement occasioned by the discoveries of natural gas in Pennsylvania, Ohio, and Indiana, and the search for this natural fuel all over the United States, noted in the report for 1886, continued with but little or no abatement through 1887. Wells have been drilled from the Hudson river on the east to the Pacific coast on the west, and from Michigan on the north to the Gulf coast on the south. It is probable that in every State and Territory, with possibly the exception of the New England States and the four southern Atlantic States, wells have been drilled, or at least examinations made, for the purpose of ascertaining whether natural gas could be found in paying quantities. As a result, gas has been found in greater or less quantities in all the States mentioned, but in most of them not in commercial quantities. It still remains true, as was stated in the report for 1886, that the western Pennsylvania field, including in this the counties of New York bordering on the oil fields of western Pennsylvania, the northwestern Ohio district, and the central-eastern Indiana district, are the three chief producers of natural gas in commercial quantities.

Repeating the statements made in the last volume of "Mineral Resources," the general result of the explorations for natural gas may be summed up as follows:

First. That along the Atlantic coast east of the Appalachian chain, including in this term the Green mountains, no gas is found, or if found at all, in such small quantities as to indicate that it is of comparatively recent origin. It is also found in such horizons and under such conditions as to give but little evidence that it is in such storage reservoirs as to promise any considerable supply.

Second. That the chief sources of the supply of natural gas in this country are to be found in the Mississippi valley, and so far as present explorations show in that portion of it east of the Mississippi river.

THE GEOLOGICAL DISTRIBUTION OF NATURAL GAS.

While natural gas has been found from the Drift to the Potsdam, it has been chiefly in the Trenton limestones of Ohio and the Paleozoic strata of the Upper Coal Measures of Pennsylvania that the great deposits of natural gas have been struck. The highest stratum in which any considerable quantity of gas has been found in Pennsylvania is the Homewood sandstone, the highest of the three recognized members of the Pottsville Conglomerate. The lowest are the Kane sand of the Roy and Archer gas pool, of Elk county. According to Mr. Carll, the geological position of the latter sand is 1,800 feet below the horizon of the Murrysville gas sand. As the question of the geological distribution of natural gas will be discussed in other publications of the Geological Survey, as well as to some extent in this report in connection with the several gas fields, it is not necessary to enter into a complete discussion of the subject here.

TOTAL CONSUMPTION OF NATURAL GAS IN THE UNITED STATES.

It is impossible to ascertain the total production or even the consumption of natural gas in the United States. While a great many wells have been accurately measured, these measurements only give the rate of production for the moment when the observations were taken. The rate changes not only from day to day, but from hour to hour and from moment to moment. It is usually greater at certain times of the day, as in the morning, than at others; it varies with the weather and with the state of the barometer. It will thus appear that, while for the wells that have been measured an estimate of their yearly production could be made, it is evident that even this would be only a rough approximation, while for those wells that have not been measured only the wildest guess could be made; and since the tendency is to very much overestimate the production, such estimates would have but very little value. Nor is it possible to arrive at the consumption of gas in cubic feet. It might be possible to ascertain in a given locality, for example, how many mills, how many furnaces, how many boilers, how many grates were using natural gas, but the rate of consumption in furnaces, boilers, and grates varies greatly. Pittsburgh measurements show that while some furnaces use but 13,000 cubic feet of gas to produce a ton of iron, others use 35,000 cubic feet, and still others as much as 65,000 cubic feet.

The best basis of calculation, therefore, is that which has been given in previous volumes of "Mineral Resources of the United States," viz.: The coal displaced by gas. Where coal is not used in a locality, or where it furnishes only a portion of the fuel, the value of wood or other fuel used is regarded as the value of coal displaced, and an estimate of the tonnage of coal that would be displaced is made, based on the selling price of coal in that locality.

The total displacement of coal by natural gas in 1887 and its value are as follows:

Amount of coal displaced by natural gas in 1887, *and its value.*

Locality.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*	
Allegheny county	5,477,000	$6,846,250
Remainder of Pittsburgh district	1,610,500	2,415,750
Western Pennsylvania, outside of Pittsburgh district	1,795,500	4,487,500
Total Pennsylvania	8,883,000	13,749,500
New York	111,000	333,000
Ohio	500,000	1,000,000
West Virginia	60,000	120,000
Indiana	300,000	600,000
Illinois	3,000	6,000
Kansas	5,000	15,000
Elsewhere	5,000	15,000
Total	9,867,000	15,838,500

A similar statement for 1885 and 1886 is as follows:

Amount of coal displaced by natural gas in 1885 *and* 1886, *and its value.*

Locality.	1885.		1886.	
	Coal displaced.	Value.	Coal displaced.	Value.
Pennsylvania:	*Short tons.*		*Short tons.*	
Allegheny county	2,000,000	$2,500,000	4,000,000	$5,000,000
Remainder of Pittsburgh district	500,000	750,000	1,000,000	1,500,000
Western Pennsylvania, outside of Pittsburgh district	500,000	1,250,000	1,000,000	2,500,000
New York	56,000	196,000	60,000	210,000
Ohio	50,000	100,000	200,000	400,000
West Virginia	20,000	40,000	30,000	60,000
Indiana	....	....	150,000	300,000
Illinois	600	1,200	2,000	4,000
Kansas	....	....	2,000	6,000
Michigan	....	....	4,000	12,000
Elsewhere	5,000	20,000	5,000	20,000
Total	3,131,600	4,857,200	6,453,000	10,012,000

From these tables it will appear that the consumption of natural gas, measured by coal displacement, in 1887, as compared with 1886, was about 50 per cent. greater, the total consumption being equivalent to coal displacement, 9,867,000 tons, as compared with 6,453,000 tons in 1886. The value of the coal thus displaced in 1887 was $15,838,500, or $1.60½ per ton.

CAPITAL INVESTED IN NATURAL GAS.

As to the amount invested in the production and transportation of the gas, and not that invested in preparing material and appliances to be used in the business, such as tubes, etc., there are no data for giving an estimate, even an approximate one. The capital of the Philadelphia Company, of Pittsburgh, is $7,500,000. As a guess, it might be said that this is probably equal to that of all other companies supplying Pittsburgh, which would make the capital of companies coming into that city $15,000,000. We presume that the capital invested in the production and transportation of gas in western New York and West Virginia, outside of the companies supplying Pittsburgh, would be, at a low estimate, equal to this amount, and might possibly run up to double this amount, making the total capital invested in western Pennsylvania, western New York, West Virginia, and those parts of eastern Ohio that are supplied from western Pennsylvania, from $30,000,000 to $45,000,000. Including the amounts invested in Ohio, besides eastern Ohio, supplied from western Pennsylvania, Indiana, Illinois, Michigan, Kansas, and other States, the amount would probably reach $50,000,000; it may possibly exceed this.

Pennsylvania.—The paper on natural gas in Pennsylvania contributed by Mr. John F. Carll, of the Pennsylvania Geological Survey, to the natural gas supplement No. 2 of the *American Manufacturer*, is so admirable and exhaustive a presentation of this subject that it is reproduced here:

"On a prominent ridge near the center of Genesee township, Allegany county, New York, lies a small cluster of dislocated blocks of Olean Conglomerate, capping a smoothly weathered summit about 2,350 feet above ocean level and 800 feet above Little Genesee creek, one of the headwater tributaries of Allegheny river. Some of the crumbling masses, composed partly of coarse pebbles and partly of fine sand, are 30 feet in height, and measure, laterally, 50 feet or more upon a side. When viewed from a distance their outlines upon the horizon resemble the ruins of some ancient castellated stronghold. These rocks are the most northern remnants of the basal member of the great Carboniferous formation which once spread in a continuous stratum over all this country; and their isolation is due to the destructive action of atmospheric erosion, which has been ceaselessly at work during countless ages disintegrating and removing the surrounding conglomerate and carving out valleys hundreds of feet deep into the underlying strata.

"Tracing this rock towards the southwest it gradually dips at an average rate of about 19 feet to the mile, taking upon its back first the remaining members of the conglomerate series (No. XII), and then in succession the Lower Productive Coal Measures, the Lower Barren Measures, the Monongahela group, the Washington County group, and the Green County group—a vertical thickness of Carboniferous rocks measuring, in the aggregate, about 2,800 feet in Green county.

"Between Olean and Pittsburgh, the banks of Allegheny river afford an excellent opportunity for studying the dip of these country rocks. The distance is 255 miles as the current runs, and the water falls 703 feet. At Olean (1,402 feet above ocean) the river flows in rocks of Chemung age, the nearest and most northerly outcrop of Olean conglomerate in that region, lying about 6 miles south of the town and 940 feet above the river, this being the northerly edge of the great Bradford oil field. From Olean to the State line not a vestige of it remains in the hills north and west of the river, and only one or two small outlines within 10 miles east of it. From the State line to Kinzua village some patches lie at a distance on either side; and three miles lower down, the river forces its way at Great Bend through a cañon-like cut between almost perpendicular walls of conglomerate and sandstone. The base of the Olean is here 612 feet above the river and 1,813 feet above tide. A short distance southeast of this a summit rises to 2,154 feet, taking in all the members of the conglomerate series; and 3 miles northwest the Quaker Hill coal is mined, the only workable bed of coal west of the Allegheny river in Warren county.

"At Tidioute, the northerly end of the productive portion of the Venango oil group, the base of the Olean conglomerate lies 580 feet above river level; at Oil City, 325 feet, and at Franklin, 265 feet. Down to this point no workable coals are found west of the river (except at Quaker Hill, as noted above), and none within many miles east of it, but proceeding southward the coal beds of the Allegheny River series are soon seen in full development, and frequently outcropping in the river banks.

"From Franklin to Parkers, on the Butler oil belt, the Olean, now represented by a medium-grained sandstone, may be seen gradually approaching nearer and nearer to water level, and just below the mouth of Red Bank creek, after passing over the Brady's Bend anticlinal, it goes under and disappears. Following the conglomerate, the coal beds of the Allegheny River series come down to water level one after the other and go under, leaving the lower members of the Barren Measures to hold the river bed throughout the last 20 miles of its course.

"According to the usual formula, which allows a vertical distance of about 1,200 feet between the Pittsburgh coal and the base of the Olean-Sharon conglomerate (where all of the strata are normally developed), the base of this conglomerate at Pittsburgh should lie about 850 feet below the river, or 150 feet below ocean level, for the Pittsburgh coal is exposed in the south bank of the Monongahela 350 feet above water level. Here, then, we find the Olean-Sharon overlaid by more than 1,200 feet of newer rocks and ascertain that it has fallen in level from its outcrop south of Olean, 2,340 feet+150 feet=2,490 feet, an average of about 19 feet to the mile on a direct line. Proceeding onward towards the southwest, the Pittsburgh coal is seen dipping very decidedly in that direction, although the general slope is interrupted by several important anticlinals, until it sinks beneath the highlands in the southwestern portion of Greene county to a calculated depth of about 1,600 feet. On these summits, therefore, the drill must descend (theoretically) 1,600 feet+1,200 feet=2,800 feet to reach the geological horizon at which wells in the Bradford district located at the base of the Olean conglomerate commence to drill; and there are thousands of wells in the northern valleys which are located from 100 to 800 feet lower than this.

"I have been thus particular in tracing the horizon of the Olean-Sharon conglomerate across the State because it defines the base of the wedge-shaped mass of Carboniferous rocks above it, and also lies approximately parallel with all the important oil and gas sands below it. Absolute parallelism can not be claimed, of course, for all sedimentary rocks are more or less variable in composition and erratic in their methods of deposition. But inasmuch as the scope of this article will not admit of details, we may treat the underlying beds as if they were of uniform thickness throughout, and review them in the following order:

	Feet.
1. Carboniferous rocks, varying in thickness from 50 feet to	2,800
2. Shales and sandstone, thickness, say	450
3. Venango oil-sand group, thickness, say	350
4. Slate and shale, thickness, say	500
5. Warren oil group and McKean oil group, thickness, say	600
6. Slate and shale, thickness, say	100
7. Elk oil group, thickness, say	400

"No. 1 has been shown to be thin at the north and to increase greatly in thickness as it is traced towards the southwest. North of a parallel passing through Brady's Bend it has produced neither oil nor gas in valuable quantities; but south of this—in the counties of Lawrence, Beaver, Washington, and Greene—where higher members of the Carboniferous series come in and the basal sands lie under sufficient cover, they are in some localities sporadically productive. In Lawrence and Beaver, oil of heavy gravity has been found in them; in Washington and Greene both heavy and light oils, and sometimes large outflows of gas without oil. But the total output of oil and gas from these Carboniferous rocks is very small as compared with that from deeper horizons.

"No. 2, in its normal development in Venango, holds the Shenango sandstone near its top and the Pithole grit near its center, neither one of which has there produced either oil or gas in paying quantities. In the southern part of Butler county it takes in a new member—the Mountain limestone—which gradually increases in thickness towards the south. Here, also, it carries the Butler gas sand, possibly representing the Pithole grit of Venango county and the Berea grit of Ohio. This rock furnishes strong gas wells in some parts of Butler county, and has likewise produced gas in Allegheny county, but the wells have rather an ephemeral existence as compared with those sunk to deeper sands. The total output of oil and gas from the sand rocks in this group has been comparatively small.

"No. 3, the Venango oil-sand group, is the great underground repository from which all the country south of Warren county obtains its principal supplies of oil and gas. A line drawn from the northwest corner of Warren county to the northwest corner of Clearfield county approximately locates the northeastern end of the productive portion of it. Northeast of this line no profitable oil or gas well has ever been obtained in rocks lying in the horizon of the Venango group—nor in any of the rocks above it—all the oil and gas of eastern Warren and Forest, Elk, McKean, Potter, and Allegany, New York, coming from older and underlying strata. Southwest of it no paying oil well has been found in rocks lying beneath this group, although hundreds of wells have been sunk to depths varying from 100 feet to 300 feet below it; nor has any valuable deposit of gas been discovered below it, except in the Speechley gas field in the eastern part of Venango county, where a southwestern extension of one of the members of the Warren group proves productive under a comparatively small area.

"The great depth of wells southwest of Pittsburgh has led some people to infer that the oil and gas of that region comes from rocks lying at a considerable distance beneath the oil sands of Venango and Butler; but we have shown above that the increased thickness of Carboniferous rocks accounts for the greater depth of drilling required in that locality. There need be no ambiguity about this matter, for so many wells have been drilled on the oil belt from Warren county to Greene, and the First sand, or top member of the Venango group, is so persistent and easily recognized along the entire range of developments that there is no difficulty in tracing it from well to well all the way from its outcrop on Hosmer run, in Warren county, to Waynesburgh, in Greene county. The following table shows its position in relation to ocean level at the points named and its average dip per mile from place to place.

Dip of Venango first oil sand.

Altitudes + or − ocean level.	Localities.	Total fall.	District.	Rate per mile.
Feet.		*Feet.*	*Miles.*	*Feet.*
+1,430	Hosmer run to Church run	330	13	25 +
+1,100	Church run to Franklin	377	18	21 −
+ 723	Franklin to Bullion run	83	10	8½−
+ 640	Bullion to Petrolia	521	18	29 −
+ 119	Petrolia to Great Belt City	285	14	20 +
− 166	Great Belt City to Pittsburgh	624	28	22 +
− 790	Pittsburgh to Washington	360	23	16 −
−1,150	Washington to Waynesburgh	235	20	11½+
−1,385	Waynesburgh			
+1,430 / −1,385	Hosmer run, Warren county, to Waynesburgh, Greene county	2,815	137	20½

"In Warren and Venango the First Sand ranges from 40 to 75 feet in thickness, and where properly identified has always been known as First Sand; but in Butler county it increases in volume and sometimes splits into two members. Where this happens—as at Petrolia—the upper part is called 'Second Sand,' the lower 'Fifty-foot rock.' Where solid and very thick, as on Thorn creek, it passes under the name of the 'Hundred-foot rock.' The 'Gantz Sand' and 'Fifty-foot rock,' at Washington, the 'Salt-water Sand' at Pittsburgh, and the 'Murrysville Gas Sand,' are simply different names applied locally to one and the same stratum—the First Sand of Oil creek.

"No. 4, composed of slate and shale, may be rated as a barren group. Some 'slush oil' has been obtained in its horizon at North Warren, and also in the Bradford district, but the deposits are only of local importance, being limited to very small areas as compared with the extensive range of the group.

"No. 5. Included in this interval of 600 feet we have the 'white sands' of eastern Warren and Forest, including the Speechley sand of Venango, and also the 'black sands' of the Bradford and Allegany districts. Both groups have been very prolific of oil, and they have also furnished many large high-pressure gas wells yielding little or no oil. In many places the 'white sands' are still capable of furnishing powerful gas wells; but the 'black sands' of Bradford have been so long under the drill, and are now so thoroughly relieved from pressure that the gas wells in this district have ceased to be of importance except for local use, and the oil wells are reduced to an average production of less than a barrel and a half per day.

"No. 6 is a barren interval of slate and shale, which lies between the representative of the Bradford oil sand, as found in wells in the Wilcox gas pool, and the top member of the Elk group.

"No. 7. This interval contains several brown sands, which appear to have their best development in Elk county. The wells of Kane district, and those recently drilled in the eastern part of Elk county, find their oil in these sands. They also furnish large volumes of high-pressure gas in the Wilcox pool, at Kane City, Johnsonburgh, and in a number of experimental wells in Elk county.

"Reviewing the above, it is seen that all the large deposits of oil and gas thus far discovered in western Pennsylvania have been found in groups Nos. 3, 5, and 7. The greatest output of gas from No. 7 is in the Wilcox pool, located on the West Branch of Clarion river, about a mile and a half north of the Elk-McKean county line. Here are about 30 wells (some of which have shown a pressure of 850 pounds to the square inch), sending gas through three 8-inch lines to Bradford, and thence to Salamanca and Buffalo, 87½ miles from the wells, and also east to Olean, Wellsville, and Cameron's Mills, 115 miles. A portion of the gas used on this end of the line is drawn from the Allegany field. Another deposit underlying Kane county supplies that town with all the gas it can use, and is also being drawn upon by a new gas line recently completed to Bradford. At Johnsonburgh, Elk county, good wells are obtained and the gas is piped about 8 miles and utilized in the town of Ridgway. The rocks of No. 5 hold large deposits of gas in two important fields—Sheffield, in Warren county, and Speechley, in Venango county. From the first, gas is piped to Sheffield, Clarendon, Warren, Corry, and Erie, and also to Jamestown, New York; from the last (where more than 100 wells have been drilled) to Oil City and Titusville, Franklin, Mercer, and Sharon; Meadville, two lines; and to Tionesta.

"No. 3, as before remarked, supplies all the natural gas now being utilized through pipe lines in that part of the State lying south of the Speechley pool, except in two or three cases, where the Butler gas sand is the productive rock. Pittsburgh depends entirely upon this group for fuel gas. On the east its pipe lines connect with wells drilled into the first sand only; on the west with wells sunk to the bottom of the group—the gas coming from several disconnected horizons in it.

The principal gas pools now under the drill in this part of the State are as follows:

"*Kittanning*, Armstrong county; the town abundantly supplied.

"*Tarentum*, Allegheny county; formerly a very promising field, but pressure now reduced to a point which renders the gas almost valueless for pipe-line purposes.

"*Pine Run*. northern part of Westmoreland county; gas piped to Apollo, Leechburgh, Freeport, and Natrona. This product comes from a rock lying below the First Sand.

"*Murrysville*, Westmoreland county; gas all piped in the direction of McKeesport and Pittsburgh, and some now going to Tarentum.

"*Grapeville*, Westmoreland county; gas piped to Johnstown, Cambria county, on the east, and to Connellsville on the south.

"*Baden*, Beaver county; gas piped to the river towns and Allegheny City.

"*New Sheffield*, Beaver county; gas piped northward to Rochester, Beaver, New Brighton, Beaver Falls, New Castle, and Youngstown, Ohio; also westward to New Liverpool and Wellsville, Ohio.

"*Hickory, Canonsburgh, etc.*, Washington county; gas piped to Pittsburgh on the east, to Steubenville, Ohio, on the west, and Wheeling, West Virginia, on the southwest.

"*Brownsville*, Fayette county; gas piped to Brownsville; source in one of the lower sands of the Venango group.

"In addition to these important pools there are a number of large gas wells scattered throughout this region, some of which are utilized locally, while others are wasting their products.

"It would be both interesting and instructive to trace developments in each of the pools just named from the date of the first well down to the present time, but space forbids; a brief review of one of them is all that can be attempted here.

"The first well at Murrysville was completed November 3, 1878. It was drilled for oil, and the intrusion of gas in such volume and force as to prevent deeper drilling was a disappointment to the owners. An oil well would have given them immediate returns for their outlay, but an uncontrollable gas well in that locality could bring in no revenue unless additional capital was invested in providing the appliances for utilizing its product. The conveyance of natural gas through pipe-lines of considerable length, and its utilization for manufacturing and domestic purposes, were no new things at that time, for as early as 1872 the Newton gas well, in Crawford county, through 5½ miles of 3¼-inch pipe, supplied over 250 fires (large and small) at refineries, manufactories, and dwellings in the city of Titusville; in the fall of the same year the Fairview well, in Butler county, furnished fuel gas through 7 miles of mains to Fairview, Petrolia, Karns City, and Argyle; in 1875, 19 miles of 6-inch pipe were laid from the Lardentown gas well, in Butler county, to Sharpsburgh and Millvale, to furnish fuel for the iron mills; in scores of other places in the oil regions gas has been piped to distances varying from a few hundred feet to 5 miles, and employed for steam-generating and domestic purposes. All these plants worked satisfactorily, yet, incredible as it may seem, notwithstanding these positive proofs of the practicability of piping natural gas, and of its superior excellence as a fuel, Pittsburgh capital could not be induced to invest in Murrysville gas, and no attempt was made to pipe it to Pittsburgh until men from the oil regions came into the field in 1882—and then the first gas piped came from new wells, old Haymaker No. 1 not being connected with the lines until late in 1883. The second well in the field was completed August 20, 1882; the third, February, 1883; in which year more active operations commenced.

"On January 1, 1885, the Murrysville pool extended southward to include Lyons run, and the Daum farm contained fourteen completed wells, which had been drilled in the following order: 1, Haymaker No. 1, Remaley farm, Murrysville, November 3, 1878; 2, Pew & Emerson No. 1, Fundis farm, Murrysville, August 20, 1882; 3, Boulton & Doubleday No. 1, Remaley farm, Murrysville, February, 1883; 4, Hostetter & Brown No. 1, Harvey farm, Murrysville, March 20, 1883; 5, Haymaker No. 2, Cooper farm, Lyons run, April 25, 1883; 6, Boulton & Doubleday No. 2, Cooper farm, Lyons run, July, 1883; 7, Hostetter & Brown No. 2, Harvey farm, Murrysville, December 20, 1883; 8, Boulton & Doubleday No. 3, Cooper farm, Lyons run, (?), 1883; 9, Hukill No. 1, Dick farm, Lyons run, March 1, 1884; 10, Philadelphia Company No. 1, Verier farm, Murrysville, May 1, 1884; 11, Pew & Emerson No. 2, Meanor farm, Murrysville, August, 1884; 12, Hukill No. 2, Daum farm, Lyons run, August 2, 1884; 13, Hukill No. 3, McWilliams farm, Lyons run, November 1, 1884; 14, Hostetter & Brown No. 3, Stewart farm, Murrysville, December 20, 1884. At that time numbers 6 and 8 were connected with the Acme Gas Company's line to Braddock, etc., which line first commenced to deliver gas December 1, 1883.

"Numbers 1, 2, 4, 5, 7, 11, and 14 were connected with the Fuel Gas Company's lines to Pittsburgh. Numbers 9, 12, and 13 belonged to the Carpenter Natural Gas Company, which made its first delivery at McKeesport, January 8, 1885. Nos. 3 and 10 were blowing into the air, the first being small, the last very large. There were also seven wells drilling or preparing to drill.

"By January 1, 1887, seventy-four wells were completed, and developments extended about a mile northeast of Murrysville. By November 1, 1887, one hundred and fourteen wells were completed, and developments had been carried northeastward to Pucketta creek, making the present length of the belt about 8 miles. The southerly end of the gas deposit is definitely fixed near the Daum farm (the gas rock south of that being flooded with water), but the northerly end is not yet fully defined, although recent developments on that end of the belt seem to indicate nothing very promising north of Pucketta creek; at least nothing in direct connection with the Murrysville pool.

"If we date the commencement of natural gas pipe-line service in Pittsburgh, say, November 1, 1884 (previous to that but little gas, comparatively, had been delivered), the business is now just entering its fourth year. What rapid strides it has made may be inferred from the fact that one hundred wells have been drilled on the Murrysville belt (saying nothing about other localities) within the last two years and ten months. But it is to be noticed that sixty wells (two and a half per month) were drilled during the first two years, and forty (four per month) during the succeeding ten months; hence it may be pertinent to inquire whether this increased monthly average of new wells was made necessary by a corresponding increase in the demands of consumption, or a corresponding decrease in the output from the old wells. Oil operators have learned by experience that when an oil pool is thoroughly outlined by drilling no additional number of wells can permanently increase or even check its declining production. The history of gas pools must be the same (some of them have already made their record), for both products have a common origin and both are contained in the same series of sand rocks.

New York (*a*).—Previous volumes of Mineral Resources have already given the early history of the utilization of natural gas in this State, including the history of the discovery and utilization of gas at Fredonia, Vernon, and Westfield. This need not be repeated here. Natural gas springs are more abundant in the State of New York than in either Pennsylvania, Ohio, or Indiana. With the exception, however, of the wells below described, in the vicinity of the Allegany oil district, no gas wells have been found within the boundaries of New York which are comparable for productiveness to those found in the other three States. A well has recently been drilled to a depth of about 500 feet within the Buffalo city limits, and sufficient gas is reported to have been obtained to supply fuel sufficient for the boilers for two drilling wells. A natural gas flow was struck in a well at Rodman, in Jefferson county, September 4, 1886. It is reported that this gas was

a Condensed from a paper by Mr. Charles A. Ashburner in the Natural Gas Supplement of the American Manufacturer.

found at a depth of 162 feet in a "seam of slate"—limestone—having been drilled through from the top of the well to a depth of 160 feet. This limestone is evidently the upper portion of the Trenton. In many parts of Albany and Greene counties natural gas springs issue from rocks of different geological ages, from the Chemung shales and sandstones down and into the Hudson River shales. The total thickness of the strata which have produced gas in different parts of Albany and Greene counties is at least 12,000 feet. These may be grouped as follows:

Total thickness of gas-producing strata in Albany and Greene counties, New York.

	Feet.
Pocono, Catskill, or White sandstone No. X	1,000
Catskill Red sandstone No. IX	
Chemung sandstones and shales	5,300
Portage shales and sandstones	
Genesee shales	
Hamilton sandstones and flags	1,975
Marcellus slate and shales	
Upper Helderberg limestone	
Cauda Galli grit and sandstone	
Oriskany sandstone	
Lower Helderberg limestone	300
Water lime	
Salina salt group	
Niagara limestones	
Clinton, Medina, and Oneida	Wanting.
Hudson River shales and slates	3,500
Trenton limestone	125

At Oak Hill, in the northern part of Durham township, Greene county, gas has been issuing for many years from the flaggy sandstones of the Chemung. On Benjamin Auchampaugh's farm and on Miles Posson's farm, in Knox township, Albany county, gas has been issuing from the Hudson River shales at the bottom of the geological section, which has so far been found to contain gas. The rocks lying between those outcropping on the farms mentioned and the Chemung strata at Oak Hill include the strata along the outcrops of which most of the springs have been found in a number of localities in the two counties referred to. The fact that these rocks contain sufficient gas to exhibit itself in springs is not conclusive evidence that gas will be found in the vicinity of these springs in commercial quantities.

During 1886 three wells were drilled in this region, one about 3½ miles from Cairo to a depth of 2,200 feet, one at Knowersville to a depth of 3,012 feet, and one on the Finch farm, about 4½ miles west of Knowersville, to a depth of 2,200 feet. The Cairo well is situated at the foot of Black Head mountain, 610 feet above the village of Cairo and 956 feet above tide, the elevation of the crest of Black Head mountain being 3,975 feet. This well was located by oil men from Pennsylvania, under the belief that the same formations would be passed through as in the Knowersville well. As a matter of fact, the Cairo well would have had to be drilled to a depth of 5,300 feet before the drill could have encountered the strata in which the Knowersville well was commenced. Relative to the existence of gas in this region Mr. Ashburner says:

"Although gas in commercial quantities may be found in eastern New York, I have no hesitancy in asserting that it can not be found in the region between Kingston, Catskill village, and the Cairo well. The gas which came from the Knowersville well at the close of 1887 was obtained at a depth of 497 feet; the gas sand was only 6 inches thick. At the close of 1887 gas had been issuing from this well for about sixteen months without any perceptible diminution in either the confined pressure of the gas (40 pounds per square inch) or in the amount of gas produced. If in other wells the Knowersville well gas sand should be found of greater thickness than it is in the Knowersville well, it is quite probable that it may contain gas in commercial quantities. The Knox well, which was drilled in the Finch farm, 4½ miles west of Knowersville, passed the geological horizon of the Knowersville gas sand at a depth of 1,050 feet, but no gas was found. Drilling was stopped in this well at a depth of 2,200 feet, or 1,200 feet above the top of the Trenton limestone."

Relative to the probabilities of finding gas in this vicinity, Mr. Ashburner reaches the following conclusions:

"First. Although the geological structure of the rocks, from the Catskill sandstone down to the Trenton limestone, within certain districts in northwestern Greene county and parts of Albany county is such as to make it possible for them to contain gas, yet at the same time we have no positive facts upon which to base the opinion that gas exists in any of these strata in any quantity except in the Hudson River shales, with the possibility of finding it in the top strata of the Trenton limestone.

"Second. If the Knowersville-well gas should be found at any point other than in the Knowersville well, it will undoubtedly be found in pools of small area as compared to the gas pools in the vicinity of Pittsburgh. The pools will be scattered and the gas will undoubtedly be found in quantities much smaller and at pressures much less than in the Pittsburgh district.

"Third. There is no geological or physical reason why gas may not be found in the Trenton limestone within those areas, where the geological structure of the limestone does not preclude its existence. These areas within practical piping distance of Albany are confined principally to northern Albany and eastern Schenectady counties.

"Fourth. Although it is impossible with our present knowledge to predict the existence or non-existence of gas in commercial quantities in the Hudson River shales and Trenton limestone in this region, the geological facts would warrant the drilling of exploration wells, properly located, to settle the question.

"Fifth. In order to test the existence or non-existence of gas in the Hudson River shales and the Trenton limestone, wells should be drilled at such points in northern Albany and Schenectady counties where the dip of the rocks is most favorable to its existence and where the possibly gas-bearing rock could be struck in wells from 1,000 to 1,500 feet deep.

"Sixth. I have no hesitation in saying that the non-existence of gas in the district can not be inferred without the drilling of further wells, first within the vicinity of the Knowersville well, and second at proper points to be determined upon for testing the Trenton limestone."

As to the importance of the gas district of Allegany county, the only one which has been drawn upon for commercial supplies of gas, Mr. Ashburner says:

"The principal gas wells have been found along the fringe and a little beyond the boundary of the oil-producing territory. No geological report has ever been published on the oil and gas sands in this region, so that a few facts from many which I have in my possession, and which I have gathered at different times during the past twelve years, will, no doubt, prove of special value in this connection. Before giving these facts I desire to state briefly some of my conclusions, which the facts later given will throw some light upon. I can not, however, within the brief space of this article, give all the facts which may be necessary to prove all of my conclusions to the satisfaction of the reader.

"First. The geological horizon of the Allegany oil and gas sand, or what is commonly and locally known as the Richburgh sand, is, without doubt, the same as that of the main producing oil and gas sand of the Bradford region, meaning the principal oil and gas producing Bradford sand referred to in my report on the Bradford oil region, published in 1880. This sand, at the city of Bradford, lies 1,030 feet below water level.

"Second. The oil sand struck in the old Waugh and Porter well, on lot 34, Boliver township, at a depth of 1,330 feet, and commonly called the Waugh-Porter sand, is undoubtedly the same as the Bradford sand, and in consequence the same as the Richburgh sand. This sand was struck in the old Cranston well No. 1, lot 29, Genesee township, at a depth of 1,704 feet, and in the Cranston well No. 2, on the same lot, at a depth of 1,709 feet. This sand is without doubt the same also as the sand which proved so productive in the old Davis wells on lot 31, Genesee township, in the old Davis and Haldeman wells, lot 24, Genesee township, and lot 17, Clarksville township, and also in the Armour and White wells on lot 24, Genesee township. The depth of the sand in these wells below the bottom of the Genesee conglomerate, which is identical with the Olean conglomerate, is practically the same as the depth of the Bradford sand at Bradford, below the bottom of the Olean conglomerate. It is certain that the producing sand in the wells just referred to is the same productive oil and gas sand in the vicinity of Richburgh, Boliver, and Allentown; in other words, the Bradford, the Upper Waugh-Porter, and the Richburgh sands are geologically the same, although they differ much in their physical characteristics. This conclusion has been questioned by a number of operators in the Allegany district, also by several professional geologists. It has been questioned by the operators because the strata above the main producing sand in the different localities are quite different. The sandy measures in the 1,000 or 1,500 feet immediately overlying the oil-sand of Bradford are poor guides in looking for the oil and gas sands in new or wild-cat territory around either the Allegany or Bradford oil and gas districts. They lead to confusion, error, and disappointment. It is true that in a limited territory within the Bradford district there are distinct sand beds 300 and 600 feet, respectively, above the Bradford oil and gas sand, but I am quite confident that it is impossible to determine the position of the main producing oil and gas sand by the location of these upper sands."

Most of the gas wells operated in the Allegany district are at present controlled and operated by the Empire Fuel Gas Company, limited, of Wellsville. In the spring of 1887 this company had about 2,000 individual consumers along its various pipe lines, which measured in the aggregate about 125 miles, the pipes ranging from 8 inches to 2 inches in diameter. At the same time this company owned 102 wells, 73 of which produced oil, 4 oil and gas combined, and 25 gas alone.

Prices charged consumers by the Empire Gas Fuel Company, limited.

Cook stoves	per month..		$3.50
Heating stoves, according to the size of the room, ranging from	per month..	$3.00 to	6.00
Lights in dwellings	do		.25
Lights in stores	do		.30
Boilers, from	per day..	1.25 to	1.50
Furnaces, from	per month..	6.00 to	9.00

Although the characteristics of the Allegany gas wells are different in many respects from the gas wells in northern Pennsylvania, yet, in the main, the history of these wells will no doubt be found to be much the same as the history of the gas wells in northern Pennsylvania, particularly those in northern McKean county. Relative to explorations in sections of this State, Mr. Ashburner makes the following statement:

"A well was drilled to a depth of 1,400 feet in Neversink valley, near the border of Orange and Sullivan counties, which cost about $15,000; no indications of gas were met with, and the well was abandoned. A well was drilled in the town of Barker, in Chenango valley, to a depth of 2,175 feet, at a cost of about $10,000; indications are said to have been found in this well of the existence of salt, oil, and gas. A well was drilled near Morrisville, in Madison county, to a depth of 2,000 feet; a stream of gas is reported to have issued at one time from this well which, being lighted, produced a flame 75 feet high. A well is being drilled near Norwich, Chenango county, which is about 900 feet deep. It is reported that 'the indications are promising.' What promising indications might be gathered from the drilling of this well it is impossible for a geologist familiar with the region and with the geology of natural gas to imagine. Another well is about to be drilled in Broome county, near the borders of Chenango, to a depth of 2,000 feet."

Ohio.—The statement relative to natural gas in Ohio is based upon the reports of Prof. Edward Orton. His résumé of natural gas in Ohio, published in the Natural Gas Supplement of the *American Manufacturer* can hardly be improved upon, and is therefore reproduced:

"The year 1887 has done something for the discovery, and much more for the utilization, of natural gas in Ohio. The fields previously known have been extended and to some extent defined, and several new fields have been brought to light, one of them of great importance. In southern Ohio, at a single point, a gas horizon, not before found productive in that portion of the State, has been discovered. In northern Ohio, on the lake shore, a slowly increasing use of the shale gas, so easily available, is reported.

"Throughout the State at large a vast amount of exploration has gone forward, and, except in a few favored localities, there are no returns whatever in money value for the large outlays that have been made in the search. Drilling has been especially active in the southwestern corner of the State. In all the county towns of this region, and in many villages besides, one or more deep wells have been sunk. At a few points small supplies of gas have been obtained from the Utica shale, but so far as known no value has been found in the Trenton limestone in any of the wells that have been drilled here.

"*Geological horizons.*—The several strata from which gas is now obtained in Ohio are the following, named in descending order:

"1. The Berea grit.

"2. The Ohio shales.

"3. The Clinton limestone.

"4. The Utica shale.

"5. The Trenton limestone.

"Each of these sources of gas will be briefly described, as it is at present developed in the State.

"1. *The Berea grit.*—This famous stratum has been tested by the drill at many points in eastern Ohio during 1887, but no great additions to its production are reported. The search has been especially persistent in Muskingum, Guernsey, Belmont, Harrison, and Jefferson counties. Considerable encouragement has been found in the behavior of several of the wells drilled in the two counties at the head of this list, but no facts are yet made public that warrant us in believing that any large reservoirs have been tapped. The search for gas in this region is much more intelligent than ever before. All of the geological elements involved are carefully studied and account is made of those promising help. It is rather humiliating to confess that though more intelligent, the search is scarcely more successful than it has hitherto been. In

Washington county high-pressure gas from this stratum is believed to be available, but there are no towns near enough to the possible fields or rich enough to develop and utilize their stocks. In the Macksburgh field the gas is disappearing with the oil.

"The Neff wells still remain the largest sources of Berea grit gas in Ohio. Four of them are found in a little cluster, picturesquely situated at the junction of the Kokosing and Mohican rivers, in the northwest corner of Coshocton county. Two of the wells were drilled in 1865 and two within the last ten years. Their total production at the present time is about 400,000 cubic feet of gas per day, at a temperature of 60° F. It is used in the manufacture of lampblack, an important interest, which was originated here. The wells require frequent attention in the way of the removal of the salt water that follows the gas, the pump being employed at intervals of three or four days. The gas shows remarkable persistency, as the dates above named will indicate, but these wells furnish no ground for believing that high-pressure gas in large volume will continue to flow indefinitely. The little wells of East Liverpool are still maintained for the lighting of the town and for the supply of a few stoves, but they are declining. It is scarcely possible that the best gas production of the Berea grit in eastern Ohio has yet been reached. Nothing in the way of gas that is comparable with the oil of the Macksburgh field has been thus far attained. It is to be regretted that so much money must be lost in making this exploration, but the prize is so great that the work will still go forward.

"2. *The Ohio shales.*—These wide-spread sources of 'surface indications' and low-pressure gas are gradually coming to be counted for what they really are, viz., valuable repositories of easily-obtained and fairly-durable home supplies of the best of fuel. It is not in them to yield the high-pressure gas of the reservoir rocks. When this fact is fully understood and accepted the shale will be studied and worked for itself alone. It seldom covers anything better than the shale itself in the way of a supply of natural gas.

"3. *The Clinton limestone.*—The Clinton limestone, in its outcrops in southwestern Ohio, is a bituminous rock on a small scale. Attention was called to this fact twenty years ago in the geological reports of this district, but the idea that it might become, under proper cover, a reservoir of oil or gas in paying quantities seems never to have been entertained by anyone. The first display of this new function was made at Fremont, in northern Ohio. The shallow gas wells of this town all derive their supply unmistakably from the Clinton limestone. None of them exceed 20,000 feet per day in production, and, therefore, the new horizon has created no great excitement in that section of the State. In Wood county a single well has shown the Clinton limestone to be an oil rock as well as a gas rock, the production reaching 30 barrels per day for several weeks; but here again, from the fact that this well was the only one out of several hundred that found any such supply, the discovery has not seemed important. The recent experience of Lancaster, however, has given a new value to the formation. Two years ago a company was organized here to drill to the Trenton limestone. They have not yet struck the Trenton limestone, but they have struck what is better, viz., high-pressure gas in the Clinton limestone, 1,000 feet or more above the level of the Trenton. In so doing they have added another source of high-pressure gas to the Ohio scale. The discovery is discounted, however, in advance, for a large part of southern Ohio, from the fact that the Clinton limestone has been passed already in very many wells without a hint of gas or oil in noteworthy quantity. The first well at Lancaster yielded 73,000 feet of gas per day before it was shot. Its production was thought to be largely increased by the shot. Well No. 2 yields about 800,000 feet of gas per day from a 5⅝-inch pipe, and well No. 3 about 900,000 cubic feet from a 4¼-inch pipe. The gas is perfectly dry, and apparently freer from sulphur than Trenton limestone gas. Its closed pressure is doubtless high, on account of the depth from which it comes. The discovery is one of great value to Lancaster. The drilling of these Lancaster wells requires a large outlay. Salt water needs to be cased off at about 1,900 feet in the Niagara shale or the upper beds of the Clinton. Well No. 2 is cased with 5⅝-inch pipe to a depth of 1,900 feet. This is the largest line of regular casing known in the State. The gas horizon is a little less than 2,000 feet deep; it is a highly crystalline limestone, included between two beds of red rock, the upper one being a deposit of the famous fossil ore of the Clinton formation. Small flows of Clinton gas appear to have been struck at a depth of about 2,000 feet, and at Cleveland, in the Deep Rolling well, at 3,150 feet. The Lancaster discovery will doubtless lead to more drilling in the country around the town, but a considerable number of the nearest towns have tested the new horizon already, as has been previously stated.

"4. *The Utica shale.*—It is from this formation that numerous small but still valuable flows of gas have been derived in deep wells throughout southwestern and central Ohio during the last few months. In this group of wells the maximum production thus far obtained by any single well does not much exceed 100,000 cubic feet per day. The closed pressure has been found to be less than 100 pounds in all cases noted. The gas of Miamisburgh, Middletown, Hamilton, Camden, Felicity, Huntsville, and numerous other towns is derived from the Utica shale. As to the persistency of the supply, there are not facts enough to furnish good ground of judgment at present, but the appearances do not, as a rule, betoken a long life to the wells. This horizon appears to be the only one available to southwestern Ohio for natural gas. It is not of a sort to arouse a great deal of enthusiasm. At best it is a domestic supply and not adapted to manufacturers' uses.

"5. *The Trenton limestone.*—In this closing section we come to what is, in reality, the only important source of natural gas in Ohio at the present time. By whatever standards it is judged, the Trenton limestone is accrediting itself as one of the most remarkable repositories of gas and oil that has ever been discovered. It is furnishing in Ohio and Indiana the largest continuous gas fields of the country. Unlike the Pennsylvania fields, these western competitors are not confined to anticlinals or arches, but they stretch out like coal fields. Four counties embrace the large production of Ohio at the present time, viz., Hancock, Wood, Auglaize, and Mercer. The two latter were added to the list in 1887. The St. Mary's field, under which both of these can be included, constitutes a very large and promising territory. Its wells have not yet reached the proportions of the best wells of Findlay, it is true, nor is the rock pressure of the gas as great, but they range in production from one to five million cubic feet per day, and their pressure is ample to force the gas to Lima, Greenville, Sidney, Piqua, and other thriving towns of this part of the State, which have either introduced it already or are now making arrangements to do so. It is obvious that the developments going forward here are of very great present and prospective importance.

"The Findlay field still continues to be a main center of interest. As this town led in the discovery of the gas, so it has kept at the front in its utilization. It has made a wonderful growth during the present year. Large amounts of capital have been brought in from abroad, and a score or more of substantial manufacturing enterprises have been established here. The supply of gas from its wells is ample for all present uses, and the rock pressure when last tested was maintained at the figures that have prevailed for the past two years, viz., 375 to 400 pounds per square inch. That the gas is in reality a stored product, however, begins to be apparent to all good observers of the field, and the town is at last entering on a line of action that should have been adopted from the first. Economy in the use of the gas is beginning to be insisted upon, and the vandal-like waste of the choicest fuel of the world is no longer to be tolerated. It is not to the credit of the intelligence of the towns of Ohio and Indiana—fortunate enough to secure the new fuel—that, when found, they have wasted it in such barbaric fashion. The Karg well alone (the largest well of Findlay) is responsible for a total loss of at least 1,500,000,000 cubic feet of the gas of the field. This volume would meet all the legitimate requirements of Findlay for domestic, manufacturing, and municipal purposes for several years. The amount of gas wasted in the new fields in vain display during the last year is mournful to contemplate. Much of this waste has been demanded by speculators who were engaged in working up 'booms' for the several towns. In a number of these towns 500,000 to 1,000,000 feet have been misused in this way every day for months together. Now that Findlay is entering upon a measure of economy in the use of the gas, the cry is raised that the supply is running low. I do not know of any facts that bear out this claim, but I am sure that if the town had adopted two years ago some similar measure, it would have been of immense advantage to it either in the near or more distant future. Having neglected this obvious duty so long, no better time for reformation can be found than the present. The Findlay field proper has been extended 3½ miles to the southeast of the town by bringing in a very important well, viz., the Ballard well. To the eastward, also, in Marion township, prolific territory has been developed. From this subdivision of the field, gas is now being transported by a pipe line to Tiffin. The largest development of the year, however, has been carried forward in Bloom township, Wood county, and in contiguous territory, for the supply of the two pipe lines that lead to Toledo, and the lines that supply Fostoria and Fremont. Many valuable wells have been drilled here, and this section of the general field is second to none in importance. The gas is, for the most part, used by the pipe-line companies with due care and economy. The village corporation of Fostoria, however, which has drilled wells and laid a pipe line of its own, is still 'making night hideous' with the baleful glare of a line of stand pipes encircling the town. It must be added that the town is making excellent use of its newly acquired advantages in the establishment of important manufactories. Bowling Green is adding to its gas supply by bringing in much stronger wells, two or three miles to the southward. Several of the wells approach a production of 1,000,000 feet of gas per day, and some of them may exceed this figure. The town has been fortunate in securing several valuable manufacturing plants. In fact, it is making as substantial progress and reaping as substantial benefits as any town of the new gas fields, Findlay alone excepted. The wells of Carey have proved virtual or total failures, but drilling done several miles to the west of the town, during the year, has been more fortunate, affording a full supply for all present demands. The wells of Oak Harbor continue to supply the town. A half dozen or more have now been drilled and some failures have occurred, but the supply has been thus far equal to the demand.

"Two towns, that lie well outside of the Findlay field and the Findlay conditions, remain to be mentioned, viz., Bryan and Tiffin. In both of these locations the Trenton limestone lies far below the dead-line of the main field, but minor relief appears to come into effect to save them from entire failure. Bryan has now drilled four wells, at an expense of more than $25,000. For this outlay there is at the present time to be entered on the credit side 225,000 cubic feet of gas per day, derived from two wells, both of which have been torpedoed, and the best of which is apparently falling off in production quite rapidly. If the search is continued, it is quite possible that high-pressure gas will be struck at last in quantity sufficient for the use of the town. The areas of relief are, however, likely to be small, and the duration of the supply will be correspondingly reduced. Tiffin has kept up a persistent search for oil or gas, and at last is rewarded by a well of unusual capacity for one outside of the belt of main production. Its last well is estimated by a competent judge to be 1,250,000 cubic feet per day. The estimate is probably based on measurements. The gas of Tiffin comes from a depth of 1,500 feet, and has therefore a high, closed pressure. The first real success in this field was attained by Messrs. Loomis & Nyman, in a well drilled at their machine works in the summer of 1887. The volume of gas was small, being about 60,000 feet per day, but its closed or rock pressure was at least 50 per cent. greater than that of the Findlay wells. A gauge graduated to 600 pounds showed this entire amount of pressure when the well was shut in, and the index still traveled on, reaching, finally, a point that was counted at least 650 pounds.

"The most important addition of the year, to our knowledge, of the Trenton limestone as a source of gas remains to be briefly stated. It is this: The rock is largely productive only when its upper portions have been replaced by dolomite or magnesian limestone. This change has taken place in the Ohio and Indiana gas fields, and also to the north and northwest of these regions. In southern Ohio, however, there is not a trace of this replacement, and consequently the Trenton limestone within this region is in no sense a reservoir of oil or gas. The constant failures of the attemps to find gas or oil in the new horizon in this, and in many other directions, are sufficiently explained by the facts here referred to.

"From Quebec to the Rocky mountains the drill has been set in operation in order to reach the new gas rock of Ohio. The formation is is easily enough reached in a thousand instances, but it proves disappointing when it is reached. This disappointment will be found to depend upon the chemical composition of the rock. The normal composition of the limestone, the composition which prevails through nine-tenths, or perhaps ninety-nine hundredths, of its extent, forbids its being a gas rock or oil rock in any important sense. It is, therefore, by no means enough that the geological formations of any district are the same in the scale as those of the Findlay field to insure an oil field or a gas field therein. It must also be added that the upper beds of the Trenton limestone in the new district shall have suffered the dolomitic replacement that has taken place in the Findlay gas rock. Nor is this condition enough. The limestone must not only be porous, but it must be disposed in the right relations to surrounding portions of the stratum to enable it to accumulate gas or oil. In other words, the porous rock must have a due relief. On this condition, nature inexorably insists. The porous rock will be filled when found, but ninety-nine times in a hundred it will be filled with salt water. It is only in the fortunate exceptions that porosity and structure combine to make the Trenton limestone a source of Findlay gas or Lima oil."

West Virginia.—But little can be added to what has already been said in previous volumes of Mineral Resources as to the occurrence of natural gas in West Virginia. It still remains true that the chief sources of supply of the gas used in this State are from the Washington (Pennsylvania) field. Towards the close of the year some explorations were made in various parts of the State, but without very important results.

In the neighborhood of Charleston a well was drilled which, it was claimed, produced more than 1,000,000 cubic feet per day.

Indiana.—So rapid has been the succession of events in connection with the development of natural gas, that Indiana, which did not assume any importance as a producer of natural gas until near the close of 1886, became, in 1887, one of the three chief districts of the United States; the other two being the Findlay (Ohio) and the Pittsburgh (Pennsylvania) districts. The first well put down in Indiana for natural gas was drilled in 1885, without any result. It was not until October, 1886, that the large vein at Kokomo was struck at a depth of 908 feet.

In the report on natural gas in Mineral Resources for 1886, some attention was paid to the Indiana gas field. Since the publication of that volume, however, a great deal of new light has been thrown upon the geological conditions under which the gas is stored in that State. Dr. A. J. Phinney, of Muncie, Indiana, to whom more than any one else we are indebted for a knowledge of these conditions, takes the position that the so-called "Wabash arch," which is supposed to exist in Indiana, is purely hypothetical, and that the Cincinnati arch extends into this State and furnishes the reservoir for most, if not all, of the gas found in commercial quantities in Indiana. Dr. Phinney expresses the belief that the Cincinnati arch was formed beneath the ocean, and only lifted above it at the close of the Paleozoic age. This Cincinnati anticlinal nowhere presents the topographical features of a mountain range, but consists rather of a broad tract from 50 to 125 miles wide, from which the Upper Silurian and succeeding formations dip rapidly away to the east and southeast on the one side and to the west and northwest on the other. South of Nashville the Trenton limestone, in which is stored the gas found in Indiana, is the surface rock over a large area.

This Cincinnati arch extends from the south line of Tennessee through Nashville and Cincinnati to Lake Erie, between Toledo and Sandusky. The main body of the arch, however, after entering Ohio near Point Pleasant, turns gradually to the northeast. Entering Indiana south of Union City, Randolph county, it extends nearly to the north line of the State, though it is broader and relatively lower north of the Wabash river. The crown of the arch at this point will probably be found near Wabash, or between Wabash and Peru. West of Union City the crown of the arch probably lies near Muncie. A sharp ridge or fold arises in Mercer county, Ohio, and extends northeasterly in the general line of the arch from Tennessee to Lake Erie. This is named the Lima axis by Professor Orton, though better known as the Findlay arch. In the study of the portion of the arch north of the Ohio river, after it divides or forks, we must consider the portion in Indiana as broader and higher and the Ohio fold sharper and more depressed. In order to give a better understanding of the Cincinnati arch we give the following table of altitudes of the upper surface of the Trenton limestone, as compared with sea level. Beginning at Crestline, Ohio, the following towns, near by, on straight line, found the upper surface of the Trenton formation as follows:

Depth below sea-level of the Trenton limestone at certain points in Ohio and Indiana.

	Feet.		Feet.
Crestline, Ohio	1,650	Decatur, Indiana	460
Bucyrus, Ohio	1,235	Huntington, Indiana	270
Upper Sandusky, Ohio	492	Wabash, Indiana	193
Beaver Dam, Ohio	445	Peru, Indiana	215
Delphos, Ohio	447	Logansport, Indiana	314
Van Wert, Ohio	434	Monticello, Indiana	378

The character of the Lima axis is better shown in the section from Tiffin, Ohio, to Fort Wayne, Indiana:

	Feet.		Feet.
Tiffin, Ohio	746	Paulding, Indiana	875
Findlay (Jones's well), Ohio	328	Fort Wayne, Indiana	686
Leipsig, Ohio	746		

The upper surface of the Trenton limestone is undulated over all portions of the arch. It is to this high tract, the Cincinnati arch, called Trenton limestone, that we are indebted for the large accumulation of gas in Indiana. Without this large reservoir the gas would have been scattered over a large territory, following the crests of every wave in the Trenton, but not in sufficient quantities anywhere to warrant the expense of drilling.

Relative to the relation between the upper surface of the Trenton and the sea level Dr. Phinney says:

"It is a significant fact that so far not a single gas well of value has been found in the Trenton limestone where its upper surface is below the 100-foot sea level. This 100-foot dead line then marks the approximate limit of the gas area. Outside of this area, wherever the Trenton is porous, it is full of salt water. South of Greenfield, however, the Trenton is usually very close, so that salt water is not found, as a rule, until the Trenton has been penetrated 100 or more feet. Over the higher portions of the areas the rock does not seem to be porous except in spots or narrow strips, so that the limit of the productive gas area in this section is very indefinite. At Kentland the Lower Silurian rocks are exposed over a small area, and the Trenton will probably show some disturbance here. This seems to be the eastern terminus of the La Salle axis of Illinois. In the above the sea-level line is taken as the datum line simply for convenience, and not because the salt water comes from the sea, as this is probably not the case. As the slopes of the Cincinnati arch are gradual and not broken, so far as now known, it is evident that whatever gas may have accumulated in the Trenton outside of the present gas area has had free means of escape into the higher portion of the arch. The depth at which the Trenton is found below sea level has nothing to do with the accumulation of gas, provided there are arches or ridges of sufficient capacity to act as reservoirs, but so far as now known the Cincinnati arch is the only large reservoir, and its relations with the other portions of the Trenton are such that the gas would, in obedience to its own laws, rise into the higher portion of the arch. The horizon of the salt water in the Trenton must vary as the Trenton is elevated or depressed, for the impervious cover presented by the Utica shale prevents its upward escape.

"Laterally, the Findlay arch or Lima axis on the east prevents its lateral flow in that direction, and as the arch is depressed so we find the salt-water horizon between 400 and 500 feet below sea level. The Indiana arch has a higher level, hence we find the salt-water horizon at a higher level—about 100 feet below sea-level. Between the outcrops of the Trenton in Kentucky and Ohio on the south and northern Michigan and Canada on the north is a deep basin in the Trenton. This limestone is a reservoir of water, salt from the solution of saline material in the rock, that has a tendency to rise into all portions of the arch until an equilibrium is established. That an equilibrium is not established is evident from the height at which the salt water will rise in the wells outside of the gas area, as at Huntington, where it rose about 50 feet, or about 680 feet above the 100-foot dead line. This shows that the salt water is under considerable pressure at this point—323 pounds to the square inch. With such a pressure it is no wonder that the gas and oil are found in the higher portion of the arch. The salt water must crowd upon the gas until the resistance offered by the compressed gas is equal to the pressure of the salt water. If this be true, then it is not difficult to see the influence that the quantity of gas in the reservoir has played in determining the horizon of the salt water. It must also follow that as the reservoir becomes exhausted the salt-water horizon will rise. With the gas under such an enormous pressure the bulk must be very much reduced, until 1,000 cubic feet would not occupy the space of over 40 cubic feet. As the oil has lower specific gravity than water, so we must expect to find it above the water but below the gas, and so far all the oil has been found outside of the gas area. The sooner we understand the relation that the salt water, oil, and gas sustain to each other, the better we will be able to determine the probability of finding either at any locality. The Cincinnati arch is the reservoir for the gas. That the gas is found in this arch is no accident, but the result of well-defined and fixed laws, that govern not only the distribution of gas, but oil and salt water as well. Gas and oil will no doubt be found in many places outside of the productive area proper, but the flow will be small. In the above statements I have referred only to the gas area in the Trenton limestone. The other gas bearing rocks have so far proved of so little value and the flow, where strong at first, so soon failing, that one is not justified in expecting a large and permanent supply from this source.

"The gas-bearing portion of the Trenton limestone varies in thickness from 2 to 20 feet, and all the records so far show that it is simply porous rock. The thickness of the porous portion varies within short distances, so that one well may be quite small and a gusher be found less than one mile away."

The natural-gas reservoir is believed to be one of the largest in the world, but the length of time the supply will last is entirely a matter of conjecture. The rock pressure of the gas varies from 320 to 340 pounds per square inch, according to the depth at which the gas is found and the distance from salt water. In the southeastern portion of the State, however, where the limestone is not porous, the pressure ranges from 18 to 50 pounds per square inch. The length of time required for wells to reach their maximum pressure varies with the volume that will flow from the well in a given time; in other words, wells of a capacity of 500,000 cubic feet per day require about three minutes to reach their maximum pressure, while the "gushers" of ten millions and upwards require only a few seconds; small wells require hours, perhaps days.

It is exceedingly difficult to get accurate statements of the production of certain Indiana gas wells. There is no doubt that the capacity of these wells has been very much overstated. Indeed, it is frankly acknowledged in many cases that such is the fact. The following statement is believed to be very nearly correct as to the wells named:

Of the large gas wells, we have the Fairmount: open pressure, $3\frac{3}{4}$ pounds, $5\frac{5}{8}$-inch casing; capacity, 11,500,000 cubic feet per day. The McCullough well at Anderson: open pressure, $2\frac{6}{16}$ pounds, $5\frac{5}{8}$-inch casing; capacity, 9,795,000 cubic feet per day. Hartford City No. 2: 2 pounds open pressure, $5\frac{5}{8}$-inch casing; capacity, 8,990,000. The following wells have a capacity exceeding 5,000,000 cubic feet per day: Nos. 5 and 7, at Kokomo; No. 5, at Marion; the Jonesborough well, No. 2, at Fairmount; the Wainwright and Enterprise wells, at Noblesville; No. 6, at Anderson. The following have a daily capacity varying from 3,000,000 to 5,000,000 cubic feet per day: Nos. 1, 3, and 5, at Anderson; Nos. 1 and 2, at Greenfield; the Wheeler well, at Noblesville; the Kimberlin well, the Mallory, and perhaps two or three others near Noblesville; Elwood No. 3 (?), Summitville well; Greentown well (?); Selma well, and Dunkirk No. 1.

The other large wells range from 1,000,000 to 3,000,000 cubic feet a day, while the smaller paying wells have a daily capacity of from 150,000 to 1,000,000 cubic feet.

The smaller wells range from 5,000 to 850,000 cubic feet per day. Wells of 5,000 and 10,000 cubic feet per day are not paying wells, and are not considered in the following list of towns that have found gas in paying quantities:

List of towns in Indiana having paying gas wells.

Towns.	Wells.	Towns.	Wells.
Portland	7	Sheridan	1
Dunkirk	2	Broad Riffle	1
Red Key	1	New Britton	1
Camden	1	Fisher Station and vicinity	4
Winchester	2	Windfall	1
Union City	1	Frankton	1
Farmland	2	Elwood	3
Montpelier	2	Alexandria	1
Muncie	9	Sharpsville	1
Eaton	1	Fortville	1
Shideler	1	Pendleton	2
New Corner	1	Near Lawrence	1
Albany	1	Swayzee	1
Yorktown	1	Greentown	1
Selma	1	Kokomo	8
Cowan	1	Xenia	1
Spiceland	2	Amboy	1
Hagerstown	2	Lefontaine	1
Knightstown	3	Marion	7
Middletown	1	Jonesborough	1
Morristown	1	Summitville	1
Carthage	1	Fairmount	2
Lawrenceburgh	1	Upland	1
Aurora	1	Hartford City	3
Greenfield	3	Anderson	6
Noblesville and vicinity	16	New Marion County region	8 or 9
Arcadia	1	Millersville	1
Cicero	1	Greensburgh	3 or 4

It is probable that a few wells in the vicinity of Noblesville and in Marion county to the south have not been included in the above list. Oil has been found in small quantities at Francesville, Cicero, Peru, Montpelier, Winchester, Bryant, Brightwood, Greenfield, Royal Centre, and Warren."

Kentucky.—From an admirable article by Prof. Moritz Fischer, of the Kentucky Geological Survey, published in the Natural Gas Supplement of the *American Manufacturer*, we condense the following statement relative to natural gas in Kentucky:

The discoveries of the last two years in the western gas fields of northern Ohio and Indiana have caused great interest in Kentucky and a wide-spread search in this State for gas. Most of the wells sunk in the State this year have proved unprofitable, yet they have contributed facts which enable us to locate approximately the gas horizons of the State.

The elevation or depression of the base of the Trenton above or below sea level is found in the following table:

Distance of the base of the Trenton limestone above or below sea-level in Kentucky.

Locality.	Feet.	Remarks.
Cincinnati	308+	Near arch of the Cincinnati anticlinal.
Lexington	715+	
High Bridge	765+	
Harrodsburgh	692+	
Danville	720+	
Louisville	581—	Western slope of the Cincinnati anticlinal.
La Grange	24—	
Bardstown	163—	
Lebanon	36+	
Frankfort	495+	West of arch of the Cincinnati anticlinal.
Maysville	82—	East slope of the Cincinnati anticlinal.
Richmond	226+	

The oil and gas bearing Trenton limestone of northern Ohio and Indiana is covered by 350 feet of Utica shale, a formation entirely wanting in Kentucky.

The principal traits of the Trenton, Hudson river, Clinton, and Niagara are as follows:

Trenton.—Limestones, highly crystalline, alternating with very thin, argillaceous shales. Some siliceous beds; very fossiliferous.

Hudson River.—Limestones, crystalline, bluish thin beds, alternating with argillaceous shales. Middle part one mass of sandy shales. Upper and lower part alternations of limestones and shales; very fossiliferous.

Clinton.—Shales, argillaceous, impregnated with various mineral salts. Formation unreliable; fossils rare.

Niagara.—Limestone, crystalline, magnesian, light gray, bedded in thin layers; shales and clay beds; fossils rare.

General characteristics.—Shallow water deposits; shales changing from calcareous to argillaceous, with true clay beds in Niagara. All groups are a constant alternation of thin shales and limestones, the latter made up from comminuted fossil remains; occurrence of bituminous products; weak oil and gas flows in Trenton and Hudson beds. The mode of deposition favors great accumulations of organic remains.

A little heavy, dark oil, with weak brine, has been found at 70 feet near Lexington, Kentucky, in Trenton rock. Near North Middletown, Bourbon county, Kentucky, a well in Lower Hudson, 98 feet deep, yields 100 gallons of good lubricating oil per week. The oil is black and has a gravity of 23½° B. The Lower Hudson, west and northwest of Cincinnati, gives promise of a fair supply of low-pressure gas. A weak flow is obtained in Lewisburgh, near Covington, and within the last month productive wells have been found near Cincinnati, in Cheviot, at Lawrenceburgh, and Aurora, Indiana. This horizon is likely to be found in the river counties west of Covington. and may prove quite remunerative. Weak flows of gas have been obtained from wells sunk in the neighborhood of Louisville, on both sides of the Ohio river. Data obtainable are not sufficient to locate the horizon of productive formation. It would seem to lie in either Upper or Middle Hudson, at least for the Third Street well, Louisville, and the wells located at Old Deposit, near Louisville, one of the latter giving a flame of 20 feet high. The flow increased since gas was first struck, four weeks ago. Exploration of this territory, in such close proximity to a great market, should be vigorously pushed. The Clinton and Niagara have been penetrated by a number of wells, and give no encouragement to the prospector. These wells being near the outcrop of the formations, their evidence is not conclusive.

The Black shale is the most promising oil and gas horizon in the State, having an average of 10 per cent. of bitumen. This shows an enormous amount of hydrocarbons stored in it, and how productive a horizon of gas it may become. Three gas wells in the State derive their supply from it. The following data were kindly furnished by Maj. William T. Davis, of Louisville, Kentucky:

Section of Mooreman well, Brandenburgh, Meade county, Kentucky.

Locality.	Feet.	Remarks.
Saint Louis	50	Gas and strong brine. Well sunk 1864. Flows with undiminished force.
Keokuk	450	
Lick Shales	5	

Section of Doe Run well, Rock Gas Company, near Brandenburgh, Meade county, Kentucky.

Locality.	Feet.	Remarks.
Keokuk	475	Gas and strong brine. Daily flow, 1,000,000 cubic feet.
Lick Shales	15	

Section of Major Davis well, Tobacco Landing, Harrison county, Indiana, five miles east of Brandenburgh, Kentucky.

Locality.	Feet.	Remarks.
Keokuk	375	Gas and strong brine. Measured by Mr. Ashburner. Showing a daily flow of 805,000 cubic feet. Flow increased slightly since.
Lick Shales	25	

These are constant wells, and the field deserves careful attention as the most promising source of a supply for Louisville. Adjacent to the Cumberland anticlinal much oil has been obtained from the black shale. Wells of 100 to 250 feet depth have sometimes produced 300 barrels per day. Poor shipping facilities have prevented the development of this gas and oil territory. The Keokuk would seem to give no promise of gas. The following tables show how misleading records may be if based on study of outcrops only:

Well No. 1, *Bowling Green, Warren county, Kentucky.*

Locality.	Feet.	Remarks.
Saint Louis	200	Gas, oil. Weak flow of both. Well 1,782 feet. Drilled 150 feet into Trenton.
Keokuk	150	
Do	50	

Well No. 2, *five miles from Bowling Green, Warren county, Kentucky.*

Locality.	Feet.	Remarks.
Saint Louis	100	Gas flowing 600,000 cubic feet per day. Another well drilling.
Keokuk	150	

Proofs of the existence of gas are not wanting in the Carboniferous strata. North of Manchester, Clay county, is the well-known 'burning spring.' It bubbles up through a pool of water, and when lighted gives a flame 6 feet high. There are several of these springs near by. Some years ago a well on Jug Fork, Big Sandy river, gave the largest flow of gas ever found in the State. Eye-witnesses report a flame 60 feet high. A few miles from this well is another of equal capacity. The flow for either of them has been estimated at 10,000,000 cubic feet per day, and still continues with undiminished force. A large area of eastern Kentucky will doubtless prove productive gas territory. It would be a waste to open these reservoirs at present.

This examination of Kentucky geology attests the presence of low-pressure gas in certain formations. They are the same in the gas districts of Ohio, Indiana, and Kentucky, but they vary in physical and chemical characters, mode of deposition, and erosion. Any one of these factors often decides their economic value.

Tennessee.—If natural gas is found in Tennessee it will be somewhere in that portion bounded by the edge of the Cumberland table-land on the east, and by the Tennessee river on the west, a space of some 200 miles. The greater part of this area is the civil division known as middle Tennessee. In this territory there are three sharply-defined topographical divisions:

First. The mountain table-land, known as the Cumberland, 2,000 feet above tide, with a width from east to west of from 40 to 50 miles.

Second. This is surrounded by a vast circular area of flat highlands, named the Rim

Third. A unique depression known as the Central basin.

The rocks in this division, as given by Professor Safford, are as follows:

Cumberland table-land	1. Coal Measures, 500 to 600 feet. (Locally 2,500 feet.)
	2. Carboniferous limestone, 300 to 700 feet.
Highland Rim	3. Sub-Carboniferous, 300 to 600 feet. Limestones. Calcareo-siliceous beds and shales. Heavy cherty layers.
	4. Hamilton (Devonian) black shale, 10 to 50 feet.
Often wholly absent	5. Corniferous limestone, 0 to 10 feet.
	6. Lower Helderberg, 0 to 100 feet.
	7. Niagara, 0 to 200 feet.
	8. Clinton, 0 to 100 feet.
Basin	9. Hudson River, 500 feet.
	10. Trenton, 500 feet.

The Coal Measures of Tennessee are badly denuded. They contain no Catskill, Chemung, or Portage to supply the gas sands, oil sands, shale covers, etc. Nor is there any Ohio or Indiana Utica shale to serve as a cap for the rich store of material escaping from the Trenton limestone. The floor of the Central basin is made up of outcropping Hudson river and Trenton limestones, all of which contain phosphates. Referring to the prospect of securing gas in this territory, Professor Safford, in a contribution to the Natural Gas Supplement, No. 2, of the *American Manufacturer*, says: "That they are charged with a measure of gas is proved by the fact that for the last sixty years and more wells bored in the limestones have yielded gas, often in quantities to astonish and bewilder our Tennessee borers. The wells have been usually driven for water, sometimes for salt water. They do not always yield a noticeable volume of gas, though it is common for them to do so. The gas wells are not confined to any special part of the basin. One bored within the last two years, and within the limits of the city of Nashville, supplied a flow of gas which when ignited burned with a volume of flame 8 feet high. It continued to flow for six weeks, the volume, however, growing less and less until it ceased to attract attention. This gas was for a time utilized in a house near by for lighting purposes. The well is only about 80 feet deep. It was started in the lower limestones of the Hudson River series and terminated in the Trenton. Another well, 20 or 22 miles southeast from Nashville, bored for water in 1858, and wholly within the Trenton, reached gas at a depth of less than 100 feet, which blew out strongly, burnt furiously, greatly alarming the owners, who fled and could not be induced to return for some time. About October 1, 1887, another well, 12 miles northeast from Murfreesboro, also bored for water, and in the Trenton, at about 100 feet yielded a similar exhibition of gas. And still another on the eastern side of the basin, during the month just passed, at a depth of 52 feet, supplied a volume of gas which burned at the end of a 5-inch stovepipe with a flame three feet high, and so continued for several days without diminution. These are but few examples of many that might be given. They illustrate the general character of burning wells of the basin. The gas is of low pressure, and is met with both in the Hudson River and Trenton rocks. I can but think that the gas of such wells, of some of them at least, if properly cared for, could in a small way be made useful for domestic purposes and for a considerable length of time. So far no high-pressure gas has been found. The deep wells sunk for the purpose have been failures. We have in Nashville at this time in process of boring (for water) a well which has reached a depth of 1,250 feet without any special show of gas, and this at no great distance from the first gas well spoken of, and within the city. Both wells have their mouths in about the same geological horizon. The deep one may pass quite through our Trenton."

In the "Rim," the Hudson and the underlying Trenton are found under the characteristic strata of this section, which is the sub-Carboniferous. As a rule more or less gas has been met with in drilling oil wells, which are found in front of the Cumberland table land on the "Rim" area, but the amount is comparatively small. In several counties along the western base of the Cumberland table-land, as in White and Warren counties, moderate quantities of gas have been encountered in wells drilled for salt or petroleum. West of Nashville some gas has been found. Nearer Nashville, at the western edge of the Central basin, a well has been drilled, starting in the Niagara and descending into the Hudson and Trenton, in all a depth of 1,620 feet. At a depth of 250 feet in the Hudson gas was encountered which blazed up 4 or 5 feet when ignited. Below this no more gas was encountered. Two wells were bored in 1887, 6 and 8 miles, respectively, from Chattanooga, with no important results. A little gas was met with in one of them, which, when fired, blazed up for a few minutes.

Relative to natural gas in Tennessee, Professor Safford reaches the following conclusions: "(1) The gas so far obtained in Tennessee has no practical value, and (2) the gas and oil, such as we have, come from the Hudson River and Trenton limestones."

Alabama.—Though some explorations have been made for natural gas in Alabama, it is next to impossible to get definite information as to the exact facts shown by the drill. It is only known that gas has not yet been found in any considerable amounts, whatever the future may have in store. So far as has been learned the only gas yet struck in the State was at Hartsell's, Morgan county, a few miles north of Decatur. The boring is still in progress. At Pratt Mines boring is in progress, but as yet no gas has been found, except a little about a year ago. At Gadsden it is reported that gas has just been found, but the report is not confirmed. There are also rumors of discoveries in other localities, but the reticence of parties drilling prevents ascertaining the facts.

Illinois.—In previous volumes of Mineral Resources we have referred at some length to the early explorations for gas in the State of Illinois, but little can be added to what has already been stated. At quite a number of localities in the State gas has already been found. In 1871 gas from a well 30 feet deep, sunk on the Champion farm, 4 miles west of Mattoon, was utilized; this gas has been flowing for nearly seventeen years. On the Dunlap farm, just south of Champaign and upon the Somers and Meriotts farms, are three wells, respectively 65, 80, and 95 feet deep, all of which have been used for household purposes from three to five years. The Cunningham well, 4 miles south of Mattoon, has exceeded the Champion in its flow, but has only been opened about seven months. At Bloomington, Minier, McComb, Mendota, Buda, La Salle, Maroa, Carlinville, Litchfield, Decatur, Lamoille, Beardstown, Edwinsville, and many other towns, there are evidences of drift deposits. At Minier, in certain situations, it can be made to flow and burn for weeks by simply boring a hole 10 feet deep with a post auger. A small amount of this drift gas has also been discovered in Chicago, in building the lake tunnel. Oil and gas have also been reported from the neighborhood of Kankakee. The wells are nearly all in the Glacial drift, which accounts for the small supply at all of the wells, and the short-lived supply at many. The Litchfield gas and oil, however, come from near the base of the Lower Coal Measures.

On the whole, therefore, it will be seen that at present there is no probability of gas being found in commercial quantities in Illinois.

Missouri.—Quite a number of gas wells were drilled in 1887 in various parts of the State of Missouri, but without finding gas in any considerable quantities. About all that can be said relative to the explorations in this State is, that nothing absolute has been proved relative to the possibilities of finding gas, except that it has not yet been found in commercial quantities. The probabilities are that it will not be. The geological structure of the State is quite varied, the surface being chiefly underlaid by rocks of the Palæozoic, Huronian, and Laurentian systems.

Quite a number of gas springs are known to exist in various parts of the State, especially in the vicinity of Saint Louis in the eastern part, and in the vicinity of Kansas City in the northwestern section. In Saint Louis, where these springs are known to exist, gas has been obtained in limited quantity in a number of wells, most of the gas coming from either the glacial or alluvial drift. "In no case," so Mr. Ashburner expresses the belief, "has gas been obtained from solid and porous rock reservoirs such as those in which the commercial gas is found in Pennsylvania, Ohio, and Indiana."

The natural gas in the neighborhood of Saint Louis to which the most attention has been directed was that of the Cotton Compress Company, which was found in 1875 at the bottom of a driven well some 27 feet deep. The gas when first struck flamed to a height of 20 to 30 feet, but very soon diminished in quantity, so that it was only sufficient to illuminate the engine room. In many wells driven in Saint Louis to obtain water for the breweries, puffs of gas have been found at depths varying from 200 to 1,500 feet.

The existence of gas springs in Kansas City has also been known for many years, and gas is frequently found in connection with the digging or driving of wells in this neighborhood. Quite a number of wells have been drilled in this neighborhood with the hope of obtaining a supply of gas. In a well drilled in the Excelsior brick yard, a flow of gas was obtained at a depth of 180 feet; in another well, on Seventeenth street, at a depth of 344 feet; in the Kellogg well, near the natatorium, at the depth of 810 feet, and in other wells at depths from 250 to 800 feet, gas having been found at the latter depth in the Tustin well, which is the deepest drilled in Kansas City, it having been sunk to the depth of 1,700 feet. On the whole, therefore, it will be seen that, while some gas has been obtained in Missouri, gas has not been found in commercial quantities.

Kansas.—Some statements have already been given in previous reports on natural gas in Mineral Resources relative to explorations that have been made in Kansas. Many wells have been put down in this State. It is reported that up to near the close of 1887, 115 natural gas companies had been organized for the purpose of exploring for gas, chiefly in the vicinity of oil and gas springs.

At Ellsworth, in the center of the State, gas was struck at the depth of 1,190 feet, which appeared to increase in strength as the drill went deeper. Several wells have been drilled at Kansas City. Some of these had been producing for several years, and the gas from them had been utilized in a small way at the brick works, flour mill, and a planing mill. Gas has also been found at Iola, in Allen county, and was utilized in a hotel near by. The gas was found in the limestone at a depth of 628 feet. At Marion, in Allen county, gas was found at a depth of 103 feet; at Independence, Montgomery county, in the black shale at a depth of 420 feet; at Liberty, in the same county, at the depth of 103 feet; at Moundville in Labette county, at a depth of 400 feet; at Girard, in Crawford county; at Mound City and La Cygne, in Linn county, and in many other parts of the State gas has been found in greater or less quantities.

In the vicinity of Paola, in Miami county, gas has been known to exist for many years, and has been developed chiefly in connection with drilling for oil. Mr. Robert Hay, in speaking of the developments at Paola, says:

"In 1865 a Saint Louis company drilled two wells about 10 miles east of Paola. These wells are reported to have been drilled to a depth of 700 feet, when the tools were lost. No gas was encountered. About the same time several wells were drilled in the vicinity of Osawatomie that produced nothing but salt water and a small quantity of oil. In 1874 a well was drilled to the depth of 300 feet along the Wea, 1 mile from Paola. In 1882 a well was drilled on the Westfall farm in the vicinity of the tar spring situated about 8 miles east of Paola. Natural gas was found in this well, and as a result the Kansas Oil and Mining Company was organized. The name of this company was subsequently changed to the Paola Gas Company. This company has bored a number of wells in the vicinity of the town, and also on the Westfall farm. On this farm, well No. 1 struck the gas sand at a depth of 304 feet, and drilled into the sand 4 feet. This well was cased to a depth of 200 feet. The confined gas pressure of the well is reported to have been 66 pounds to the square inch. About 1,300 feet south of west of well No. 1, well No. 2 was drilled to a total depth of 442 feet. Gas sand was struck at a depth of 300 feet, and proved to be 35 feet thick; in this well considerable water was found; the gas pressure is said to have been the same as that at well No. 1. The third gas well, or that which is locally known as well No. 4, was drilled at a distance of 100 feet from well No. 2. Sand in this well was struck at a depth of 288 feet, and the pressure of the gas is reported to have been 55 pounds to the square inch. A well known as Boon's well, which is located nearer the town of Paola than the Westfall wells, gave a pressure of 40 pounds to the square inch. Another well at Beavertown, 5 miles east of Paola, is reported to have found gas at a depth of 76 feet. In addition to these wells, several other wells have been drilled in the vicinity of Paola, some of which have proved dry, and in others gas has been obtained. The natural gas found in the vicinity of Paola is utilized in the town both for heating and lighting purposes."

At this place, Paola, a glass manufactory, with a capacity of twelve pots, was erected for the consumption of natural gas, a gas company having agreed to give them the gas from one entire field, containing a number of wells. The factory was started and an attempt made to manufacture glass, but sufficient heat could not be obtained, and they were compelled to cease operations, owing, as claimed by the glass people, to the amount of gas supplied being entirely inadequate. It is, however, but fair to state that the gas company claimed that this difficulty arose from a want of knowledge on the part of those in charge of the factory of the proper methods of combustion, a sufficient supply of air not having been admitted to the furnace.

The most important developments in connection with the production of natural gas in Kansas have been in the vicinity of Fort Scott, Bourbon county. Over thirty wells have been drilled in this town or its vicinity. The principal wells, and those which are at present supplying the town, are owned by the Fort Scott Economy Fuel Company. In well No. 1 on the Stewart farm, in this town, which was drilled to a depth of 281 feet, gas was found at three different depths. First, in the sand rock at a depth of 25 feet; second, in the sand rock struck at a depth of 192 feet 10 inches, this sand being 42½ feet thick; and, third, in conjunction with the Lewis coal bed at a depth of 277 feet 3 inches. The highest and lowest gas veins amounted to nothing, while the middle gas horizon is that from which the gas now being used in Fort Scott is obtained. The gas sand is located in the Lower Coal Measures, Relative to natural gas in Kansas, Mr. Ashburner says:

"The facts given above relating to the occurrence of gas in the State of Kansas should not be taken as offering direct encouragement for the drilling of wells in search of gas in large commercial quantities, until additional facts shall have been gathered in the field, and carefully systematized and studied by an expert geologist. The existence of gas or oil springs, or even of gas itself in a gas well in limited quantities, is not always a positive indication of the existence of either oil or gas in quantities sufficiently large to make it profitable to drill wells for their development."

Arkansas.—Oil and gas have been found in small quantities in various places throughout the Mesozoic region of this State, but so little is known of the geology and so few wells have been drilled in an attempt to secure gas that no opinion can be expressed of the possibilities. A deep well has been sunk at Fort Smith in search of natural gas, but so far without results. Natural gas has also been found in the Coal Measures at Fayetteville, in Washington county. The discovery was made in sinking a well for water. The amount of gas found was insignificant, and no attempt has been made to determine whether or not it exists in paying qnantities.

Colorado.—While there are evidences in many localities in Colorado that natural gas exists, the quantity heretofore found has been too small to be of value. In the widespread coal fields of the State there are various points at which a little gas naturally escapes, but so far no one has had the courage to undertake borings with a view to finding large quantities. Some of these blow-holes exist in Coal basin on Rock creek, a branch of the Roaring Fork of Grand river, and in Pitkin county. Mr. R. C. Hills, of the Colorado Fuel Company, has noted the occurrence of these natural outlets in a paper read before the Colorado Scientific Society in November, 1886. The gas was tested by him and found to be the ordinary type of natural gas. In August of 1886, while exploring the anthracite beds on Anthracite creek, near Irwin, and in Gunnison county, he struck quite a strong flow of gas with the diamond drill. The gas came from the heavy beds of sandstone of the Fox Hills group of the Colorado Cretaceous, and about 200 feet above the upper anthracite seam. The gas was not tested, but its inflammability was the source of great annoyance at night, often enveloping the drill in a sheet of flame. After the drill-hole was abandoned a barrel was inverted over the stand-pipe and a hole made in the bottom through which the gas might escape. A flame about one foot in height was steadily produced. The well has not been examined this year to see if the gas continues to flow. This is the first case of a steady flow of gas being found in Colorado.

The numerous oil wells sunk near Florence, in Fremont county, have also produced more or less gas, although not in quantity yet. In October the town of Florence was illuminated from a newly struck well, but the supply of gas did not last long. Near Louisville, in Weld county, during the summer of 1887, natural gas was found in drill-holes put down to explore for the northern Colorado coal seams. The discovery here has been the subject of investigation and much discussion, but the quantity found proved small and the supply inconstant. That there are other localities in Colorado where gas will be found can not be doubted, but the attempt has not yet been made.

Denver is situated in the center of a synclinal fold and on the Tertiary beds, under which lie the northern Colorado coal seams, probably at a depth of about 1,600 to 1,800 feet. The western outcrop of the fold is the Great Hogback, the eastern summit being probably about 20 miles east of Denver. If the theory that gas usually is found near or at the summit of anticlinal folds is tenable, then it would seem that the proper place to bore for gas would be at some point on the Kansas Pacific railway at that distance from Denver. The field is practically unexplored, and what it may produce as a result of boring can not be guessed at. It is not, however, in the least improbable that Denver may some day be supplied with natural gas in economic quantities. That it will be found at some point in the State is not questioned.

California.—During the past year boring for natural gas has been carried on at several places in California. Though nearly all the parties operating have met with some encouragement, small flows of gas having been found, none have as yet been notably successful. In some cases enough gas has been obtained to illuminate a number of large buildings, and even to be used in a limited way as a fuel, but no great quantities have as yet been discovered. As is usually the case, gas has been found in some quantities in boring the petroleum wells in the oil region of this State, and indications of gas have also been found in a number of counties not included in the petroleum districts proper. Some gas has been found in Nevada county, near Boca, and in Santa Cruz county, at Highland. In Sonoma county the current of natural gas was known as early as 1859, and at one or more wells the gas is collected and used for domestic purposes. In Contra Costa county natural gas has been observed to bubble up in several mineral springs, and it is also said that it has been found in considerable quantity at Nicasio, Marin county. The gas found near Kelseyville, Lake county, has been used to make steam, and gas has also been found in certain localities in Solano, Sacramento, Tehama, and Mendocino counties, but not, so far as has been learned, in any commercial quantities. In San Joaquin, in the vicinity of the city of Stockton, in Humboldt, and in Los Angeles counties occurs the gas which has been used commercially. The gas found in Los Angeles and Humboldt counties has chiefly been found in the sinking of oil wells. The wells on Oil creek, in Humboldt county, sunk in 1866, have constantly given off gas since, and wells sunk in other parts of this county about the same date and since, have given continuous flows of gas in some quantity, but from none of the wells in Humboldt county has the flow been sufficient to supply more than two or three burners or to furnish a dwelling house with fuel and light.

In Los Angeles county a considerably greater quantity of gas has been found than in Humboldt. At the Puente wells the gas issues from the wells under a very slight pressure; the quantity is small, and it is drawn directly from the wells to the furnace. As an experiment, the gas escaping from No. 5. well was cased in tight, when the pressure increased to about 100 pounds per square inch. It is a remarkable fact, in connection with the gas in these wells, that it continues to escape from the petroleum for some time after the latter is tanked, and it also appears that the gas thus evolved is capable under some circumstances of redepositing a quantity of liquid petroleum. In Pico cañon, in this same county, there are two wells, known as Pico No. 12 and Pico No. 13; the first of which pumps about 18 barrels a day, and the second some 40 barrels a day; these produce a larger quantity of gas than any other wells in this oil section. Only a portion of it is required to make steam for pumping these two wells, the balance being allowed to escape and burn in the air.

By far the most important gas-producing district of California, however, is in the neighborhood of Stockton, in San Joaquin county. In the vicinity of this city a large number of artesian wells have been bored; the first of these, the celebrated Court House well, was bored during the years 1854 to 1858. The water coming from the bottom of the well (1,000 feet) brought up with it considerable gas. Quite a number of wells have been bored in this neighborhood, nearly all of which produce gas to a greater or less extent. A well in Castoria township, bored in 1883 to a depth of 1,140 feet, discharges considerable gas, which is collected in a tank and used for lighting, heating, and cooking in the house of the proprieter. The supply of gas is very much more than sufficient for the purposes named. At the old water works enough gas is collected to cushion the pumps, and at the new water works all three wells carry gas. The gas from well No. 1 is passed over gasoline to enrich it in carbon, and is used for lighting the engine room. Altogether eleven ordinary burners are in use, the gas being used directly as it comes from the well. The gas from wells No. 2 and No. 3 is not used. The McDougald well produces a large amount of gas. By actual measurement it registered between 7,000 and 8,000 cubic feet per twenty-four hours. About 14 miles west of Stockton a well was sunk to a depth of 1,435 feet in 1883, and quite a copious flow of gas struck.

In December, 1883, the Standard Gas Light and Fuel Company was incorporated at Merced, with the object of developing natural gas in the San Joaquin valley, and in the summer of the next year the California Well Company was organized at Stockton for a similar purpose. The Crown Mills well, an old artesian well, was bored out and sunk to a depth of 1,220 feet, when a large flow of gas was discovered, showing by careful measurements 18,000 cubic feet in twenty-four hours. A well bored by the California Well Company near Stockton gave a total of 81,000 to 82,000 cubic feet in twenty-four hours.

As to the possibility of natural gas being found in quantity sufficient to give this fuel any economic value in California, there are various opinions. Mr. William Irelan, jr., State mineralogist, speaking of this, says:

"It is doubtful whether natural gas will be found in our petroleum sections of any great economic value, as the rocks in places turned up, as they are, on edge and fractured, preclude the possibility of securing gas in quantities approaching anywhere near the amount found in the eastern States. The greater portion of the gas that may have existed in the underground reservoirs has long since escaped through the many natural outlets, or fissures, formed during the period when the rocks were turned up and faulted. In sections where the rocks lie in nearly a horizontal position and do not show signs of having been disturbed to any appreciable extent, there is a possibility of finding gas, but, unfortunately, such conditions are very scarce in our petroleum sections. Therefore, under the existing geological conditions, it would seem to be folly to expect that prospecting for gas, along our petroleum belt, would pay interest on the waste of time and money. It is already proved, along the oil belt, by the scarcity of flowing wells and the disturbed condition of the country rock, that natural gas, if existing at all, is not in sufficient quantity to warrant the expense of seeking it."

Quebec.—Mr. J. Obalski, government mining engineer of the Province of Quebec, has made a very thorough study of the conditions under which natural gas has been found, both in the United States and in Canada. The following statement relative to natural gas in Quebec is condensed from his report:

"Natural gas was discovered many years ago in the valley of the Saint Lawrence, between Quebec and Montreal, especially in the vicinity of Lewisville. The first attempt to procure gas for commercial usage was made in 1880. A well was sunk near Saint Maurice to a depth of 50 feet, but no gas was found. The same year, however, the Rev. Mr. Laflamme read a paper on the subject of gas at Lewisville by the light of gas procured in the vicinity. In 1883 a strong flow of gas was obtained at a depth of some 70 feet, and in 1885 a company was organized and a well sunk to the depth of 1,115 feet on a property in the concession of Beausejour. A fair quantity of gas was obtained from different depths, as will be seen in the following statement:

Record of a Quebec gas well.

From 0 to 75 feet	75 feet clay and sand, with some veins of inodorous gas and water.
From 75 to 215 feet	140 feet sandstone, somewhat calcareous.
From 215 to 640 feet	425 feet red and brown schists, soft, with abundant emanations of gas with the odor of kerosene at 316, 370, 580, 640 feet, the 580 feet vein being the most productive.
From 640 to 820 feet	180 feet impure limestone, oily beneath; a vein of gas at 820 feet.
From 820 to 1,115 feet	255 feet black schist; compact.

According to the latest information received, the gas is still flowing. Soon after these operations, during the session of the Quebec legislature in 1886, a Canadian company, known as the Combustible Gas Company, with Mr. Cyrille Duquet, of Quebec, as president, secured from the Government the exclusive privilege of utilizing natural gas in the Province of Quebec.

This company made a boring of 1,500 feet at Maisonneuve, near Montreal, and three others of 500 to 600 feet at Lewisville. These works yielded great abundance of gas, which was even used to heat the Water Company's steam-boiler for some time. Besides, not a month passes without a report being received of gas having been found in digging wells for water.

An examination of the geological map of the province will show that the valley of the river Saint Lawrence, between Quebec and Montreal, is formed of Trenton limestone, overlaid by Utica, Hudson River, and Medina schists, the whole being covered by a layer of alluvium, averaging 50 to 80 feet thick. At several points on the north coast these formations appear at the surface, but they are more habitually covered with alluvium. We have but slight information as regards the south shore, where these formations may possibly be covered by other strata. At all events, in the region south of Three Rivers, red schists have been discovered, which apparently belong to the Medina formation. The Saint Gregoire borings were drilled through similar schists, and, so far, the Trenton limestone has not been reached. The formation indicated on the map as being that of the south shore is somewhat hypothetical, owing both to the want of borings and the thickness of the alluvial layer. It may, however, be stated that the formation between Quebec and Montreal, which lies visible for some miles on the north shore, and extends over 50 to 60 miles on the south, probably contains gas and petroleum.

Mr. Obalski sums up the possibilities as follows:

"To sum up these conditions, we remark that those that are perceptible and can be ascertained without the performance of any work are deemed favorable (see conditions 1 and 3); the others have to be verified by special operations, but the knowledge we have gives hope that they will be realized. This, in addition to the discovery of gas in the superficial alluvium and in the solid rock, should be deemed sufficient to encourage explorations, and I am thoroughly convinced that rich gas and petroleum districts exist in the region just indicated."

STRUCTURAL MATERIALS.

BY WILLIAM C. DAY.

THE BUILDING INDUSTRY IN GENERAL. (a)

The year 1887 was on the whole a prosperous one for the building industry, although the last quarter showed a falling off in the amount of building done in a number of important cities.

As compared with 1886, labor troubles exerted very much less detrimental influence directly upon building, and indirectly upon the production of structural materials in 1887. The most important hindrance resulted from labor troubles in Chicago in the spring of 1887, causing a falling off in the amount of building done in that city, and consequently affecting the local production of structural materials and the production of building stone in localities which supply that market. In considering the state of the building industry in the the entire country, however, this drawback can not be regarded as of great weight.

Considerable has been done during the year in the way of discoveries of new sources of supply and of new developments and additions to capacity of plants for the quarrying of natural material and for manufacturing it.

The following table has been constructed on the basis of statistics furnished by the building inspectors and commissioners of the various cities considered. The figures represent in general the number of permits issued during the year and the estimated values of the buildings for which permits were given. Although the buildings for which permits are issued may not all be completed during the same year, still this fact does not diminish the value of the figures as showing the comparative condition of the industry in different years:

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a In the preparation of this report valuable aid has been rendered by the following gentlemen, to whom especial acknowledgments are hereby tendered: To Mr. Robert H. Dalby, of Slatington, Pennsylvania, for general statistics in regard to slate from the Slatington region, Pennsylvania; to Mr. U. Cummings, general superintendent of the Standard Cement Company, of New Haven, Connecticut, formerly of Buffalo, New York, for statistics in regard to the production of natural-rock cement in the United States; to the New York *Real Estate Record and Guide*, for statistics of structural materials in New York City.

Number and value of the buildings for which permits were issued in thirty-one cities during the years 1884, 1885, 1886, *and* 1887.

Cities.	1884.		1885.		1886.		1887.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Portland, Maine:								
Frame buildings	56	....	67	....	91	....	109	$140. 000
Brick, stone, and iron buildings	25	....	14	....	32	....	33	225, 000
Total	81	$210, 000	81	$250, 000	123	$300, 000	142	365, 000
Boston, Massachusetts: (*a*)								
Frame buildings	1, 123	3, 078, 145	1, 372	4, 552, 538	1, 353	3, 992, 792	1, 431	4, 153, 181
Brick, stone, and iron buildings	312	5, 400, 775	348	6, 218, 800	346	8, 113, 100	417	6, 108, 825
Total	1, 435	8, 478, 920	1, 720	10, 771, 338	1, 699	12, 805, 892	1, 848	10, 262, 006
Fall River, Massachusetts:								
Frame buildings	416	....	200	....	205	....	273	
Brick, stone, and iron buildings	7		12		25		27	
Total	423	866, 450	212	330, 975	230	666, 750	300	831, 450
Salem, Massachusetts:								
Frame buildings	60	....	92	....	90	....	102	....
Brick, stone, and iron buildings	5	....	9	....	4	....	10	....
Total	65	250, 000	101	376, 000	94	317, 000	112	406, 000
Providence, Rhode Island:								
Frame buildings	393	1, 145, 840	452	1, 273, 745	407	1, 194, 607	465	1, 166, 540
Brick, stone, and iron buildings	16	239, 400	13	364, 700	12	168, 750	14	293, 500
Total	409	1, 385, 240	465	1, 638, 445	419	1, 363, 357	479	1, 460, 040
Bridgeport, Connecticut:								
Frame buildings	240	360, 000	280	420, 000	350	630, 000	....	....
Brick, stone, and iron buildings	20	100, 000	25	125, 000	34	170, 000	.....	....
Total	260	460, 000	305	545, 000	384	800, 000	....	....
Brooklyn, New York:								
Frame buildings	1, 304	....	1, 261	....	1, 774	....	2, 123	....
Brick, stone, and iron buildings	1, 435	....	1, 377	....	2, 216	....	1, 752	....
Total	2, 739	12, 672, 334	2, 638	11, 465, 795	3, 990	20, 318, 485	3, 875	18, 008, 325
New York City:								
Frame buildings	655	1, 331, 906	580	1, 416, 683	650	1, 505, 735	840	2, 151, 765
Brick, stone, and iron buildings	2, 242	40, 148, 402	2, 788	43, 957, 330	3, 442	57, 233, 998	3, 504	64, 917, 805
Total	2, 897	41, 480, 308	3, 368	45, 374, 013	4, 092	58, 739, 733	4, 344	67, 069, 570
Wilmington, Delaware:								
Frame buildings	....	....	....	....	....	....	....	....
Brick, stone, and iron buildings	326	730, 225	280	668, 590	192	622, 983	....	....
Total	....	....	....	....	....	....	301	548, 340
Philadelphia, Pennsylvania:								
Frame buildings	....	....	....	....	....	....	....	....
Brick, stone, and iron buildings	....	....	....	....	....	....	....	....
Total	4, 938	....	6, 326	....	7, 561	....	7, 695	....

a Values estimated for completed buildings.

Number and value of the buildings for which permits were issued, etc.—Continued.

Cities	1884.		1885.		1886.		1887.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Pittsburgh, Pennsylvania:								
Frame buildings	.....	....	795	....	847	....	1, 173	$1, 157, 341
Brick, stone, and iron buildings	.....	....	647	....	568	....	737	2, 757, 558
Total	.....	....	1, 442	$3, 030, 429	1, 415	$2, 401, 809	1, 910	3, 914, 899
Baltimore, Maryland:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	2, 250	$3, 107, 472	3, 237	4, 340, 125	2, 305	3, 587, 900	2, 464	3, 244, 750
Total	2, 250	3, 107, 472	3, 237	4, 340, 125	2, 305	3, 587, 900	2, 464	3, 244, 750
Washington, District of Columbia:								
Frame buildings	151	94, 784	325	195, 255	392	295, 689	366	351, 260
Brick, stone, and iron buildings	1, 042	3, 293, 070	1, 333	3, 297, 252	1, 802	4, 412, 240	1, 885	4, 584, 500
Total	1, 193	3, 387, 854	1, 658	3, 492, 507	2, 194	4, 707, 929	2, 251	4, 935, 760
Richmond, Virginia:								
Frame buildings	186	154, 200	244	124, 900	137	125, 000	355	205, 000
Brick, stone, and iron buildings	226	733, 200	238	896, 400	204	528, 600	184	668, 700
Total	412	887, 400	483	1, 021, 300	341	653, 600	539	873, 700
Louisville, Kentucky:								
Frame buildings	669	....	604	....	570	....	420	....
Brick, stone, and iron buildings	301	....	243	....	340	....	496	....
Total	970	1, 295, 854	847	2, 160, 523	910	1, 507, 368	916	1, 487, 602
Saint Louis, Missouri:								
Frame buildings	620	371, 136	510	456, 825	491	405, 892	648	555, 370
Brick, stone, and iron buildings	1, 989	6, 945, 549	2, 160	6, 919, 694	1, 732	6, 624, 927	1, 842	7, 607, 544
Total	2, 609	7, 316, 685	2, 670	7, 376, 519	2, 223	7, 030, 819	2, 490	8, 162, 914
Kansas City, Missouri:								
Frame buildings	1, 438	722, 862	2, 227	1, 357, 207	3, 420	3, 098, 802	3, 758	2, 622, 306
Brick, stone, and iron buildings	418	2, 840, 126	703	4, 401, 420	629	7, 244, 655	650	6, 646, 955
Total	1, 856	3, 562, 988	2, 930	5, 758, 627	4, 049	10, 343, 457	4, 408	9, 269, 261
Savannah, Georgia:								
Frame buildings	312	....	278	....	228	....	190	....
Brick, stone, and iron buildings	28	....	55	....	52	....	28	....
Total	340	....	333	....	280	....	218	....
Galveston, Texas:								
Frame buildings	.....	....	116	177, 630	181	394, 400	.....	....
Brick, stone, and iron buildings	.....	....	7	123, 500	6	229, 000	.....	....
Total	.....	....	123	301, 130	187	623, 400	.....	....
Topeka, Kansas:								
Frame buildings	572	....	603	....	696	....	576	....
Brick, stone, and iron buildings	103	....	68	....	75	....	69	....
Total	675	821, 828	671	406, 671	771	494, 291	645	621, 596
Evansville, Indiana:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	.....	....	.....	....	.....	....	.....	....
Total	.....	....	.....	....	.....	....	411	266, 273

Number and value of the buildings for which permits were issued, etc.—Concluded.

Cities.	1884.		1885.		1886.		1887.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
Cleveland, Ohio:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	.....	....	.....	....	.....	....	.....	....
Total	.....	....	1,932	$1,731,960	1,587	$1,564,200	1,537	$1,756,273
Columbus, Ohio:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	.....	....	.....	....	.....	....	.....	....
Total	984	$1,090,222	537	648,058	804	916,807	854	1,086,419
Toledo, Ohio:								
Frame buildings	.....	....	.....	....	436	324,580	342	520,000
Brick, stone, and iron buildings	.....	....	.....	....	108	298,515	374	736,000
Total	.....	....	.....	....	644	623,095	716	1,256,000
Detroit, Michigan:								
Frame buildings	.....	....	1,328	1,437,819	1,533	1,561,864	1,326	....
Brick, stone, and iron buildings	.....	....	563	2,040,500	520	2,335,350	687	....
Total	.....	....	1,891	3,478,319	2,053	3,897,214	2,013	3,916,973
Marquette, Michigan:								
Frame buildings	6	24,251	8	19,829	4	16,492	10	34,190
Brick, stone, and iron buildings	3	27,317	6	53,351	2	21,600	4	98,793
Total	9	51,568	14	73,180	6	38,092	14	132,983
Chicago, Illinois:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	4,169	20,689,600	4,638	24,530,125	4,664	21,324,400	4,833	19,778,100
Total	4,169	20,689,600	4,638	24,530,125	4,664	21,324,400	4,833	19,778,100
Minneapolis, Minnesota:								
Frame buildings	.....	....	.....	....	.....	....	.....	....
Brick, stone, and iron buildings	.....	....	.....	....	.....	....	.....	....
Total	.....	....	3,075	7,718,668	4,485	9,179,522	4,620	9,731,068
Saint Paul, Minnesota:								
Frame buildings	2,075	1,667,035	2,964	2,238,026	3,017	2,488,271	3,780	6,452,807
Brick, stone, and iron buildings	269	2,387,490	385	1,921,182	553	3,567,571	675	6,486,407
Total	2,344	4,054,525	3,349	4,159,208	3,570	6,055,842	4,455	12,939,214
Fargo, Dakota:								
Frame buildings	.....	....	11	35,500	17	29,000	13	31,300
Brick, stone, and iron buildings	.....	....	4	120,000	4	49,500	2	104,000
Total	.....	....	15	155,500	21	78,500	15	135,300
Omaha, Nebraska:								
Frame buildings	.....	....	600	957,318	1,150	2,224,390	1,968	....
Brick, stone, and iron buildings	.....	....	62	1,908,145	145	2,950,750	226	....
Total	.....	....	662	2,865,463	1,295	5,175,140	2,194	9,000,000

In the following table are the figures (taken from the foregoing table) showing the values for all cities except those for which data are wanting, for 1886 and 1887, placed side by side for the sake of comparison:

Names of cities.	1886.	1887.
Portland, Maine	$300, 000	$365, 000
Boston, Massachusetts	12, 805, 892	10, 262, 006
Fall River, Massachusetts	666, 750	831, 450
Salem, Massachusetts	317, 000	406, 000
Providence, Rhode Island	1, 363, 357	1, 469, 040
Brooklyn, New York	20, 318, 485	18, 008, 325
New York City, New York	58, 739, 733	67, 069, 570
Pittsburgh, Pennsylvania	2, 401, 809	3, 914, 899
Baltimore, Maryland	3, 587, 900	3, 244, 750
Washington, District of Columbia	4, 707, 929	4, 935, 760
Richmond, Virginia	653, 600	873, 700
Louisville, Kentucky	1, 507, 368	1, 487, 602
Saint Louis, Missouri	7, 030, 819	8, 162, 914
Kansas City, Missouri	10, 343, 457	9, 269, 261
Topeka, Kansas	494, 291	621, 596
Cleveland, Ohio	1, 564, 200	1, 756, 273
Columbus, Ohio	916, 807	1, 086, 419
Toledo, Ohio	623, 095	1, 256, 000
Detroit, Michigan	3, 897, 214	3, 916, 973
Marquette, Michigan	38, 092	132, 983
Chicago, Illinois	21, 324, 400	19, 778, 100
Minneapolis, Minnesota	9, 179, 522	9, 731, 068
Saint Paul, Minnesota	6, 055, 842	12, 939, 214
Fargo, Dakota	78, 500	135, 300
Omaha, Nebraska	5, 175, 140	9, 000, 000
Total	174, 091, 202	190, 645, 203

It is evident from this table that for the twenty-five cities compared there was a total gain of $16,554,001 in 1887, or 9.6 per cent. over 1886.

In the report for 1886 a consideration of the kinds of building done and the kinds of materials used in quite a number of cities and towns in the United States was given. The following is a presentation of similar information in regard to other cities and towns, and also, in cases where changes have been made apparent by increased activity in building, the same towns as were treated of in the 1886 report.

ALABAMA.

Birmingham.—The marked increase in the last three years in the amount of manufacturing done in the city has, of course, increased largely the amount of building. The demand has been chiefly for business houses and a cheap class of tenement houses for the working people. At present, however, some attention is being directed toward dwellings of better quality. The stone used is chiefly limestone from the central and the southern part of the State; granite from Georgia, sandstone from Ohio, and oölitic limestone from Bowling Green, Kentucky, have also been used. The demand for roofing slate has decidedly increased. The increase in the amount of building done in Birmingham has exerted a very noticeable effect in stimulating the production of various kinds of structural material in that region.

Mobile and Montgomery.—One-story frame buildings for residences and brick buildings for stores are erected in these cities. Very little stone is used; some of this is granite from Stone mountain, Georgia, and sandstone from Blount county, Alabama.

CALIFORNIA.

Los Angeles.—Building in this city received quite an impetus in the latter part of 1886, and great activity was shown during nearly the whole of 1887. Some fine business blocks were erected, the material used being chiefly brick with granite and terra-cotta trimmings. The granite is quarried in the foot-hills near the city, and sandstone from Ventura county, California, and from Flagstaff, Arizona. Slate for roofing purposes is very little used. That which has been used came from Pennsylvania. Dwelling houses are frame structures. Lumber was quite costly for a time; it is brought from northern California and Puget Sound.

San Francisco.—In this city granite, quarried at the Rocklin, Penryn, and Folsom quarries, is quite liberally used; also sandstone from the vicinity of San José and from Niles Cañon; slate is almost unknown, shingles and tin being the usual roofing materials.

DAKOTA.

Fargo.—There is at present in Fargo a demand for buildings of a better class than have thus far been built. Stone from Kasota, Minnesota, and Berea, Ohio, is used in buildings of the better class.

FLORIDA.

Towns in Florida use comparatively little of the ordinary kinds of building stone, but coquina is used more and more. The principal quarries are on Anastasia Island, opposite Saint Augustine. New quarries of this material are being opened near Rockledge, on the Indian river. Much of the brick used in Florida comes from Georgia and Alabama. Ornamental brick and tile are expensive, owing to high transportation charges, and are consequently used only in decorating fire-places, etc., in the best private dwellings.

ILLINOIS.

Chicago.—For foundations and ordinary work Joliet and Lemont (Illinois) limestone is used; for ornamental work the following are used: Brown sandstone from Connecticut; red sandstone from Long Meadow, Massachusetts; sandstones of all kinds from different sources in Ohio, the Lake Superior region, and, to a less degree and quite recently, from Colorado. Bedford (Indiana) limestone is quite popular. Georgia marble is being introduced with great satisfaction, particularly the pinkish gray variety. Granite from Maine, Missouri, and Minnesota is largely used.

Brick of all kinds is used in enormous quantities; ornamental materials in general are extensively indulged in.

A great variety of roofing materials is employed, particularly for flat roofs; for steep roofs, slate and tile are liberally used, with, however, considerable opposition to tile from architects.

There are agencies in Chicago for forty or more different kinds of stone from all parts of the country; all these varieties are used in buildings in the city. There is said to be at present a surplus of large tenement houses in Chicago, and the greatest demand now exists for small private dwelling houses. The demand for slate is very good and rapidly increasing, particularly for red and purple slate, the supply of which is not by any means abundant.

The strikes which occurred in the spring of 1887 in Chicago caused quite a falling off in the amount of building done as compared with 1886. Building was limited for quite a time to the absolute requirements of the population.

INDIANA.

Indianapolis.—For the foundations of buildings in this city limestone from Flat Rock and Saint Paul, Indiana, is chiefly employed; for superstructures Bedford (Indiana) oölitic limestone is very popular. The demand for ornamental brick, tile, and terra cotta is steadily increasing from year to year.

LOUISIANA.

New Orleans.—Very little stone is used in New Orleans; frame dwellings are chiefly built, while brick is used in business buildings; pressed brick is quite freely employed. Slate from the Bangor region, Pennsylvania, is used to a limited degree.

MASSACHUSETTS.

Boston.—The foundations of buildings are usually granite; for superstructures and for ornamental trimmings in brick buildings, etc., sandstones from Nova Scotia, Long Meadow, Massachusetts, and from Ohio are quite extensively employed. For roofing purposes, slate, tin, composition of tar and gravel, and recently copper, are used.

No increase over the present consumption of ornamental brick and tile is anticipated, since the present tendency is towards the use of stone for ornamental work, and toward greater simplicity in construction.

The Bedford oölitic limestone, from Bedford, Indiana, is being introduced and is meeting with encouraging approbation.

Holyoke.—Three-fourths of the buildings in this city are of brick, of which about 15,000,000 are annually consumed. Long Meadow sandstone is most freely used for trimmings of brick buildings of the better class. Vermont granite and marble are also employed. Slate is used on all steep roofs, and there is good demand for it, shingles not being allowed within the fire limits.

MISSOURI.

Kansas City.—The stone used for foundations is limestone quarried locally. Warrensburgh (Missouri) sandstone is more used than any other stone for superstructures; Colorado sandstone is also used; Massachusetts sandstone finds a slight demand. The oölitic limestone of Bedford, Indiana, is well liked in so far as it has been used.

NEBRASKA.

Omaha.—Building in Omaha has been quite active during 1887. Sandstone from Warrensburgh, Missouri, and from Colorado has been quite freely used. Sandstone and granite from New England quarries are also in use.

NEW YORK.

Niagara Falls.—The utilization of the water-power of this city, and the consequent introduction of large manufacturing concerns, have done much towards advancing the rapidity of building, but the general character of the buildings is still rather behind other developments. Within the last two years, however, a change for the better has been taking place. Locally-quarried limestone, and granite quarried on the Canadian side, about 6 miles away, are the stones most freely used. Stores and offices and dwellings for working people are in greatest demand.

Rochester.—Long Meadow sandstone and sandstone from various New York State quarries is used for superstructures, while foundation stone is quarried locally. Ornamental brick and tile have not been extensively used, but are growing in favor.

Syracuse.—Building was actively carried on in this city during 1887. The stone commonly used is Onondaga gray and blue limestone, quarried on the Indian reservation 7 miles from the city. Pressed bricks, manufactured in the city, are abundantly used.

OHIO.

Toledo.—A great increase in the amount of building done in Toledo characterized 1887. Limestone locally quarried is largely used, and sandstone from the Cleveland and Berea districts. The consumption of brick was very liberal during the past year; ornamental brick and tile are considerably used in the best buildings, but the great demand has been for the more unpretentious dwellings.

OREGON.

Portland.—Building was brisk in 1887. The dwelling-houses are frame structures, and the business buildings are chiefly of brick; pressed brick is not much used; slate for roofing is practically unknown. Basalt from Saint Helen, on the Columbia river, near the mouth of the Willamette, is used more than any other stone. There seems to be a liberal supply of all the various kinds of building stone in the State, but little of it has been developed.

PENNSYLVANIA.

Philadelphia.—In addition to what was said in regard to building in this city in the report for 1886, it may be said that there seems to be a falling off in the erection of the smaller houses in the city. Large banking and office buildings have been built in considerable numbers during the year. Suburban dwellings are receiving considerable attention.

TEXAS.

San Antonio.—Owing to the severe droughts which have prevailed in the region of this city for a few years past, and the consequent failure of crops, but little building has been done. Brick has been in use for only the past five years. Common brick of a light yellow color is made 150 miles from the city, and pressed brick comes from Saint Louis. Large beds of excellent brick clay, pronounced by some equal to the clay from which Saint Louis pressed brick is made, has been found 12 miles northwest of the city. The Bexar Brick and Tile Company has been formed to manufacture pressed brick.

An excellent quality of cement is manufactured near the city by the Alamo Cement Company; it has been used in a number of public buildings, including the State capital at Austin.

WISCONSIN.

Madison.—Sandstone quarried near the city and also from Ohio, limestone quarried 7 miles from the city and also from Waukesha and Joliet, are the building stones most used. Frame cottages costing from $1,600 to $2,500 have been in greatest demand. The climate does not favor roofs of either slate or tile; it is said that the hailstorms, which are prevalent, do much damage to slate roofs.

VIRGINIA.

Petersburgh.—The development of extensive granite quarries near this city has resulted in the adoption of this stone, but frame structures are chiefly erected. Virginia slate is used for roofing.

BUILDING STONE.

Production.—The value of the building stone quarried in the United States during the past six years is estimated in the following table:

Value of building stone produced in the United States, 1882 *to* 1887.

Years.	Value.
1882	$21,000,000
1883	20,000,000
1884	19,000,000
1885	19,000,000
1886	19,000,000
1887	25,000,000

As will at once be noticed, the figure for 1887 is decidedly higher than that for 1886. There was undoubtedly a decided gain in production during 1887 over 1886, but it did not amount to as much as $6,000,000; the estimate for 1886 was somewhat too low.

The plan of obtaining information from the most important quarry regions over the country was carried out in much greater detail for the past year than for 1886, owing to increased facilities for correspondence.

The estimate for 1887 is entirely independent of former years and is based upon the data received for 1887 alone. It is extremely gratifying to note the interest and the spirit of co-operation shown by correspondents, who have in many cases put themselves to trouble and inconvenience in order to insure scrupulous exactness in their replies.

The year 1887 has been a prosperous one for producers of all kinds of stone for building and other purposes. Labor troubles have not materially interfered with the interests of the quarry industry when the country at large is considered, although the strikes which occurred in Chicago, in the spring of 1887, quite markedly affected quarry regions which contribute largely to that market; among them are included two or three of the eastern sources of granite and sandstone supply.

Among the new discoveries and developments which have been made during the year, those in connection with marble are perhaps most noteworthy, indicating that the demand for this product is increasing rapidly and substantially; this is true particularly with reference to its use for purposes of interior decoration in buildings.

The statistics furnished by Mr. John C. Smock, of the New York State Museum, Albany, New York, show a remarkable increase in the production of stone, particularly bluestone, in the State of New York since the census year 1880.

A large proportion of the granite produced in the country is used in the manufacture of Belgian paving blocks; its use for monumental purposes is quite rapidly increasing.

GRANITE AND ALLIED ROCKS.

The value at the quarries of the granite and allied rocks produced during 1887 is estimated at $7,440,000. The most important granite producing States are, in order of importance, Massachusetts, Maine, Rhode Island, Connecticut, Virginia, and New Hampshire. In all these States granite has been produced steadily for many years and the principal localities of production are well known to builders, architects, and consumers generally throughout the country. It is true, however, that in a number of States, among which may be specially mentioned Georgia, California, and Colorado, producers are making vigorous efforts to develop and advertise granite of a quality and character regarded as sufficiently good to justify bringing the stone into active competition with that from the older and better known sources of supply.

The use of granite for monumental purposes is increasing steadily and substantially.

The following statements, arranged in tabular form, give items of production, and such other information as has been received from some of the granite producing localities:

The production of granite in 1887.

States.	Localities.	Value of product.	Remarks.
Massachusetts	Quincy	$520,000	There are about ten firms at Quincy, employing an average of twenty-five men; there are also from twenty to thirty so-called quarry holes where three to five men each are employed. The stone is shipped to the principal cities over a large portion of the country, as far West as Nebraska. The production in 1887 was about 10 per cent. greater than that in 1886.
	Rockport	286,000	There are fifteen quarries in operation. The product is used for three different purposes; an amount valued at $147,000 is used for building and ornamental purposes; $100,000 worth is used for paving blocks, and the remainder is used for breakwater construction.
	Milford	75,000	This figure represents a gain over the production of 1886. The stone is sent to the principal cities of the Eastern and Middle States, and as far West as Omaha, Nebraska.
	Monson	....	In 1887 28,700 tons of granite were produced. The quarries at Monson were opened and worked on a small scale in 1824; in 1839 commenced a progressive development, which has continued up to the present; the product is well known over the entire country.
Maine	Mount Desert	53,000	Of this amount $25,000 represents the value of paving blocks, used chiefly in New York City; the remainder is the value of stone used for building purposes; the building stone was used in Philadelphia, Pittsburgh, Boston, and Southport, Connecticut.
	East Blue Hill	....	50,000 cubic feet were produced in 1887, used mainly in New York, Philadelphia, and Pittsburgh
	Deer Isle	150,000	The product of 1887 is estimated to be from one-third to one-half greater than that of 1886.
	Mount Waldo	300,000	
	Bristol	7,000	
	South Thomaston	30,000	
	Berwick	10,000	
	Norridgewock	15,000	This product was used chiefly in cities in Maine, excepting 20,000 feet which was shipped to Saint Paul, Minnesota.
Rhode Island	Niantic	15,000	Extensive quarries were opened in September, 1887, at Pascoag.
Connecticut	Niantic	60,000	
	Sterling	25,000	
	Greenwich	75,000	
	Bridgeport	50,000	
Vermont	Barre	225,000	The amount quarried is about 300,000 cubic feet. The granite industry at Barre has grown up within the past eight years. The product is largely used for monuments. The increase in production over 1886 is 25 per cent. Between seven hundred and nine hundred men are employed in cutting the stone into monuments. A railroad is about to be built, connecting the quarries with the main line. This will save a haul of 4 miles. These new quarries were opened in 1887.

The production of granite in 1887—Continued.

States.	Localities.	Value of product.	Remarks.
Pennsylvania	Chester county	$50,000	The quarrying of granite in Chester county dates back to 1885. The stone is used for building, monumental work, Belgian blocks, curbing, and flagging.
Virginia	Richmond	250,000	This figure represents the value of the product of five quarries in the vicinity of Richmond; $150,000 of this amount is the value of stone used for building and the remainder for paving blocks and curbing.
New Hampshire	Concord	135,000	This represents the stone quarried within 3 miles of Concord at sixteen or eighteen quarries; one-half was used for monumental purposes, and the other half for building. The building stone goes chiefly to Boston and several other New England points and New York City. Monuments are sent all over the country, chiefly to Ohio, Indiana, Pennsylvania, Michigan, and Illinois. The production for monumental work is rapidly increasing. Three quarries were opened in 1887; one was abandoned.
	Fitzwilliam	60,000	
California	....	....	The amount of granite quarried in 1887 at the places mentioned in last year's report is about the same as that of 1886, viz: Penryn, 10,000 tons; Pino and Rocklin, 5,000 tons; Folsom, 7,000 tons.
	San Bernardino county	....	It is estimated that 100,000 cubic feet of stone, for the greater part granite, was taken from three quarries, the New Westerly at Declezville, the Victor quarry at Victor, and the Casabianca, all in San Bernardino county. The value of the product is estimated at $75,000. The product was used chiefly at Los Angeles, a little in San Bernardino, Riverside, and Santa Ana. In 1886 only about 10,000 feet were produced. The stone from the New Westerly quarry is a fine, close granite used for fine building and monumental work.
Georgia	Atlanta	400,000	The quarrying of granite in the vicinity of Atlanta is carried on with the greatest activity. Paving blocks, curbing, and flagging took the greater part of the product. It was shipped to southern and western States generally.
Wisconsin	Marinette county	18,500	The production of granite in Wisconsin is comparatively new, as no mention of the production of granite in this State is made by the census returns of 1880. During 1887, $20,000 was expended on machinery for the further development of quarries at Pike. Paving blocks are chiefly produced at these quarries.

New discoveries and developments.—Early in 1888 The Old Dominion Granite Company was organized at Petersburg, Virginia, for the purpose of quarrying granite. The Petersburg Granite Quarrying Company of New Jersey leased quarries in the vicinity of Petersburg, Virginia, and proceeded with their development early in 1888.

The D'Alton Granite Quarrying Company is beginning the development of quarries in Dinwiddie county, Virginia.

At Elberton, Georgia, the development of granite quarries is proceeding actively. The Southern Granite Company of Atlanta, Georgia, bought several hundred acres of granite lands in 1887, and increased their operations very materially. At Griffin, Georgia, Mr. Andrew Taylor leased granite lands and began quarrying.

A new granite quarry was opened at New Bridge, South Carolina, by Mr. W. H. Pearce, of Greenville.

New granite quarries at Guilford, Howard county, Maryland, are being developed by Messrs. Smith & Johnson, of Baltimore.

The New Orleans, Birmingham and Notasulga Granite Company was organized at Birmingham, Alabama, in July, 1887; capital, $35,000.

Extensive quarrying was begun at the Brownville, Colorado, granite deposit in September, 1887.

COMMON LIMESTONE.

Production.—The value of the common limestone quarried in the United States during 1887 is estimated at $6,250,000.

The following tabular statements give the value of the limestone produced in some of the limestone regions during 1887:

Production of the principal limestone regions in 1887.

States.	Localities.	Value of product.	Remarks.
Illinois	Munroe county	$11,400	There is said to be considerable good building stone in Munroe county, but little of it is quarried on account of the lack of railroad facilities.
	Kankakee	100,000	The value of the product of 1887 is 25 per cent. greater than that of 1886. From a part of the product 20,000 barrels of lime were produced.
	Joliet	540,000	This represents the value of the product of eighteen quarries in what is known as the Joliet district. No great increase over the product of 1886 was made. Strikes in Chicago in the spring of 1887 caused reduction of out put; this was also the case in 1886. Two companies organized in the fall of 1887 will produce stone during 1888. This does not include the value of stone used for flux.
	Grafton	40,000	
	Lemont	300,000	
Indiana	Kokomo	10,000	The production of 1887 was decidedly greater than that of 1886.

Production of the principal limestone regions in 1887—Continued.

States.	Localities.	Value of product.	Remarks.
Indiana	Bedford	$332,250	The production of 1887 exceeded that of 1886 by 20 per cent. Strikes in Chicago in the spring of 1887 delayed business quite seriously. Two new mills with ten gangs of saws were built in 1887; three new channelers were bought and one new quarry was opened. In April, 1888, 1,102 cars were shipped; in the same month of 1887, 451. The demand for this stone is very good, and rapidly increasing.
	Wabash	10,140	The production of 1887 is 25 per cent. greater than that of 1886.
	Logansport	5,000	One new quarry was opened during the year.
Iowa	Cedar Falls	10,000	About the same product was yielded in 1886.
	Gilmore	8,000	
Kansas	Montgomery county	100,000	Product not so great as in 1886.
Kentucky	Louisville	70,000	The stone is all used in Louisville production no greater than in 1886.
Minnesota	Winona	17,000	
	Red Wing	6,000	Product largely used for lime burning; twelve new kilns were erected in 1887; this will largely increase the production of 1888.
	Lake City	10,000	
Missouri	Saint Charles	10,000	
Ohio	Greene county	8,500	Production is greater than that of 1886.
	Leesville	25,000	This figure represents an increase of 20 per cent. over 1886.
	Sandusky	15,000	
	Springfield	20,000	
Pennsylvania	Newtown	20,000	
	Conshohocken	72,000	This stone is largely used for foundations of buildings and heavy (bridge) masonry. It is not used in superstructures. The product of 1887 was not so large as that of 1886.
	Reading	250,000	
	Lancaster	19,250	
Wisconsin	Fond du Lac	75,000	

The following table, compiled by Mr. Thomas B. Bancroft, chief inspector of mines in Ohio, gives the production of all grades of limestone in that State for 1886:

Production of limestone in the State of Ohio in 1886.

Counties.	Weeks worked.	Men employed.	Burned for lime.	Used for fluxing.	Dimension stone.	Ordinary building stone.	For piers and protection purposes.	Flagging.	Paving.	Curbing.	For ballast and macadam.
			Short tons.	*Short tons.*	*Cubic feet.*	*Cubic yards.*	*Cubic yards.*	*Square feet.*	*Square feet.*	*Linear feet.*	*Cubic yards.*
Allen	24	67	7,969	....	....	10,857	310	17,000	....	3,775	9,831
Adams	9	6	587	....	....	....	....	....	....	....	....
Butler	22	42	....	....	....	7,307	730	4,850	....	8,870	....
Belmont	....	4	2,450	....	....	....	....	....	....	....	1,055
Clinton	16	24	1,160	....	13,000	1,553	280	....	....	....	370
Crawford	28	14	936	....	....	1,329	....	8,640	....	....	....
Clarke	37	126	19,591	23	22,632	17,912	480	2,845	....	12,788	2,375
Clermont	10	13	....	....	....	2,237	....	....	....	....	551
Delaware	30	35	23,949	....	1,600	1,642	....	2,000	....	....	500

Production of limestone in the State of Ohio in 1886—Continued.

Counties.	Weeks worked.	Men employed.	Burned for lime.	Used for fluxing.	Dimension stone.	Ordinary building stone.	For piers and protection purposes.	Flagging.	Paving.	Curbing.	For ballast and macadam.
			Short tons.	*Short tons.*	*Cubic feet.*	*Cubic yards.*	*Cubic yards.*	*Square feet.*	*Square feet.*	*Linear feet.*	*Cubic yards.*
Darke	27	9	1, 460								
Erie	38	101	30, 350	28, 430		21, 095	2, 505	200	78, 336		1, 720
Franklin	37	76	5, 516	35, 094	17, 425	27, 759	698			4, 588	650
Greene	25	61	18, 768		23, 077	3, 354	740	5, 250		100	1, 389
Hardin	22	52	315			1, 193	140	60			10, 762
Holmes	14	14	75			140	24				611
Highland	30	66	11, 192		51, 583	4, 352		21, 811	7, 200	5, 000	61
Hamilton	33	452	11, 006			63, 972			54, 000		25, 605
Hancock	32	41	3, 406			11, 928	926	125			2, 453
Jackson				15, 879							
Lucas	29	39	1, 051		12, 900	3, 843	4, 700	426	10, 800		2, 346
Logan	36	21				5, 427	2, 000				
Lawrence				67, 669							
Mahoning				30, 823							
Muskingum	31	51	3, 265	14, 344	10, 475	1, 892	37			1, 250	1, 116
Montgomery	37	141	4, 683		149, 100	19, 709	2, 596	47, 496		3, 000	392
Marion	44	133	56, 400	45, 489	4, 550	16, 866	2, 981	14, 200			25, 742
Miami	35	152	5, 813		158, 846	34, 315	6, 232	39, 647	300	18, 079	5, 825
Ottawa	38	269	189, 310	34, 113	8, 417	10, 882	32, 551	300		2, 700	28, 736
Perry	5	20		2, 022							
Preble	22	64	8, 342		7, 750	5, 308	4, 267	19, 750			1, 411
Putnam	4	17				502					
Paulding		2				355					
Seneca	30	67	14, 036		71, 808	5, 243	182	3, 300	4, 000		32, 618
Stark	23	12	3, 530								
Sandusky	35	65	28, 450		4, 950	1, 203	70			500	3, 749
Shelby	28	10	4, 620								
Scioto				52, 544							
Tuscarawas				1, 650							
Van Wert	26	9	4, 310			2, 313	277				1, 040
Wood	31	86	47, 415		7, 334	10, 586	306				23, 351
Wyandot	22	22	7, 315		1, 250	157	18				2, 551
Total	....	2, 383	517, 270	328, 080	566, 697	295, 231	63, 050	187, 900	154, 636	60, 650	186, 810

New discoveries and developments.—The Woodstock Iron Company, of Anniston, Alabama, and also the East Tennessee, Virginia, and Georgia Railroad Company propose to develop limestone quarries near Rock Mart, Georgia, during 1888.

MARBLE.

Production.—The value of the marble produced in the United States during 1887 was $3,100,000. The greatest activity is shown in the marble industry all over the country. All sources of production report considerable gains over 1886, and in most of them extensive preparations were made during the year for increased output during 1888. Comparatively little of the marble produced in this country is used for building purposes, but is chiefly consumed for monuments, tombstones, interior decoration of buildings, and in the manufacture of furniture. From present indications it seems probable that the production of 1888 will markedly exceed that of 1887

The production of marble at the most important localities in the United States is given in the following table:

Production of marble in the principal regions in 1887.

States.	Localities.	Value of product.	Remarks.
Vermont	East Dorset	$75,000	This represents the value of the product of four quarries in 1887. The production was about the same as in 1886.
	Brandon	200,000	It is estimated that the production of 1887 is double that of 1886. A new quarry, which is turning out to be very valuable, was opened during 1887.
	Rutland	2,000,000	The production of 1887 did not exceed greatly that of 1886. One new quarry was opened. The stone is used chiefly for monumental purposes; about $250,000 worth was used for building purposes.
Maryland	Cockeysville	160,000	The production of 1887 is 20 per cent. greater than that of 1886.
Tennessee	Whitesburg	150,000	Production about same as for 1886.
	Rogersville	150,000	This represents a gain of 20 per cent. over 1886.
	Mooresburg	100,000	
	Concord	120,000	
Georgia	Atlanta	150,000	The condition of the marble industry in Georgia is most flourishing. The production is $50,000 above that of 1886, and $150,000 was expended in increasing facilities for production.
New York	Tuckahoe	40,000	
	Pleasantville	20,000	
California	Amador county	5,000	The production of marble in Amador county was larger in 1887 than in 1886. The product is shipped principally to Oakland. Statements in regard to "new developments" will be found under that head.

New discoveries and developments.—The Orvillo Marble Company, of Rutland county, Vermont, has sold a marble quarry to persons from Maryland for $50,000. The quarry is on the line of the proposed Clarendon and Rutland railroad. Developments will be made during 1888.

The Oriental Marble Company was organized in the latter part of 1887, with a capital stock of $50,000, to work marble quarries near Knoxville, Tennessee. The principal office is at Washington, District of Columbia. This company will probably produce marble during 1888. Developments are promised during 1888 of a marble quarry on the property of Mr. H. D. Hardin, of Rome, Georgia. The American Marble Company, of Marietta, Georgia, has decidedly increased its facilities for the production of marble.

The Georgia Marble Company has expended $150,000 recently in adding to its facilities of production; the effects of this will probably be made manifest during 1888.

Discoveries of quarries of fine marble have been made near Fort Collins, Larimer county, Colorado; some attention has been drawn to these quarries from cities in the east; their development seems probable. During the summer of 1887 fine specimens of mottled marble were taken from a deposit 17 miles from Glenwood Springs, Garfield county, Colorado. No developments have yet been reported. A marble quarry was opened in the fall of 1887 at Crested Butte, Colorado; it consists of white, black, serpentine, and variegated marbles. Fine marble specimens have been taken from deposits near Crystal, Gunnison county, Colorado; efforts are being made for the development of these quarries; at present transportation facilities are needed.

A quarry of marble, said to be of fine quality, has been discovered in Churchill Cañon, Lyon county, Nevada; the deposit includes white and variegated black marble.

The Parian Marble Company has been organized, with a capital of $1,250,000. The quarries to be worked by this company are located 4½ miles west of Nephi, Juab county, Utah; the main office of the company will be in Salt Lake City.

The Black Hills Marble and Mining Company has been organized, with a capital stock of $250,000, for the purpose of quarrying marble and other stone near Buffalo Gap, Custer county, Dakota.

Development of the Inyo Marble Company's quarries, described in the last report, in Owens River valley, Inyo county, California, has been pushed rapidly during the past year. The improvements made during 1887 were the construction of a mill containing a 30-horse power engine, saws, and rubbing bed for producing finished marble, and a railroad from the quarries to the main line. Enough has been done to develop partially the quarry of white marble, and to obtain a few blocks of the colored varieties. A considerable output seems probable for 1888.

At the marble quarries located 10 miles northwest of Colton, San Bernardino county, California, a mill for sawing and polishing was erected and put in operation during 1887. The product has met with ready sale in the adjacent towns, where it has given such general satisfaction that it is likely to exclude the imported stone in a short time. Some marble has been taken out during the year from the Victor bed in the same county. It seems probable that this stone will be actively worked hereafter; the Southern Pacific Railroad Company, anticipating such result, has laid down a track connecting the quarry with the main line at Victor Station.

Quarrying is going on at the quarry in Antelope valley, Mono county, California; the stone is sent to Reno, where the company has works for dressing it. Some of the stone makes a near approach to onyx, being of variegated color. A company was formed during 1887 to quarry onyx on Glover mountain, near Colton, San Bernardino county, California. It was found that the previously quarried marble was running into onyx as developments progressed. Contracts have been formed with builders in that region for the delivery of considerable quantities. From the mines in San Luis Obispo and Solano counties something less than the usual amount of onyx was quarried. Shipments to the East amounted to about 100 tons, chiefly from Solano county.

Wagon transportation from the quarry in San Luis Obispo county to the railroad has been an obstacle, but as a railroad is to be run to the quarry the prospects are that operations will be on a larger scale. The stone is of very fine quality.

The marble quarries in Loudoun county, Virginia, have been developed sufficiently to allow large orders for the product to be filled. It is said that other quarries will be opened during 1888.

During the summer of 1887 the Antique marble quarry, in St. Genevieve county, Missouri, was equipped with sawing machinery having a capacity to run 48 saws. It is shipped to Chicago, where finishing work is done.

SANDSTONE.

Production.—The value of the sandstone produced in the United States during 1887 is estimated at $6,500,000.

In connection with sandstone a paper on "Building Stone in the State of New York," by Mr. John C. Smock, issued as a bulletin of the New York State Museum, is of particular interest. As the result of visits to the quarries in New York State, aided to some extent by correspondence with the largest producers, it was found that in 1887 there were 342 stone quarries in the State. Of these 11 are granite and gneiss, 7 marble, 235 sandstone, 73 limestone, and 16 slate. The total number of laborers employed, including quarrymen and stonecutters at quarries, was 5,400, an increase of one-third over the number reported by the United States census of 1880. The value of the product, including all kinds of stone, is estimated at $3,500,000. The value in 1880 was $1,261,495. The value of the equipment or plant is estimated to be not less than $1,600,000. It represents the machinery, tools, and sheds necessary for quarry work, and excludes mills for cutting and dressing the stone.

The following statement is made by the Union Bluestone Company, of New York City:

Output of bluestone by Union Bluestone Company, New York City, for the year 1887.

Description.	Cubic feet.	Description.	Cubic feet.
Flagging	3, 188, 217	Axed, 20-inch curb	40, 129
Platforms	29, 019	Rubbed flagging and hearths.	55, 815
Rock	23, 878	Planed flagging	100, 311
Cut garden	25, 793	Planed headers	57, 252
Curb	877, 424	Planed platforms	31, 897
Gutter	126, 539	Sawed and planed	58, 734
Sills	426, 671	Well stone	8, 496
Coping	343, 020	Elevated railroad foundation	
Door sills	3, 639	stone, 3,467 pieces	....
Steps	12, 234	Corners, 1,340 pieces	....
Belgian bridge crossings	150, 920		
Rubbed sills	125, 791		5, 753, 055
Rubbed curb and lintels	67, 276		

In addition to the above, $93,000 worth of manufactured stone was sold for building and other purposes. As these figures represent nine-tenths of all the bluestone quarried in the State, the total output may be safely stated to be 6,400,000 cubic feet, and its value in round numbers $1,750,000.

The following is a tabular account of different localities in the United States producing sandstone in 1887:

Production of sandstone in the principal localities in 1887.

States.	Localities.	Value of product.	Remarks.
Connecticut	Portland	$540,000	This figure represents some increase over 1886. One new quarry was opened during 1887. Markets in the West were very much injured by the strikes in Chicago in the spring of 1887.
Massachusetts	Roxbury	10,000	
	Springfield	475,000	The product was 25 per cent. greater than in 1886. Stone from this region is shipped to the principal cities of the the East and as far west as Kansas City, Missouri, and Omaha, Nebraska.
	East Long Meadow	70,000	The product is shipped to the principal cities of the East and as far west as Omaha, Nebraska.
Ohio	Buena Vista	31,000	The production for 1887 is reported as 25 per cent. less than that of 1886.
	Bellaire	15,000	
	Leesville	25,000	The production of 1887 is from 15 to 20 per cent. greater than that of 1886. It is used principally at towns in Ohio and Indiana.
	Cuyahoga and Lorain counties.	700,000	Stone from these sources is shipped all over the East and South and as far west as Denver. Canada forms a good market. The production of 1887 represents a large increase over 1886. In this region 8 new channeling-machines, 5 gangs of saws, and other machinery for quarrying and hoisting.
	Lancaster	30,000	Production was somewhat better than in 1886. Two new quarries opened.
West Virginia	Wheeling	150,000	
Colorado	Entire State	813,680	The development of the sandstone quarries in Colorado advanced rapidly in 1887, the chief business being done by the Union Pacific Railway Company from its Buckhorn and Stout quarries in the Hogback. The business of carrying this stone in cars which would otherwise largely return empty to Missouri river points is an important one to the railway, but the margin of profit, after paying expenses and freight, is so small that it discourages small quarry owners from attempting to reach the Missouri Valley markets.

New discoveries and developments.—The Wadesborough Brown Stone Company, with a capital of $200,000, has purchased the property of the Atlantic Brown Stone Company, and will add considerably to the existing plant and open up a number of quarries, which will probably be producing in 1888.

A sandstone quarry of good quality has been opened up at Tempe, Maricopa county, Nevada. The close proximity of this quarry to the railroad is a great advantage, and it is expected that developments will be made.

SLATE.

Production.—The following table shows the production of slate for the years 1884 to 1887, inclusive:

Production of roofing slate in all sections during the years 1884, 1885, 1886, *and* 1887.

[Squares of 100 square feet each.]

Sections.	1884.	1885.	1886.	1887.
Bangor and Pen Argyl region, Pennsylvania	195, 505	196, 832	215, 341	230, 000
Slatington section, Pennsylvania	104, 000	108, 000	109, 000	112, 000
Vermont	85, 000	130, 000	111, 385	120, 000
Maine	41, 000	34, 000	36, 000	37, 000
Chapman's	29, 499	26, 328	24, 464	28, 439
Peach Bottom	10, 000	14, 500	12, 000	20, 000
Virginia	9, 000	17, 300	16, 600	19, 000
Michigan	7, 000	10, 000	12, 000	7, 200
Total	481, 004	536, 960	536, 790	573, 639

Total yearly production of roofing slate from 1879 *to* 1887, *inclusive.*

Years.	Number of squares.	Average price per square, delivered on cars.	Value.
1879	367, 857	....	....
1880	382, 867	....	....
1881	454, 070	....	....
1882	501, 000	....	....
1883	506, 200	....	....
1884	481, 004	$3. 85	$1, 851, 865
1885	536, 960	3. 07	1, 648, 467
1886	536, 790	3. 00	1, 610, 370
1887	573, 439	3. 00	1, 720, 317

The year 1887 has been an active one for the roofing slate industry, and the above tables show a decided gain in production. The increase in production of 1887 over 1886 is due not only to the general advance in building operations over the country, but also to a steadily increasing demand for slate rather than other material for roofing purposes. In a number of cities fire-proof material is required by law for roofs, and in the case of steep roofs slate is, in the great majority of cases, preferred to roofing tiles on the score of less cost and weight, and in cold climates, greater durability.

The demand for slate seems to be increasing more rapidly in the west, south, and southwest than in other sections of the country.

Prices.—The prices of slate in New York for different times are given in the following table, which shows a more encouraging condition of business than last year.

Comparative prices of roofing slate at New York January 1.

	1885.	1886.	1887.	1888.
Purple	$6. 00 to $7. 00	$6. 00 to $7. 00	$5. 00 to $6. 00	$5. 00 to $6. 00
Green	6. 00 7. 00	6. 00 7. 00	5. 00 6. 00	5. 00 6. 00
Red	15. 00	15. 00	10. 00	12. 50
Black	4. 50 5. 00	4. 50 5. 00	3. 50 4. 00	3. 50 5. 00

Exports.—The exports of roofing slate from New York City for 1887, as well as for 1886, show a falling off as compared with the year previous; although the decrease in 1887 is small as compared with that of 1886.

Exports of roofing slate from New York for 1887.

	Pieces.	Value.
South America	79, 800	$2, 188
West Indies	82, 910	3, 240
Africa	6, 300	172
New Zealand and Tasmania	51, 500	1, 378
British Australia	2, 083, 041	55, 074
Total	2, 303, 551	62, 052

Exports of roofing slate from the port of New York from 1876 *to* 1887, *inclusive.*

Years.	Tons.	Pieces.	Value.
1876	19, 475	646, 985	$377, 233
1877	25, 565	2, 895, 428	646, 272
1878	12, 320	1, 834, 225	308 852
1879	4, 792	3, 085, 124	166, 220
1880	11, 267	1, 698, 522	220, 292
1881	2, 927	3, 522, 527	138, 904
1882	864	4, 337, 801	153, 318
1883	187	1, 488, 226	54, 063
1884	50	2, 776, 236	90, 262
1885	....	4, 113, 204	115, 206
1886	....	2, 825, 246	79, 064
1887	....	2, 303, 551	62, 052

Slate finds every year new applications which increase its consumption to a greater or less extent. Its use for various purposes in connection with interments is one which seems just now to be markedly increasing; these purposes are grave covers, coffin boxes, monuments, and slabs. Aside from the use of slate as a roofing material, the slate industry seems to be almost in its infancy when, in addition to the applications of it already made, are considered the numerous possible applications which may be realized in the future. The following table shows the shipments from the Slatington section during 1887 of slate for all purposes :

Comparative table of the annual sales in the Slatington section.

Articles.		1885.	1886.	1887.
Roofing squares		108, 000	109, 000	112, 000
School slates	cases	39, 872	42, 388	40, 740
Flagging	pieces	31, 849	58, 713	64, 959
	cases	1, 429	1, 673	1, 824
	cars	27	21⅓	15
Blackboards	cases	5, 882	6, 791	11, 119
Mantels	pieces	8	....	....
	cases	24	21	....
Hearth slate	do	2	1	....
Rough, sawed, and shaved	do	46⅔	32	....

The amount of slate produced in Vermont during 1887 for milling purposes alone, entirely aside from roofing purposes, is 2,000,000 square feet, 1 inch thick, valued at $350,000. At Fair Haven, Vermont, 430,000 square feet, worth $38,700, were produced for purposes other than roofing.

In Virginia 350 tons of slate were used for milling purposes.

Improvements in machinery, by which the cost of manufacture is reduced, are reported from a number of localities.

The following table shows the exports of manufactured slate, largely school slates, from New York during 1887. The figures represent a large proportion of the entire exports for the year:

Exports of manufactured slate from the port of New York, 1876 *to* 1887 *inclusive.*

Years.	Cases.	Value.	Years.	Cases.	Value.
1876	10,612	$87,500	1882	14,625	$68,150
1877	8,675	68,437	1883	8,943	40,674
1878	13,274	88,215	1884	12,189	53,021
1879	17,505	74,251	1885	10,573	49,965
1880	15,674	76,709	1886	9,498	40,804
1881	14,414	62,109	1887	9,433	39,560

Exports of all kinds of slate from the port of New York, 1876 *to* 1887 *inclusive.*

Years.	Value.	Years.	Value.
1876	$464,733	1882	$221,468
1877	714,709	1883	94,737
1878	397,067	1884	143,283
1879	240,471	1885	165,171
1880	297,001	1886	119,868
1881	201,013	1887	101,612

New discoveries and developments.—The Anglo-American Bangor Slate Company, limited, has been organized in London with a capital stock of £120,000, shares £25 each, to acquire by purchase land in Northampton county, Pennsylvania.

A slate quarry has been opened up on the road between Colorado Springs and Cañon City. The slate is said to be of fine quality. No actual production has yet been reported.

A company, of which Mr. J. K. Barton is president, has been organized at Rock Mart, Georgia, for the purpose of mining and manufacturing slate.

It is reported that the California Slate Company is preparing to ship a large quantity of slate from quarries in El Dorado county to Oakland and San Francisco.

A superior quality of roofing slate exists in Antelope island, one of the islands of Great Salt Lake. No developments have yet been reported.

Quite a number of new quarries in seams of slate previously worked have been opened during 1887 at all the various slate sections heard from; but they can hardly be regarded as new discoveries, being simply additions to the quarries previously in active operation.

The slate developments near Little Rock, Arkansas, given in the report for 1886 have not yet reached the stage of actual production, although about 50 squares were quarried as a sample in 1887. Tests of strength show this slate to be equal to that produced at Brownville, Maine.

In the same region another preliminary development is being pushed, and early in 1888 about 70 squares were made. This slate is about equal in quality to Northampton and Lehigh Valley slate. All slate in this immediate region appears to be well adapted for roofing purposes, but is not so good for school slates.

Nine miles west of Hot Springs some work has been done upon a purple vein of slate, which will answer for mantel and slab work. In addition to the places already named, there are others which show good surface indications. Mr. Alonzo Hull, of Little Rock, is able to give information in regard to all slate in this region.

Imports and exports of building stone.—The following tables show the extent of the foreign commerce of the United States in marble and other stone:

Marble imported and entered for consumption in the United States, 1867 *to* 1883 *inclusive.*

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	....	....	....	....	....	$192,514	$2,540	$51,978	$247,032
1868	....	....	....	....	....	309,750	4,403	85,783	399,936
1869	....	....	....	....	....	359,881	3,898	101,309	465,088
1870	....	....	....	....	....	332,839	3,713	142,785	479,337
1871	$5,973	$168	$77	$44	$28	400,158	1,134	118,016	525,598
1872	3,499	1,081	452	....	318	475,718	4,017	54,539	539,624
1873	3,124	21	....	....	....	396,671	4,148	69,991	473,955
1874	1,837	....	....	....	....	474,680	2,863	51,699	531,079
1875	1,456	427	96	....	....	527,628	1,623	72,389	603,619
1876	595	126	203	87	....	529,126	1,151	60,596	591,885
1877	2,124	....	....	....	....	349,590	1,404	77,293	430,411
1878	198	11	8	....	....	376,936	592	43,915	421,660
1879	184	....	....	....	....	329,155	427	54,857	384,623
1880	....	....	....	....	....	531,908	7,239	62,715	601,862
1881	339	....	....	....	....	470,047	1,468	82,046	553,900
1882	655	....	....	....	....	486,331	3,582	84,577	575,145
1883	619	....	....	....	....	533,096	2,011	71,905	607,631

During the last four fiscal years the classification has been as follows:

Classification.	1884.	1885.	1886.	1887.
Marble:				
In blocks, rough or squared, of all kinds	$511,287	$429,186	$410,843	$415,615
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles.	12,941	43,923	81,497	109,866
All manufactures of, not specially enumerated	67,829	54,772	34,546	48,884
Total	592,057	527,881	526,886	574,365

Building stone (exclusive of marble), paving stone, and stone ballast imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	Building stone, dressed.	Building stone, rough.		Sandstone.	Slate chimney pieces, mantels, etc.	Roofing slate.	Limestone.	Paving stones.	Ballast.	Total value.
		Quantity	Value.							
		Long tons.								
1867	....	....	....	....	$37, 510	$85, 204	....	....	....	....
1868	$59, 081	....	....	....	16, 045	118, 776	....	$5, 718	....	....
1869	61, 408	....	$8, 237	$4, 171	19, 602	85, 364	....	467	$3, 987	....
1870	150, 619	....	....	3, 201	19, 879	107, 521	....	2, 034	10, 518	....
1871	145, 759	1, 455	16, 982	3, 660	21, 381	117, 484	....	....	34, 703	....
1872	162, 614	10, 723	39, 515	7, 680	25, 925	107, 192	$2, 459	5, 529	11, 303	$362, 217
1873	218, 236	20, 226	73, 889	6, 160	26, 643	91, 503	1, 486	3, 788	17, 143	438, 848
1874	238, 680	19, 658	81, 645	8, 534	27, 519	80, 519	1, 639	7, 246	21, 882	467, 664
1875	275, 633	15, 748	67, 357	10, 986	42, 022	16, 342	2, 023	2, 017	9, 025	425, 405
1876	316, 404	8, 199	34, 124	7, 174	44, 266	2, 051	1, 938	1, 005	9, 350	416, 312
1877	201, 034	7, 584	25, 571	5, 492	34, 479	4	1, 705	485	6, 272	275, 042
1878	153, 693	10, 197	37, 878	7, 136	39, 935	275	2, 614	1, 950	6, 989	250, 470
1879	125, 493	6, 845	24, 531	13, 956	46, 260	620	1, 456	2, 943	2, 365	217, 624
1880	75, 501	11, 035	43, 997	10, 220	51, 165	72	2, 560	2, 383	7, 572	193, 470
1881	76, 741	15, 867	65, 950	15, 115	46, 862	2	1, 990	3, 799	5, 401	215, 860
1882	104, 296	16, 778	75, 369	....	45, 774	154	2, 710	16, 599	8, 792	253, 694
1883	127, 476	14, 324	64, 767	....	44, 375	2, 813	1, 841	2, 629	5, 745	249, 646
1884	122, 463	12, 198	50, 860	....	34, 640	16, 099	143	2, 576	2, 551	229, 332
1885	145, 344	13, 183	64, 680	....	56, 913	5, 196	....	....	4, 056	276, 189
1886	171, 840	13, 084	65, 459	....	60, 512	4, 366	....	....	3, 759	305, 936
1887	220, 585	13, 513	63, 690	....	46, 188	529	....	....	2, 011	333, 003

Marble and stone of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Rough.	Manufactured.	Total.	Fiscal years ending June 30—	Rough.	Manufactured.	Total.
1826	....	$13, 303	$13, 303	1857	....	$111, 403	$111, 403
1827	....	3, 505	3, 505	1858	....	138, 590	138, 590
1828	....	3, 122	3, 122	1859	....	112, 214	112, 214
1829	....	2, 647	2, 647	1860	....	176, 239	176, 239
1830	....	4, 655	4, 655	1861	....	185, 267	185, 267
1831	....	3, 588	3, 588	1862	....	195, 442	195, 442
1832	....	3, 455	3, 455	1863	....	138, 428	138, 428
1833	....	5, 087	5, 087	1864	$57, 715	144, 647	202, 362
1834	....	7, 359	7, 359	1865	74, 261	183, 782	258, 043
1835	....	8, 687	8, 687	1866	89, 703	112, 830	202, 533
1836	....	4, 414	4, 414	1867	53, 983	138, 558	192, 541
1837	....	5, 374	5, 374	1868	60, 399	105, 046	165, 445
1838	....	5, 199	5, 199	1869	62, 266	87, 135	149, 401
1839	....	7, 661	7, 661	1870	42, 227	138, 046	180, 273
1840	....	35, 794	35, 794	1871	135, 672	137, 613	273, 285
1841	....	33, 546	33, 546	1872	156, 976	165, 311	322, 287
1842	....	18, 921	18, 921	1873	96, 735	189, 795	286, 530
1843 (9 months)	....	8, 545	8, 545	1874	126, 669	168, 977	295, 646
1844	....	19, 135	19, 135	1875	125, 968	254, 356	380, 324
1845	....	17, 626	17, 626	1876	95, 480	236, 255	331, 735
1846	....	14, 234	14, 234	1877	131, 716	917, 937	1, 049, 653
1847	....	11, 220	11, 220	1878	142, 661	597, 356	740, 017
1848	....	22, 466	22, 466	1879	143, 457	430, 848	574, 305
1849	....	20, 282	20, 282	1880	199, 051	453, 912	652, 963
1850	....	34, 510	34, 510	1881	220, 362	409, 433	629, 795
1851	....	41, 449	41, 449	1882	180, 774	433, 656	614, 430
1852	....	57, 240	57, 240	1883	152, 182	389, 371	541, 553
1853	....	47, 628	47, 628	1884	188, 245	415, 015	603, 260
1854	....	88, 327	88, 327	1885	182, 719	(a)330, 786	513, 505
1855	....	168, 546	168, 546	1886	159, 553	(a)445, 708	605, 261
1856	....	162, 376	162, 376	1887	211, 819	(a)348, 533	560, 352

a Includes roofing slate.

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1887, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1872	$1,229	1880	$6,816
1873	4,571	1881	709
1874	1,928	1882	4,848
1875	3,428	1883	490
1876	13,371	1884	8,420
1877	8,475	1885	14,406
1878	3,448	1886	4,617
1879	6,364	1887	4,133

Summarizing the foregoing statistics, the movement during the fiscal years 1882 to 1887 may be stated thus:

Balance of trade in marble and stone.

Fiscal years ending June 30—	Imports.	Exports.			Excess of imports over exports.
		Of domestic production.	Re-exports of foreign production.	Total exports.	
1882	$828,839	$614,430	$4,848	$619,278	$209,561
1883	1,475,658	541,553	490	542,043	933,615
1884	821,389	603,260	8,420	611,680	209,709
1885	804,C70	513,505	14,406	527,911	276,159
1886	832,822	605,261	4,617	609,878	222,944
1887	907,368	560,352	4,133	564,485	342,883

CEMENT.

***Production.*—The following table shows the production of the natural-rock cements in the leading districts during 1887.**

Production of cement made from natural rock in the leading districts in 1887.

	Barrels of 300 pounds.		Barrels of 300 pounds.
Rosendale, Ulster county, New York	2,338,744	Howe's Cave, New York	150,000
Akron, New York	715,000	Eastern Ohio	100,000
Louisville, Kentucky	1,189,000	Onondaga, New York	250,000
La Salle, Illinois	165,000	Kansas City, Missouri	150,000
Utica, Illinois	160,000	Manhattan, Kansas	25,000
Mankato, Minnesota	160,000	Virginia, Georgia, Texas and New Mexico	200,000
Milwaukee, Wisconsin	340,000		
Lehigh Valley, Pennsylvania.	600,000	Total	6,692,744
Potomac River	150,000		

The average value per barrel of the above natural-rock cement was 77½ cents, making a total of $5,186,877 as the value of the product of 1887.

The following table shows the production for the past six years:

Production of cement made from natural rock in the United States from 1882 *to* 1887.

Years.	Barrels of 300 pounds.	Average price per barrel.	Total value.
1882	3,165,000	$1.10	$3,481,500
1883	4,100,000	1.00	4,100,000
1884	3,900,000	.90	3,510,000
1885	4,000,000	.80	3,200,000
1886	4,350,000	.85	3,697,500
1887	6,692,744	.77½	5,186,877

It is plain, from the above tables of production, that the natural cement industry is in a decidedly flourishing condition; it furthermore appears from inquiry that at none of the works above mentioned was the supply fully equal to the demand. If the rate of production attained during the spring of 1888 is maintained through the year a total of 7,500,000 barrels is indicated as the production of 1888.

Estimated production of American Portland cement from 1882 *to* 1887.

Years.	Barrels of 400 pounds.	Average price per barrel.	Total value.
1882	85,000	$2.25	$191,250
1883	90,000	2.15	193,500
1884	100,000	2.10	210,000
1885	150,000	1.95	292,500
1886	150,000	1.95	292,500
1887	250,000	1.95	487,500

The total production of all kinds of cement during the past six years was about as follows:

Total production of all kinds of cement in the United States from 1882 *to* 1887.

Years.	Barrels.	Value.
1882	3,250,000	$3,672,750
1883	4,190,000	4,293,500
1884	4,000,000	3,720,000
1885	4,150,000	3,492,500
1886	4,500,000	3,990,000
1887	6,942,744	5,674,377

Imports of cement at New York, in casks of 400 *pounds.*

Years.	From Great Britain.	From European continent.	Total casks.	Cost on pier per cask.	Total value.
1877	47,632	10,818	58,450	....	....
1878	51,477	19,040	70,517	....	....
1879	80,834	25,212	106,046	....	....
1880	120,833	45,080	165,913	....	....
1881	149,486	73,186	222,672	....	....
1882	171,202	190,924	362,126	$2.60	$941,528
1883	158,602	143,363	301,965	2.70	815,306
1884	155,477	201,085	356,562	2.50	891,405
1885	187,955	250,860	438,815	2.05	899,571
1886	261,464	301,887	563,351	....	....
1887	432,327	385,903	818,230	....	....

Cement imported and entered for consumption in the United States, 1868 *to* 1887.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
				Barrels.	
1868		$10,168	1878		$184,086
1869		9,855	1879		212,719
1870		18,057	1880		373,264
1871		52,103	1881		441,512
1872		172,332	1882	370,406	683,684
1873		209,097	1883	456,418	802,294
1874		286,429	1884	(*a*)585,768	825,095
1875		261,741	1885	554,396	874,070
1876		247,200	1886	650,032	733,297
1877		201,074	1887	1,070,400	1,101,994

a Classed simply as cement; kind not specified since 1883. It is probable, however, that about 95 per cent. of the total imports is Portland cement.

Comparative prices per barrel of cement in New York January 1, 1884 *to* 1888.

	1884.	1885.	1886.	1887.	1888.
Rosendale	$1.10 to $1.20	$1.00	$1.10 to $1.25	$1.20 to $1.25	$1.15 to $1.20
Portland	2.40 2.75	$2.50 to 3.00	2.25 2.50	2.00 2.25	2.25 2.50
Roman	2.75 3.50	2.75 3.50	2.75 3.25	2.65 2.85	2.65 2.85
Keene's common	5.00 6.00	5.00 6.00	4.50 6.00	4.50 5.50	4.50 5.50
Keene's fine	9.25 9.75	9.50 10.00	9.00 10.00	7.50 8.50	7.00 8.25

New developments.—The works at Akron, New York, Mankato, Minnesota, Saint Louis, Missouri, and La Salle, Illinois, all under the control of the Standard Cement Company, have been increased in capacity to 1,000,000 barrels during 1887. In the fall of 1887 construction was commenced upon a large plant at Jeffersonville, Indiana, and completed in the spring of 1888. The works of the Milwaukee Cement Company have been increased by the addition of a mill costing $150,000, with a capacity of 2,000 barrels per day.

Early in 1888 a company was organized at Pittsburgh for manufacturing cement, capital $50,000. The works are on the line of the Pittsburgh Junction railroad, and have a capacity of 50 tons per day. The annual output is expected to reach 12,000 to 20,000 barrels. The president of the company is Mr. John Q. Everton, who has patents pending for the process to be employed.

The Chicago Cement and Lime Works Company, with a capital stock of $500,000, has been incorporated at Chicago. Extensive works are to be established at Blue Island, where cement rock of good quality is to be found.

The Chattanooga Cement Manufacturing Company, capital stock $250,000, has taken steps toward the erection of cement works near the Citico furnace. The process to be used is the Broin process, involving the utilization of blast-furnace slag. The capacity of the works will be 600 barrels per day. The works of Messrs. Thomas Cooley & Co., of Erie, Tennessee, have been increased to a capacity of 2,000 barrels per month.

The Lawrence Cement Works, at Eddyville, New York, were burned in July, 1887. The loss was $140,000.

The first attempt in the United States to use the Ransome process of burning and grinding cement, already described in the report on cement for 1886, has just been made by the Portland Cement Company, of Portland, Oregon. These works have just commenced operations, and are located at Oregon City, Clackamas county. The material used is a natural Portland cement rock found in Douglas county, Oregon, and is said to be unlimited in quantity. The Ransome revolving cylinder is used, and the natural material is burned in a powdered state, using an ordinary gas producer to furnish gas as fuel, which is burned in the cylinder simultaneously supplied with air, the heat being thus under perfect control. The abundant water power of the Willamette river is utilized. The works have now a capacity for producing 30,000 barrels of cement per annum; but this capacity can be tripled by the addition of only the necessary grinding mills.

A very interesting paper on "Hydraulic cements, natural and artificial, their comparative values," was read before the Society of Arts of the Massachusetts Institute of Technology, Boston, in November, 1887, by Mr. U. Cummings, general superintendent of the Standard Cement Company. This publication gives some historical information of interest and discusses in a very thorough manner the relative values of natural and artificial, or Portland, cement from the standpoint of their methods of manufacture, their composition, the changes which take place during manufacture, and the tests which they have stood, both preliminary to their adoption in particular cases by engineers and after their use in structures for a greater or less length of time.

The superiority that can be claimed for an artificial cement over the natural product lies chiefly in the fact that it is possible to control the proportions of the ingredients in artificial cement, while in natural cement rock variations in the proportions of clay and carbonate of lime always exist, the lower layers usually containing more clay than those above, and the variation amounting in some deposits to as much as 20 per cent. Usually, however, a large percentage of the deposit is evenly enough proportioned to yield a good cement when all parts are mixed together. Very excessive variations are, however, occasionally met with. The following quotation from this paper will show the author's views in regard to the manufacture of Portland cement: "The Portland cement manufacturer has it in his power to control the proportions of the materials he uses, and renders it possible for him to make his product uniform. Careful attention to proportions and mixing and care in the matter of calcination will produce a cement that seemingly leaves little to be desired. But so long as these details are intrusted to the hands of ordinary laborers—and there seems to be no other way—so long as the natural cements sustain their present reputation, and through their very cheapness keeping down the price of Portland, none but the cheapest class of labor can be employed in the manufacture of artificial cements, and, no matter how vigilant the superintendent may be, there will be failures, and sometimes disastrous ones."

Mr. Cummings also enters a vigorous protest against the prevailing custom of basing conclusions, in selecting cements, upon the results of tensile-strength tests alone. He claims that the connecting link which ought to exist between general good quality and high tensile strength is concealed, and that "practical experience teaches that we can find both good and bad cements that will sustain a high tensile strain, and that we can find both good and bad cements that will test low."

The subject of properly testing and comparing cements was referred to in the last report as one to which more attention should be given, and the impression that tensile-strength tests alone do not tell the whole story in regard to a cement seems to be gaining in strength.

Interest in cement made with blast-furnace slag as one of the ingredients seems to be rapidly gaining ground. The following, taken from London "Engineering," is a brief account of some of the processes which involve slag as an ingredient:

"Three kinds of cement are made from blast-furnace slag. The first, which is really more of a mortar than a cement, is produced by grinding slag sand with 15 per cent. of lime and 15 per cent. of oxide of iron. The grinding is generally done wet, and the product requires to be used within a few hours after being made, so that its employment is quite local. The second cement is made by grinding 75 per cent. of dry slag sand with 25 per cent. of dry slaked lime, according to Mr. Larsen's patent. It is essential that the ingredients should be finely pulverized, and that they should be intimately commingled. For this purpose the inventor uses a machine which he calls a 'homogeneizer.' The third cement is made according to a process brought out by Mr. Frederick Ransome. Equal weights of slag, sand, and chalk are ground together in a wet state, and after being dried are burned either in a kiln or revolving furnace, the process followed being similar to that used in making Portland cement. The following table gives analyses of two of the cements we have mentioned, and also of two examples of Portland cement:

Analyses of cements.

	Lime.	Silica.	Alumina.	Ferric oxide.	Ferrous. oxide.	Magnesia.	Water.
No. 1 slag cement	22.9	21.01	19.85	8.80	4	4.36	12
No. 2 slag (Larsen)	41.96	24.34	18.74	.14	.27	6.57	4.70
Portland (No. 1)	59.9	24.07	6.92				
Portland (No. 2)	55.57	22.92	8.0				
Middlesbro' slag	40	52.34					
Middlesbro' (No. 2)	36.88	51.12					
Middlesbro' (No. 3)	40.45	50.08					

The first and second analyses are by Mr. J. E. Stead. The non-essential ingredients are not given.

"From this it will be seen that the first two cements are widely different in their chemical constitution from Portland cement, and they are still more different in their physical condition, for the lime is mostly free, the materials not having undergone the incipient fusion which Portland cement experiences. Now, in the slag the proportion of lime to alumina and silica is about as 39:51, while in cement it is as 58:31; therefore 100 parts of slag, including the inert matters, require the addition of 56 parts of lime, or of 100 parts of dry chalk or limestone, to provide the constituents of a good cement, and this is the mixture used in Ransome's process. The result gives a product which exceeds the strength of Portland cement, and which improves by age. Samples seven years old are in existence, and show no signs of deterioration. Of course, the process is only commercially feasible in districts where slag is produced, but there it offers a means of turning a useless product into a valuable material, and, if it be carried out by Ransome's revolving furnace, the expense for plant is comparatively small."

LIME.

The production of lime in the United States during 1887 is estimated at 46,750,000 barrels, worth $23,375,000.

For comparison with the production of previous years the following table is presented:

Estimated production of lime in the United States from 1882 *to* 1887.

Years.	Barrels of 200 pounds.	Average value at kiln.	Total value.
1882	31,000,000	$0.70	$21,700,000
1883	32,000,000	.60	19,200,000
1884	37,000,000	.50	18,500,000
1885	40,000,000	.50	20,000,000
1886	42,500,000	.50	21,250,000
1887	46,750,000	.50	23,375,000

In the preparation of this report correspondence with lime producers in all parts of the country afforded a sound and reliable foundation upon which to base the above estimate. Although the numerous replies received can by no means be regarded as making up an accurate census of the product, some of them are presented below in more or less detail merely to give a general idea of the condition of the industry as a whole, and fairly close estimates of individual localities:

States.	Localities.	Production, barrels of 200 pounds.	Remarks.
Alabama	Silura	175,000	Production increased by 10 per cent. over 1886; one new kiln established. There are nine kilns, but only six operated through the year.
	Calera	150,000	This amount represents an increase over 1886. Kilns were not operated to their full capacity.
	Long View	200,000	More lime made and better prices secured than ever before. One new kiln erected during 1887.
California	San Francisco	295,000	This figure represents an increase of 15 per cent. over 1886. A number of new kilns were erected, increasing the capacity by 100,000 barrels.
Connecticut	New Haven	115,000	Production increased by 10 per cent. over 1886. One new kiln erected.
	Canaan	105,000	Production 10 per cent. larger than 1886. Two new kilns were established in 1887, thus increasing the total capacity 25 per cent.

States.	Localities.	Production, barrels of 200 pounds.	Remarks.
Indiana	Huntington	420,000	This is estimated to be 20 per cent. higher than the production of 1886.
Iowa	Maquoketa	200,000	This figure is estimated as 10 per cent. higher than production of 1886.
	Wilton Junction	120,000	The increase in production over 1886 is 20 per cent.
Kentucky	Louisville	150,000	The production was about the same as that of 1886.
Maine	Knox county	1,987,000	There are about thirty-two producers of lime in the region for which this figure is given.
	Rockland	1,388,443	The production for 1886 was 1,282,000 barrels. There are twenty-one producers.
Maryland	Cockeysville	350,000	There was a falling off in the product of this region in 1887. A new quarry of limestone has been opened.
	Buckeystown	262,500	The production was 15 per cent. behind that of 1886.
	Baltimore	245,000	Production less than 1886.
Massachusetts	Adams	40,000	This is 1,000 barrels ahead of 1886.
Michigan	Detroit	84,000	This product is very little if any ahead of 1886. The producing capacity was increased 10 per cent. during the year.
	Bellevue	70,000	The lime made here is said to be quite pure.
Minnesota	Duluth	60,000	This figure is 40 per cent. above the production of 1886. All the limestone comes from Kelly's Island, Lake Erie.
	Red Wing	200,000	Production about same as 1886. Producing capacity increased by 17 per cent, two kilns being erected.
New York	Buffalo	100,000	This is believed to be no higher than the product of 1886. The competition with Canada is quite active and close.
	Elmira	14,350	The lime produced here is made partly from shell and partly from limestone from Le Roy, New York, and partly from Bellefonte, Pennsylvania.
	Glens Falls	1,000,000	This product includes that of Warren, Washington, and Saratoga counties. The production is less than in 1886. Competition with Canada has kept production down.
Ohio	Toledo	593,000	The production did not materially increase above that of 1886.
	Cleveland	350,000	This figure is about the same as that for 1886.
	Carey	35,000	About the same amount was produced in 1886. A new limestone quarry was opened, but not worked during 1887.
	Marion	252,000	This figure is 20 per cent. greater than that for 1886. The producing capacity was increased by addition to plants already existing by about 20 per cent.
Pennsylvania	Chester and Montgomery counties.	1,159,458	The product of 1886 was 1,017,500 barrels. Philadelphia and suburbs form the chief market for this product.
	Allentown	105,000	The production of 1887 was slightly in advance of 1886, but the producing capacity was increased by 10 per cent. during 1887.
	High Spire	105,000	About the same figure as for 1886.
	Keystone Junction	87,500	25 per cent. higher than the production of 1886.
Tennessee	Erin	100,000	The production at Erin has rapidly increased.
Texas	Austin	80,000	The production is said to be 25 per cent. above that of 1886.
Vermont	Saint Albans	180,000	There was no considerable advance over 1886.
Wisconsin	Milwaukee	1,000,000	Slightly increased production over 1886.

In New York City the price of Rockland lime was lower in 1887 than in 1886; this was due to a war between commission merchants in New York City, and also to stronger competition with the product from St. Johns, New Brunswick. According to the "Record and Guide" the total growth of supply in New York will approximate 160,000 barrels; of this increase 50,000 barrels came from Maine, 90,000 from New Brunswick, and 20,000 from other sources.

Comparative prices per barrel of eastern lime at New York on January 1, 1878 *to* 1888.

Years.	Common.	Fine.	Years.	Common.	Fine.
1878	$0.80	$1.00	1884	$1.00	$1.20
1879	.80	.90	1885	1.00	1.20
1880	.85	1.00	1886	1.00	1.20
1881	.90	1.00	1887	1.00	1.20
1882	1.25	1.40	1888	1.00	1.10
1883	1.10	1.40			

Lime imported and entered for consumption in the United States.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1869	....	$10,800	1879	....	$13,196
1870	....	9,063	1880	....	15,852
1871	....	11,315	1881	....	24,968
1872	....	11,014	1882	73,093	36,879
1873	....	8,260	1883	76,889	41,224
1874	....	10,964	1884	53,505	26,370
1875	....	7,328	1885	54,676	28,270
1876	....	7,367	1886	82,855	41,307
1877	....	12,823	1887	132,239	57,226
1878	....	14,344			

Lime and cement of domestic production exported from the United States, 1864 *to* 1887.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Barrels.			*Barrels.*	
1864	....	$86,386	1878	82,507	$98,334
1865	....	94,606	1879	60,657	74,097
1870	31,175	61,490	1880	41,989	52,584
1871	27,575	51,585	1881	57,555	83,598
1872	39,686	69,218	1882	67,030	100,169
1873	27,873	52,848	1883	74,687	120,106
1874	41,349	69,080	1884	65,768	108,437
1875	64,087	98,630	1885	79,627	127,523
1876	53,827	77,568	1886	81,465	123,103
1877	78,341	97,923	1887	71,282	107,770

BRICK.

Production.—In collecting the statistics of brick production in the United States for 1887 the plan of obtaining replies direct from producers as a basis for a final estimate was very much more completely and effectively carried out than for the 1886 report. The results of the large correspondence thus made necessary, are very satisfactory, and to indicate the extent of the ground covered it may be stated that the aggregate number of brick actually returned by replies to letters of inquiry addressed to manufacturers in cities and towns all over the country was 4,050,465,000.

The year 1887 was an unusually brisk one in brickmaking; the total production of common brick is estimated at 5,790,000,000, valued at $30,976,500.

New developments.—The number of new brick-yards reported as estabished during 1887 is 204; this number, which is without doubt lower than the true figure, does not by any means represent the total increase in producing capacity, as in many places additions in the way of improved machinery and improved methods were made which largely increased manufacturing capacity, aside from the establishment of entirely new plants.

The production of pressed brick is estimated at 284,000,000. The year has been a prosperous one for fine brick. Philadelphia and Trenton pressed brick have been in particularly good demand. New developments and additions to capacity have been made at Zanesville, Ohio, and the demand for the product of this plant is steadily and quite rapidly increasing.

The following table gives the production of some of the more important cities and towns in thirty States. The figures in this table are estimates by the leading producers in the places named. In the majority of cases the agreement between the many independent estimates for one and the same place was very satisfactory:

Production of brick in the principal localities during 1887.

States.	Cities or towns.	Number.	Value.
Alabama	Montgomery	19,000,000	$95,000
Arkansas	Little Rock	12,000,000	84,000
Colorado	Denver	51,500,000	334,750
Connecticut	Berlin and vicinity, Middletown, Hartford, North Haven and vicinity.	62,000,000	372,000
Delaware	Wilmington	33,000,000	260,000
District of Columbia	Washington	100,000,000	750,000
Georgia	Albany	3,500,000	19,250
	Atlanta	40,000,000	250,000
	Columbus	8,000,000	40,000
	Macon	25,000,000	125,000
Illinois	Bloomington	15,000,000	90,000
	Chicago	450,000,000	2,796,840
		(a)23,000,000	505,000
	Lincoln	4,800,000	28,800
	Rockford	4,000,000	30,000
	Springfield	14,300,000	69,000
	Urbana	3,500,000	21,000
Indiana	Elkhart	5,500,000	27,500
	Evansville	21,500,000	107,500
	Hobart	4,000,000	24,000
	Indianapolis	28,000,000	168,000
	Porter	10,000,000	80,000
	South Bend	9,000,000	54,000
Iowa	Des Moines	18,000,000	90,000
	Muscatine	5,000,000	25,000
	Sergeant Bluff	3,500,000	17,500
Kentucky	Covington	18,000,000	90,000
	Lexington	8,000,000	56,000

a Pressed.

Production of brick in the principal localities during 1887—Continued.

States.	Cities or towns.	Number.	Value.
Louisiana	Baton Rouge	5,000,000	$30,000
	Hammond	11,000,000	60,500
	New Orleans	40,000,000	240,000
	Tangipahoa	9,500,000	57,000
Maine	Eliot	12,000,000	60,000
	New Castle	9,000,000	45,000
	Portland	9,000,000	54,000
	South Penobscot	5,500,000	33,000
	West Hampden	8,000,000	40,000
Maryland	Baltimore	175,000,000	1,400,000
Massachusetts	Cambridge	55,000,000	330,000
	Summerville	10,000,000	60,000
	Taunton	17,000,000	72,000
Michigan	Detroit	70,000,000	350,000
	Flint	4,000,000	20,000
	Lansing	3,750,000	18,750
Minnesota	Minneapolis	30,000,000	180,000
	Saint Paul	11,000,000	55,000
Mississippi	Osyka	9,000,000	54,000
Missouri	Kansas City	100,000,000	600,000
	Nevada	7,000,000	42,000
Nebraska	Lincoln	18,000,000	126,000
	Omaha	80,000,000	509,000
New Hampshire	Dover	10,500,000	63,000
	Gonic	14,000,000	86,000
New Jersey	Hackensack	80,000,000	440,000
	Matawan	22,000,000	132,000
	Perth Amboy	60,000,000	270,000
	Sayreville	124,000,000	620,000
	Trenton	(a)22,000,000	207,000
		23,000,000	140,000
New York	Albany	24,000,000	120,000
	Buffalo	50,000,000	400,000
	Dutchess Junction	16,000,000	80,000
	Haverstraw	350,000,000	2,000,000
	Jamestown	5,000,000	28,000
	Newburgh	48,000,000	288,000
	New Windsor	57,000,000	285,000
	Rondout	108,000,000	648,000
	Rochester	25,000,000	150,000
	Verplanck	5,000,000	30,000
Ohio	Akron	10,000,000	57,500
	Bridgeport	12,000,000	90,000
	Cincinnati	100,000,000	500,000
	Toledo	27,500,000	137,500
	Toronto	45,000,000	270,000
	Zanesville	20,000,000	180,000
Pennsylvania	Allentown	13,200,000	79,200
	Philadelphia	100,000,000	800,000
	Allegheny and Pittsburgh	149,700,000	898,200
	Reading	26,000,000	156,000
	Sharon	12,000,000	60,000
	York	7,500,000	45,000
Rhode Island	Providence	15,000,000	90,000
Tennessee	Chattanooga	28,000,000	175,000
	Clarksville	5,000,000	30,000
	Memphis	35,000,000	210,000
Texas	Dallas	16,000,000	96,000
	Galveston	6,000,000	42,000
	Paris	10,000,000	60,000
	San Antonio	5,000,000	40,000
	Texarkana	6,000,000	36,000
Virginia	Norfolk	12,000,000	72,000
	Richmond	25,000,000	180,000
West Virginia	Wheeling	8,000,000	64,000
Wisconsin	Menominee	12,250,000	75,000
	Milwaukee	50,000,000	350,000
	West DePere	7,500,000	37,500

The following statements in regard to a number of the brick producing localities may be found of interest as showing in a somewhat detailed manner the condition of the industry in 1887:

Condition of the brick industry in 1887.

States.	Towns.	Number of brick made in 1887.	Remarks.
Alabama	Montgomery	19,000,000	This figure exceeds production of 1886 by about 7,000,000. Those not locally used were shipped to Birmingham, Bessemer, Decatur, and Briarfield, Alabama. A few were sent to southern Alabama and Florida. One new yard was established.
Colorado	Denver	51,500,000 (a) 2,000,000	There was trouble from strikes in Denver. Machinery was introduced to some extent. The increase over 1886 was about 10 per cent. Cost of labor was higher. Four new yards were established during 1887.
Connecticut	Berlin and vicinity, and other towns.	62,000,000	This figure is the production of twenty-four yards situated at and near Berlin, and at Middletown, Hartford, and North Haven. Production about same as in 1886, prices lower. Used mainly in Connecticut, a few sent to Rhode Island and New York. Two yards fitted with new machinery.
Delaware	Wilmington	33,000,000	Production same as 1886. One new yard established.
District of Columbia.	Washington	100,000,000	This figure is not much greater than that for 1886. Two new yards established.
Georgia	Atlanta	40,000,000	About same figure as for 1886. Product used mainly in Atlanta, Birmingham, Anniston, Alabama, and Chattanooga, Tennessee. A few sent to southern Georgia and Florida. Four new yards in 1887.
	Columbus	8,000,000	This is one-third more than the product of 1886.
	Macon	25,000,000	Production increased 25 per cent. over 1886. Product used about one-half in Macon and small towns in vicinity, the other half is shipped mainly to Florida. Two new yards were established.
Illinois	Bloomington	15,000,000	Production in excess of 1886. One new yard established. Bricks quite largely used for street paving.
	Chicago	450,000,000	The figure for 1886 was 400,000,000. Strikes in the early part of the season among bricklayers quite seriously affected the brick production as well as building in general. Seven new yards were established during the year. This does not include 23,000,000 pressed brick.
	Springfield	14,300,000	This figure is 20 per cent. above that for 1886, chiefly owing to the fact that the dry season drove tile makers into brick manufacture. The manufacture of paving brick is increasing quite rapidly.
Indiana	Evansville	21,500,000	Production not much greater than that of 1886. Brick chiefly used locally and in neighboring towns, though some quite large shipments were made to Birmingham, Decatur, and Florence, Alabama. One large yard for pressed brick was started in 1887.

a Fire brick.

Condition of the brick industry in 1887—Continued.

States.	Towns.	Number of bricks made in 1887.	Remarks.
Indiana	Indianapolis	28,000,000	This figure represents the product of Marion county, including Indianapolis. The product of 1887 is 20 per cent. ahead of 1886. The introduction of natural gas has benefited the industry markedly.
	South Bend	9,000,000	Production about same as in 1886.
Iowa	Des Moines	18,000,000	The production of 1887 was very little if any greater than that of 1886. One new yard was established.
Kentucky	Covington	18,000,000	This figure is probably about 1,000,000 more than that for 1886. Two-thirds of the product was used in Cincinnati. One-third used locally.
	Lexington	8,000,000	Production 2,000,000 larger than that of 1886. Chiefly locally used.
Louisiana	Hammond	11,000,000	This figure is greater than that for 1886. Brick used mainly in New Orleans.
	New Orleans	20,000,000	This amount was manufactured in the city proper, but there are about as many more made in the vicinity, making a total consumption of 40,000,000 in the city during 1887. The consumption of 1887 is not believed to be greater than that of 1886.
Maryland	Baltimore	175,000,000	The production in Baltimore during 1887 is about 5 per cent. greater than in 1886. The pressed brick are among the finest in the market anywhere in the country, and all the brick are of fine quality.
Massachusetts	Cambridge	55,000,000	This figure is about the same as that for 1886. Brick used mainly in Boston.
	Summerville	10,000,000	Production little, if any, greater than that of 1886. Brick used in Boston and vicinity.
	Taunton	17,000,000	About the same amount in 1886. Product used in New Bedford, Fall River, and Boston.
Michigan	Detroit	70,000,000	This figure is greater by 20,000,000 than that for 1886.
Minnesota	Minneapolis	30,000,000	This represents an increase of 10 per cent. over the production of 1886. One new plant established during 1887.
	Saint Paul	11,000,000	A gain over 1886.
Missouri	Kansas City	100,000,000	An increase of 20 per cent. over 1886. Three new yards were established.
Nebraska	Lincoln	18,000,000	The production increased by one-third in 1887.
	Omaha	80,000,000	The production of 1886 was 75,000,000. Five new yards were established in 1887.
New Hampshire	Dover	10,500,000	This represents no material increase over 1886.
	Gonic	14,000,000	Slightly greater than product of 1886. Used mainly in Boston and other cities of Massachusetts.
New Jersey	Hackensack	80,000,000	This figure represents the output of thirteen yards on the Hackensack river, and is 12,000,000 more than that for 1886.
	Matawan	22,000,000	Production of 1887 slightly greater than that of 1886. This figure does not include vicinity of Matawan.
	Perth Amboy	60,000,000	Production of 1887 was larger than that of 1886.

Condition of the brick industry in 1887—Continued.

States.	Towns.	Number of bricks made in 1887.	Remarks.
New Jersey	Sayreville	124,000,000	Ten per cent. more were made in 1887 than in 1886. Three new yards were established.
	Trenton	(a) 45,000,000	Production not greatly increased over 1886.
New York	Albany	24,000,000	Of this amount 20,000,000 were locally used, and the balance in New York City.
	Buffalo	50,000,000	Three million more in 1887 than in 1886. One new yard established.
	Haverstraw	350,000,000	Production said to be about the same as that of 1886. One new yard established, making fifty-two altogether.
	Newburgh	48,000,000	Production about the same as for 1886.
	New Windsor	57,000,000	Production about the same.
	Rondout	108,000,000	Production greater. Valuation about same.
	Rochester	25,000,000	Production about same as in 1886.
	Verplanck	5,000,000	Strikes at Verplanck did great damage to the industry, as only two yards operated throughout 1887, while in 1886 ten were in operation and 50,000,000 brick were made.
Ohio	Akron	10,000,000	Production about same as for 1886.
	Bridgeport	12,000,000	One-half of this product is pressed brick, the other half common brick. There were very few made in 1886.
	Cincinnati	100,000,000	The production was 20 per cent. greater than that of 1886. Cincinnati draws also a large supply from neighboring towns. Eight new yards were established.
	Toledo	27,500,000	The production was 10 per cent. larger in 1887 than in 1886.
	Toronto	45,000,000	The production of 1887 is 25 per cent. larger than that of 1886.
	Zanesville	20,000,000	The brick produced in Zanesville include some very fine enameled and highly ornamental brick. The production was 20 per cent. ahead of 1886.
Pennsylvania	Allentown	13,200,000	Production was in excess of 1886.
	Philadelphia	100,000,000	This city draws a large additional supply of brick from various places in the surrounding region. Brick are shipped from Philadelphia over a large part of the country.
	Allegheny and Pittsburgh.	149,700,000	There were produced 32,000,000 more in 1887 than in 1886. Four new yards were established and eight others increased their facilities.
	Reading	26,000,000	This figure is in excess of the amount produced in 1886.
	Sharon	12,000,000	Production no greater than that of 1886.
	York	7,500,000	Production about same as for 1886.
Rhode Island	Providence	15,000,000	Production about the same as in 1886.
Tennessee	Chattanooga	28,000,000	Production was 25 per cent. greater than that of 1886.
	Memphis	35,000,000	The product was 8,000,000 greater than that of 1886.
Texas	Dallas	16,000,000	The production was one-third greater than that of 1886, but the indications for 1888 are a great falling off.
Virginia	Norfolk	12,000,000	Production no greater than that of 1886.
	Richmond	25,000,000	This is about the annual production of Richmond.
Wisconsin	Eau Claire and Menominee.	15,000,000	Production somewhat larger than that of 1886.
	Milwaukee	50,000,000	Five million greater than product of 1886.

a 22,000,000 pressed brick; 23,000,000 common brick.

At about the close of 1887 experiments with oil as fuel in burning brick were carried out by Messrs. May, Purington & Co., of Chicago. The experiments were conducted at Dalton, Illinois, and were with kilns containing 225,000 and 280,000 brick. This use of oil enables the brick manufacturer to dispense with considerable high-priced labor at the kilns. The time of burning is shortened about two days. The experiments are regarded as highly successful.

A new brick, called iron brick, has been invented by Louis Jochum, of Ottweiler, near Saarbrück, Germany. It is made by mixing equal parts of finely ground red argillaceous slate and finely ground clay and then adding 5 per cent. of iron ore. This mixture is then treated with a 25 per cent. solution of sulphate of iron, together with a certain quantity of finely divided iron ore. It is then molded in a press, dried, dipped once more in a nearly concentrated solution of sulphate of iron mixed with the finely divided ore and then baked for forty-eight hours in the oxidizing flame and twenty-four hours in the reducing flame. The German Government testing laboratory for building material has reported favorably on this product.

Firebrick.—The following table gives the production of firebrick in the last few years:

Estimated production of firebrick for 1883, 1884, 1885, 1886, *and* 1887.

	1883.	1884.	1885.	1886.	1887.
Ohio	23,000,000	25,000,000	25,000,000	25,000,000	30,000,000
Pennsylvania	55,000,000	50,000,000	50,000,000	52,000,000	54,000,000
New Jersey	21,000,000	20,000,000	20,000,000	22,000,000	23,000,000
Scattering	7,000,000	8,000,000	10,000,000	11,000,000	12,000,000
Total	106,000,000	103,000,000	105,000,000	110,000,000	119,000,000

Production of fire-clay in Ohio in 1886.

Counties.	Number of weeks worked.	Number of miners.	Number employed in manufacture.	Production.
				Short tons.
Columbiana	40	51	499	56,233
Hocking	40	7	50	13,802
Jackson	47	20	92	12,218
Jefferson	49	60	469	115,024
Lawrence	46	20	76	17,150
Muskingum	....	3	....	751
Mahoning	27	1	4	600
Stark	29	8	12	17,250
Scioto	35	19	132	23,075
Tuscarawas	37	33	98	10,606
Totals and average	39	222	1,432	266,709

All the reports on firebrick indicated decidedly increased production over 1886. The increased demand for firebrick to be used in blast-furnace construction in the South, particularly in Alabama and Tennessee, as well as in cities in the Northwest, was the chief cause for the jump in production. Prices were generally better in 1887 than in 1886, except in New York city, where, as shown by the following table, they were substantially the same.

Prices of firebrick in the New York market per thousand.

Years.	Welsh.		English.		American No. 1.		American No. 2.	
1884	$30.00 to	$35.00	$25.00 to	$30.00	$33.00 to	$35.00	$25.00 to	$30.00
1885	25.00	30.00	25.00	30.00	30.00	35.00	25.00	30.00
1886	24.50	30.00	22.00	30.00	30.00	35.00	25.00	30.00
1887	21.50	24.00	22.00	24.00	30.00	33.00	23.00	28.00
1888	21.00	22.50	22.00	24.00	30.00	33.00	23.00	28.00

The following table shows the amount, in short tons, of fireclay used by the Colorado works for the past few years:

Fireclay used by the Colorado works.

Years.	Cambria Brick and Tile Company. (*a*)	G. A. Duncan & Co. (*a*)	Golden Brick and Coal Company. (*a*)	Denver Fireclay Company. (*b*)	Denver Firebrick Company. (*b*)	Total.
1880	....	4,000	5,000	1,200	....	10,200
1881	2,000	6,000	4,500	1,200	....	13,700
1882	3,000	9,000	960	1,500	4,000	18,460
1883	3,000	10,000	750	1,200	1,600	16,550
1884	500	12,000	1,200	3,200	....	16,900
1885	....	15,000	800	4,500	....	20,300
1886	....	6,000	200	2,600	3,685	12,485
1887	....	4,000	200	2,900	4,150	11,250

a Located at Golden. *b* Located at Denver.

New developments.—The establishment of quite a number of new firebrick works shows the very good condition of the industry at present. It is probable that firebrick will be produced during 1888 by new works at Muscadine, Bessemer, Anniston, and Warrior, Alabama. The rapid erection of blast furnaces in this State in the last two years has created a very decided demand for firebrick which has thus far been supplied by sources outside of the State. Fireclay exists in quantity near Tuscaloosa, Alabama, and the establishment of new works there is regarded as not improbable in the near future. In Georgia firebrick works are to be established at Cartersville and Carrollton probably during 1888. The Texas Firebrick and Tile Company, of Athens, Texas, organized with a capital stock of $50,000, will erect works during 1888. A vein of fireclay 14 feet in thickness was discovered during 1887, near Crow's Mill, Fayette county, Pennsylvania; efforts will be made to utilize it. New works are to be built for the manufacture of firebrick near the mouth of Brady's Run, Beaver county, Pennsylvania. The Savage Firebrick Company, at Hyndman, Pennsylvania, erected three additional large kilns, making eight in all. These works have been run to their full capacity. At Kansas City, Missouri, a company has been formed to manufacture terra cotta and firebrick. It is probable that a company will be formed to work a vein of fireclay which has been discovered near Charleston, West Virginia. Experiments have been carried out upon fireclay obtained at Trinidad, Colorado; the results are encouraging, and it is probable that it will be used in the manufacture of firebrick.

Fireclay has also been discovered on Three-Mile creek, Gunnison county, Colorado; it will be used for the manufacture of firebrick for the coke ovens of the Grand River Coal and Coke Company.

The Glade Firebrick Company, capital stock $100,000, has been chartered to manufacture firebrick and other clay products at Nuzum, West Virginia.

The Montana Fireclay Brick Company has been organized at Anaconda, Montana. It is estimated that 5,000,000 firebrick are annually used in Montana.

The imports of firebrick for the last four years are as follows:

Firebrick imported in 1884, 1885, 1886, *and* 1887.

Years.	Number.
1884	1,524,000
1885	3,401,449
1886	3,463,002
1887	4,684,428

A decided increase for 1887 above 1886 is evident.

Pottery.—The statistics upon which the following report on the pottery industry in the United States is based and the brief history of the industry in this country, have been furnished by Mr. Joseph Willets, president of the Willets Manufacturing Company, of Trenton, New Jersey, and secretary of the statistical committee of the American Potters' Association.

The following table gives the materials, with their amounts and values, used in the manufacture of American pottery during the year 1887:

Materials.	Amount.	Value.
	Tons.	
Kaolin, or china clay	22,000	$231,000
Ball clay	6,000	36,000
Fireclay	15,000	45,000
Ground flint	19,800	168,300
Ground feldspar	10,200	112,200

The above are the most important materials which enter into the composition of earthenware. The coal used in firing the kilns far exceeds in tons the amounts of all other materials combined, and in value it is much greater than any other item in the cost of production, except labor, which many times exceeds the cost of all materials, coal included, used in making crockery. The consumption of coal in American potteries is much less at the present time than formerly, owing to the substitution of natural gas for coal by Western potteries. It is estimated that without doubt one-third of all the pottery wares of the country were fired by natural gas in 1887. White lead, oxide of zinc, boracic acid, and cobalt are all important items in the production of pottery, but are small in quantity as compared with the items above mentioned, although considerable items in the cost.

The following is a brief sketch of the rise and progress of the pottery industry in the United States:

The first pottery established in the United States was in New York city in its earliest days, when under Dutch rule. It was situated near the North river, above the present Chambers street, the locality being at that time well out of town, in the country. More than a century ago, perhaps, a small pottery was established in Trenton, New Jersey, by some Frenchmen; here porcelain, similar to what is now known as French china, was made, and it is said that the goods were very creditable. This establishment existed for some years, but it attained no great importance. At Philadelphia there was a similar pottery venture, also making porcelain or china wares, which are well spoken of for quality. This enterprise was sustained for a number of years, but failed to reach a permanent existence.

There were other attempts to establish potteries in various parts of the country from time to time, and the one which seems to have given the greatest concern to English manufacturers was one established in South Carolina. This was contemporary with the great Josiah Wedgwood, who has been called the father of the pottery industry in Great Britain from the fact that he made great improvements in the quality of the earthenware (or as he called it "queensware") which gave a very great impetus to the business in England. This South Carolina pottery proved quite alarming to Wedgwood, as he feared that it might become a dangerous competitor in supplying the earthenware markets of the colonies; he therefore petitioned Parliament that the manufacture of such goods be prohibited. He seemed to think that, with the excellent materials found in South Carolina for making earthenwares, the industry would become a successful one. His fears, however, proved groundless, as the unequal struggle was of short duration.

One or two pottery enterprises, inaugurated within the past forty years, making special articles of white crockery ware rather than a general assortment, maintained their existence only, and can not be termed successful.

The term pottery industry as used in this report, and as understood at the present time, does not include the many little potteries scattered all over the United States making stoneware jugs, pie plates, drain tile, yellow crockery, etc., and which employ from six to twenty men each. These little establishments made the cheapest and commonest class of pottery products, with which foreign competition was powerless. Owing to the very low-priced class of such wares, the expenses of their importation bore so large a proportion to their cost at the foreign potteries that competition was out of the question. In fact, in many cases the crates in which the goods were packed and the inland transportation charges equaled the original cost of the goods themselves. The pottery industry, as now spoken of, had, therefore, practically no existence in the United States in 1861, the several hundreds of so-called potteries in this country which statistics show then existed being all of the class above referred to. The Morrill tariff bill, and the increase from 24 to 35 per cent. and the subsequent increase to 40 per cent. did not act as inducements towards the establishment of any new enterprise. In 1863 the rapidly increasing premium on gold offered the necessary inducement, and several pottery enterprises were inaugurated; these manufactured at first the commonest classes of crockery ware for domestic uses, but as experience gave confidence, and the wares gradually found favor, better grades were made until the standard of the chinaware used by the millions of American citizens and manufactured in this country is recognized as equal to that made anywhere. It is true that there are several potters in the United States who make more or less of very fine art pieces which are forcing recognition on account of their superior excellence, but the stability of the pottery industry rests upon the fact that it supplies the wants of the people for fine and common crockery for domestic uses, of which we in this country manufacture about 60 per cent. The American potter does not claim to be the peer of his foreign competitor in art productions, but he does claim to equal any foreign manufacturer in the class of china which he produces for the American people. To-day the English potter is copying American shapes, designs, and styles of decorations. How different is this state of affairs from that which existed a few years ago, when the American potter depended upon foreign ideas for his shapes and designs. With the development of the manufacturing process, talent for designing shapes and patterns or styles of decoration has likewise progressed until we have made our own American shapes and designs, which foreigners have been compelled to copy and adopt in order to find a market for their wares in the United States.

This country still takes about 40 per cent. of the total crockery wares exported by England; this is about the proportion that has been maintained for many years, thus showing that the American potter has increased his output in keeping with the increased consumption of the country.

In regard to the present prices of pottery it may be said that the consumer can now obtain for $2.50 what in 1861 would have cost $4.

The pottery industry gives directly employment to about 10,000 people, to whom wages amounting to about $4,000,000 are paid; this amount being nearly 50 per cent. of the total value of the output of the potteries. In addition to these there are many thousand more employed in the preparation of the materials for the potters' use, such as mining the clays, quartz, feldspar, and grinding and washing the materials. To these people nearly as much more in wages is paid; in fact, a careful estimate shows that 90 per cent. of the cost of manufacturing pottery is paid for labor in one form or another.

The decorating branch of this industry is one of its most interesting features, and one in which great advances have been made in late years. It gives employment of a light, interesting, and elevating character to many young people, both male and female. The growth of this branch has been wonderful, and has made the demand for beautiful decorations, both simple and elaborate, very general and far more widespread throughout the country than ever before. Formerly beautiful decoration was to be found only in costly French or English wares, and the consumption was consequently limited to the wealthiest classes. Now beautiful decorated wares are found in almost any household, where they have been obtained at prices which would have been considered impossible a few years ago, and which have reduced very greatly the cost for French and English decorated products, and to a very great extent have enabled American decorated ware to supersede the foreign.

New discoveries of kaolin.—Toward the close of 1887 large deposits of kaolin were found in several parts of South Carolina, notably at Beech Island. At Tunnel Hill, North Carolina, works are being built to manufacture high grades of white clay. The Pioneer Pottery Works will purchase land and build large works to manufacture plain and decorated white ironstone china. Their capital stock is $70,000.

The following table gives the imports of pottery products since 1880:

Earthenware and china imported and entered for consumption in the United States, 1880 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Brown earthen and common stoneware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen stone, or crockery, glazed, etc.	Total.
1880	$31, 504	$334, 371	$1, 188, 847	$3, 945, 666	$5, 500, 388
1881	27, 586	321, 259	1, 621, 112	4, 413, 369	6, 383, 326
1882	36, 023	316, 811	2, 075, 708	4, 438, 237	6, 866, 779
1883	43, 864	368, 943	2, 587, 545	5, 685, 709	8, 686, 061
1884	50, 172	982, 499	2, 664, 231	666, 595	4, 363, 497
1885	44, 701	823, 334	2, 834, 718	963, 422	4, 666, 175
1886	39, 154	807, 645	2, 967, 058	1, 024, 235	4, 838, 092
1887	40, 288	955, 838	3, 608, 465	938, 780	5, 543, 371

Drain tile.—The drain-tile industry is increasing steadily from year to year in those western States in which extensive underground drainage has been found to be a necessity. A cause which operated to no inconsiderable extent against the production of tile during 1887 in a number of these States, particularly Indiana and Illinois, was long continued drouth, which had the effect of reducing the demand for drain tile and of causing tile manufacturers to produce brick instead of tile for a portion of the year. There was less tile laid in 1887 in Illinois, Indiana, Iowa, and Ohio than in 1886, owing to this drouth; it is also true that less was produced, for the same reason. The production of brick was aided to a considerable extent by the turning of tile works into brick works. The value of the drain tile produced in 1887 is estimated at $14,000,000.

In the absence of a sufficient number of closely approximate returns of tile production in the most important of the western tile producing States, the following abstract of a paper on "The Tile Business in Illinois," by D. W. Dame, of Lanark, Illinois, is presented. The information contained in this paper was obtained from township assessors and from the tile makers themselves. The following table will give an idea of the condition of the tile industry of Illinois on January 1, 1884:

Table showing condition of tile industry in Illinois January 1, 1884.

Number of counties in which tile is manufactured..	75
Number of factories..................................	526
Amount of capital employed	$3,794,000
Number of employés	5,495
Amount paid in wages during the year.............	$1,434,163
Average number of months in operation...........	7
Whole number of tile made..........................	176,962,821
Total cost of fuel	$504,960
Estimated home value of total product............	$3,960,858

From an examination of the dates of establishment of the different factories, it is found that only 5 per cent. of the present number were in operation in 1875, and that in 1880 there was only 32 per cent. of the present number then in existence. On January 1, 1887, there were 824 factories in operation, and only 65 per cent. of this number were in operation on January 1, 1884; it is therefore evident that the really great impetus in this industry has been developed in the last six years.

During the year 1887 about twenty new factories were put in operation, and many of the older factories materially enlarged their capacity; there were then, on January 1, 1888, 844 factories in Illinois. The great central portion of the State, especially east of the Illinois river, has about four-fifths of all the factories in the State. This district embraces what is known as the corn and wheat belt, and is distinguished for its uniform fertility. Seventy-seven per cent. of these factories are using steam-power for manufacturing and steam for drying the product. It is also found that the steam factories produce 92 per cent. of all tile made, so that it is practically a steam industry, and is becoming more so every year.

The actual consumption of fuel during 1887 by the 844 tile factories approximated nearly the same as that of the year 1886 by 824 factories, which was 286,287 tons of coal and 30,421 cords of wood; the total cost of this fuel was $676,008. The probable total amount annually disbursed for fuel by the tile makers of Illinois is $700,000. The whole number of men employed is found to be 8,509, and the aggregate amount disbursed annually in wages is $2,237,204. The estimated amount invested in this industry throughout the State is $6,062,053; estimated product in 1887 is 333,000,000 tile, being nearly the same as that of 1886. There were 63,000 miles of tile laid in 1886. On account of the great drouth of 1887, it is estimated that only about 61,000 miles were laid. The total cost of laying tile in 1886, at 20 cents per rod, was $3,904,000.

The magnitude of the tile industry in Illinois may be approximately known when we compare what has been done in the past with what is to be done in the future. The State has an area of 55,410 square miles, 60 per cent. of which (33,246 square miles) seriously needs thorough underdrainage, while much of the rest would be materially benefited by it. To lay drains of tile 40 feet distant on 33,246 square miles would require the annual product of the 844 tile factories now in Illinois during a period of 69 years.

The above information in regard to Illinois is of particular interest, inasmuch as the conditions of a number of other Western States, particularly Indiana, Iowa, Missouri, and Ohio, are quite similar to those of Illinois, and therefore some light is thrown upon the probable status of the tile industries of those States as well as Illinois.

The following table gives an idea of the tile industry in Indiana up to the year 1884:

Production of drain tile in Indiana.

Years.	Number of establishments.	Capital employed.	Value of product.	Hands employed.
1879	297	$456, 489	$623, 720	948
1880 (*a*)	486	700, 000	900, 000	2, 187
1882	261	491, 130	764, 345	1, 086
1883	387	759, 562	1, 133, 515	1, 517
1884	513	958, 920	1, 659, 820	1, 880

a Estimated; evidently too high.

IMPORTS AND EXPORTS.

As will be seen from the following tables, there is a considerable importation of clay and its products, especially china, porcelain, etc., and a small export trade:

Clay imported and entered for consumption in the United States, 1867 *to* 1883 *inclusive.*

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fireclay.		Total Value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280. 25	$3, 113			6, 383. 75	$72, 204	$75, 317
1868	211. 00	2, 522			8, 383. 75	66, 958	69, 480
1869	324. 10	3, 587			12, 963. 75	84, 645	88, 232
1870	239. 40	2, 619			8, 014. 15	76, 057	78, 676
1871	290. 20	3, 383			10, 900. 48	103, 144	106, 527
1872	274. 00	3, 358			13, 081. 20	128, 130	131, 488
1873	251. 18	2, 978	1, 378. 30	$13, 091	12, 883. 82	141, 927	157, 996
1874	277. 20	3, 440	89. 21	1, 378	12, 909. 14	147, 782	152, 600
1875	300. 06	3, 694	130. 47	1, 977	10, 374. 65	116, 307	121, 978
1876	246. 73	3, 097	142. 00	2, 152	11, 799. 12	126, 738	131, 987
1877	400. 00	4, 460	204. 26	3, 009	11, 680. 14	129, 016	136, 485
1878	335. 07	4, 095	3, 499. 30	38, 899	9, 406. 74	95, 877	138, 871
1879	361. 21	4, 269	4, 774. 60	45, 272	8, 477. 80	87, 948	137, 489
1880	578. 00	6, 925	7, 823. 66	67, 740	11, 899. 80	117, 350	192, 015
1881	267. 55	3,207	6, 887. 37	66. 654	12, 444. 28	123, 545	193, 406
1882	908. 27	11, 444	13, 954. 85	135, 448	12, 181, 39	119, 620	266, 512
1883	1, 241. 27	14, 309	12, 870. 60	115, 492	7, 841. 32	74, 673	204, 474

Classified imports of clay during the fiscal years 1884, 1885, 1886, *and* 1887.

Kinds.	1884.		1885.		1886.		1887.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	16,112	$131,063	10,626	$83,722	14,183	$110,452	20,387	135,853
All others:								
Unwrought	11,021	85,990	9,736	76,899	11,807	89,626	15,411	127,768
Wrought	2,149	16,158	3,554	29,839	3,908	34,129	1,841	22,740
Total	29,282	233,211	23,916	190,460	29,898	234,207	37,639	286,361

Building brick imported and entered for consumption in the United States, 1868 *to* 1887.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
1868		$44,453	1878	25,170	$166
1869		59,359	1879	918,840	4,534
1870		46,892	1880	349,000	1,662
1871		52,997	1881	539,600	3,002
1872		5,275	1882	711,150	9,168
1873	963,500	6,982	1883	764,700	7,958
1874	594,330	4,929	1884 (*a*)	531,820	9,985
1875	495,500	3,278	1885	1,220,000	12,905
1876	411,550	3,147	1886	6,219,441	19,461
1877	129,970	897	1887	2,732,519	30,790

a Classed as "brick other than firebrick."

Bathbrick and firebrick imported and entered for consumption in the United States, 1868 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1868	$8,763	1878	$36,679
1869	86	1879	44,681
1870	19,112	1880	60,589
1871	18,215	1881	82,581
1872	47,502	1882	69,575
1873	60,442	1883	124,948
1874	66,428	1884	(*a*)103,309
1875	50,325	1885	35,616
1876	69,063	1886	43,371
1877	43,548	1887	53,684

a Firebrick only, since 1883.

Firebrick imported since 1877.

Fiscal years ending June 30—	Imports.	Fiscal years ending June 30—	Imports.
	Number.		*Number.*
1877	303,870	1883	1,250,135
1878	244,614	1884	1,524,000
1879	690,954	1885	3,401,449
1880	1,504,462	1886	3,463,002
1881	1,968,230	1887	4,684,428
1882	2,831,033		

Earthenware and china imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Brown earthen and common stone ware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen, stone, or crockery, glazed, etc.	Total.
1867	$48,618	$418,493	$439,824	$4,280,924	$5,187,859
1868	47,208	309,960	403,555	3,244,989	4,005,712
1869	34,260	400,894	555,425	3,468,970	4,459,549
1870	47,457	420,442	530,805	3,461,524	4,460,228
1871	96,695	391,374	571,032	3,573,254	4,632,355
1872	127,346	470,749	814,134	3,896,664	5,308,893
1873	115,253	479,617	867,206	4,289,868	5,751,944
1874	70,544	397,730	676,656	3,686,794	4,831,724
1875	68,501	436,883	654,965	3,280,867	4,441,216
1876	36,744	409,539	718,156	2,948,517	4,112,956
1877	30,403	326,936	668,514	2,746,186	3,772,059
1878	18,714	289,133	657,485	3,031,393	3,996,725
1879	19,868	296,591	813,850	2,914,567	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175
1886	39,154	807,645	2,967,058	1,024,235	4,838,092
1887	40,287	955,837	3,608,464	938,780	5,543,368

Value of tiles imported for consumption in the United States, 1868 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Encaustic.	Roofing and paving.	Total.
1868	$11,420	....	$11,423
1869	7,599	$1,443	9,042
1870	8,549	875	9,424
1871	4,771	884	5,655
1872	8,083	31,453	39,536
1873	18,717	51,772	70,489
1874	14,193	51,010	65,203
1875	15,401	45,360	60,761
1876	15,267	29,903	45,170
1877	16,787	42,143	58,930
1878	13,112	41,032	54,144
1879	17,355	31,177	48,532
1880	16,896	34,063	50,959
1881	21,106	43,717	64,823
1882	27,729	46,562	74,291
1883	16,459	83,777	100,236
1884	16,011	115,770	131,781
1885	10,312	99,258	109,570
1886	7,719	80,420	88,139
1887	11,642	66,094	77,736

Value of clay exported from the United States, 1865 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1865	$29,975	1878	$8,384
1869	5,065	1879	6,314
1870	2,354	1880	8,355
1871	10,904	1881	8,762
1872	5,275	1882	17,458
1873	4,970	1883	17,790
1874	8,146	1884	7,725
1875	13,933	1885	8,225
1876	4,325	1886	9,978
1877	5,493	1887	16,774

Value of brick, etc., of domestic production exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Brick and lime.	Brick, lime, and cement.	Firebrick and firetile.	Brick, other than fire.	Total.
1826	$6,075				$6,075
1827	3,365				3,365
1828	4,573				4,573
1829	3,717				3,717
1830	2,482				2,482
1831	4,412				4,412
1832	3,502				3,502
1833	3,866				3,866
1834	4,294				4,294
1835	4,133				4,133
1836	6,829				6,829
1837	29,626				29,626
1838	31,322				31,322
1839	16,298				16,298
1840	16,949				16,949
1841	14,064				14,064
1842	5,728				5,728
1843 (nine months)	3,883				3,883
1844	12,833				12,833
1845	8,701				8,701
1846	12,578				12,578
1847	17,623				17,623
1848	24,174				24,174
1849	8,671				8,671
1850	16,348				16,348
1851	22,045				22,045
1852	13,539				13,539
1853	32,625				32,625
1854	33,194				33,194
1855		$57,393			57,393
1856		64,297			64,297
1857		68,002			68,002
1858		103,821			103,821
1859		160,611			160,611
1860		154,045			154,045
1861		93,292			93,292
1862		83,385			83,385
1863		99,313			99,313
1864		49,106			49,106
1865		64,105			64,105
1866		146,874			146,874
1867		102,324			102,324
1868		140,338			140,338
1869		83,229			83,229
1870			$4,483	$25,091	29,574
1871			18,471	9,279	27,750
1872			10,233	14,305	24,538
1873			14,651	10,632	25,283
1874			22,365	11,290	33,655
1875			14,476	12,120	26,596
1876			20,348	18,035	38,383
1877			9,892	25,571	35,463
1878			13,900	254,446	268,346
1879			11,096	51,714	62,810
1880			12,027	36,299	48,326
1881			12,290	27,989	40,279
1882			30,649	50,870	81,519
1883			47,120	56,227	103,347
1884			41,012	60,702	101,714
1885			31,058	41,181	72,239
1886			41,343	35,579	76,922
1887			47,427	45,557	92,984

During the years given there were exported from the port of New York the following numbers of brick:

Building brick and firebrick exported from New York.

Calendar years.	Building brick.		Firebrick.	
	Number.	Value.	Number.	Value.
1877	13, 603, 475	$70, 629	45, 000	$2, 185
1878	4, 471, 980	29, 457	118, 994	3, 148
1879	1, 381, 775	9, 371	94, 976	6, 867
1880	921, 654	7, 486	80, 000	3, 208
1881	971, 500	8, 663	181, 359	8, 361
1882	778, 000	7, 026	269, 810	9, 843
1883	2, 642, 625	21, 737	358, 616	11, 039
1884	1, 702, 850	14, 148	300, 100	9, 042
1885	973, 000	8, 894	....	12, 059
1886	977, 500	9, 075	223, 010	7, 838
1887	580, 500	5, 785	294, 250	9, 566

Value of earthenware and stoneware of domestic manufacture exported from the United States.

Fiscal years ending September 30, until 1842, and June 30 since.	Value.	Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1790	$1, 990	1846	$6, 521	1867	$29, 308
1791	1, 984	1847	4, 758	1868	29, 528
1826	1, 958	1848	8, 512	1869	19, 213
1827	6, 492	1849	10, 632	1870	42, 120
1828	5, 595	1850	15, 644	1871	37, 383
1829	5, 592	1851	23, 096	1872	48, 941
1830	2, 773	1852	18, 310	1873	53, 909
1831	7, 378	1853	53, 685	1874	59, 494
1832	6, 333	1854	33, 867	1875	92, 253
1833	12, 159	1855	32, 119	1876	73, 846
1834	12, 745	1856	66, 696	1877	87, 355
1835	16, 427	1857	34, 256	1878	98, 035
1836	13, 391	1858	36, 783	1879	80, 898
1837	14, 249	1859	47, 261	1880	106, 724
1838	12, 019	1860	65, 086	1881	123, 177
1839	11, 645	1861	40, 524	1882	180, 773
1840	10, 959	1862	32, 108	1883	227, 547
1841	6, 737	1863	88, 244	1884	236, 247
1842	7, 618	1864	67, 591	1885	135, 385
1843 (nine months)	2, 907	1865	93, 258	1886	150, 272
1844	4, 884	1866	31, 616	1887	246, 897
1845	7, 393				

ABRASIVE MATERIALS.

Buhrstones.—The value of the millstones produced in the United States during the past five years from the well-known sources in New York, Pennsylvania, and Ohio is given in the following table:

Estimated value of buhrstones produced in the United States from 1883 *to* 1887.

Years.	Esopus.	Cocalico.	North Carolina grit.	Total value.
1883	$120,000	$30,000	....	$150,000
1884	110,000	40,000	....	150,000
1885	90,000	10,000	....	100,000
1886	100,000	10,000	(*a*)$30,000	140,000
1887	75,000	5,000	20,000	100,000

a For 300 complete sets.

The industry is decreasing and the demand for millstones would be even less, except for their use in grinding paints and various substances other than flour, for which rollers are being introduced more and more. The imports, principally of French buhrstones, are given below:

Buhrstones and millstones imported and entered for consumption in the United States, 1868 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Rough.	Made into millstones.	Total.	Fiscal years ending June 30—	Rough.	Made into millstones.	Total.
1868	$74,224	....	$74,224	1878	$87,679	$1,928	$89,607
1869	57,942	$2,419	60,361	1879	101,484	5,088	106,572
1870	58,601	2,297	60,898	1880	120,441	4,631	125,072
1871	35,406	3,698	39,104	1881	100,417	3,495	103,912
1872	69,062	5,967	75,029	1882	103,287	747	104,034
1873	60,463	8,115	68,578	1883	73,413	272	73,685
1874	36,540	43,170	79,710	1884	45,837	263	46,100
1875	48,068	66,991	115,059	1885	35,022	455	35,477
1876	37,759	46,328	84,087	1886	40,722	676	41,398
1877	60,857	23,068	83,925	1887	25,660	557	26,217

Grindstones.—The production of grindstones in the United States is largely controlled by the Cleveland Stone Company, a consolidation of more than a dozen producing companies in Ohio and Michigan. Their quarries extend to New Hampshire. The total production in 1887 is estimated at 40,000 tons, valued at the quarries at $240,000. The production is slightly greater than in 1886, but the value is less than that recorded last year. The details of manufacture were given in the last report, to which the reader is referred for further information..

Imports.—These are chiefly from Newcastle-on-Tyne and from Nova Scotia and New Brunswick.

Grindstones imported and entered for consumption in the United States, 1868 to 1887 inclusive.

Fiscal years ending June 30—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	....	$25, 640	....	$35, 215	$60, 855
1869	....	15, 878	....	99, 715	115, 593
1870	....	29, 161	....	96, 444	125, 605
1871	385	43, 781	3, 957. 15	60, 935	104, 716
1872	1, 202	13, 453	10, 774. 80	106, 494	113, 947
1873	1, 437	17, 033	8, 376. 84	94, 900	111, 933
1874	1, 443	18, 485	7, 721. 44	87, 525	108, 010
1875	1, 373	17, 642	7, 656. 17	90, 172	107, 814
1876	1, 681	20, 262	6, 079. 34	69, 927	90, 189
1877	1, 245	18, 546	4, 979. 75	58, 575	77, 121
1878	1, 463	21, 688	3, 669. 41	46, 441	68, 129
1879	1, 603	24, 904	4, 584. 16	52, 343	77, 247
1880	1, 573	24, 375	4, 578. 59	51, 899	76, 274
1881	2, 064	30, 288	5, 044. 71	56, 840	87, 128
1882	1, 705	30, 286	5, 945. 61	66, 939	97, 225
1883	1, 755	28, 055	6, 945. 63	77, 797	105, 852
1884	....	....	....	....	86, 286
1885	....	....	....	....	50, 579
1886	....	....	....	....	(*a*)45, 713
1887	....	....	....	....	(*a*)37, 549

a Classed as finished or unfinished.

Novaculite.—The production of novaculite in the Hot Springs region of Arkansas, and of whetstones and scythe stones in Indiana, New Hampshire, and Vermont, shows no marked change over 1886, the total production being estimated at 1,200,000 pounds, worth, before dressing into whetstones, $16,000. The imports increased from a value of $16,749 in the fiscal year 1886 to $21,479 in 1887.

Corundum.—The production of corundum in 1887 was practically limited to the mines of the Hampden Emery Company, at Laurel Creek, in the northwestern part of Rabun county, Georgia, and at Cullasaja or Corundum Hill, about 8 miles northeast of Franklin, Macon county, North Carolina.

The production from these mines during the past three years is given below:

Production of corundum in 1886 *and* 1887.

	1886.		1887.	
	Short tons.	Value.	Short tons.	Value.
Corundum Hill	290	$52, 200	250	$45, 000
Laurel Creek	355	63, 990	386	69, 480
Total	645	116, 190	636	114, 480

There are many other localities in western North Carolina, Georgia, and Alabama which contain corundum in sufficient quantity and pure enough to be sold profitably. Several specimens have been examined in this office which were very satisfactory, and without doubt efforts will be made to open other deposits in 1888 and 1889. It may be said that Iredell county, North Carolina, will probably furnish corundum in the future.

Emery imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
1867	....	....	428	$14, 373	924, 431	$38, 131	....	$52, 504
1868	....	....	85	4, 531	834, 286	33, 549	....	38, 080
1869	....	....	964	35, 205	924, 161	42, 711	....	77, 916
1870	....	....	742	25, 335	644, 080	29, 531	....	54, 866
1871	....	....	615	15, 870	613, 624	28, 941	....	44, 811
1872	....	....	1, 641	41, 321	804, 977	36, 103	....	77, 424
1873	610, 117	$29, 706	755	26, 065	343, 828	15, 041	$107	70, 919
1874	331, 580	16, 216	1, 281	43, 886	69, 890	2, 167	97	62, 366
1875	487, 725	23, 345	961	31, 972	85, 853	2, 990	20	58, 327
1876	385, 246	18, 999	1, 395	40, 027	77, 382	2, 533	94	61, 653
1877	343, 697	16, 615	852	21, 964	96, 351	3, 603	....	42, 182
1878	334, 291	16, 359	1, 475	38, 454	65, 068	1, 754	34	56, 601
1879	496, 633	24, 456	2, 478	58, 065	133, 556	4, 985	....	87, 506
1880	411, 340	20, 066	3, 400	76, 481	223, 855	9, 202	145	105, 894
1881	454, 790	22, 101	2, 884	67, 781	177, 174	7, 497	53	97, 432
1882	520, 214	25, 314	2, 765	69, 432	117, 008	3, 708	241	98, 695
1883	474, 105	22, 767	2, 447	59, 282	93, 010	3, 172	269	85, 490
1884	143, 267	5, 802	4, 145	121, 719	513, 161	21, 181	188	148, 890
1885	228, 329	9, 886	2, 445	55, 368	194, 314	8, 789	757	74, 800
1886	184, 366	7, 751	3, 430	83, 868	335, 161	14, 877	212	106, 708
1887	143, 317	5, 830	2, 987	66, 601	530, 957	24, 003	1, 191	97, 625

Exports of manufactured emery.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1878	$813	1883	$1, 857
1879	1, 608	1884	3, 565
1880	1, 265	1885	99, 232
1881	1, 312	1886	38, 820
1882	1, 242	1887	39, 668

Infusorial earth.—Mr. William M. Newman, manager of the Infusorial Earth and Silica Mining Company of New York, states that a new deposit of infusorial earth has been opened at Pope's Creek, Maryland, and that it was actively worked in 1887. Below will be found an analysis of this material by Mr. P. de P. Ricketts, of New York. This, together with the deposit at Dunkirk, Maryland, described in the last report, and the output of a fine quality in Nevada, gives a total of about 3,000 tons as the total production of the country, valued at $15,000.

Analysis of infusorial earth from Pope's Creek, Maryland.

	Per cent.
Moisture	3. 47
Silica	81. 53
Alumina	3. 43
Protoxide of iron	3. 33
Lime	2. 61
Magnesia	Trace.
Soda	1. 43
Potash	1. 16
Sulphur	. 47
Organic matter, oxygen, etc	2. 57
Total	100. 00

A deposit apparently of great purity occurs near Linkville, Klamath county, Oregon. The beds have been deposited in an extinct lake, as in the case of the occurrences reported by Mr. J. S. Diller in northern California. A thickness of 40 feet is exposed on Lost River, and the deposit has been traced 10 miles. The distance to Willow creek, on the California and Oregon railroad, is 60 miles.

PRECIOUS STONES.

BY GEORGE F. KUNZ.

Gem mining.—During 1887 no work was done either at Mount Mica, Paris, Maine, or at Stony Point, North Carolina, which are the two most noted localities where gems are sought for systematically. At Mount Apatite, Auburn, Maine, some work was carried on during the fall of 1887; $200 worth of tourmalines and $400 worth of other minerals were found.

Several localities in North and South Carolina and Kentucky have been opened and ordinary mining operations carried on for the purpose of producing zircon, and several other comparatively rare minerals which have been only looked upon as gems heretofore, but are now used for making the oxides of zirconium, lanthanum, cerium, etc. These oxides are needed for manufacturing purposes.

The following table gives an approximation of the value of the gems produced in the United States during the past five years. It does not include about 20 tons of zircon and quite large quantities of allanite, monazite, and samarskite which were mined for use in manufactures as stated above.

Estimated production of precious stones

Species.	1883.			1884.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	....	....	....	....	$800	$800
Sapphire gems	$200	$2,000	$2,200	$250	1,500	1,750
Chrysoberyl	100	....	100	25	....	25
Topaz	1,000	....	1,000	200	300	500
Beryl	200	300	500	300	400	700
Emerald	500	....	500	....	....	....
Hiddenite	100	500	600	....	....	....
Tourmaline	....	....	....	1,500	500	2,000
Smoky quartz	2,500	7,500	10,000	2,000	10,000	12,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	5,000	....	5,000	10,000	500	10,500
Garnet	1,000	5,000	6,000	1,000	3,000	4,000
Anthracite	....	2,500	2,500	....	2,500	2,500
Pyrite	1,500	500	2,000	2,000	1,000	3,000
Amazonstone	3,500	250	3,750	2,500	250	2,750
Catlinite (pipestone)	10,000	....	10,000	10,000	....	10,000
Arrow points	1,000	....	1,000	1,000	....	1,000
Trilobites	500	....	500	500	....	500
Sagenitic rutile	500	500	1,000	500	500	1,000
Hornblende in quartz	500	100	600	500	100	600
Thompsonite	250	500	750	250	500	750
Diopside	200	100	300	....	....	....
Agate	1,000	500	1,500	4,000	500	4,500
Chlorastrolite	500	1,000	1,500	500	1,000	1,500
Turquois	1,500	500	2,000	1,500	500	2,000
Moss agate	1,000	2,000	3,000	1,000	2,000	3,000
Amethyst	2,000	250	2,250	2,000	250	2,250
Jasper	2,000	500	2,500	2,000	500	2,500
Sunstone	250	200	450	250	200	450
Fossil coral	500	250	750	500	250	750
Rutile	....	....	....	....	....	....
Total	47,300	26,450	73,750	54,275	28,550	82,825
Gold quartz	40,000	75,000	115,000	40,000	100,000	140,000

in the United States from 1883 *to* 1887.

1885.			1886.			1887.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
....	....	....	....	$60	$60	....	....	....
....	$500	$500	$250	500	750	....	$500	$500
....	....	....	....	....	....	....	....	....
$1,000	250	1,250	1,000	....	1,000	$1,500	500	2,000
250	500	750	....	5,500	5,500	500	3,000	3,500
....	....	3,200	3,000	200	3,200	....	....	....
....	....	2,500	3,500	1,000	4,500	....	....	....
500	100	600	3,500	2,000	5,500	300	200	500
2,000	5,000	7,000	2,000	5,000	7,000	1,500	3,000	4,500
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,500	11,500
5,000	1,500	6,500	500	1,000	1,500	35,000	1,000	36,000
200	2,500	2,700	1,250	2,000	3,250	2,500	1,000	3,500
....	2,500	2,500	....	2,500	2,500	2,000	....	2,000
1,500	500	2,000	1,500	500	2,000	2,000	500	2,500
2,500	250	2,750	2,000	250	2,500	1,500	200	1,700
10,000	....	10,000	10,000	....	10,000	5,000	....	5,000
....	2,500	2,500	....	2,500	2,500	....	1,500	1,500
....	1,000	1,000	1,000	....	1,000	500	....	500
....	250	250	1,750	....	1,750	....	....	....
....	300	300	200	....	200	....	100	100
250	500	750	100	300	400	250	500	750
100	....	100	....	....	....	50	....	50
1,000	1,000	2,000	1,000	1,000	2,000	3,000	1,000	4,000
....	....	....	500	500	1,000	300	500	800
1,500	2,000	3,500	1,000	2,000	3,000	1,000	1,500	2,500
500	2,000	2,500	1,000	1,000	2,000	200	750	950
2,000	100	2,100	2,000	100	2,100	2,000	100	2,100
....	....	....	....	....	....	....	....	....
250	100	350	200	100	300	50	100	150
....	....	....	1,000	....	1,000	1,500	500	2,000
750	....	750	750	....	750	....	....	....
39,300	24,850	69,850	49,000	29,510	78,510	70,650	17,950	88,600
40,000	100,000	140,000	....	....	40,000	....	....	75,000

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	Glaziers'.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906			$1,317,420	$291	$1,318,617
1868	484			1,060,544	1,465	1,062,493
1869	445	$140		1,997,282	23	1,997,890
1870	9,372	71		1,768,324	1,504	1,779,271
1871	976	17		2,349,482	256	2,350,731
1872	2,386	89,707		2,939,155	2,400	3,033,648
1873		40,424	$176,426	2,917,216	326	3,134,392
1874		68,621	144,629	2,158,172	114	2,371,536
1875		32,518	211,920	3,234,319		3,478,757
1876		20,678	186,404	2,409,516	45	2,616,643
1877		45,264	78,033	2,110,215	1,734	2,235,246
1878		36,409	63,270	2,970,469	1,025	3,071,173
1879		18,889	104,158	3,841,335	538	3,964,920
1880		49,360	129,207	6,690,912	765	6,870,244
1881		51,409	233,596	8,320,315	1,307	8,606,627
1882		92,853	449,513	8,377,200	3,205	8,922,571
1883		82,628	443,996	7,598,176	(a)2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315		9,139,460
1885	11,526	30,426	371,679	5,628,916		6,042,547
1886	8,949	32,316	302,822	7,915,660		8,259,747
1887	9,027	33,498	262,357	10,526,998		10,831,880

a Not specified since 1883.

Imports of substances not included in the foregoing table, 1868 to 1887 inclusive.

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazilian pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerschaum.	Total.
1868								$62,270		$62,270
1869		$70	$269		$427			22,417	$6,407	29,590
1870			766		1,433			18,975	3,998	25,172
1871		1	661		180			37,877	698	39,417
1872		529	207		2,426		$83	59,598	2,194	65,037
1873	$151	1,310		$1,237	1,534	$595	230	63,805	5,608	74,470
1874	177	1,524			1,448	1,057	527	28,152	270	33,155
1875	520	5,165		57	7,169	715	1,278	33,567	2,902	51,373
1876	293	1,567			15,502	187	109	33,559	21,939	73,156
1877	579	1,904	(a)69		17,307	329	718	28,650	9,304	58,860
1878	82	404		76	13,215	1,119	1,252	12,667	16,308	45,123
1879	138	364			17,821	203	147	11,327	19,088	49,088
1880	57	2,346			36,860	2,317	62	5,492	30,849	77,983
1881	486	1,700		5	42,460	1,102	89	2,501	72,754	121,037
1882	901	5,084		111	72,479	4,174	1,474	669	56,118	141,010
1883	14	2,895			40,166	3,472	681	(b)1,303	58,885	107,416
1884		6,100		3,496	56,301	4,692	158		43,169	113,916
1885	124			6,541	21,722	3,242	659		42,590	74,878
1886	284			17,379	27,215	5,665	219		23,417	74,179
1887	12	1,247		35,291	34,238	10,011	307		35,478	116,584

a Not separately classified since 1877. *b* Not specified since 1883.

Exceptional discoveries of gems—Diamond.—In April, 1887, Mr. Lewis M. Parker, a tenant on the farm of Daniel Light, three-fourths of a mile northwest of Morrow Station, and 13 miles south of Atlanta, Georgia, found a diamond on the farm. The stone afterwards came into the possession of Mr. W. W. Scott, of Atlanta, who sent it to the writer for examination. It proved to be an octahedral crystal weighing $4\frac{1}{12}$ carats (828 milligrams), two-fifths of an inch long and one-fourth of an inch wide. It measured 9 by 10 by 7 millimeters, is slightly yellow and has one small black inclusion. The specific gravity was found to be 3.527. Curious long, shallow pittings mark the surface. A stone of from $1\frac{1}{12}$ to 2 carats could be cut from it.

Mr. L. O. Stevens, of Atlanta, Georgia, has informed the writer that a colored man called on him during the past year with a 2-carat diamond, defective and of poor color, which he stated he had found in his garden within a few miles of Atlanta. He has shown no desire to sell or lend the stone for examination.

Zircon.—Opaque green zircons in crystals 1 inch long and $1\frac{1}{2}$ inches wide, were found by Mr. Nimms in Saint Lawrence county, New York, at the town of Fine. They were curious, but not of gem value. Fully 25 tons of this mineral will be raised during 1888, from Henderson county, Kentucky, for use in a new incandescent gas-burner manufactured in Philadelphia.

Beryl.—Prof. Eugene A. Smith obtained from Coosa county, Alabama, some light golden yellow beryl of sufficient transparency to furnish small gems. Blue-green beryl that afforded fair gems was reported by Mr. William E. Hidden, from Mitchell county, near the Yancey county line, North Carolina.

Phenacite.—Dr. S. L. Penfield describes phenacite from Topaz butte, 5 miles north of Florissant and the same distance from Mount Antero, Colorado. Mr. W. B. Smith describes the occurrence of topaz and phenacite at Topaz butte (*American Journal of Science*, February, 1887, III. Series, vol. 34, p. 130). An extensive find of phenacite crystals (few of gem value, however,) associated with aquamarine crystals, was made at Mount Antero, Colorado, in the fall of 1887. The phenacites were almost quartzoids in form. The occurrence is described by the Rev. R. F. Cross, in a note in the *American Journal of Science*, February, 1887, p. 161, vol. 34.

Garnet.—A variety of spessartite garnet was found at Amelia Court House, Virginia, in masses several inches across, and dark brown, dark red, or honey brown in color, which would afford cut gems from 1 to 10 carats in weight. These are the finest specimens of this variety of garnet yet found. Fully $1\frac{1}{2}$ tons of the almandite garnets of Salida, Colorado, were found during the past year and sold as tourists' or mineralogical specimens at from 30 cents to \$1 a pound. One absolutely perfect dodecahedron weighed over 14 pounds. In the proceedings of the "Philadelphia Academy of Natural Sciences," 1886, p. 355, Dr. George Koenig describes a titaniferous garnet from southwestern Colorado, and also analysis of schorlomite from Magnet Cove, Arkansas, which he finds to be titaniferous garnet.

Tourmaline.—A large number of green tourmalines, some quite stout and several inches in length, have been found at Franklin Furnace, Sussex county, New Jersey, but although they are an important addition to our mineralogical collections and the outer parts of some of the crystals are of a rich almost chrome green, yet not a single one was observed which would cut a transparent gem of even a few carats.

Prof. R. B. Riggs, of the laboratory of the Geological Survey, recently made over 25 analyses of tourmalines of all colors. He found the question of the color of the lithia tourmaline a very interesting one. The color of the iron and magnesian varieties depends on the amount of iron present. It ranges from the colorless De Kalb through all the shades of brown to the Pierrepont black, while the lithia tourmaline, containing more or less manganese, gives the red, green, and blue, as well as the colorless varieties. The shades of color do not depend on the absolute amount of manganese present, but rather on the ratios existing between that element and iron. Thus, when the amount of manganese bears a specific proportion to the iron, we have the colorless, pink, or very pale green tourmaline. An excess of manganese produces the red varieties; and if the iron is in excess the various shades of green and blue result.

Rubellite.—Mr. William Irelan, jr., reports the finding of transparent rubellite in fine crystals 1 to 2 inches long, in San Diego county, California.

Hiddenite.—Rev. Alfred Free, in a report on a placer mine at Bracket Town, McDowell county, North Carolina, mentions the finding of a small crystal of spodumene of the hiddenite variety. He had also observed blue, green, and pink tourmaline at the same locality.

Rock crystal.—In the last report reference was made to the occurrence of rock crystal in what was believed to be a part of Virginia, but which, on visiting the locality, the writer found was really the mountainous part of Ashe county, North Carolina. My attention was first called to this locality by the receipt thence, by Messrs. Tiffany & Co., of a 51-pound fragment of a large crystal, which was said to have been broken from a mass weighing 300 pounds by a twelve-year old mountain girl. This large crystal was found on the Mintor Blevin farm on Long Shoal creek, in Chestnut Hill township, though crystals have also been found at two places 600 feet apart on the L. C. Gentry farm, about one mile from the former locality. All three places are 50 miles from Abingdon, Virginia, and 40 miles from Marion, Virginia. Crystals have also been found close to the north fork of Piny creek, on the Saint Ledger Brooks farm. At the latter place was found a remarkably clear distorted crystal, weighing 20½ pounds, which is absolutely perfect, and is the finest piece of rock crystal ever found in the United States; and on the Gentry farm one crystal was found weighing 188 pounds, and another weighing 285 pounds. The latter was 29 inches long, 18 inches wide, and 13 inches thick, showing one pyramidal termination entirely perfect and another partly so; it sold for over $500 for use in the arts. A number of others have also been found. All these localities are on a spur of Phœnix mountain, and the crystals have all been found in decomposed crystalline rocks, principally coarse felspathic granite, which has all decomposed even to a greater depth than that at which these crystals occur. Most of them are obtained by digging where one crystal has been found or striking and unearthing them with a plow. Altogether several dozen crystals have been found, weighing from 20 to 300 pounds each, and future working will doubtless bring many fine ones to light. Some of these afford larger masses of clear rock crystal than have ever before been found in the United States, and suggest its use for such objects of luxury as crystal balls, clock cases, mirrors, etc., which are now to be seen in the Austrian treasury at Vienna.

From the vicinity of Fairfax county, Virginia, Mr. James W. Beath obtained quartz with alternate green and white veinings, the green being produced by chloritic inclusions. When cut it forms an interesting ornamental stone, and several hundred dollars' worth of it have been sold.

Mr. H. L. Hosmer reports that crystals of smoky quartz a foot in length are occasionally found at Sterling, Montana.

Chrysoprase.—Mr. William Irelan, jr., reports from Tulare county, California, beautiful semi-transparent chrysoprase of fine color. This has also been found in Douglas county, Oregon.

Agate.—At Sioux Falls, Dakota, the company that is cutting and polishing the agatized wood from Arizona and the quartzite found at Sioux Falls has, after a great deal of experimenting, perfected the methods of sawing and polishing hard materials so as greatly to reduce the cost. Among the objects produced were a round column 11¼ inches wide and 21 inches high, cut transversely across the tree, so that the heart was visible on two sides of it, with the radiations in all directions; and sections measuring 25, 24, 17½, and 13 inches in diameter, respectively, so highly polished that when turned with the back to the light they form a perfect mirror. All the specimens were brilliant in color and rivaled any work ever done in hard materials. The company has removed from the forest 180 tons of material, and 20 tons of sections have been ground down to show its characteristic beauties. Perhaps $100,000 worth is now undergoing the cutting and polishing process.

Pectolite.—A massive pectolite of unusually dense structure has been announced by Mr. William P. Blake as occurring in Tehama county, California, in masses of considerable size and susceptible of a high polish. In a letter to the writer he gives the following description: "It occurs in a vein, and is broken out in rough tabular masses from 2 to 3 or more inches in thickness, but it is reported that much larger masses can be obtained. It is exceedingly tough and hard to break. The punctured surfaces are irregular, without cleavage, but have a silky luster and crypto-crystalline structure, exhibited in extremely fine inseparable fibers, which are radial, curved, and interlaced, and are perhaps embedded in a siliceous magma, but the fibers constitute the bulk of the mass. The color is white, with a delicate shade of sea green, and translucent. Exposed or weathered portions lose their porcelain-like translucency, and become white and somewhat earthy in appearance, and exhibit the crypto-fibrous structure with more distinctness. Specimens cut and polished across the end of a slab-like mass show on one side a narrow selvage of breccia, made up of fragments of the pectolite and of dark-colored wall rock mixed and firmly cemented together. On the opposite side or border of the mass there are distinctly formed parallel planes of concentric layering, from the surfaces of which the fibers diverge. These layers and the brecciated border opposite show the vein-like formation of the mass between the walls. The hardness is 6 to 6.5. In the blow-pipe flame it burns to a white enamel and gives off a little water. It may be found useful as an ornamental stone for making small objects—cups, plates, handles, or for carving figures or inlaid work." This is identical with the pectolite from Alaska, described by Prof. F. W. Clarke.

Peristerite.—Large quantities of peristerite are reported by Mr. C. M. Skinner at Cavendish, Vermont., near Cavendish Falls, in the railroad cut 22 miles northwest of Bellows Falls.

Oligoclase.—Of great interest is the transparent oily green oligoclase containing small, white, starlike inclusions, which impart to the mass all the appearance of green glass, and with included white minerals found at a depth of 400 feet in mica near Bakersville, North Carolina. It was found by Mr. Daniel Bowman.

A very interesting variety of sunstone was found by Mr. J. A. D. Stephenson at the quarry in Statesville, North Carolina. Several hundred dollars' worth of it has been sold as gems.

Albite.—In the Allen mica mines at Amelia Court House, Amelia county, Virginia., as a by-product in mica mining, a remarkable series of albite has been found, tabular, but measuring 4 to 7 inches in length and forming large groups; also the same mineral in massive form of the moonstone variety, and tons of amazonstone in bright cleavages.

Rhodonite of the variety known as fowlerite has been found in Franklin Furnace, New Jersey, in groups of rich, flesh colored crystals finer than ever before known. Some of these were 6 or 7 inches in length and several inches thick, forming groups a foot across. Although of value for gem material they possess a higher mineralogical value, and more than $1,000 worth was sold for specimens. The rhodonite so well known as occurring in bowlders at Cunningham, Massachusetts, has recently been traced to the ledge, and we may now hope to see this stone used extensively for decorative and ornamental purposes, as at this locality it is one of the richest pink and flesh colored minerals known.

Turquois.—Additional evidence of the antiquity of the turquois workings of New Mexico and Arizona has been gathered by the Hemenway expedition, sent out by Mrs. Hemenway under the direction of Mr. Frank H. Cushing. About 10 miles from Tempe, Arizona, where the excavations are being made, a shell encrusted with turquois and garnet representing the form of a frog was found.

Cyanite.—Mr. Daniel A. Bowman communicates that the cyanite mentioned in the last report was found near the summit of Yellow mountain, alongside the road to Marion, about 4 miles southeast of Bakersville, North Carolina, at an altitude of 5,500 feet. Some of this is transparent, from one-eighth to one-half inch across and several inches long. So rich is its color that it was sold for sapphire. Its low hardness unfits it to some extent for use as the gem for which it is to be worn. It is a handsome mineralogical gem, however.

Crocidolite.—In the *American Journal of Science*, III Series, volume 34, page 108, Prof. A. A. Chester published analyses of the crocidolite from Beacon Hill Pole, Cumberland, Rhode Island, an interesting occurrence of this mineral, though not in gem form.

Labradorite.—The well-known Labradorite rock in Lewis county, New York, is so plentiful that the reflection of the bowlders has given the river that runs through the locality the name of Opalescent river. This is being extensively cut as an ornamental stone.

Mexican onyx.—The handsomest and lowest priced of our ornamental stones, and one which has been introduced most extensively, is the so-called Mexican onyx or Tecalli, as it was first called, from the town of that name in the state of Pueblo, Mexico, where it is found. The deep colors are richer than those of any marble known, and its wavy stalagmitic structure and the high polish which it can take have made it popular throughout the whole civilized world. With a metal mounting the effect is greatly enhanced. It occurs in almost unlimited quantities, and fully $500,000 worth has been used in the United States for table tops, mantels vases, etc.

FOREIGN SOURCES.

In this, the fifth of the annual reports on precious stones in the United States, which have done much toward awakening a wide-spread interest in American gems, it was thought well to give a brief sketch of some of the most important changes which are taking place in precious stones at the principal sources, which are usually foreign.

Diamonds.—The author of the "Arabian Nights" undoubtedly thought that he was imagining the wildest and most improbable things when he described the collection of such treasures in the Valley of Diamonds by "Sinbad the Sailor." Yet when compared with the African mines this profusion of wealth has paled into utter insignificance. A glimpse at these new valleys of diamonds will be interesting. The primitive method of washing was carried on for centuries by thousands of slaves, who, like those who built the pyramids, were driven by a master mercilessly goading them on, whip in hand. To-day we have the most ingenious and powerful machinery, which allows fewer diamonds to escape than would the keenest and most disciplined army of washers.

At the Kimberley diamond mines in South Africa wonderful progress has been made in the last decade. About 1877 the work of consolidating the different companies began. Originally the mines were worked as 3,238 separate claims, each 31 feet square, with a 7½ foot roadway between every two claims; now these are all united in about forty companies. A mine in the early days was a bewildering sight. Miles of wire cables running from individual claims were stretched across it in all directions; to these were attached the buckets for carrying the earth, reef, or wall rock of the mines, and at times water. Some of the claims were almost level with the surface, while others next to them might be cut down 200 feet, and others only 100 feet, yet all being worked independently. At the sides were endless belts with pockets for carrying the earth. One of the results of this independent system of working was that rock was dropped so recklessly that it is said to have been as dangerous as the battlefield to stand around the edges of the claims. Not only was the loss of life great from this source, but also from the falling of immense masses of reef, loosened by the blasting, which sometimes buried a score of men at once. But improved methods were gradually introduced. Steam railroads were run into the mine, and parts of it were leveled down. Millions of tons of reef required removing, and the only way to accomplish this was to assess every company in the mine proportionately. At first many mistakes were made, if mistakes they can be called when the problems offered for solution were entirely new and untried. The yellow or surface soil which overlaid the blue stuff pulverized so readily that it could be taken to the washing machine direct; but as the claims were extended down into the blue rock this proved harder, and dynamite became necessary. Immense quantities of it are now used for blasting. Through careless storing, 30 tons of dynamite, 10 tons of blasting powder, and gelatine, in all worth $80,000, exploded on January 10, 1884, with terrific effect; the smoke column, 1,000 feet high, was visible at the River diggings, 35 miles distant.

After the earth is raised it is put on the sorting ground, where it is partially disintegrated by water and the action of the atmosphere. It is then further broken up by hand and taken to the "compound" or diamond-sorting machine. After being more finely broken up it is passed down into large vats containing immense centrifugal wheels, by which, as they rapidly revolve, the rock is finely divided. The lighter minerals, such as quartz, mud, and mica, are then floated out, while the diamonds, garnets (some of which are exceedingly rich in color, and of large size and are sold under the name of cape rubies), and other heavy minerals, are concentrated in the lower part of the "compound." So thoroughly does this pulverize the rock and earth that all the diamonds, even those of the size of a pinhead, are saved.

A prize of £5,000 was offered for the best tunnel or shaft system for use at the Kimberley mines, and the prize was awarded to the Jones system, which is sunk on the coffer-dam principle. At present there are seven shafts and inclined planes in the Kimberley mine alone, all sunk at some point in the reef outside of the mine. From 11,000,000 to 13,000,000 gallons of water are annually hoisted from the Kimberley mine at a cost of 6 pence per load of 100 gallons.

In addition to many miles of aerial tramways, there are over 170 miles of tramway around the four Kimberley mines, 2,500 horses, mules, and oxen, and 350 steam engines, representing 4,000 horse power, are employed in the works. For labor, £1,000,000 are annually expended, and over £1,000,000 for fuel and other supplies. The gross capital of the companies is nearly £10,000,000. Over 10,000 natives, each receiving £1 per week, and 1,200 European overseers at an average wage of £5, are employed. It is now proposed to consolidate all the companies into an enormous diamond trust, with a capital of £10,000,000, but at the present quotations of the shares of the company they are valued at over £14,000,000. The supposition long held that this unification would ultimately be accomplished is partly confirmed by the report, this spring, that the house of the Rothschilds, of London, is about to put in operation a project for the consolidation of the diamond mines into one gigantic trust for the regulation of prices and production.

The South African mines yielded during the last ten years 27,878,587 carats, valued at £31,717,341. The yield for 1887 was 3,646,899 carats, worth £4,033,582 at a valuation of £1 2*s.* 1½*d.* a carat. In December, 1887, a single sale of rough diamonds was recorded of £150,000, and in February, 1888, of £250,000, or $750,000 and $1,250,000, respectively. The average value of a carat of diamonds for some years from the respective mines has been as follows:

Average value of a carat of South African diamonds.

	s.	*d.*
Kimberley mine	17	6¼
De Beers mine	17	8
Bultfontein	18	2½
Dutoits Pan	24	7¼
River digging	47	6

The product of the latter mine, while only one one hundred and twenty-fifth of the weight in carats, was worth one sixty-second of the entire product, the stones averaging much finer quality.

The approximate annual yields for the last ten years have been as follows:

Yield of South African diamonds during the past ten years.

Years.	Carats.	Value.
1878	2, 540, 000	£2, 672, 734
1879	2, 610, 000	2, 864, 631
1880	3, 030, 000	3, 168, 000
1881	3, 315, 000	4, 200, 000
1882	2, 385, 000	3, 500, 000
1883	2, 312, 000	2, 359, 466
1884	2, 204, 786	2, 228, 678
1885	2, 287, 263	2, 228, 680
1886	3, 047, 639	3, 261, 570
1887	3, 646, 899	4, 033, 582
River diggings	500, 000	1, 200, 000
Total	27, 878, 587	31, 717, 341

Not only has the yield of the African mines been great, but the diamonds have been of much larger average size than those from any of the old mines. The finding of a 17-carat stone in the Brazilian diggings was sufficient to secure the freedom of the fortunate slave who found it; but stones of this size are found by the hundred here. A 100-carat stone scarcely creates as much excitement as a stone of one-fifth the size did in Brazil.

It is estimated that from one-fifth to one-quarter of all the yield never reached the proper owners, as the native diggers swallow and conceal the diamonds in every possible manner. Hence it became necessary for the companies, in self-defense, to take extraordinary precautions against this great loss, and overseers or special searchers were appointed, who made the most thorough examination of all who left the mines. The natives use most ingenious methods for the concealment of the gems. On one occasion some officers, suspecting that a kafir had stolen diamonds, gave chase and caught up with him just after he had shot one of his oxen. No diamonds were found upon the kafir, it is needless to say, for he had charged his gun with them, and after the disappearance of the officers he dug them out of his dead ox. Diamonds have been fed to chickens, and a post-mortem recently held over the body of a kafir revealed the fact that death had been caused by a 60 carat diamond which he had swallowed. Early in the history of the mines a detective force, consisting of men, women, and children, was formed, and the severest punishment is still inflicted on transgressors of the diamond act. None but those authorized by law, termed patented agents, less than fifty in number, are allowed to purchase or even to possess rough diamonds at Kimberley.

The actual loss of diamonds would not have been so great but for the irregular diamond buyers, or "I. D. B.s," as the "fences" are called, who sent the stones to England and undersold the company in the London market. It was a question at one time whether the mines could be profitably worked under such disadvantages. Within the last two years, however, this pilfering has been in great measure checked by the adoption of what is known as the compound system, by which the "boys" are housed and fed under contract for a certain term, provided with amusements and liquor, and thus kept apart from the influences of the vicious whites. Now the visitors who buy from native diggers what they suppose to be valuable diamonds and secrete them until they have passed beyond the reach of the officials, find to their disgust that they have purchased fac-similes in glass, perfect even to the characteristic yellow tint peculiar to many diamonds from this locality.

Diamonds weighing 38,000,000 carats, or over 7½ tons, have been found here. In the rough their aggregate value is £50,000,000, and after cutting, £100,000,000, or nearly $500,000,000 more than the world's yield during the two preceding centuries. Of the whole yield not more than 8 per cent. can be said to be of the first water, 12 per cent. of the second water, 25 per cent. of the third, while the remaining 65 per cent. is called bort, a substance which, when crushed to powder, is of use in the arts for cutting hard substances and engraving. This must not be confounded with the carbon (carbonado) found in Brazil, an uncrystalline form of the diamond, which, from its structure, is adapted for use in drills for boring and tunneling rocks, etc., and has never yet been found in South Africa. It is worth from six to ten times as much as bort.

More diamonds weighing over 75 carats after cutting have been found since the African mines were opened than were known before. The Victoria, the Great White, or the Imperial Diamond, is supposed to be from South Africa. Concerning its early history very little is known; in fact, where the stone was found is only a matter of conjecture—a remarkable circumstance when we consider that it is the largest brilliant in the world. The original weight of the stone was 457½ carats, or 3$\frac{1}{60}$ troy ounces; after cutting, 180 carats, valued at £100,000.

On March 28, 1888, there was found in the De Beers mine an octahedral crystal of diamond weighing 428½ carats; it is not entirely white, having a slight yellow tinge. It was valued at £3,000. From its form it is believed that it will cut into a brilliant of 200 carats, hence it will be the largest known.

Production of diamonds at the Griqualand West mines, Kimberley, De Beer's, Dutoitspan, Bultfontein, and St. Augustine, from September 1, 1882, *to December* 31, 1887.

Years.	Carats.	Value.	Average per carat.	
			s.	*d.*
1882, four months	856, 353⅜	£1, 119, 210	26	1½
1883	2, 312, 234⅛	2, 359, 466	20	4¾
1884	2, 204, 786½	2, 562, 623	23	2¾
1885	2, 287, 261	2, 228, 678	19	5¾
1886	3, 047, 639¾	3, 261, 574	21	5
1887	3, 646, 899¾	4, 033, 582	22	1½
Total	14, 355, 174½	15, 565, 133	21	8¼

Comparative yearly exports of diamonds from January 1, 1883, *to December* 31, 1887

Years.	Carats.	Declared value.			Average per carat.	
		£	*s.*	*d.*	*s.*	*d.*
1883	2, 413, 953⅜	2, 742, 521	1	0	22	8⅝
1884	2, 263, 686⅝	2, 807, 288	3	4	24	9½
1885	2, 440, 788⅛	2, 492, 755	13	2	20	5
1886	3, 135, 432¾	3, 507, 210	14	0	22	4
1887	3, 599, 036¼	4, 251, 837	14	6	23	7½
Total	13, 852, 897⅛	15, 801, 613	6	0	22	9¾

Imports of diamonds into Kimberley from the River diggings, from September 1, 1882, *to December* 31, 1887.

Years.	Carats.	Value.	Average per carat.
			s. d.
1882, four months	5,742⅜	£26,010	20 11⅛
1883	14,800⅜	37,112	50 1¾
1884	19,710⅜	57,639	58 5¾
1885	27,992	56,123	40 1⅛
1886	38,673⅞	84,829	43 10¼
1887	46,171½	95,433	41 4⅛
Total	153,090½	337,146	44 0½

Summary of imports of diamonds into Kimberley from September 1, 1882, *to December* 31, 1887.

Whence imported.	Carats.	Value.	Average per carat.
			s. d.
Colony, England, etc	130,133½	£127,831	19 7¾
Orange Free State	306,660⅝	505,428	32 11½
River diggings (Barkly West)	153,090½	337,146	44 0½
Total	589,884⅝	970,405	32 10¾

Summary of production of diamonds at the Griqualand West mines for the year 1887.

Mines.	Carats.	Value.			Average per carat.
		£	s.	d.	s. d.
Kimberley	1,333,832½	1,410,207	12	1	21 1¾
De Beer's	1,014,048	1,022,878	6	5	20 2
Dutoitspan	696,576¼	987,283	17	8	28 4⅛
Bultfontein	602,246	612,962	18	6	20 4¼
St. Augustine	197	250	0	0	25 4½
Total	3,646,899¾	4,033,582	14	8	22 1½

Production of diamonds, Kimberley mine, from September 1, 1882, *to December* 31, 1887.

Years.	Carats.	Value.	Average per carat.
			s. d.
1882, four months	380,955¼	£456,420	23 11½
1883	947,817⅜	846,705	17 10¼
1884	642,438	634,332	19 9
1885	523,774½	458,858	17 6¼
1886	889,864	883,503	19 10¼
1887	1,333,832½	1,410,207	21 1¾
Total	4,718,681⅝	4,690,025	19 10½

The diamond mines at Salabro, Brazil, known as the Canavieiras, were discovered in 1882 by a poor miner who had worked in the earlier mines, now nearly exhausted. They are situated at a distance of two days' journey from Canavieiras, near the river Pardo, and the gems are found at a depth of about 2 feet in a red gravel. They are very fine in quality, and are remarkable for their purity and whiteness, the crystals being of such a form that scarcely any cleaving is necessary.

History repeats itself, and as, when the Brazilian mines were first discovered, they sent the stones to India to enter the European markets in European wrappers, so Bultfontein diamonds were sent to Canavieiras to be shipped to Europe as the product of that mine.

So great was the rush for these mines at first that, notwithstanding the rumors of a malarial climate and epidemic diseases, by the end of the first year 3,000 miners were at work where shortly before was a virgin forest. For a time even this number was exceeded. The other Brazilian mines have been only slightly worked of late years.

The recent concentration of some of the diamond mining companies in South Africa in their efforts to regulate the production and price has led to an increased interest in mines located in Brazil and India. During the past year the Madras Presidency Diamond Fields Company (limited) has been organized with a capital stock of £190,000. To prove that the Indian mines are not yet exhausted, operations will be commenced at the Wadjra Karur field in the Madras presidency. On this field of 554 acres was found a very fine 67½ diamond crystal which furnished a 25 carat stone called the Gow-do-Norr, valued by the company at £15,000. An English company has recently been formed, under the name of the "Hyderabad Deccan Mining Company," to work the mines in Krishna valley, India, where it is thought that the famous Kohinoor diamond was found.

Diamonds have been found in the Tertiary gravels and recent drift near Bingera in Inverell, Australia; also along the Cudgeon river, 160 miles northwest of Sydney, and in other districts. The colors are white, straw, yellow, light brown, pale green, and black. The largest stones yet found were cut into gems weighing 3½ and 3 carats, respectively. A trial made by the Australian Diamond Mining Company produced 190 diamonds, weighing 197¾ carats, from the washing of 279 loads of earth. These Australian fields can scarcely be called productive as yet, nor from present appearances do they seem likely to become formidable competitors of the South African fields.

India, Borneo, and Australia are now yielding very few diamonds, probably not more than 1 per cent. of the entire product. These three countries, together with Brazil, yield probably less than 10 per cent. of the total output.

Imports of diamonds.—From the custom import lists we find that after deducting the approximate value of cut stones other than the diamond, we find that import duty was paid on about $90,000,000 worth of cut diamonds in the last twenty-one years; of these $68,000,000 worth were imported during the last ten years. In 1868 $1,000,000 worth were imported and $1,200,000 worth in 1867, but about $10,000,000 in 1887, or ten times as many as twenty years ago, showing the increase of wealth and the great popularity of the diamond among Americans, the above being the wholesale import figures. A single firm sells more than the entire imports of twenty years ago.

Diamond dust worth $464,905 has been imported since 1878, $289,430 worth from 1868 to 1878, and in 1869 to 1871 only $228 worth; whereas with the opening of the Kimberley mines $80,707 worth were imported the first year, showing what great benefit the arts received from the opening of the African diamond mines.

In 1878 the importations of uncut diamonds amounted to $63,270; in 1887 to $262,357; the total for the decade was $2,728,214, while in 1883 there were imported $443,996 worth, showing that although we are cutting four times as many diamonds as we were in 1878, yet the importations have been falling off. This is partly because in the years from 1882 to 1885 a number of our jewelers opened diamond-cutting establishments, but have either given up the business or sold out to others; for, in spite of the protective duty of 10 per cent. on cut stones, cutting can not be profitably carried on here on a scale large enough to enable one of the partners to reside in London, the great market for rough diamonds, to take advantage of every fluctuation in the market, and purchase large parcels which can be cut immediately and converted into cash; for nothing is bought and sold on a closer margin than rough diamonds.

Diamond cutting.—The recent death of Mr. Henry D. Morse, of Boston, known as the pioneer diamond cutter of the United States, brings to mind many interesting reminiscences. He has scarcely received the credit he deserved for his work. That he was the first in this country to cut diamonds is well known, and the best cutters in the United States to-day received their training under him. But educating young Americans, both men and women, to his art, was not his greatest work. He showed the world that the art which had so long been monopolized by the Hollanders was degenerating in their hands into a mere mechanical trade. His treatment of the diamond has given a great stimulus to the industry both in the United States and abroad. Shops were opened here and in London in consequence of his success. He was one of the few who studied the diamond scientifically, and he taught his pupils that mathematical precision in cutting greatly enhances the beauty and consequently the value of the gem. His artistic eye, sound judgment, and keen perception enabled him to carry the art nearer to perfection than is often attained.

It was in his shop that a machine for cutting diamonds was invented which did away in great measure with the tediousness and inaccuracy of the old manual process. Thanks to his labors, we now have among us the best cutters in the world—men who can treat the diamond as it should be treated to develop its greatest beauty. The fact that so many fine stones were recut here after he started his wheel led to a great improvement abroad in cutting, especially in the French Jura and in Switzerland, where both sexes are now employed at the trade; and, as a result, the diamonds sold to-day are decidedly better than those of twenty years ago, before Mr. Morse turned his attention to the work. He, above all others, has shown us that diamond-cutting is properly an art and not an industry.

There are at present about 12 cutting establishments in this country, employing from 1 to 50 men each, and in all about 100, at salaries ranging from $20 to $50 per week. Most of the cutting done here is of a high class, some shops being almost entirely employed in recutting stones previously cut abroad. Ten years ago nearly all the diamonds used in the United States were purchased through brokers or importers. To-day, owing to the marvelous growth of the diamond business here, and the facilities for transatlantic travel, many of the large retail houses buy their diamonds direct in the European markets; and some have even established branches or agencies abroad.

In 1877 an international syndicate composed of London, Paris, and Amsterdam jewelers, wishing to establish a uniform value for the carat, confirmed 205 milligrams as the standard, and this has been pretty generally used abroad. Recently the discussion of the question has been reopened, and it will probably end in the general adoption of the above standard in place of the twenty or thirty conflicting systems now in use in different parts of the world.

Twenty years ago the wholesale diamond merchants of Amsterdam did not exceed 8 in number; but the development of the African mines has given so great an impetus to the trade, that within the past decade several diamond exchanges or clubs have been established as headquarters for the transaction of business; one of these, the "Handelsbond," has a membership of 800 and owns a fine building, the rooms of which are so arranged with respect to light as to render deception difficult and to facilitate the sale of diamonds. Others known as the "Golconda" and the "Koh-i-noor" are generally thronged with brokers and merchants, as also are the neighboring coffee houses.

At present there are between 50 and 60 large diamond-polishing establishments, employing perhaps 3,500 polishers, who, however, no longer receive the princely wages of from $80 to $200 a week which they received when the African mines first began to produce so largely, and much higher prices were paid for products of the second and third quality. When fortune smiled on them the cutters lived in luxury; to-day they only receive $15 to $40 a week, and some even less than the former figure. To-day every establishment does its own selling. It will doubtless be eventually a question of the survival of the fittest, and the entire cutting will be controlled by a few powerful firms.

Sapphire.—In 1882 a very remarkable discovery of sapphire was made in the Zanskar range of the northwestern Cashmere Himalaya, near the line of perpetual snow, a short distance from the village of Machel and one-half day's journey from the top of Umasi pass. The stones were found at the foot of a precipice, where a land slide had taken place, the including rocks being gneiss and mica.

At first they were merely collected by the villagers, who were attracted by the beautiful colors; and so little was their value realized that they were used as flints for striking fire with steel. They were so abundant at first that one writer speaks of having seen about a hundred weight of them in the possession of a single native. Traders, however, soon carried them to the distant commercial centers, where their value became known. There was an instant rush of jewelers' agents to the locality of the mine, and the price rose rapidly until about £20 per ounce was paid for good specimens, at which rate they have remained. The Maharajah of Cashmere promptly exercised his authority and sent a regiment of sepoys to take possession of the mines and harry the natives who were suspected of having stones in their possession or any knowledge of new localities where the gems could be found. Any one they laid hands on who had money was suspected either of having sold sapphires or of being about to purchase them, and was despoiled or even imprisoned. This naturally enough had the effect of compelling secrecy. Several crystals were found weighing from 100 to 300 carats each. During the first year of the discovery the Delhi jewelers are said to have bought up more than £20,000 worth of these sapphires. Exceptionally fine sapphires to-day bring from $65 per carat to $125 per carat, which is less than before this great find.

The acquisition of the Burmese ruby mines cost the British Government a vast sum of money. On the wars of 1826 and 1852 England expended $75,000,000 and $15,000,000, respectively, and after all this sacrifice of treasure the Burmah and Bombay Trading Company claimed, four years ago, that King Thebaw, of Burmah, had arbitrarily canceled the leases by which the company controlled the output of the ruby mines near Mandalay. A meeting was accordingly held at Rangoon, on October 11, 1884, presided over by Mr. J. Thompson, agent for Messrs. Gillanders, Arbuthnot & Co. The result was the war of 1886, which involved the raising of an army of 30,000 men and an outlay of $5,000,000, but the British Government gained control of the long coveted ruby mines. The question which next presented itself was, how should they be worked? Several firms were desirous of securing the lease, and after the Indian Government had virtually closed a lease to Messrs. Streeter & Co., the London jewelers, at an annual rental of 4 lakhs of rupees (£40,000), for a term of five and one-half years, with the privilege of collecting 30 per cent. on all stones mined by others, the home Government revoked the lease for some unexplained reason, probably on account of trade jealousies, although Mr. Streeter had apparently every assurance of the acceptance of his proposition and had even made preparations to begin work at the mines.

The ruby mines of Burmah are situated in the valley of the Mogok, 51 miles from the bank of the Irrawaddy river and about 75 miles north of Mandalay, at an altitude of 4,200 feet. Concerning these mines very little has been learned up to the present, as they were always the monopoly of the Crown and were jealously guarded. It was said that they paid King Thebaw's Government annually 100,000 rupees and one year 150,000 rupees. Mining is carried on there by forty or fifty wealthy natives, who employ the poorer townspeople at liberal wages; but at present only seventy-eight mines or diggings are in operation and the work is done in the most primitive manner. The gravel is carried in baskets. The holes from which they are taken are allowed to fill with water every night. All of the gems are sent to Ruby Hall, Mandalay, to be valued. At present the royalty exacted by the English Government is 30 per cent. A stone was lately sold in Mandalay for 8,000 rupees, but without the knowledge of the officials.

One thing, at least, we learned from the British occupation of Burmah, namely, that King Thebaw did not own the dishes of rubies which were said to outrival anything known. His possessions of this kind proved to be only a few stones of poor quality.

Watch jewels.—About 1,200,000 watches with jeweled works are annually manufactured in the United States, requiring about 12,000,000 jewels, 7 to 21 for each watch; of these 5,000,000 are ruby and sapphire, and 7,000,000 are garnet jewels, valued at over $300,000. Most of them are imported, but the Waltham Company does its own cutting, employing in this department about 200 hands, under the superintendence of Mr. W. R. Wills. About 15,000 carats of bort, in powdered form, are used annually in slitting and drilling these jewels. Nearly all the ruby, sapphire, and garnet used for jewels are imported, but it is hoped that American materials will soon be used. To be of value for this purpose, the material must be of some decided shade of red or blue, of a hardness greater than quartz, and free from flaws.

During the last decade new stones have come into favor, some neglected ones have regained their popularity, and still others, such as the amethyst and cameos, have been thrown out entirely. The latter, no matter how finely cut, would not find purchasers now at one-fifth of their former value; about ten years ago they were eagerly sought after at from four to twenty times the present prices. Rubies were considered high ten years ago, and a further rise was not looked for, but today they are still higher, a $9\frac{5}{16}$ carat stone having been quoted at $33,000. There is no demand at present for topaz, yet a syndicate of French capitalists has been organized to control the topaz mines of Spain in the expectation that after twenty years of disfavor this gem will again be popular. Coral has felt the change of fashion, for during the last three years the imports have been less than $1,000 per annum, and in the last ten years in all $33,956, whereas in the ten years preceding $388,570 worth were imported. The popularity of amber, on the other hand, is increasing. The imports of amber beads for the ten years, 1868 to 1878, amounted to less than $5,000, whereas during the last ten years $35,897 worth have been introduced. Amber amounting to only $47,000 was imported from 1868 to 1878, but over $350,000 worth from 1878 to 1888. Brazilian pebbles worth $65,000 have been cut or sold ready for regrinding since 1878, and less than $3,000 in the ten years preceding.

Ten years ago few of our jewelers carried more than the following stones in stock: Diamond, ruby, sapphire, emerald, garnet, and occasionally a topaz or aquamarine. The gem and mineralogical collections contained a large series of beautiful stones, hard, and of rich color, but known here as "fancy stones" and by the French as *pierres de fantasie.* Since then considerable interest has centered in these fancy stones, and any leading jeweler is not only expected to be familiar with, but to keep almost all of them in stock. This change may be partly referred to the fact that since the Centennial Exhibition art matters have received more attention among us than before.

The Duke of Connaught gave his bride elect a cat's-eye ring as an engagement token; this was enough to make that stone fashionable and to increase its value greatly. The demand soon extended to Ceylon, where the true chrysoberyl cat's-eye is found, and stimulated the search for them there. In the chrysoberyl cat's-eye the effect is the result of a twinning of the crystal, or of a deposit between its crystalline layers of other minerals in microscopic inclusions. If the stone be cut across these layers *en cabochon*, or carbuncle cut, as it is called, a bright line of light will be noticed on the dome-like top of the stone. In price they range from $20 upwards; exceptional stones have sold at from $1,000 to $8,000.

In the search for these chrysoberyl cat's-eyes an endless series of chrysoberyls has been found, of deep golden, light yellow, yellow green, dark green, sage green, yellowish brown, and other tints. They are superb gems, weighing from 1 to 100 carats each, ranking next to the sapphire in hardness. They gave a great surprise to the gem dealers; for it was found that the darker leaf green or olive green stones possessed the wonderful dichroitic property of changing to columbine red by artificial light, the green being entirely subdued and the red predominating. They were in fact alexandrites, a gem which had formerly been found only in Siberia, and even there of poor quality; though found in large crystals, a perfect gem of even 1 carat was a great rarity. Here, however, fine gems but rarely under 4 carats were found and an exceptional one weighed 67 carats. They can be numbered among the most remarkable gems known. Strange to say, among this alexandrite variety a few have been found which combine the characteristics of the cat's-eye and the alexandrite and were accordingly named the alexandrite cat's-eye.

Moonstones also from this same province of Kandy, Ceylon, were brought to light by this search for cat's-eyes. It would not be an overestimate to say that 100,000 of these stones have been mounted here in the last four years. They vary in size from one-eighth of an inch to nearly 2 inches long and 1 inch thick, and many of them surpass anything hitherto known of their kind in beauty and size, selling from 50 cents to $100 each, in a few exceptional cases $150. Those displaying the *chatoyant* white and the opalescent blue color are especially beautiful.

The demand for the cat's-eye also brought into demand the then rare mineral from the Orange river, South Africa, known as crocidolite, more especially that variety that has been altered to a quartz cat's-eye. In this stone an infiltration of siliceous material coated each fiber with quartz or chalcedony, giving it the hardness of 7. This pleasing stone readily sold for $6 a carat, and at the outset for even more; but owing to the excessive competition of two rival dealers, who sent whole cargoes of it to the London market, the price fell to $1, or even to 25 cents per pound in large quantity. Even table tops have been made of this material by veneering. Vases, cane heads, paper weights, seals, charms, etc., were made of it and sold in large quantities. Burning it produced a bronze-like luster, and by dissolving out the brown oxide of iron coloring an almost white substance was obtained, which was dyed by allowing it to absorb red, green, and brown colored solutions. These, owing to the delicacy of the fibers, were evenly absorbed. Ten years ago this material was practically unknown, but so extensively has it been sold that to-day it is to be found at every tourist's stand, whether on the Rigi, on Pike's Peak, in Florida, at Los Angeles, or at Nishni Novgorod, showing how thoroughly organized is the system of distribution in the gem market. The green quartz cat's-eye from Hof, Bavaria, has also been brought into use and quite extensively sold, but at present both these varieties are only used in the very cheapest jewelry.

Since it has become generally known that Queen Victoria is partial to the opal, the old and stubborn superstition concerning it, which is said to date from Scott's "Anne of Geierstein," has been slowly yielding, until now the gem has its share of public favor. During the last two years ten times as many opals have been imported as were brought here during the preceding decade, many of these being the fine Hungarian stones. Mexican fire opals are much more common, as those tourists know to their sorrow who buy these stones at exorbitant prices in Mexico, hoping thus to pay the expenses of the trip, until they find on reaching New York that they are worth only about a quarter of what they paid for them.

The opal mines of Mexico are situated on the Hacienda Esperenza, near Queretaro. It is believed that a demand of 50,000 stones per annum could be supplied without raising the price perceptibly.

The opal mines of Dubreck, Hungary, yield the Government a revenue of $6,000 annually. The output is so carefully regulated that the market is never glutted.

About ten years ago a new and very interesting variety of opal was brought from the Baricoo river, Queensland, Australia, where it was found in a highly ferruginous jasper-like matrix, sometimes apparently as a nodule and then again in brilliant colored patches, or in specks affording a sharp contrast with the reddish brown matrix, which admits of a high polish and breaks with a conchoidal fracture. Many of these stones are exceedingly brilliant. They are of the variety known as harlequin opals, their color being somewhat yellow as compared with the Hungarian stone, although not less brilliant. The rich ultramarine blue opal is quite peculiar to this locality, and the green variety almost transcends the Hungarian. A company capitalized at £200,000 has been formed, and the gems are extensively mined. Many curious little cameo-like objects, such as faces, dogs' heads, and the like, are made by cutting the matrix and the opal together.

Green beryls, blue and green sapphires, white and bluish topaz, garnets, and zircons have been found at New England in New South Wales, and precious opals are obtained from the Abercrombie river.

During the last ten years the taste for collecting jade and other carved hard stone objects has greatly increased, especially among Americans, owing to the stimulus given by the Centennial, Paris and Amsterdam expositions, and the breaking up by sale of many of the large collections. The value of carved jades outside of China and India can not be far from $2,000,000.

In the United States there are, perhaps, twenty buyers, who have purchased fully $500,000 worth of this material, many of the pieces being among the finest known, such as the private seal and other objects from the sacking of the Emperor of China's summer palace. The finest pieces, brought over by Tienpau, included some of the best that ever left China, and were intended for the Amsterdam exhibition; the choicest specimens of the Wells, Guthrie, Michael, and Hamilton palace collections are now owned in the United States. Experienced agents have been frequently sent to India and China to secure the finest objects as they presented themselves. One collection alone is worth over $100,000; single objects sometimes selling for over $5,000, and one exceptionally fine specimen being valued at over $10,000. Explorations in Alaska have brought to light the fact that jade was used by the natives for implements, and it is almost proved that it is found not only as bowlders but also *in situ*. The National Museum, the Emmons, Everett, Peabody Museum, Canadian Geological Survey, Dresden, and other collections, including the writer's own, contain several hundred objects, at least, that are made of this Alaskan material. A fact of interest in this connection is that Prof. F. W. Clarke found among the objects collected for the National Museum one which, on analysis, proved to resemble pectolite so closely that he referred it to that species. It has the hardness of jade, a specific gravity of 2.873, and is pale green in color. The same discovery was made almost simultaneously by foreign observers.

The theory that jadeite or chalchiuitl was highly prized by the aborigines has been greatly strengthened during the last ten years. Prof. J. J. Valentine, in his paper before the American Antiquarian Society, April 27, 1881, on the Humboldt celt or votive adze and the Leyden plate, two remarkable carved jadeites, offered some exceedingly interesting suggestions. The Humboldt celt was presented to Humboldt by Del Rio in 1803, and the Leyden plate was given to that museum by A. S. Von Bramm, who found it near St. Felipe, close to the borders of Guatemala, in Honduras. They are both 9 inches in length and 3¼ inches wide; the former 1⅗ inches in thickness, and the latter only one-fifth inch. This similarity of dimensions suggests to me that the two objects were originally part of one and the same celt. Before the same society, in April, 1886, Professor Putnam exhibited his remarkable series of Nicaragua and Costa Rica jadeites, which were all ornaments made by cutting into halves, thirds, or quarters one large celt perforated by one or two drilled holes, in one instance two of them fitting together. The 16-pound adze exhibited by myself at the American Association for the Advancement of Science meeting of 1887, from which fully two pounds had been cut; the breastplate recently found measuring only one-half inch thickness; and the fact that even Burmese jadeite, when burned or exposed to a high temperature, will assume the grayish-green color of the Mexican, all tend to support Professor Fisher's theory that this jadeite originally came from there. Additional evidence is the striking resemblance between the Maya and ancient Burmese styles of carving, although Dr. Meyer, of Dresden, firmly believes that this material will yet be found *in situ* in Mexico. The imperial jade quarries of Burmah, in the Mogung district, 90 miles from Bhamo are leased by two companies, who pay a royalty of $30,000 annually. The trade is entirely in the hands of the Chinese. At the Colonial Exhibition in London in 1886 there were exhibited large rounded and waterworn blocks of jade weighing hundreds of pounds called panaum by the Maories. Much of it is of the finest green color and was worked into charms, knife-handles, etc. Dr. W. Buller exhibited a fine collection of Maori ornaments and clubs, or neeris, heitikas, and other native ornaments made of this stone.

Collections of gems.—A regrettable dispersion of jewels and precious stones took place in May, 1886, when the famous collection formed by the late Henry Philip Hope, and exhibited at the South Kensington Museum for many years, was sold at auction. The Hope collection included the "Saphir Merveilleux" of Madame de Genlis's "Tales of the Castle;" the King of Kandy's cat's-eye, the largest known, having a diameter of 1½ inches; the Mexican Sun opal, carved with the head of the Mexican Sun God, and known since the sixteenth century; an enormous pearl, the largest known, weighing 3 ounces and measuring 2 inches in length; the aqua-marine sword-hilt, made for Murat, King of Naples; and also many curious diamonds, sapphires, emeralds, and several hundred unique and magnificent gems. Such a collection should have been preserved intact as a national possession.

In 1886 it was decided by the French Assembly that the Crown jewels, with the exception of the famous "Regent" diamond, two of the Mazarins, and a few historic pieces reserved for the national museums, should be sold at public auction. These exceptions were made because it was feared that they would fall into the hands of Americans. The sale of this great historic collection took place in May, 1887. The forty-eight parcels were subdivided into one hundred and forty-six lots, and there were sixty-eight buyers; the sales to twelve of them brought over 100,000 francs each. The largest lot, the great corsage, which sold for 811,000 francs, was purchased by a single American firm, the largest buyer at the sale. The purchases of this firm amounted to 2,249,600 francs, or about 34 per cent. of the entire sum realized; while as to quality the same firm obtained more than two-thirds of the finest gems, among them were three Mazarins; a pear-shaped rose brilliant weighing $24\frac{27}{32}$ carats, for 128,000 francs; a pear-shaped white brilliant weighing $22\frac{1}{4}$ carats, for 81,000 francs; a white brilliant weighing $28\frac{7}{16}$ carats, for 155,000 francs; and an oval brilliant weighing $18\frac{1}{32}$ carats, for 71,000 francs; or 435,000 francs for the four. All but one of their purchases were secured by private American customers. The great interest attached to this sale was due not only to the fact that many of the gems were of very fine quality, but also to their historic associations; the history of many of them could be traced back several hundred years.

The collection of antique gems, numbering three hundred and thirty-one pieces, formed by the late Rev. C. W. King, of Trinity College, England, the greatest of all writers on engraved gems, was sent to the United States for sale in 1881. This collection represents the summing up of Mr. King's vast knowledge, and none has ever been more thoroughly studied. His numerous writings mark an epoch in the study of this branch of archæology, and only the loss of his sight led him to part with his treasure. The growing interest and taste in archæological matters in the United States induced him to send it here to be sold intact. In October, 1881, through the friendly mediation of Mr. Feuardent, it was purchased and presented to the Metropolitan Museum of Art by Mr. John Taylor Johnson, the president of the museum, where it now remains. Near it will be placed the Sommerville collection. Mr. Maxville Sommerville, while spending the past thirty-two years of his life in Europe, Asia, and Africa, has collected cameos, intaglios, seals, and other historical gems, and as a result of his liberal expenditure of time and money he is to-day the owner of one of the most unique and valuable collections of engraved gems in the world. It numbers over one thousand five hundred specimens, including Egyptian, Persian, Babylonian, Etruscan, Greek, Roman, Aztec, and Mexican glyptic, or jewel-carving art. All of these are represented by specimens of singular excellence, affording us a panoramic view of the achievements of civilized man in this direction. This remarkable collection, now at his home in Philadelphia, has been loaned to the Metropolitan Museum of Art, New York, where it will soon be placed on exhibition, and the public will be afforded every facility to study the beautiful achievements of the glyptic art.

Of greater antiquity and archæological value, because representing a period before gems were cut in the form of intaglios, is the collection of the Rev. W. Hayes Ward, consisting of 300 Babylonian, Persian, and other cylinders. Two hundred of these he himself collected in Babylon and its vicinity, and sold to the Museum at a nominal figure. Since that time he has collected 100 more cylinders. Many of them date from 2500 B. C. to 300 B. C., and are cut in lapis lazuli, agate, carnelian, hematite, chalcedony, jasper, sard, etc.

The death of Dr. Isaac Lea, of Philadelphia, in his ninety-fifth year, deprived the world of a great investigator in the field of precious stones. During the last twenty years of his exceptionally long and useful life, he devoted almost his entire time to studying the microscopic inclusions in gems and minerals, and the cabinet he left contains thousands of specimens of rubies, sapphires, chrysoberyls, tourmalines, garnets, quartz, etc., all of which he had subjected to the most rigid microscopic scrutiny, noting every interesting fact on the accompanying label. Only a small part of his work on this highly interesting subject has been published by the Philadelphia Academy of Sciences in two papers (in 1869 and 1876), but Dr. Lea made ample provision in his will for the publication of the remainder. His extensive collections of minerals and shells were bequeathed to the National Museum and the gem collection to his daughter. Two months before his death the writer spent two hours with him examining a series of quartz inclusions, over which he worked with all the enthusiasm and brightness of youth.

One of the many benefits traceable to the New Orleans Exposition was the appropriation given to the National Museum for their exhibit. This was wisely expended by Prof. F. W. Clarke in the purchase of a complete series of precious stones, many of which, although not expensive, are still the finest in the United States, from an educational standpoint. Since the exposition, many fine specimens have been added by purchase and donation, especially the diamonds and pearls presented by the Iman of Muscat to President Buchanan, consisting of 138 diamonds and 150 pearls, all of good quality. The collection numbers about 1,000 specimens, and embraces almost every known variety of precious stone, many of them very fine examples.

FERTILIZERS.

SOUTH CAROLINA PHOSPHATE ROCK.

The production of phosphate rock increased from 430,549 long tons in 1886 to 480,558 long tons in 1887—a gain of over 50,000 tons. The total value decreased, however, on account of slightly lower prices. The average price of crude land rock in 1887 was $3.75 per long ton, though some sales were made at $3.50 and $4 during the year. The average price of crude river rock was about $4. There is a difficulty in fixing this average on account of the objections shown by the sellers, together with the small amount of river rock sold in this country, as shown by the report; the sources of inquiry are limited. One large seller said that he sold none in this country in 1887, and therefore could not give any price. There were, however, some small sales made at about $3.50 to $3.75, principally to local buyers. Ground rock, whether land or river, or both, which is frequently the case, commanded about the same price, and the average price was $6.50 per ton of 2,000 pounds.

About the same condition of affairs existed in 1887 as in 1886, and efforts were made by the river miners to obtain special rights from the legislature, but were unsuccessful. The depressed condition of the fertilizer trade may also be added as a factor in the change of prices; the desire on the part of the miners to maintain past business relations with their buyers was productive of strong competition, and lower prices were the natural result. The following statistics have been compiled with great care by Mr. Paul C. Trenholm, of Charleston.

Phosphate rock shipped from and consumed in South Carolina during the calendar year 1887.

Destination.	Crude.	Ground.	Total.
From Charleston.			
Domestic—	*Long tons.*	*Long tons.*	*Long tons.*
Baltimore	60,830		60,830
Philadelphia	20,434		20,434
New Town Creek, New Jersey	6,431		6,431
Weymouth, Massachusetts	14,635		14,635
Wilmington, North Carolina	6,204		6,204
Boston *a*	377		377
Richmond, Virginia	3,577		3,577
Barren Island, New York	9,475		9,475
Seaford, Delaware	1,012		1,012
New York	3,268	6,219	9,487
Mantua Creek, New Jersey	2,090		2,090
Wilmington, Delaware	8,169		8,169
Clark's Cove, Massachusetts	600		600

a In part for reshipment to Weymouth.

Phosphate rock shipped from and consumed in South Carolina, etc.—Continued.

Destination.	Crude.	Ground.	Total.
From Charleston—Continued.			
Domestic—Continued—	*Long tons.*	*Long tons.*	*Long tons.*
Union Landing, New Jersey	3, 204	....	3, 204
Elizabethport, New Jersey	3, 986	....	3, 986
Coopers Creek, New Jersey	655	....	655
Booth Bay, Maine	3, 180	....	3, 180
Orient, Long Island	525	....	525
South Carolina Railroad	9, 729	....	9, 729
Charleston and Savannah Railroad	16, 754	....	16, 754
Northeastern Railroad	564	....	564
Total domestic	175, 699	6, 219	181, 918
Foreign—			
Liverpool	1, 995	....	1, 995
Bremen	280	....	280
Havre	205	....	205
Elsinore	250	....	250
St. Petersburg	200	....	200
Reval	100	....	100
Bristol	550	....	550
Dublin	920	....	920
Cork	510	....	510
United Kingdom	4, 730	....	4, 730
Total foreign	9, 740	....	9, 740
Grand total shipped from Charleston	185, 439	6, 219	191, 658
From Beaufort and vicinage.			
Domestic ports except that mined in the marshes on which no royalty is paid and not cleared through the custom-house	....	....	15, 905
Foreign ports	....	....	189, 995
Grand total from Beaufort	....	....	205, 900

SUMMARY.

		Long tons.
From Charleston (domestic, 181, 918; foreign, 9, 740)		191, 658
From Beaufort and vicinage (domestic, 15, 905; foreign, 189, 995)		205, 900
Estimated consumption at Charleston		70, 000
Estimated consumption at Beaufort		13, 000
Grand total shipped from and consumed in South Carolina in 1887		480, 558
Grand total shipped from and consumed in South Carolina in 1886		430, 549
		50, 009
Decrease in shipments from Charleston		1, 826
Increase from Beaufort and vicinage		37, 835
Charleston shipments:		
Decrease, domestic	5, 640	
Increase, foreign	3, 814	
Net decrease as above		1, 826
Beaufort shipments:		
Increase, domestic	1, 283	
Increase, foreign	36, 552	
Net increase as above		37, 835
Total increase		36, 009
Crude rock shipments from Charleston increased this year over last		1, 554
Ground rock shipments from Charleston decreased this year over last		3, 380
Net decrease shipments as above		1, 826

NOTE.—Ninety-nine per cent. of the shipments from Charleston is land rock, and from Beaufort and vicinage is all river (and marsh) rock.

The production of phosphates in previous years is given in the following table. The years are trade years ending May 31, except 1886 and 1887, which are the regular calendar years.

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1867	6	....	6
1868	12,262	....	12,262
1869	31,958	....	31,958
1870	63,252	1,989	65,241
1871	56,533	17,655	74,188
1872	36,258	22,502	58,760
1873	33,426	45,777	79,203
1874	51,624	57,716	109,340
1875	54,821	67,969	122,790
1876	50,566	81,912	132,478
1877	36,431	126,569	163,000
1878	112,622	97,700	210,322
1879	100,779	98,586	199,365
1880	125,601	65,162	190,763
1881	142,193	124,541	266,734
1882	191,305	140,772	332,077
1883	219,202	159,178	378,380
1884	250,297	181,482	431,779
1885	225,913	169,490	395,403
1885 (June 1 to December 31)	149,400	128,389	277,789
1886 (calendar year)	253,484	177,065	430,549
1887	261,658	218,900	480,558

The details concerning the disposition of these phosphates are given in the following tables, the years being trade years ending May 31, except 1886:

Detailed statement of total foreign and coastwise shipments and local consumption since July 1, 1874.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Other points.	Total.	Total for each year.
		Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	
June 1, 1874, to May 31, 1875.	Foreign ports	44,617	25,929	....	70,546	122,790
	Domestic ports	7,000	25,560	....	32,560	
	Consumed	....	19,684	....	19,684	
June 1, 1875, to May 31, 1876.	Foreign ports	50,384	25,431	....	75,815	132,896
	Domestic ports	9,400	28,831	....	38,231	
	Consumed	....	18,850	....	18,850	
June 1, 1876, to May 31, 1877.	Foreign ports	73,923	28,844	....	102,767	163,220
	Domestic ports	6,285	40,768	....	47,053	
	Consumed	....	13,400	....	13,400	
June 1, 1877, to May 31, 1878.	Foreign ports	100,619	21,123	....	121,742	208,323
	Domestic ports	8,217	60,729	....	68,946	
	Consumed	....	17,635	....	17,635	
June 1, 1878, to May 31, 1879.	Foreign ports	97,799	21,767	....	119,566	199,365
	Domestic ports	8,618	52,281	....	60,899	
	Consumed	....	18,900	....	18,900	
June 1, 1879, to May 31, 1880.	Foreign ports	47,157	14,218	....	61,375	190,763
	Domestic ports	13,346	94,002	....	107,348	
	Consumed	....	22,040	....	22,040	
June 1, 1880, to May 31, 1881.	Foreign ports	62,200	8,568	....	70,768	266,734
	Domestic ports	65,895	91,929	....	157,824	
	Consumed	....	38,142	....	38,142	
June 1, 1881, to May 31, 1882.	Foreign ports	89,581	22,905	....	112,486	332,077
	Domestic ports	57,465	111,314	7,875	176,654	
	Consumed	....	42,937	....	42,937	
June 1, 1882, to May 31, 1883.	Foreign ports	94,789	28,251	....	123,040	378,380
	Domestic ports	36,175	150,545	26,000	212,720	
	Consumed	....	42,620	....	42,620	

Detailed statement of total foreign and coastwise shipments, etc.—Continued.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Other points.	Total.	Total for each year.
		Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	
June 1, 1883, to May 31, 1884.	Foreign ports	132, 114	20, 539	....	152, 653	431, 779
	Domestic ports	34, 711	181, 363	6, 329	222, 403	
	Consumed	5, 800	50, 923	....	56, 723	
June 1, 1884, to May 31, 1885.	Foreign ports	111, 075	11, 495	....	122, 570	395, 403
	Domestic ports	30, 963	161, 700	13, 170	205, 833	
	Consumed	12, 000	55, 000	....	67, 000	
June 1, 1885, to Dec. 31, 1885.	Foreign ports	105, 761	8, 581	....	114, 342	277, 789
	Domestic ports	16, 321	112, 126	....	128, 447	
	Consumed	5, 000	30, 000	....	35, 000	
Jan. 1, 1886, to Dec. 31, 1886.	Foreign ports	153, 443	5, 926	....	159, 369	430, 549
	Domestic ports	14, 622	187, 558	....	202, 180	
	Consumed	9, 000	60, 000	....	69, 000	
Jan. 1, 1887, to Dec. 31, 1887.	Foreign ports	189, 995	9, 740	....	199, 735	480, 558
	Domestic ports	15, 905	181, 918	....	197, 823	
	Consumed	13, 000	70, 000	....	83, 000	

Guano brought from islands, rocks, and keys appertaining to the United States, 1869 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Long tons.			*Long tons.*	
1869	15, 622	$253, 545	1879	8, 733	$95, 137
1870	14, 318	356, 830	1880	12, 795	147, 051
1871	14, 154	340, 235	1881	16, 883	179, 882
1872	4, 209	60, 865	1882	15, 249	160, 016
1873	11, 014	161, 690	1883	7, 873	92, 130
1874	6, 877	100, 345	1884	9, 333	106, 431
1875	7, 269	122, 012	1885	12, 100	86, 166
1876	14, 785	192, 972	1886	5, 770	38, 839
1877	6, 060	79, 822	1887	8, 226	55, 671
1878	17, 930	211, 239			

Phosphates imported and entered for consumption in the United States, 1868 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	99, 668	$1, 336, 761	....	$88, 864	$1, 425, 625
1869	18, 480	217, 004	....	61, 529	278, 533
1870	47, 747	1, 414, 872	....	90, 817	1, 505, 689
1871	94, 344	3, 313, 914	....	165, 703	3, 479, 617
1872	15, 279	423, 322	....	83, 342	506, 664
1873	6, 755	167, 711	....	218, 110	385, 821
1874	10, 767	261, 085	....	243, 467	504, 552
1875	23, 925	539, 808	....	212, 118	751, 926
1876	19, 384	710, 135	....	164, 849	874, 984
1877	25, 580	873, 459	....	195, 875	1, 069, 334
1878	23, 122	849, 607	....	285, 089	1, 134, 696
1879	17, 704	634, 546	....	223, 283	857, 829
1880	8, 619	108, 733	....	317, 068	425, 801
1881	23, 452	399, 552	....	918, 835	1, 318, 387
1882	46, 699	854, 463	133, 956	1, 437, 442	2, 291, 905
1883	25, 187	537, 080	96, 586	798, 116	1, 335, 196
1884	28, 090	588, 033	35, 119	406, 233	984, 266
1885	20, 934	393, 039	40, 068	611, 284	1, 004, 323
1886	14, 383	341, 647	80, 581	1, 142, 151	1, 483, 798
1887	12, 981	338, 467	72, 390	998, 883	1, 337, 350

There have been some changes in the mining companies since the report for 1885, and below is the present list:

List of phosphate mining companies in South Carolina.

RIVER COMPANIES.	
Coosaw Mining Company	Coosaw river.
Farmers' Mining Company.	Coosaw river.
Oak Point Mines Company.	Bull river.
Carolina Mining Company.	Beaufort river.
H. B. Jennings	Stono river.
Sea Island Chemical Company.	Saint Helena Sound.
C. O. Campbell	Charleston.
John Hanson	Charleston.
LAND COMPANIES.	
Charleston Mining and Manufacturing Company.	Ashley river.
LAND COMPANIES—continued.	
C. C. Pinkney, jr	Ashley river.
Rose Phosphate Mining and Manufacturing Company.	Ashley river.
C. H. Drayton & Co	Ashley river.
William Gregg	Ashley river.
Gibbon & Hannahan	Ashley river.
George W. Grafflin	Ashley river.
Bolton Mines	Stono river.
Saint Andrews Mines	Stono river.
Henry Dotterer	Stono river.
E. J. Mead	Cooper river.
W. C. Bradly	Rantowles creek.
F. C. Fishburne	Charleston and Savannah railroad.
C. O. Campbell	Charleston.

Other States.—Phosphate rock was also produced in North Carolina, Alabama, and Florida, but in very small amount compared to South Carolina. Probably 1,000 tons will cover the product of the States other than South Carolina. In North Carolina the production of a ground conglomerate is continued by Messrs. French Brothers and the North Carolina Phosphate Company. At Coatopa, Alabama, the regular production of low grade phosphate rock seems established, and about 500 tons were sold in 1887. In Florida developments are promised on the Peace river, near Arcadia, De Soto county, and at several other points.

For a detailed account of the occurrence of calcium phosphates in the different conditions, as South Carolina phosphate rock, apatite, etc., the reader is referred to "Bulletin No. 46 of the United States Geological Survey," "The Nature and Origin of Deposits of Phosphate of Lime," by Dr. R. A. F. Penrose. In the introduction, which is written by Prof. N. S. Shaler, it is stated that the workable deposits of phosphates are found in a greater variety of circumstances than those which contain most mineral substances of economic value. It is not likely that we have as yet exhausted the inquiry into the modes of occurrence of these substances; but the synopsis made in the report of the experience in this and other countries, which is much more extensive than any other which has been published, is intended to serve as a guide to the further search for phosphatic manures. The conditions of occurrence of these deposits in Europe make it plain that the search for them in this country may be directed advantageously to many districts in which they have not as yet been found.

"So far the vein deposits of apatite, such as those which are so abundant north of the St. Lawrence, have not been found in workable quantities within the limits of the United States, though the general geological conditions of the Laurentian area exist in the Adirondack district and in the southern parts of the Appalachian system as well as in several districts of the Rocky mountains. It would be remarkable if extensive deposits of this nature, so common in Canada and in the equivalent rocks of Northern and Southern Europe, should not be found at many points in our American Archæan formations. It is on this account that so much space in the report is given to the description and illustration of the Canadian apatite deposits. So, too, we may hope to find in the ancient rocks of this country deposits analogous to the great Logrosan and Caceres veins in the province of Estremadura, Spain.

"The Cretaceous deposits of Belgium (which at the present time are, next after the phosphate beds of South Carolina, the most productive in the world) present a type of beds the like of which have not as yet been discovered in the United States, though deposits of the same age, formed under about the same conditions, abound in this country. It is not to be expected that phosphatic deposits will exactly repeat themselves in strata of the same age in widely separated regions, yet it is clear from the summary account of the geological distribution of these phosphates in Europe and North America that in the case of these, as well as in that of other substances of value in the arts, there are certain guiding principles which we may base on the stratigraphy of the deposits to aid our search."

The known workable deposits of a phosphatic nature are limited to certain portions of the geologic section from which Professor Shaler draws certain general conclusions as to the best method of prosecuting the search for unknown deposits of American phosphates. These conclusions are essentially as follows:

"First, as regards the superficial and recently formed deposits of phosphates, we are driven to the conclusion that this class of deposits may reasonably be sought for wherever soft calcareous beds containing a certain amount of lime phosphate have been subjected to long continued leaching by waters containing the share of carbonic acid gas which belongs to all rainwater after it has passed through the mat of decayed vegetation." As long ago as 1870, Professor Shaler became convinced that it was to the leaching out of the carbonate of calcium by the carbonated water of the soil bed that we owe, in the main, the concentration of the nodular phosphates of South Carolina, and this is considered the key to the most common forms of superficial accumulations of nodular phosphates, although it is still necessary to explain many of the details of this process to adapt it to the peculiar circumstances of particular deposits. It is evidently essential to this process of concentration that the surface of the deposits which are leaching away should have been preserved from the action of mechanical erosion, which would have prevented the formation of phosphatic concentrates.

In regard to the swampy deposits of this country Professor Shaler states that inquiry has satisfied him that beneath the surface of many of our fresh-water marshes, and probably in lesser degree beneath the marine deposits of the same nature, there is a more or less important concentration of lime phosphates constantly going on. The effect of this action is seen in the remarkable fitness of these fresh-water swamp soils for the production of grain crops. For instance, in the case of the Dismal Swamp district in Virginia and North Carolina we find that the soils on which the swamp deposit rests are extremely barren, while in the mud which has accumulated beneath the swamp there is a rich store of phosphates, potash, and soda; which causes the soil of these swamps to be extremely well suited to grain tillage as soon as it is drained.

In a similar way in the swamps of New England and elsewhere we find the bog-iron ores, which are frequently accumulated in their bottoms, very rich in phosphatic matter. The evidence is not yet complete that this phosphatic material becomes aggregated into nodules in the swamp muds, but the number of cases in which nodules have been found in this position makes it quite likely that the nodulation of the material may go on in that position. The present condition of the inquiry goes, in a word, to show that, wherever we have a region long overlaid by swampy matter, we may expect a certain concentration of lime phosphates in the lower part of the marsh deposit. Wherever the swamp area lies upon somewhat phosphatic marls which have been slowly washed away by the downward leaching of the waters charged with the acids arising from decayed vegetation, or where the swamp deposits, even when not resting on such marls, are in a position to receive the waste from beds containing phosphates, we may expect to find a considerable concentration of phosphatic matter in the swamp bed. By the erosion of these swamps we may have the nodules of phosphate concentrated in beds such as occupy the estuaries of the rivers near Charleston, South Carolina.

The area of swamp lands which fulfill these conditions is very large. They exist in numerous areas in more than half the so-called Southern States. At present it can only be said that they afford the conditions which, so far as the theory goes, should lead to the accumulation of phosphatic deposits of greater or less importance. It will be a simple matter to explain these deposits, though it is a task requiring a patient study of a large field. Although it is likely that the phosphatic materials will be found aggregated into nodules at many points in this area it will not be safe to assume that they will be found in the same form as those which occur about Charleston, South Carolina. The nodules found in the beds about the last-named point, though in my opinion originating beneath swampy deposits, have apparently been, in part at least, swept from their original beds by the rivers which enter the sea at that point, and have thus been concentrated in estuarine deposits.

Although local concentrations of phosphatic nodules other than those now known may well be sought for in the Southern States, I do not think that the precise conditions or character of the deposits as found at Charleston should be expected to repeat themselves elsewhere. It is characteristic of the process of concentration of phosphatic, as well as of other matter into nodules that the material takes on a great variety of aspects, each proper to a particular site, and this although the surrounding circumstances of the several localities may apparently be identical.

Next lower on the geologic section we have, in the Tertiary region of the Mauvaises Terres, extensive deposits of vertebrate remains which may possibly yield some commercially important supplies of bone phosphates. Although none of the existing sources of supply of these materials comes from deposits of the nature of those found in Nebraska, the conditions of that remarkable region are so peculiar that it will not be well to pass it by without inquiry.

While the American Cretaceous deposits are, as a whole, decidedly different from those of the Old World, the Greensand beds of the section in the two countries present considerable likeness in their characters. It is probable that in this country, as in Europe, considerable parts of the Cretaceous section are somewhat phosphatic, and that those beds containing disseminated phosphatic matter have been in many places exposed to the process of leaching in former geologic periods. Therefore we may reasonably search in the Cretaceous beds of this country for the same class of phosphatic deposits which have proved so important in the northern parts of Europe.

Although some peculiar deposits of phosphates have been found in the Devonian rocks of Nassau, it may safely be assumed that below the line of the Cretaceous we have no facts to guide us in our search for phosphates until we come to the horizon of the Upper Silurian limestones, at about the level of the uppermost beds of the Upper Silurian, as far as that level can be determined by the perplexing assemblage of fossils. There occurs in Bath county, Kentucky, a thick bed of much decayed very phosphatic siderite. This deposit covers but a small area, and consists of a patch of limestone about 15 feet thick, which has been converted into siderite by the inleaching of iron-bearing waters from the ferruginous Ohio (Devonian) shales which formerly overlaid the bed. Since the escarpment of the Ohio shales retreated beyond this bed it has been subjected to oxidation, and is now in the main converted into a much-decayed limonite. Beneath this limonite there is a greenish argillaceous sand, which contains frequent nodules of lime phosphate. These nodules are smooth-surfaced, and not unlike some of the nodules from the Carolina district. They contain as much as 92 per cent. of lime phosphate. It seems likely that these nodules were formed by the leaching out of the lime phosphate from the overlying ferruginous layers, which has completely removed the lime carbonate, but has not removed the whole of the less soluble lime phosphate.

Although this deposit of nodules is not of sufficient abundance to have any economic value, it is clear that we have in it an indication of a method where, by a slight variation of the conditions, important beds of nodular phosphates might be found.

In the horizons of the Cambro-Silurian section, or, as it is generally called, the Lower Silurian, there is much greater reason to expect the occurrence of workable phosphates than in the beds immediately above.

It is likely that the most important of the Spanish deposits belong in strata of this period, and the Welsh deposits of this general age are of noteworthy extent. We know, moreover, that the commoner marine animals of this part of the geological section were particularly adapted for the secretion of lime phosphate.

The search of this portion of the section for phosphates should be directed to two ends: first, to finding beds of very phosphatic limestone; and, second, to discovering veins formed by a segregation of lime phosphates either in the form of the Spanish deposits referred to by Dr. Penrose or in the condition of nodular accumulations. The area of rocks of these Lower Silurian and Cambrian periods in this country is very extensive, and so far there has been no search of them for phosphatic materials. The little work done in Kentucky during the above-mentioned geological survey served only to show that the proportion of lime phosphate in the rocks is extremely variable, and that in certain beds it is so considerable that the material might advantageously be used in a local way for fertilizing purposes. Among the analyses recently made by the chemists of the Kentucky geological survey is one which indicates the presence of phosphoric acid in considerable quantities in the limestones of Corniferous age exposed at Stewart's mill, on Lulbegrud creek, in Clark county. This partial analysis, made under Mr. John R. Procter, director of the Kentucky survey, is as follows, viz:

Analysis of Corniferous limestone from Clark county, Kentucky.

	Per cent.
Lime carbonate	21.380
Magnesia	3.055
Phosphoric acid	9.710
Potash	.830
Soda	.228
Siliceous nodules insoluble in acid	27.580

The search for phosphatic materials in the stratified rocks demands a method of inquiry that has not yet been applied to the study of our rocks. It seems to me that the method, or rather methods, should be as follows:

First, there should be a careful inquiry to determine the share in which the several important groups of rock-making organic forms contribute phosphatic matter to strata. This can be accomplished by carefully comparing the chemical character of particular strata with the fossils the beds contain. When this determination is made we shall have one means of guiding our inquiries, which will surely be of great value in the search for bedded phosphates.

Secondly, we should have a carefully executed chemical survey of our stratified rocks. Enough can be gathered from the scattered records of chemical analyses to make it plain that certain features of the chemical character of particular beds or divisions of strata often extend laterally for great distances. This is shown in a general way by the character of the soils formed of the waste of particular horizons; for instance, the deposits of the horizon on which lies the Cincinnati group of this country and the equivalent deposits of Europe are nearly always well suited to grasses and grains and have a great endurance to tillage. It is now desirable to take these beds which promise to afford mineral manures and subject each stratum to analyses which shall determine the quantity of phosphoric matter, soda, and potash which they contain, so that their fitness for use as mineral manures may be ascertained.

Below the level of the Silurian and Cambrian strata, and partly in those sections where they have been much metamorphosed, lies the field of the vein phosphates. It is more than likely that in this vast thickness of rocks with their development in this country there are many extensive sources of this class of phosphates which await discovery. As yet no careful search has been made for such veins in any part of the United States. The regions most likely to contain such deposits are found in the central parts of the Appalachian system of mountains, especially in the section from Virginia southward; in the Archæan district of Missouri and Arkansas, and in the vast region of highly metamorphic rocks of the Cordilleran district, extending from the Rocky mountains to the Pacific ocean. It is true that at present the economic value of phosphatic deposits in the western part of the continent would probably be small, on account of the great cost of transportation to the seaboard districts; but the growing use of phosphatic manures in the Mississippi valley and the rapid exhaustion of the soils of that district will soon give commercial importance to any sources of supply of phosphates that may be found in any parts of the Cordilleras which are convenient to transportation.

At the present the methods of using mineral phosphates are extremely costly; not only is the material brought into the soluble condition by saturation in sulphuric acid, but it is then mingled with ammoniacal and other matter to increase its effect as a fertilizer. The result is that, although a ton of Carolina phosphate now costs but $6, the average price of the manufactured product to the consumer at the phosphate factories is about $30 per ton. It is probable that the essential value of the phosphatic ingredients to the plants of most soils is not enhanced by this costly treatment, though an incidental but dearly purchased gain, in the case of some crops, is obtained from the ammoniacal matter. The only effect of the superphosphatizing on the phosphatic matter is to make it more immediately absorbable by the plants. If placed on the soil without any other preparation than grinding, lime phosphate will slowly pass into a condition in which it may be absorbed by plants, while if treated with sulphuric acid it is, for a time at least, in a soluble state. That this treatment is not essential is well shown by the fact that the phosphatic matter derived from the rocks is brought into a condition for absorption by the ordinary process of the decay in soils. Our present costly method of applying phosphates has come about through the commercial history of artificial manures, which is as follows:

Before guanos were brought into use the English farmers had learned that they could profitably use the phosphatic marls of their Tertiary and Cretaceous deposits without any artificial preparation. If guanos had not existed it seems likely that mineral phosphates would have always been used in this way. When the Peruvian guanos came into use they afforded a much more stimulating material than any other purchasable manures, and in a short time they established the type of commercial fertilizers. When the sources of supply of these guanos became in part exhausted, artificial compounds, formed on a basis of rock phosphates or apatites, were devised to take their place. These were made to imitate the effect of the guanos as closely as possible. Like them, they gave a quick, though temporary, stimulus to the soil, enabling the farmer to obtain the greater part of the return for his investment in the season following the application of the high-priced manure. Very generally the fertilizer, guano or compounded material, was applied with the seed or dibbled in the soil alongside the young plant, so that it would be immediately available in the first stages of its growth, and, what is a more important consideration, that it might take less of the substance to give the effect than if it were sown broadcast over the surface or mingled with the soil of the whole field.

In this way a habit has been established in the art of using phosphates, as well as in the composition of the material, which, like all commercial habits, is hard to overcome. The question to be determined is as to the utility of phosphates with other modes of treatment than those which are applied to the imitation guanos. At present this treatment requires the commingling of the lime phosphate with a number of costly substances. The manufacture can only be advantageously carried on at points remote from the districts where the materials are produced and remote from the fields where they are used, so that the costs of transportation are great.

At present the use of these manufactured fertilizers is great and increasing, as shown in the following paragraphs:

Manufactured fertilizers.—Maj. E. Willis, of Charleston, South Carolina, states that while the volume of business in fertilizers was smaller in 1887 than in the previous year, it was at the same time remunerative, except for the introduction of English acid phosphate in Savannah, Mobile, Norfolk, and New Orleans, from which points it was distributed into much of the territory formerly supplied from Charleston. The lower railroad freight offered from these points has also taken it into the cotton States to points favoring its distribution and delivery into Alabama, Georgia, Mississippi, and Tennessee, while the shipments from abroad to Charleston show a marked decline in imported acid phosphates and fertilizers. The want of harmony in the management of the manufacturing companies forced prices down at one time during the season to as low as $11 per ton for bulk acid phosphate and $19 for 2 per cent. ammoniated fertilizers. The average price for the season was $13.10 for acid phosphate and $25 for ammoniated fertilizers.

The following tables give the shipments of fertilizers from Charleston since 1878, and also a list of the manufacturers of fertilizers. It is probable that the output of 1888 will materially exceed that of 1887.

Statement of manufactured fertilizers shipped from Charleston since 1878.

Calendar years.

By—	1878.	1879.	1880.	1881.	1882.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
South Carolina railway:					
January	6,789	6,559	17,449	14,930	18,391
February	12,662	14,445	17,368	18,523	19,837
March	15,019	12,044	10,814	18,721	12,107
April	1,795	2,513	2,761	3,599	1,711
May	44	53	707	189	548
Northeastern railroad:					
January	879	285	1,381	2,186	2,424
February	1,817	3,231	3,366	3,256	5,362
March	3,371	2,731	3,382	4,939	7,285
April	1,579	634	977	3,044	955
May	141	48	201	28	198
Charleston and Savannah railway:					
January	676	1,016	1,102	951	690
February	584	1,791	1,249	1,155	1,272
March	436	1,444	476	2,375	594
April	95	675	203	629	100
May	2	5	9	50	14
Georgetown, Peedee, Santee, and Edisto steamers:					
January to June	1,263	1,364	2,560	2,950	2,002
Total five months	47,152	48,838	64,005	77,525	73,490
For remainder of year	4,848	11,162	15,995	25,000	29,000
Grand total	52,000	60,000	80,000	102,525	102,490

By—	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
South Carolina railway:					
January	17,721	21,443	23,299	16,037	16,937
February	32,618	29,171	27,175	26,836	26,632
March	21,626	18,118	26,846	25,840	23,953
April	2,971	5,019	4,813	2,974	3,756
May	720	441	210	381	430
Northeastern railroad:					
January	5,430	5,194	7,070	4,847	5,316
February	9,708	12,318	11,398	12,771	13,104
March	9,091	7,822	10,570	11,620	10,487
April	1,638	2,413	2,001	1,620	1,776
May	216	220	119	183	240
Charleston and Savannah railway:					
January	2,059	4,196	3,435	1,897	3,760
February	2,888	5,373	4,457	3,827	4,280
March	1,003	3,525	2,466	3,379	1,899
April	225	1,234	640	201	355
May	33	20	27	817	98
Georgetown, Peedee, Santee, and Edisto steamers:					
January to June	3,517	6,309	6,869	5,400	6,300
Total five months	111,464	122,816	131,395	118,630	119,323
For remainder of year	20,000	17,184	18,605	24,370	12,477
Grand total	131,464	140,000	150,000	143,000	131,800

Manufacturers of fertilizers in the neighborhood of Charleston.

C. C. Pinckney	Ashley river.	Ashepoo Phosphate Company.	Ashley river.
Ashley Phosphate Company.	Do.	Wando Phosphate Company.	Do.
Edisto Phosphate Company.	Cooper river.	Etiwan Phosphate Company.	Cooper river.
Atlantic Phosphate Company.	Ashley river.	Stono Phosphate Company.	Ashley river.
Pacific Guano Company	Rikersville.	Wilcox and Gibbs Guano Company.	Cooper river.

The ingredients of manufactured fertilizers other than phosphoric acid, especially kainite and potassium chloride or "muriate of potash," will be considered in other portions of this report.

Marls.—The production of marl in New Jersey is decreasing slowly, principally because the lands within easy reach of the marl beds have been supplied, and it does not seem necessary to continue the application of marl to the same land each year. About 600,000 tons, valued simply at the cost of digging from the beds, at 50 cents per ton, were used in 1887. Manufactured fertilizers are increasing in popularity. In Virginia vigorous use has begun with green sand marl on the Pamunkey river, near West Point, with results said to be very satisfactory. There are many beds of similar marls in this region, and their use is only a matter of time. A specimen taken from the farm of Dr F. J. S. Gorgas, near Lancaster Court House, Lancaster county, contained 2.37 per cent. of potash (K_2O) and 0.20 per cent. of phosphoric acid, according to an analysis by Mr. W. F. Hillebrand of the U. S. Geological Survey. The marls of Alabama, Mississippi, and Florida are receiving more and more attention, and will probably become one of the principal sources of phosphoric acid and, in some instances, of potash in these States.

Rates of valuation for commercial fertilizers in North and South Carolina.—The system of drawing samples of all the fertilizers sold in these States at the points where they are consumed is actively prosecuted by the departments of agriculture. To fulfill the requirements and attain the objects, as far as possible, of the law regulating the sale of commercial fertilizers, the analyses resulting from these samples, and the guaranty branded on the sacks from which the samples were drawn, are published in the monthly reports of these departments. Whenever such comparison shows a deficiency in the amount of any ingredient guarantied to be present special attention is called to the fact by italicizing the name of the brand and the deficient ingredient. In addition a value per ton is given for each fertilizer based upon a certain value per pound for the phosphoric acid and potash contained in the fertilizers; that is, 6½ cents per pound is given as the value of the available phosphoric acid. This is equivalent to $1.30 per ton for each 1 per cent. For ammonia, the value is 16 cents per pound; for potash, 5 cents per pound. The only change for the past season is in the rate of available phosphoric acid, which has been reduced from 7½ cents per pound on account of the decline of the cost of acid phosphate. These relative commercial values are intended to show the approximate cash values of these fertilizers at the seaboard. The values, of course, do not include the costs involved in handling and transportation to point of consumption, nor interest charges on time sales, which must be added by the consumer. The following valuable table has been compiled by the chemist of the Department of Agriculture of South Carolina, which shows the average commercial value, according to the system described above, of all the fertilizers examined in each season from 1881 to 1887, including even the value of cotton-seed meal. The numbers in parentheses indicate the number of specimens analyzed:

Average composition and valuation of the commercial fertilizers analyzed in South Carolina.

	Seasons.						Average 1881–'87.
	1886–'87.	1885–'86.	1884–'85.	1883–'84.	1882–'83.	1881–'82.	
Acid phosphates:							
Number of analyses	29	34	16	16	22	12	......
Soluble phosphoric acid	10.20	......	9.50	8.59	8.76	8.08	......
Reduced phosphoric acid	3.17	......	3.12	4.06	2.52	3.46	......
Available phosphoric acid	13.37	12.55	12.62	12.65	11.28	11.54	12.33
Insoluble phosphoric acid	1.84	......	2.46	2.20	2.47	2.70	......
Total phosphoric acid	15.21	......	15.08	14.85	13.75	14.24	......
Relative commercial value	$17.38	$16.38	$16.41	$16.45	$14.66	$15.00	$16.03
Acid phosphates with potash:							
Number of analyses	20	22	24	37	33	18	......
Soluble phosphoric acid	9.45	......	8.27	7.24	7.35	7.05	......
Reduced phosphoric acid	2.76	......	2.52	3.53	2.83	3.49	......
Available phosphoric acid	12.21	10.95	10.79	10.77	10.18	10.54	10.91
Insoluble phosphoric acid	1.47	......	2.27	2.22	2.45	2.62	......
Total phosphoric acid	13.68	......	13.06	12.99	12.63	13.16	......
Potash	1.78	2.37	2.21	1.94	1.55	1.60	1.91
Relative commercial value	$17.65	$16.61	$16.24	$15.94	$14.78	$15.30	$14.18
Ammoniated acid phosphates:							
Number of analyses	2	6	1	9	18	9	......
Soluble phosphoric acid	8.70	......	......	7.40	6.39	7.58	......
Reduced phosphoric acid	2.05	......	......	2.82	2.84	2.35	......
Available phosphoric acid	10.75	10.93	......	10.22	9.23	9.93	10.21
Insoluble phosphoric acid	2.24	......	......	2.05	2.95	2.00	......
Total phosphoric acid	12.99	......	......	12.27	12.18	11.93	......
Ammonia	3.99	2.67	......	3.01	2.77	2.82	3.05
Relative commercial value	$26.75	$22.75	......	$22.92	$20.86	$21.89	$23.03
Complete fertilizers:							
Number of analyses	113	109	91	82	99	60	......
Soluble phosphoric acid	6.94	......	6.51	6.06	5.60	6.18	......
Reduced phosphoric acid	2 81	......	2.54	2.91	2.57	2.70	......
Available phosphoric acid	9.75	9.30	9.05	8.97	8.17	8.88	9.02
Insoluble phosphoric acid	1.86	......	2.20	2.34	2.64	2.44	......
Total phosphoric acid	11.61	......	11.25	11.31	10.81	11.32	......
Ammonia	2.57	2.61	2.57	2.77	2.63	2.72	2.64
Potash	1.89	2.17	1.99	1.53	1.53	1.74	1.81
Relative commercial value	$22.79	$22.61	$21.98	$22.05	$20.57	$20.24	$21.97
Kainite:							
Number of analyses	20	24	20	9	5	2	......
Potash	12.82	12.98	13.39	13.40	12.84	14.40	13.31
Relative commercial value	$12.82	$12.98	$13.39	$13.40	$12.84	$14.40	$13.31
Cotton-seed meal:							
Number o analyses	15	16	3	......	......	......	......
Ammonia f	8.68	8.82	8.29	......	......	......	8.63
Relative commercial value	$27.78	$28.54	$26.53	......	......	......	$27.62

Averages of the fertilizer manufacturers' guarantees.

	Seasons.			
	1886-'87.	1885-'86.	1884-'85.	1883-'84.
Acid phosphates:				
Available phosphoric acid	11.50	11.67	11.41	12.48
Relative commercial value	$14.95	$15.17	$14.83	$16.22
Acid phosphates with potash:				
Available phosphoric acid	$10.35	10.12	9.90	9.44
Potash	1.28	1.44	1.82	1.64
Relative commercial value	$14.74	$14.56	$14.69	$13.91
Acid phosphates with ammonia:				
Available phosphoric acid	9.50	9.54	....	9.20
Ammonia	3.75	3.11	....	2.04
Relative commercial value	$24.35	$22.35	....	$18.49
Complete fertilizers:				
Available phosphoric acid	8.22	8.22	8.40	7.46
Ammonia	2.13	2.18	2.18	2.08
Potash	1.34	1.49	1.51	1.31
Relative commercial value	$18.85	$19.16	$19.41	$17.67

Apatite.—Supplementary to the extended statement concerning the occurrence and use of apatite in Ontario and Quebec, in the report for 1885, it may be stated that the production of 1887 was 23,690 tons, valued at the mines at $319,815, according to the official returns of Mr. E. Coste, mining engineer to the geological survey of Canada. In 1886 the production was 20,495 tons, valued at the mines at $304,245. This amount was computed by Mr. Coste by adding to the export returns of the customs department the small quantity used in the manufacture of superphosphate at the Brockville works.

Production of Canadian apatite from 1878 *to* 1887, *inclusive.*

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1878	3,701	1883	17,840
1879	11,927	1884	22,143
1880	7,974	1885	24,290
1881	15,601	1886	20,495
1882	17,181	1887	23,690

GYPSUM.

While the deposits in Ohio and Michigan continue to be the chief sources of supply, use is being made of the large deposits in central Kansas. The manufacture of plaster of Paris has recently begun at Ashland and near Comanche City, the ledge at the gypsum bluffs on the north side of the Cimarron river, near the line of Clark and Comanche counties, being the sources of supply of the crude material. Dr. Workman, of Ashland, can give further details concerning this development.

Production.—The total production of crude gypsum for use in making calcined and land plaster in the United States is estimated at 95,000 short tons in 1887, valued at $425,000. The trade remained practically steady, except for increased imports.

Estimated total production of plaster in the United States during 1885 and 1887.

Years.	Land plaster.		Calcined plaster.	
	From native stone.	From imported stone.	From native stone.	From imported stone.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
1885	49,100	51,500	26,000	46,200
1886	50,000	52,000	26,000	46,000
1887	45,000	61,000	37,000	54,000

Michigan.—The total production in Michigan increased from 52,369 short tons in 1886 to 54,310 short tons in 1887. The average price of land plaster was $3 per ton and for calcined plaster $10 per ton, or $1.50 per barrel of 300 pounds.

In Michigan the production increased slightly, as shown below:

Amount of land plaster and calcined plaster produced in Michigan.

Years.	Land plaster.	Stucco, barrels of 300 pounds.	Years.	Land plaster.	Stucco, barrels of 300 pounds.
	Short tons.			*Short tons.*	
Land plaster, previous to 1866	100,000		1876	(a) 39,131	64,386
1866	14,604		1877	(a) 40,000	(a) 55,000
1867	17,439		1878	40,000	48,346
Stucco, previous to 1868		(a) 80,000	1879	43,658	50,800
			1880	49,570	106,004
1868	28,837	34,966	1881	33,178	112,813
1869	29,996	41,187	1882	37,821	135,165
1870	31,437	46,179	1883	33,227	201,133
1871	41,126	48,685	1884	27,888	156,677
1872	43,536	59,767	1885	28,184	141,575
1873	44,972	82,453	1886	29,378	153,274
1874	39,126	82,449	1887	28,794	170,107
1875	27,019	61,120			

a Partly estimated.

Aggregate production of land and calcined plaster in Michigan during the years named.

Manufacturers.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Grand Rapids Plaster Company	11, 013	6, 703	8, 118	8, 126	9, 375
F. Godfrey & Brother	11, 232	9, 158	9, 108	8, 801	8, 479
Noble & Co	9, 700	7, 745	7, 851	6, 261	8, 241
Union Mills	10, 000	6, 661	6, 011	6, 391	6, 399
Wyoming Mills	6, 200	5, 018	5, 738	5, 413	5, 851
Alabastine Company	6, 008	8, 388	5, 128	7, 280	7, 198
Smith, Bullard & Co	9, 244	7, 716	7, 465	10, 097	8, 767
Total	63, 397	51, 389	49, 419	52, 369	54, 310

The report on gypsum in Ohio by Prof. Edward Orton, State geologist, contained in Volume VI. of the series on Economic Geology, gives a concise statement of the occurrence of gypsum in Ohio. The main features of the report are reproduced below.

GYPSUM OR LAND PLASTER IN OHIO.

BY EDWARD ORTON.

Distribution.—Land plaster or gypsum (sulphate of lime) is at present worked in Ohio at but a single locality, viz, the station of Gypsum, Ottawa county, on the Lake Shore and Michigan Southern railway, 10 miles west of Sandusky, and by only a single firm, viz, Messrs. Marsh & Co., of Sandusky. The mineral has been known here since the first occupation of the country, coming to view in the rocky floor of Sandusky bay, immediately adjacent to which the quarries are located. Not more than 25 acres have been already worked out, and there is probably as much more territory that has been proved to contain gypsum in quantity to justify working, while a large acreage to which no thorough tests have yet been applied may be reasonably expected to hold valuable deposits. Most of the proved territory is included in the 200 acres that Messrs. Marsh & Co. own, but in past years quite a large amount has been taken from the farm adjoining this upon the west. The surface, which is composed of the usual Drift clays, is but a few feet higher than the waters of the bay. In the quarries that have been thus far worked the Drift has been very shallow, being confined mainly to troughs or hollows in the limestone, the results of earlier erosion.

Geological horizon.—The gypsum of the locality above described is derived from the great series of limestones which is known in the Ohio scale as the Lower Helderberg or Waterlime formation. This series is much the largest single division of limestones in the State. Its maximum thickness under cover does not fall short of 700 feet. In outcrop we do not find more than 100 feet in vertical sections which can be connected in a combined section. The largest measurements of this sort are found in Highland county, near Greenfield. In the northern part of the State there are frequently found, rising from under the Drift beds that cover and obscure all of the bedded rocks, sections of a few feet of the Waterlime series, but it has not been possible hitherto to combine these isolated sections in any way so as to show the entire thickness of strata represented by them. The breadth of country occupied by the formation, however, is good enough proof that it has a thickness as great at least as that claimed for it above. Gypsum appears to be distributed at frequent intervals throughout this series in this particular portion of the State. In the deep well drilled in 1886 at Sandusky, a bed 9 feet in thickness was reported by the driller at a depth of 272 feet, or about 150 feet below the base of the Corniferous limestone. It was also reported in smaller amount at many other points in the next 800 feet of rock passed by the drill. It is, however, possible that the gypsum which actually occurs in the drillings from a considerable number of points in the descent may have been derived, in part, at least, from the highest deposits by the action of the rope and the passage of the tools in drilling. At Port Clinton, also, 3 miles to the westward, gypsum was found at various points from 90 to 190 feet below the surface. These deposits are deeply buried at the quarries now under discussion, and must be correlated with some of the lower beds at Sandusky, already reported.

The former reference of the gypsum of these quarries to the Salina group must be abandoned. Twenty-five miles west of this locality, viz, at Genoa, the Waterlime is found resting directly upon the Guelph beds of the Niagara. It carries here its most characteristic fossil, viz, *Leperditia alta.* It is 400 feet or more above this horizon that the gypsum beds are found. The assignment of these gypsum beds to the Lower Helderberg series is rendered much less revolutionary than it would have been thought to be a few years since, by the discovery that some of the important plaster quarries of central New York are to be referred to this same series. This discovery was made by Prof. S. G. Williams, and is recorded by him in the American Journal of Science, September, 1885.

At various other points gypsum is found in the outcrops of the formation, and notably in the vicinity of Sylvania, Lucas county, while in the deep wells recently drilled through northern and central Ohio it is the exception to miss deposits of gypsum in the samples of drillings. The last case reported is 3 feet of pure fibrous gypsum from a depth of 150 feet at Upper Sandusky.

Mode of occurrence and origin.—The plaster beds occur in the following sections, viz:

Section of the gypsum-bearing strata, near Sandusky, Ohio.

	Feet.
Drift clays	12 to 14
(Level of bay, 8 feet below surface.)	
No. 1. Gray rock, carrying land plaster	5
Blue shale	½
No. 2. Bowlder bed carrying gypsum in separate masses imbedded in shaly limestones	5
Blue limestone, in thin and even courses	1
No. 3. Main plaster bed	7
Gray limestone, in thin courses	1
No. 4. Lowest plaster bed, variable	3 to 5
Mixed limestone and plaster, bottom of quarry. Water enters here in quantity.	

Sections like the one here given will yield 50,000 tons of plaster to the acre. The beds are not even and horizontal, but are found in waves or rolls, the summits of which rise 5 to 8 feet above the general level.

The bed marked No. 1 in the section is a mixed deposit of shale and plaster, that has hitherto been rejected, but which has recently been found fully available for grinding into a dark-colored land plaster. It has been lost by erosion in much of the territory already worked, and is not commonly counted among the valuable resources of the quarries.

No. 2 is one of the most interesting divisions of the section. Scattered through the calcareous shales balls of gypsum occur, concretionary in form, varying in diameter from 6 to 24 inches. For a long while it was thought that they were of inferior value, and they were ground into land plaster, but recently it has been found that the purest product of the quarries can be derived from these same plaster balls. The gypsum yielded by them when they have been carefully freed from their shaly envelopes proves to be of the whitest and purest sort, such as is used as terra alba.

But the division marked No. 4 is the main reliance of the quarries. It is from this that the chief supply of plaster for calcination is derived. The gray rock by which it is separated from the overlying section is an even-bedded limestone of the most characteristic Lower Helderberg type. It contains a considerable percentage of gypsum distributed through the rock, as is shown in the following analysis by Professor Lord:

Analysis of limestone containing gypsum.

	Per cent.
Carbonate of lime	34.20
Carbonate of magnesia	28.49
Sulphate of lime	27.76
Alumina and oxide of iron	1.21
Silica	0.31
Water, not determined	....
Total	91.97

A rock of this character will make an excellent fertilizer for many soils, but it would not be profitable to grind it here, where the better grades are equally available.

The composition, in part, of the blue limestone (No. 1) that is found between divisions No. 2 and No. 3 of the section given above, and of the shaly envelope by which the plaster bowlders are covered (No. 2) are also given herewith.

Composition of blue limestone and shale envelope accompanying gypsum deposit.

	1.	2.
	Per cent.	*Per cent.*
Carbonate of lime	43.48	28.55
Carbonate of magnesia	36.07	24.40
Silica	16.45	41.93

A careful search was made for fossils in the limestones that include the plaster beds, but none were found. The conditions would necessarily be unfavorable to all forms of life where beds of gypsum were in process of formation.

As to the origin of these accumulations through northern Ohio, all the facts point to deposit from a shallow land-locked and contracting sea during the Lower Helderberg period. The first deposit from such a sea, undergoing concentration, is sulphate of lime, either in the form of gypsum or anhydrite. The latter form is very often found in connection with beds of rock salt, immediately underlying them as a general rule. At only one point in northern Ohio have beds of rock salt been reported in this series, viz., at Newburgh, near Cleveland. The shallowness of the sea in this period is well established by the sun-cracks and wave marks that are so conspicuously shown in the rocks, that represent it throughout their outcrops in this part of the State. That the sea must have been land-locked or cut off from free communication with the main ocean is also an obvious deduction from the concentration of the sea water that went forward.

The facts pertaining to the gypsum deposits now under consideration were given by Professor Newberry (Geol. of Ohio, vol. 2, p. 135), and valid conclusions were drawn by him as to the mode of origin of these deposits. He urged the views presented on the previous page, and showed the unsatisfactory nature of the alternative explanation, viz., that beds of gypsum are due to the action of the waters of acid springs on beds of carbonate of lime. The widespread discoveries of deposits similar to those of Ottawa county in the deep wells that have been drilled in such numbers throughout northern Ohio during the last three years reinforce and sustain this view in a very effective way. The acid spring theory no one would be bold enough to urge as an explanation of deposits that are measurably continuous over thousands of square miles of territory.

Composition and uses.—The gypsum produced by the quarries now under consideration is devoted to two main uses, viz., calcined plaster or stucco, and land plaster. About 40 per cent. goes to the first product and 60 per cent. to the latter. The total value of the calcined plaster considerably exceeds, however, that of the land plaster. Under this latter division, dental plaster, glass works plaster, and also the terra alba of the works are counted.

The calcined plaster of Messrs. Marsh & Co.'s production is recognized in the markets as of great excellence and purity. Its reputation is fully sustained by the following analysis, made by Professor Lord, from an average sample of the output of the quarry:

Analysis of calcined plaster.

	1.	2.
	Per cent.	*Per cent.*
Lime	32.52	32.76
Sulphuric acid	45.56	46.20
Water	20.14	20.00
Magnesia	0.56	0.03
Alumina	0.16	0.29
Insoluble residue	0.68	0.46
Total	99.62	99.74

The best stone of the quarry goes into this division. All that is streaked with shale or which from any cause is "off color," is turned into land plaster. Into this division is also put all the surface stone which is known as "rotten plaster." The latter is somewhat stained by surface infiltration, but analysis No. 2 shows that it has lost nothing of value, and the sample tested belongs to the best product of the quarry.

The analysis of the land plaster in like manner shows the great excellence of the entire product of the quarries and the slight differences separating the two divisions which are made of it. It is as follows:

Analysis of Michigan land plaster.

	Per cent.
Lime	32.35
Sulphuric acid	46.38
Water	19.70
Magnesia	.54
Alumina	.60
Insoluble residue	.91
Total	100.48

A small amount of the purest stone, and mainly derived from the bowlders previously described, is supposed by the manufacturers to be used as terra alba. The main applications of this form of gypsum are in mischievous adulterations. The calcined plaster reaches the general markets of the country as far east as Pittsburgh and Buffalo, and to the southward indefinitely. The land plaster is largely used in Michigan. Ohio farmers have been slow to avail themselves of this excellent fertilizer. About 6,000 tons are used annually by glass manufacturers. The production of these quarries is specially adapted to this demand.

Production.—The production of the quarries and works for the last few years are shown in the following table:

Production of calcined and land plaster in Michigan.

	Calcined plaster.			Land plaster.		
	Barrels.	Average price.	Total value.	Short tons.	Average price.	Total value.
1881	12,409	$1.55	$19,234	3,705	$4.35	$16,117
1882	16,888	1.46	24,656	4,404	4.33	19,069
1883	20,919	1.41	29,496	4,678	4.15	19,414
1884	20,307	1.38	28,024	4,217	4.09	17,248
1885	8,686	1.31	11,379	4,038	4.03	16,273
1886	21,256	1.29	27,420	4,186	3.87	16,200
1887	21,981	1.28	28,135	4,098	3.87	15,860

The works are now in excellent condition, having been rebuilt in 1885. This fact accounts for the small production of that year. The mills were previously located at the railroad, nearly a mile distant from the quarries, and large expense was incurred in hauling the stone to the mills, but now a railroad switch runs into the quarries and excellent facilities for hauling the stock and loading the product have been secured. The works will allow an easy expansion to meet an enlarging demand. There is enough proved gypsum to keep the mill in operation for a considerable term of years, and there is good reason to believe that when proper exploration shall be undertaken large accessions will be made to the acreage already known. An attempt was made by Messrs. Marsh & Co. in 1885 to introduce the roller process for grinding the rock, but the experiment proved unsuccessful, and a return was made to the time-honored method. The water that fills the quarries to the lake level, unless kept down by the pump, is a strong sulphur water, carrying a notable quantity of sulphuretted hydrogen. The source of this product is probably to be found in decompositions of the gypsum of the rocks through organic matter carried downwards by surface waters. Such an origin is possible, at least. The oxidation of the sulphuretted hydrogen gives rise to sulphuric acid which produces an acid re-action in the water, rendering it unfit for boiler use.

Colorado.—In Colorado the only increase in the production of gypsum has been at the Stewart's Stucco and Cement Company, at Colorado Springs. This company supplies the demand of the entire Rocky mountains. The production at these works in 1887 was:

Production of gypsum in Colorado in 1887.

	Pounds.
Plaster of Paris	1,200,000
Cement	18,400

No effort has been made to develop the gypsum beds of Dakota, Wyoming, or western Colorado.

California.—There were ground last year, at the Golden Gate Plaster mills in San Francisco, the only works of the kind on the Pacific coast, 2,700 short tons of gypsum. The supply of the raw material for these mills continues to be obtained from Point Sal, Santa Barbara county, very little coming now from the San Marcos islands off the coast of Lower California, whence a large proportion of it was at one time derived. The home made article is of such excellence and afforded at such low prices that importations have been greatly reduced during the past twelve years, decreasing from 23,000 barrels in 1875 to 8,000 barrels in 1887. The average price in San Francisco was $2.75 per barrel.

TOTAL IMPORTS.

Gypsum imported and entered for consumption in the United States, 1867 to 1887, inclusive.

Fiscal years ending June 30—	Ground or calcined.		Unground.		Manufactured plaster of Paris.	Total.
	Quantity.	Value.	Quantity.	Value.		
	Long tons.		*Long cwts.* (*a*)			
1867	....	$29, 895	1, 959, 020	$95, 386	....	$125, 281
1868	....	33, 988	1, 753, 881	80, 362	....	114, 350
1869	....	52, 238	2, 740, 785	133, 430	$844	186, 512
1870	....	46, 872	2, 144, 733	100, 416	1, 432	148, 720
1871	....	64, 465	2, 008, 010	88, 256	1, 292	154, 013
1872	....	66, 418	1, 906, 787	99, 902	2, 553	168, 873
1873	....	35, 628	2, 378, 520	122, 495	7, 336	165, 459
1874	....	36, 410	2, 474, 350	130, 172	4, 319	170, 901
1875	....	52, 155	1, 875, 440	115, 664	3, 277	171, 096
1876	....	47, 588	2, 794, 263	127, 084	4, 398	179, 070
1877	....	49, 445	1, 953, 120	105, 629	7, 843	162, 917
1878	....	33, 496	1, 784, 774	100, 102	6, 989	140, 587
1879	....	18, 339	1, 939, 259	99, 027	8, 176	125, 542
1880	....	17, 074	2, 406, 540	120, 642	12, 693	150, 409
1881	....	24, 915	2, 572, 140	128, 107	18, 702	171, 724
1882	5, 737. 14	53, 478	2, 567, 740	127, 067	20, 377	200, 922
1883	4, 291. 34	44, 118	3, 157, 020	152, 982	(*b*)21, 869	218, 969
1884	4, 996. 25	42, 904	3, 326, 200	168, 000	....	210, 904
1885	6, 418. 00	54, 208	2, 343, 220	119, 544	....	173, 752
1886	5, 911. 41	37, 642	2, 445, 400	115, 696	....	153, 338
1887	4, 814. 23	33, 736	2, 934, 160	162, 154	....	195, 890

a 112 pounds. *b* Not specified since 1883.

Alabaster and spar ornaments imported and entered for consumption in the United States, 1867 to 1887, inclusive.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1867	26, 129	1878	$8, 148
1868	27, 891	1879	7, 986
1869	21, 564	1880	9, 730
1870	22, 982	1881	19, 078
1871	47, 633	1882	34, 292
1872	23, 108	1883	23, 179
1873	22, 011	1884	38, 982
1874	16, 463	1885	31, 796
1875	16, 185	1886	20, 231
1876	18, 323	1887	24, 861
1877	16, 000		

These imports are chiefly from Nova Scotia. The total exports from Canada since 1874, as taken from the report of Mr. Eugène Coste, are given below.

Exports of crude gypsum from Canada from 1874 *to* 1886.

Years.	Ontario.		Nova Scotia.		New Brunswick.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1874	....	....	67, 830	$68, 164	....	....	67, 830	$68, 164
1875	....	....	86, 065	86, 193	5, 420	$5, 420	91, 485	91, 613
1876	120	$180	87, 720	87, 590	4, 925	6, 616	92, 765	94, 386
1877	....	....	106, 950	93, 867	5, 030	5, 030	111, 980	98, 897
1878	489	675	88, 631	76, 695	16. 335	16, 435	105, 455	93, 805
1879	579	720	95, 623	71, 353	8, 791	8, 791	104, 993	80, 864
1880	875	1, 240	125, 685	111, 833	10, 375	10, 987	136, 935	124, 060
1881	657	1, 040	110, 303	100, 284	10, 310	15, 025	121, 270	116, 349
1882	1, 249	1, 946	133, 426	121, 070	15, 597	24, 581	150, 272	147, 597
1883	462	837	145, 448	132, 834	20, 242	35, 557	166, 152	169, 228
1884	688	1, 254	107, 653	100, 446	21, 800	32, 751	130, 141	134, 451
1885	525	787	81, 887	77, 898	15, 140	27, 730	97, 552	106, 415
1886	350	538	118, 985	114, 116	23, 498	40, 559	142, 833	155, 213
Totals	5, 994	9, 217	1, 356, 206	1, 242, 343	157, 463	229, 482	1, 519, 663	1, 481. 042

The total production of gypsum in Canada in 1887 is given as 154,008 short tons, valued at $157,277. The production of Ontario is practically all consumed there, chiefly as land plaster.

SULPHUR.

BY WILLIAM C. DAY.

Production.—The only source from which sulphur is produced in the United States at present is the Cove Creek sulphur works at Cove creek, Utah, operated by the Dickert and Myers Sulphur Company. The production in 1887 amounted to 3,000 short tons, valued at $100,000.

The entire product was marketed in California, Oregon, and the Territories. Needed improvements in transportation facilities have not yet been made, and the product must still be hauled in wagons a distance of 25 miles to the railroad.

Prices.—At the close of 1886 the price of crude sulphur was $19.50 to $19.75 per long ton for seconds; at the close of 1887 the price was $24.90. The following table gives the average price of sulphur for each month of 1887:

Average price of crude sulphur (seconds) for each month of 1887.

Months.	Price per ton.	Months.	Price per ton.
January	$20.50	July	$18.67
February	21.10	August	19.25
March	20.50	September	22.07
April	20.25	October	23.50
May	20.00	November	25.00
June	19.57	December	24.90

These figures show a regular decline from $20.50 per long ton in January to $18.67 in July, when the minimum was reached. From July the price rose, reaching the maximum in November. The average price for the year was $21.28. In the early part of 1888 the price of sulphur declined from $24.90 to $20.67, which figure is the average for May, 1888. A sudden rise took place the following month, the price reaching $27, the maximum for June, the average for the month being $26.75, a higher figure than was attained at any time during 1887. This rise is accounted for by the high freight rates which prevailed in June. On the whole, the outlook for 1888 is for higher prices than those of 1887, the average price per month for the first six months of 1888 being in each case higher than for the corresponding months of 1887.

Sulphur imported and entered for consumption in the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Crude.		Flowers of sulphur.		Refined.		Ore. (a)	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
	Long tons.		*Long tons.*		*Long tons*			
1867..	24, 544. 10	$620, 373	110. 05	$5, 509	250. 55	$10, 915	....	$636, 797
1868..	18, 150. 55	446, 547	16. 48	948	64. 75	2, 721	....	450, 216
1869..	23, 589. 69	678, 642	96. 59	4, 576	645. 04	27, 149	....	710, 367
1870..	27, 379. 60	819, 408	76. 34	3, 927	157. 24	6, 528	$1, 269	831, 132
1871..	36, 131, 46	1, 212, 448	65. 54	3, 514	92. 26	4, 328	754	1, 221, 044
1872..	25, 379. 55	764, 798	35. 97	1, 822	56. 94	2, 492	....	769, 112
1873..	45, 533. 27	1, 301, 000	55. 29	2, 924	35. 97	1, 497	....	1, 305, 421
1874..	40, 989. 55	1, 260, 491	51. 08	2, 694	56. 68	2, 403	....	1, 265, 588
1875..	39, 683. 10	1, 259, 472	17. 83	891	....	....	....	1, 260, 363
1876..	46, 434. 72	1, 475, 250	41. 07	2, 114	43. 87	1, 927	....	1, 479, 291
1877..	42, 962. 69	1, 242, 888	116. 34	5, 873	1, 170. 80	36, 962	....	1, 285, 723
1878..	48, 102. 46	1, 179, 769	158. 71	7, 628	149. 51	5, 935	....	1, 193, 332
1879..	70, 370. 28	1, 575, 533	137. 60	6, 509	68. 94	2, 392	....	1, 584, 434
1880..	87, 837. 25	2, 024, 121	123. 70	5, 516	158. 36	5, 262	....	2, 034, 899
1881..	105, 096. 54	2, 713, 485	97. 66	4, 226	70. 96	2, 555	....	2, 720, 266
1882..	97, 504. 15	2, 627, 402	158. 91	6, 926	58. 58	2, 196	....	2, 636, 524
1883..	94, 539. 75	2, 288, 946	79. 13	3, 262	115. 33	4, 487	....	3, 296, 695
1884..	105, 112. 19	2, 242, 697	178. 00	7, 869	126. 00	4, 765	....	2, 255, 331
1885..	96, 839. 44	1, 941, 943	120. 56	5, 351	114. 08	4, 060	....	1, 951, 354
1886..	117, 538. 35	2, 237, 989	212. 61	8, 739	116. 05	3, 877	....	2, 250, 605
1887..	96, 881. 55	1, 688, 360	278. 56	9, 980	83. 55	2, 383	....	1, 700, 723

a Latterly classed under the head of pyrites.

Statement, *by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year, from* 1876 *to* 1887 *inclusive.*

[Quantities expressed in long tons.]

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.								
Dutch West Indies and Guiana.	1, 515	$15, 427	......	....	......	....	......	....
England	30	1, 211	425	$14, 631	(?)	$16	2	$335
Scotland	24	910	472	13, 231	160	3, 961	806	19, 287
Gibraltar	......	....	290	7, 789	......	....	......	....
Quebec, Ontario, Manitoba, etc	......	....	......	....	12	264	......	....
Italy	46, 941	1, 439, 839	41, 819	1, 194, 000	47, 494	1, 161, 367	64, 420	1, 453, 138
Japan	456	16, 291	437	13, 137	256	7, 548	224	4, 528
Portugal	......	....	......	....	......	....	467	10, 410
Total	48, 966	1, 473, 678	43, 443	1, 242, 788	47, 922	1, 173, 156	65, 919	1, 487, 698
DISTRICTS.								
Baltimore, Maryland	5, 157	157, 828	3, 882	105, 175	5, 455	138, 202	6, 969	157, 243
Barnstable, Massachusetts	......	....	......	....	......	....	600	13, 780
Boston and Charlestown, Masachusetts	5, 031	154, 883	3, 931	101, 215	5, 795	131, 945	7, 841	173, 506
Charleston, South Carolina	......	....	......	....	526	12, 267	605	13, 812
Delaware, Delaware	450	13, 500	......	....	......	....	890	21, 907
Huron, Michigan	......	....	......	....	12	264	......	....
Newark, New Jersey	......	....	1, 071	31, 802	462	13, 240	443	10, 175
New Orleans, Louisiana	172	5, 705	150	4, 750	......	....	100	2, 087
New York, New York	24, 524	721, 092	21, 867	654, 997	28, 240	690, 989	36, 543	827, 193
Philadelphia, Pennsylvania	12, 549	385, 071	9, 216	256, 224	6, 657	167, 222	11, 704	263, 467
Providence, Rhode Island	600	18, 232	1, 739	45, 487	519	11, 479	......	....
San Francisco, California	483	17, 367	862	27, 768	256	7, 548	224	4, 528
Savannah, Georgia	......	....	725	15, 370	......	....	......	....
Total	48, 966	1, 473, 678	43, 443	1, 242, 788	47, 922	1, 173, 156	65, 919	1, 487, 698

Statement showing the imports into the United States of crude sulphur, etc.—Continued.

Countries whence exported and custom districts through which imported.	1880.		1881.		1882.		1883.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.								
England	1	$22					13	$379
Scotland	1,664	36,444	1,668	$43,311	755	$20,294	3	88
France	988	23,580			526	13,770	34	858
French West Indies					2	8		
Greece					500	13,927		
Italy	80,301	1,862,712	102,771	2,645,293	92,944	2,504,862	92,861	2,248,870
Japan	282	4,744	691	16,253	2,980	66,356	1,038	23,714
San Domingo					240	7,875		
Spain			308	8,637			500	12,856
Spanish possessions in Africa and adjacent islands					9	310	87	2,030
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795
DISTRICTS.								
Baltimore, Maryland	13,827	313,342	16,477	430,917	13,781	364,384	11,977	286,438
Beaufort, South Carolina					540	13,889		
Boston and Charlestown, Massachusetts	8,207	183,486	8,860	226,801	7,467	194,317	7,756	173,569
Charleston, South Carolina	1,061	25,398	3,065	78,741	6,025	161,281	4,051	106,235
Middletown, Connecticut					9	310		
New Orleans, Louisiana	280	7,121	100	2,646	220	6,516	428	10,378
New York, New York	46,657	1,083,784	57,608	1,463,082	46,531	1,260,222	45,385	1,110,313
Philadelphia, Pennsylvania	10,679	264,892	17,987	477,547	14,839	408,611	22,772	549,095
Providence, Rhode Island	1,255	31,155	650	17,507	1,244	33,036	535	13,830
Richmond, Virginia					660	17 760		
San Francisco, California	1,270	28,324	691	16,253	6,054	151,234	1,072	24,572
Savannah, Georgia					586	15,842	560	14,365
Total	83,236	1,927,504	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795

Countries whence exported and customs districts through which imported.	1884 (*a*).		1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.								
Belgium			190	$4,766	60	$1,718		
Danish West Indies							861	$5,250
England			606	15,084	81	2,535	162	4,437
France							290	6,951
Quebec, Ontario, Manitoba, and the Northwest Territory						9		
Italy			94,370	1,894,858	112,283	2,166,565	89,924	1,588,146
Japan			1,541	25,683	4,972	66,505	6,146	83,576
Spain			134	1,552				
Total	105,143	$2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360
DISTRICTS.								
Baltimore, Maryland	15,037	303,226	14,505	285,006	19,307	364,958	12,547	225,669
Barnstable, Massachusetts	650	16,163	480	11,040	1,617	35,385	1,152	22,816
Beaufort, South Carolina	600	13,259	610	12,847				
Boston and Charlestown, Massachusetts	5,294	112,152	5,125	99,712	3,681	69,898	4,850	85,575
Champlain, New York						9		
Charleston, South Carolina	6,125	132,570	8,525	169,564	13,350	265,265	12,420	220,598
New Orleans, Louisiana			102	2,282	250	5,102		
New York, New York	52,478	1,135,725	45,537	909,123	58,758	1,115,519	46,711	792,114
Philadelphia, Pennsylvania	18,786	401,468	18,696	381,010	15,568	300,749	15,267	269,216
Providence, Rhode Island	651	15,517	1,840	37,432	1,265	25,930	600	11,291
San Francisco, California	5,522	112,598	1,421	33,937	3,600	54,517	3,176	50,521
All other customs districts							660	10,560
Total	105,143	2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360

a Sources not reported.

The recovery of sulphur from alkali waste.—The recovery of sulphur from alkali waste in the Leblanc process of alkali manufacture has occupied the attention of alkali makers for more than half a century. The great need for a process which would accomplish such a saving may be at once appreciated when one contemplates the fact that at Widnes, England, alone there are now accumulations of waste amounting to 8,000,000 tons, and covering an area of 450 acres, and that there are annually produced 1,500,000 tons. This waste consists of calcium sulphide about 25 per cent., ferrous sulphide 0.94 per cent., calcium carbonate about 25 per cent., moisture about 34 per cent., and other material which need not be considered here. The total quantity of sulphur present in this waste as sulphides varies from 11 to 14.5 per cent. The amount of sulphur thrown away is, then, about 180,000 tons annually.

A process of probable value for the recovery of the heretofore wasted sulphur has at last been devised, after about six years of labor by (*a*) Mr. Alexander M. Chance, of Oldbury, England. This process depends upon the fact that carbonic acid gas as given off from a lime kiln will decompose the sulphide of calcium in vat waste and liberate hydrogen sulphide; this fact was conclusively proved in 1861 by Mr. William Gossage, who devoted about thirty years to efforts to accomplish the result reached by Mr. Chance in 1887. The problem of economically utilizing the hydrogen sulphide was the great obstacle which has been overcome.

In carrying out this process the mixture of alkali waste and water, preferable as a thin cream from which the coarser portions have been removed by means of a sieve, is introduced into a series of vessels, connected by pipes and furnished with inlet and outlet ways; lime-kiln gases are pumped through some or all of such vessels; the lime-kiln gases consist of carbonic acid gas about 30 per cent., and nitrogen 70 per cent. When the gases, entering the first vessel, come in contact with the mixture of alkali waste and water, the carbonic acid is absorbed by any free lime present, producing calcium carbonate, and is further absorbed by the sulphide of calcium, producing in the presence of water calcium carbonate and hydrogen sulphide. The hydrogen sulphide thus formed, being driven forward, passes into another vessel, where it meets with a further quantity of alkali waste and is absorbed, with production of sulph-hydrate of calcium $Ca(HS)_2$. By this process, which may be termed twofold absorption, first of the carbonic acid and then of the hydrogen sulphide, the gases issuing for a time from the last vessel contain neither carbonic acid nor hydrogen sulphide, or merely traces; they are allowed to escape, passing however, as a precautionary measure, through a purifier containing oxide of iron or lime.

The first point achieved by the process, is therefore, the elimination of a considerable quantity of inert, diluent gases, chiefly nitrogen, which are allowed to escape, leaving the remaining gases proportionately en-

a Journal of the Society of Chemical Industry, vol. vii, page 163.

riched. When it is found that the gases issuing from a certain vessel contain a large proportion of hydrogen sulphide, in consequence of the fact that the carbonic acid is now acting upon the calcium sulph-hydrate formed as above mentioned, and that therefore, for each equivalent of carbonic acid absorbed two equivalents of hydrogen sulphide are being evolved thus,

$$CO_2+CaH_2S_2+H_2O=CaCo_3+2H_2S.$$

the outlet from the last vessel is closed and another outlet from the intermediate vessel from which the hydrogen sulphide is issuing in sufficient strength, is opened, and the gases are conducted, as long as they contain sufficient hydrogen sulphide, to a gas-holder whence they are utilized for the purpose of making sulphur or sulphuric acid.

After the complete decomposition of the waste, a decomposition so complete that the filtered water does not blacken or darken when a solution of a lead salt is added, the mixture which remains behind consists chiefly of precipitated carbonate of lime in the form of mud, which may be used in the black-ash furnaces in place of limestone.

The conversion of the hydrogen sulphide into free sulphur and water is accomplished by means of a so-called (*b*) Claus kiln; the reaction is as follows:

$$H_2S+O=H_2O+S.$$

This is effected by mixing the hydrogen sulphide with a regulated quantity of air and sending the mixture through a layer of anhydrous oxide of iron, which, by the heat generated in the reaction itself, is maintained at a dull red heat, the oxide of iron itself undergoing no change. Free sulphur, accompanied by vapor of water, passes off, the free sulphur being obtained in the fused or the sublimed form, according to the temperature of the kiln and of the depositing chambers.

As soon as the success of the process of recovering the sulphur in its elementary form was established, attention was turned to the manufacture of sulphuric acid by burning the hydrogen sulphide in a kiln connected with a complete set of chambers furnished with a Glover tower and a Gay-Lussac absorbing column. The heat generated by the burning of the hydrogen sulphide has proved to be amply sufficient to work the Glover tower and to concentrate, in addition, a considerable quantity of acid in an open evaporating pan placed upon top of the kiln.

Of the total sulphur hitherto thrown away in the vat waste there is obtained as sulphuric acid in the chambers about 90 per cent. of the average quantity of sulphur proved by analysis to be present in the vat waste.

Up to March 3, 1888, 3,000 tons of vat waste were operated upon for the manufacture of both sulphur and sulphuric acid.

The success of this process has been unquestionably proved and its importance is further made apparent by the fact that 300,000 tons of pyrites a year are used for the purpose of making soda by the Leblanc

b "Obtaining sulphur from sulphide of hydrogen," C. F. Claus, Eng. pat. 3608.

process in England; the total quantity of pyrites imported into England during 1887 was 597,595 tons. The amount of sulphur to be recovered is estimated at 100,000 tons per annum. The amount of sulphur imported into the United Kingdom in 1887 was 32,624 tons, so that the home demand could be supplied and 60,000 or 70,000 tons would be available for export. If the sulphur is recovered in the form of brimstone then the effect will be felt by the Sicilian sulphur producers; but if recovered in the form of sulphuric acid the production of pyrites in Spain may be affected. According to present prices the recovering process will pay well for the production of either sulphuric acid or brimstone, without putting any value whatever on the carbonate of lime recovered.

PYRITES.

Production.—The following table shows the domestic production of pyrites since 1882:

Quantity and spot value of pyrites mined in the United States from 1882 *to* 1887.

Years.	Quantity.	Average value per ton.	Total value.
	Long tons.		
1882	12,000	$6.00	$72,000
1883	25,000	5.50	137,500
1884	35,000	5.00	175,000
1885	49,000	4.50	220,500
1886	55,000	4.00	220,000
1887	52,500	4.00	210,000

The condition of the pyrites industry in 1887 did not differ very considerably from that in 1886. There were not more than four new users of pyrites in 1887, according to Mr. H. J. Davis whose material aid in connection with this report is hereby acknowledged. The low prices at which brimstone ruled during the greater part of 1887 tended to retard the erection of pyrites furnaces.

There is a disinclination on the part of manufacturers of sulphuric acid to change from the use of sulphur to that of pyrites as raw material. This is due to the fact that the change involves new experiments and also greater care in operating with pyrites, although the profits are greater with pyrites than with sulphur. It is hardly probable that the use of pyrites will very materially increase until the profits of acid-making fall to so low a point that the necessity for the practice of every economy becomes imperative.

The chief sources of pyrites in the United States are the same as those reported for 1885 and 1886.

Quantity of imported pyrites containing not more than 3½ per cent. copper.

Years.	Long tons.	Value.
1884	16,710	$50,632
1885	6,078	18,577
1886	1,605	9,771
1887	16,578	49,661

The amounts of pyrites given in the above table do not include all of the imports because some of the custom-houses do not separate pyrites from iron ores.

For an account of the Chance process of recovering sulphur from alkali waste in the Leblanc soda process and its bearing on the pyrites industry, the reader is referred to the first portion of this article on sulphur, and for recent statements concerning Spanish pyrites to the article on copper.

SALT.

BY WILLIAM A. RABORG.

The statistics of salt production in 1887 have been obtained through the superintendents of the various salt-producing districts and by correspondence with the producers. The total amount was 7,831,962 barrels, valued at $4,093,846. While these figures show an increase of 124,881 barrels over 1886, there was a decrease in value of $642,739. This was occasioned by the manufacture in New York State of less dairy salt, which brings the highest price.

The following table serves to show by States the amount of salt produced in the United States during the years 1883 to 1887 inclusive:

Salt product of the United States from 1883 *to* 1887 *inclusive.*

States.	1883.	1884.	1885.	1886.	1887.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Michigan	2, 894, 672	3, 161, 806	3, 297, 403	3, 677, 257	3, 944, 309
New York	1, 619, 486	1, 788, 454	2, 304, 787	2, 431, 563	2, 353, 560
Ohio	350, 000	320, 000	306, 847	400, 000	365, 000
West Virginia	320, 000	310, 000	223, 184	250, 000	225, 000
Louisiana	265, 215	223, 964	299, 271	299, 691	341, 093
California	214, 286	178, 571	221, 428	214, 285	28, 000
Utah	107, 143	114, 285	107, 140	164, 285	325, 000
Nevada	21, 429	17, 857	28, 593	30, 000	....
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories, estimated	400, 000	400, 000	250, 000	240, 000	250, 000
Total	6, 192, 231	6, 514, 937	7, 038, 653	7, 707, 081	7, 831, 962

MICHIGAN.

Michigan furnished over one-third of all the salt consumed in the United States during the year 1887, New York one quarter, other States, one-sixth and one-fourth was imported.

The total amount of salt manufactured in Michigan during the year was 3,944,309 barrels, valued at $2,291,842, an increase of 267,052 barrels over the preceding year. The following table gives the locality of each salt-producing district and the number and capacity of the works:

SALT-PRODUCING DISTRICTS OF MICHIGAN.

Location of each salt-producing district, and the number and capacity of the works.

Districts.	Counties.	Companies operating.	Steam blocks.	Pan blocks.	Covers.	Manufacturing capacity.
						Barrels.
No. 1	Saginaw	52	45	12	4,000	1,400,000
No. 2	Bay	31	34	......	500	1,300,000
No. 3	Huron	11	4	8	......	350,000
No. 4	Saint Clair	13	12	2	......	600,000
No. 5	Iosco	8	8	......	......	300,000
No. 6	Midland	4	3	1	......	200,000
No. 7	Manistee	9	9	......	......	900,000
No. 8	Mason	3	2	1	......	300,000
No. 9	Gratiot	1	1	......	......	15,000
Total	......	132	118	24	4,500	5,365,000

From the above it is found that 132 firms were engaged in the manufacture of salt during the year 1887, operating 118 steam and 24 pan blocks. Total number of blocks, 142; and 4,500 salt covers, with an estimated manufacturing capacity of 5,365,000 barrels of salt.

The following table shows the amount of salt inspected in Michigan since 1869, the first year of the establishment of the State salt inspection:

Grades of salt made in Michigan as reported by the inspectors.

Years.	Fine.	Packer's.	Solar.	Second quality.	Common coarse.	Total for each year.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1869	513,989	12,918	15,264	19,117	......	561,288
1870	568,326	17,869	15,507	19,650	......	621,352
1871	655,923	14,677	37,645	19,930	......	728,175
1872	672,034	11,110	21,461	19,876	......	724,481
1873	746,702	23,671	32,267	20,706	......	823,346
1874	960,757	20,090	29,391	16,741	......	1,026,979
1875	1,027,886	10,233	24,336	19,410	......	1,081,865
1876	1,402,410	14,233	24,418	21,668	......	1,462,729
1877	1,590,841	20,389	22,949	26,818	......	1,660,997
1878	1,770,361	19,367	33,541	32,615	......	1,855,884
1879	1,997,350	15,641	18,020	27,029	......	2,058,040
1880	2,598,037	16,691	22,237	48,623	......	2,685,588
1881	2,673,910	13,885	9,683	52,821	......	2,750,299
1882	2,928,542	17,208	31,335	60,222	......	3,037,307
1883	2,828,987	15,424	16,735	33,526	......	2,894,672
1884	3,087,033	19,308	16,957	38,508	......	3,161,806
1885	3,230,646	15,480	19,849	31,428	......	3,297,403
1886	3,548,731	22,221	31,177	71,235	3,893	3,677,257
1887	3,819,738	19,385	13,903	73,905	17,378	3,944,309

Production of Michigan salt in 1887 by districts.

Districts.	Fine salt, bulk.	Fine.	Common coarse.	Packer's.	Second quality	Solar.	Total.
	Bbls.	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*
No. 1, Saginaw county	255,038	833,610	1,183	1,273	10,162	13,903	1,115,169
No. 2, Bay county	237,162	623,276	1,999	1,107	27,918	......	891,462
No. 3, Huron county	20,154	155,125	......	456	847	......	176,582
No. 4, St. Clair county	32,950	279,618	4,500	9,346	2,285	......	328,699
No. 5, Iosco county	......	308,227	781	......	......	......	309,008
No. 6, Midland county	470	31,237	500	......	9,049	......	41,256
No. 7, Manistee county	68,213	778,091	4,185	7,203	13,883	......	871,575
No. 8, Mason county	7,681	186,817	4,230	......	9,761	......	208,489
No. 9, Gratiot county	......	2,069	......	......	......	......	2,069
Total	621,668	3,198,070	17,378	19,385	73,905	13,903	3,944,309

Increased and decreased inspection per district in 1886 *and* 1887.

Districts.	1886.	1887.	Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*
No. 1, Saginaw county	1,213,764	1,115,169	....	98,595
No. 2, Bay county	907,384	891,462	....	15,922
No. 3, Huron county	240,569	176,582	....	63,987
No. 4, St. Clair county	250,602	328,699	78,097	....
No. 5, Iosco county	235,143	309,008	73,865	....
No. 6, Midland county	67,121	41,256	....	25,865
No. 7, Manistee county	683,103	871,575	188,472	....
No. 8, Mason county	79,221	208,489	129,268	....
No. 9, Gratiot county	350	2,069	1,719	....
Total	3,677,257	3,944,309	471,421	204,369
Net increase	....	....	267,052	....

New blocks.—A new vacuum pan block, with capacity of about 500 barrels per day, has been built at Ludington by Messrs. Butters & Peters. The results of this method of manufacture are very satisfactory. In Saint Clair county, Mr. Albert Miller has built a large steam block below Algonac; capacity about 400 barrels per day. This is one of the finest blocks in the State, and is producing an excellent salt. The Diamond Crystal Company, at Saint Clair, has also been added to this district. This firm manufactures a superior article of dairy salt. Its capacity is about 125 barrels per day.

The Michigan Salt Association.—The product of the salt manufacturers is placed on the market by the Michigan Salt Association, of which all the manufacturers, with a few exceptions, are members. It is stated that the benefits derived from a unity of interest were so patent that during the past year nearly all of those manufacturers who had previously operated independently became members of the association, which now practically handles the entire product of the State. The sales of the association during 1887, as shown by the secretary's books, were 3,201,537 barrels as against 2,685,989 barrels in 1886.

Salt car line.—During 1887 the movement of the salt product was greatly delayed owing to the scarcity of cars. To obviate this as much as possible a car line company, composed of salt manufacturers, was organized and is known as the "Michigan Salt Line." The capital stock is $75,000. Contracts were let for the construction of one hundred and twenty freight cars to be run between the Saginaw valley and Chicago. Each car has a capacity of 150 barrels of salt, and the whole number can move 18,000 barrels.

Michigan dairy salt.—The Michigan Dairy Salt Company's works are located on the west side of the Saginaw river, opposite East Saginaw, and were established in 1877. This is the only manufactory at Saginaw for the production of a fine grade of dairy and table salt. The production last year was over 85,000 barrels, and it is sold, like most of the salt, through the Michigan Salt Association. The principal distributing points are Milwaukee, Chicago, Saint Louis, Memphis, Nashville, Louisville, and Toledo, from which commercial centers it is shipped to all parts of the country. This particular product is manufactured from the first and second lifts only of No. 1 fine salt, which is first washed in a purified solution of brine to remove all traces of calcium salts. The process is a patented one and is only used by this company. The salt is dried in a cylinder and screened to get rid of all impurities. It is next ground and packed in sacks, and then into barrels. It is also sold in bulk. The cost of production is about three times that of No. 1 fine salt. The output averages nearly 2,000 barrels per week at the price of $1.30 per barrel. The following analyses are from the four principal manufacturers of dairy salt in the world, and were made by Mr. George A. Mariner, analytical chemist of Chicago:

Analyses of dairy salt.

	Michigan Dairy Salt Company.	Onondaga F. F.	Ashton, England, F. F.	Higgins, England, F. F.
	Per cent.	*Per cent.*	*Per cent*	*Per cent.*
Chloride of sodium	99.45	99.152	98.547	98.506
Insoluble matter	.063	.026	.056	.030
Calcium sulphate	.356	.721	1.227	1.206
Calcium chloride	.131	.047	....	....
Magnesium chloride	Trace...	.034	.059	.031
Magnesium sulphate	....	....	.076	.161
Total	100.000	99.980	99.965	99.934

Prices.—For the past twenty-one years there has been a steady decrease in the average price of Michigan salt, ranging from $1.80 per barrel in 1866 to 58 cents in 1887. The prices for the various grades during 1887 were as follows: Solar, 80 cents; fine, packers and common coarse, 60 cents; and second quality 45 cents.

NEW YORK.

During the year 1887 the production of salt in the State of New York amounted to 2,353,560 barrels, valued at $936,894, being 78,003 barrels less than in the preceding year. The product is derived from the Onondaga Springs reservation and the Warsaw district. On account of the manufacture of less dairy salt, which brings a higher price, on the Onondaga reservation, the total value of the product for the State was somewhat less than in 1886. The salt made at the above localities during the past five years has been as follows:

Production of salt in New York for the years 1883 to 1887, inclusive.

	1883.	1884.	1885.	1886.	1887.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	7,497,431	6,942,270	6,934,299	6,101,757	5,695,797
Warsaw district	600,000	2,000,000	4,589,635	6,056,060	6,072,000
Total	8,097,431	8,942,270	11,523,934	12,157,817	11,767,797

Onondaga Springs reservation.—On the Onondaga Springs reservation, in and near the city of Syracuse, the amount of salt inspected during the year 1887 was 5,695,797 bushels, valued at $436,894 (405,960 bushels less than in 1886); of this amount 2,576,823 bushels were produced in the fine salt works by artificial heat and 3,118,974 bushels in the coarse salt works by solar evaporation.

The following table shows the total production of salt, arranged according to the various inspection districts of the reservation.

Salt inspected at the Onondaga wells in 1887.

Districts.	Solar.	Fine ground.	Ground solar.	Ground dairy.	Aggregate.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Syracuse	848, 176	713, 606	119, 374	20, 157	1, 701, 313
Salina	178, 888	618, 366	15, 795	12, 244	825, 293
Liverpool	1, 044, 180	45, 775	....	....	1, 089, 955
Geddes	912, 561	806, 402	....	360, 273	2, 079, 236
Total	2, 983, 805	2, 184, 149	135, 169	392, 674	5, 695, 797

The following is a statement of the number of bushels of salt made at the Onondaga salt springs since June 20, 1797, the date of the first lease:

Production of the Onondaga district, 1797 *to* 1887, *inclusive.*

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797	....	25, 474	25, 474	1843	318, 105	2, 809, 395	3, 127, 500
1798	....	59, 928	59, 928	1844	332, 418	3, 671, 134	4, 003, 552
1799	....	42, 704	42, 704	1845	353, 455	3, 408, 903	3, 762, 358
1800	....	50, 000	50, 000	1846	331, 705	3, 507, 146	3, 838, 851
1801	....	62, 000	62, 000	1847	262, 879	3, 688, 476	3, 951, 355
1802	....	75, 000	75, 000	1848	342, 497	4, 394, 629	4, 737, 126
1803	....	90, 000	90, 000	1849	377, 735	4, 705, 834	5, 083, 569
1804	....	100, 000	100, 000	1850	374, 732	3, 894, 187	4, 268, 919
1805	....	154, 071	154, 071	1851	378, 967	4, 235, 150	4, 614, 117
1806	....	122, 577	122, 577	1852	633, 595	4, 288, 938	4, 922, 533
1807	....	175, 448	175, 448	1853	577, 947	4, 826, 577	5, 404, 524
1808	....	319, 618	319, 618	1854	734, 474	5, 068, 873	5, 803, 347
1809	....	128, 282	128, 282	1855	498, 124	5, 584, 761	6, 082, 885
1810	....	450, 000	450, 000	1856	709, 391	5, 257, 419	5, 966, 810
1811	....	200, 000	200, 000	1857	481, 280	3, 830, 846	4, 312, 126
1812	....	221, 011	221, 011	1858	1, 514, 554	5, 518, 665	7, 033, 219
1813	....	226, 000	226, 000	1859	1, 345, 022	6, 549, 250	6, 894, 272
1814	....	295, 000	295, 000	1860	1, 462, 565	4, 130, 682	5, 593, 247
1815	....	322, 058	322, 058	1861	1, 884, 697	5, 315, 694	7, 200, 391
1816	....	348, 665	348, 665	1862	1, 983, 022	7, 070, 852	9, 053, 874
1817	....	408, 665	408, 665	1863	1, 437, 656	6, 504, 727	7, 942, 383
1818	....	406, 540	406, 540	1864	1, 971, 122	5, 407, 712	7, 378, 834
1819	....	548, 374	548, 374	1865	1, 886, 760	4, 499, 170	6, 385, 930
1820	....	458, 329	458, 329	1866	1, 978, 183	5, 180, 320	7, 158, 503
1821	....	526, 049	526, 049	1867	2, 271, 892	5, 323, 673	7, 595, 565
1822	....	481, 562	481, 562	1868	2, 027, 490	6, 639, 126	8, 666, 616
1823	....	726, 988	726, 988	1869	1, 857, 942	6, 804, 295	8, 662, 237
1824	....	816, 634	816, 634	1870	2, 487, 691	6, 260, 422	8, 748, 113
1825	....	757, 203	757, 203	1871	2, 464, 464	5, 910, 492	8, 374, 956
1826	....	811, 023	811, 023	1872	1, 882, 604	6, 048, 321	7, 930, 925
1827	....	983, 410	983, 410	1873	1, 691, 359	5, 768, 998	7, 460, 357
1828	....	1, 160, 888	1, 160, 888	1874	1, 667, 368	4, 361, 932	6, 029, 300
1829	....	1, 129, 280	1, 129, 280	1875	2, 655, 955	4, 523, 491	7, 179, 446
1830	....	1, 435, 446	1, 435, 446	1876	2, 308, 679	3, 083, 998	5, 392, 677
1831	....	1, 514, 037	1, 514, 037	1877	2, 525, 335	3, 902, 648	6, 427, 983
1832	....	1, 652, 985	1, 652, 985	1878	2, 788, 754	4, 387, 443	7, 176, 197
1833	....	1, 838, 646	1, 838, 646	1879	2, 957, 744	5, 364, 418	8, 322, 162
1834	....	1, 943, 252	1, 943, 252	1880	2, 516, 485	5, 482, 265	7, 998, 750
1835	....	1, 209, 867	1, 209, 867	1881	3, 011, 461	4, 905, 775	7, 917, 236
1836	....	1, 912, 858	1, 912, 858	1882	3, 032, 447	5, 307, 733	8, 340, 180
1837	....	2, 167, 287	2, 167, 287	1883	2, 444, 374	5, 053, 057	7, 497, 431
1838	....	2, 575, 033	2, 575, 033	1884	2, 353, 860	4, 588, 410	6, 942, 270
1839	....	2, 864, 718	2, 864, 718	1885	2, 439, 332	4, 494, 967	6, 934, 299
1840	....	2, 622, 305	2, 622, 305	1886	2, 772, 348	3, 329, 409	6, 101, 757
1841	220, 247	3, 120, 520	3, 340, 767	1887	3, 118, 974	2, 576, 823	5, 695, 797
1842	163, 021	2, 128, 882	2, 291, 903				

The strength of the brines in each district for each month in the season, during the years 1886 and 1887, is shown in the following table, which is compiled from the report of Dr. T. E. Englehardt, State chemist:

Strength of the brines for the years 1886 *and* 1887.

Months.	Syracuse.		Salina.		Liverpool.		Geddes.	
	Degrees salinometer.		Degrees salinometer.		Degrees salinometer.		Degrees salinometer.	
	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.
April	69.68	....	76.25	....	76.25	....	72.10	....
May	69.09	69.13	73.80	71.98	73.80	71.98	70.36	69.50
June	68.94	68.75	73.03	71.99	73.03	71.99	71.14	72.00
July	68.58	67.98	72.29	70.33	72.29	70.33	72.17	73.50
August	68.00	67.16	72.90	70.71	72.90	70.71	73.10	72.80
September	67.44	67.87	73.83	70.89	73.83	70.89	73.36	73.50
October	66.68	67.34	74.77	71.41	74.77	71.41	73.56	74.00
November	67.79	67.73	73.86	70.86	73.86	70.86	73.90	73.00
Average	68.27	67.99	73.84	71.17	73.84	71.17	72.46	72.61

The following table shows the average strength of the brines in degrees of the salinometer (reduced to correspond with a temperature of 60° F.) in the years from 1865 to 1887, inclusive, except 1868, for which year there are no records:

Average strength of Onondaga brines.

Years.	Syracuse.	Salina.	Liverpool.	Geddes.	Average.
1865	66.17	66.47	60.65	66.17	64.86
1866	65.90	65.81	58.34	65.90	63.98
1867	64.44	64.35	64.35	63.95	64.27
1869	60.98	60.36	60.36	59.02	60.18
1870	59.49	58.94	58.94	59.34	59.17
1871	63.00	62.35	62.35	63.82	62.88
1872	65.10	66.00	67.00	66.20	66.07
1873	63.43	65.33	65.43	67.52	65.43
1874	63.80	66.15	66.15	67.15	65.81
1875	63.88	66.38	66.38	69.50	66.54
1876	66.75	67.70	67.70	69.33	67.87
1877	68.94	69.19	69.19	69.59	69.23
1878	69.93	70.58	70.58	70.02	70.27
1879	66.61	67.47	67.47	67.16	67.17
1880	66.13	67.10	67.10	67.55	66.97
1881	67.02	66.68	66.68	68.21	67.14
1882	67.75	67.24	67.24	68.63	67.71
1883	66.67	68.30	68.30	69.34	68.15
1884	67.88	71.58	71.58	70.10	70.28
1885	67.63	70.99	70.99	69.25	69.72
1886	68.27	73.84	73.84	72.46	72.10
1887	67.30	70.77	70.77	72.20	70.26

Wells.—There are on the reservation five groups of wells: the Syracuse, De Wolf, Gere, Salina, and Geddes. The largest of these, the Syracuse group, is composed of fourteen wells, of which, owing to the lack of strength of the brine, only nine were pumped continuously during the season, and two others at intervals as the demand for brine made it necessary.

The De Wolf group of six wells, including two private wells pumped by the State, was used during the season, with the exception of one private well which gave out.

The Gere group is composed of six wells, all of which have been used.

The Salina or Marsh group comprises twelve wells, of which two failed; the remaining ten were all used. The Geddes group consists of twelve wells, of which nine are private, but all are pumped by the State; only nine were used during the past season, three of the private wells having failed.

The above wells which were operated during 1887 averaged a depth of 330 feet, and were worked during eight months of the year.

Warsaw salt district.—In 1887 the production of salt in the Warsaw district amounted to 6,072,000 bushels, valued at $500,000. During the year there were fifty wells in operation, varying in depth from 800 to 2,500 feet.

The following table gives the production for the year, by sub-districts

Production of salt in the Warsaw district, New York.

Sub-districts.	Bushels.
Warsaw	3,225,000
Mount Morris	510,000
Silver Springs	357,000
Le Roy	505,000
Pifford, Conesus Lake, York	1,475,000
Total	6,072,000

About 1,500,000 bushels of the above were converted into dairy and table salt.

There was not much variation in the strength of the brine during the year, the average being about 90° of the salinometer.

The "grainer" process is largely used in this district, and consists of a system of wooden vats about 135 feet long 12 feet wide and 20 feet deep, in which steam pipes are suspended, so that when the vats are filled with brine the pipes are totally submerged. Live steam passing through these pipes evaporates the water; the salt crystallizing on the surface falls to the bottom of the vat, and is each day lifted with shovels in to the drip barrels, where it remains for a few hours for drainage before removal to the bins.

Another method is the use of large open iron pans about 20 feet wide and 130 feet long, under which arched furnaces are placed and the heat applied direct to the pan. As the salt crystallizes and falls to the bottom of the pan it is raked with hand rakes on to the drips on either side of the pan, and after draining is wheeled to the bins.

A small amount of the salt is made in steam-jacketed kettles.

OHIO.

It is estimated that the salt production of Ohio during the year 1887 was 365,000 barrels, valued at $219,000, being 35,000 barrels and $41,000 in value less than that for the preceding year.

The following table gives the estimated production of salt in Ohio from 1882 to 1887 inclusive:

Estimated production of salt in Ohio from 1882 *to* 1887.

Years.	Barrels.	Value.
1882	400,000	$300,000
1883	350,000	231,000
1884	320,000	201,600
1885	306,847	199,450
1886	400,000	260,000
1887	365,000	219,000

From the report of the geological survey of Ohio, Volume VI., the following statement of the salt industry is obtained:

The industry is depressed; only those localities are still producing which possess some special advantage in the way of strong brine, cheap fuel, easy transportation, or valuable bitter water. The Hocking Valley region, which at one time produced 50,000 barrels per annum, is entirely abandoned, the last furnace in the district which supplied a local trade having been abandoned about a year ago. The Cambridge and Muskingum Valley fields bear the same stamp. These two fields, producing at one time an annual product of 80,000 barrels, are now represented by a few small furnaces supplying a local trade. The Dover and Pomeroy fields have shown more vitality. These localities are favored by cheap fuel and valuable bitter water, the Pomeroy having the advantage of cheap river transportation to large markets. But even in these localities those furnaces which are less favorably located are abandoned. At Pomeroy seven furnaces remain where thirteen flourished shortly after the war.

The cause of this decline has been the rapid development and enormous production of the Michigan field and later the development of rich fields in western New York. The advantage that Michigan promises is an extremely strong brine. There is some recompense, however, in the fact that although lacking strong brines, Ohio can still furnish cheap fuel.

A condensed statement of the workings at the different salt-producing localities is shown in the following table:

Capacity of the different salt-producing localities in Ohio.

Counties.	Owners.	Furnaces.	Daily capacity.	Average depth of wells.	Strength of brine (Baumé).	Daily consumption of coal.
			Barrels.	*Feet.*	*Degrees.*	*Tons.*
Meigs	Ohio River Salt Company.	7	1,400	1,100	9 to 9½	35 to 45
Tuscarawas	Tuscarawas Valley Salt Company.	3	570	875	10	16 to 20
Morgan		4	340	700	7½	6 to 8
Columbiana	New Lisbon Salt Company.	1	65	650	10	7
Guernsey	A. Alexander	1	10	430	5	4 to 5

The following analyses were made with the view of determining the difference in amount of impurities between the salt precipitated when the pans or grainers are newly filled and that precipitated just before the bitter water is drawn off:

Analyses of Ohio salt.

	Canal Dover. (*a*)		Pomeroy. (*b*)	
	No. 1.	No. 2.	No. 1.	No. 2.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	8.050	16.170	2.800	7.680
Chloride of calcium	1.714	5.230	.585	2.700
Chloride of magnesium	.807	2.346	.256	1.095
Silica and iron	Trace.	Trace.	Trace.	Trace.
Chloride of sodium	89.429	76.254	96.359	88.525

a From Dover furnace. *b* From Coal Ridge furnace.

No. 1 is salt first precipitated in each case.

The following table shows the analyses of brine and bitter water:

Brine and bitter water analyses.

	No. 1.	No. 2.	No. 3.	No. 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	89.545	90.472	55.360	69.000
Total solids	10.455	9.528	44.640	31.000
Sodium chlorid	71.645	79.273	30.128	7.603
Calcium chloride	18.665	14.397	48.969	64.810
Magnesium bromide	.271	.097	.592	.429
Sodium iodide	.013	.012	.024	.037
Silica	.024	.043	.032	.039
Iron and alumina	.096	.082	.054	.069
Specific gravity	1.0732	1.0713	1.317	1.307

WEST VIRGINIA.

The Kanawha valley, which was at one time the largest salt-producing locality in the United States, has been somewhat overcome latterly in its struggle with the salt developments of Michigan, where there are stronger brines, cheaper fuel (sawdust), and easier access to the great consuming markets of the West. The salt wells of West Virginia, however, are still available, and if natural gas be developed as largely as the sanguine promoters hope, this cheap fuel may largely reinstate the salt manufacture, and even without gas there is mention of reviving some of the furnaces; using for cheap fuel slack coal and screenings.

The following table gives the production of salt in West Virginia from 1882 to 1887:

Estimated production of salt in West Virginia from 1882 *to* 1887.

Years.	Barrels.	Value.
1882	400, 000	$300, 000
1883	320, 000	211, 200
1884	310, 000	195, 300
1885	223, 184	145, 070
1886	250, 000	162, 500
1887	225, 000	135, 000

LOUISIANA.

During the past few years there has been a steady increase in the production of salt at the Petite Anse rock salt mine, the output of which during the year 1887 amounted to 47,753 short tons (341,093 barrels), at a spot value of $118,735.

From a report made by Dr. H. Carrington Bolton regarding the above mine the following statements are obtained:

The mine is now worked by a system of chambers and cross-headings. The method of operating is to run galleries about 6 to 8 feet high, and then to work upward to a height of 40 feet, leaving between the galleries large pillars to support the roof. The blasting is done by dynamite, of which eighty to one hundred boxes (of 100 pounds) are used every month. About one hundred men are employed by the company, fifty of whom work below the surface. Ventilation is necessitated by the great quantity of dynamite exploded daily, and air is supplied by a fan 8 feet in diameter and 4 feet wide, driven at about 250 revolutions per minute. This, it is estimated, supplies about 600,000 cubic feet of air per hour. The salt brought to the surface is crushed between corrugated rollers driven at high speed; one set breaks it into lumps from 2 to 3 inches in diameter, and another into one-half inch lumps and finer. It is then ground into various grades by six buhrstone mills, each capable of grinding 50 tons in ten hours. The salt is sorted by jigs, revolving reels, and blowers, the fine dust being blown out by a horizontal current of air striking against a column of falling salt. The salt is sent into market in eight grades: 1. Rock salt in lumps from 100 to 300 pounds, used by farmers for cattle. 2. Crushed salt that passes over one-half inch screens and through three-fourth inch screens. 3. "Fish salt," including all which passes through a one-half inch screen. 4. Coarse ground. 5. Medium ground. 6. Fine ground. 7. For sack and barrel salt the coarser particles of grade 6 are screened out with a wire screen of 10 meshes to the inch, and the fine dust is blown out. 8. The fine dust thus blown out divides itself by gravity into an impalpable part (which is thrown away, being a small percentage) and a coarser part which forms table salt. The salt is shipped to market in sacks and barrels.

The amount of salt in sight is very great, and the possible extent of the deposit is enormous. Borings show that about 142 acres of ground are underlaid with salt, the extreme depth of which has not been ascertained, though borings have been sunk 190 feet. Everywhere the character of the salt is the same. At present the owners of the property have leased the mining privilege to the American Salt Company.

In the following table the production and price per grade of salt during 1887 is shown:

Production and price per grade of Petite Anse, Louisiana, salt during the year 1887.

Grades.	Production.	Spot value.	Total value.
	Short tons.		
Lump	2,393	$5.00	$11,965
Crushed	12,824	2.40	30,777
Fish	2,361	2.40	5,666
Coarse	20,522	2.25	46,175
Fine	9,540	2.50	23,850
Table	110	2.75	302
Total	47,750	....	118,735

From 1882 to 1887 the production of the Petite Anse mine was as follows:

Production of the Petite Anse mine from 1882 *to* 1887.

Grades.	1882.	1883.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Lump	20	405	1,485	3,267	3,268	2,393
Crushed	5,995	10,595	7,550	11,038	12,789	12,824
Fish	....	....	....	....	....	2,361
Coarse	16,595	22,480	15,750	20,585	18,873	20,522
Fine	2,940	3,625	6,280	6,958	6,967	9,540
Table	....	25	290	50	60	110
Total..	25,550	37,130	31,355	41,898	41,957	47,750

UTAH.

About 45,500 tons (325,000 barrels) of salt, valued at $102,375, were produced in Utah during the year 1887, showing an increase of 8,500 tons over the preceding year.

Of the above amount 40,000 tons were obtained from the waters of Salt Lake; the remainder was from the southern portion of the Territory. The amount of table salt made is estimated at 12,000 tons.

In Juab county, near Nephi, the quarries continued to supply the stock ranges, and at Salina, Sevier county, it is quarried principally for table salt.

The following is a list of the manufacturing companies in the neighborhood of Salt Lake, and the amount of salt made by each:

Production of salt near Salt Lake City, by companies in 1887.

Manufacturing company.	Short tons.
Hot Springs Salt Company	3,000
Syracuse Salt Company	12,000
Jeremy & Company	10,000
Lyman & Wallace	10,000
All others	5,000
Total	40,000

KANSAS.

During 1887 the prospector's drill, in seeking coal and gas in Kansas, found rock salt in beds, said to be from 10 to 100 feet thick, in Ellsworth, Rice, Reno, Kingman, and Harper counties. The average depth at which salt was struck is 715 feet. Prof. Robert Hay states that the distribution is very extensive; and while no production of importance has been recorded, it is hoped that a considerable industry will be developed during 1888.

PACIFIC COAST STATES.

The following information regarding the salt industry of the Pacific Coast States is furnished by Mr. Charles G. Yale:

"Of about 28,000 tons of salt manufactured in California during 1887, 25,000 tons were produced from the artificial salines on the bay of San Francisco, and nearly all of the remainder from the deposit owned by the New Liverpool Company, and situated near Dos Palmos, in San Diego county. The salt of this company is disposed of in southern California and western Arizona, none of it reaching the San Francisco market. The output of the salines on San Francisco bay might and would have been much larger had not the several companies owning these properties co-operated to restrict and regulate the production, a policy thought necessary by the small profits formerly realized from these works.

"The average price of California salt does not exceed $7 per ton, much of it being crude and impure and adapted only for the common uses. Owing to some concerted action on the part of the manufacturers, the salt industry of California is in a better condition at present than it has been for several years."

IMPORTS AND EXPORTS.

Salt imported and entered for consumption in the United States, 1867 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Cake.		In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		
1867..	....	..	254, 470, 862	$696, 570	229, 304, 323	$336, 302	....	....	$1, 032, 872
1868..	....	....	308, 446, 080	915, 546	219, 975, 096	365, 458	....	....	1, 281, 004
1869..	....	$1, 752	297, 382, 750	895, 272	256, 765, 240	351, 168	....	....	1, 248, 192
1870..	....	9, 698	288, 479, 287	797, 194	349, 776, 433	507, 874	68, 597, 023	$87, 048	1, 401, 814
1871..	....	2, 436	283, 993, 799	800, 454	274, 730, 573	355, 318	64, 671, 139	66, 008	1, 224, 216
1872..	....	....	258, 232, 807	788, 893	257, 637, 230	312, 569	57, 830, 929	60, 155	1, 161, 617
1873..	....	....	239, 494, 117	1, 254, 818	388, 012, 132	525, 585	86, 756, 628	86, 193	1, 866, 596
1874..	....	....	358, 375, 496	1, 452, 161	427, 294, 209	649, 838	105, 613, 913	126, 896	2, 228, 895
1875..	....	1, 867	318, 673, 091	1, 200, 541	401, 270, 315	549, 111	110, 249, 440	119, 607	1, 871, 126
1876..	....	....	331, 266, 140	1, 153, 480	379, 478, 218	462, 106	118, 760, 638	126, 276	1, 741, 862
1877..	....	....	359, 005, 742	1, 059, 941	444, 044, 370	532, 831	132, 433, 972	140, 787	1, 733, 559
1878..	....	....	352, 109, 963	1, 062, 935	414, 813, 516	483, 909	100, 794, 611	96, 898	1, 643, 802
1879..	....	2, 480	375, 286, 472	1, 150, 018	434, 760, 132	532, 706	94, 060, 114	95, 841	1, 781, 045
1880..	....	21, 667	400, 970, 531	1, 180, 082	449, 743, 872	548, 425	109, 024, 446	119, 667	1, 869, 841
1881..	1, 397, 579	8, 187	412, 442, 201	1, 242, 543	529, 361, 042	658, 068	133, 395, 065	144, 347	2, 053, 145
1882..	8, 954, 834	55, 622	329, 969, 300	1, 086, 932	399, 100, 228	474, 200	134, 777, 569	147, 058	1, 763, 812
1883..	7, 863, 756	43, 363	312, 911, 360	1, 035, 946	412, 938, 686	451, 001	142, 065, 557	154, 671	1, 684, 981
1884..	8, 416, 147	40, 646	340, 759, 010	1, 093, 628	441, 613, 517	433, 827	126, 605, 276	122, 463	1, 690, 564
1885..	11, 614, 534	52, 334	351, 276, 969	1, 030, 029	412, 322, 341	386, 858	140, 067, 018	121, 429	1, 590, 650
1886..	7, 935, 237	32, 722	322, 227, 674	982, 350	399, 563, 989	384, 147	129, 641, 792	126, 899	1, 526, 118
1887..	15, 366, 588	43, 766	327, 379, 530	999, 505	355, 012, 544	356, 442	104, 642, 806	99, 438	1, 499, 151

Customs districts and ports into which salt was imported during the fiscal year ending June 30, 1887.

Districts.	Quantity.	Value.
	Pounds.	
Aroostook, Maine	664, 400	$1, 490
Baltimore, Maryland	54, 565, 248	97, 278
Bangor, Maine	2, 971, 696	3, 361
Barnstable, Massachusetts	7, 100	11
Belfast, Maine	544, 469	508
Boston and Charlestown, Massachusetts	102, 495, 054	137, 036
Brazos de Santiago, Texas	18, 467	66
Champlain, New York	96, 040	889
Charleston, South Carolina	8, 575, 210	8, 596
Chicago, Illinois	34, 144, 758	85, 025
Cincinnati, Ohio	224, 000	608
Cuyahoga, Ohio	515, 200	1, 399
Detroit, Michigan	369, 600	2, 609
Duluth, Minnesota	806, 400	5, 378
Galveston, Texas	27, 548, 726	42, 247
Gloucester, Massachusetts	51, 681, 800	50, 974
Huron, Michigan	3, 353, 728	20, 140
Indianapolis, Indiana	3, 167, 975	8, 599
Kansas City, Missouri	2, 744, 052	5, 709
Key West, Florida	208, 679	264
Milwaukee, Wisconsin	358, 400	2, 531
Mobile, Alabama	7, 387, 744	9, 480
New Haven, Connecticut	1, 914, 624	2, 709
New Orleans, Louisiana	26, 320, 501	60, 022
New York, New York	237, 558, 071	493, 174
Norfolk and Portsmouth, Virginia	26, 976, 788	52, 598

Custom districts and ports into which salt was imported, etc.—Continued.

District.	Quantity.	Value.
	Pounds.	
Oregon, Oregon	168,000	$432
Oswegatchie, New York	104,536	1,122
Paso del Norte, Texas	434,741	1,473
Passamaquoddy, Maine	4,360,017	6,172
Pensacola, Florida	4,150,720	4,141
Philadelphia, Pennsylvania	74,202,366	132,253
Portland and Falmouth, Maine	18,853,458	25,487
Providence, Rhode Island	9,641,073	9,940
Richmond, Virginia	2,621,835	6,306
Saint Louis, Missouri	1,075,200	2,920
San Francisco, California	13,394,297	47,391
Savannah, Georgia	17,214,097	17,117
Superior, Michigan	1,800	9
Vermont, Vermont	326,414	1,809
Willamette, Oregon	10,847,656	36,980
Wilmington, North Carolina	11,649,530	15,517
Wiscasset, Maine	1,792,206	1,836
Yorktown, Virginia	10,346,809	30,363
All other customs districts	3,932,877	4,062
Total	780,336,362	1,438,031

Imports of salt by countries during the fiscal year ending June 30, 1887.

Countries.	Quantity.	Value.
	Pounds.	
Belgium	21,740	$154
France	40,702,765	43,116
Germany	155,470	918
England	457,701,055	1,082,448
Ireland	1,000	38
Gibraltar	1,478,400	1,174
Nova Scotia, New Brunswick, and Prince Edward Island	4,242,280	7,305
Quebec, Ontario, Manitoba, and the Northwest Territory	10,535,292	36,680
British West Indies	66,856,721	84,586
Hong-Kong	100	1
Italy	128,172,107	115,288
Mexico	575,858	1,692
Dutch West Indies	18,672,470	19,755
Portugal	30,698,339	24,026
Azores, Madeira, and Cape Verde Islands	89,960	92
Spain	18,577,781	18,626
Cuba	1,615	9
Porto Rico	1,358,609	1,628
Venezuela	494,800	495
Total	780,336,362	1,438,031

Salt, of domestic production, exported from the United States.

Fiscal years ending September 30 until 1842, and June 30 since.	Quantity.	Value.	Fiscal years ending June 30.	Quantity.	Value.
	Bushels.			*Bushels*	
1790	31,935	$8,236	1858	533,100	$162,650
1791	4,208	1,052	1859	717,257	212,710
1830	47,488	22,978	1860	475,445	129,717
1831	45,847	26,848	1861	537,401	144,046
1832	45,072	27,914	1862	397,506	228,109
1833	25,069	18,211	1863	584,901	277,838
1834	89,064	54,007	1864	635.519	296,088
1835	126,230	46,483	1865	589,537	358,109
1836	49,917	31,943	1866	670,644	300,980
1837	99,133	58,472	1867	605,825	304,030
1838	114,155	67,707	1868	624,970	289,936
1839	264,337	64,272	1869	442,947	190,076
1840	92,145	42,246	1870	298,142	119,582
1841	215,084	62,765	1871	120,156	47,115
1842	110,400	39,064	1872	42,603	19,978
1843 (nine months)	40,678	10,262	1873	73,323	43,777
1844	157,529	47,755	1874	31,657	14,701
1845	131,500	45,151	1875	47,094	16,273
1846	117,627	30,520	1876	51,014	18,378
1847	202,244	42,333	1877	65,771	20,133
1848	219,145	73,274	1878	72,427	24,968
1849	312,063	82,972	1879	43,710	13,612
1850	319,175	75,103	1880	22,179	6,613
1851	344,061	61,424	1881	45,455	14,752
1852	1,467,676	89,316	1882	42,085	18,265
1853	515,857	119,729	1883	54,147	17,321
1854	548,185	159,026	1884	70,014	26,007
1855	536,073	156,879	1885	(a)4,101,587	26,488
1856	698,458	311,495	1886	4,762,657	29,827
1857	576,151	190,699	1887	4,224,685	25,270

a Pounds from 1885.

The following table shows the amount and value of the salt exported from the United States during the year 1887; also the countries to which the product was shipped:

Exports of salt, by countries.

Countries to which exported.	Quantity.	Value.
	Pounds.	
Brazil	280	$5
Central American States:		
Costa Rica	31,455	441
Guatemala	8,270	36
Honduras	40,038	487
Nicaragua	80,724	1,036
China	7,150	21
Danish West Indies	400	6
France	285	6
French West Indies	700	12
French Guiana	3,698	34
French possessions, all other	139,790	453
England	200	5
Nova Scotia, New Brunswick, and Prince Edward Island	6,000	30
Quebec, Ontario, Manitoba, and Northwest Territory	178,730	953
British Columbia	388,942	1,274
Newfoundland and Labrador	25,620	283
British West Indies	108,561	1,231
British Honduras	5,660	102
Hawaiian Islands	850,360	2,392
Hayti	5,060	85
Japan	52,000	221
Liberia	834	9
Mexico	108,179	1,651
Dutch West Indies	100	2
Peru	280	3
Russia, Asiatic	1,232,400	3,391
San Domingo	34,606	496
Cuba	162,991	1,546
United States of Colombia	732,972	8,980
Venezuela	400	7
All other islands and ports	18,000	72
Total	4,224,685	25,270

BROMINE.

Production.—Nearly all the bromine manufacturers ceased operation temporarily in May, 1887, on account of the accumulation of stock and dullness of trade. The total production was only 199,087 pounds, with a total value, where produced, of $61,717. The average price was held at 31 cents per pound. The production by States is given in the following table:

Production of bromine in the United States from 1883.

Sources.	1883.	1884.	1885.	1886.	1887.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Pomeroy, Ohio	171, 116	159, 881	110, 000	111, 866	59, 312
Tuscarawas valley, Ohio	23, 334	21, 710	15, 000	15, 000	45, 350
West Virginia	106, 650	99, 509	85, 000	126, 391	16, 425
Pennsylvania	....	....	60, 000	49, 549	78, 000
Michigan	....	....	40, 000	125, 528	....
Total	301, 100	281, 100	310, 000	428, 334	199, 087

Mr. C. W. Bodey, the pioneer producer of bromine at Canal Dover, Ohio, states that the industry began in 1846, when Dr. David Alter, at Freeport, Pennsylvania, first made bromine, using earthen retorts. He continued this until 1850, when he attempted the use of stills cut out of sandstone blocks. These were used until he abandoned the manufacture in 1855 or 1856. From this time till 1866 no bromine was made in the United States. It was then taken up again by Mr. C. W. Bodey, who was sent out by Messrs. Rosengarten & Sons, of Philadelphia, to investigate the subject, and who began the manufacture again, using some of Dr. Alter's apparatus. The Freeport works were abandoned in March, 1871, and the Tarentum works in 1874. No bromine has been made there since. Mr. Bodey has compiled the following interesting table of the production of bromine at Freeport, Tarentum, and Canal Dover. The figures for earlier years are the entire product of the country. The production of salt at the bromine works is given for late years; it shows that 222,669 pounds of bromine were produced from the mother liquor of 259,350 barrels of salt, or nearly one pound to the barrel:

Total production of bromine at Freeport and Tarentum, Pennsylvania, and at Canal Dover, Ohio.

Years.	Freeport.	Tarentum.	Canal Dover.	Canal Dover. (*a*)
	Pounds.	*Pounds.*	*Pounds.*	
1866	1,484	44	....	....
1867	3,843	6,990	....	....
1868	3,985	8,757	....	....
1869	3,321	8,335	....	....
1870	2,295	10,790	....	....
1871	249	11,893	615	....
1872	....	7,480	1,363	....
1873	....	10,344	2,922	....
1874	....	9,052	6,253	....
1875	....	....	1,059	....
1876	....	....	9,664	....
1877	....	....	17,484	20,364
1878	....	....	17,968	22,124
1879	....	....	17,626	21,937
1880	....	....	16,864	20,461
1881	....	....	19,508	22,693
1882	....	....	23,604	26,835
1883	....	....	25,184	27,092
1884	....	....	21,404	25,613
1885	....	....	20,936	24,357
1886	....	....	20,683	23,191
1887	....	....	21,437	24,683
Total	15,177	73,685	244,574	259,350

a Barrels of salt (280 pounds each).

Imports.—The imports of bromine in the fiscal year 1886 amounted to 22,099 pounds, valued at $6,288, and for the calendar year 1887 to 66,307 pounds, valued at $16,216. These are the only imports of bromine in recent years.

Use.—In addition to the use of bromine for the manufacture of potassium and sodium bromides, attention has been given lately to its value as a disinfectant. Mr. James C. Bayles, president of the New York Board of Health, states that a solution of 1 pound of bromine in 250 gallons of water was found strong enough for all practical purposes. Care must, of course be taken in making the solution to avoid the escape of the very irritating and poisonous fumes and this was effected by immersing the bottle in water before removing the stopper. It is applied with an ordinary sprinkling pot from a wagon having a street sprinkling attachment, and works admirably for the purpose of destroying odors from gas-saturated soil.

POTASSIUM SALTS.

By William C. Day.

Occurrence and sources.—Potassium is found in nature widely distributed in various combinations. It occurs as a constituent of many silicates, forming from 1.7 to 3.1 per cent. of the granite composing the earth's crust. Among the silicates which contain potash as an essential constituent may be mentioned potash feldspar or orthoclase, leucite, and analcime. Pure chloride of potassium, sylvine, KCl, is found in considerable deposits, together with carnallite, $KCl+MgCl_2+6H_2O$, in the mines of Stassfurt, Germany. This salt and others occur in the water of the ocean and in lakes, such as the Dead Sea, as well as in many mineral waters and in ordinary spring water. All fertile soils contain potassium compounds. These are taken up by plants; potash is also the essential alkali contained in the animal body. The potash which sheep draw from the land is excreted in large quantity from the skin in the sweat. No less than one-third of the weight of raw merino wool consists of this material.

Manufacture.—Formerly nearly all the potash used in the arts and manufactures was obtained from the ashes of land plants; but of late years the increasing demand for potash (for the preparation of various compounds in which it has not yet been found possible to replace that alkali by soda, namely, the chlorates, prussiates, chromates, etc., and more especially of saltpeter for the manufacture of gunpowder) has led to the invention of several processes by which potassium salts may be obtained either directly from mineral sources or from the waste products of manufacturing operations.

In the United States, Canada, Russia, Sweden, Germany, and some parts of Tuscany and France, where large forests occur, potash is obtained from the ashes of trees and of land plants in general. The process of extraction consists briefly in incineration, the resulting ashes consisting chiefly of carbonates, chlorides, sulphates, phosphates, and silicates of potassium, sodium, calcium, magnesium, and iron; carbonates generally constitute by far the larger proportion of the ash, which is treated with water to dissolve out the soluble constituents. The lye thus formed yields on evaporation what is known as crude potash, consisting mainly of potassium carbonate with considerable potassium sulphate and usually 12 per cent. of water. In Germany the sulphate of potassium is sometimes separated by allowing it to crystallize out of the liquor before boiling down. The crude potash is next calcined, thus getting rid of organic matter and water, giving what is known as *pearl ash.* The incineration of plants has the advantage over other methods of obtaining potassium salts that it yields potassium carbonate which by mere neutralization with the proper acid is converted into other salts used in manufactures, whereas other sources yield the potassium for the most part in the form of chloride or sulphate, the transformation of which into other desirable compounds is by no means so direct as with the carbonate, although in the case of the preparation of potassium nitrate for gunpowder the chloride is at once available.

On account of the diminution of forest trees efforts to obtain potash from other sources have been made, and one of the results has been the manufacture of potash as a by-product from the beet-root sugar industries. The uncrystallizable sugar in the molasses from beets is converted into alcohol, and potassium salts are extracted from the residue. This plan, which is carried out on the large scale in France and Germany, consists in inducing fermentation in the molasses, separating by distillation the alcohol thus formed, evaporating to dryness the residual liquors, calcining the solid mass, and treating the salts as described for ordinary potashes. The aggregate quantity of potassium salts produced from the beet-root sugar manufacture in Europe is quite large and is yearly increasing.

The ashes of marine plants known as "kelp" in Great Britain, and "varec" in France, are now produced solely for their contents of iodine and potassium salts. The potassium salts extracted are chiefly the chloride and sulphate which, with chloride of sodium, are the principal constituents of kelp.

Potassium occurs in sea water as chloride and sulphate to the average amount of 0.257 parts in 1000 of sea water. The extraction of these salts from sea water has been carried on for about fifteen years in the southern part of France by a process largely dependent for success upon the natural advantages of the climate, which are: a powerful summer's sun and a sufficient difference in temperature between day and night. The sea water is first left to evaporate during the summer in shallow ponds; a considerable quantity of common salt is thereby obtained, mixed toward the last with magnesium sulphate. The mother liquor is also evaporated in shallow ponds, and yields during the day common salt and at night a mixture of sulphate of magnesium and a double sulphate of potassium and magnesium. The mother liquor from these is evaporated in other ponds, and a crop of crystals is obtained consisting of a double chloride of potassium and magnesium, which, when dissolved in water heated by steam, yields chloride of potassium on cooling. The mixed magnesium and potassium-magnesium sulphates are re-dissolved and evaporated, giving rise to the double salt K_2SO_4, $MgSO_4+6H_2O$, which is used for the manufacture of alum and for the production of carbonate of potassium by the Leblanc process. The mother liquor containing only the epsom salts is worked up in winter.

The following account of the vast salt beds at Stassfurt by Prof. C. Napier Hake is reprinted from the journal of the English Society of Chemical Industry:

Stassfurt is a small town of some 12,000 inhabitants, about 25 miles southwest of the city and fortress of Magdeburg, in Prussia. It lies in a plain, and the river Bode, which takes its rise in the Hartz mountains, flows through it. The history of the salt industry in Stassfurt is a very old one, and dates back as far as the year 806. Previous to the year 1839 the salt was produced from brine pumped from wells sunk about 200 feet into rock. The brine in the course of time became so weak, as regards the common salt it contained, that it was impossible to carry on the manufacture from this source without loss. In 1839 the Prussian Government, which owned these saline springs, commenced boring with the object of discovering the whereabouts of the bed of rock salt from which the brine had been obtained, and in the year 1843—seven years after the commencement of the borings—the top of the rock salt was reached at a depth of 770 feet. The boring was continued 1,080 feet into the rock salt without reaching the bottom of the layer. At this total depth of 1,850 feet the boring was suspended. On analyzing the brine obtained from the bore hole it was found to consist, in 100 parts by weight, of:

Analysis of brine first obtained at Stassfurt, Germany.

	Per cent.
Sulphate of calcium	4.01
Chloride of potassium	2.24
Chloride of magnesium	19.43
Chloride of sodium	5.61

A result not only unexpected but disappointing, since the presence of chloride of magnesium in such quantities dispelled, for the time, all hopes of striking on the pure rock salt. The Government, however, guided by the opinions expressed by Dr. Karsten and Professor Marchand, namely, that the presence of chloride of magnesium in such quantities was probably due to a deposit lying above the rock salt, determined to investigate the matter further, and in the year 1852 the first shaft was commenced, which, after five years, had penetrated, at a depth of 1,000 feet, into a bed of rock salt, passing on its way, at a depth of 770 feet, a bed of potassium and magnesium salts 80 feet thick. The lowest deposit of all consists of rock salt. The bore hole was driven 850 feet into it without reaching the bottom of the layer. Its depth is therefore unknown. The deposit lying immediately on the bed of rock salt consists chiefly of sulphate of magnesium as the mineral kieserite. Still further towards the surface the deposit consists of the double chloride of potassium and magnesium, known as the mineral carnallite, mixed with sulphate of magnesium and rock salt. The deposit on the rise of the strata consists of the double sulphate of potassium and magnesium combined with one equivalent of chloride of magnesium, and intermingled with common salt to the extent of 40 per cent. This double sulphate is known as the mineral kainite, and is a secondary formation, resulting from the action of a limited quantity of water on a mixture of sulphate of magnesium and the double chloride of potassium and magnesium, as contained in the uppermost deposit previously spoken of.

The upper bed of the rock salt, resting on a thick bank of anhydrite, is also a later formation. Almost imperceptible layérs of polyhallite are present in this deposit and at greater intervals than in the lower and older deposit. It has therefore probably originated from the action of water on the older deposit. This upper bed of rock salt varies in thickness from 125 to 300 feet, and its extent is comparatively limited. It is worked in preference to the older deposit, where both exist in the same mine, it being of much purer quality, averaging about 98 per cent., in the mines of the New Stassfurt Mining Company and in the Royal Prussian mines.

Sixteen different minerals have already been discovered in the Stassfurt deposits. They may be divided into primary and secondary formations. Those of primary formation are rock salt, anhydrite, polyhallite (K_2SO_4, $MgSO_4$, $2CaSO_4$, $2H_2O$), kieserite ($MgSO_4$, H_2O), carnallite (KCl, $MgCl_2$, $6H_2O$), boracite ($2Mg_3B_8O_{15}$, $MgCl_2$), and douglasite ($2KCl$, $FeCl_2$, $2H_2O$). Those of secondary formation, resulting from the decomposition of the primary minerals, are nine in number, namely, kainite (K_2SO_4, $MgSO_4$, $MgCl_2$, $6H_2O$), sylvine (KCl), tachydrite ($CaCl_2$, $2MgCl_2$, $12H_2O$), bischofite ($MgCl_2$, $6H_2O$), krugite (K_2SO_4, $MgSO_4$, $4CaSO_4$, $2H_2O$), reichardtite ($MgSO_4$, $7H_2O$), glauberite ($CaSO_4$, Na_2SO_4), schönite (K_2SO_4, $MgSO_4$, $6H_2O$), and astrakanite ($MgSO_4$, $4H_2O$). Only four of these minerals have any commercial value, namely, carnallite, kainite, kieserite, and rock salt. The yield of boracite, which is found in nests in the carnallite region of the mine, is too insignificant to be classed among those just mentioned.

The mine may be divided chemically into four regions, (1) the rock salt, (2) the kieserite, (3) the carnallite, (4) the kainite region. The rock-salt region has almost the same composition throughout. Its character is crystalline, though in this region well-defined crystals are never met with. In other parts of the mine, especially in the carnallite region, it is found crystallized in three distinct forms—the cube, the tetrahedron, and the octahedron, colored different shades of red and blue. Specimens have also been found of varied structure, laminated, granular, and fibrous.

The rock salt is ground more or less fine, according to requirement. Before passing through the mill it is sorted by hand labor, the purest being utilized as table salt, large quantities of which are exported even to India. The finest quality is sold at about 10 shillings per ton, the second quality, containing about 98 per cent. of chloride of sodium, realizing about 5 shillings per ton. The accompanying table shows the output of rock salt and other minerals, in tons, between the years 1861 and 1881:

Output of minerals at Stassfurt, 1861 *to* 1881.

	Rock salt.	Carnallite and kieserite.	Kainite.	Various minerals.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
1861 to 1865	44, 494	29, 603	....	....
1866 to 1870	58, 937	118, 099	11, 689	....
1871 to 1875	64, 233	433, 859	18, 039	....
1876 to 1880	96, 856	643, 363	55, 773	....
1880 (*a*)	118, 105	528, 211	137, 795	4, 100
1881 (*a*)	149, 222	744, 722	155, 301	5, 300

a These quantities were supplied by four mines, namely, Royal mine, Stassfurt, the Leopoldshall mine, the New Stassfurt mine, and the Douglashall mine, belonging to the Consolidated Alkali Company.

The deposit lying on top of the rock constitutes the so-called kieserite region. The thickness of this deposit is about 56 meters, and its average composition as follows:

Average composition of the kieserite layer at Stassfurt.

	Per cent.
Kieserite	17
Rock salt	65
Carnallite	13
Tachydrite	3
Anhydrite	2
Total	100

In the pure state kieserite is amorphous and translucent, possessing a specific gravity of 2.517. It contains 87.1 per cent. sulphate of magnesia and 12.9 per cent. water, corresponding to the formula $MgSO_4, H_2O$. Exposed to the air it becomes opaque from the absorption of moisture, and is converted into epsom salts; 100 parts of water dissolve 40.9 parts of this mineral at 18° C. The solution, however, takes place very slowly at this temperature.

This deposit has not been worked to any great extent. Its composition is interesting as showing the gradual decrease of the proportion of common salt and the commencement of the separation of the more soluble salts.

Each of the two divisions of the mine just described contains only one mineral of importance. The third division, called the carnallite region, contains a variety of minerals, and to this deposit Stassfurt owes its world-wide fame. The average thickness of this deposit is about 80 feet, and its composition is as follows:

Average composition of the carnallite region at Stassfurt.

	Per cent.
Carnallite	60
Kieserite	16
Rock salt	20
Tachydrite	4

There is besides a small quantity of magnesium bromide. These minerals are deposited in the order given above, in successive layers, varying in thickness from 0.4 to 39 inches, the different colors of these minerals giving the deposit a remarkable appearance. The predominating mineral in this region is carnallite, a double chloride of potassium and magnesium, containing 26.76 per cent. chloride of potassium, 34.50 per cent. chloride of magnesium, and 38.74 per cent. water, corresponding to the formula $KCl, MgCl_2, 6H_2O$. In the pure state it is colorless and transparent, and possesses a specific gravity of 1.618. It is very hygroscopic, and is easily soluble in water, 100 parts of which dissolve 64.5 parts of the mineral. It may be artificially formed from a solution of chloride of potassium, containing not less than 26 per cent. of chloride of magnesium. The deposit which figures to the right of the carnallite region is, as before mentioned, a secondary formation, and consists principally of the mineral kainite. This deposit, though limited as compared to the other salt deposits, is yet of vast extent. The average composition of this deposit is:

Average composition of the kainite region at Stassfurt.

	Per cent.
Sulphate of potash	23.0
Sulphate of magnesia	15.6
Chloride of magnesium	13.0
Chloride of sodium	34.8
Water	13.6
Total	100.0

In the pure state it is colorless and almost transparent, and possesses a specific gravity of 2.13; 100 parts of water dissolve 79.5 parts of it. Cold water does not decompose it, but from its saturated hot solution the double sulphate of potassium and magnesium separates, and the chloride of magnesium remains in solution.

This brief explanation of the various strata will suffice to give a clear idea of the character of the mines from which the raw materials are drawn.

The following generally accepted theory of their formation is presented:

The entire deposit is supposed to have resulted from the evaporation of an inland sea in communication with the ocean. The water of this inland sea must have become more and more concentrated as time went on, owing to evaporation, until the point of saturation was reached, when the common salt would begin to separate. This would naturally take place during the hot summer months, while during the winter months, when the temperature was considerably lower, the calcium sulphate deposited from the fresh inflowing water, each gypsum zone marking a new period of precipitation. These zones, like the circular rings in trees, afford us a basis for speculation regarding the period of time during which the deposit was in course of formation. Thus, supposing the rock-salt deposit to be 600 meters thick, 6,600 years would have elapsed during the process. Reverting once more to the question of the separation of these salts, let us assume that the connection between this inland sea and the ocean had been cut off for some time. The mother liquor, though still containing common salt in large proportions, would also contain all the more soluble potassium and magnesium salts which had been accumulating during the previous period. As evaporation went on, the common salt and calcium sulphate would have been still alternately deposited until the point of saturation was reached, when the potassium would be thrown down in the form of the tri-sulphate of potassium, magnesium, and calcium, and in the place of the calcium sulphate. At a higher degree of concentration, and consequently at a later period, sulphate of magnesium was crystallized, accompanied by a small proportion of carnallite, and finally, the most soluble salt of all, the double chloride of potassium and magnesium, separated out with sulphate of magnesium in the proportion of 60 per cent. carnallite to 16 per cent. kieserite. The crystallization of common salt continued to the end, but its proportion to the other salts decreased towards the surface. The deposit, which originally had the shape of a basin, was lifted in the center by volcanic action, the fault striking southwest. The deposit is protected from the solvent action of water, first by a layer of clay, and further by a thick layer of anhydrite, the stratum above consisting to a large extent of the Bunter sandstone.

There are eleven mines sunk along the strike of the fault. At Aschersleben the deposit lies almost horizontal. In Stassfurt the dip of the deposit is 40° in the Prussian mine and 60° in the New Stassfurt mine, and at the other end of the fault the deposit is almost vertical. Only one shaft has been sunk on the east border of the fault, the other ten being situated on the west side. The distance from the Aschersleben shaft to the Douglashall shaft is about 10 miles.

These potash deposits, instead of being regarded as a source of profit, were looked upon for some time as an incumbrance. When they had to be removed in order more economically to work the rock salt they were carted onto the banks of the river, to be washed away during the period of the floods. The first attempt to utilize these deposits as a raw material in Stassfurt was made by Dr. Frank, who established a factory in the year 1860. He was shortly followed by Dr. Gruneberg and Messrs. Leisler and Townsend, and in the year 1863, 13,500 tons of raw material were consumed by eleven factories. In 1883 the manufacture of chloride of potassium, etc., was carried on by the following firms:

Ascania Company, limited, Leopoldshall.
Beit & Philippi, in Stassfurt.
Concordia Company, limited, Leopoldshall.
Harburg-Stassfurt Company, limited, in Stassfurt.
N. F. Loefass, in Stassfurt.
The Mineral Salts Production and Moorlands Reclamation Companies, in Aschersleben. (a)
Consolidated Alkali Company, limited, in Wester Egeln.
Lindeman & Co., in Stassfurt. (a)
Maigatter, Green & Co., in Leopoldshall.
Müller & Allihn, in Leopoldshall.
F. Müller, in Leopoldshall.
F. R. Müller & Co., in Schönebeck.
C. Nette Faulwasser & Co., in Leopoldshall.
Schachnow & Wolff, in Leopoldshall.
Stassfurt Chemical Company, limited, in Stassfurt.
Stein & Keitz, in Leopoldshall.
United Chemical Company, limited, in Leopoldshall.
Vorster & Gruneberg, in Leopoldshall.
Wüstenhagen & Co., in Hechingen.

The raw potash or carnallite salt has the following composition in 100 parts:

Composition of crude carnallite at Stassfurt.

	Per cent.
Carnallite:	
Chloride of potassium	16.2
Chloride of magnesium	24.3
Kieserite—Sulphate of magnesium	9.7
Common salt	18.7
Chloride of calcium	0.2
Clay and anhydrite	2.1
Water	28.8

The process by which the chloride of potassium is separated from this raw material will first be described, and then the by-products and waste products and their treatment. The manufacture of chloride of potassium is based on the decomposition of the carnallite contained in the raw material, in a hot saturated solution, potassium chloride separating out on cooling and chloride of magnesium remaining in solution. The process, though simple in theory, is complicated in practice, owing to many difficulties, some of which will be mentioned presently. The process of manufacture may be divided into four operations: (1) Dissolving the raw salt; (2) evaporating its cold mother liquor; (3) dissolving the artificial carnallite resulting from the evaporation; (4) refining the crystallized chloride of potassium.

(a) These two companies are owners of mines and work their own raw material.

The raw salt is delivered by the mines to the various factories in an unground state. The large blocks are broken up by a stonebreaker, or by a mill of similar construction to a coffee mill, and the material is then lifted by means of an elevator into the dissolving pan, a cylindrical wrought-iron vessel, in which is contained a boiling saline solution, preferably of chloride of magnesium. The solution is kept boiling by high-pressure open steam as the salt is delivered into it. The carnallite dissolves entirely, but the kieserite and common salt to a small extent only. The resulting hot solution, which has a specific gravity of 1.32, is then run into deep pans, the sides of which are surrounded by some non-conducting substance. Milk of lime is sprinkled over the surface of the turbid liquor, which decomposes a small portion of the soluble magnesium salts, magnesia being formed, which, on subsiding, carries down with it the fine precipitate of sulphate of calcium. This fine precipitate is formed during the boiling of the solution, from the double decomposition of the chloride of calcium, contained in the tachydrite, with sulphate of magnesium. This method of clarifying the liquor has, after many experiments, been found to be the best and also the cheapest.

The hot solution thus clarified is then run into shallow pans and allowed to cool for two or three days. Two-thirds of the potassium chloride contained in the solution crystallizes out and a part of the common salt with it. By this method the first product of crystallization, when refined, contains from 80 to 85 per cent. of KCl.

By another method the solution is boiled to a specific gravity of 1.34 instead of 1.32, chloride of magnesium liquor being used as a solvent. The solution is then run into the settling pan and diluted down to a specific gravity of 1.32, in order to prevent the separation of chloride of potassium as carnallite, which would otherwise take place at the higher grade. Less common salt is dissolved in the first place, consequently the solution is much richer in potassium chloride. The first product of crystallization, after being refined, is an almost pure potassium chloride, and is not less in quantity than by the first method. This simple process was introduced by Dr. Dupré into the works of Messrs. Leisler & Townsend in the year 1862, and was successfully kept a secret for fifteen years. It is now universally in operation.

As regards the cold mother liquor, the composition of this in 100 parts is as follows:

	Per cent.
Chloride of potassium	4.09
Chloride of sodium	1.74
Chloride of magnesium	20.49
Sulphate of magnesia	2.98
Water	70.70

In order to obtain the 4 per cent. of chloride of potassium still remaining in this mother liquor the solution is concentrated by evaporation to a specific gravity of 1.34, when the chloride of potassium almost completely separates out, on cooling, in the form of double chloride of potassium and magnesium, or artificial carnallite, this double salt being insoluble in a concentrated solution of chloride of magnesium. The double salt is allowed to drain, and is then dissolved in boiling water to saturation, and on cooling deposits a very pure chloride of potassium. The chloride of potassium resulting from the various operations described is further purified by steeping in cold water, and is then allowed to drain, when it is afterwards either calcined at a gentle heat in reverberatory furnaces or dried by steam in specially constructed pans. It is generally exported packed in jute bags containing two hundredweights each.

The by-products resulting from the process just described are kieserite and epsom salts, crystallized and anhydrous sulphate of soda, a mixed salt which is sold as potash manure, chloride of magnesium, magnesium hydrate, and bromine. The first four, viz., kieserite, epsom salts, crystallized and anhydrous sulphate of soda, are obtained from the residue remaining in the pan after the potash salt has been dissolved out of the raw material. The product sold as potash manure is obtained from the sludge remaining in the settling pan. The last three, viz., chloride of magnesium, magnesium hydrate, and bromine, are obtained from the last mother liquor. With regard to the first four, the deposit, which represents 30 to 40 per cent. of the raw material used, has the following composition:

Composition of by-products from the crystallization of potassium chloride.

	Per cent.
Sulphate of magnesia	26.8
Common salt	34.2
Chloride of magnesium	9.9
Chloride of potassium	2.1
Sulphate of calcium	8.5
Anhydrite	10.3
Water	8.2

The deposit, while still hot, is thrown out of the dissolving pan into a funnel-shaped iron box, at the bottom of which is a grating with bars about one-fourth of an inch apart. A shower of cold water is allowed to play on the surface, by which the common salt is dissolved. The kieserite breaks up into very fine particles, and passes through the grating as a sludge in suspension, accompanied by small quantities of undissolved common salt and crystals of anhydrite. It next passes into a drum sieve, which revolves by the action of the flowing liquor. The finely-divided kieserite falls through the meshes into a pan below, the impurities passing over and along and falling out at the other end. The kieserite is then allowed to subside, and is rapidly formed into blocks weighing from 50 to 70 pounds each. Within a few hours these become very hard from the absorption of one molecule of water, in which condition it is exported, without the necessity of further packing. It contains—

Composition of kieserite as shipped.

	Per cent.
Sulphate of magnesium	60
Sulphate of calcium	5
Common salt	3
Anhydrite	10
Water	22

The kieserite serves as a raw material, in Stassfurt and elsewhere, for the manufacture of epsom salts. The process consists simply in dissolving it and allowing the hot solution to crystallize.

This same deposit also serves as a raw material for the manufacture of sulphate of soda, which can, however, only be carried on during the winter months, when the thermometer is at zero. The residue is thrown from the dissolving pan and collected outside the works in large heaps, where it remains exposed to the action of the air until the kieserite, from the absorption of water, is converted into a more soluble form. When the heap accumulated is in a sufficiently soluble condition a shallow trench is dug round it and puddled out with clay, with an outlet leading to a large tank. A steam and water pipe is laid side by side from the works to the heap and hot water injected over the surface continuously. A concentrated warm solution of common salt and sulphate of magnesia runs out at the bottom of the heap, and collecting in the trench flows into the tank, where it is allowed to clarify. The clear liquor is pumped into shallow wood reservoirs standing in the open air. One cold night affords sufficient time for the complete separation of sulphate of soda from this solution.

As much as 10,000 tons of sulphate of soda have been produced in Stassfurt during one winter. The crystallized salt is either recrystallized or is converted into anhydrous sulphate, either by calcination or by Pechiney's process, which consists in adding to a concentrated hot solution 17 to 20 per cent. of common salt. About 85 per cent. of the sulphate of soda present in the solution separates out as the anhydrous salt. Pechiney's process is used by the Stassfurt Chemical Company only, other manufacturers preferring to dehydrate the crystals by calcination. The residue remaining in the settling pan yields a not unimportant by-product. This residue, which is in a more or less fluid state, is run into large reservoirs, in which the solid matter is allowed to subside, and the supernatant liquor is siphoned off. The still thin sludgy mass is thrown onto a sloping platform of brickwork, where it is left until it is sufficiently drained to bear transport, when it is calcined. The hard, partially-fused mass is then ground to a fine powder, and is packed in bags, each containing two hundred-weights, and exported as a potash manure. The composition of this mixture will be seen from the analysis given below:

Composition of residue from making sodium sulphate.

	Per cent.
Chloride of potassium	15.0
Chloride of magnesium	19.8
Chloride of sodium	13.1
Sulphate of magnesium	16.8
Insoluble	35.3

It is a curious fact in connection with the calcining of this sludge that though the heat is sufficient to melt the mass, only 5 per cent. of the chloride of magnesium present is decomposed. This is no doubt due to the presence of other salts, especially sulphates. In spite of the low percentage of potash in this so-called "potash manure" and of the high percentage of chloride of magnesium and other salts, which can scarcely be called fertilizers, it has an enormous sale, principally in Russia and the colder northern parts of Europe.

The last mother liquor supplies three by-products, namely, crystallized magnesium chloride, magnesium hydrate, and bromine. This liquor has a specific gravity of 1.32, and consists of—

Composition of the final mother liquor from Stassfurt salts.

	Per cent.
Chloride of magnesium	35
Chloride of potassium	1
Chloride of sodium	1
Sulphate of magnesium	3
Bromide of magnesium	0.2
Water	59.8

The crystallized chloride of magnesium is produced by evaporating the mother liquor to a specific gravity of 1.34. The potassium and sodium chlorides and the magnesium sulphate separate out, and the hot concentrated liquor is run into casks, where it solidifies on cooling to a white translucent mass, containing about 50 per cent. of chloride of magnesium. It is largely exported to England, being used by cotton spinners as a thread lubricator. The cost of production of one ton of crystallized chloride of magnesium in Stassfurt, including casking, is about $4.

The Consolidated Alkali Company manufactures large quantities of magnesium hydrate by the following process: The 3 per cent. of sulphates contained in the last mother liquor are first removed by a solution of calcium chloride. A quantity of milk of lime is then added, rather less than sufficient to decompose the whole of the chloride of magnesium. The precipitated magnesia is allowed to settle as far as practicable, and is then passed through filter presses, in which it is thoroughly washed by water. The magnesia thus prepared contains only 0.1 per cent. of sulphate of lime, and is used by continental sugar refiners as a clarifier.

A certain quantity of this mother liquor is utilized for the distillation of the bromine contained in it. This is carried out in large sandstone vessels saturated with tar, manganese dioxide and sulphuric acid being used to liberate the bromine.

Many proposals have been made and numerous patents have been taken out for the further utilization of this mother liquor, but it still figures largely as a waste product. Of the 6,000,000 cubic feet yearly produced, corresponding to 150,000 tons of dry $MgCl_2$, one-half only is recovered, the remainder being run into the river, carrying with it 300,000 pounds of bromine.

The coal used in this industry is a lignite, the heating value of which is about one-third that of English coal. Large deposits exist in the immediate neighborhood. The absence of good and cheap coal is a serious drawback to the development of a new industry, and this is one of the greatest difficulties manufacturers have to contend with. Another difficulty is that the water in Stassfurt is saturated with sulphate of lime, the river water in the immediate neighborhood of the works not being available for manufacturing purposes, owing to excessive pollution by salt liquors. Thus manufacturers are compelled to study the economical use of fuel in the construction of their plant.

The dissolving pan, which is usually 7 feet in diameter and 8 feet deep, is entirely closed and steam tight, except where an iron tube passes into it. This tube is 1 foot in diameter, and projects about 2 feet above the cover of the pan. The coarsely-ground raw material falling from the elevator passes through the tube into the dissolving pan, in which there is a quantity of boiling mother liquor sufficient to close the lower end of the iron tube. Only just sufficient steam is allowed to enter so as to keep the solution gently boiling. If the steam valve is opened too much the contents of the pan are forced through the iron tube. With a little experience and care this result is easily avoided; the arrangement works well, and the solution is completed with the use of a minimum amount of steam. The pans used in Stassfurt for evaporating the mother liquors are variously constructed. In the works built by Messrs. Leisler & Townsend, which have now passed into the hands of the Stassfurt Chemical Company, limited, the whole of the mother liquor is concentrated in iron pans by high-pressure steam contained in copper coils, the condensed water being used for feeding the steam boilers. Messrs. Wüstenhagen & Co., in Hechingen, have constructed an evaporating pan which gives good results as regards economizing fuel. Another method of dealing with the mother liquors is as follows: Pans, which are 15 to 20 feet long, 4 feet wide, and about $3\frac{1}{2}$ feet deep, are arranged in sets of three, and to each set a condenser is attached—that is to say, an iron reservoir, in which is placed a copper worm. The furnace is built on the central pan, the fire gases passing through the two tubes of this pan, and, further, through the tubes of the smaller closed pans to the right and left of it. The cold mother liquor is pumped into a condenser where it becomes heated by the steam evolved from the pans. From the condenser it is run into closed pans, where it is concentrated to a point just below that at which the common salt contained in it would separate out. At this point of concentration it is run into an open central pan, where the evaporation is completed.

The drying of the chloride of potassium is carried out in most of the factories in calcining ovens. Some of the works, however, have adopted a mechanical drying apparatus. This consists of a circular cast-iron plate, inclosing a series of pipes cast in the form of a coil. The plate is surrounded by a sheet-iron border. A stirring arrangement, consisting of a shaft with double arms, to one of which is attached scrapers, to the other rollers, revolves slowly, and continually turns over the salt and grinds it to a very fine powder. The apparatus is heated either by waste or high-pressure steam. When the salt is sufficiently dry the position of the scrapers is altered, the salt is pushed out through a door in the side, and falls into bags held under it. One apparatus is capable of delivering 2½ to 3 tons of dried salt into bags in twenty-four hours, at a cost of 25 cents per ton.

As to the cost of production of chloride of potassium (known commercially as muriate of potash), taking the price of the raw material at $2.50 per ton, and containing 16 per cent. chloride of potassium (one-fifth of which is lost during the process of manufacture), then, for the production of one ton of 80 per cent. chloride of potassium 6¼ tons of raw material would be required—

Cost of producing one ton of potassium chloride.

Cost of 6¼ tons of raw material	$15.00
For wages	2.85
Fuel	3.60
Repairs, packing, etc	4.85
Making a total of	26.30

In the year 1880 a committee was formed by the owners of all the mines, or their representatives, to regulate the price of raw material and also the quantity that should be worked, the object being to keep the demand for the manufactured product in advance of the supply, and thus benefit the manufacturers. The price and output of the raw material are settled every three months, and a certain fixed quantity apportioned to each factory according to its size.

Private enterprise, however, is threatening the stability of this arrangement, and it is doubtful whether it will remain in force much longer. An English company in Aschersleben, near Stassfurt, has successfully sunk a shaft into the potash deposits, and has erected large works for the production of chloride of potassium, etc. The new Stassfurt Mining Company, one of the mines included in this arrangement, is, in anticipation of a change, erecting plant sufficient to consume 600 tons of its own raw material daily. Under these circumstances the price of chloride of potassium can scarcely be maintained so successfully as heretofore. Manufacturers, indeed, are anxiously looking out for sources of profit which would make them independent of the production of chloride of potassium.

The mineral kainite, which has hitherto been almost exclusively used as a fertilizer, is now attracting more attention as raw material for the production of the double sulphate of potassium and magnesium, a salt identical in composition with the very rare mineral schönite.

Between the years 1878 and 1882 no less than twenty patents were obtained for the working of kainite, but of these twenty processes only three have been successfully repeated on a manufacturing scale. Artificial schönite is in great demand as a fertilizer, also for the manufacture of sulphate of potash and potash alum, and realizes a comparatively high price.

The first of these processes, patented by Messrs. Botscher & Bruniyes, is worked by the United Chemical Company. The second, patented by Dr. Precht, is worked by the New Stassfurt Mining Company, with which he has been so long and honorably connected. The third, by Dr. Dupré, of Stassfurt, and Mr. C. Napier Hake, has been in successful operation during the last three years at the works of the Stassfurt Chemical Company. In time the inexorable law of the survival of the fittest, will ultimately determine which of these three processes is the best. As regards the influence of the Stassfurt industry on allied manufactures in England, doubtless many saltpeter makers have suffered from German competition, owing to the development of Stassfurt; and it is very well known that the manufacture of potassium carbonate is now almost entirely in the hands of Germans.

Raw wool has already been referred to as a source of potassium compounds. These compounds are, first, a peculiar substance called by the French "suint," (and believed to be the potassium salt of an animal acid containing nitrogen), potassium carbonate, sulphate, and chloride. These salts are obtained by placing the wool in casks, pressing it down thoroughly, and then pouring cold water over it. The solution thus resulting is boiled down to dryness; the dry product is broken into lumps and calcined in retorts; the residue is lixiviated, and the solution is boiled to a specific gravity varying from 30° to 50° B. The chloride and sulphate of potassium crystallize out on cooling, and the mother liquor, when boiled down to dryness, yields potassium carbonate. The production is generally 70 to 90 pounds of pure carbonate and 5 to 6 pounds of sulphate and chloride of potassium to every 1,000 pounds of raw wool.

Numerous processes have been proposed for extracting potassium salts from feldspar and other silicates, but none of them has been carried out on a manufacturing scale.

INDIVIDUAL POTASSIUM SALTS.

Potassium carbonate.—Under the preceding heading, "Manufacture," etc., the extraction of potassium carbonate from various natural sources has been considered; in still larger quantity, however, it is manufactured from potassium sulphate obtained both from the Stassfurt beds and from sea water. The sulphate is converted into the carbonate by heating it in a reverberatory furnace with the proper quantity of limestone and coal, the product being treated exactly as in Leblanc's process for obtaining carbonate of sodium from salt cake. This process is treated of under sodium compounds in this volume.

Uses.—Potassium carbonate is largely used in the manufacture of soft soap, yellow prussiate of potash, potassium bichromate, iodide, bromide, permanganate, hydrate, and chlorate, and also for crystal glass.

Production.—During 1880 the production of potash and pearlash amounted to 4,571,671 pounds, valued at $232,643; this amount was produced in seven States—Indiana, Maine, Michigan, Minnesota, New York, Ohio, and Wisconsin.

The following table, by Mr. William L. Rowland, is taken from the census report of 1880:

Table showing the production and value of potash and pearlash in 1880.

States.	Number of establishments.	Product.	
		Pounds.	Value.
Indiana	3	232, 500	$11, 625
Maine	8	279, 299	14, 010
Michigan	27	1, 393, 962	62, 542
Minnesota	1	146, 000	5, 840
New York	8	515, 500	23, 442
Ohio	12	493, 229	20, 761
Wisconsin	9	1, 511, 181	94, 423
Total	68	4, 571, 671	232, 643

According to quite a large number of returns from potash producers in several of western States, particularly Michigan, Indiana, Ohio, and Wisconsin, and also the estimates of the large dealers in New York City, the production of potash in 1887 is estimated at 5,000 casks of 700 pounds each, or 3,500,000 pounds. This shows that there has been a falling off of at least 1,000,000 pounds since 1880. The product of 1887 is valued at 4 cents per pound, making a total of $140,000. Twenty years ago the industry was eight to ten times as important as now. The demand is still good, but the supply is not maintained. The only process used in the United States is the leaching of wood ashes, and, as already indicated, the depletion of forests, as well as competition from foreign sources caused by the manufacture of potash from waste products of the beet-sugar industry and from the Stassfurt salts, have caused a materially decreased domestic production. The importations of this substance in various forms amount to about 4,500,000 pounds annually, as shown in the table at the end of this chapter.

Potassium chloride.—The most important source of this salt at present is the Stassfurt beds. The preparation of potassium chloride at Stassfurt and in other localities from sea water has already been fully described; it is also obtained as a by-product in the purification of saltpeter.

Uses.—Potassium chloride is used largely in the manufacture of potassium nitrate for gunpowder, and for the preparation of alum, potassium chlorate, sulphate, and carbonate; it is also employed in freezing mixtures, together with niter and sal-ammoniac, and it is used to some extent in medicine.

The potassium chloride industry in Germany is at present in a very flourishing condition; this is largely due to the increasing demand for the salt in the manufacture of potassium nitrate for gunpowder. Reference to the table of imports at the end of this chapter shows that the amount of muriate of potash imported in 1886 is more than double the quantity imported in 1881 and about eight times the import of 1872.

Saltpeter, or potassium nitrate.—This salt occurs, together with other nitrates, as an efflorescence on the soil in various hot countries, especially in Bengal, but also in America, Egypt, Syria, Persia, and Hungary. In India it is regularly and systematically collected as it is found, and after approximate purification is exported in large quantity, as well as locally used to some extent. In a number of European countries saltpeter is prepared from nitrogenous organic material by exposing it to the air until putrefaction takes place, when it is mixed with such substances as lime, mortar, wood ashes, etc., resulting ultimately in the formation of various nitrates, all of which are converted into potassium nitrate, which is purified by recrystallization. This process has now, however, disappeared in England, France, and Germany, and is used in other countries only in a small degree.

Since the discovery of the large quantities of potassium chloride at Stassfurt this salt has been largely used for the manufacture of saltpeter. This process depends upon the double decomposition which takes place when potassium chloride and sodium nitrate are mixed in solution in definite proportions and under certain necessary conditions. The products of this decomposition are sodium chloride and potassium nitrate. Sodium chloride is deposited from the hot solution, and in cooling potassium nitrate crystallizes out, the solution being continually agitated to promote the formation of minute crystals.

The great use of potassium nitrate is, of course, in the manufacture of gunpowder; other purposes for which it is used are in the manufacture of nitric acid, gun cotton, in freezing mixtures, in glass manufacture, for pickling meats, as a fertilizer, for the manufacture of pharmaceutical preparations, and in medicine.

The conversion of sodium nitrate into potassium nitrate by means of potassium chloride is continually increasing in this country, although the amount of potassium nitrate imported shows as yet no material falling off, having averaged between 10,000,000 and 11,000,000 pounds since 1879; the increase in the amount of potassium chloride since 1879 has, however, been very great, the amount for 1879 having been 21,334,022 pounds, while for 1887 it was 39,800,600 pounds. The amount of saltpeter used in the manufacture of gunpowder in the United States is estimated at about 6,500,000 pounds, valued at $325,000.

The consumption of potassium nitrate in powder manufacture has been very materially affected, owing to the fact that the great bulk of the blasting powder now produced contains sodium nitrate instead of potassium nitrate, the latter salt being used only for the best grade (A) of blasting powder, while for grade B sodium nitrate is used.

Sources in the United States.—As was stated in the report for 1882, saltpeter is found native in many of the Western and Southwestern States and in the Territories of the Far West; but up to that time none had been discovered the quality of which would justify refining. Early in 1887, however, a deposit in Hobble Creek cañon, about 8 miles from Springville, Utah county, Utah Territory, was discovered, which promises to be of importance. The deposit occurs in a porous sandstone formation, the rock being soft and easily worked. A company, with a capital stock of $250,000, has been incorporated, with headquarters at Salt Lake City. The names of the shareholders are as follows: William C. Pavey, J. B. Walden, T. J. Baker, W. A. Nelden, H. C. Wallace, P. P. Shelby, C. W. West, all of Salt Lake City. Another deposit was also discovered early in 1887 near Milford, Beaver county, Utah, but no developments are yet reported.

Deposits of niter, known as the Humboldt niter beds, exist in Nevada, and from the results of a recent examination the opinion has been expressed that some 12,000 or 15,000 tons a year could be profitably produced. These beds are well situated and accessible, but as yet no developments have been made. Beds of niter recently discovered near Mount Hope, Eureka county, Nevada, are said to be quite extensive. Steps have been taken to secure capital for opening up these beds for investigation. If they turn out to be of sufficient value, it is probable that they will be worked.

Potassium sulphate.—This salt, as has already been shown, occurs native in the Stassfurt salt beds, where it is present in kainite, which has the composition K_2SO_4, $MgSO_4$, $MgCl_2 + 6H_2O$. Kainite also occurs in the salt beds of Kalusz, in Austrian Galicia. Until within a few years it has been used almost exclusively as a fertilizer, but is now attracting attention as a raw material for the production of artificial schönite,

K_2SO_4, $MgSO_4 + 6\ H_2O$, which, besides being in great demand as a fertilizer, is used in the manufacture of potassium sulphate and potash alum.

Between 1878 and 1882 no less than twenty patents for the working of kainite at Stassfurt were granted, but of these only three have been successfully repeated on a manufacturing scale. Potassium sulphate is also obtained, as already described, from ashes of land plants (chiefly in Germany), from kelp, and from sea water; it is also a by-product in the manufacture of potassium bichromate. Besides being converted in large quantities into potassium carbonate by the Leblanc process, potassium sulphate is used for the manufacture of alum and glass, and as a purgative in medicine.

Imports.—Sulphate of potassium has been imported in quantity for the past three years; the amount introduced in 1887, namely, 1,996,324 pounds, being nearly six times the import of 1884, which was 346,348 pounds.

The potassium salts thus far considered occur in various forms and in more or less pure condition in nature, and they are therefore the salts of prime importance, inasmuch as other potassium compounds commercially used are derived from them by various processes of chemical manufacture. The compounds yet to be considered are such products of manufacture.

Alum.—The following table gives the production of alum for the past six years:

Alum made in the United States from 1882 *to* 1887.

Years.	Quantity.	Price per pound	Value.
	Pounds.	*Cents.*	
1882	36,000,000	2	$720,000
1883	35,000,000	2⅛	743,750
1884	38,000,000	1⅞	712,500
1885	80,000,000	1¾	1,400,000
1886	90,000,000	1½	1,350,000
1887	90,000,000	1¾	1,575,000

These statistics include not only alum proper, but also ammonia alum and aluminum sulphate.

For low grades the average price per pound was 1¼ cents, for crystallized 1¾ cents, and for high grade concentrated, 2½ cents.

The following table shows the imports of various manufactured products classed under the head of alum. Quite a material increase over 1886 is evident from this table, although the figures for 1887 are still far below those of several previous years.

Alum (classed as alum, alum substitute, aluminous cake, and sulphate of alumina) imported into the United States, 1867 *to* 1887 *inclusive.*

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	5, 573, 285	$85, 760	1878	8, 645, 248	$107, 394
1868	3, 110, 095	47, 887	1879	5, 961, 057	65, 708
1869	2, 038, 549	34, 385	1880	2, 112, 570	23, 435
1870	2, 485, 722	39, 969	1881	2, 086, 950	22, 331
1871	4, 712, 840	74, 450	1882	2, 487, 188	29, 930
1872	3, 996, 826	64, 465	1883	1, 695, 661	21, 126
1873	4, 218, 621	66, 243	1884	1, 461, 041	19, 497
1874	4, 053, 588	67, 913	1885	2, 243, 920	37, 707
1875	6, 951, 396	112, 516	1886	2, 070, 125	35, 343
1876	7, 266, 735	103, 152	1887	3, 687, 255	54, 008
1877	8, 259, 175	112, 275			

In regard to its sources, uses, etc., alum has been fully considered in previous volumes of the "Mineral Resources." To what has already been said in regard to alum the following statement of the proportions used for different purposes may be added: Paper making, a little more than one-half; dyeing, two-ninths; drug trade, color makers, and baking powders, one twenty-seventh each; morocco dressers, one forty-eighth, and the remainder for calico printers.

Caustic potash.—This substance was formerly much more used than at present, having been largely replaced by the cheaper caustic soda, particularly in all cases in which its use depends upon its strongly basic properties. It is prepared by treating potassium carbonate in solution with milk of lime, which results in the formation of caustic potash in solution and precipitated carbonate of calcium. The solution is then evaporated in polished cast-iron vessels, stopping the evaporation when the specific gravity reaches 1.16 if the product is to be free from iron. In this case the evaporation is continued in a vessel of silver free from copper. Commercial caustic potash solution has a specific gravity of 36° B. To prepare the solid caustic potash the solution is evaporated to dryness and then fused and cast in the form of sticks. The product thus prepared contains the impurities of the potassium carbonate used, namely, alumina, potassium chloride, potassium sulphate, and potassium silicate. To get rid of these the commercial product must be dissolved in pure alcohol, which leaves undissolved the potassium sulphate and silicate; but traces of potassium chloride, carbonate, and acetate are generally present.

Potassium bromide.—This salt is manufactured from bromine by a number of different processes. One of these consists in dissolving bromine in caustic potash solution, when a mixture of bromide and bromate of potassium is formed. If this mixture be evaporated and gently ignited pure bromide is left, the bromate being decomposed. Another process consists in bringing bromine water (bromine in solution) and amorphous phosphorus together, thus causing the production of hydrobromic acid, which is then neutralized with milk of lime; insoluble phosphate and phosphite of lime are precipitated while calcium bromide remains in solution; this on treatment with potassium carbonate yields insoluble calcium carbonate, and potassium bromide remains in solution and may be obtained by evaporation.

A third process depends upon the formation of bromide of iron, which takes place when bromine water and iron filings are brought together. The bromide of iron is then decomposed by potassium carbonate, which causes the precipitation of the iron while potassium bromide remains in solution.

Potassium bromide is largely used in medicine for internal as well as external applications. It is also employed in photography.

Potassium iodide.—This salt is prepared by methods similar to those in use for potassium bromide. It is quite largely used in medicine.

Potassium chlorate is prepared on the large scale by the following process: Chlorine, generated in the ordinary way from manganese dioxide, and hydrochloric acid, is passed into milk of lime until the liquid is nearly saturated. After this the solution of chloride and chlorate of calcium thus produced is evaporated and then treated with potassium chloride, resulting in the formation of potassium chlorate, which crystallizes out, and is then washed and dried.

Potassium chlorate is used in very large quantities for a variety of purposes, among which may be mentioned its use as a source of oxygen gas, in the manufacture of matches, for pyrotechnic purposes, in calico printing, in the manufacture of potassium permanganate, in medicine, and in the manufacture of bromine, particularly in Michigan, where it is advisable to use as little sulphuric acid as possible; and, since less of this is necessary when potassium chlorate is employed, this salt has taken the place of manganese dioxide, and its use is spreading also to those bromine wells of West Virginia which contain calcium chloride in large quantity.

The table at the end of this chapter shows that since 1869 the increase in the imports of potassium chlorate has been very great, the highest figure, 1,855,899 pounds, having been reached in 1887, while the lowest figure, that for 1869, was 270,006 pounds.

Potassium chromate and bichromate.—For description of processes employed in manufacture, statistics, etc., the reader is referred to the reports on chromium in this and previous volumes of the Mineral Resources.

Yellow and red prussiate of potash.—Yellow prussiate of potash, or potassium ferrocyanide, is prepared on the manufacturing scale by melting potassium carbonate or crude potash mixed with iron filings and various animal materials, such as horn, claws, dried blood, wool, feathers, leather cuttings, etc. The operation is conducted in hemispherical cast-iron vessels set in brick work and heated by a fire with a circular flue. The animal materials are decomposed, their nitrogen uniting with carbon and potassium to form potassium cyanide, while the sulphur contained in the potash and in the animal matter unites with potassium and iron to form potassium iron sulphide. In the subsequent lixiviation of the fused mass the substances above mentioned react to produce potassium ferrocyanide, which must be purified by recrystallization. This salt forms the starting point for the preparation of almost all the so-called cyanogen compounds. It is used in the manufacture of Berlin blue, but its importance, for a number of reasons, is not so great as in former years.

The table of imports at the end of the chapter shows that the maximum amount, 544,167 pounds, was reached in 1881. The amount for 1887, viz, 412,130 pounds, is larger than for any year previous to 1881 or since, except the year 1883, when the amount imported was 510,522 pounds.

Red prussiate of potash, or potassium ferricyanide is manufactured by some process of oxidizing the yellow prussiate. The process commonly used on the large scale consists in passing chlorine through a solution of the yellow prussiate. It is used in dyeing wool and in the preparation of aniline black and violet, etc. The imports of this salt, like those of the yellow prussiate, reached the maximum, 106,424 pounds, in 1881, falling off regularly until the past year, for which the imports, 80,492 pounds, are higher than for any year since 1881.

Table of imports of potassium salts for the years 1869 to 1887, inclusive.

Years.	Muriate of potash.		Bicarbonate of potash and calcined or pearl ash.		Carbonate of potash, or fused.		Caustic potash.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1869	....	....	362,237	$20,649	....	....	....	....
1870	....	....	418,910	26,035	....	....	....	....
1871	....	$61,270	170,823	10,550	....	....	....	....
1872	5,821,551	126,418	430,765	34,555	....	....	....	....
1873	7,765,495	158,768	465,073	38,507	....	....	....	....
1874	7,444,280	134,289	440,330	36,923	....	....	....	....
1875	11,741,710	190,587	531,465	38,999	....	....	....	....
1876	9,884,722	157,542	329,149	20,643	....	....	....	....
1877	13,693,193	209,413	397,700	25,057	....	....	....	....
1878	19,655,204	292,603	374,392	22,721	....	....	....	....
1879	21,334,022	250,818	211,467	12,178	....	....	....	....
1880	24,024,554	331,489	405,941	22,317	....	....	....	....
1881	22,801,259	335,799	798,585	39,214	....	....	....	....
1882	43,475,660	743,825	1,036,476	55,045	....	....	....	....
1883	30,742,333	535,259	1,571,012	93,817	....	....	....	....
1884	48,712,767	731,409	126,160	7,025	1,729,242	$79,722	785,018	$44,174
1885	40,839,704	613,674	45,895	2,004	2,841,705	102,384	1,000,140	48,431
1886	46,824,006	721,736	29,426	1,543	4,266,608	153,799	1,296,062	62,221
1887	39,800,600	592,432	21,734	533	4,584,934	159,526	1,237,857	56,184

Table of imports of potassium salts, etc.—Continued.

Years.	Chlorate of potash.		Chromate and bichromate of potash.		Crude potash.		Hydriodate, iodide, and iodate of potash.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1869	270, 006	$64, 262	877, 432	$78, 288	....	....	....	....
1870	359, 104	80, 737	1, 235, 946	127, 333	....	....	....	....
1871	595, 068	85, 315	2, 170, 473	223, 529	....	....	17, 842	$49, 503
1872	609, 822	167, 065	1, 174, 274	220, 111	....	....	1, 514	6, 520
1873	696, 261	176, 124	1, 121, 357	178, 472	....	....	1, 037	5, 248
1874	804, 346	188, 148	1, 387, 051	218, 517	....	....	1, 041	5, 380
1875	755, 791	161, 189	1, 417, 812	183, 424	....	....	483	1, 499
1876	474, 598	104, 549	1, 665, 011	175, 795	....	....	61	125
1877	1, 122, 442	202. 992	2, 471, 669	264, 392	....	....	195	396
1878	768, 758	128, 227	1, 929, 670	211, 136	....	....	81	276
1879	1, 110, 854	170, 843	2, 624, 403	221, 151	948, 206	$39, 696	50	203
1880	1, 305, 133	180, 660	3, 505, 741	350, 279	564, 807	22, 557	182	759
1881	1, 086, 781	150, 444	4, 404, 237	402, 088	537, 009	25, 451	480	1, 267
1882	1, 219, 280	164, 906	2, 449, 875	261, 006	957, 124	50, 580	137	528
1883	1, 444, 979	173, 617	1, 990, 140	208, 681	982, 843	54, 216	50	69
1884	1, 169, 790	126, 272	2, 593, 115	210, 677	107, 411	5, 308	147	182
1885	1, 395, 966	159, 270	1, 448, 539	92, 556	53, 771	2, 233	122	200
1886	1, 827, 199	230, 478	1, 985, 809	139, 117	464, 431	16, 869	44	96
1887	1, 855, 899	223, 321	1, 722, 465	120, 305	159, 342	4, 077	55	170

Years.	Nitrate of potash or saltpeter, crude.		Nitrate of potash or saltpeter, refined.		Prussiate of potash, red.		Prussiate of potash, yellow.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1869	8, 878, 996	$313, 114	106, 007	$4, 435	25, 560	$10, 576	146, 219	$35, 703
1870	(*a*)9, 001, 265	347, 280	226, 160	10, 859	45, 810	18, 222	287, 876	61, 870
1871	(*a*)7, 808, 150	320, 944	133, 452	7, 821	17, 480	7, 222	255, 325	58, 009
1872	(*a*)5, 201, 191	244, 710	79, 564	6, 011	326	203	33, 005	11, 266
1873	10, 682, 038	498, 932	(*a*)523, 858	31, 141	2, 650	1, 348	263, 112	94, 516
1874	8, 280, 341	392, 515	(*a*)166, 277	12, 530	21, 515	14, 622	151, 057	46, 679
1875	9, 457, 954	380, 286	(*a*)222, 113	16, 988	9, 454	6, 791	133, 023	32, 290
1876	7, 507, 213	279, 635	(*a*)352, 515	20, 510	9, 534	5, 042	55, 439	13, 647
1877	10, 322, 255	382, 091	(*a*)549, 039	29, 562	22, 669	11, 517	18, 500	3, 876
1878	8, 126, 384	332, 162	(*a*)302, 583	18, 286	12, 287	5, 640	56, 000	11, 874
1879	8, 294, 987	342, 392	(*a*)351, 401	19, 161	33, 100	14, 167	25, 020	5, 299
1880	11, 309, 351	428, 904	(*a*)1, 051, 705	58, 598	47, 990	21, 394	112, 617	22, 483
1881	11, 014, 226	414, 631	(*a*)322, 936	19, 536	106, 424	49, 685	544, 167	108, 954
1882	11, 796, 091	439, 459	(*a*)435, 794	26, 719	71, 678	26, 000	326, 020	64, 391
1883	10, 534, 081	382, 589	(*a*)199, 468	11, 372	53, 495	21, 046	510, 522	100, 701
1884	10, 152, 878	320, 336	112, 463	5, 768	64, 219	24, 044	346, 092	66, 870
1885	11, 753, 940	341, 222	119, 207	4, 525	69, 784	23, 956	183, 457	34, 512
1886	10, 471, 618	285, 629	54, 211	2, 599	57, 100	19, 005	338, 967	51, 581
1887	10, 522, 118	298, 070	218, 473	9, 723	80, 492	22, 831	412, 130	58, 300

Years.	Sulphate of potash.		Kainite and kieserite.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Tons.*	
1869	....	....	....	....
1870	....	....	....	....
1871	....	....	....	....
1872	....	....	....	....
1873	....	....	....	....
1874	....	....	....	....
1875	....	....	....	....
1876	....	....	....	....
1877	....	....	....	....
1878	....	....	....	....
1879	....	....	....	....
1880	....	....	....	....
1881	....	....	....	....
1882	....	....	....	....
1883	....	....	....	....
1884	346, 348	$6, 227	126, 167	$757, 014
1885	11, 888	190	84, 220	483, 780
1886	651, 883	10, 850	102, 391	650, 689
1887	1, 996, 324	38, 986	76, 551	446, 018

a Including partially refined.

SODIUM SALTS.

By William C. Day.

The process of manufacturing metallic sodium which has thus far been employed consists in reducing sodium carbonate or soda ash by means of charcoal or other form of carbon. The process is as follows: 30 kilograms of soda ash are thoroughly ground up with 13 kilograms of slack or small coal and 3 kilograms of chalk. This mixture is placed in an iron cylinder 1.2 meters long and 0.14 meter in diameter, coated with fireclay, and this introduced into a reverberatory furnace in which it can be heated up to whiteness. The ends of the cylinder are closed by iron plates, through one of which passes a 1-inch iron gas pipe, serving to conduct gas and sodium vapor; the latter condenses in an iron receiver. In a successfully conducted operation the amount of sodium obtained is one-third of the theoretical yield.

The invention of a new process for the manufacture of sodium (equally applicable also to potassium) has recently been made by Mr. H. Y. Castner. The following account of this process is taken mainly from an article by Mr. James MacTear, F. C. S., published in the "Journal of the Franklin Institute," Vol. 123, p. 463. The process consists in reducing either the hydrate or the carbonate of sodium in fused state by means of carbide of iron or its equivalent, a mechanical mixture of carbon and iron so intimate that the two substances can be separated only by aid of acids or intense heat. Such a compound is obtained by coking a mixture of tar and iron; the latter is in an extremely finely divided condition and produced by reduction of oxide of iron ("purple ores") with carbonic oxide or hydrogen. Such proportions of iron and tar are used as will yield on coking a product having the composition, iron 70 per cent. and carbon 30 per cent., equivalent to the formula FeC_2. This after being ground is ready for use and consists of fine particles of iron coated with carbon. This is then mixed, preferably with caustic soda rather than carbonate on account of greater fusibility, in such proportion that the carbon in the so-called "carbide" shall not be in excess of the amount theoretically required to reduce all the soda to sodium, according to the following equation:

$$6NaOH + FeC._2 = 2Na_2Co_3 + 6H + Fe + 2Na.$$

This mixture has thus far been treated in crucibles of cast steel, but cast-iron crucibles having been found suitable it is intended to use them rather than the more expensive steel; they are capable of holding 15 pounds of caustic soda together with the proper proportion of the carbide. After charging the crucible it is placed in a small furnace, where it is kept at a low heat for about thirty minutes, during which time the mass fuses, boils violently, and a large part of the hydrogen is expelled by the combined action of the iron and carbon; the carbide, owing to its gravity, remains in suspension throughout the fused soda. At the end of the time stated the contents of the crucible have subsided to a state of quiet fusion. The crucible is then raised to its position in the distilling furnace and connected with the condenser. The hydrogen escaping from the condenser is lighted and serves to show by the size of the flame how the operation is progressing in the crucible; the distillation of sodium begins soon after the crucible is in its place.

In the application of this process to the preparation of potassium a little less of the "carbide" is used than is required by the reaction, so that no carbonic oxide is formed and all danger of the formation of the explosive compound of potassium and carbonic oxide is removed. In the preparation of sodium, however, it has been found advisable to use a little more "carbide" than the reaction calls for, and this accounts for the presence of a small quantity of carbonic oxide (about 5 per cent.) in the escaping gas. This small amount of carbonic oxide rarely combines with any of the sodium in the tube, which never becomes choked from the formation of the black compound.

The average analyses of the residues left in the crucible after the distillation show their composition to be as follows:

Residue in the Castner sodium process.

	Per cent.
Carbonate of soda	77
Peroxide of sodium	2
Carbon	2
Iron	19

The average weight of these residues, from operating upon charges of 15 pounds of caustic soda and 5¼ pounds of carbide, is 16 pounds. These residues are treated either to produce pure crystallized carbonate of soda or caustic soda, and the iron is recovered and used again with pitch in the formation of carbide. Operating on charges as above mentioned the yield has been:

Yield in the Castner process.

	Pounds.
Sodium, actual	2.50
Sodium, theory	2.85
Soda, carbonate, actual	13.00
Soda, carbonate, theory	13.25

The average time of distillation has thus far been one hour and a half, and as the furnace used was arranged for three crucibles, 45 pounds of caustic soda are treated every ninety minutes, producing 7½ pounds of sodium and 39 pounds of carbonate of soda. The furnace is heated by gas from a Wilson gas producer, consuming one hundredweight of fuel per hour. The following estimate of cost, etc., is given from the actual running of the furnace, working with the above charges, for twenty-four hours:

Cost per furnace charge in the Castner process.

	Cost.
720 pounds of caustic soda, at $53.24 per ton	$17.12
150 pounds of "carbide," at 1 cent per pound	1.50
Labor	4.84
Fuel	4.08
Reconverting 624 pounds of carbonate into caustic, at a cost of about $23.20 per ton on the caustic produced, say	4.84
Total	32.38
Deducting value of 475 pounds of caustic soda recovered	11.28
Cost of 120 pounds of sodium	21.10
Cost, per pound, 17½ cents.	

There is no doubt that the crucibles may be used two hundred times before they become unfit for further use. Upon these facts the claim is based that sodium may be produced upon the large scale at a cost of less than 25 cents per pound. By the old process the cost of producing 1 pound of sodium is about $1.

This process is now carried out on the large scale at the Castner works at Oldbury, England. At the same works sodium is employed in the manufacture of aluminum. The following account of the process employed is taken from the London *Engineering:*

"For the manufacture of the double chloride of aluminum and sodium, the company employs twelve regenerative heating furnaces, each 20 feet high by 30 feet long and 15 feet wide. There are 5 retorts in each furnace, or 60 retorts in all. The capacity of the plant is about 6,000 pounds per day. The furnaces are charged with a mixture of alumina and carbon. When the charge has reached the proper temperature, which takes about an hour, chlorine gas is admitted in definite proportions, the amount being regulated by a series of valves. The process is continued for about two days, about 100 pounds of chlorine being passed into the furnace daily. During the two days of the operation the double chloride is being continually distilled from the charge, and when the whole of the latter has been got out the chlorine gas is stopped and the double chloride obtained is withdrawn from the condensers in the form of a crystalline mass of about 2½ hundredweight. The double chloride contains about 12 per cent. of aluminum, and yields under treatment with sodium about 10 per cent. of aluminum. The plant employed for the generation of chlorine is a modified Weldon plant, and is declared by Sir Henry Roscoe to be the most perfect one extant. The same authority, speaking of the double chloride process as a whole, has just reported that 'the plant necessary for carrying on this process is very extensive, and much of it is entirely novel in its character, and, in consequence, it is not in quite so forward or perfect a condition as that of the sodium manufacture; but portions of it are complete, and these have been at work already satisfactorily, whilst the remainder is on the eve of completion.' The double chloride, on being withdrawn from the furnaces or stills, is stored for use in air-tight chambers, each capable of containing two tons.

"In the treatment of the chloride by sodium so as to produce aluminum, two special kinds of furnaces are employed at the Oldbury works. One of these has a slanting hearth, somewhat after the form of a bath-tub. The furnace is heated by gas, as are all the furnaces and other apparatus used throughout the works. The temperature of the furnace is about 1,000°C. The charge consists of about 25 pounds of sodium, 80 pounds of chloride, and 30 pounds of cryolite, which is used as a flux. These materials are charged into the furnace through a hopper at the top, and after an interval of about an hour and a quarter the slags are drawn off, and the aluminum is run out into a cup at the bottom. About 8 pounds of aluminum are obtained from each charge. The second form of furnace employed does not materially differ from the one just described, except in regard to the method of withdrawing the charge of aluminum, which is allowed to settle to the bottom of a crucible, whence it is withdrawn by removing a plug in the bottom. In the latter case the aluminum is found enveloped in its slag, the latter having to be broken before it is withdrawn. Both furnaces are now under careful experiment, and it is probable that one will be definitely adopted before long. The aluminum is cast in the form of small pigs not unlike the shape of pig-iron. Each pig weighs about a pound."

The chemical reactions that occur in the manufacture of aluminum are as follow:

(1) The sodium process—

$$6NaHo + FeC_2 = 2Na + 2Na_2CO_3 + 6H + Fe.$$

(2) The chlorine process—

$$Al_2O_3 + 3C + 6Cl + NaCl = NaClAl_2Cl_6 + 3CO.$$

(3) The aluminum process—

$$Al_2Cl_6 + 6Na = 6NaCl + 2Al.$$

Sodium salts.—In the report on "Glass Materials" by Mr. Joseph D. Weeks in "Mineral Resources of the United States, 1885," an interesting account of the various sodium compounds used in making glass was given. Of the sodium compounds used in the manufacture of glass, soda ash is the most important, although, as was shown by Mr. Weeks, the consumption of salt cake for this purpose has quite markedly increased since 1880. Almost all of the soda ash consumed in the United States is imported principally from England. The amount imported during 1887 is 117,533 long tons; the amount manufactured in the United States during the same year is 38,065 long tons. Most of this product comes from the works of the Solvay Process Company at Geddes, New York. A full description of these works and their history was given in the report by Mr. Weeks already referred to. In addition it may be said that they are now manufacturing bicarbonate of soda, a branch of manufacture which has been undertaken by them since 1885.

About one-fourth of the soda ash of domestic manufacture is used in glass making; something less than one-fourth for the manufacture of bicarbonate of soda and sal soda; one-fifth in paper manufacture; nearly one-fifth for the manufacture of soap and chemicals, and the remainder for various minor purposes.

The following table was compiled by the English chief inspector of alkali works, Mr. A. E. Fletcher, and published in the *Engineering and Mining Journal.* The table shows very clearly the relative positions of the Leblanc and the ammonia process since 1877 (quantities given in long tons):

Annual production of alkali, etc., in the United Kingdom.

Years.	Salt decomposed.	Alkali, 48 per cent.		Soda crystals.	Caustic soda.	Bleaching powder. (*a*)	Bicarbonate of soda.	Total.
		Leblanc process.	Ammonia process.					
1877	578, 201	217, 556	6, 220	169, 769	74, 663	105, 529	12, 109	1, 164, 047
1878	568, 542	196, 876	11, 116	170, 872	84, 612	105, 044	11, 756	1, 148, 818
1879	615, 287	230, 683	15, 526	185, 319	86, 511	115, 290	13, 083	1, 126, 699
1880	700, 016	266, 093	18, 800	192, 926	106, 384	131, 606	13, 539	1, 429, 364
1881	675, 099	238, 687	20, 400	203, 773	108, 310	135, 826	12, 853	1, 394, 948
1882	679, 935	233, 213	39, 000	180, 846	116, 864	135, 170	14, 115	1, 399, 143
1883	705, 732	227, 284	52, 750	188, 678	119, 929	141, 868	13, 609	1, 452, 188
1884	690, 502	204, 072	61, 480	182, 567	141, 639	128, 651	14, 576	1, 423, 486
1885	722, 472	184, 597	77, 530	202, 705	144, 954	132, 761	15, 179	1, 480, 198
1886	713, 112	165, 782	85, 000	182, 379	153, 884	136, 234	15, 083	1, 454, 465

a This includes chlorate of potash, taking 5 tons of bleaching powder for 1 ton of chlorate. The amount of chlorate of potash now made is 7,000 tons per annum.

The present relative conditions of the Leblanc and the Solvay processes of soda manufacture are of considerable interest from the scientific as well as from the commercial standpoint. The Leblanc process, until within a few years, has monopolized this branch of manufacture; but it has suffered in the time mentioned from the competition of the Solvay process to the extent indicated in the foregoing table. The value of the existing Leblanc plant is estimated by the inspector at £3,000,000. In 1887, 600,000 tons of sulphuric acid were used to decompose the salt used as raw material. Both of these processes are attended by very large waste. With the Leblanc process the waste is that of sulphur, which forms 15 per cent. of the total material thrown away—an aggregate of 1,500,000 tons, or 225,000 tons of sulphur. At Widnes, England, 8,000,000 tons of waste have accumulated, and when it is remembered that this waste decomposes under atmospheric influences with the production of noxious gases, an idea of its objectionable character may be obtained. The Messrs. Chance Brothers, of Oldbury, have devised a process for recovering the sulphur from the tank waste. This process consists, in brief, of decomposing the waste by means of carbonic acid under the proper conditions of temperature and pressure. The sulphur is liberated in the form of hydrogen sulphide, which is available for the production of sulphur in its elementary condition or of sulphuric acid. The lime becomes carbonate. (*a*) This process is pronounced a commercial success by the chief government inspector.

The waste connected with the Solvay process is that of chlorine, and as yet no means have been devised for preventing it. The importance of a successful method of saving this chlorine in the Solvay process may be appreciated when it is considered that the manufacture of bleaching powder from the hydrochloric acid of the Leblanc process is the great stronghold of that process, by which it is enabled to continue in competition with the Solvay process.

A process devised by Messrs. Parnell & Simpson has for its object ultimately the consolidation of these two great processes into one. The following account is taken from an article by Dr. Francis Wyatt in the *Engineering and Mining Journal:*

"Its primary object is to provide a substitute for the lime used to recover the ammonia in the Solvay process; and, as a secondary but important object, it seeks to recover the sulphur lost in the 'tank waste'. This two-fold purpose is accomplished by using the waste to decompose the residual ammonium chloride. The ammonia combines with the waste to form ammonium sulphide, which passes over in gaseous form from the decomposing apparatus, leaving a residual liquor of calcium chloride. The ammonium sulphide is used instead of simple ammonia to saturate the salt solution. By the addition of pure carbonic acid gas the sulphide is decomposed, ammonium bicarbonate is formed in the liquor, whence bicarbonate of soda is derived, according to the usual reaction, with evolution of hydrogen sulphide. This latter gas is conducted into a holder of special construction to be stored, and is burned for the production of sulphur by what the inventors have called 'a method of restricted combustion.' The gain by this process is said to be equal to a ton of lime saved and six hundredweights of sulphur recovered per ton of carbonate produced, and no voluminous explanations are necessary to show even those who are but slightly conversant with the subject that the scope of this invention tends to change completely the conditions to which the manufacture of soda is at present subject. This preliminary and hasty general review has been sufficient to show that neither of the two great rival processes can be regarded as complete in itself, for while the one may fairly lay claim to the monopoly of profitable soda making, the other certainly enjoys the monopoly of bleaching powder.

"The Leblanc manufacturers are known to be losing considerably on

(*a*) For a full account of this process, see the article on sulphur in this volume.

every ton of alkali they produce, but they have counteracted this loss by a combination amongst themselves which so consolidates their interests, that a sufficiently remunerative price is affixed to their by-product, not only to make up for the loss on their soda, of which they have wisely restricted the production to the bare equivalent of the bleaching powder required for consumption, but to allow a certain reasonable profit on the entire output. Whenever there is a fall in soda this all-powerful combination restores the equilibrium by increasing the price of bleaching powder, and nothing can shake or alter this condition until the Solvay process can produce cheap chlorine."

During 1887 the operations of obtaining sodium carbonate from Owen's lake have continued. The process of obtaining soda by evaporating the water pumped into vats along the shore seems to be established as a success, and it is expected that works for refining the soda for market will be located at Boland, a new town at the terminus of the Carson and Colorado railroad, 2 miles below Keeler, Inyo county, California.

Sodium nitrate.—Although, as was stated in "Mineral Resources of the United States," 1882, sodium nitrate is known to occur in Humboldt county, Nevada, and in California, no developments have yet been made, and the large quantity of sodium nitrate annually consumed in the United States is still imported. As is shown by the table of imports at the end of this chapter, the largest amount of sodium nitrate ever imported was entered in 1882; from this time until 1886 there was a falling off each year, but in 1887 the imports rose from 101,216,225 pounds in 1886 to 172,291,911 pounds in 1887. The amount of sodium nitrate directly used in the manufacture of blasting powder is already quite large and is increasing. The amount employed as raw material in the manufacture of potassium nitrate through the double decomposition of sodium nitrate and potassium chloride is a large item of consumption

Imports of sodium salts.

Years.	Sodium.		Nitrate of soda.		Bicarbonate of soda.		Carbonate of soda.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1869	....	....	28, 866, 364	$600, 691	18, 092, 250	$540, 263	485, 695	$7, 638
1870	....	....	31, 122, 795	752, 604	15, 014, 629	347, 530	468, 390	6, 564
1871	....	....	50, 290, 377	1, 254, 965	18, 998, 399	421, 177	1, 070, 820	18, 108
1872	....	....	35, 817, 597	934, 118	13, 530, 188	374, 231	....	......
1873	....	....	59, 757, 241	1, 469, 243	10, 571, 049	369, 867	....	......
1874	....	....	61, 978, 316	1, 338, 141	11, 873, 182	435, 455	....	......
1875	....	....	52, 105, 826	968, 855	6, 853, 588	231, 755	....	......
1876	....	....	57, 887, 218	1, 055, 357	4, 482, 911	125, 587	....	......
1877	....	....	54, 246, 531	1, 324, 299	3, 765, 165	98, 277	....	......
1878	....	....	42, 258, 855	937, 223	3, 693, 494	92, 917	....	......
1879	....	....	76, 285, 858	1, 348, 580	2, 392, 719	60, 701	....	......
1880	....	....	68, 043, 426	1, 830, 396	2, 211, 113	53, 270	....	......
1881	....	....	94, 341, 161	2, 356, 167	1, 951, 851	58, 312	....	......
1882	....	....	184, 598, 857	3, 911, 610	1, 627, 086	52, 361	....	......
1883	....	....	127, 892, 324	2, 336, 681	2, 298, 914	55, 081	....	......
1884	....	$62	121, 202, 296	1, 983, 378	2, 154, 922	49, 377	....	......
1885	....	4	109, 361, 808	1, 696, 056	2, 516, 951	50, 535	....	......
1886	....	15	101, 216, 225	1, 681, 824	3, 220, 927	54, 511	....	......
1887	....	356	172, 291, 911	2, 614, 162	2, 478, 669	45, 801	....	......

Imports of sodium salts—Continued.

Years.	Sal soda crystals.		Soda ash.		Sulphate of—			
					Glauber salts.		Salt cake.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1869...	19, 215, 883	$228, 229	131, 348, 209	$2, 356, 640	346, 003	$3, 786	....	$1, 752
1870...	20, 004, 440	206, 802	128, 772, 962	2, 114, 355	105, 001	1, 349	....	2, 097
1871 ..	28, 637, 489	281, 892	145, 428, 215	2, 387, 583	234, 800	2, 879	....	2, 436
1872...	21, 587, 244	299, 844	143, 177, 508	2, 819, 409	7, 070	276	....	......
1873...	27, 237. 478	482, 341	188, 443, 202	4, 778, 668	62, 182	2, 483	....	......
1874...	31, 126, 647	477, 983	149, 203, 789	3, 670, 573	169. 046	3, 056	....	......
1875...	27, 666, 534	379, 857	170, 892, 671	3, 532, 601	71, 593	2, 256	....	......
1876...	20, 074, 269	249, 691	165, 502, 897	2, 967, 372	11. 718	420	....	......
1877...	18, 648, 665	187, 351	200, 631, 499	3, 285, 966	285	14	....	......
1878...	19, 520, 840	178, 219	208, 425, 700	3, 128, 772	395	31	....	......
1879...	17, 706, 535	139, 235	227, 893, 121	3, 036, 480	7, 357	131	....	......
1880...	23, 814, 230	178, 963	289, 511, 967	4, 292, 633	6, 198	89	....	......
1881...	15, 695, 044	119, 792	295, 227, 766	4, 154, 258	775	15	....	......
1882...	29, 842, 140	242, 978	267, 250, 809	3, 399, 961	384, 392	2, 425	8, 954, 834	55, 622
1883...	22, 199, 712	162, 481	323, 726, 726	4, 006, 638	26, 341	367	7, 863, 756	43, 363
1884...	25, 323, 589	212, 031	287, 401, 005	3, 510, 411	728, 957	4, 803	8, 416, 147	40, 646
1885...	26, 039, 782	203, 179	260, 932, 988	3, 065, 989	11, 314	220	11, 614, 534	52, 334
1886...	30, 687, 608	197, 240	279, 931, 929	3, 229, 030	961, 781	5, 970	7, 935, 237	32, 722
1887...	25, 681, 496	164, 567	263, 274, 392	2, 857, 930	613, 132	2, 601	15, 366, 588	43, 766

Years.	Caustic soda.		Silicate of soda or other alkaline silicate.		Rochelle salts.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1869..........	13, 705, 254	$448, 661	....	$678	750	$149
1870..........	20, 804, 681	653, 790	....	....	145	34
1871..........	27, 952, 469	677, 710	....	7, 325	100	27
1872..........	29, 992, 539	1, 037, 329	919, 934	14, 003	....	....
1873..........	28, 871, 629	1, 269, 142	302, 204	5, 047	....	....
1874..........	34, 282, 189	1, 516, 133	125, 870	2, 175	....	....
1875..........	37, 669, 885	1, 419, 292	116, 219	2, 047	....	....
1876..........	32, 093, 691	1, 107, 200	164, 441	2, 473	....	....
1877..........	33, 375, 447	1, 043, 933	262, 184	3, 314	....	....
1878..........	33, 178, 762	1, 015, 554	332, 859	4, 597	8, 349	1, 645
1879..........	45, 767, 366	1, 209, 470	409, 906	5, 703	142	43
1880..........	43, 693, 333	1, 056, 497	1, 021, 571	14, 855	22, 425	4, 380
1881..........	49, 465, 385	1, 168, 277	557, 251	8, 367	33	9
1882..........	56, 878, 896	1, 282, 412	106, 101	1, 444	40	10
1883..........	52, 172, 490	1, 134, 265	216, 137	2, 207	40	10
1884..........	79, 002, 327	1, 800, 423	257, 200	2, 360	....	....
1885..........	71, 606, 399	1, 551, 209	447, 988	3, 990	....	....
1886..........	77, 843, 401	1, 558, 761	133, 365	1, 428	....	....
1887..........	83, 849, 903	1, 608, 490	475, 039	6, 002	....	....

FLUORSPAR.

Production.—The amount of fluorspar mined in the United States during 1887 was 5,000 short tons, valued, in its crude state at the mines, at $20,000. The sources in the United States are the same as those given in the report for 1886.

Uses.—Two-thirds of the product is used in iron, brass, and steel works, the remainder in glass works and for the production of hydrofluoric acid and other chemicals. It has recently been tried as an experiment in blast furnaces for the reduction of iron ores, but the results of this trial are not yet known.

As is shown by the table of imports of cryolite, given at the end of this article, this mineral has been imported at the rate of 6,000 to 8,000 tons per annum since 1883. The sodium and aluminum contained in cryolite are manufactured into various sodium salts, alum, aluminum, suplhate, etc., while the fluorine appears chiefly in calcium fluoride, a by-product. At least 10,000 tons of calcium fluoride are thus produced, valued at $3 per ton.

Cryolite.—The cryolite consumed in the United States still comes entirely from Greenland. As is shown by the following table, the amount imported for 1887 considerably exceeds that reported for previous years:

Imports of cryolite for the years 1871 *to* 1887 *inclusive.*

Years.	Amount.	Value.
	Tons.	
1871		$71,058
1872		75,195
1873		84,226
1874		28,118
1875		70,472
1876		103,530
1877		126,692
1878		105,884
1879		66,042
1880		91,366
1881		103,529
1882	3,758	51,589
1883	6,508	97,400
1884	7,390	106,029
1885	8,502	113,847
1886	6,866	91,890
1887	11,732	157,034

MICA.

There was marked depression in the industry during 1886, due to increased importations and particularly to the tendency on the part of consumers to substitute small sheets for the large ones formerly used in stoves. In North Carolina the product declined to a very small amount. The importations were nearly doubled and a considerable stock was probably carried over from the previous year. In the regions outside of North Carolina a tendency towards cheaper and more skillful methods of mining and cutting probably compensated to some extent for the decline in price. In 1887 the industry adapted itself to the new condition of things, especially the production of smaller sheets, and the output was increased.

Production.—In 1886 the production was, roundly, 40,000 pounds, valued at $70,000. In 1887 this increased to 70,500 pounds, valued at $142,250. The following table gives the production since 1884. In these estimates the production of second class mica is included with first class although the latter is usually referred to by the trade in giving quotations:

Production of mica from 1884.

	1884.	1885.	1886.	1887.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
North Carolina	100,000	60,000	24,000	50,000
Valencia mine, New Hampshire	25,000	29,000	7,500	....
Other mines in New Hampshire	3,260	1,000	5,000	17,000
Cribbensville mines, New Mexico	1,000	2,000	1,400	....
Black Hills	18,150	....	600	....
Virginia	....	....	1,500	3,500
Total	147,410	92,000	40,000	70,500

For comparison the table of imports is given below. The marked increase in 1886 and 1887 will be noticed:

Unmanufactured mica imported and entered for consumption in the United States, 1869 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1869	$1,165	1879	$9,274
1870	226	1880	12,562
1871	1,460	1881	5,839
1872	1,002	1882	5,175
1873	498	1883	9,884
1874	1,204	1884	28,284
1875	....	1885	28,685
1876	569	1886 (*a*)	43,107
1877	13,085	1887 (*a*)	63,480
1878	7,930		

a Including mica waste.

In Virginia mica mining was begun in 1886, at the old Henry mine, by Mr. Ira R. Allen. Five or six other companies have begun mining mica in this region. None of the plants, however, have much probability of ultimate success, as their mica is found mixed with ocher and not in place. In preparing this mica for market it is first split into sheets about one-eighth of an inch thick. It is cut by machinery and then dressed; that is to say, the rough scales peeled off until the surfaces are perfectly smooth. If there are any blisters in the mica it can only be sold as second class. One man cuts about 50 pounds of mica a day. The principal waste is in finishing the sheets, when perhaps 33 per cent. of the mica is lost. The average yield of finished mica is not quite 10 per cent. of the total quantity mined.

Rocky Mountain division.—The only mica mining in New Mexico is in the Cribbensville district, which has been previously mentioned. During 1886 the work was principally exploitation; only 1,400 pounds were mined, and of this amount 800 pounds were shipped to England. In 1887 no mica is known to have been mined.

In Dakota the mica deposits have been slightly developed in order to hold claims, but no mica was sold in 1886 or 1887.

Mica waste.—The use of this substance for decorative purposes in wall paper, etc., is increasing; about 600 tons were used in 1887. It is obtained from New Hampshire and Virginia. There are two firms in Richmond who grind mica waste. Messrs. Traylor & Hargrove grind about 350 tons a year. The best quality is sent, after grinding, principally to New York, to be used for decorative purposes. The second quality is used, without grinding, for steam and water valve seats. The rest is sold for mixing with fertilizers. It is claimed that it aids the retention of moisture. The Richmond Lubricating Company grinds about 200 tons of mica a year, which is used very much as the above, except that the poor grades are used in making axle grease. The price paid varies from $10 to $15 per ton, according to quality.

MICA MINING IN NORTH CAROLINA. (*a*)

BY WILLIAM B. PHILLIPS.

History.—Modern mica mining has been carried on in North Carolina only since 1868. The rediscovery of the deposits in this State appears to have been made by Hon. Thomas L. Clingman, Asheville, North Carolina, although, according to the late Mr. W. C. Kerr, State geologist of

a In the preparation of this sketch I have been greatly aided by the miners and dealers in Mitchell, Yancey, Jackson, Haywood, Cleveland, and Stokes counties. I would especially return my public acknowledgments to Messrs. J. L. Rorison, D. A. Bowman, Frank Sanders, S. W. Blalock, T. A. Love, and Jesse Washburn, of Mitchell county; A. H. McFalls and W. W. Green, of Cleveland county; E. S. Bowers, of Jackson county; L. H. Smith, of Yancey county; and the Pepper Mining Company, of Stokes county.

North Carolina (*a*), several valuable deposits in Mitchell county were worked by prehistoric people more than two hundred years ago. Whoever these "old men" were, whether natives or wandering tribes, Spanish soldiers, or Norsemen, they left behind them abundant evidence of their skill and industry. We know little or nothing about them, except that they worked the deposits and disposed of the mica in some cases, perhaps (*b*), to the mound builders or other inhabitants of the Ohio valley.

That they possessed considerable skill in the location of valuable deposits is shown by the fact that when the mines were reopened in 1868–'69 the best mica was obtained by following their leads. Being perhaps (*c*) unacquainted with the use of iron tools and unable to cope with very hard rock, their mining operations were quite simple, consisting generally in trenching and fire setting. Sheets of mica of considerable size have been obtained from some Indian mounds (*d*).

The discoveries of these "ancients" lay unutilized until 1867. In the fall of 1867 General Clingman (*e*) was told by a New York dealer in mica that a good quality was then so scarce he had been obliged to pay as much as $8 per pound for some small sheets. This induced General Clingman to institute a search for good mica in North Carolina. He began work in the latter part of 1867, or early in 1868, and from Cleveland county obtained several barrels of good mica, which he sent to New York. A little work was also done at this time in Rutherford and Burke counties, but with no very satisfactory results. Having an intimate knowledge of Mitchell and Yancey counties, he decided to prospect there. In his own words: "I therefore made careful examinations of many places in those counties. I selected as the best points for work the Ray mine, Yancey county, the Silvers (sink hole) (*f*), and Buchanan (Clarissa) mines in Mitchell county. It was my singular good fortune to choose as the best the very three mines that have since been found the most valuable."

General Clingman then returned to New York and made an agreement with Messrs. Sloan & Mendon, of Liberty street, to engage in the mica business together, and Mr. Mendon came out to North Carolina and visited the Ray mine. Not being much impressed with the outlook, however, he returned home, and shortly afterwards, together

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a Geol. of North Carolina, Vol. I, pp. 300–302; Trans. Amer. Inst. Min. Engrs., 1880; Eng. and Min. Jour., Vol. XXXI, No. 13, p. 211; Foster's Prehistoric Races of America, pp. 191 and 270.

b Foster, *idem.*

c Some indications of the use of other than stone tools are said to have been found.

d Foster, *idem.*

e Private communication, October 25, 1887. See also his "Speeches and Writings," pp. 130–133.

f At the Sink Hole mine are still to be seen the most extensive remains of the ancient workings. General Clingman was searching for silver when he found the mica. "Speeches and Writings," pp. 130–133.

with Mr. Sloan, abandoned the enterprise. General Clingman carried on the work alone at the Silvers mine, and got out several hundred pounds of fine mica. Being obliged to leave in order to attend to some more pressing business, he instructed his foreman to collect all the mica and store it away. This, however, was not done, and several large blocks were left on the ground. A stock drover passing that way with his wagon picked up one of these and carried it to Knoxville, Tennessee. There it was seen by Mr. J. G. Heap, of the firm of Messrs. Heap & Clapp, dealers in stoves and tinware, who at once recognized its value. Disposing of their business in Knoxville, Messrs. Heap & Clapp went at once to Mitchell county and began mica mining.(*a*) This was in 1869. For several years they conducted a very profitable business, realizing for some of the mica, as Mr. Heap himself assured the writer, as much as $11 per pound.

For the first few years the business was carried on quietly, and in such a way that but little recorded information is to be had concerning it. Prof. W. C. Kerr (*b*) thought that the total production to the end of 1881 was 400,000 pounds, valued at $800,000.

Accepting these figures and using the statistics given in the several volumes of the "Mineral Resources of the United States," we have:

Amount and value of the mica produced in North Carolina from 1868 *to* 1887.

Years.	Pounds.	Value.
1868 to 1881	400,000	$800,000
1882 estimated as 60 per cent	60,000	150,000
1883 estimated as 60 per cent	68,400	171,000
1884	100,000	253,000
1885	60,000	105,000
1886	24,000	42,000
1887	50,000	87,500
Total	762,400	1,608,500

While, indeed, it is regretted that these figures can not be accepted as absolutely correct, it is believed that they are approximately so, and will serve to convey an idea of the extent of the business for the past few years. The actual amount of mica mined in North Carolina since 1868 may be somewhat over these figures, and the value may be somewhat greater than that given, as the average value is nearer $2.25 than $2 per pound.

The yield for 1887 had to be estimated on what was considered a reasonable basis. One dealer in Mitchell county (*c*) bought up to October 24,000 pounds, and 50,000 pounds is held to be a fair estimate of the total output, with an average value per pound of $1.75. The former high prices for mica do not now obtain; it is probable that the

a C. H. Wiley, U. S. Treasury expert, in "Internal Commerce of the United States, 1886," p. 235.

b "Mineral Resources of the United States, 1882," p. 661.

c S. W. Blalock, Ledger Post-office, North Carolina.

highest price now paid is $4. Most of the dealers in the State were' as late as October, holding their 1887 output in hope of better prices. The figures given are the best that could be had under the circumstances, and without personal inquiry.

There has always been a curious reticence on the part of our miners and dealers. Whatever reasons they may have had for this in the past they can hardly apply now, for if any help is to come to the industry it will come only on a frank revelation of the true condition of it.

The average spot value of cut mica in the United States has declined since 1884, as the following table will show:

Fluctuations in the spot value of cut mica in the United States since 1882.

Years.	Spot value.	Years.	Spot value.
	Per pound.		*Per pound.*
1882	$2.50	1885	$1.75
1883	2.50	1886	1.75
1884	2.53	1887	1.75

Two reasons may be given for this decline:

(1) The scarcity of large sheets of mica in 1883–'84 compelled stove manufacturers to change their patterns and substitute smaller sizes.(*a*) Of the larger sheets there has not been of late a plentiful supply, while smaller sheets can always be had. It was to avoid the use of large sheets, which were more costly, that the change was made. As an instance of the result, it is said that a manufacturer of stoves bought in 1884 $30,000 worth of mica, and now does not buy over $5,000 worth.

(2) The importation of foreign mica. This has been steadily increasing for several years, as the following statistics, furnished by the United States Treasury Department, will show:

Value of imported mica, 1876 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1876	$569	1882	$5,175
1877	13,085	1883	9,884
1878	7,930	1884	27,555
1879	9,274	1885	38,685
1880	12,562	1886	43,107
1881	5,839	1887	63,340

There is no import duty on mica. Accepting the statistics given in the several volumes of the Mineral Resources, we find the following fluctuations in the value of North Carolina mica:

a Messrs. Eugene Munsell & Co., New York, private communication, February 3, 1888.

Fluctuations in the total value of North Carolina mica, 1882 to 1887, inclusive.

Years.	Total value.	Years.	Total value.
1882	$150,000	1885	$105,000
1883	171,000	1886	42,000
1884	253,000	1887	87,500

Since 1884 the value of North Carolina mica has decreased from $253,000 to $87,500, and the value of imported mica has increased from $27,555 to $63,340. As North Carolina yields 60 per cent. of the total domestic production, and the quality of her mica is at least as good as that from any other source, we can easily see that the industry in the whole country is not in a very flourishing condition. It is gratifying to know that there are some evidences of a better outlook for the future in the introduction of improved machinery. A new company has lately leased the Clarissa mine in Mitchell county, and will equip it with steam or air drills, better pumps, etc.

Mining.—There are now about twelve mines in operation, confined almost entirely to Mitchell, Yancey, Jackson, and Macon counties. There are good mines also in Haywood, Cleveland, Watauga, and Stokes counties, but they are not now worked. In almost every one of the western counties good mica has been found and to some extent mined, but the present low prices restrict operations to those localities where the greatest amount of local experience has been acquired.

The average depth of the mines is probably not far from 75 feet; only two, the Clarissa, 3½ miles east of Bakersville, Mitchell county, and the Flat-rock, 8 miles southeast, have attained a greater depth than 300 to 400 feet. Nearly all are worked by shafts, (*a*) vertical or underlie; a few, as the Deake, Flat-rock, etc., have day-levels also. Steam power is used very sparingly, most of the hoisting being by horse power.

The mica vein, as has been remarked by Prof. W. C. Kerr, (*b*) is only a vein of very coarse granite, perhaps injected, and having the characteristics of more or less independent dikes, being in this respect unlike the New Hampshire deposits. (*c*)

The width of the veins varies within wide limits from 2 to 20 feet, or even in places 40 feet, as at the old Pizzle mine. The strike and dip are generally those of the inclosing rocks, strike northeast and dip southeast at a high angle. The wall rock is for the most part hornblendic gneiss, in some mines a gray schistose gneiss, passing into a coarse grained syenite. In some places the wall is a more or less decomposed black or dark gray mica-slate. Although the mica vein is in general a bedded vein, instances of contact veins and veins cutting across the stratification (the true lode) are occasionally met with.

a The New Hampshire mines are mostly worked by open cuts.

b *Eng. and Min. Journ.*, Vol. XXXI., No. 13, p. 211.

c Prof. N. S. Shaler, United States Tenth Census, Volume XV., p. 833.

The mica is found sometimes on the hanging wall, sometimes on the foot wall, and sometimes in more or less segregated "bunches" towards the middle of the vein. The irregularly shaped "stringers," or "off shoots" yield at times a good deal of excellent mica.

No details can now be given as to the influence of the wall, the dip, strike, depth, or "capping" on the quality or quantity of the mica, nor of the effect, if any, of the numerous granitic intrusions in the vicinity of the veins. It is hoped at a later date to undertake some investigations on these interesting questions.

Bearing in mind that a mica vein is but a vein of very coarse granite, in which the quartz, feldspar, and mica have all crystallized on a large scale, we may understand why certain proportions among these ingredients should influence mining operations.

Each substance has to a great extent crystallized by itself, and we have in the vein not an intimate mixture of small particles, as in ordinary granite, but a collection of three different kinds of crystals, some of them, as mica and feldspar, being very large. A mica crystal has been found that made two two-horse wagon loads, and could not have weighed less than 2,000 pounds. A feldspar crystal from the Burnet Mica mine, Buncombe county, now in the State museum at Raleigh, weighs 800 pounds.

The writer has in his possession a piece of a feldspar crystal weighing 30 pounds. It is almost rectangular in shape, and was said to have formed part of a crystal 6 feet long. This would have weighed 500 pounds. Although no large crystals of quartz have been found in mica veins, still large masses of crystallized quartz are met with sprinkled through and through with small garnets.

It is said by some miners that where quartz predominates the mica is apt to be of an inferior quality, the contrary being the case where feldspar predominates, and well crystallized feldspar is regarded as a sure indication of fine mica. Where, however, the flesh-colored feldspar occurs in any quantity some think the yield of mica is apt to decrease. The same influence is ascribed to the uranium minerals. Observations on these points do not yet allow any but the most general conclusions.

A notable phenomenon in mica veins, and one which of course renders the mining operations at times precarious, is the nipping or narrowing of the vein, sometimes to almost entire discontinuance. A good deal of local experience is then necessary for deciding whether or not the work should cease at that place. Instances are not uncommon when one set of miners has ceased work and another at a later date resumed the driving to find a widening of the vein within a few feet.

This is particularly the case when the capping is quartz ore and the nipping rapid. This capping, which is a dark well crystallized quartz with numerous small garnets sprinkled through it, is very difficult to drill. It often occurs that even three-handed drilling with a fresh set of steels every half hour accomplishes but little.

The feldspar is mostly orthoclase, though albite and oligoclase also occur, and is generally well crystallized and hard. At times it is more or less decomposed and even coarsely granular (soft fluccan), and is then applied to the soil in the cultivation of corn and wheat. Good results have followed its use, as it contains a considerable amount of potash.

The mica is mostly muscovite.

Origin.—As to the origin of the mica veins no definite opinion can now be offered. They can hardly be regarded as essential members of the strata in which they occur. They are of later origin than either their hanging or foot wall, and their contents reveal an igneous or aqueo-igneous origin. While indeed they for the most part have the strike and dip of the inclosing rocks, instances are not unknown where they cut across the inclosing rocks, as at the Balsam Gap mine, Buncombe county, and the Westall mine, Yancey county.

In the efforts of the vein matter to insert itself the inclosing rocks have been twisted and contorted in many directions and in various degrees; in one instance, according to Professor Kerr (*a*), forcing the rocks into opposite dips at the surface.

The New Hampshire deposits, according to Professor Shaler (*b*) "appear to be obscure beds, closely following the general run of the apparent bedding that characterizes the granites in this part of the country." The North Carolina deposits, on the contrary, appear to have arisen through the injection of material from below, the fissures following indeed the general run of the bedding of the inclosing rocks, but cutting across this when the line of least resistance did not coincide with a plane of stratification. That the vein material in filling the fissure met with great resistance on the part of the contiguous rocks is shown by the contortions, foldings, and disruptions which they exhibit. It might well have happened that at times there was less resistance transverse to the bedding than parallel to it, and at such times the fissure would partake of the nature of a true lode.

The crystallized quartz would seem to indicate a crystallization from an aqueo-igneous solution. This is rendered the more probable by the occurrence of thin sheets of quartz between sheets of mica and by the impression of the edges of mica sheets on fragments of well-crystallized quartz, forming a sort of pyramid with microscopic steps. So far as known this latter phenomenon has not been observed on the feldspar, though thin sheets of this also have been found between sheets of mica. The impression of the edges of mica sheets upon the quartz would seem to indicate that the mica crystallized first, and in so doing inclosed at times some quartz between the layers, and at other times some feldspar. It is not here discussed whether in the aqueo-igneous magma filling the fissure the mica, quartz, and feldspar were present as such, but bearing in mind what has been said as to the impressions on quartz and the inclosures of quartz and feldspar, it would appear that in the

a Eng. and Min. Journ., vol. 31, No. 13, p. 212. *b* Tenth U. S. Census, vol. 15, p. 833.

order of crystallization we have mica, feldspar, quartz. Although the inclosing rocks offered considerable resistance to the fissuring force, still, after the entrance of the vein matter, it was free to crystallize in large nearly pure masses.

Some blocks of mica are curiously bent and twisted, as if resistance had been offered to the free extension of the crystal either by the wall or the matrix. From this or similarly acting forces comes the "A" mica, a striated mica with the striæ forming the letter A, or rather a V, as there are seldom any cross lines. These striations are from 2 to 12 inches long, and inclose angles of 30° to 45°. The curvature of mica blocks amounts at times to 10° to 15°. A mica is not salable, as the striations interfere with its transparency.

In addition to these phenomena a shearing force would seem to have acted at times. Some blocks of mica are cut through and thin filaments of mica left adhering to the edges. This may have been caused by a slow slipping along the middle leg of a fold, as the edges do not exhibit the appearance usually caused by cutting or shearing with heavy instruments.

Associated minerals.—The minerals associated with mica are numerous and interesting. From a list prepared by the late Prof. W. C. Kerr, and now published for the first time, they are as follows:

List of minerals associated with mica in North Carolina.

Albite.	Glassy feldspar (sanidin).	Samarskite.
Allanite.	Garnet, red and black.	Thulite.
Amazonstone.	Gummite.	Torbernite.
Apatite.	Hatchettolite.	Tourmaline.
Arethunite (? P.).	Limonite.	Uraninite.
Autunite.	Magnetite.	Uranocher.
Beryl.	Menaceanite.	Uranotil.
Biotite.	Muscovite.	Yttrogummite.
Columbite.	Phosphuranylite.	
Euxenite.	Rogersite.	

Dr. F. A. Genth, for some time chemist and mineralogist to the North Carolina geological survey, has had the kindness to correct and supplement this list. He writes: (*a*)

Amazonstone, perhaps.—Doubtful.

Autunite (Torbernite?).—All autunite.

Biotite, probably; but I have not seen it from mica veins, as far as I remember.

Euxenite.—Does not contain TiO^2. Is not true euxenite.

Glassy feldspar (sanidin).—Very doubtful.

Pyrochlore.—In minute octahedrons at the Ray mine, with black tourmalines.

Yttrogummite.—I do not know of any analysis having been made. Very doubtful.

Fluorite, in pseudomorphous granular patches after apatite.

Apatite seems to be fluorapatite.

Orthoclase.—Often completely altered to kaolinite.

a Private communication, October 3, 1887.

It is not known what Professor Kerr meant by arethunite, as the list was not found until after his death.

The Flat Rock, Deake, and Mart Wiseman mines, in Mitchell county, and the Ray mine, in Yancey county, are famous localities for nearly all these minerals. At the Wiseman mine there has been found a block of A mica weighing nearly 200 pounds, and a piece of samarskite of 94 pounds. This latter mineral is worth about $1.50 per pound.

Dressing mica.—The blocks of mica hoisted from the mine are sent to the stripping room, where extraneous matter, as pieces of quartz, feldspar, wall rock, and fragments of mica, are removed. The blocks are then split by means of wedges or heavy knives and are sent to be "scribed." This scribing is an operation demanding considerable skill and experience, the purpose being to get from a given rough sheet the largest number of valuable sheets. The patterns by which the mica is scribed are pieces of tin, sheet iron, etc., of different sizes and shapes, as determined by the order from the manufacturers of stoves. By far the greater part of cut mica is used for stove windows and peep holes, and the size and shape of the pieces are determined by the special order, just as in special orders for firebrick. Formerly the size of the cut sheets largely influenced the price of clear mica, but now, although, of course, the quality is still regarded as of prime importance, the size beyond certain dimensions, say 6 by 8 inches, is not. The number of patterns varies from time to time. In Mitchell county, about one hundred different patterns are used, the sizes running in inches from 1 by 1 to 6 by 8, or as large as the stock will allow, increasing by one-fourth inch. The cut mica varies in value from 10 cents to $6 per pound, the average being not far from $1.75. One hundred pounds of good block mica may yield 33⅓ pounds cut mica; an inferior block may yield only 5 pounds; the average is 10 to 12 pounds. The writer is informed that a 100-pound block from the Flat Rock mine gave 75 pounds of cut mica. This is the highest yield he has ever heard of, and is very far above the average. It will at once appear that upon the skill of the scriber depends, to a great extent, the yield of the cut mica. An unskilled scriber may get from a given block only one-half as much cut mica as one experienced in the art. After the blocks have been split and scribed they are sent to the cutters. These are workmen provided with heavy shears, and they cut through the sheets along the scribing. The different sizes are then wrapped in paper, generally in 1-pound packages, packed closely in a strong box, and sent to market. As most of the mines lie remote from rail, 25 miles or more, the transportation is a considerable item of expense.

Mica waste.—In mica mining there is a great deal of waste. Not only must the blocks be freed from adhering quartz, feldspar, etc., but the mica itself is subjected to close scrutiny, and all pieces unavailable for good sheets are rejected. Great heaps of quartz and feldspar accumulate about the mines, and great heaps of waste mica about the dressing house. None of these materials have as yet been much utilized. Prof. W. C. Kerr stated (*a*) that in the seventeeth century the Indians packed kaolin (resulting from the decomposition of feldspar) from the mountains of western North Carolina to the seaboard for exportation. The Indian name for the Smoky mountains (Unaka) may thus have been derived from the Indian name for kaolin (unakeh, white). It has been proposed to utilize the feldspar (orthoclase) for the manufacture of potash salts, but the present large deposits of potash minerals, already soluble in water, at Stassfurt, etc., would perhaps prevent a successful business of this kind, even should the method be applicable. The waste mica might perhaps be used as an absorbent for nitro-glycerine in the manufacture of mica powder. It is sometimes used, finely pulverized and mixed with graphite or grease, as a lubricant. A little is used also for silvering wall papers, and other decorative purposes. The ancients used it for adorning the interior of their palaces. If an economic use could be found for it, it could be had in large quantities, and at a cost of 10 cents a pound.

It has been stated (*b*) that the Carolina micas are much more extensively impregnated with foreign substances in dendritic and other forms than the New Hampshire mica, and also that the twisted structure is more common in southern than in northern (New Hampshire) mica. If this is true, there is more waste from North Carolina mines than from those of New Hampshire, and the business must be more precarious in the former place. As regards the first two points the writer is not yet in a position to give an opinion. It may be true that North Carolina mica mines yield more off-color and A mica than the New Hampshire mines. We may even go so far as to agree that the geological differences between the two sections could account for it. Such general statements, however, unsupported by the facts upon which they may be based, should be received cautiously. In the North Carolina mines no very close watch is kept over the yield of clouded or A mica; it is extremely doubtful if any mine keeps any account of it. The proportion between the cut mica and the waste mica affords no indication of the yield of clouded or A mica. It often happens that the waste mica contains no clouded and but little A mica. Some mines are famous for their clouded mica, while others have very little. The same is true of A mica. It is not known to the writer how strict and detailed a watch is kept in New Hampshire over all the products of the various mines, and therefore he can not speak of them. But it is known that any assertions as to the yield of the North Carolina mines in clouded, twisted, or A mica rest upon very insecure data. The statistics as to the yield of cut mica are not satisfactory, and this is the only matter of much consequence.

According to the United States Tenth Census there were in the United States in 1880, 78 mica mines, 71 of these being in North Carolina; of

a Engineering and Mining Journal, Vol. XXXI., No. 13, p. 212.

b N. S. Shaler, Tenth United States Census, Vol. XV, p. 834.

these 78, 22 were worked, 17 of them in North Carolina. The capital invested in the United States was $337,900, $6,900 being in North Carolinia; total number of hands employed 272, in North Carolina 177; total paid in wages $65,600, $29,650 in North Carolina; total production 81,669 pounds, valued at $127,825; North Carolina producing 42,669 pounds, valued at $61,675.

Thus North Carolina had invested 2.42 per cent. of the total capital, employed 65.4 per cent. of the total labor, yielded 52 per cent. of the total product, and 48.3 per cent. of the total value.

Based on the value of the product $1 capital in North Carolina in 1880 was equal to $44.65 in New Hampshire, her sole important competitor. This latter State had invested, as real and personal property, $314,000, and the value of her product was $62,900. North Carolina had invested $6,900, and the value of her product was $61,675.

It would certainly be a most remarkable business that yielded $8.93 per dollar invested, particularly so when it is remembered that of the stuff hoisted only from 10 to 12 per cent. is utilized. If the twelve or fifteen mines operated in North Carolina in 1887 can show anything like such a profit as this they can hold their output for several years yet. It is feared that such profits are forever past.

Mica in Alabama.—In Alabama, along a line stretching from Chilton county northeast through Coosa, Clay, and Cleburne counties, there are numerous evidences of prehistoric mica mining (*a*). Many pits are met with around which pieces of mica are still to be seen. In some places, just as in Mitchell county, North Carolina, large pine trees have grown up on the débris, so that a considerable time must have elapsed since the mines were worked. About ten years ago Col. James George, of Clanton, Chilton county, now deceased, prospected for mica, and some fairly good specimens were obtained, but the investigations were not continued. It is not thought that any mica has been marketed from Alabama. The indications of good mica along the line mentioned are, however, sufficient to warrant additional and more extended examinations.

Other Southern States.—No mica is reported from any other Southern State, though some mines have been opened in South Carolina, Georgia, Virginia, and West Virginia. In 1881 a mica mine was opened in Anderson county, South Carolina, and some miners from Mitchell county, North Carolina, employed. The enterprise was not successful, and the miners returned home shortly afterwards. Good mica has been found in South Carolina, notably in Anderson, Oconee, and Pickens counties. The mica-bearing rocks of western North Carolina do not protrude into Tennessee, except at intervals, and then only for short distances (*b*). Some prospecting has been done in Tennessee near Roan mountain, but the results were not considered satisfactory.

a Eugene A. Smith, State Geol. Ala., private com., Oct. 4, 1887.
b James M. Safford, State Geol. Tenn., private com., Oct. 8, 1887.

GRAPHITE.

The production of graphite for the finer uses, such as lead pencils, is still limited to Ticonderoga, New York, whence the Joseph Dixon Crucible Company reports having mined for all purposes about the same amount as in 1886, viz., 328,000 pounds. In addition to this supply there are several localities where more or less impure graphite is mined and sold principally for foundry facings and for paints. The Heron mine near Raleigh, North Carolina, produced about 20,000 pounds, which was sold for paint, and at Cumberland Hill, Rhode Island, 600 tons were sold for foundry facings, besides a larger amount, 3,000 tons, of material intermediate between graphite and anthracite from Cranston, which was sold for metallurgical purposes, and not in competition with graphite.

New developments.—It is stated that the old mine at Nelson, New Hampshire, has been purchased and is to be operated in 1888 with quite a large capital. In Virginia there is prospect of developing a mine at Philomont, Loudoun county. At Asheville, North Carolina, Mr. John M. Campbell is developing what promises to be a graphite deposit, and considerable attention is being given to the deposits in Wake county. In Georgia a company for producing graphite has been organized at Cartersville, and another property in Lumpkin county has been sold for the same purpose. There is a report of graphite near Tulare, California.

Imports.—About two-thirds of the production of graphite at Colombo, in Ceylon, is shipped to the United States, where it sells for from $1\frac{1}{2}$ to 2 cents per pound for dust, $2\frac{1}{2}$ to $2\frac{3}{4}$ for chip, and $3\frac{1}{4}$ to 4 cents for lump. The remaining third of the Ceylon production goes to England.

German graphitic clay to the amount of 232,400 pounds is included in the table. The production of graphite in Nova Scotia in 1887 was 300 tons, worth $2,400. This will probably increase, due to the interest of Americans in Canadian mines. It is practically all exported to the United States.

Graphite imported and entered for consumption in the United States, 1867 *to* 1887, *inclusive.*

Fiscal years ending June 30—	Unmanufactured.		Manufactured.	Total.
	Quantity.	Value.		
	Cwts.			
1867	27,713	$54,131	....	$54,131
1868	68,620	149,083	....	149,083
1869	74,846	351,004	....	351,004
1870	80,795	269,291	$833	270,124
1871	51,628	136,200	3,754	139,954
1872	96,381	329,030	....	329,030
1873	157,539	548,613	....	548,613
1874	111,992	382,591	....	382,591
1875	46,492	122,050	....	122,050
1876	50,589	150,709	17,605	168,314
1877	75,361	204,630	18,091	222,721
1878	60,244	154,757	16,909	171,666
1879	65,662	164,013	24,637	188,650
1880	109,908	278,022	22,941	300,963
1881	150,927	381,966	31,674	413,640
1882	150,421	363,835	25,536	389,371
1883	154,893	361,949	21,721	383,670
1884	144,086	286,393	1,863	288,256
1885	110,462	207,228	....	207,228
1886	83,368	164,111	....	164,111
1887	168,841	331,621	....	331,621

MINERAL PAINTS.

White lead.—There are at present about thirty-five white lead corroders in the United States, most of whom manufacture by the so-called Dutch process. The principal firms are located as follows:

Principal manufacturers of white lead.

Boston Lead Company, Boston, Massachusetts. (*a*)
Salem Lead Company, Salem, Massachusetts.
Cornell Lead Company, Buffalo, New York.
Atlantic White Lead Company, New York City. (*a*)
Jewett White Lead Company, New York City.
Brooklyn White Lead Company, New York City. (*a*)
Ulster White Lead Company, New York City.
Union White Lead Manufacturing Company, New York City. (*a*)
Bradley White Lead Company, Brooklyn, New York. (*a*)
John T. Lewis & Brother, Philadelphia, Pennsylvania. (*a*)
Wetherill & Brother, Philadelphia, Pennsylvania. (*a*)
Harrison Brothers & Co., Philadelphia, Pennsylvania. (*a*)
The Davis and Chambers Lead Company, Pittsburgh, Pennsylvania. (*a*)
Beymer-Bauman Lead Company, Pittsburgh, Pennsylvania. (*a*)
Armstrong & McKelvey, Pittsburgh, Pennsylvania. (*a*)
Pennsylvania White Lead Company, Pittsburgh, Pennsylvania. (*a*)
M. B. Suydam & Brother, Pittsburgh, Pennsylvania.
Fahnestock White Lead Company, Pittsburgh, Pennsylvania. (*a*)
Maryland White Lead Company, Baltimore, Maryland. (*a*)
Saint Louis Lead and Oil Company, Saint Louis, Missouri. (*a*)
Collier White Lead Company, Saint Louis, Missouri. (*a*)
Southern White Lead Company, Saint Louis, Missouri. (*a*)
Kentucky Lead and Oil Company, Louisville, Kentucky.
Josiah Gebhardt & Co., Dayton, Ohio. (*a*)
Eckstein White Lead Company, Cincinnati, Ohio. (*a*)
Anchor White Lead Company, Cincinnati, Ohio. (*a*)
Eagle White Lead Company, Cincinnati, Ohio.
J. H. Morley & Co., Cleveland, Ohio. (*a*)
Peninsular White Lead and Color Works, Detroit, Michigan.
D. B. Shipman White Lead Company, Chicago, Illinois.
Carter White Lead Company, Omaha, Nebraska.
Whittier, Fuller & Co., San Francisco, California. (*a*)

Returns from nearly every manufacturer show a total product of nearly 70,000 short tons of white lead in 1887. This is an increase over 1886. The general opinion is that the trade was moderately good, though prices were not very remunerative at 5.40 cents per pound for dry white lead. The price of pig lead was 4.50, leaving a difference of 0.9 of 1 cent per pound. In 1830 the price for white lead was 7.75 cents per pound, the difference between that price and pig lead being 3.55 cents.

a Also manufacture lead oxides.

Imports of red lead, white lead, and litharge from 1867.

Fiscal years ending June 30—	Red lead.		White lead.		Litharge.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1867	926, 843	$53, 087	6, 636, 508	$430, 805	230, 382	$8, 941
1868	1, 291, 144	76, 773	7, 533, 225	455, 698	250, 615	12, 225
1869	808, 686	46, 481	8, 948, 642	515, 783	187, 333	7, 767
1870	1, 042, 813	54, 626	6, 228, 285	365, 706	97, 398	4, 442
1871	1, 295, 616	78, 410	8, 337, 842	483, 392	70, 889	3, 870
1872	1, 513, 794	85, 644	7, 153, 978	431, 477	66, 544	3, 396
1873	1, 583, 089	90, 891	6, 331, 373	408, 986	40, 799	2, 379
1874	756, 644	56, 305	4, 771, 509	323, 926	25, 687	1, 440
1875	1, 048, 713	73, 131	4, 354, 131	295, 642	15, 767	950
1876	749, 918	54, 884	2, 546, 766	175, 776	47, 054	2, 562
1877	387, 260	28, 747	2, 644, 184	174, 844	40, 331	2, 347
1878	170, 608	9, 364	1, 759, 608	113, 638	28, 190	1, 499
1879	143, 237	7, 237	1, 274, 196	76, 061	38, 495	1, 667
1880	217, 033	10, 397	1, 906, 931	107, 104	27, 389	1, 222
1881	212, 423	10, 009	1, 068, 030	60, 132	63, 058	2, 568
1882	288, 946	12, 207	1, 161, 889	64, 493	54, 592	2, 191
1883	249, 145	10, 503	1, 044, 478	58, 588	34, 850	1, 312
1884	265, 693	10, 589	902, 281	67, 918	54, 183	1, 797
1885	216, 449	7, 641	705, 535	40, 437	35, 283	1, 091
1886	466, 855	17, 239	755, 193	54, 243	23, 770	794
1887	435, 336	16, 971	747, 933	55, 834	47, 783	1, 716

In the last report of this series the statement was made that the white lead made in Kremnitz has the reputation of being the finest in the world; and this statement has appeared frequently from many sources. It appears from the report of Consul-General of Austria Jussen that white lead has never been made at Kremnitz, but that name is a corruption of "Kremser-weiss," a prime quality of white lead, sometimes the product of Krems, in Austria. Riffault, who wrote a treatise on colors some years ago, described a process for making white lead which he styled "an improved Kremnitz process," and which is the same process as that described on page 703 of the last report. It is not known whether this process is now used in this country or not.

Oxides of lead.—Returns from the producers amounted to 2,634 short tons of red lead, 1,492 tons of litharge, and 245 tons of orange mineral. These returns are not complete, and the combined production of all three may have been as high as 7,000 short tons. The prices were: Red lead 5.40 cents, litharge 4.50 cents, and orange mineral 6.50 cents per pound.

Zinc white.—The large production of 1886 was maintained in 1887 at 18,000 short tons, valued at $1,440,000. The price averaged 4 cents per pound.

Imports of zinc oxide (zinc white) from 1867.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	1, 569, 322	$91, 330	1878	2, 451, 060	$140, 157
1868	1, 954, 485	95, 518	1879	2, 274, 935	117, 886
1869	1, 819, 208	105, 844	1880	2, 288, 604	123, 113
1870	2, 064, 234	113, 254	1881	2, 044, 778	106, 990
1871	2, 075, 898	103, 492	1882	2, 538, 090	125, 599
1872	3, 660, 091	193, 448	1883	1, 877, 804	93, 987
1873	3, 530, 465	233, 421	1884	3, 259, 919	148, 817
1874	1, 974, 469	136, 281	1885	2, 331, 694	96, 405
1875	2, 800, 998	181, 455	1886	2, 776, 061	110, 341
1876	2, 460, 144	161, 944	1887	2, 846, 128	110, 820
1877	2, 068, 729	130, 719			

Barytes.—The production in 1887 was larger than in 1886. Returns from the principal producers show that in all 15,000 short tons of crude barytes were produced in the United States, valued at $75,000 at the spot where mined. The finished value would be several times greater, as it includes 5,000 tons of carefully floated material sold by Messrs. Page and Krausse, of Saint Louis, Missouri, for $15 to $30 per ton at the works. In addition to this Missouri product, the principal output was in Virginia, where two new deposits were opened in 1887. About the usual amount of crude barytes was imported, principally from Germany.

Imports of blanc-fixe, satin white, enameled white, lime white, and all combinations of barytes with acids of water from 1867.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	445, 310	$12, 615	1878	4, 955	$1, 047
1868	177, 995	5, 876	1879	1, 993	329
1869	182, 984	6, 292	1880	4, 400	752
1870	97, 643	4, 072	1881	11, 330	2, 027
1871	147, 464	5, 910	1882	52, 364	1, 781
1872	70, 469	5, 091	1883	28, 525	1, 231
1873	119, 972	4, 457	1884	71, 059	1, 871
1874	118, 384	4, 079	1885	28, 538	588
1875	145, 728	4, 899	1886	53, 617	1, 052
1876	15, 744	2, 091	1887	78, 808	1, 621
1877	4, 500	809			

Other white pigments.—There is little change in the use of terra alba, whiting, and Paris white, which are made entirely from imported materials, except a small quantity of terra alba from the best quality of Michigan gypsum. The imports are as follows:

Imports of terra alba from 1869.

Fiscal years ending June 30—	Not aluminous.		Aluminous.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
1869		$7, 002. 00		
1870		7, 911. 00		
1871		133, 028. 00		
1872		6, 444. 00		
1873		2, 235. 00		$44, 994. 00
1874		1, 029. 00		56, 821. 00
1875				45, 726. 00
1876		27, 897. 00		20, 876. 00
1877		45, 471. 00		344. 75
1878		33, 509. 00		683. 46
1879		33, 250. 00		7, 081. 30
1880		34, 718. 00		14, 737. 00
1881		30, 186. 00		9, 796. 56
1882	283, 946	1, 572. 00	12, 008, 101	30, 522. 37
1883	149, 782	800. 00	10, 592, 552	19, 533. 00
1884			10, 066, 496	25, 187. 89
1885			20, 510, 540	41, 378. 21
1886			12, 558, 836	25, 078. 00
1887			15, 378, 437	39, 431. 00

Imports of whiting and Paris white from 1867.

Fiscal years ending June 30—	Whiting and Paris white, dry.		Fiscal years ending June 30—	Whiting and Paris white, dry.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
1867	8, 168, 123	$40, 879	1878	1, 871, 374	$7, 905
1868	5, 530. 042	19, 390	1879	1, 365, 867	5, 976
1869	3, 438, 396	17, 289	1880	1, 803, 577	7, 503
1870	5, 650, 728	27, 293	1881	1, 974, 913	7, 806
1871	5, 219, 396	24, 710	1882	1, 722, 711	6, 675
1872	6, 392, 717	31, 464	1883	2, 216, 018	8, 396
1873	6, 197, 017	32, 622	1884	3, 910, 829	15, 189
1874	3, 749, 122	24, 734	1885	1, 401, 783	6, 157
1875	4, 170, 569	22, 491	1886	899, 038	5, 029
1876	2, 605, 332	13, 270	1887	1, 248, 142	4, 657
1877	2, 390, 333	11, 269			

Ultramarine.—The production of this pigment by the three manufacturers—the American Ultramarine Works, in Newark, New Jersey; the Germania Ultramarine Works, Whitestone, Long Island; and the International Ultramarine Works, in Westfield, Staten Island—was less in 1886 than the amount given in the last report. The entire product of 1886 was not more than 2,225,000 pounds; this increased to about 2,500,000 pounds in 1887, valued in first hands at $225,000. The prices range from 5 to 20 cents per pound, according to the usual trade conditions of quality and quantity sold; the average being 9 cents per pound.

Imports of ultramarine from 1867.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867		$78, 490. 00	1877	1, 559, 027	$203, 7[illegible]. 73
1868		96, 638. 00	1878	1, 279, 297	162, 486. 55
1869		72, 101. 00	1879	1, 020, 003	131, 762. 14
1870		92, 174. 00	1880	1, 214, 770	162, 653. 41
1871		92, 142. 00	1881	913, 935	127, 352. 37
	170, 947	23, 674. 00	1882	906, 684	122, 988. 32
1872	670, 839	86, 997. 00	1883	819, 625	105, 654. 00
1873	1, 037, 949	136, 908. 00	1884	1, 015, 875	114, 227. 00
1874	1, 257, 637	165, 634. 00	1885	999, 128	97, 486. 00
1875	1, 468, 487	203, 773. 00	1886	1, 060, 547	98, 613. 00
1876	1, 394, 697	191, 606. 00	1887	647, 382	62, 535. 00

Ocher.—The production of ocher is extending through the Southern States, and several new sources of supply have been reported since the last report; the production from these sources increased the total to 8,000 long tons, valued at $75,000. The output of several old companies increased also. The Oxford ocher handled by Mr. Wallace Dunbar, of New York, increased by about 200 tons.

Metallic paint.—The total production increased 12,000 long tons, valued at $235,000. The increase was due to the output of the new Clinton Metallic Paint Company, of Clinton, New York, and to the increased product in Chattanooga, Tennessee, Baraboo, Wisconsin, and

Cape Girardeau, Missouri. A valuable description of the occurrence, history, etc., of metallic paint along the Lehigh river, in Pennsylvania, is given by Mr. Frank A. Hill, in Part IV. of the "Pennsylvania Geological Survey's Annual Report for 1886." The region described is the source of the Prince metallic paint. It has been mined since 1856, and more than 60,000 tons have been produced altogether.

Imports.—The imports of ocher and metallic paint of various kinds are given in the following tables. The item French mineral also includes a large quantity of Paris green.

Imports of ocher of all kinds from 1867 *to* 1883.

Fiscal year ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral, French, and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,373	$385	....	$35,374	....	$2,083	1,430,118	$9,923
1868	6,949	333	....	11,165	....	500	3,670,093	32,102
1869	65,344	2,496	2,582,335	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,465	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,763	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,352	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	1,524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	25,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42,563
1880	91,293	4,233	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	3,201,880	30,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883 (*a*)	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,593

a Since 1883 classified as "dry" and "ground in oil."

Imports of ocher of all kinds from 1884.

Fiscal years ending June 30—	Dry.		Ground in oil.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
1884	6,285,588	$70,191	156,295	$5,233
1885	5,312,564	52,824	79,467	3,763
1886	5,413,086	58,980	127,757	4,742
1887	5,435,725	54,239	47,258	6,653

Imports of umber from 1867.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	2,147,342	$15,946	1878	1,038,880	$8,302
1868	345,173	2,750	1879	986,105	6,959
1869	570,771	6,159	1880	1,877,645	17,271
1870	708,825	6,313	1881	1,475,835	11,126
1871	470,392	7,064	1882	1,923,648	20,494
1872	1,409,822	18,203	1883	785,794	8,419
1873	845,601	8,414	1884	2,946,675	20,654
1874	729,864	6,200	1885	1,198,060	8,504
1875	513,811	5,596	1886	1,094,593	8,656
1876	681,199	7,527	1887	1,521,114	12,033
1877	1,101,422	10,213			

Graphite.—In addition to the use of from 10,000 to 12,000 pounds of graphite from Ticonderoga, New York, used for making paint by the Joseph Dixon Crucible Company, an impure variety was produced in North Carolina to the extent of of 20,000 pounds and used for paint. Bituminous coal from Pennsylvania is also used for common paints.

Quicksilver vermilion.—The production was slightly less than in 1886. It is estimated at 600,000 pounds, worth on the average 54 cents per pound. The imports remained practically constant, being valued at $10,141 in 1887. The imports for previous years are given below.

Imports of quicksilver vermilion from 1867.

Fiscal years ending June 30—	Quantity.	Value.	Fiscal years ending June 30—	Quantity.	Value.
	Pounds.			*Pounds.*	
1867	....	$123, 506	1878	9, 843	$5, 772
1868	....	90, 648	1879	11, 382	6, 105
1869	247, 382	145, 665	1880	11, 952	5, 997
1870	104, 523	57, 262	1881	14, 243	7, 391
1871	79, 195	43, 935	1882	12, 496	6, 214
1872	120, 067	49, 237	1883	19, 549	8, 795
1873	87. 008	65, 796	1884	....	10, 472
1874	42, 324	39, 443	1885	....	8, 244
1875	9, 460	10, 831	1886	....	10, 767
1876	18, 981	17, 679	1887	....	10, 141
1877	23, 315	14, 660			

Imitation vermilion of various kinds, such as chrome vermilion, eosine vermilion, etc., were sold to the extent of 700,000 pounds.

MINERAL WATERS.

By A. C. Peale.

Although the returns of mineral waters for 1887 comprise the figures from only 215 springs, as compared with 225 for 1886, the value of the product remains about the same. For the 153 springs actually reporting, there is an increase in value of about $46,000 over the value reported by 172 springs in 1886. The number of gallons reported by these springs is, however, 444,648 gallons less. In estimating for the 62 springs that have failed to answer this year, the figures have been made low rather than high, and it is possible that the total production and its value for 1887 would very closely approximate that of 1886, if reports could be obtained from all the spring owners.

Three new springs have been added to the list for the North Atlantic States, and still the total number for that section is less than for previous years except 1883 and 1884. With this reduction, however, the number of gallons sold remains about the same, with an increased value for the year, although over 40 per cent. of the springs are not represented. The new springs are the Underwood Spring, of Falmouth, Cumberland county, Maine, the Ponce de Leon Spring, of Meadville, Crawford county, Pennsylvania, and Hafer's Chalybeate Springs, near Bedford, Bedford county, Pennsylvania.

The list for the south Atlantic States remains the same as for 1886, but there are more springs not reporting figures. Notwithstanding this, the value of the production has slightly increased.

The southern central States lose one spring from the total on the list of the last year, but show an increase in value corresponding to that noted in the other sections. Two new springs are added, viz., Boyd Springs, of Hope, Hempstead county, Arkansas, and Manitou Springs, Ozark, Franklin county, in the same State.

In the northern central States one new spring is added to the list in Ohio (the Odevene Spring of Delaware, Delaware county, Ohio), and one in Indiana (the Lithian Spring at Attica, Fountain county). The total list shows a falling off of 3 springs from 1886, and a large decrease in the number of gallons sold, and also a falling off of nearly one-half from the value of the preceding year.

The western States and Territories lose only one spring; the number of gallons sold is very much larger for 1887, as is also the total value and the average price per gallon.

The imports of artificial waters show a falling off of nearly two-thirds, while those of natural waters have increased over 300,000 gallons, making the total importation for 1887 about 268,000 gallons more than that of 1886, while the increase in value is something over $11,000. It is interesting to note that in 1886 the imports of artificial mineral waters increased largely and the imports of natural waters decreased, while for 1887 the contrary is true.

IMPORTS.

Mineral waters imported and entered for consumption in the United States, 1867 *to* 1883 *inclusive.*

Fiscal years ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All, not artificial.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370,610	$24,913	3,792	$360	....	$137	....	....	$25,410
1868	241,702	18,438	22,819	2,052	554	104	....	....	20,594
1869	344,691	25,635	9,739	802	1,042	245	....	....	26,682
1870	433,212	30,680	18,025	1,743	2,063	508	....	....	32,931
1871	470,947	34,604	2,320	174	1,336	141	....	....	34,919
1872	892,913	67,951	....	....	639	116	....	....	68,067
1873	35,508	2,326	....	....	355	75	394,423	$98,151	100,552
1874	7,238	691	....	....	95	16	199,035	79,789	80,496
1875	4,174	471	....	....	5	2	395,956	101,640	102,113
1876	25,758	1,399	....	....	....	....	447,646	134,889	136,788
1877	12,965	1,328	....	....	....	22	520,751	167,458	168,808
1878	8,229	815	....	....	....	....	883,674	350,912	351,727
1879	28,440	2,352	....	....	3	4	798,107	282,153	284,509
1880	207,554	19,731	....	....	....	....	927,759	285,798	305,529
1881	150,326	11,850	....	....	55	26	1,225,462	383,616	395,492
1882	152,277	17,010	....	....	....	....	1,542,905	410,105	427,115
1883	88,497	7,054	....	....	....	....	1,714,085	441,439	448,493

It appears from the foregoing table that previous to 1873 natural mineral waters were not distinguished from the artificial waters. Since 1884 the artificial waters have not been classified according to the receptacles in which they have been imported.

Imports for the fiscal years 1884, 1885, 1886, *and* 1887.

Years.	Artificial mineral waters.		Natural mineral waters.	
	Gallons.	Value.	Gallons.	Value.
1884	29,366	$4,591	1,505,298	$362,651
1885	7,972	2,157	1,660,072	397,875
1886	63,134	16,903	1,521,642	358,595
1887	21,243	6,473	1,832,061	380,299
Total	121,715	30,124	6,519,073	1,499,420

EXPORTS.

Exports of natural mineral waters, of domestic production, from the United States.

Fiscal years ending June 30—	Value.	Fiscal years ending June 30—	Value.
1875	$162	1881	$1,029
1876	80	1882	421
1879	1,529	1883	459
1880	1,486	1884, 1885, 1886, and 1887	None.

The amount of artificial mineral waters exported is also trifling.

PRODUCTION.

Natural mineral waters sold in 1883, 1884, 1885, 1886, *and* 1887.

	Springs reporting.	Gallons sold.	Value.
1883.			
North Atlantic States	38	2,470,670	$282,270
South Atlantic States	27	312,090	64,973
Northern central States	37	1,435,809	323,600
Southern central States	21	1,441,042	139,973
Western States and Territories	6	169,812	52,787
	129	5,829,423	863,603
Estimated	60	1,700,000	256,000
Total	189	7,529,423	1,119,603
1884.			
North Atlantic States	38	3,345,760	328,125
South Atlantic States	27	464,718	103,191
Northern central States	37	2,070,533	420,515
Southern central States	21	1,526,817	147,112
Western States and Territories	6	307,500	85,200
	129	7,715,328	1.084,143
Estimated	60	2,500,000	375,000
Total	189	10,215,328	1,459,143
1885.			
North Atlantic States	51	2,527,310	192,605
South Atlantic States	32	908,692	237,153
Northern central States	45	2,925,288	446,211
Southern central States	31	540,436	74,100
Western States and Territories	10	509,675	86,776
	169	7,411,401	1,036,845
Estimated	55	1,737,000	276,000
Total	224	9,148,401	1,312,845
1886.			
North Atlantic States	49	2,715,050	177,969
South Atlantic States	38	720,397	123,517
Northern central States	40	2,048,914	401,861
Southern central States	31	822,016	58,222
Western States and Territories	14	781,540	137,796
	172	7,087,917	899,365
Estimated	53	1,862,400	384,705
Total	225	8,950,317	1,284,070
1887.			
North Atlantic States	40	2,571,004	213,210
South Atlantic States	34	614,041	147,149
Northern central States	38	1,480,820	208,217
Southern central States	29	741,080	87,946
Western States and Territories	12	1,236,324	288,737
	153	6,643,269	945,269
Estimated	62	1,616,340	316,204
Total	215	8,259,609	1,261,473

Alabama.—Reports of sales have been received from five springs for 1887, which show a slight increase in the number of gallons of water sold, the value remaining about the same as for 1886. The following are the springs reporting: Bailey springs, Bailey Springs, Lauderdale county; Bladen springs, Bladen Springs, Choctaw county; Healing springs, Healing Springs, Washington county; White Sulphur springs, Sulphur Springs, DeKalb county.

Arkansas.—The number of commercial waters of Arkansas for 1887 is increased by two new springs, and the total value of the production shows an increase of several thousand dollars. The springs represented in the report are: Boyd springs, Hope, Hempstead county; Dovepark springs, Dovepark Springs, Hot Spring county; Eureka springs, Eureka Springs, Carroll county; Mountain Valley springs, Mountain Valley, Garland county; Potash sulphur springs, Potash Sulphur, Garland county; Siloam springs, Siloam Springs, Benton county.

California.—Six of California's springs report for 1887, as follows: Azule spring, San José, Santa Clara county; Geyser soda spring, Litton's, Sonoma county; Litton seltzer spring, Litton's, Sonoma county; Napa soda springs, Napa Soda Springs, Napa county; Pacific Congress, Saratoga, Santa Clara county; Tolenas soda springs, Fairfield, Solano county.

Colorado.—Both of Colorado's commercial waters have reported for 1887, and both show an increase in production and value. The springs are: Manitou springs, Manitou Springs, El Paso county; Springdale seltzer spring, Springdale, Boulder county.

Connecticut.—Two of the three springs on the new list for 1886 have failed to report for 1887. The status of the remaining springs is about the same as for the preceding year. Those reporting are: Aspinock mineral spring, Putnam Heights, Windham county; Bozrah mineral spring, Bozrah, New London county; Oxford chalybeate spring, Oxford, New Haven county.

Georgia.—Notwithstanding the fact that two springs report for 1887, as against one for 1886, there is a considerable decrease both in number of gallons and in value. The springs reporting are: Catoosa springs, Catoosa Springs, Catoosa county; Ponce de Leon springs, Atlanta, Fulton county.

Idaho.—This Territory is represented for the first time on our list in the Soda springs, Soda Springs, Oneida county.

Illinois.—Only two of the springs of Illinois send reports. They are: Glen Flora springs, Waukegan, Lake county; Perry springs, Perry Springs, Pike county.

Indiana.—One new spring is added to the list for Indiana for 1887. Six springs report as follows: Hosea's (New Point Comfort) mineral springs, Blue Lick, Clark county; Indian springs, Indian Springs, Martin county; King's mineral spring, Muddy Fork, Clark county; Lafayette artesian well, Lafayette, Tippecanoe county; Lithium spring, Attica, Fountain county; West Baden springs, West Baden, Orange county.

Iowa.—The number of springs reporting remains the same as for 1886, but there is an increase in their production. The springs reporting are: Dunbar's mineral springs, College Springs, Page county; Old M. C. springs, Colfax, Jasper county; Ottumwa mineral springs, Ottumwa, Wapello county.

Kansas.—One of the Kansas mineral waters has been taken from the market, leaving but three to report for 1887. These are: Geuda springs, Geuda Springs, Cowley county; Iola mineral well, Iola, Allen county; Topeka mineral wells, Topeka, Shawnee county.

Kentucky.—The springs reporting for 1887 are four in number, and the figures are increased over those of 1886. The springs are: Bedford springs, Bedford, Trimble county; Grayson springs, Grayson Springs, Grayson county; Lower Blue Lick springs, Blue Lick Springs, Nicholas county; Upper Blue Lick springs, Davidson, Nicholas county.

Maine.—The list for Maine is increased by one spring. Of the twelve springs, seven report sales for 1887. These springs are: Auburn mineral spring, Auburn, Androscoggin county; Boothbay medicinal spring, East Boothbay, Lincoln county; Hartford cold spring, Hartford, Oxford county; Poland mineral spring, South Poland, Androscoggin county; Scarborough mineral spring, Scarborough, Cumberland county; Summit mineral spring, Harrison, Cumberland county; Underwood spring, Falmouth, Cumberland county.

Maryland.—No reports have been received from Maryland.

Massachusetts.—Five of seven springs in Massachusetts report sales for 1887, with a slight reduction. The springs reporting are: Allandale mineral spring, West Roxbury, Suffolk county; Crystal mineral spring, Stoneham, Middlesex county; Commonwealth mineral spring, Waltham, Middlesex county; Echo Grove mineral spring, Lynn, Essex county; Everett crystal spring, Everett, Middlesex county.

Michigan.—The only spring in Michigan reporting for 1887 is the Mount Clemens mineral spring, Mount Clemens, Macomb county.

Minnesota.—The Inglewood spring, Minneapolis, Hennepin county, is the only spring reporting sales for Minnesota.

Mississippi.—Only two springs report sales for 1887. They are: Castalian springs, Durant, Holmes county; Cooper's well, Raymond, Hinds county.

Missouri.—Five springs report for 1887, with an increase over the figures for 1886. They are: Eldorado springs, Eldorado Springs, Cedar county; Mooresville mineral springs, Mooresville, Livingston county; Randolph springs, Randolph, Clay county; Reiger mineral springs, Mercer county (post-office address, Lineville, Wayne county, Iowa); Sweet springs, Sweet Springs, Saline county.

New Hampshire.—Two of the springs having the water on sale in 1886 now report that the water is free. The springs reporting sales are:

Moultonborough mineral springs, Moultonborough, Carroll county; Ponemah spring, Milford, Hillsborough county.

New Mexico.—No reports have been received from New Mexico for 1887.

New York.—Just about one-half of the commercial mineral waters are represented in the figures sent in for 1887. The springs reporting are: Adirondack spring, Whitehall, Washington county; Avon springs, Avon, Livingston county; Massena springs, Massena, Saint Lawrence county; Oak Orchard acid springs, Alabama, Genesee county; Deep Rock springs, Oswego, Oswego county; Carlsbad spring, Saratoga Springs, Saratoga county; Champion spring, Saratoga Springs, Saratoga county; Excelsior spring, Saratoga Springs, Saratoga county; High Rock spring, Saratoga Springs, Saratoga county; New Putnam spring, Saratoga Springs, Saratoga county; Star spring, Saratoga Springs, Saratoga county; Union spring, Saratoga Springs, Saratoga county; Vichy spring, Saratoga Springs, Saratoga county; Verona springs, Verona, Oneida county; Victor spring, Darien Centre, Genesee county; Sharon White Sulphur spring, Sharon Springs, Schoharie county.

North Carolina.—Of the seven springs credited to North Carolina as having the water on sale six have reported, as follows: Leinster Poison springs, Statesville, Iredell county; Lemon springs, Lemon Springs, Moore county; Panacea springs, Panacea Springs, Halifax county; Park's Alkaline springs, Caswell county (postoffice address, Danville, Virginia); Seven springs, Seven Springs, Wayne county; Thompson's Bromine Arsenic springs, Crumpler, Ashe county.

Ohio.—Two new springs have been added to the list for Ohio, making a total of nine for the State. Of these the following six have reported sales for 1887: Berlin mineral water, Berlin Heights, Erie county; Electro-magnetic springs, Fountain Park, Champaign county; Len-a-pe springs, Delaware, Delaware county; Magnetic springs, Bellbrook, Greene county; Odevene spring, Delaware, Delaware county; Ohio magnetic springs, Magnetic Springs, Union county.

Oregon.—Two springs are represented on the list for Oregon. They are: McCallister's soda springs, 35 miles east of Jacksonville, Jackson county; Wilhoit springs, Wilhoit, Clackamas county.

Pennsylvania.—Although two new springs are added to the list for Pennsylvania the only springs reporting are: Black Barren mineral springs, Pleasant Grove, Lancaster county; Minnequa springs, Minnequa, Bradford county.

Rhode Island.—The two springs of Rhode Island report increased sales for 1887. They are: Holly springs, Woonsocket, Providence county; Ochee springs, Providence, Providence county.

South Carolina.—Reports have been received from all the springs of commercial value, as follows: Chick's springs, Chick's Springs, Greenville county; Garrett's springs, Spartanburgh, Spartanburgh county; Glenn springs, Glenn Springs, Spartanburgh county.

Tennessee.—The six mineral springs on our list for Tennessee report an increase for 1887. They are: Horn's mineral spring, Lebanon, Wilson county; Hurricane springs, Tullahoma, Coffee county; Idaho springs, Clarksville, Montgomery county; Red boiling springs, Red Boiling Springs, Macon county; Rhea springs, Rhea Springs, Rhea county; Tate spring, Tate Springs, Grainger county.

Texas.—Reports have been received from the following seven springs: Crabtree's sour wells, Sulphur Springs, Hopkins county; Dalby springs, Dalby Springs, Bowie county; Hynson's iron mountain spring, Marshall, Harrison county; mineral wells, Mineral Wells, Palo Pinto county; Sour Lake, Sour Lake, Hardin county; Texas sour springs, Luling, Caldwell county; Wootan wells, Wootan Wells, Robertson county.

Vermont.—One of the springs on the list for 1886 reports the water as free, and three springs report sales. They are: Alburgh springs, Alburgh Springs, Grand Isle county; Brunswick White Sulphur springs, Brunswick, Essex county; Clarendon springs, Clarendon Springs, Rutland county.

Virginia.—Nineteen springs in this State report a large increase in the total production and value for 1887. The springs reporting are: Alleghany springs, Alleghany Spring, Montgomery county; Bear Lithia springs, Harrisonburgh, Rockingham county; Blue Ridge springs, Blue Ridge Springs, Botetourt county; Buffalo Lithia springs, Buffalo Lithia Springs, Mecklenburgh county; Chase City mineral water, Chase City, Mecklenburgh county; Cold Sulphur springs, Goshen Bridge, Rockbridge county; Farmville Lithia springs, Farmville, Prince Edward county; Healing springs, Healing Springs, Bath county; Hunter's Pulaski alum springs, Dublin, Pulaski county; Jordan White Sulphur springs, Jordan Springs, Frederick county; Massanetta springs, Harrisonburgh, Rockingham county; Rockbridge alum springs, Alum Springs, Rockbridge county; Rock Enon springs, Rock Enon Springs, Frederick county; Rockingham springs, Rockingham, Rockingham county; Seven springs, Abingdon, Washington county; Shenandoah alum springs, Shenendoah Alum Springs, Shenandoah county; Stribling springs, Stribling Springs, Augusta county; Wallawhatoola alum water, Millborough Springs, Bath county; Wolf Trap Lithia water, Wolf Trap, Halifax county.

Washington Territorg.—Medical Lake reports about the same number of gallons as for 1886.

West Virginia.—Four springs report for 1887. They are: Capon springs, Capon Springs, Hampshire county; Red Sulphur springs, Red Sulphur Springs, Monroe county; Salt Sulphur springs, Salt Sulphur Springs, Monroe county; White Sulphur springs, White Sulphur Springs, Greenbrier county.

Wisconsin.—Eleven springs report for 1887. They are: Arcadian mineral spring, Waukesha, Waukesha county; Bethesda mineral spring, Waukesha, Waukesha county; Gihon spring, Delavan, Walworth county; Glenn mineral spring, Waukesha, Waukesha county; Horeb spring, Waukesha, Waukesha county; Mineral Rock spring, Waukesha, Waukesha county; Prairie du Chien artesian wells, Prairie du Chien, Crawford county; Saint Croix mineral spring, Osceola Mills, Polk county; Shealtiel springs, Waupaca, Waupaca county; Siloam spring, Waukesha, Waukesha county; Sheboygan natural mineral water, Sheboygan, Sheboygan county.

Summary of reports of mineral springs for 1887.

	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	7	5	12
New Hampshire	2	0	2
Vermont	3	2	5
Massachusetts	5	2	7
Rhode Island	2	0	2
Connecticut	3	2	5
New York	16	14	30
New Jersey	0	0	0
Pennsylvania	2	5	7
SOUTH ATLANTIC STATES.			
Delaware	0	0	0
Maryland	0	1	1
District of Columbia	0	0	0
Virginia	19	6	25
West Virginia	4	2	6
North Carolina	6	1	7
South Carolina	3	0	3
Georgia	2	1	3
Florida	0	0	0
SOUTH CENTRAL STATES.			
Kentucky	4	2	6
Tennessee	6	2	8
Alabama	4	1	5
Mississippi	2	2	4
Louisiana	0	0	0
Texas	7	1	8
Indian Territory	0	0	0
Arkansas	6	0	6
NORTH CENTRAL STATES.			
Ohio	6	2	8
Indiana	6	1	7
Illinois	2	1	3
Michigan	1	1	2
Wisconsin	11	3	14
Minnesota	1	0	1
Iowa	3	2	5
Missouri	5	1	6
Dakota	0	0	0
Nebraska	0	0	0
Kansas	3	0	3
WESTERN STATES AND TERRITORIES.			
Alaska	0	0	0
Wyoming	0	0	0
Montana	0	0	0
Colorado	2	0	2
New Mexico	0	1	1
Arizona	0	0	0
Utah	0	0	0
Nevada	0	0	0
Idaho	1	0	1
Washington	1	0	1
Oregon	2	0	2
California	6	1	7
Total	153	62	215

USEFUL MINERALS OF THE UNITED STATES.

A PARTIAL LIST OF ORES, MINERALS, AND MINERAL SUBSTANCES OF INDUSTRIAL IMPORTANCE, ARRANGED ALPHABETICALLY BY STATES AND TERRITORIES.

EDITED BY ALBERT WILLIAMS, JR.

The following lists are based upon those published in the volume of Mineral Resources for 1882, pages 664–775, and very closely follow the form then adopted. The design is to show, in as compact and concise a form as possible, the principal occurrences of the ores, minerals, and mineral substances of industrial importance of the several States and Territories, and to indicate whether these resources are or are not at present being utilized. Since the original lists were compiled, the rapid growth of the mineral industries of the country, changes in the channels of trade, transportation and consumption, new utilizations, and recent discoveries, have, to a considerable extent, altered the condition of affairs, more especially in the South and in the States and Territories of the far West. These changes, for the most part, have been progressive. In addition to new finds of valuable deposits, many of the occurrences known and recorded at the date of the 1882 report, but which were not at that time available, are now, for the reasons just stated, being drawn upon. It has therefore seemed advisable to present such new information as may bring the whole subject more nearly up to date.

In regard to the localities cited, it has not been deemed necessary or advisable to make the references very detailed. Often a quite general statement gives a more comprehensive view of the occurrences than if they were minutely and specifically enumerated; indeed, to quote all the localities which are known and have already been reported would render the lists too bulky for convenient reference; and the utility of such a plan would be for the professional mineralogist rather than for the student of economic conditions. As a rule, however, the principal localities are indicated with sufficient clearness, though the more extensive deposits, such as coal and iron fields, gold belts, etc., are mentioned in general terms.

It will be noticed that the form of the lists is twofold, the substances mined or utilized being segregated from those which, for commercial or other reasons, are not at present being worked. Under the first head it is intended to give only such cases as have a decided industrial importance, excluding irregular sporadic workings; under the second head, to include only such occurrences as seem to have a prospective value; that is, which, with further increase of population and consumption, or better and cheaper means of mining, extraction, and conveyance to market, may in the future be available. The scheme therefore excludes a large number of occurrences which would be highly interesting from a purely mineralogical point of view, but which have no economic significance. It is, of course, almost impossible to draw a hard and fast line as to workable quantities, and some irregularity in this respect has been unavoidable. Two substances of highly-important industrial bearing—natural gas and mineral water—are not here considered in detail. They occur in almost every State and Territory, and are utilized in many, but the localities are so numerous that a complete list of them would only be confusing. Possibly available gas fields occur in almost every State except in New England and a few Southern States, but the discoveries, utilizations, and abandonments follow each other so rapidly that any statement, however complete for this year, would be misleading as to the next. The present state of the industry, as well as the trade in mineral waters, are shown in the body of this report (pp. 464–502 and 680–687).

In the compilation of the lists prepared in 1882 the greater part of the work for the eastern States was done by Prof. John C. Smock, and that for the Rocky Mountain region by Mr. C. Whitman Cross. To these gentlemen is also due an important portion of the information now given. At the end of the lists will be found mention of those who have contributed essential assistance in the present compilation, though by no means all are named who have kindly interested themselves in it. An extensive correspondence has been carried on with geologists, mining engineers, and other local authorities, and various published reports have also been consulted. Notwithstanding the time and attention given to the subject, it must be frankly confessed that the lists, even in their revised state, are far from being complete. It is therefore hoped and earnestly solicited that corrections, alterations, or additions may be brought to the notice of the present compiler, to the end that in the event of a future issue of similar lists, and also for the general purposes of the series of Mineral Resources, as much fresh information as possible may be gathered together.

ALABAMA—Mined.

Mineralogical name.	Common name.	Remarks.
Coal, var. bituminous.	Coal, bituminous coal.	Three distinct coal fields: 1. Coosa, 100 square miles; 2. Cahaba, 230 square miles; 3. Warrior, 5,000 square miles. The Coosa field contains two or three seams 3 feet and upwards in thickness; mined at Broken Arrow and Trout creek, in St. Clair county. The strata in this field are more faulted and broken than in the other fields. The Cahaba field extends from the south prong of Canoe creek, in St. Clair county, to Haysop creek, in Bibb county, a distance of 60 miles. Down to Helena, in Shelby county, the field has an average width of 5 or 6 miles. Below that point the width increases towards the southwest, the maximum width of 15 miles being in the latitude of Blocton, in Bibb county. The southern end of this field has a greater thickness of Measures and a larger number of coal seams than the rest of the field. Above the Brock's Gap seam (near the base of the Measures) there are 4,000 feet of Measures, holding thirty-nine, seams of coal, eleven of which are over 2½ feet thick, the eleven having an aggregate thickness of 40 feet of coal. The synclinal of the Cahaba field, like the main synclinal of the Warrior, descends to the south and southwest, bringing the upper Measures to the surface. The seams of the Cahaba field appear to be less interbedded with slate than those of the Warrior; and the Cahaba contains less of what are called "Flat Measures" than the Warrior. The seams of the Cahaba field are mined at the following places: At Henryellen, Jefferson county; Helena, Montevallo, and Brierfield, Shelby county; and at Blocton, Bibb county. The Warrior field includes all the Coal Measures of Alabama drained by the Warrior and Tennessee rivers, Lookout mountain being an outlier of the plateau portion of this field. The basin region of the field lies to the southwest of Cullman county. The Measures of this field sink towards the southwest, bringing the upper beds to the surface in that direction. The greatest thickness of strata in this field—3,000 to 4,000 feet—is in Tuscaloosa county. The coal seams in the lower part of the field are about forty in number, of which fourteen have a thickness of 2½ feet and upwards. Of these fourteen, nine are 4 feet thick; and of these nine, three are over 6 feet. Coal is mined at the following localities: Warrior Station, Brake, Jefferson mines, New Castle, Walker mines, Black Diamond mines, Coalburgh, Brookside, Pratt mines, Woodward, Blue Creek mines, and Morrow mines, Jefferson county; Horse Creek mines, Cordova, York, Coal valley, Day's gap, Patton, Corona, and Kansas, Walker county; Tuscaloosa and Coaling, Tuscaloosa county; and near Huntsville, Madison county.
	Fire clay	Common in Coal Measures, and also in the lowest cretaceous beds (Tuscaloosa formation). Fire-brick works, from materials of the Tuscaloosa formation, have been in operation for many years at Bibbville, Bibb county, and recently an excellent quality of fire clay has been mined at Tuscaloosa. In the siliceous clays of the Buhrstone division of the Tertiary is a material which will probably soon come into use for manufacture of fire brick.
	Flagging stone	In the yellow sandstone of Red Mountain group, bordering the valley from Bucksville to Saint Clair Springs, and at Pratt's ferry, on Cahaba river. Sandstone flags of Coal Measures, Plank Shoals, on North river, Tuscaloosa county. Thin-bedded limestone in Lower Silurian and sub-Carboniferous group; also gneisses and mica schists of metamorphic region. Fine quarries at Tallahassee falls on Tallapoosa river in siliceous slates (itacolumite). Some rock quarried at Farrell's mill and other localities in Lee county. Many localities opened for local supplies.
Gold	Gold	In the counties of Cleburne, Clay, Talladega, Coosa, Chilton, Elmore, Tallapoosa, Chambers, and Randolph gold occurs both in quartz veins and in surface gravel. The gravels were partly thoroughly worked over some forty years ago. The quartz veins have also been worked at many localities. Recently a good deal of attention has been given to the gold-bearing veins in Talladega county, and several companies have begun work upon them. Of mines formerly worked are the Arbacoochee and Chulifinnee mines, Cleburne county; Riddle mines, Talladega county (at present there are several other mines in operation in this county),

ALABAMA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gold (cont'd)...	Gold..................	Stewart's mines and other localities on Weogufka and Hatchett creeks, Coosa county; Rippito mines, Chilton county; Haral's mines, Clay county; Goldville, Tallapoosa county; Pinetucky mines, Randolph county; also found in small quantity in quartz pebble beds overlying Coal Measures near Fayette Court-house, Fayette county, and near Gold Mine in Marion county. These localities are at a distance from any region where gold-bearing rocks are in place, and the gold is associated with drift-gravel brought from a distance.
	Granite..............	Localities in the metamorphic region. Worked for local supply mainly. Near Bradford, and also Rockford, Coosa county; Notasulga, Macon county; Auburn and Chewacla, Lee county; Tallahassee, Tallapoosa county; Milltown, Chambers county. Not properly granites, but thick-bedded gneisses.
Graphite.......	Plumbago, black lead.	Localities in Chilton, Clary, Coosa, Chambers, Randolph, and Tallapoosa counties. Dug near Millerville, Clay county; north of Milltown, Chambers county; and between Wedowee and Louina, Randolph county, for use as a lubricating agent. Occurs in black, graphitic schists; also in argillaceous, schistose rocks. Not mined, except locally.
Halloysite.....	....	Near Sulphur Springs station, De Kalb county. Mined extensively for manufacture of fine ware. Also found southeast of Stevenson, in Jackson county. Both occur in cherty strata of Lower sub-Carboniferous.
Hematite......	Fossil ore, dyestone ore, red iron ore.	Interstratified with the shales and sandstones of the Clinton group of the Lower Silurian, along each border of the anticlinal valleys, as follows: Brown's valley, extending from Reid's gap, Blount county, northeastward to Tennessee line. The red ore in this valley appears in considerable quantity at several localities in Marshall and Jackson counties. Murphree's valley, from Village Springs northeastward on both sides of the valley, beds of ore of great thickness and of good quality; just now beginning to be utilized. In Roup's and Jones's valley, extending from Clement's mill, in Tuscaloosa county, to Village Springs, Blount county, and Springville, St. Clair county, the red ore ridges are seen on both sides of the valley, and from Bucksville, Tuscaloosa county, up to Jonesborough, Jefferson county, the ridge is duplicated by faulting on the western side of the valley. The ore appears in considerable thickness near Vance's, in Tuscaloosa county, and thence northeastward through Jefferson county, where it is mined at many places—Sloss's, Hilman's, Woodward's, and Eureka mines, southwest of Birmingham; above Birmingham, mines have been opened at Irondale, Jefferson county, and near Springville, St. Clair county. In the Cahaba valley, between Cahaba and Coosa coal fields, the ore is chiefly on the eastern side of the valley; not mined. In the Coosa valley, lying northeast of the Cahaba coal field and east of Lookout mountain, are many fine beds of this ore. On the western side of the valley mines are worked near Springville, St. Clair county, and Attala, Etowah county. East of Ashville, St. Clair county, are two red ore ridges parallel to each other not yet developed. East of Lookout mountain are many occurrences of red ore, mined at Round mountain and Gaylesville, Cherokee county; also near Gadsden. In Will's valley, west of Lookout mountain, extending from Attala northeastward to Georgia, the red ore is on both sides of the valley; mines at Portersville and one or two other points. Another horizon of red oölitic ore is known in Alabama just below the Trenton limestone, observed near Pratt's ferry, in Bibb county, and in several places in Jones's valley, southwest of Birmingham; thickness of the bed only a few feet; not mined anywhere.
Kaolinite......	Kaolin, clay..........	Near Jacksonville, Calhoun county, extensive beds; near Louina, Randolph county. [See, also, Halloysite.]
Limonite......	Brown hematite......	Occurs as "gossan" at outcrops of pyritous ores—copper mines in Cleburne, Clay, and Coosa counties. In concretionary masses associated with hornblendic rock and worked formerly at localities in Clay and Chilton counties.

ALABAMA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite (continued).	Brown hematite	Ore banks at top of the dolomitic limestone (Calciferous) in the Coosa valley. These are opened at intervals from near Columbiana in Shelby county northeast to Georgia line; Alabama furnace, Talladega county; Woodstock furnace, at Anniston, Calhoun county; Stonewall, Rock Run, and Tecumseh furnaces, in Cherokee county. In Cahaba valley ore occurs at intervals from near Centreville, Bibb county, northeast through Shelby and Saint Clair counties to Gadsden, in Etowah county. Furnace at Brierfield, Bibb county. In Roup's and Jones's valley ore occurs from Clement's mill, Tuscaloosa county, through parts of Bibb, Shelby, and Jefferson counties. Many mines in Bibb and Tuscaloosa counties. In Murphree's valley no mines worked for lack of transportation. In Will's valley mined at several points between Attala and the Georgia line. Brown's valley in Marshall and Jackson counties; no mining. Sub-Carboniferous formation in the Tennessee valley in northern Alabama carries limonite. Largest bank in Franklin county from Cedar creek to Newburgh. Occurs eastward in Limestone, Lawrence, and Madison counties. In the narrow anticlinal valleys of middle Alabama this sub-Carboniferous ore is rarely found in banks of economical importance. In the Lower Cretaceous (Tuscaloosa) formation, limonite is of frequent occurrence at places, in large quantity and of good quality, as at Vernon, Lamar county, where it supplied a furnace now out of blast. Not yet mined elsewhere. Overlying the Uppermost Cretaceous and Lowermost Tertiary strata in Alabama, are some extensive beds of limonite, much of it "needle ore." As representative localities, may be given Fort Deposit, Lowndes county; northern part of Butler county; southern edge of Montgomery county; and vicinity of Eufaula, Barbour county. None of these deposits have as yet come into use. South of the last named localities are numerous occurrences of limonite, sometimes in considerable, and perhaps workable, quantity in Pike, Covington, and other counties.
	Marble	White marble 4 miles west of Talladega, and also at several points southwest near Syllacauga in same county. This is the "Talladega marble." A black marble is obtained in the localities southwest of Talladega. White, crystalline marble (dolomite) at Chewacla lime works, Lee county, and northeast and southwest for several miles. Non-crystalline, compact grey, and white marble quarried near Pratt's Ferry, Bibb county. Many localities in Trenton and Calciferous formations in valley of Cahaba river, Bibb and Shelby counties. Variegated marbles (sub-Carboniferous) widely distributed in the Tennessee valley; works at Dickson, Colbert county; many localities in Lauderdale, Limestone, Madison, and Jackson counties; other outcrops along sub-Carboniferous rocks in the valleys from Georgia line southwest to center of State. The mountain limestone at many points in Alabama is of great purity, and would make a good marble. Tertiary white and yellow crystalline limestone at Gainestown, Clarke county.
	Marl	Greensand marls (phosphatic) occur at several horizons in the Cretaceous; the most important—containing from 5 to 10 per cent. phosphoric acid—lies just below the rotten limestone. Thickness of bed about 5 feet; occurs in Pickens, Greene, Hale, Perry, Autauga, Elmore, and Macon counties. Utilized in some small degree in Perry and Autauga counties. Another somewhat similar bed of phosphatic greensand marl occurs near the summit of the rotten limestone, and outcrops across the State in Sumter, Marengo, Dallas, Wilcox, Montgomery, and Bullock counties. Utilized at Coatopa, Sumter county, and Snow Hill, Dallas county. This bed holds on an average 1½ per cent. of phosphoric acid. Greensand shell marls. In the Tertiary are several important beds of greensand and shell marls, the most important being the Nanafalia, Wood's Bluff, and Claiborne marls, occurring in Choctaw, Washington, Marengo, Clarke, Wilcox, Monroe, and Butler counties, and eastward to Georgia. The Nanafalia marl is dug at Nanafalia landing, Marengo county, and shipped to Mobile.

ALABAMA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Marl (continued)	Ordinary marls. The impure argillaceous limestones, both of Cretaceous and Tertiary age, yield, on disintegration, true marls, in places strongly phosphatic. The "Lime Hills" region of Choctaw, Washington, Clarke, Monroe, and Conecuh owe their agricultural peculiarities to this kind of marl.
	Millstones and grindstones.	Millstone grit has been quarried at many points in its outcrops for millstones. Near Pikeville, Marion county, a ferruginous conglomerate is widely used. A siliceous rock of Lower Eocene, in Choctaw, Clarke, Monroe, Butler, Crenshaw, and Pike counties, sometimes used as a buhrstone. Granite of Coosa, Tallapoosa, Chambers, and Randolph counties is made into millstones at most of "flat-rock" outcrop. Chewacla lime works—a porphyritic gneiss quarried for millstones. Grindstones are made in southwest part of Talladega county (magnesian limestone horizon). Whetstones made from sandstones quarried near Eldridge, Walker county.
Muscovite	Mica	Randolph county.
	Ochers	Red ocher of good quality is found near Burksville, in Jefferson county, and near Talladega, in the Silurian rocks (composition, ferric oxide, 82.6; alumina, 4.4; silica, 11.8). In the Lower Cretaceous (Tuscaloosa) extending across the State along the southern and western borders of the Paleozoic, are many occurrences of both red and yellow ochers, in Marion, Fayette, Lamar, Tuscaloosa, Bibb, Autauga, and Elmore counties. Worked to some extent at Vineton, Autauga, and near Coosada station, Elmore county.
	Sandstone	Potsdam sandstone in Calhoun and Talladega counties. Sandstone of Coal Measures quarried in Cullman county, and Red Gap, northeast of Birmingham, Jefferson county; Wills's Valley, De Kalb county (Clinton); also near Anniston, Calhoun county.
Steatite, talc	Soapstone	Dudleyville and southwest for several miles, Tallapoosa county, Oak Bowery, Chambers county, quarried for limekiln linings; T. 23, R. 25 E., in Chambers county, used for headstones; Randolph county, Clay county; ancient excavations in Tallapoosa, Chambers, Coosa, Clay, and Lee counties. Steatite of good quality worked near Lafayette and Opelika.

ALABAMA—Not Mined.

Asbestus	Asbestus	Near corundum deposits, Tallapoosa county.
Barite	Barytes, heavy spar	Elyton, Jefferson county; Pratt's Ferry, Bibb county; Maguire's Shoals, Cahaba river; Talladega county, several points; near Whiting station, Shelby county; near R. Stringfellow's, Clay county (T. 20, R. 1 E.); Chewacla lime works, Lee county; old Benton iron works, Calhoun county.
Cassiterite	Tin ore, tinstone	Rockford, Coosa county, loose crystals in granitoid gneiss. Southeast of Ashland, Clay county; works erected here for smelting tin, not now in operation.
Chalcopyrite	Copper pyrites, yellow copper ore.	Wood's mine, Cleburne county, a bedded lode with pyrite, in mica schist; Smith's mine, near Wood's, Cleburne county; T. 21, R. 6 E., Clay county, with pyrite in quartz rock; T. 20, R. 7 E., and also near Ashland, Clay county; T. 23, R. 22 E., Tallapoosa county; and in small quantities at many other localities in Talladega, Randolph, Clay, Tallapoosa, and Coosa counties. Smelting works erected at Wood's mine, Cleburne county; not now in operation.
Corundum	Emery	Near Dudleyville, Tallapoosa county, and 10 to 15 miles to southwest; near Mount Olive, Coosa county. Veins or seams generally broken down and too much altered to be utilized.
Covellite	Indigo copper	Sec. 24, T. 19, R. 7 E., Clay county, with pyrite and quartz in small quantity.

ALABAMA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Galenite	Galena, lead ore	Benton iron works, Cane creek, Calhoun county; also in T. 14, R. 7 E.; near Guntersville, on Tennessee river, Marshall county; near New Market, Madison county. Elsewhere in lumps on surface, nowhere in workable quantity.
Gold	Gold	Placer deposits near Somerville, Morgan county.
Gypsum	Gypsum	Gypsum occurs in Choctaw and Clarke counties in quantity which may prove to be of economic importance; in the Upper Tertiary. Also recently found in the Cretaceous.
Hematite	Red iron ore	Northern and northwestern parts of Madison county and elsewhere.
Lignite	Brown coal, wood coal.	In Tertiary of southern and southwestern parts of State. Horse creek and many places eastward, in Marengo, Barbour, Clarke, Choctaw, Monroe, Wilcox, and other counties. Also in the Cretaceous, mostly as lignitized trunks, in Pickens, Green, and other counties. Some of the Tertiary lignites have recently been tested with satisfactory results by Professor Stubbs in the clarifying of sugar.
Magnetite	Magnetic iron ore	Impregnating sandstone, Pope mountain, Talladega county; Kennedy's, Clay county, loose; near Fredonia and near Oak Bowery, in Chambers county; T. 24, R. 20 E., in Coosa county; south of Wedowee, Randolph county; Millersville, in Clay county. Nowhere mined, but probably occurring in quantity and quality to justify mining in a belt extending from the southern edge of Cleburne county, southwest through Clay and other counties.
Manganese ore (Pyrolusite ?)	Manganese	Near Greenpond and other localities in Tuscaloosa and Bibb counties; Anniston, Calhoun county, where it has been used by the Woodstock Iron Company in the manufacture of ferro-manganese; near Kelly's Creek post-office, St. Clair county; near Blountsville and above Chepultepec, Blount county; and in many other localities of occurrences of Lower Silurian and sub-Carboniferous limonites. (See above.) Also in the region of the crystalline rocks, south of Candutchkee, Clay county.
Melaconite	Black oxide of copper, black copper.	Wood's copper mine, Cleburne county, with other ores of copper; T. 20, R. 7 E., Clay county (Copper Mine).
	Millstone and grindstone.	Near Huntsville, Madison county; formerly worked.
Muscovite	Mica	Old mines in T. 18, R. 11 E., Randolph county, and in T. 20, R. 6 E., Clay County, and near Bowden, Clay county. T. 22, R. 16 E., Chilton county; a little mining some years ago.
	Ochers	Near New Market and other points in Madison county.
	Phosphates	These occur both in Cretaceous and Tertiary formations, and at four distinct geological horizons as below shown: *Cretaceous.* (1) At the base of the Rotten Limestone. The material here occurs in (*a*) irregular nodules (coprolites, pseudo-coprolites) and shell casts of nearly pure phosphate of lime, containing about 25 per cent. of phosphoric acid; (*b*) impregnating greensands, described above under marls. (2) At the summit of the Rotten Limestone where the phosphatic matter is in the form of nodules, or disseminated through greensands and limestones. The phosphatic limestones occur at many localities in Sumter, Marengo, Dallas, and many other localities in intimate association with phosphatic greensand marl. *Tertiary.* (3) The Nanafalia marl above described contains an indurated stratum holding over 6 per cent. of phosphoric acid. (4) The upper beds of the Tertiary (White Limestone) hold, in places, a good deal of phosphoric acid, either in nodules of nearly pure phosphate of lime or disseminated through the calcareous strata. In this latter form it gives rise to the fertile soils of the "Lime Hills" of Choctaw, Washington, Clarke, Monroe, and Conecuh counties. While in places, as near Hamburgh, Perry county, the high-grade nodular phosphates are found on the surface in large quantity, representing the débris from the disintegration of the containing rocks during many centuries, as yet no occurrence is known of this class of phosphates which can probably be profitably mined.

ALABAMA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrite	Pyrites	Smith's and Wood's copper mines, Cleburne county, with copper ores, T. 19, R. 7 E., Clay county; a thick bed accompanied by covellite. Montgomery copper mine, Clay county, in large quantity. Tps. 20 and 21, Rs. 6 and 7 E., Clay county, with copper pyrites. Many other localities as occurrences simply.
Pyrolusite (see Manganese ore).		
Pyrrhotite	Magnetic pyrites	At Wood's copper mine, Cleburne county, along with pyrite, chalcopyrite, and other ores of copper.
Quartz	Quartz	T. 22, R. 16 E., Chilton county, a crumbling quartz rock; also in Randolph, Tallapoosa, northwest Macon, Lee, Chambers, and other counties. In the Tennessee valley, north Alabama, particularly in Lauderdale county, the siliceous (cherty) rocks of the sub-Carboniferous formation yield at many places a fine white, pulverulent silica that might be used in glass-making.
Quartz (2)	Sand	Near Claiborne, Monroe county; a fire material.
	Sandstone	Thin beds of white sandstone near Huntsville, Madison county.
Siderite	Spathic iron ore, carbonate of iron.	T. 9, R. 10 W., Winston county; also in Jefferson and Walker counties; not utilized.
Siderite (2)	Black band ore	Newcastle station, Warrior station, and other localities in Jefferson, Tuscaloosa, and Walker counties, in Coal Measures.
	Slate (for roofing)	T. 21, R. 3 E., in Talladega county; Buxahatchee creek, in Shelby county; and in T. 19, R. 7 E., Clay county. No quarries working.
Sphalerite	Zincblende	Wood's copper mine, Cleburne county.

ALASKA—Mined.

Mineralogical name.	Common name.	Remarks.
Argentite	Silver glance	Glacier bay, in dolomitic limestone.
Berthierite	Sulphide of antimony and iron.	Glacier bay, associated with silver and gold.
Coal, var. lignite	Lignite	Cape Lisburne, Arctic coast, occasionally utilized by whalers and U. S. revenue vessels.
Galenite	Galena, sulphide of lead.	Juneau, associated with pyrite and mined for gold and silver; Golovin bay, auriferous.
Garnet	Garnet	Large crystals of iron garnet obtained by natives at Wrangel.
Gold	Gold	Juneau, Douglas island, Silver Bow basin, Sitka, Yakutsk, Berner's bay, and numerous placers on tributaries of the Yukon. The Alaska gold fields contain free gold in quartz veins and irregular lodes, auriferous sulphurets, and shallow placers.
Pyrite	Pyrites, iron sulphuret	Auriferous, at Douglas island, mined for gold.
Silver, native	Wire silver	Glacier bay, associated with native copper.
Sphalerite	Blende, black jack	Juneau, mined for gold and silver.
Tetrahedrite	Gray copper	Glacier bay, mined for silver and gold.

ALASKA—Not Mined.

Mineralogical name.	Common name.	Remarks.
Asbestus	Asbestus	Reported in several localities.
Calcite	Limestone	Near Sitka, Kielisnoo, Glacier bay, and elsewhere.
Copper	Native copper	In small quantities, Glacier bay; also at headwaters of Copper river.
Chalcopyrite	Copper pyrites	Islands of Alexander archipelago.
Coal, bituminous.	Coal	Reported at several places; more properly lignite (?).
Gold	Gold	Many unworked placers, especially on the Yukon and along the coast.
Galenite	Galena, sulphide of lead.	Several unworked claims.
Graphite	Plumbago, black lead	Near Port Clarence, Glacier bay, Golovin bay.
Lignite	Lignite	Coast of Arctic ocean, near Cook's inlet, Admiralty and Kuiu islands, Woody island, on Kobuck river and tributaries of the Yukon.
Muscovite	Mica	Reported in considerable quantities at various points.
Pyrite	Pyrites, iron sulphuret	Near Sitka and at many other points; often auriferous.
	Silver	Silver ores, mainly with base sulphurets, at various points, not worked but thought to be available.

ARIZONA—Mined.

Anglesite	Sulphate of lead	Mineral Park, Mohave county, and many silver-lead mines.
	Antimonial lead ores	
Argentite	Silver glance	Associated with other ores of lead, zinc, and silver.
Arsenopyrite	Mispickel, arsenical pyrites.	When associated with other gold and silver ores, it is mined along with these for the precious metals.
Atacamite	Chloride of copper	Occasionally found with other ores of copper
Azurite	Blue carbonate of copper, copper carbonate, often called "bromide of silver."	With other copper ores.
Barnhardite	Sulphide of copper and iron.	With other copper ores.
Berthierite	Sulphide of antimony and iron.	Associated with argentiferous ores.
	Bismuth ores	In small quantities with the gold and silver ores of Tombstone district and elsewhere.
Bornite	Variegated copper ore.	With other ores of copper.
Braunite	Manganese ore	Used as flux by smelters when argentiferous.
Brogniardite	....	Associated with other argentiferous ores.
Cerargyrite	Chloride of silver, horn silver, "chloride."	With other silver ores in many mines, and is the principal silver ore of the Territory.
Cerussite	Carbonate of lead, "carbonate."	Mined for its lead for use in smelting argentiferous or auriferous ores, and for its silver contents.
Chalcanthite	Bluestone	
Chalcocite	Copper glance	Associated with other copper ores.
Chalcopyrite	Copper pyrites	When sufficiently argentiferous and auriferous it is mined for these metals; when associated with other copper ores, it is mined along with these for its copper.

ARIZONA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chrysocolla	Silicate of copper	Occasionally found with other ores of copper.
Copper (native)	Copper	Found often in small quantities, interspersed through other copper ores.
Cuprite	Copper oxide, "red copper."	With other ores of copper.
Dioptase	Emerald copper	Occasionally found with other ores of copper.
Dolomite	Dolomite, magnesian limestone.	
Dufrenoysite	Arsenical lead ore	Associated with other ores of lead, zinc, and silver; mined when argentiferous. Mineral Park, Mohave county.
Dyscrasite	Antimonide of silver	Associated with other ores of lead and silver.
Embolite	Chlorobromide of silver.	Occasionally found with other silver ores.
Fluorite	Fluorspar	
Freieslebenite	Antimonial sulphide of silver.	With other argentiferous ores.
Galenite	Galena	Invariably argentiferous, and sometimes slightly auriferous. Mined for its contents of precious metals, as well as for its lead in smelting other silver and gold ores.
	Garnet rock	
Gold	Gold	In alluvium in many ravines and water-courses; also in veins associated with common pyrite, chalcopyrite, blende, galena, mispickel, serpentine, heavy spar, and many other ores and rocks.
	Granite	
Graphite	Graphite, plumbago, black lead.	Rare.
Hematite	Iron ore	Mined as flux in lead smelting.
Lignite	Lignite	Northeastern Arizona, between 109° and 111° longitude and 35° and 37° latitude.
Limonite	Ocher	Mined as ore and flux.
Malachite	Green carbonate of copper, copper carbonate.	With other copper ores. Important source of copper. Globe, Bisbee, and Clifton.
Malaconite	Black oxide of copper.	With other ores of copper.
Miargyrite		With other argentiferous ores.
Polybasite		Occasionally with other argentiferous ores. Fine large specimens at Silver King mine.
	"Porphyry"	As building stone.
Proustite	Light ruby silver	With other argentiferous ores.
Pyrargyrite	Dark ruby silver	With other argentiferous ores. Fine specimens at Tip-top mine.
Pyrite	Pyrites, iron pyrites	When sufficiently auriferous in itself, or when associated with other silver or gold ores, it is mined for the precious metals.
Pyrolusite	Binoxide of manganese	Plentiful in Tombstone district, and used as flux in lead smelting. Always more or less argentiferous.
Pyrrhotite	Magnetic pyrites	Occasionally met with. Sometimes auriferous.
Quartz	Quartz	Gangue.
Siderite	Brown spar, spathic iron ore.	Associated with silver ores.

ARIZONA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Silver, native ..	Silver..................	Occasionally found in other argentiferous ores.
Sphalerite	Blende, zincblende....	Very abundant in many mines, especially below water level. Generally both argentiferous and auriferous to a smaller or larger extent; when associated with other silver and gold ores, it is mined along with these for the precious metals.
Stephanite.....	Brittle silver	With other silver ores.
Sternbergite ...	....	With other silver ores.
Stromeyerite ..	....	With other cupriferous and argentiferous ores.
Talc	Talc, soapstone	
	"Tellurium"	Occurs in very small quantities with selenide of silver in Tombstone district; but the tellurium minerals have not been determined.
Tetrahedrite...	Faherz, gray copper .	When sufficiently argentiferous, it is mined for silver; rather abundant.
Turquois	Turquois	Irregularly produced at Turquois mountain, Cochise county.
Wulfenite	Lead spar, molybdate of lead.	Fine crystals at Castle Dome. A common occurrence in southern Arizona.
Zinkenite......	Sulphide of antimony and lead.	When associated with argentiferous ores it is mined along with these for the precious metals.

ARIZONA—Not Mined.

	Alabaster	Superstition mountains; near Pueblo Viego, Pima county; near sulphur springs; in La Gija range, and elsewhere.
	Alum	Verde river.
Alunogen......	Sulphate of alumina ..	Verde river.
Anglesite......	Sulphate of lead	Occurs with other lead ores.
Anhydrite	Anhydrous gypsum ..	On Verde river and many other places.
Asbestus	Asbestus	Some brought in from Tonto basin and from the Great Colorado plateau.
Asphaltum	Asphaltum, bitumen..	In sandstone on Great Colorado plateau.
Aurichalcite...	Brass ore	With other ores of zinc.
Barytes........	Heavy spar	Abundant; often gangue of argentiferous and auriferous ores.
Breunerite.....	Brown spar	Often met with.
	Building stone........	Marble, limestone, sandstone, granite, and eruptives.
Calamine	Silicate of zinc	Several deposits.
Calcite.........	Carbonate of lime, calcspar.	Abundant.
Caledonite	Impure sulphate of lead.	Occurs with other lead ores.
Cervantite.....	Antimony ocher	Occurs in some abundance, associated with other antimony ores.
Chalcanthite...	Blue vitriol, sulphate of copper.	Often found in ravines contiguous to copper mines.
Cinnabar	Cinnabar	Float only found.
Copperas	Green vitriol, sulphate of iron.	Occasionally found with pyrites.

ARIZONA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Crednerite	Oxide of manganese and copper.	Many reported localities.
Crocoite	Chromate of lead, red lead.	Occasionally met with in other lead ores.
Dechenite and descloizite.	Vanadate of lead	Occasionally met with in other lead ores.
Dolomite	Magnesian limestone	Abundant.
Epsomite	Epsom salt	Verde river.
	Fire clays and refractory stone.	Of excellent quality; found at various places.
Fluorite	Fluorspar	Abundant on the Great Colorado plateau. Occasionally met with near Prescott.
Garnet	Garnet	Plentiful on Great Colorado plateau and other places.
Glauberite	Sulphate of soda and lime.	Verde river.
Gold	Gold	Many deposits of alluvium and detritus, often quite rich in gold, exist, which are not mined owing to scarcity of water and for want of capital to construct reservoirs in which to retain the waters that run to waste in rainy seasons. Many auriferous veins are not worked for want of proper reduction works, or because of high cost of labor and transportation.
Gypsum	Gypsum, plaster of Paris.	Abundant in Verde range and elsewhere.
Halite	Common salt	Along Verde river, associated with gypsum, sulphate of magnesia, and sulphate of soda; used to a small extent for cattle; too impure for table use. Headwaters of Salt river and in Tonto basin, Gila county.
Hansmannite	Black manganese	Many deposits.
Hematite, micaceous iron, and itabiryte.	Iron ore	Many deposits not developed.
Leadhillite		Occurs with other lead ores.
Lignite	Coal	Prospected only.
Limonite	Iron ore	Many deposits.
Magnesite	Carbonate of magnesia	
Magnetite	Magnetic iron ore	Several veins near Prescott.
Manganite	Manganese ore	
Mirabilite	Glauber salt	Verde river.
Molybdenite	Sulphide of molybdenum.	Argentiferous; Tombstone district; near Camp Verde; 10 miles south of Prescott.
Muscovite	Mica	Several deposits, but as none of them have been developed their value is unknown.
Opal (varieties cacholong and hyalite).	Opal	Several localities in Yavapai county.
Phœnicochroite	Subsesquichromate of lead.	Occasionally met with in other lead ores
Platinum	Platinum	Reported, but doubtful.
Psilomelane	Black manganese	Many occurrences.
Pyrolusite	Gray manganese	Many deposits.
Pyromorphite	Phosphate of lead	Occasionally found with other lead ores.

ARIZONA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Sandstone	Of excellent quality; in great abundance on Great Colorado plateau; also 2½ miles northwest of Prescott. Red, brown, blue, and white sandstone of good quality in the Grand Cañon region.
	Silver ores	Many argentiferous veins, of known richness, which are not mined for want of capital and proper reduction works, or, rather, because present cost of labor and transportation does not warrant erection of works.
Smithsonite	Carbonate of zinc	Found with other ores of zinc.
Stibnite	Sulphide of antimony	Large veins of good quality of ore, which are not worked because of high rates for transportation to markets.
Talc	Talc	Frequent.
Tetradymite	Telluride of bismuth	Two miles south of Bradshaw City.
Thenardite	Commonly called Verde salt.	Large deposit of it on Verde river, about a mile from Camp Verde; sometimes quite pure, at other times mixed with gypsum, sulphate of magnesia, chloride of sodium, etc. A very little of it is used for cattle.
Turquois	Turquois	Found at Mineral Park, and attempts have been made to work it, but not successfully.
Vanadinite	Vanadate of lead	Associated with other lead ores.
Vauquelinite	Chromate of lead and copper.	Occasionally met with in other lead ores.
Volborthite	Vanadate of copper	Occasionally met with in other copper and lead ores.
Volgerite	Antimony ocher	Occurs in some abundance, associated with other antimony ores.
Willemite	Anhydrous silicate of zinc.	Several good-sized deposits or veins are known to exist.
Wulfenite	Molybdate of lead	Occasionally met with in other lead ores; nearly always present with silver ore of Tombstone in small quantity.

ARKANSAS—Mined.

	Agate	Finely variegated, Montgomery county.
	Brick clay	Several localities.
Calamine	Zinc silicate	Marion county.
Coal	Coal	The true Coal Measures cover about 7,000 square miles, though not all of this area yields coal in commercial quantities. The coal beds of Washington county are in the sub-Carboniferous. Bituminous coal is mined in Franklin county at Pickarty bank and Philpot bank; at several openings in Johnson county; at Grave's bank, Sullivant and Boling's bank, and Rudy bank, Crawford county; at Big creek, near Auburn; several mines near Greenwood, near Hartford, Huntington, Hackett City, near Jenny Lind, and at McNally's and Watt's banks, Sebastian county; Choate, Dacus, and McRae mines, Yell county. Semi-anthracite is mined near Alston, Franklin county; at and near Coal hill and near Spadra, Johnson county; Ouita and Shinn mines, near Russellville, Pope county.
Galenite	Galena, lead sulphide.	Pulaski county (silver-lead and zinc); Carroll county; Lawrence county; Marion county (partly argentiferous); Newton county; Searcy county (argentiferous); Sevier county (with antimony ore and argentiferous); Garland county; Howard, Scott and Polk counties (partly argentiferous and associated chalcopyrite, sphalerite); Montgomery and Pike counties. Many new mines. More or less antimony in nearly all the mines lately opened.

ARKANSAS—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Granite	Near Little Rock, Pulaski county; near Benton, Saline county.
Hydrozincite, marionite.	Zinc carbonate, earthy calamine.	Marion county.
Jamesonite	Gray antimony ore, sulphide of antimony and lead.	Antimony City, Sevier county.
	Limestone	Black limestone, for ornamental and inside uses, Independence county. Oölitic limestone near Batesville takes good polish.
	Lithographic stone	Searcy county.
	Marble	Carroll, Newton, Searcy, Madison, Marion (encrinital limestone), and Van Buren counties.
	Marl	Calcareous and shell marls in Greene, Clark, Hempstead, Pike, Jefferson, Lonoke, Madison, and Saint Francis counties; gypseous marls in Greene and Pike counties.
Millerite	Nickel sulphide	Rabbit Foot mine, near Benton, Saline county.
	Millstone and buhrstone.	Independence, Izard, and Lawrence counties.
Novaculite	Oilstone	Several localities in Hot Spring, Garland, and Saline counties, known as "Ouachita oilstone" and "Arkansas stone." Mining principally at Whetstone mountain.
	Potters' clay	Near Benton, Saline county; Texarkana, Miller county; Arkadelphia, Clark county.
Psilomelane	Manganese ore	Near Batesville, Independence county, and elsewhere.
Pyrolusite	Manganese dioxide	Cushman, Batesville, Independence county; near Little Rock, Pulaski county.
Quartz	Quartz crystal	Near Crystal Springs, Montgomery county.
	Sandstone	Near Cabin creek, Johnson county; Batesville, Independence county; Dardanelle, Yell county.
	Silver	In galena, blende, chalcopyrite, and iron ores.
Sphalerite	Zincblende, black jack	Independence, Lawrence, and Pulaski counties.
	Syenite (?)	Cove creek, Hot Spring county.
Tetrahedrite	Fahlerz	Kellogg mine, 10 miles north of Little Rock, Pulaski county, with argentiferous galena and blende.
	Zinc ore	With many of the lead occurrences.

ARKANSAS—Not Mined.

Apatite	Phosphate of lime	Magnet cove, Hot Spring county.
Azurite	Blue carbonate of copper.	As an incrustation, Sevier county; Saline county; Montgomery county.
Barite	Barytes, heavy spar	Montgomery and Polk counties.
Brookite, arkansite.	Titanic acid	Magnet cove, Hot Spring county.
Calamine	Zinc silicate	Hopper, Pierce, Raney, Kotch, Miller, and Calamine mines; Sharp, Searcy, and Baxter counties.
Celestite	Strontium sulphate	White, Pike county.
Chalcopyrite	Copper pyrites	With galena, Pulaski, Sevier, Howard, Polk, Pike, Hot Spring, Marion, and Saline counties; Mount Ida district silver mines, Montgomery county.

ARKANSAS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Coal, var. lignite.	Lignite, brown coal...	Ashley, Bradley, Dallas, Greene, Ouachita, Saline, and Union counties.
	Copper ore............	Boone county.
	Fire clay	Sebastian, Pike, and Crawford counties.
Galenite	Galena, lead sulphide.	Saline, Montgomery, and several other counties.
Gold...........	Gold..................	Said to occur at Silver City, Montgomery county, in quartz; Bella mine, Sevier county; also in pyrite. Of doubtful importance.
Gypsum	Gypsum	Greene county, in clay on Little Missouri; large deposit near Murfreesborough; Plaster bluffs, Pike county.
Halite	Rock salt.............	Dallas county; Hot Springs county.
Hematite	Red iron ore	Lafferty creek, Independence county; Marion county; Polk county.
	Hydraulic limestone ..	Saline county; also many counties in northern part of the State.
Hydrozincite, marionite.	Earthy calamine, zinc carbonate.	Lawrence, Marion, Searcy, Baxter, Benton, and Polk counties.
Jamesonite	Gray antimony ore, sulphide of antimony, and lead.	Antimony, Bluff mine, Sevier county; Montgomery county.
Kaolinite	Kaolin, kaolin clay ...	Pulaski and Saline counties.
Limonite	Brown hematite, iron ore.	Carroll, Fulton, Lawrence, Ouachita, Pulaski, Randolph, Saline, Montgomery, Polk, Washington, White, and Sebastian counties; near Center Point, Howard county; Antimony City, Sevier county.
Limonite (2) ...	Yellow ocher	Greene county.
	Lithographic stone ...	Independence and Stone counties.
Magnetite	Magnetic iron ore.....	Magnetic cove, Hot Spring county (abundant on surface as lodestone).
Malachite	Green carbonate of copper.	Sevier, Montgomery, and Pulaski counties; as an incrustation only, in Saline county.
Marcasite	Iron pyrites...........	In sheets and pseudomorphs in lignite beds, Wolf creek, Pike county.
Melaconite (?)..	Black oxide of copper.	Tomahawk mine, Searcy county, in large quantity; Fulton county.
Millerite.......	Nickel sulphide.......	Saline county.
Muscovite	Mica..................	Magnet cove, Hot Spring county.
Niter	Saltpeter..............	Marion and Newton counties, in caves.
Perofskite	Titanate of lime	Magnet cove, Hot Springs county.
Petroleum	Petroleum	Scott county.
	Potter's clay..........	Greene, Pulaski, Saline, Clark, and Miller counties.
Psilomelane ...	Manganese ore	Independence county, in sub-Carboniferous limestone; Lawrence, Pulaski, Marion, Montgomery, Saline, and Polk counties.
Pyrite	Pyrites, iron sulphide.	Hot Spring county, vein reported 4 yards wide; Kellogg mine, Pulaski county; Caddo cove, Montgomery county.
Pyrolusite	Manganese dioxide ...	Pope, Pulaski, Montgomery, and Howard counties.
Quartz.........	Rock crystal..........	Crystal mountain, Montgomery county; sparingly in Howard and Sevier counties.
Rutile	Rutile	Magnet cove, Hot Spring county.

ARKANSAS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Sandstone	Franklin, Searcy, Johnson, Van Buren, Yell, and Independence counties.
Serpentine	Serpentine	Magnet cove, Hot Spring county; Polk county (doubtful importance).
Siderite	Spathic iron ore	Franklin county, thin beds with alternating shales; Madison, Pope, White, Johnson, and Van Buren counties; Washington county, in black shales (sub-Carboniferous); near Benton, Saline county.
	Silica, amorphous	Eight miles north of Batesville, formerly utilized as a polish and sold at Saint Louis.
	Slate, flagstone, and roofing slate.	Pulaski, Saline, and Polk counties.
Smithsonite	Zinc carbonate	In interstices in magnesian limestone at Calamine, Lawrence county; Bath and Koch mines, same locality. Associated with blende, Wood's mine, Marion county; Searcy county.
Sphalerite	Zincblende	With calamine and smithsonite in magnesian limestone, Lawrence county; Bath and Koch mines, Lawrence county (same locality); exposed at openings and in magnesian limestone, Wood's mine, Marion county; Kellogg mine, Pulaski county; Bellale mine, Sevier county; Silver City, Montgomery county; Sharp, Boone, and Saline counties.
Steatite	Talc, soapstone	Large deposit in Saline county; Pulaski county.
Stibnite	Antimony sulphide, gray antimony ore.	Several localities, Sevier county; with ocher and jamesonite at Antimony Bluff mine; with jamesonite and galena occurs traversing sandstone, Pike county.
Wad	Bog manganese ore	North fork White river, Izard county; Saline and Pulaski counties; Montgomery county, in quantity.
Zincite	Zinc oxide	Lawrence county.

CALIFORNIA—Mined.

Aragonite	"Suisun marble," onyx marble.	Solano and San Luis Obispo counties. Used for mantels, pedestals, and smaller ornaments.
Asbestus	Asbestus	Placer and Butte counties.
Asphaltum	Asphaltum	Los Angeles, San Luis Obispo, Santa Barbara, and Santa Cruz counties. Used extensively in paving, roofing, etc., and employs considerable capital and labor throughout the State.
Calcite	Limestone	Burned for lime in Santa Cruz, Placer, San Luis Obispo, Amador, Napa, El Dorado, Los Angeles, and other counties.
Calcite (2)	Marble	Quarried for coping and building in Calaveras, San Bernardino, Inyo, Placer, Mono, and Tuolumne counties.
	Cement	Solano and Santa Cruz counties.
Chromite	Chromic iron ore	San Luis Obispo, Alameda, Sierra, Shasta, Placer, and Del Norte counties. Shipped to the eastern States.
	Clay	Contra Costa, Placer, and El Dorado counties. Used for pottery, but no fine ware yet made.
Cinnabar	Cinnabar	Lake, Sonoma, Napa, Fresno, and Santa Clara counties.
	Copper ore	Calaveras, Nevada, Del Norte, Sierra, Plumas, San Diego, Santa Clara, and Amador counties. Generally shipped to England or eastern States.
Galenite	Galena, lead ore	Inyo, San Diego, Kern, Mohave, and San Bernardino counties. Usually argentiferous.
	Granite	Sacramento, Calaveras, Monterey, San Bernardino, and Placer counties.

CALIFORNIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gypsum	Gypsum, plaster of Paris.	Point Sal, Santa Barbara county.
Halite	Salt	Alameda county, a large plant for manufacturing salt from the water of the bay of San Francisco. Natural deposit at Dos Palmas, San Diego county.
Lignite	Coal	Contra Costa, San Diego, and Fresno counties.
Magnesite	"Magnesia"	Cedar mountain, Alameda county.
Mercury, native.	Native quicksilver	Small quantity in some of the cinnabar mines.
	Onyx	San Luis Obispo and Solano counties.
Petroleum	Petroleum, coal oil	Santa Clara, Santa Cruz, Los Angeles, Ventura, and Santa Barbara counties. A large part of the California petroleum is of the heavy or lubricating variety.
	Sandstone	Solano, Santa Clara, Sonoma, Kern, Alameda, and all coast counties.
Saponite	Rock soap	Ventura county.
	Slate	El Dorado county.
	Soda carbonate	Produced from water of Owen's lake, Inyo county, by solar evaporation.
Steatite	Soapstone	Placer, El Dorado, Calaveras, Tuolumne, and Nevada counties. Used as furnace lining; sawed into bricks for the market.
Stibnite	Antimony sulphide	San Emidio cañon, Kern county.
Thinolite, gaylussite.		Mono county, used for making lime.
Tincal	Borax	San Bernardino, Inyo, Lake, and Mono counties.
	Tufa	Santa Cruz county; used for making cement; various other purposes in other counties.

CALIFORNIA—Not Mined.

	Agate and carnelian	Monterey county.
	Alabaster	Alabaster cave, El Dorado county; also in Solano, Tuolumne, Los Angeles, Fresno, and other counties.
Aragonite	Onyx marble	Siskiyou and Kern counties; found in small fragments not large enough to work.
	Arsenic ores	Principally mispickel.
Asbestus	Asbestus	Tulare, Yolo, Butte, Placer, San Diego, El Dorado, and Mariposa counties; in small quantity, limited market.
Azurite	Blue carbonate of copper.	Inyo, San Bernardino, Modoc, Monterey, Calaveras, and Shasta counties.
Barite	Barytes, sulphate of baryta.	Calaveras county; in small quantity in silver mines of Calico district, San Bernardino county; Indian valley, Plumas county; White mountains, Inyo county.
	Bismuth ores	
	Bitumen	Santa Clara, Los Angeles, Santa Barbara, and Ventura counties, and almost all coast counties.
	Buhrstone	Inyo county.
Calcite	Marble	Ione, Amador county; near Pence ranch, Butte county; near Eureka, Humboldt county; Posy Creek and Tehachipi, Kern county; Carmelo Bay, Monterey county; Bear Creek, Nevada county.

CALIFORNIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Calcite (2)	Limestone	San Bernardino, Mono, San Benito, Inyo, Santa Cruz, Placer, El Dorado, Nevada, Shasta, and Calaveras counties.
Cassiterite	Tin ore	San Bernardino county, Temescal district.
	Cement	Alameda, Amador, and Contra Costa counties
	Chalk	Silver Mountain district, Alpine county.
Chromite	Chromic iron ore	Sonoma, Santa Clara, San Mateo, Napa, Fresno, Amador, Tuolumne, El Dorado, Sacramento, Tulare, and Solano counties.
Cinnabar	Cinnabar	San Luis Obispo, Trinity, and other counties.
	Clay (brick)	Kern, Tuolumne, Amador, Mono, Marin, Lake, Inyo, Sonoma, Mendocino, and many other counties.
Chrysocolla	Silicate of copper	Inyo, San Bernardino, Mono, and San Diego counties.
Corundum	Corundum	In drift at San Francisquito pass, Los Angeles county.
Diamond	Diamond	In gold placers, Shasta, Butte, El Dorado (largest in California found here), Amador, and other counties.
	Diatomaceous earth	Said to occur in twenty counties, and is in some localities abundant.
Erubescite	Variegated copper ore	Sierra and Plumas counties.
Erythrite	Red cobalt ore	Kelly mine, Compton, Los Angeles county.
	Feldspar	Mariposa county.
Fluorite	Fluorspar	
Galenite	Galena	San Bernardino, Mono, Shasta, Amador, and other counties.
Garnet	Garnet	
	Granite	Mariposa, Nevada, and many other counties.
Graphite	Plumbago	Near Sonora, Tuolumne county, Kern, Alpine, Fresno, and Los Angeles counties.
Halite	Salt	Inyo and San Bernardino counties.
Hematite	Iron ore	Placer, Sierra, El Dorado, Napa, Shasta, Amador, Inyo, Alameda, Del Norte, Butte, Alpine, and Nevada counties. Many localities show excellent iron, but for want of suitable fuel and for commercial reasons the iron mines have not been largely worked as yet.
Irodosmine	Irodosmine	In gold placers.
Kalinite	Alum	Efflorescence at Silver Mountain district, Alpine county; Howell mountain, Napa county.
Kaolinite	Kaolin	Near Calico, San Bernardino county.
Lignite	Coal	Is found of inferior quality in small quantity in the following counties, but in some cases further development will probably show better results: Alameda, San Luis Obispo, Placer, Monterey, Lake, San Benito, Los Angeles, Kern, San Bernardino, Fresno, Calaveras, Butte, Shasta, San Diego, and Lassen counties.
Limonite	Iron ore	Calaveras, Tulare, San Luis Obispo, Placer, and Santa Clara counties.
	Litharge	San Bernardino county.
	Lithographic stone	Kern county. Quality fair; quantity not known.
Malachite	Green carbonate of copper.	San Diego, Colusa, Shasta, Tuolumne, Los Angeles, Amador, Tulare, Del Norte, Placer, Contra Costa, Mono, San Luis Obispo, Sonoma, Mariposa, and San Bernardino counties.
Magnesite	"Magnesia"	Near Madrone station, Santa Clara county; Gold, Kern, and Damascus, Placer county; Arroyo, Seco, Monterev county; near Visalia, Tulare county.

CALIFORNIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite	Magnetic iron ore	Placer, Shasta, Amador, Plumas, Butte, Yuba, El Dorado, San Benito, Mariposa, Del Norte, and San Diego counties.
	Marl	Various localities.
Muscovite	Mica	El Dorado and Mariposa counties; Gold lake, Plumas county; Ivanpah, San Bernardino county; Susanville, Lassen county; Tehachipi, Kern county.
	Natural gas	Near Stockton, San Joaquin county; near Sutter buttes, Sutter county; Livermore valley, Alameda county; Portola valley, San Mateo county. Being prospected by boring.
	Nickel ore	San Benito and Kern counties; near San Antonio, Monterey county; also Tuolumne and Mono counties.
Obsidian	Obsidian	Mono, Modoc, and Lake counties.
	Ocher, red and yellow.	Calaveras, Sonoma, and San Francisco counties; Clear lake, Lake county; near San Pasquale, San Diego county; Fort Miller, Fresno county; McBride's ranch and Mono lake, Mono county; Yosemite valley, Mariposa county.
Petroleum	Petroleum, coal oil	San Luis Obispo, Los Angeles, Contra Costa (?), Fresno, Kern, Monterey, Santa Barbara, San Bernardino, San Mateo, Humboldt, Marin, Colusa, Tulare, and San Diego counties.
Platiniridium	Platinum	Mendocino, Del Norte, Humboldt, and Trinity counties.
	Pumice stone	Mono, Modoc, Lake, San Francisco, and San Diego counties. Many deposits in the Sierra Nevada counties not worked; a deposit near San Francisco formerly utilized.
Priceite	Borate of lime	Del Norte county.
Pyrite	Iron sulphurets	Alpine, Amador, Placer, Lake, Inyo, Nevada, Shasta, Tuolumne, Mono, El Dorado, and San Luis Obispo counties, and otherwise very generally distributed, and usually auriferous.
Pyrolusite	Manganese ore	Sonoma, Marin, Calaveras, Mariposa, and Alameda counties; on Red rock, San Francisco bay; near Columbia, Tuolumne county; also Nevada, San Bernardino, Plumas, and Santa Clara counties.
	Quartz sand	For glass-making.
	Roofing slate	El Dorado county. Of first-class quality; pronounced equal to best Welsh roofing slate.
	Sandstone	Santa Clara, Shasta, Tuolumne, San Mateo, and Napa counties.
Saponite	Rock soap	Santa Barbara, San Benito, and San Bernardino counties.
Selenite	Gypsum	Ventura, Los Angeles, Monterey, Kern, Lake, Santa Barbara, Tulare, and Lassen counties.
Sphalerite	Zincblende, "black jack."	Tulare and San Mateo counties. Small deposit of no present value.
Steatite	Soapstone	Yuba, Tuolumne, Kern, Los Angeles, Nevada, Fresno, Amador, Marin, and Tulare counties.
Stibnite	Sulphide of antimony.	San Benito, Los Angeles, Tulare, and Santa Clara counties.
Strontianite	Carbonate of strontia.	
Sulphur	Sulphur	Lake, Napa, Ventura, Tulare, and other counties.
	Syenite	San Mateo county.
Thenardite	Sulphate of soda	Inyo and Mono counties.
Thinolite, gay-lussite.		Lassen and Mono counties.
Trona	Carbonate of soda	Inyo, Mono, and San Bernardino counties.

CALIFORNIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Tufa	Kern, Shasta, Mono, and San Luis Obispo counties.
Ulexite	Borate of lime	Kern, Inyo, Mono, and San Bernardino counties.
	Umber	
Wolfram	Tungstate of iron	

COLORADO—Mined.

Alaskaite		San Juan county, Poughkeepsie gulch, Alaska mine. Occurs in quantity as massive mineral with tetrahedrite, chalcopyrite, barite, and quartz.
Altaite	"Telluride"	Boulder county, Gold Hill district. Argentiferous and auriferous.
Aglesite	Sulphate of lead	Clear Creek county, and adjacent parts of Summit and San Juan counties. A frequent surface ore of galena veins. Usually argentiferous, and mined for both lead and silver. Lake county, frequently associated with cerussite in the "sand carbonate" ores near Leadville. (See Cerussite.) Is undoubtedly a common decomposition product of galena, though seldom worthy of special notice. Chaffee county, at Madonna mine, in large masses, often as pseudomorph after galena.
Argentite	Silver glance	Clear Creek county, near Georgetown. In small quantities with other silver minerals. Not uncommon. San Miguel county, Marshall creek. In quartz veins with tetrahedrite, galena, sphalerite, and some silver. Occasional. Ouray county, not uncommon.
Arsenopyrite	Mispickel, arsenical pyrites.	Gilpin county. Of rare occurrence, sometimes highly argentiferous, but of no great economic value. Occasionally auriferous. Gunnison county, near Ruby camp. With proustite. Argentiferous. San Miguel county, Mount Wilson. Argentiferous; associated with tetrahedrite.
Bismite	Bismuth ocher	Cummins City, Grand county, North Park.
Bismuthinite	Bismuth sulphide	Cummins City, Grand county, North Park. Red Mountain district, Ouray county.
Bornite	Peacock ore	Clear Creek county, Spanish Bar district. San Juan county, Red Mountain district. With stromeyerite; argentiferous. Yankee Girl and Silver Bell mines. Ouray county. Near Maysville, Chaffee county. Fremont county. In small quantity with niccolite at Gem mine, Grape Creek cañon; argentiferous.
Brochantite		Monarch mine, Chaffee county.
Calcite	Marble	In fine large beds at Fort Collins, Weld county.
Cerargyrite	Horn silver, "chloride"	Lake county, near Leadville; particularly on Fryer hill. Not common. Summit county, near Breckenridge. On fissure planes of a quartzite. Illinois mine, Schanck hill. Custer county, near Silver Cliff. In small quantities impregnating a rhyolitic rock.
Cerussite (argentiferous).	"Carbonate," "hard carbonate," "sand carbonate."	Occurs in greater or less quantity with nearly all galena ores, as in Summit county, Eagle county, Chaffee county, Gunnison county, Ouray county, San Miguel county, Dolores county, etc.; but in Lake county, near Leadville, it is worthy of special note. As a compact mineral, usually with some quartz, it is called "hard carbonate;" as a loose sand deposit, often quite extensive, it is termed "sand carbonate." In the latter form it is often accompanied by anglesite and pyromorphite, which are, however, seldom distinguished. The cerussite is usually argentiferous, and is mined for both silver and lead. Aspen, Pitkin county, and at Silver Cliff, Custer county; mined extensively.

COLORADO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcocite	Copper glance........	Clear Creek county, near Idaho Springs. With siderite and small crystals of sphalerite (argentiferous). San Miguel county. Occurs almost alone, in sandstone with matrix of calcite (argentiferous). Ouray county, at Ironton (argentiferous, massive).
Chalcopyrite ..	Copper pyrites, "yellow copper;" when iridescent and tarnished, "peacock ore."	Boulder county, particularly in Grand Island and Ward districts. Argentiferous, and in the latter also auriferous. Gilpin county. A very common and sometimes rich gold ore. Also argentiferous in many places. Occurs in veins in gneiss, with pyrite, sphalerite, galena, and tetrahedrite. Clear Creek county. Also abundant here, but chiefly a silver ore. Summit county, in Snake River region. Similar in occurrence to that of Clear Creek county. Chaffee county. An argentiferous ore, associated with galena, etc. Gunnison county, various mines, usually argentiferous and auriferous. Huerfano, Hinsdale, San Juan, Ouray, and San Miguel counties. A common argentiferous ore, usually associated with galena, tetrahedrite, pyrite, etc.
Coal, var. anthracite.	Anthracite	Gunnison county, near Crested Butte. Of Cretaceous age, but said to possess the qualities of the best Carboniferous anthracite. The veins are now being extensively developed. Gunnison county, also at Ragged mountain in the same horizon; seam being now opened (coal of good quality), and near Irwin, on Anthracite creek (39-inch vein), Routt county. Small seams of good anthracite in the Elk Head mountains (Upper Cretaceous). Crystal City, Rock creek, Pitkin county, in large beds.
Coal, var. bituminous.	Lignite, soft coal......	Bituminous coal from the Laramie group of the Cretaceous formation (post-Cretaceous according to some authors) is extensively mined at the eastern base of the Rocky mountains. In the northern part of the State the chief development is in Weld county (at Erie); Boulder county (at Canfield, Langford, Louisville, etc.); and in Jefferson county (at and near Golden). In El Paso county, at Franceville, on the Denver and New Orleans railroad, developments have been recently made. In Fremont county the coal fields southeast of Cañon City are extensively worked. In the southern part of the State the same coal beds are largely productive at Walsenburg in Huerfano county, and near El Moro and Trinidad, in Las Animas county. In Park county, near Como, in the South Park, coal of the Laramie group is worked. Cretaceous coals of a lower geological horizon than the Laramie are found in many places in the mountain districts of the State. In most instances the development is slight. Near Crested Butte, in Gunnison county, are large beds of a very fine bituminous coal, occurring near the anthracite, and which are now actively worked. This coal produces an excellent coke, and is also used in Denver, Leadville, etc., for gas manufacture. In La Plata county, near Durango, are several thick veins of Cretaceous coal, which are now mined. The same coal is said to appear in Conejos county, adjoining La Plata county on the east, but is not yet worked. Pitkin county. Several large seams of superior coking coal have recently been opened in the western parts of the county in the Huntsman's hills. They are now being extensively worked and the coke shipped to Leadville. Garfield county. The Coal Measures contain an abundance of semi-coking and splint coals of superior quality. Mines are in active operation at Sunshine and South Cañon. In Routt, Delta, and Mesa counties there are large seams of excellent domestic coal, but the production at present is very limited. The Measure in these counties is a continuation of the Upper Cretaceous coal series of Gunnison, Pitkin, and Garfield counties. Near Rico, in Dolores county, coking coal, of Lower Cretaceous age (Dakota), is slightly mined for local use. Seams only 2 feet thick. In San Miguel and Ouray counties small viens in the Dakota Cretaceous have been operated in a small way for local consumption. In the Upper Cretaceous of Ouray county large seams of semi-coking coal of fair quality have been worked to a limited extent.
Casalite	....	Old Lunt mine, near Ouray; Comstock mine, La Plata county.

COLORADO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Embolite	Chlorobromide of silver.	Lake county, near Leadville. Of frequent occurrence, particularly on Fryer and Carbonate hills. Occurs chiefly in a siliceous iron ore in cavities, and on fissure planes.
Enargite		Gilpin county, Russell gulch; particularly in the Powers mine. Argentiferous; with pyrite and fluorite. Rio Grande county, Summit district. Both auriferous and argentiferous; often carries free gold. With pyrites only, in quartz matrix. San Juan county, Red mountain, abundant. Argentiferous, with tetrahedrite and galena in quartz veins.
	Fire clay	Jefferson county; seams in the sandstone of the Dakota Cretaceous. Extensively mined near Golden, and used in the manufacture of fire-bricks, muffles, etc., at Golden and Denver. Doubtless occurs in the same geological horizon at many places along the foothills. This clay is of the very finest quality. Garfield county. A plastic clay from the Dakota Cretaceous, near Glenwood springs, is mixed with crushed quartz and made into bricks for the coke ovens at Cardif. These bricks stand a very high temperature without softening, but the amount of silica is an objection to their use in metallurgical furnaces.
Galenite, argentiferous.	Galena	Boulder county, Grand Island district; with chalcopyrite, sphalerite, and smaller quantities of other minerals. Gilpin county, Clear Creek county. In these counties a very common ore, associated with one or more of the minerals pyrite, chalcopyrite, sphalerite, tetrahedrite. Summit county, Snake River district. Occurrence as in Clear Creek county, near Breckenridge, Ten-mile district. In limestone, with pyrite, sphalerite, etc. Eagle county, near Red cliff. In limestone, as above. Lake county, Leadville region. Very prominent ore occurs in limestone; often much altered into cerussite (see Cerussite); Homestake peak; in Archæan. Pitkin county. At Aspen and Ashcroft (argentiferous with barite and quartz), worked largely. Park county. Occurs on easterly slope of the Mosquito range; same manner as at Leadville. Chaffee county, several districts. Important ore. Custer county, near Silver cliff. Bull Domingo mine, and in small quantities elsewhere. Fremont county. Cotopaxi, in cañon of the Arkansas; limited. Gunnison, Saguache, Huerfano, Rio Grande, Hinsdale, San Juan, Ouray, San Miguel, Dolores, and La Plata counties. In all these counties galena is an abundant ore of silver. It is most frequently associated with tetrahedrite, which is also argentiferous; in many cases with chalcopyrite, and more rarely with various other minerals. Is usually mined and treated for lead as well as silver.
Gold, native	Gold	Routt county. Placers in Hahn's Peak region. Pitkin county. At Independence, in veins with quartz; production limited. Boulder county. Placers limited; associated with telluride minerals in Magnolia, Sugar Loaf, Gold Hill, and Central districts. In quartz veins with pyrite, fluorite, and barite, near Jamestown. Gilpin county. Placers limited. Common in small quantities with auriferous minerals of region; *i. e.*, pyrite, chalcopyrite, and sphalerite. Clear Creek county. Sparingly in placers on Clear creek. Summit county. Placers in French, Fuller, and other gulches. Moderately productive near Breckenridge; also in dendritic coatings in fissure planes of a schistose rock; limited. Park county. Placers on the western and eastern borders; limited. Veins near Montgomery; little worked. Lake county. Placers on California gulch; about exhausted. In veins near Leadville, and very limited. Chaffee county. Placers very little worked at present. In quartz veins in Granite and Hope districts; limited. Saguache county. In veins, with pyrolusite; also associated with native silver on Carnero creek; limited. Costilla county. Placers near Placer; veins, Grayback gulch, south end of the Sangre de Cristo mountains. Rio Grande county, Summit district. In a ferruginous decomposition product of pyritiferous veins; also with enargite, same region.

COLORADO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gold, native (continued).	Gold	Ouray county, Uncompahgre district. Placers near mouth of Dallas creek; not now paying. San Juan county, in Arrastra gulch, near Silverton. In quartz veins; limited. Hinsdale county. Golden Wonder mine in quartz vein. San Miguel county. In veins and placers. La Plata county. Placers on Rio La Plata and Rio de las Animas; veins near Parrott City.
Gypsum	Gypsum	Made into plaster of Paris at Colorado City, El Paso county.
Hematite	Specular iron	Lake county, Breece iron mine, Breece hill, near Leadville. Very pure ore; large, irregular deposits in porphyry.
Hessite	Telluride of silver	Boulder county, Gold Hill district. (Important ore.) Red cliff, Eagle county. Occasionally important in La Plata county.
Hessite, var. petzite.	"Telluride"	Boulder county. Not uncommon ore. Important; Gold Hill mines especially. Hinsdale county, Hotchkiss mine. (This mineral seems to be a telluride of gold and silver, but is impure, and the species can not be considered as determined.)
	Limestone	Abundant in every county in the State.
Limonite	Brown hematite, brown iron ore.	Saguache county, at Hot springs, western foothills of the Sangre de Cristo range, 8 miles from Villa grove, large body interbedded with limestone nearly 100 feet thick in places; very pure ore; extensively worked by the Colorado Coal and Iron Company. Pitkin county, in extensive beds near Ashcroft.
Magnetite	Magnetic iron ore	Costilla county, Grayback gulch, 5 miles from Placer station, on Denver and Rio Grande railroad; interbedded with impure limestone; good ore. Worked by Colorado Coal and Iron Company. Fremont county, Iron mountain, near Pine Creek, a branch of Grape creek, 22 miles from Cañon City. Quite titaniferous; up to nearly 15 per cent. TiO_2. Worked by Colorado Coal and Iron Company. Chaffee county, in Arkansas hills, 9 miles from Salida (south Arkansas). Extensively worked by Colorado Coal and Iron Company. Gunnison county, Cebolla creek, a pure ore in large quantity. At present used only as a flux in lead smelting.
Massicot	Oxide of lead	Dolores county, near Rico, with galena ores; argentiferous. San Miguel county, upper San Miguel region, with galena; argentiferous. In less quantities in many places as decomposition product of galena.
Petroleum	Coal oil	Fremont county, near Florence, in Middle Cretaceous strata. A large number of wells in operation, most of them productive.
Phenakite		Pike's Peak and Mount Antero, fine gems, worked slightly by specimen dealers.
	Plastic clay	Common in the Laramie group; often intimately associated with the coal. Mined in various places, chiefly at Golden. Used in coarser pottery.
Polybasite (a)		Clear Creek county. San Juan county, Red Mountain district. San Miguel county. Marshall basin, in quartz veins, with pyrargyrite, sphalerite, and stephanite. Not uncommon in the Mendota mine. Yankee Girl mine, Ouray county.
Proustite	Ruby silver (light)	Gunnison county, Ruby district, with arsenopyrite; small quantity. Sheridan mine, San Miguel county. Yankee Girl mine, Ouray county.
Pyrargyrite	Ruby silver (dark)	Gilpin county, near Central City. A rare mineral. Clear Creek county. Frequently occurs in small quantity with stephanite, argentite, native silver, and the more common ores.

a While not absolutely determined, it is thought probable by experienced persons that this mineral occurs frequently with pyrargyrite, argentite, and other silver minerals; *e. g.*, in the Terrible mine, near Georgetown.

COLORADO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrargyrite (continued).	....	Gunnison county, Ruby district. With tetrahedrite and native silver. Not uncommon. Hinsdale county, Galena district, associated with stephanite. Occasional occurrence. Ouray county, Sneffle's district, with sphalerite. Not uncommon. San Miguel county, Marshall Creek basin. Occasional, with polybasite, stephanite, and sphalerite. Dolores county, near Rico; Bill Young mine, Uncompahgre district. Not uncommon, with argentite.(?)
Pyrite (auriferous).	Iron pyrites	Boulder county, Ward district. Gilpin county. Abundant; in veins with chalcopyrite, sphalerite, etc. An important ore of gold. Clear Creek county, Empire district. Abundant, but low grade gold ore. Experiments as to treatment now in progress. Rio Grande county, Summit district. With enargite. Not uncommon. San Miguel and La Plata counties. (Common.) Red Mountain, San Juan, and Ouray counties.
Pyromorphite (argentiferous).	....	Lake county, near Leadville. Associated with cerussite in the "sand carbonate." (See Cerussite.)
Pyrrhotite.....	Magnetic iron pyrites.	San Juan county, Needle mountains. Limited quantity; auriferous.
Quartz.........	Common white quartz.	Jefferson county. Mined from veins in the foothills near Golden, and used in the manufacture of firebricks at Golden.
Quartz (?)......	Moss agate, "silicified wood," and "smoky quartz."	Very common, and much used in the manufacture of jewelry, ornaments, etc. The smoky quartz occurs near Pike's Peak, and is known in trade as "smoky topaz" or "Cairngorm stone."
	Sandstone	Beds of white sandstone, said to be suitable for glass manufacture, occur all along the eastern and western bases of the mountains, and in many places in the mountains. Sandstone for building purposes of fine quality at Morrison, Jefferson county; Trinidad, Las Animas county; Cañon City, Fremont county; and at Left Hand, Boulder county. A hard, pink-colored sandstone from latter place exported to Kansas City and elsewhere, in small rectangular blocks for street paving.
Schirmerite....	....	Boulder county. With telluride minerals in small quantity. Clear Creek county, Geneva district. Summit county, Peru district. Sparingly. San Miguel county, Howard's fork of San Miguel river. Santa Cruz mine, with bismuthinite, chalcopyrite, and galena.
Silver, native ..	Silver..................	Clear Creek county. Of frequent occurrence as companion of the argentiferous ores of the region. Usually in small quantity. Boulder county. Common in the Caribou mine. Lake county. Rare; in a few mines of the Leadville region; Evening Star, Little Chief, etc. Gunnison county, Ruby district. Associated with pyrargyrite, tetrahedrite, etc.; not uncommon. Hinsdale county, Galena district. With galena and tetrahedrite; not common. Pitkin county. At Aspen. San Miguel county. With stephanite, galena, and tetrahedrite; occasional. Boulder county. In large nuggets in Caribou district. La Plata county. Bear Creek.
Sphalerite	Zincblende	Gilpin county and Clear Creek county. A common mineral, usually argentiferous, sometimes highly so, and occurring associated with pyrite, chalcopyrite, galena, and tetrahedrite; mined for silver only. Hinsdale, San Juan, Ouray, San Miguel, Dolores, and La Plata counties. A very common, usually argentiferous, mineral; common associate galena; frequently together with chalcopyrite, tetrahedrite, or pyrargyrite. Boulder, Pitkin, and other mining counties, associated with other ores.

COLORADO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Stephanite.....	Brittle silver..........	Clear Creek county. Frequently associated in small quantity with other silver-bearing minerals of county. Hinsdale county, Galena district. Limited. San Juan county, Uncompahgre district. Occasional. Ouray county, Sneffle's and Uncompahgre districts. Occasional. San Miguel county. Not common.
Stromeyerite ..	Copper and silver sulphide.	With bornite, tetrahedrite, etc. Plutus mine, Idaho Springs; occasional. In quantity in Yankee Girl mine, Ouray county.
	"Cupreous bismuth," or "bismuth ore."	Is a name applied to a massive ore containing sulphides of copper, silver, and bismuth, with small quantities of other sulphides. This ore is common in the quartz veins of Uncompahgre district, in Ouray county. Associated with tetrahedrite, chalcopyrite, and sphalerite. *Note.*—Crystals of this ore, having the form of tennantite, analyzed at the École des Mines, Paris, contained 8 per cent. bismuth, and was regarded as bismuthiferous tennantite. Obviously, however, the massive mineral may with equal propriety be classed under tetrahedrite.
Tellurium (native.)	Tellurium	Boulder county. Auriferous and argentiferous; common with the other tellurides of the county.
Sylvanite......	"Telluride"	Boulder county, Gold Hill and other districts. La Plata county, Junction creek, and at head of the Rio la Plata. In quartz veins.
Tennantite	Arsenical fahlerz	Freeland mine, Clear Creek county. Frank Hough mine, Hinsdale county.
Tetrahedrite...	Gray copper, fahlerz..	Gilpin and Clear Creek counties. Very abundant; argentiferous in both; auriferous in Gilpin; common associates pyrite, galena, sphalerite, and chalcopyrite. Summit county, adjoining Clear Creek county. Lake county, a few mines in the Sawatch range. Limited. Hinsdale, San Juan, Ouray, and San Miguel counties. A very abundant silver ore, associated with one or more of the minerals pyrite, chalcopyrite, sphalerite, galena, and occasionally with others; most prominent ore mineral of the San Juan region. Huerfano county. Rarely. Gunnison county, Ruby district. With pyrargyrite and native silver.
Uraninite......	"Pitchblende"	Gilpin county, near Central City. Discovered and worked for uranium by Richard Pearce, esq., of Denver; not at present productive; occurs with other uranium minerals, torbernite, etc.
Topaz	Topaz	Pike's Peak and Mt. Antero. In size and quality suitable for gems.
Zinconite	Antimonial sulphide of lead.	Red Mountain district, San Juan county.

COLORADO—Not Mined.

Alabandite	Manganese sulphide .	Argentiferous, with rhodocrosite; Queen of the West mine; Summit county.
Cassiterite.....	Tinstone..............	In small crystalline masses in albite and quartz, Devil's Head mountain, Douglas county. With amazon stone at Florissant, El Paso county.
Chalcanthite ..	Bluestone............	Clear Creek county, and adjacent parts of Summit county. In considerable quantities in veins, with tetrahedrite, galena, chalcopyrite, sphalerite, barite, etc. Prospective.
Coal, var. bituminous.	Soft coal..............	At Elwood, Rio Grande county, Summit mining district.
Chrysocolla....	Silicate of copper, blue copper.	Custer and Saguache counties; Sangre de Cristo mountains; undeveloped.

COLORADO—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Cinnabar	Cinnabar	La Plata county. In sandstone; said to be rich; undeveloped.
Corundum	Corundum, emery	Chaffee county, near Buena Vista and Calumet; in a thin stratum of soft schist; small bluish crystals very numerous, sometimes constituting 30 per cent. of the rock by weight. Prospective source of corundum; perhaps of sapphire.
Fluorite	Fluorspar	Boulder and Jefferson counties. Veins in Archæan; said to be extensive; used in small quantities as a flux in smelting; San Juan county, Poughkeepsie gulch; in veins with quartz.
Graphite	Plumbago, black lead.	Gunnison county; 3½ miles north of Pitkin; branches of Quartz creek; impure; in quartz veins 2½ feet thick; no present value; near Trinidad, Las Animas county.
Gypsum	Gypsum	In the Jurassic and Triassic strata along the eastern base of the Rocky mountains. Often in pure state, and available for many purposes. Opened on the Cache la Poudre river, at Morrison, and near Cañon City. Also occurs in the South park, and at many other points where the Jurassic and Triassic strata are exposed.
	Infusorial earth	Small bed at West Denver.
Hematite	Specular iron ore	Large beds with magnetite near Ashcroft and Carbondale, Pitkin county.
Magnetite	Magnetic iron	Park county, near Hamilton; said to occur in quantity, and of good quality; undeveloped. Boulder county, near Caribou; veins in Archæan; undeveloped. Gunnison county; irregular deposits in limestone near Snowmass mountain (pure ore, titaniferous). Near Ashcroft and Carbondale.
	Marble	Jefferson county, near Morrison. A brownish, mottled rock. Specimens polished at Exposition of 1882; not in use yet. Chaffee county; large beds of white and variegated marble said to have been recently discovered. Gunnison county. An extensive bed of white and clouded marble 80 feet thick, of excellent quality, occurs on the head of Yule creek and on Rock creek; has been explored by diamond drill and open cuts, but is not otherwise developed. Also at Crystal City, Pitkin county.
Molybdenite	Sulphide of molybdenum.	Gunnison county, two miles from Pitkin, in quartz veins. Possible source of molybdenum. Also in Boulder county.
Muscovite	Mica	Fremont county, Cotopaxi. Veins in Archæan; prospected somewhat. Jefferson county, Bear creek; scarcely explored as yet, but apparently not important.
	Natural gas	Pitkin county. "Blowers" in the middle Cretaceous shales at Coal basin; also in the oil shales of the Green River group on the head of the Muddy fork, in Delta county; undeveloped; natural flow limited.
Nicolite		Fremont county, Grape creek cañon, Gem mine. In dolomite, with bornite, and rarely native silver; not yet used as ore of nickel.
Petroleum	Oil shales	Extensively developed, geologically, in Garfield and Delta counties, constituting the greater part of the rocks of the Green River Eocene. In the Book cliffs the richer rock occurs in bands, about fifty in number, from 2 feet to 15 feet thick. Destructive distillation gives from 15 per cent. to 35 per cent. of condensed hydrocarbons and 10 per cent. to 20 per cent. of gas. Prospective source of lubricating oil.
Serpentine	Serpentine	Park county, Buckskin gulch. A mottled rock, largely calcite, but deeply colored by true serpentine; prospective use as ornamental stone. Near Gothic, Gunnison county.
Smaltite	Gray cobalt ore	Gunnison county, near Gothic. In a vein with calcite gangue, associated with small quantities of erythrite and native silver; possible source of cobalt. Analysis by M. W. Iles, American Journal of Science, May, 1882.

COLORADO—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Sphærosiderite (including the alteration products).	Nodular iron ore, carbonate ore, clay ironstone.	A thin seam of sphærosiderite occurs above the coal of the Laramie formation in many parts of Colorado and New Mexico. In some places it has weathered out in nodules, which are found upon the plains in great quantity. It is found near Trinidad and El Moro, in Las Animas county, Walsenburgh, in Huerfano county, and Marshall, in Boulder county. The greater part is too impure for use.
Sphalerite	Zincblende	In large bed at Cotopaxi county, Fremont.

CONNECTICUT—Mined.

Albite, orthoclase.	Feldspar	Southeast part of Middletown and at Portland, Middlesex county, in a granite range; Portland and Glastonbury, continuation of vein; Branchville, Fairfield county.
Barite	Heavy spar	Cheshire, New Haven county; in sandstone.
Calcite and dolomite.	Marble	New Preston, Litchfield county, dolomitic limestone; North Canaan, Litchfield county; Milford, New Haven county.
	Flagging stone	Bolton, Tolland county, mica slates noted for their excellence. A fine-grained gneiss quarried at Higganum.
	Granite	Plymouth, Litchfield county; North Groton, New London county; Portersville; upper Mystic; Bridgeport, Fairfield county; Derby, New Haven county; Chatham, Middlesex county, syenitic granite. Stony creek and Leets island, Millstone Point.
Limonite	Brown hematite	Ore Hill, Salisbury, Litchfield county; Chatfield ore bed near Salisbury; Indian Pond ore bed, Sharon, Litchfield county; Davis ore bed, Salisbury; Chapin mine, near Chapinville, Litchfield county; Kent ore bed, Kent, Litchfield county; Scoville ore bed, Salisbury; extensive beds and worked steadily, yielding a superior ore.
Muscovite	Mica	Branchville, Fairfield county; Portland and elsewhere in small quantity.
Quartz	Quartz	Middlesex county, in feldspar mines. Glastonbury, Hartford county; Branchville, Fairfield county.
Sandstone	Sandstone	Portland and Chatham, Middlesex county, celebrated quarries; Farmington, Hartford county; North Haven and East Haven, New Haven county.
	Trap rock	Rocky Hill, Hartford county; Meriden, New Haven county; West Rock and Pine Rock, New Haven county.

CONNECTICUT—Not Mined.

Apatite	Phosphate of lime	Hadden; Litchfield; Branchville.
Arsenopyrite	Mispickel, arsenical pyrites.	Derby; New Haven county, in quartzose gneiss; Lane's mine, Monroe, Fairfield county; Wilton lead mine, Fairfield county; and Bethany, New Haven county.
Agate	Agate	Farmington, East Haven, and Woodbury.
Beryl	Beryl	Haddam; New Milford; Branchville; Portland feldspar quarries.
Bismuth (native).	Bismuth	Monroe, Fairfield county; disseminated through quartz in small quantities.
Bornite	Variegated copper ore, purple copper ore.	Granby, Hartford county; Wolcottville, Litchfield county; with chalcocite and malachite; Bristol copper mine, Hartford county; associated with chalcocite; Rocky Hill quarry, Hartford county; in veins of quartz in trap-rock.
Calamine	Silicate of zinc	Brookfield, Fairfield county; in white limestone with galena and blende.
Cassiterite	Tin ore, tinstone	Haddam, very small vein.

CONNECTICUT—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcocite	Vitreous copper	Simsbury mines, Hartford county; occurs with variegated copper and malachite in gray sandstone; southeast part of Cheshire, New Haven county, with barite in sandstone; Wolcottville, Litchfield county, with bornite and malachite; Bristol copper mine, with bornite and chalcopyrite once extensively worked.
Chalcopyrite...	Copper pyrites	Bristol copper mine; Trumbull, Fairfield county, in topaz mine with pyrite, also galena and blende; in chloritic slate of Orange, New Haven county, with pyrite; Litchfield, with pyrrhotite; Mine hill, Roxbury, Litchfield county; Middletown lead mines, Middlesex county; West Haven, New Haven county.
Copper	Copper	Native copper in the drift and in red sandstone in New Haven county; a mass weighing nearly 200 pounds and others of smaller size have been found.
Corundum	Emery.................	West Farms, near Litchfield.
	Clay	West of New Milford, Litchfield county, resulting from disintegration of gneiss, also a fire-clay; south part of Kent, Litchfield county, disintegrated graphitic gneiss vein; southeast part of Cornwall, Litchfield county, less pure than others; northwest part of Granby, Hartford county; small deposit.
Galenite	Galena.................	Middletown, Middlesex county; thin seam in quartz in mica slate; Brookfield, Fairfield county, disseminated through dolomite; Lane's mine, Monroe, Fairfield county, disseminated through quartz (argentiferous); Cobalt mine, Chatham, Middlesex county, and other localities of occurrence in minute quantities; Mine Hill, Roxbury, with siderite, the gelena containing sometimes over 1 per cent. of silver.
Garnet.........	Garnet.................	Haddam; Redding; Southbury.
Graphite.......	Plumbago, black lead.	Northwest corner of Ashford, bed in gneiss; west part of Cornwall, Litchfield county, disseminated through rock.
	Hydraulic limestone..	Near Berlin in Southington, Hartford county, in thin strata, compact, earthy, and somewhat bituminous; Northford, a gray limestone.
Limonite	Brown hematite, bog iron ore.	Stafford, Tolland county, mostly exhausted; Hebron, Tolland county; Colchester, New London county, and other localities in Tolland, Windham, and New London counties; mainly in towns of Union, Woodstock, Willington, and Tolland.
Magnetite	Magnetic iron ore.....	New Preston, Litchfield county, occurs with pyrite; Buck's, Mount Sharon, Litchfield county; Redding, Fairfield county; ore in seams traversing quartz; Newtown, Fairfield county, thin seams in quartz and in gneiss; Winchester, Litchfield county, thin stratum in gneiss.
Malachite......	Green carbonate of copper.	Simsbury mine, Granby, Hartford county, with bornite and chalcocite; Bristol copper mine, Hartford county; with bornite and chalcocite; West Haven; Rocky Hill, Hartford county; Manchester, Hartford county, worked at intervals.
Molybdenite...	Sulphide of molybdenum.	Haddam, gneiss quarries.
Muscovite.....	Mica...................	Branchville and New Milford.
Niccolite	Copper nickel	Chatham, Middlesex county; associated with smaltite; Trumbull, Fairfield county.
Pyrite	Pyrites, iron pyrites..	Brimstone Ledge, North Madison, New Haven county; Newtown, Fairfield county, in mica schist; Winchester, Litchfield county; Windsor, Hartford county, in slate; other localities, but all in small quantities. Mine Hill, Roxbury.
Pyrrhotite.....	Magnetic pyrites.....	Trumbull, Fairfield county, in a vein with pyrites, fluorite, etc., cutting micaceous limestone; New Fairfield, Fairfield county, on gneiss; Litchfield, occurs with chalcopyrite in hornblendic rock; other localities also in Fairfield county, but inconsiderable in amounts.
Quartz.........	Glass sand............	On shore of Quasipaug pond, Middletown, very fine quartz; Eastfield, fine-grained, but not so pure as above.

CONNECTICUT—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Rutile	Rutile	Plymouth, Litchfield county, occurrence; Granby, Hartford county, occurrence; North Greenwich, Fairfield county; Monroe, Fairfield county, in mica slate.
Siderite	Spathic iron ore, carbonate ore.	Mine Hill, west bank of Shepaug river, Roxbury, Litchfield county; in a vein of white quartz traversing gneiss.
Smaltite	Gray cobalt ore	Chatham cobalt mine, Middlesex county; disseminated in a bed in mica slate, and thin seam; accompanied by galenite, sphalerite, and niccolite.
Sphalerite	Zincblende	Middletown, Middlesex county, in a galena vein; Brookfield, Fairfield county, with galenite in dolomite; Chatham cobalt mine, Middlesex county; Lane's mine, Monroe, Fairfield county, with galenite; Kensington.
Talc	Steatite, soapstone	Somers, in talc slate in gneiss; Bristol.
Topaz	Topaz	Trumbull, Fairfield county. Willimantic, Windham county.
Uraninite	Pitchblende	Middletown feldspar quarry, Middlesex county; Willimantic, Windham county; Branchville, Fairfield county.
Wolfram	Wolfram, tungstate of iron.	Monroe and Trumbull.

DAKOTA—Mined.

Arsenopyrite	Arsenical iron pyrites.	Pennington county, sometimes auriferous; Custer county, of frequent occurrence, nearly always auriferous.
Asbestus	Asbestus	Pennington county, near Rockford, Slate creek and Cross mine.
Barite	Barytes, heavy spar	Pennington county, Sunday gulch, Demereaux mine.
Cassiterite	Tinstone, stream tin	Lawrence county, in albite grieson; Pennington and Custer counties, in albitic grieson. (Typical grieson, quartz, albite, and in Etta mine occasionally in spodumene.) Formation Archæn near the granite. Stream tin, Lawrence county, Nigger Hill, and generally in Pennington and Custer counties.
Cerargyrite	Horn silver, silver chloride.	Lawrence county, in Potsdam sandstone with galena; also at Carbonate camp.
Cerussite	Lead carbonate	Lawrence county, at Galena and Carbonate camp.
Chalcopyrite	Copper pyrites	Lawrence county, with galena, blende, gold, and cerargyrite.
Coal, var. lignite.	Lignite	Buford, Flannery, Mountraille, Renville, Bottineau, McHenry, Ward, Barthold, Wallace, Garfield, Stevens, McLean, Mercer, Williams, Dunn, McKenzie, Billings, Stark, Oliver, Morton, Hettinger, Bowman, Ewing, Burdick, Martin, Harding, and Butte counties.
Coal, var. bituminous.	Soft coal	Custer and Fall River counties.
Copper, native.	Native copper	Pennington and Custer counties, with sulphate malachite, and copper glance; also in limestone.
Corundum	Corundum, emery	Pennington county, near Sunday gulch.
Galenite	Galena, lead sulphide.	Lawrence county, at Carbonate camp, Galena, Box Elder, Bald mountain, and other places. Pennington county, in Unknown district, at Queen Bee mine, associated with arsenopyrite; in Harney district, in albite.
Gold	Gold	Lawrence county: Placer, Whitewood, Gold Run, Deadwood, Blacktail, False Bottom, Bear Butte, Two Bit, Nigger Hill, associated with stream tin. In veins near Galena, Spruce gulch, Lead City, Central City, Terraville, Brownsville, Greenwood, and near Rochford. Pennington county: Placer, Rapid creek, Slate creek, Newton's Fork, Castle creek and at Rockerville (in cement); also placer on Battle river and Spring creek, Bear gulch, Sunday gulch, with stream tin. In veins at Rochford, Pactola, Queen Bee, Hill City, Lookout, and Harney City. Custer county, occurs very generally over the west half of the county in placer and veins.

DAKOTA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gypsum	Gypsum	Extends entirely around the Black Hills through Lawrence, Pennington, Custer, and Fall River counties for a distance of 150 miles. In Triassic, practically inexhaustible in quantity and of the best quality. Alabaster, satin spar, selenite, and fibrous gypsum are found.
Hematite	Red iron ore	Lawrence county, on Box Elder, and near Rochford.
Jasper	Jasper	Minnehaha county, a deposit is found from 3,000 to 4,000 feet thick, susceptible of a high polish; worked to a large extent; shipped to Omaha, Saint Paul, Chicago, and other cities for building, pavements, and ornaments.
	Limestone	Lawrence, Pennington, Custer, and Fall River counties, from 300 to 1,200 feet thick; worked at Spearfish, Whitewood, Sturgis, Rapid City, and Buffalo Gap (carboniferous); rests conformably on Potsdam sandstone.
Malachite	Green carbonate of copper.	Custer county, on French creek, with copper glance, and cuprite in limestone.
	Marble	Lawrence, Pennington, Custer, and Fall River counties, deposits from 50 to 300 feet, variegated, red, yellow, and green; also pure white and cream color; quarried at Rapid City and Buffalo Gap.
Muscovite	Mica	Pennington county, associated with tin, tourmaline, columbite, wolfram, titanium, spodumene, quartz, albite, garnets, rubies, and other minerals, has been mined to some extent for commercial purposes; occurs in Archæan and granitic formations. The occurrence of commercial mica is far more general in Custer county. It has been mined far more extensively, several hundred thousand dollars' worth having been produced. As yet the mines are merely prospected on the surface. It is accompanied with the same minerals and in the same formation as in Pennington county.
Pyrite	Iron pyrites, mundic	Occurs in some of the tin mines in Pennington and Custer counties.
	Sandstone	Lawrence, Pennington, Custer, and Fall River counties. White, cream, yellow, brown, and variegated colors. Mined at Spearfish, Sturgis, Rapid City, Buffalo Gap; deposit from 200 to 400 feet thick; Cretaceous; lower strata.
	Silver	Lawrence county, at Galena and Carbonate camp; associated with galena, pyrite, and other minerals.
Sphalerite	Zincblende	Lawrence county, with galenite, gold, chalcopyrite, pyrite, and ilmenite in feldspar.
Stibnite, jamesonite (?).	Gray antimony ore	Near Silver City, Pennington county, with galena and arsenopyrite in Archæan schists.

DAKOTA—Not Mined.

Asbestus	Asbestus	Lawrence county, Upper Whitewood (Archæan); Pennington county, Rockford, in quartz-carrying gold, near Rockerville (Archæan).
Beryl	Beryl	In tin and mica mines of Pennington and Custer counties.
Chalcedony	Chalcedony	Pennington, Custer, Washington, Zeibach, and Jackson counties. In veins and placers in Tertiary; also in veins in Archæan.
Columbite		Pennington county. In some of the tin mines.
	Feldspar	Lawrence county. In veins carrying galena, chalcopyrite, blende, ilmenite, and talc.
Garnet	Garnet	Lawrence and Pennington counties. In graphite veins; perfect crystals size of hen's eggs to mustard seed (Archæan).
	Geodes	Lawrence county, Bear butte; amethyst color.

DAKOTA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Graphite	Plumbago, black lead.	Pennington county, near Rochford. Archæan schists.
	Hydraulic limestone	Lawrence, Pennington, and Custer counties (Jurassic).
Limonite	Brown iron ore	Custer county. Archæan.
	Lithographic stone	Custer and Pennington counties.
(?)	Nickel ore	Pennington county, associated with pyrite. Archæan.
	Petrified wood	Lawrence, Pennington, Custer, and Fall River counties Cretaceous.
Quartz	Rose quartz	Pennington county, associated with beryl, tourmaline, and mica. Archæan schists.
	Roofing slate	Pennington county, good quality. Archæan.
(?)	Ruby	Pennington county, of good size; perhaps available for gems.
Steatite	Talc	Lawrence county, associated with feldspar. Archæan.
Tourmaline	Tourmaline	Custer and Pennington counties. In granite and quartz and greisen.
(?)	Uranium	Lawrence county, near Central City. Archæan.
	Whetstone	Custer and Fall River counties, near Buffalo Gap (Cretaceous); Pennington county, near Tigerville (Archæan).
Wolframite	Wolfram, tungstate of iron, and manganese.	Pennington county, with columbite. (Archæan).

DELAWARE—Mined.

(?)	"Blue rock"	Churchman's quarry on Christiana creek; Clyde's quarry on Brandywine creek; Quarryville quarries, northeast of Brandywine quarries; quarries on Naaman's creek; Shell Rot hill, northeast of Wilmington; Brandywine Granite Co.'s quarry (stone much used for Government work—breakwaters, etc.), on Brandywine, all in New Castle county. This rock is used as building stone.
	Clay	Red clay, three miles south of New Castle on Delaware, New Castle county; white clay (pipeclay), below New Castle, New Castle county; red clay, in Red Lion Hundred and Pincader, New Castle county; Little creek, two miles south of Laurel, New Castle county; northwest of Georgetown, Sussex county; Mispillion creek, near Milford, Sussex county; Ponder's mill on Prime Hook creek, Sussex county; Milton, Sussex county.
	Feldspar	"Spar" quarries; Tucker's quarry, northwest of Wilmington, New Castle county. Also Hockessin pits, New Castle county.
	Greensand marl	Saint George's Hundred, Saint George's; Middletown, three miles west, on Bohemia creek at head of tidewater; Cantrell's bridge, north side of Appoquinimink; Silver run; Dwyer's run; Noxentown branch of Appoquinimink; Port Penn; Latman's mill on branch of Dwyer's creek; Scott's run. All in New Castle county.
Kaolinite	Porcelain clay	Hockessin, New Castle county. Extensive pits where kaolin of superior quality is dug. A disintegrated feldspathic rock.
	Limestone	Jeane's, on Pike creek, New Castle county; Klair's, two miles west of Centreville, New Castle county; Bullock's, on Brandywine, near Pennsylvania line, New Castle county.

DELAWARE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite	Brown hematite, bog iron ore.	Iron hill, near White Clay creek, New Castle county. Extensively quarried for supply of Maryland furnaces. Chestnut Hill pits, near Newark, New Castle county; large open pits now worked. Little creek, two miles south of Laurel, Sussex county; near Georgetown (northwest), Sussex county; Collin's ore bed on Green Meadow branch of Deep creek, Sussex county; Green branch, ten miles west of Millsborough, Sussex county; Burton's branch, one mile west of Burton, Sussex county; East Dover, Kent county.
	Marls	(See Greensand.)
Quartzite	Quartzite	Ground at Tweed's mill, near Newark, New Castle county, for manufacture of porcelain.

DELAWARE—Not Mined.

Asbestus	Asbestus	Feldspar quarries, northwest of Wilmington, New Castle county.
Limonite	Brown hematite, bog iron ore.	Nanticoke Head, Sussex county; formerly abandoned; now seems to be reforming and may be in future available.
Serpentine	Serpentine	Six miles northwest of Wilmington, New Castle county.
Succinite	Amber	Near Chesapeake and Delaware canal, Kent county.

DISTRICT OF COLUMBIA—Mined.

	Brick clay	Of fine quality; largely used for making pressed and common brick.
	Gneiss, mica schist	Rock creek; used as building stone.
Quartz	Quartz	Vein quartz; crushed for concrete road metal.
	Terra cotta clay	Terra Cotta station.

DISTRICT OF COLUMBIA—Not Mined.

Gold	Gold	Vein quartz in gneiss and schist country rock, and gravels showing traces of gold.

FLORIDA—Mined.

Clay	Clay	Brick is made from sandy clay at Lake City, Tallahassee, and Jacksonville.
Limestone	Coquina stone	Saint Augustine quarries, Rock Ledge, Brevard county, on the Indian river; for building stone.
Limestone (2)	Limestone	Gainesville, Alachua county; for building stone.
	Marl	Cretaceous marl occurs very generally skirting the eastern and southern edges of the limestone ridge traversing the axis of the State. Isolated deposits have been noted at Jacksonville and on Fort George island, Duval county. The marl is used locally on many orange groves on the St. John's river, particularly at Sanford, Orange Bend, and Lanier.

FLORIDA—Not Mined.

Mineralogical name.	Common name.	Remarks.
Lignite	Brown coal	On Suwannee river, once worked for fuel.
Limestone	Limestone	Fort Brooke, head of Tampa bay; Manatee river, Manatee county; Charlotte harbor; Jackson county, Campbellton to Marianna; Saint Mark's, Wakulla county; Ocala and Silver springs, Marion county; Rock spring, Orange county; Alachua county; Dade county (coral rock); Hernando county; Hillsborough county; Leon county; Marion county; and many additional localities.
Limonite	Bog iron ore, "hard-pan" ore.	Found around Beauclerc, Duval county, 12 miles east of Seville, and at several points on the Jacksonville, Tampa and Key West railroad, Volusia county.
	Phosphate rock	Found at intervals along the limestone ridge which extends north and south through the middle of the State. The deposits already noted are in an irregular line from Thomasville, Georgia, through Hamilton, Suwannee, Alachua, Marion, Sumpter, Polk, and De Soto counties, ending near Charlotte harbor in Manatee county. Noteworthy deposits are: In Alachua county, 2½ miles north of Waldo, near Fort Harley and Santa Fé lake, at Devil's Millhopper, a sink-hole 5 miles west of Gainesville, and at Hawthorn and Newnansville; at Ocala, Marion county; on Peace river at Arcadia, De Soto county. Isolated occurrences have been noted near Crawfordville, Wakulla county, in Gadsden county, and on Black creek, Clay county.

GEORGIA—Mined.

Barite	Barytes, heavy spar	Cartersville and Stegall, Bartow county.
	Buhrstone, millstone	Early, Burke, Screven, Bullock, and Jefferson counties.
Chalcopyrite	Pyritous copper ore, yellow copper ore, copper pyrites.	Canton mine, Cherokee county; other localities in Lumpkin, Fannin, Towns, Fulton, Carroll, Murray, Paulding (Paulding Copper Co., at Dallas), Haralson (Tallapoosa Mining Co.), Greene, and Lincoln counties.
Coal	Coal	Bituminous coal. Dade county on west brow of Lookout mountain; Coal Measures, in Chattooga county and in Walker county.
Gold	Gold	Auriferous district occupies one-third of State from North Carolina and Tennessee southwest and west to Alabama, occupying a large number of counties. Deep mines and placers, worked chiefly in Rabun, Lumpkin, Bartow, Dawson, White, Hall, and Union counties. The mining centers are at Dahlonega and vicinity, and about Auraria, in Lumpkin county. A third district is on east side of State, in McDuffie, Lincoln, and Wilkes counties. Gold occurs in quartz seams and veins, which traverse micaceous, talcose, chloritic, and hornblendic schists. The soils, disintegrated rocks and gravels, and sands also are gold-bearing over wide areas. In Bartow county the gold belt is well defined and is worked in a small way. In all the counties mentioned mining is carried on, but irregularly, on a small scale, and often only in the interval between planting seasons.
Graphite	Plumbago, black lead.	Stegall Station, Bartow county; Powder Springs, Paulding county.
Halloysite		Dade county.
Hematite	Red hematite, fossil ore.	Lookout mountain, Dade county, a continuous stratum 1 to 3 feet thick; McLemore's cove, Dade county; Iron ridge, Walker, Catoosa, Chattooga, Whitfield, and Floyd counties.
Hematite (2)	Specular iron ore	Allatoona hills, along Etowah river, Cherokee county, extensive deposits; valley of Etowah river, in Cass, Floyd, Murray, and Paulding counties. Bartow, Cobb, Milton, Pickens, Fannin, Gilmer, Union, Lumpkin, and Towns counties.

GEORGIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite	Brown hematite	Mine of Cherokee iron works, 5 miles east of Cedartown, Polk county, very extensive bed; Ætna iron works ore bank, Ætna, Polk county; ore banks of Ridge Valley iron works, Floyd county; Hall's Station banks and Bartow iron works, Floyd county; Peach-tree bank, Bartow county; iron ore reported also in Fannin, Gilmer, Whitfield, Catoosa, Gordon, Haralson, Milton, Hall, Habersham, White, Jackson, and Walker counties, in northwest and north part of State; in Greene, McDuffie, and Burke, in central belt. Bartow county supplies brown hematite to Chattanooga, Birmingham, and other points. Fine deposit at Hawkinsville, Pulaski county.
	Marble	Near Van Wert, Polk county, white; Fannin, Gilmer, Whitfield, Floyd, Walker, Catoosa, and Chattooga counties, all in northwest part of State. Extensive quarries in Pickens, Gilmer, and Fannin counties.
	Marl	Bibb, Chattahoochee, Stewart, Quitman, Thomas, Randolph, Clay, Crawford, Washington, Houston, Pulaski, Charlton, Burke, Screven, Effingham, Chatham, Bullock, Emanuel, and Jefferson counties. These counties occupy central and southern parts of State. Marls have limited use in immediate vicinity of diggings.
Muscovite	Mica	Warren, Pickens county; Heard, Cherokee, Gwinnett, Towns, and Carroll counties.
Pyrolusite	Manganese dioxide	Whitfield and Catoosa counties. Dade mines at Cartersville shipped largely in 1887.
	Slate (roofing)	Gentry's quarry, near Van Wert, Polk county; Rockmart, Polk county; Gordon and Bartow counties.

GEORGIA—Not Mined.

Amethyst	Amethyst	Rabun, Cobb, and Oglethorpe counties.
Arsenopyrite	Mispickel	Canton mine, Cherokee county.
Asbestus	Asbestus	Rabun, Fulton, Towns, Habersham, De Kalb, Paulding, and Troup counties.
Barite	Barytes, heavy spar	Near Allatoona, Bartow county, extensive bed; Murray and Bartow counties.
Chalcocite	Vitreous copper, copper glance.	Canton mine, Cherokee county; other localities with chalcopyrite.
Chromite	Chrome iron ore	Fine exposures in Towns, Heard, and Fayette counties.
Corundum	Emery	Rabun, Towns, Paulding, Cobb, De Kalb, Douglas, Cherokee, and Union counties.
Covellite	Indigo copper	Canton mine, Cherokee county, with chalcopyrite and chalcocite.
Diamond	Diamond	White and Hall counties; only few finds thus far. A recent find of a 4-carat diamond in Clayton county.
Galenite	Galena, sulphite of lead.	Harris mine, Hall county, argentiferous galena with pyrite; Cohutta mountains; Murray, Floyd, Lincoln, Habersham, Hall, Fannin, Catoosa, and Union counties.
Garnet	Garnet	Turner's mill, Paulding county.
Genthite	Nickel silicate	With millerite in Towns county.
	Granite	Stone mountain; Gwinnett, De Kalb, Heard, Oglethorpe, Clarke, Muscogee, Columbia, Richmond, Hancock, and Wilkes counties.
Graphite	Plumbago, black lead.	Pickens and Carroll counties (specimens); Habersham, Cherokee, Carroll, Clarke, Elbert, and Hart counties.
Halloysite		Walker, Catoosa, and Cherokee counties.

GEORGIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Itacolumite....	Flexible sandstone ...	Hall county; whole Chattahoochee ridge.
Kaolinite	Kaolin, porcelain clay.	Cherokee, Pickens, Heard, McDuffie, Columbia, Baldwin, Fulton, Bartow, and Richmond counties.
Limonite	Ocher......	Bartow county.
Limonite (2) ...	Umber..............	Bartow county.
Magnetite	Magnetic iron ore.....	Near Rome, Floyd county; near Villa Rica, Carroll county, no well-defined vein; Lumpkin, De Kalb, Gilmer, Cherokee, Cobb, Gwinnett, Hall, and Habersham counties.
(?)	Manganese ore........	Towns, Lincoln, Fannin, Marion, and Bartow counties. In latter has been mined for use in manufacture of ferromanganese.
Molybdenite...	Sulphide of molybdenum.	Heard county.
Novaculite	Oilstone	McDuffie, Oglethorpe, Troup, Meriwether, Heard, and Lincoln counties.
Opal	Opal (fire opal)........	Fire opal, Washington county; good specimens as gems; Bullock county; hyalite in Burke and Screven counties.
Pyrite	Pyrites, iron pyrites..	Fulton, Paulding, Haralson, Lumpkin, and Carroll counties.
Sapphire.......	Sapphire and ruby....	Blue sapphires have been found on Sequale creek; ruby in Towns county.
Serpentine.....	Serpentine............	Rabun, Towns, and Union counties.
Silver, native..	Silver................	Union, Hall, and Murray counties.
Steatite........	Talc, soapstone.......	Dalton, Whitfield county; Cobb, Union, Fannin, Gilmer, Hall, Habersham, White, De Kalb, Fulton, Murray, Jasper, Paulding, Elbert, and Clayton counties.
Tetradymite...	Tellur-bismuth	Polk, Lumpkin, Paulding, and Cherokee counties.
Tripolite	Infusorial earth	Murray, Whitfield, and Lincoln counties.

IDAHO—Mined.

Anglesite (argentiferous).	Sulphate of lead	Wood river country; in surface ores of some of the argentiferous lead mines. Small deposits at Sawtooth and Vienna, Alturas county.
Argentite......	Silver glance	Silver City, Owyhee county; Yuba City, Alturas county; Monarch mine, Atlanta, Alturas county; reported from Custer county at Bay Horse, and elsewhere.
Arsenopyrite (auriferous).	Mispickel.............	Rocky Bar, Hardscrabble, Granite, Yuba, and Shaw's mountain districts, but frequent in many other localities. Argentiferous near Ketchum, Wood River district, Alturas county.
Azarite........	Blue carbonate of copper.	Lemhi county; Alturas county; notably in Atlanta and Wood River mining district in Alturas county; in Wood river with lead ores, and in Tahoma mine, Atlanta, Alturas county.
	Calcareous tufa	Used as flux at Ketchum, Alturas county.
Calcite	Limestone	Used as flux and burned for lime.
Cerargyrite....	Horn silver, "chloride."	Many mines of Owyhee and Custer counties; surface ore of Monarch lode, Atlanta and Smoky district, Alturas county; Horn Silver and other mines, Tara creek.
Cervantite.....	Antimony ocher	Small quantities in surface lead ores of Wood River country.
Cerussite (argentiferous).	Carbonate of lead, "carbonate."	Wood River and neighboring districts; Viola mine, Lemhi county; and many mines in Custer county.

IDAHO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcopyrite (auriferous).	Copper pyrites	In many gold mines.
	Clay (common brick)	Boisé City, Ada county; Ketchum, Bellevue, and many other localities in Alturas and other counties.
	Clay (fire)	Of poor quality; refractory furnace linings, commonly brought from Santa Cruz, California.
Dufrenoysite	Sulpharsenide of lead	Crown Point mine, Banner district; Wood River district, with lead ores in considerable quantity.
Freibergite	Argentiferous tetrahedrite.	Columbia, Pilgrim, and other mines; Sawtooth district.
Galenite (argentiferous).	Galena	Important deposits in Wood River country, Alturas county, and in Lemhi and Custer counties; with best gold ores in Bonaparte district.
Gold, native	Gold	Deep placers in Boisé basin, Boisé county; placer gold is found along many of the streams throughout the Territory and in the Snake river; Pine grove, hydraulic mining in many scattered districts; quartz gold in Yankee Fork, Mount Estes, Granite, Rocky Bar, Bonaparte, Atlanta, Red Warrior, Cañon creek, Shaw's mountain, Silver City, Florence, Warren's, Wagontown, and other districts; crystallized specimens from Gold Hill mine, Granite district, Boisé county, particularly fine. Important placers and quartz mines in Cœur d'Alene region.
Hematite	Iron ore	Used as flux in smelting the lead ores of Wood River mining district.
Limonite	Bog iron ore	Used as flux at Muldoon, Alturas county.
Malachite	Green carbonate of copper.	Lemhi county.
Marcasite	White pyrites	In some gold mines.
Muscovite	Mica	Near Ruthsberg.
Proustite	Light ruby silver, arsenical ruby.	Notably in Monarch and Buffalo mines, Atlanta; associated with pyrargyrite in Sawtooth and other districts.
Pyrargyrite	Dark ruby silver, antimonial ruby.	Atlanta district; Monarch, Tahoma, Jessie Benton, Buffalo, and other mines; Sawtooth district; Smiley's basin; usually a surface ore.
Pyrite (auriferous and argentiferous).	Iron sulphuret	In many gold mines; notably in Middle Boisé mining region; at Tahoma, Monarch, Buffalo, and Yuba mines, near Atlanta, Alturas county; argentiferous in Smoky district.
	Sandstone	Fine varieties of red and gray freestone near Boisé City.
Silver, native	Silver	Atlanta district, especially in the Jessie Benton mine at Atlanta; also in surface ores of Smoky district.
Sphalerite	Zincblende	Auriferous at Bonaparte mine and in the Ada Elmore mine at Rocky Bar, Alturas county. Argentiferous in Smoky district.
Stephanite	Brittle silver	Custer and Unknown mines, Yankee Fork; also in Queen's River district, and reported elsewhere.
Stibnite	Antimony sulphide	In argentiferous lead mines of Wood river.
Tetrahedrite	Fahlerz	With antimonial and arsenical silver ores. Occurs extensively with galena in Wood River country.

IDAHO—Not Mined.

Arsenopyrite (auriferous).	Mispickel	In many localities in small quantity; often not mined because of want of proper reduction works.
Asbestus (pyroxene, hornblende (?).	Asbestus	Custer county.

IDAHO—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Azurite	Blue carbonate of copper.	With other copper ores in many unworked deposits, as in Lemhi, Custer, and Alturas counties.
Bismuthinite	Sulphate of bismuth	Reported.
Calcite	Marble	Reported.
Cerargyrite	Horn silver	Custer county and elsewhere.
Cerussite	Carbonate of lead	With other auriferous and argentiferous lead ores; Salmon River valley and other places.
Chalcopyrite	Copper pyrites	Argentiferous, in large deposits, Weiser district.
Cinnabar	Cinnabar, sulphide of mercury.	Reported as float in many places.
	Clays	In many localities.
Cyprite (argentiferous).	Copper oxide, red oxide.	Large deposits in Weiser district.
Dolomite	Dolomite	
Erubescite	Variegated copper ore.	Weiser district.
Galenite	Galena	Many unworked deposits, in most counties.
Gold	Gold	Many unworked deposits.
	Granite	Principal country rock of central Idaho; often a good building stone, but unused.
Halite	Salt	In southeastern Idaho.
Hematite	Iron ore	Many unworked deposits.
Lignite	Coal	Owyhee, Ada, and Boisé counties.
Limonite	Iron ore	Many unworked deposits.
Malachite	Green carbonate of copper.	Many localities.
Magnetite (argentiferous).	Magnetic iron ore	Wood River country; Salmon river, etc.
Marcasite	White pyrites	
Molybdenite	Sulphide of molybdenum.	Wood River district (?).
Muscovite	Mica	Fine specimens of large sheets at Payette river and near Boisé City. Samples have been shipped.
Proustite	Light ruby silver	With other silver ores.
Pyrargyrite	Dark ruby silver	With other silver ores.
Pyrite (auriferous).	Iron sulphuret	Many quartz veins.
Pyrolusite	Manganese ore	Shaw's mountain.
	Sandstone	
Sphalerite	Zincblende, "black jack."	Seldom worked except as accidental component of precious metal ores.
Stibnite	Sulphide of antimony	In some silver mines.
Tetrahedrite	Fahlerz, gray copper	Weiser district.
(?)	"Trachyte"	Used as building stone in Wood River country.

ILLINOIS—Mined.

Mineralogical name.	Common name.	Remarks.
Coal, var. bituminous.	Coal, bituminous coal.	Coal Measures occupy three-fourths of area of State, from south end of Whiteside county southward to the Ohio river. Aggregate thickness, 1,400 feet. The coal seams are all above the conglomerate, excepting in extreme southern part of State. There are six or seven seams each from 6 inches to 3 feet thick in the Upper Measures; and Nos. 1 to 9 each from 6 inches to 9 feet thick in the Lower Measures. The principal mining localities are Streator, La Salle, Spring Valley, Braceville, Braidwood, Oglesby, Wenona, and Minonk in the region nearest Chicago and tributary to that market and the northwest; Peoria and Fulton counties, on the lower Illinois river; Mercer and Henry counties, in the northwestern portion of the field; Bloomington, Lincoln, Springfield and vicinity, Decatur, Danville, Pana, Mount Olive, Staunton, Gillespie, and other points in the central portion of the State; Collinsville, in Madison county; many places in Saint Clair, Randolph, Jackson, Marion, and Williamson counties in the south and southwest, tributary to the Saint Louis and Cairo markets, and Gallatin county and vicinity of the Ohio river. The Upper, and generally unfruitful, Measures are found superimposed upon the Lower in the central and southeastern portions of the State, and the thicker seams are consequently found here at a depth of from 250 to 1,000 feet. Elsewhere the Upper Measures disappear, and the more prolific seams come within about 100 feet of the surface. The mineral in these regions being more accessible, is much more generally worked, though the deposits have not the continuity and uniformity which characterize them at a greater depth. The exact area of the workable fields is unknown, as much of the State is covered by drift. In some places the coal has been eroded and the denuded area deeply silted; borings often show coal in unexpected places and its absence in others where it was believed to exist. Actual mining in 49 counties.
	Clay	Anna, Union county (see under fire-clay also); Golconda, Pope county, a superior porcelain clay. Brick clays are common throughout the drift deposits. Excellent brick clay in Deer Park township, La Salle, etc.
	Fire clay	In Coal Measures, under coal seams. Under coal 1 A, Madison county; Wolf's Run coal mines, a thick bed; Winchester, Scott county, under Exeter coal seam, and 3 feet to 12 feet thick; near Lowell, La Salle county, used largely for pottery; Ripley and La Grange, Brown county; near Rushville, Schuyler county; Avon, Fulton county; Rock Island county; Colchester, McDonough county, used for fire-brick, etc. Generally the clay under seam No. 1 is most refractory. Heavy beds near Kaolin, Union county.
	Flagging stone.........	Alton, Madison county; Thebes, Alexander county (known as "Thebes sandstone"); Joliet, Twelve-mile Grove. and Wallingford, in Will county; Columbia and Monroe in Monroe county, a blue limestone extensively quarried; Fairfield, Wayne county; in Wabash, White, and Hamilton counties, a sandstone in Coal Measures. Calhoun, Pike, Scott, and other counties also furnish fine flagging stone.
Galenite	Galena, lead sulphide.	Upper Mississippi lead district in northwest part of State, in Jo Daviess and Stephenson counties, an area of about 700 square miles. Principal groups of "diggings" are: Galena and vicinity, Vinegar hill, Council hill, Apple river, Elizabeth, and Warren. Ore occurs in vertical crevices and in flat sheets in Galena limestone. Rosiclare lead mines and Lead Hill mines, Hardin county; galena with fluorspar and at Rosiclare with blende, also, in Saint Louis limestone—argentiferous. Pope county, several localities, accompanied by fluorite, but in small quantities. Southwest part of Jackson county, in very small pockets, in cherty limestone.
Halite	Common salt, brines ..	Near Equality, Gallatin county; salt made from brines. Salt formerly made in large quantity from brines, Brownsville, Jackson county; Central City, Marion county; Salt and Middle Forks, Vermilion county; and on Saline river, near Harrisburgh, Saline county. Salt wells at Peoria used only for minerel water. Brines also in Perry, Madison, Calhoun, and other counties

ILLINOIS—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Hydraulic limestone, cement rock.	Southwest corner of Saint Clair county, from limestone at base of Saint Louis group; Piasa creek, Madison county; Calhoun county, lower part Saint Louis limestone; bluffs of Piasa creek, Jersey county, lower part of Saint Louis limestone; Utica, La Salle county, ; beds in magnesian limestone below the calciferous limestone.
	Limestone	The limestone formations furnish stone at many localities. Following are more prominent: Randolph county; Madison county; Nauvoo, Hancock county; Warsaw, Hancock county; Rosiclare limestone, Hardin county; Phebes, Alexander county; near Jonesborough and Anna, Union county (Saint Louis limestone); Bald Rock quarries, Jackson county; Grafton quarries, Jersey county, in the Niagara limestone; Jerseyville, Jersey county (Saint Louis limestone); near C rrollton, Greene county; La Salle, Homer, Covell creek, and Lowell, La Salle county, in Trenton beds; Athens, Cook county, known as "Athens marble;" Lemonte, also in Cook county, "Lemonte marble" (these are largely used in Chicago); Quincy, Adams county, large quarries in Burlington limestone; Batavia and Aurora, in Kane county, quarries in horizon of Niagara limestone; Saratoga, Grundy county, also in Trenton; Will county quarries largely worked in the Niagara limestone at Joliet, Lockport, and Wallingford (stone known as "Joliet marble"); Gladstone, Henderson county; Cedar creek, Warren county; Dunleith, Jo Daviess county; Freeport, Stephenson county; Savannah, Carroll county; Harlem and Cherry valley, in Winnebago county; Buffalo creek, Ogle county; Big Springs and Franklin, Lee county; Calhoun county, quarries in Galena, Niagara, and Cincinnati limestone; Sterling, Whiteside county. Many other points for local use.
	Natural gas	Litchfield, near Urbana, Savoy, Mattoon, and other places; usually in small quantity.
Quartz	Sand, glass sand	La Salle county, Saint Peter's sandstone is quarried for glass manufacture at La Salle, Peru, Streator, and Ottawa; Rock river, Ogle county and Lee county; Cap au Gres bluff, Calhoun county; Ottawa and Millington, Kendall county; Kangley, and near Utica.
	Sandstone	T. 1 N., R. W., Saint Clair county; Drury creek, Jackson county; Greenbush and Berwick, Warren county; Andalusia, Rock Island county; along Kickapoo river, Peoria county; west of Springfield, Sangamon county; Xenia, Clay county; all in sandstones of Coal Measures or in conglomerate sandstones. Many other localities for limited use.

ILLINOIS—Not Mined.

Mineralogical name.	Common name.	Remarks.
Asphaltum	Bitumen	Western limits of Chicago and elsewhere in Niagara limestone, in small quantities. Carroll county, in black shales of Cincinnati group. In geodes in Jersey county.
Cerussite	Carbonate of lead, white lead ore.	Upper Mississippi lead region, with galena; rare.
Chalcopyrite	Copper pyrites	Rosiclare lead mines, Hardin county, with fluorspar an galena.
Copper, native.	Copper	On drift in northern and central counties, more rare at south. Unimportant.
Fluorite	Fluorspar	Rosiclare lead mines, Hardin county, large quantities with galena; Lead hill, same county; several places in eastern part of Pope county.
	Fire clay	Large deposits unworked, in connection with nearly all the coal beds.
Gold	Gold	Vermilion county and elsewhere in drift gravel. Doubtful importance.
Galenite	Galena, lead sulphide	In small quantity at Lowell.

ILLINOIS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Hematite	Hematite, red iron ore.	Cooper's quarry, in Jersey county, thin bed; Whitaker's creek, Greene county; Calhoun, Pike, Scott, and Madison counties, at base of Saint Louis limestone.
Lignite	Wood coal, brown coal.	Pulaski county; Alexander county, thin seams, Tertiary. Sometimes found in drift gravel in small quantities and mistaken for Tertiary lignite.
Limonite	Brown hematite	Several localities in Hardin county, formerly worked for supply of local furnaces; Iron mountain, Union county (very thin); near Avon and Utica, in Fulton county, thin beds; Marsden lead mine, Galena, with lead ore in small quantities.
	Marl	T. 38, R. 12, Cook county. A freshwater shell deposit; of small importance.
Niter	Niter, saltpeter	In caves, Jackson county, and on Cave creek.
	Peat	Cook county, several localities; west of Utica, La Salle county; Carpenterville, Rutland, and Hampshire, in Kane county; McHenry and Lake counties; Florence, Stephenson county; Boone township, Boone county; Monroe, Ogle county; Lee county; Cat-tail slough, in Whiteside county, very large body; Gold township, Bureau county. In glacial drift 50 to 90 feet below surface, of variable quality, most commonly only a soil rich in humus.
Petroleum	Petroleum	Near Chicago, in Cook county, in cavities in Niagara limestone, but not of economic importance. In similar situations and in Coal Measures in Macoupin county and at other places. In Devonian, in Jersey county; Lowell, La Salle county, from Trenton limestone.
Pyrite	Pyrites, iron pyrites.	In lead region of Jo Daviess and Stephenson counties. In limited quantities in many counties, especially in Coal Measures in layers of argillaceous slate.
Selenite	Gypsum	In Coal Measures in small quantities.
Silver	Silver	Traces in galena, upper Mississippi lead region; also in galena of Hardin county mines.
Siderite	Carbonate of iron, kidney ore, clay limestone.	Seller's landing, Hardin county; Sugar creek, T. 2, R. 1 E., Schuyler county near Palestine, Crawford county; T. 1 S., R. 10 E., Edwards county; several localities in Wayne county; these and other localities in Coal Measures, beds thin, from 1 to 2 feet thick, generally poor.
Smithsonite	Carbonate of zinc, "dry-bone."	Associated with galena and blende in lead mines, Jo Daviess county.
Sphalerite	Zincblende, "black jack."	Jo Daviess and Stephenson counties, with galena in small quantities. On Little Vermilion river, Vermilion county; Rosiclare lead mines, Hardin county, with galena. In small quantities in the Keokuk limestone in geodes in Madison, Jersey, and several other counties.

INDIANA—Mined.

Coal	Coal, bituminous coal.	The coal field of this State has an area of 7,000 square miles, occupying Warren, Fountain, Vermillion, Parke, Vigo, Clay, Owen, Sullivan, Greene, Daviess, Pike, Spencer, Perry, Vanderburgh, Dubois, Crawford, and Posey counties, in which many mines are opened, and others where less work has been done. The "block coal" field occupies about 600 square miles, stretching in a belt from 3 to 10 miles wide, from Warren county south to the Ohio river. It is mined extensively at Brazil and Carbon City, Clay county; also in Vigo, Parke, Owen, and Spencer counties. The block coal is largely used without coking in iron furnaces. Twelve coal

INDIANA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Coal (cont'd)...	Coal, bituminous coal.	seams are recognized in Indiana, and five are generally accessible, varying from 6 inches to 11 feet in thickness. The aggregate thickness of the two block coal seams is 8 feet. Four are workable, varying from 1½ to 4 feet thick. Coking coal is extensively mined in Warren, Fountain, Vermillion, Parke, Vigo, Clay, Sullivan, Greene, Daviess, Dubois, Pike, Perry, Spencer, Knox, Gibson, Vanderburgh, and Posey counties. The general thickness of the coking coal seams is 22 feet; six are workable, varying from 3 to 7 feet, averaging over 4 feet.
	Clay (fire)	South Otter creek, Clay county; Brazil and vicinity, also in Clay county; used extensively for firebrick and pottery; Reelsville, Putnam county; Parke county, and in many other localities as bottom bed to coal seams in Coal Measures area, in massive beds from 3 to 12 feet thick. Choice fire clay at Hillsdale, Vermillion county, and at Brazil, Clay county. Used for paint in Vigo county.
	Clay (pottery and terra cotta).	Under the coal seams, at Covington, Attica, and Lodi, Fountain county; Clinton, Hillsdale, and Eugene, Vermillion county; Montezuma, Annapolis, and Bloomingdale, Parke county; near Terre Haute, Vigo county; all parts of Sullivan and Clay counties; near New Harmony, Posey county; near Boonville, Warrick county; Huntingburgh, Dubois county, and Tell City, Perry county. Fluvatile clays extensively used by the Indianapolis potteries. Encaustic and terra cotta works at Brightwood, Vermillion county; near Montezuma and Annapolis, Parke county; near Crawfordsville, Montgomery county; superior ware made from Clay county deposits, and in several of the northern tier of counties.
	Flagging stone........	Laurel, Franklin county, several quarries; Wabash and vicinity, Wabash county; near Paoli, Orange county; other localities for local use. The quarries at Saint Paul and Greensburgh, Decatur county, and Putnamville, Putnam county, supply large quantities of fine stone.
	Glass sand	Pure white sand in large pockets at New Providence, Clark county, and near Elizabeth, Harrison county. Extensively used. A high hill, known as the Hoosier slide, at Michigan City, furnishes a large and cheap supply for green and colored glass.
	Grindstone	French Lick quarries, Orange county. Widely used and known as "Hindostan stone"; Dishman's quarry, northwest part of Orange county; Huron, Lawrence county. For heavy machinery, from southwest part of Harrison county. Also Chester sandstone, Redwood creek, Warren county, and Leavenworth, Harrison county.
Halite	Common salt, brines..	Coal creek, Fountain county; salt made on small scale from brines; Salt creek, Franklin county; near Hartford, Vigo county; Ott and Benham wells, Crawford county; Salt Lick, near Hartford, Dearborn county; Lodi, Fountain county, in borings in sub-Carboniferous rocks; artesian well, Terre Haute and Maxville, Vigo county; Reelsville, Putnam county; also bores in sub-Carboniferous rocks. In most deep borings for oil and gas brine is found from 100 to 2,500 feet below surface.
	Hydraulic limestone, cement rock.	On Ohio river and Silver creek, in Clark county. Hydraulic limestone is extensively quarried at Cementville, Clarksburgh, and Sellersburgh. Brown's landing, Cedar grove, and Brigg's farm, in Harrison county, a bituminous, shaly limestone; Somerset, Wabash county.
Kaolinite (Indianite in part).	Kaolin................	Bedford, Lawrence county (a very pure clay, widely used); Martin and Perry counties, earthenware clay; vast beds on and near surface between Elizabeth and Rosewood, Harrison county; also a deposit near Braysville, Owen county. At these last two places little pure white kaolin—mostly colored by iron and manganese oxides.

INDIANA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Limestone	Magnesian limestone (Upper Silurian and sub-Carboniferous) is quarried at many points in a belt extending from the Ohio across the State to the Wabash, in Huntington, Wabash, Miami, Cass, Howard, Delaware, Madison, Jasper, White, Hamilton, Shelby, Decatur, Jennings, Jefferson, and Carroll counties. The oölitic limestone (Saint Louis group) is largely quarried in Harrison, Crawford, Washington, Lawrence, Monroe, and Owen counties. Principal localities of quarries are: Mauckport and King's cave, Harrison county; Salem, Washington county; Ellettsville and Stinesville and Bloomington, in Monroe county; Spencer, in Owen county; Bedford and vicinity, Lawrence county, a gray, oölitic stone and large quarries; Wabash, Wabash county; Logansport, Cass county; Kokomo, Howard county; Eaton, Delaware county; Anderson, Madison county; Greencastle and Ocala, in Putnam county (Upper Saint Louis limestone); Longwood, Fayette county; Laurel and vicinity, Franklin county; New Point and Saint Paul, Decatur county; Fort Ritner, Jackson county; North Vernon, Jennings county; Osgood, Ripley county; Salem, Washington county; Knocksfells and Edwardsville, Floyd county; T. 4, R. 2 E., Jackson county; Bennington, Switzerland county; Saint Leon and Weisburg, Dearborn county; Vigo county.
	Lithographic stone	Near Corydon, Harrison county.
	Molding sand	Excellent quality and in quantity, mined at Centreton, Morgan county.
	Natural gas	In a broad belt and in large quantities at high pressure in Trenton rock (Lower Silurian) in Marion, Miami, Henry, Hancock, Hamilton, Tipton, Howard, Grant, Madison, Randolph, Delaware, Blackford, Wells, De Kalb, Adams, Wabash, and Jay counties, at 930 to 1,750 feet. In smaller quantities in Henry, Rush, Shelby, Decatur, Dearborn, Jefferson, Clark, and Fayette counties. Low pressure gas in southern part of Harrison county, and in smaller quantity in Parke, Vermillion, Vigo, Sullivan, Gibson, and Perry counties. Natural gas an important resource of the State.
	Ocher	Red and yellow ocher in southwest part of Owen county. Ocherous paints of many colors made at Dover Hill, Martin county, and at Ferdinand, Dubois county.
	Peat	Beds of great extent in Elkhart, Noble, Steuben, and other counties; not used as fuel.
Petroleum	Petroleum	In deep bores at Royal Center, Cass county. Heavy lubricating oil at Francisville, Pulaski county. Several wells at Montpelier, Blackford county. In small quantity at Cicero, Peru, Winchester, Brightwood, Greenfield, and Warren.
Quartz	Ganister	Knightsville, Clay county.
	Sandstone	Chester sandstones (sub-Carboniferous) well developed in Warren county, and thence in a belt traceable to Ohio river. Quarries at Williamsport and Attica, in Warren county; French Lick and Paoli, in Orange county; East Cannelton, Perry county; T. 7 and 6, R. 4 W., Greene county; near Attica and Portland, in Fountain county. Some of these quarries are actively worked, and furnish large amounts of stone.
	Whetstone and oilstone.	French Lick quarries, Orange county, above lepidodendron and fire-clay beds, three separate layers, 110 feet in all, overlying 90 feet of grindstone grit; excellent quality and large quantity for cutlery and fine tools, known as "Hindustan whetstones and oilstones."

INDIANA—Not Mined.

Copper, native.	Copper	In drift, very sparingly and rare.
Diamond	Diamond	A few small ones have been found in drift, Martinsville, Morgan county.

INDIANA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gold, native	Gold	Northeast corner of Brown county, in drift once worked. Also found in Franklin, Warren, and southern part of Morgan and Pike counties, and throughout the drift area, with garnet and magnetic sand, but in minute quantities.
Limonite	Brown hematite	Clay county, at base of millstone grit, thin bed; Greene county; Eugene, Vermillion county; many places in Martin county; Fayetteville, Lawrence county; thin beds at all these. Small beds of bog iron ore in Kosciusko county.
Limonite (?)	Bog iron ore	T. 10, R. 6 W., Clay county; Norton's creek and Helton's prairie, Vermillion county; several localities in Daviess county; Laporte and Saint Joseph counties; Ore prairie, Noble county; Jasper county.
	Natural gas	Many new localities as yet not largely productive, in addition to those in "mined" list.
	Peat	Small beds in Kosciusko county.
Pyrite	Pyrites	Disseminated through some strata of Coal Measures. Along Silver creek (Genesee Shale), in Clark county. Elsewhere common in small quantity. In roof of coal beds K and N.
Siderite	Carbonate of iron, clay ironstone.	Eaglesfield, Putnam county, formerly mined; Parke county; Coal creek and on Wabash river, in Fountain county; Brouillet's creek, Vermillion county; Browntown branch, same county, beds 18 inches to 3 feet thick; Henryville, Clark county; Vienna and Finley townships, Scott county, very lean; but manganiferous ores; sixteen beds, each 10 inches, down to 2½ inches, thick, separated by shaly strata 2 to 3 feet thick; in Vigo county; some of these beds were formerly worked; about 3,000 acres in Jasper, Stark, White, and Cass counties in layers of 1 to 3 feet thick; Indian Creek township, Monroe county.
	Marls	Rome City, Noble county; Lake James, Steuben county, and other localities in northern part of State.
Niter	Saltpeter, niter	Caves in Harrison and Crawford counties.
Petroleum	Petroleum, rock oil	Many occurrences, partly prospected, but not yet commercially important, in addition to those named in "mined" list.
Sphalerite	Zincblende	In Coal Measures sparingly, along Little Vermillion river, Vermillion county.
Tripolite	Infusorial earth	Ferdinand, in Dubois county, in cavities in limestone.

INDIAN TERRITORY—Mined.

Coal	Coal, bituminous coal.	Valuable mines at McAllister, Atoka, and other points on Missouri Pacific railway.

INDIAN TERRITORY—Not Mined.

(?)	Copper ore	Wichita mountains, southwestern part of Territory.
Gold (?)	Gold	Reported in Wichita mountains.
Coal, var. lignite	Lignite	In Cretaceous formation near Red river, southeastern part of Territory.
	Granite	Ozark hills, in eastern part.
Halite	Common salt	Salt licks in western part of Territory; have been sometimes utilized in a small way.

IOWA—Mined.

Mineralogical name.	Common name.	Remarks.
Coal, var. bituminous.	Coal, bituminous coal.	The Iowa coal field occupies about one-third of the State at southwest, and an area of 7,000 square miles or more. The Lower Coal Measures, or coal-producing territory, occupies a belt 175 miles long and 50 miles broad, which is traversed by the Des Moines river. Thickness, 200 feet. The principal mining localities are in Lee county; Hillsborough and Farmington, in Van Buren county; mines in Henry county; Coalport and Fairfield, in Jefferson county; Ottumwa, in Wapello county; Oskaloosa, in Mahaska county; Pella and Otley, in Marion county; in Warren county; Gilbert station, Story county; Des Moines, Polk county; Newton and Colfax, Jasper county; Boonesborough and Angus and Moingona, Boone county; Webster City, Hamilton county; Fort Dodge, Webster county; Eldora, Hardin county; What Cheer, Keokuk county; Muscatine and Davenport, in outlying patches, in Scott and Muscatine counties; an outlying patch at Blairstown, Benton county.
	Fire clay	Danville, Des Moines county; True Blood and Hyatt's mill, Henry county; Portland and Cedar creek, in Van Buren county; Red Oak, Montgomery county; Des Moines, Polk county; Jefferson and Wapello counties.
	Flagging stone	Denmark, Lee county (limestone); Washington, Jackson county (limestone); Hopkinton, Delaware county.
Galenite	Galena, sulphide of lead.	Lead district near Mississippi river, northeastern part of State, area of about 700 square miles. Valley Tetedes Morts diggings, Dubuque county (abandoned); vicinity of Dubuque, from Catfish creek to Little Maquoketa river, a belt 3 to 4 miles wide, area 15 square miles, has been very productive in many diggings; Buena Vista diggings, Clayton county; Benebalt creek, Clayton county; Gutenberg, on Mississippi and on Miners' creek; Mineral creek and near New Galena, Allamakee county. In Lower Magnesian limestone.
Gypsum	Gypsum	Near Fort Dodge, on Des Moines river, Webster county, thick beds of great extent.
	Hydraulic limestone, water lime, cement rock.	Buff beds at base of Trenton used for hydraulic limes; other magnesian limestone also used.
	Limestone	Near Waukon, Allamakee county; Dubuque, quarries in galena limestone; Maquoketa, Jackson county, extensive quarries in the magnesian limestone (Niagara); near Le Grand and Quary ("Iowa marble"), Marshall county; Farley and Manchester (magnesian, Niagara); Des Moines county, quarries in limestone of Carboniferous age known as Burlington limestone; the Keokuk limestone (Carboniferous age) is also extensively quarried near asylum, Mount Pleasant, Henry county; Lee county, on Mississippi (Keokuk limestone), Des Moines, Van Buren, Wapello counties; Iowa City, Johnson county, quarries in limestone of Hamilton group; Mason City, Cerro Gordo county; Pella, Marion county; Guttenberg, Clayton county; Trenton limestone is extensively quarried; Le Claire, Scott county (Niagara limestone); limestone for lime-burning at Maquoketa, Jackson county; Dubuque, Le Claire county; Cedar Rapids, Cedar county; Viola, Mt. Vernon, and numerous other places, as building stone at Anamosa, Stone City, Le Grand, Farley, etc.
	Marble	Chequest creek, Van Buren county (known as Chequest marble, white); Bonaparte (gray) marble, near Bonaparte, Van Buren county; Charles City, Floyd county (fossil marble, fine, used for mantels, table tops, etc.).
Sphalerite	Zincblende, "black jack."	In lead district, Dubuque and Clayton counties, associated with galena in flat crevices and fissures in Galena limestone; near Fairfield, Marion county; a large body in Allamakee county.

IOWA—Not Mined.

Anglesite	Sulphate of lead	In small quantities only, with galena.
Barite	Barytes, heavy spar	Accompanies galena; frequently in galena limestone.

IOWA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Cerussite	White lead ore, carbonate of lead.	Rare in lead region, associated with galena.
	Fire clay	Occurs in Coal Measures in southwest counties.
Limonite	Brown hematite	Jackson county, not in workable amount; Clinton county, numerous localities in Niagara limestone, but not of economical importance; on Skunk river, Henry county (a lean ore); near Waukon, Allamakee county (50 to 60 per cent.).
Smithsonite	Carbonate of zinc, "dry bone."	Common in lead region with blende in small quantity; on Little Maquoketa river, Dubuque county, in quantity.

KANSAS—Mined.

Calamine	Zinc silicate	Short Creek lead mines, with galenite and blende, worked for zinc.
Cerussite	Lead carbonate	Short Creek diggings, with galenite and blende.
	Clay	Fire clay in Coal Measures, Fort Scott, Bourbon county, under the coal; Lawrence, Douglas county; thence to near Leavenworth, Leavenworth county; Mill creek; in all the eastern counties as far west as Manhattan.
Coal	Coal, var. bituminous.	Coal Measures in eastern part of State, 22,000 square miles. Twenty-two beds from few inches to 7 feet thick; lower beds thicker; southeastern part of the State, south of the Kansas and east of the Shawnee, has workable beds in nearly every county; aggregate thickness of beds exceeding 1 foot thick is 25 feet. This coal is of good quality, some of it very free from sulphur; it cakes and cokes well; beds crop out in Brown, Doniphan, Miami, Bourbon, Neosho, Woodson, Coffey, Osage, Shawnee, Jackson, Atchison, Leavenworth, Linn, Cherokee, Allen, Greenwood, Franklin, Douglas, Wabaunsee, and Nemaha counties; Upper Carboniferous in northeast part of State is worked for local supply in Jefferson, Brown, Doniphan, Atchison, Jackson, Leavenworth, and Shawnee counties, and perhaps others, not in quantity for market; three principal seams worked in Coal Measures area in southeastern part of State; one, Osage vein, Osage county, a good gas coal and cokes well, bed 15 to 20 inches thick; Fort Scott coal in Bourbon and Linn counties, near Missouri line, irregular in extent, a good gas coal, rarely 2 feet thick. Cherokee coal enters from Indian Territory across southeastern part of Labette, Cherokee, and Crawford, or southeast corner of State, thence northwest into vicinity of Booneville; cokes well; good gas coal and more free from impurities than other beds; from 15 to 54 inches thick.
Galenite	Galena, lead sulphide.	Potosi, Linn county, in shales of Coal Measures in fissures in sandstone; Pleasanton, unsuccessful attempts at mining several years ago; Baxter Springs, same; Standley mines, many openings, worked at a loss to get ore in quantity; Short Creek diggings, T. 34, R. 25 E., in chert conglomerate in cavities in clay, and as float ore with blende, worked for lead and zinc.
Gypsum	Gypsum	Quarried in places in Saline, Dickinson, Cowley, Sumner, and Marshall counties as a building material.
Halite	Common salt, brines, and rock salt	Extensive deposits in central part of State; Osawatomie, Miami county, several wells; near Hamlin, Brown county, springs; valley of Fall river, Greenwood county; Mound City, Linn county, brine in wells; Marmiton, brine in wells; Emporia, Lyon county; valleys of Fall and of Verdigris rivers, salt springs; State salt springs and other salt marshes in a belt of country crossing Republican, Solomon, and Saline valleys, 80 by 35 miles; rock salt, south of great bend of Arkansas river, in beds 6 to 28 inches deep; salt industries at Solomon City, Saline county; Junction City, Davis county; rock salt at Anthony (75 feet thick), Harper county; many borings at Hutchinson (250 feet thick) and Ellsworth (140 feet thick); Lyons (250 feet thick); Kingman (200 feet thick); of considerable economic importance and remarkably pure.

KANSAS—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Hydraulic limestone, water lime, cement rock.	Magnesian limestones at Fort Scott; Lawrence; Leavenworth, to some extent hydraulic (works at Fort Scott), manufactured at Lawrence also; Atchison county.
Lignite	Brown coal	Extensive beds in the Tertiary strata, Smoky Hill valley; beds of good brown coal over large part of western Kansas, range from 3 to 7 feet thick; few beds in Dakota (Cretaceous) group, always of inferior quality; most important seam is traceable for 170 miles from north to southwest across the State, 10 to 40 inches thick, friable, much ash and in places much pyrite of cheap value in some localities; found in Washington, Republic, Cloud, Mitchell, Lincoln, Ottawa, Saline, Ellsworth, McPherson, Rice, and Barton, and perhaps other adjoining counties.
	Limestone	Near Lawrence, Douglas county; Manhattan, Atchison, Leavenworth, etc.; near Fort Scott, in Bourbon county, a fine black marble; dolomitic limestone, resembling marble, white, gray, and cream colored, abounds in Triassic formation in valley of Blue, Republican, and Neosho rivers; Junction City, extensively used, soft and easily dressed.
	Natural gas	Paola, Miami county.
Petroleum	Petroleum, coal oil, rock oil.	Mainly "rock oil" from bituminous shales and used locally for lubricating.
Smithsonite	Zinc carbonate, "dry bone."	Short creek (lead diggings), in small quantities with galena, blende, etc.
Sphalerite	Blende, "black jack," zinc sulphide.	Standley mines with galena, many openings unsuccessful; Short Creek diggings with galenite and cerussite, mines worked for lead and zinc, extension of Jophin Creek zinc district.

KANSAS—Not Mined.

Gypsum	Plaster, gypsum	Immense beds in central part of State; deposits up to 50 feet thick crop out along the Blue, the Republican, the Kansas, and the Turkey creeks, and divides between Gypsum and Holland and Turkey creeks and Cottonwood, Chase county; thick bed on Gypsum creek 16 feet thick; also on Solomon, Saline, and Smoky Hill rivers; near Cimarron river, southern part of State, massive beds.
Limonite	Bog iron ore	Many localities in small quantities.
	Marble	A beautiful black marble with buff veins, in Scott county.
Petroleum	Petroleum, rock oil	Numerous places in State; Wyandotte county and near border of Indian Territory; Baxter Springs, Cherokee county; in Brown, Atchison, Leavenworth, Miami, and Riley counties; no wells are productive of oil in marketable quantities; gas wells at Iola, Fort Scott, Kansas City, La Cygne, Mound Valley, and Rosedale.
Pyrite	Pyrites, iron pyrite	Short Creek diggings, lead mines, with galena and blende.
	Sandstone	Many localities, near Fort Scott, quarries in a buff sandstone; bluffs of South fork of Pottawatomie.
Siderite	Spathic iron ore, kidney ore.	In Coal Measures on Marais des Cygnes; near Fort Scott; on the Neosho and many others, interstratified with beds of good coal.
Sulphur	Sulphur	Wabaunsee county, associated with lignite.

KENTUCKY—Mined.

Calcite	Limestone	Oölitic extensively quarried at Bowling Green, Warren county; Princeton, Caldwell county; occurs in Meade, Hardin, Hart, Barren, Christian, and Crittenden counties.

KENTUCKY--Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Coal	Coal, bituminous coal.	Coal Measures occupy eastern part of State, a part of the Appalachian coal field; bituminous variety along Big Sandy river, twelve distinct beds are known, 8,900 square miles; western Kentucky coal field borders Ohio river and in valley and Green river, area 4,000 square miles; twelve beds, identified 2 to 6 feet thick; carry more sulphur than the coals of the Appalachian field; many collieries near railroad line; cannel coal in Breckinridge county, south of Cloverport, on Ohio river; mines at Bennetsville; head branches of Far fork, Hancock county; Adams fork, Ohio county; of workable thickness in Johnson, Letcher, Pike, Harlan, Greenup, Jackson, Owsley, Magoffin, Wolfe, Knox, Clay, Breathitt, Knott, Floyd, Bell, Leslie, Perry, and Morgan counties: coking coal from 6 to 9 feet thick in Pike, Letcher, and Harlan counties.
Dolomite	"Marble"	Lower Silurian formation, excellent building material, found along Kentucky river in Clark, Fayette, Jessamine, Woodford, and Franklin counties; a buff and cream-colored dolomite, convenient to transportation; Niagara group in Nelson and Bullitt counties, of excellent quality and in vast quantities, quarried to some extent.
	Fire clay	In Coal Measures in Greenup, Carter, and other counties of eastern coal field, and Edmonson, Muhlenburgh, and other counties of western coal field; Boone furnace property, Carter county, bed 8 to 10 feet thick; St. Louis group; Londer's bank, near Kenton furnace, Greenup county; Pea ridge, Schultz creek, Greenup county; excellent fireclay (Tertiary) in Ballard, Hickman, and Fulton counties; near Blandville, Ballard county; McCracken, Fulton, and Hickman counties.
Halite	Salt, brines	Brine is obtained from wells in the eastern coal fields, and sub-Carboniferous limestones in western part of State; worked in Meade county; weak brines in Washington, Nelson, Boyle, Lincoln, and other central counties, from the Lower sub Carboniferous and the Upper Hudson River beds; a spring flows from the clayey limestones in Mercer county.
Hematite	Fossil ore	Bath and Fleming counties.
	Hydraulic limestone	Jefferson, Oldham, Meade, and Grayson counties; Ohio river falls, Louisville; Chenowick creek, Jefferson county; Mitchell's springs, Meade county; La Grange, Oldham county; Curry's fork of Floyd's creek, Oldham county; Bardstown, Nelson county; Grayson's springs, a magnesian limestone; Jeptha knobs, Shelby county; some layers generally in the base of the Trenton limestone, but have not been used for cement.
Limonite	Brown hematite	Red River iron region, between Licking and Kentucky rivers, ores at base of Coal Measures; Hanging Rock region, embracing whole or parts of Greenup, Boyd, Carter, Lawrence, and Johnson counties, in northeastern part of State. Iron made from these ores noted for its excellence for castings. In abundance from Ohio river southward to southern part of Carter county; Bath county, Cumberland River iron region, embracing whole or parts of Trigg, Lyon, Livingston, Crittenden, and Caldwell counties, in western part of State; occurs in clay and chert above Saint Louis, or sub-Carboniferous limestones, irregular shape and uncertain extent, but aggregate of ore immense; most extensive deposits are between the Tennessee and Cumberland rivers, and of excellent quality, Nolin district, in Edmonson, Butler, Muhlenburgh, and Grayson counties; ores occur near base of Coal Measures. Oriskany ore lately discovered on north slope of Pine mountain, Bell county.
	Lithographic stone	Glasgow junction, Barren county, and Estill county; localities in Wayne, Pulaski, Warren, and Rockcastle counties.
	Marl	Bullitt and Spencer county line, Lower Silurian; in all counties of Lower Silurian; in Clinton and Niagara shales of Madison, Garrard, Lincoln, Washington, Marion, and Nelson counties; in the Chester group of sub-Carboniferous in many counties is a marly shale with from 4 to 6 per cent. of potash, 1 or 2 per cent. of phosphoric acid, and 15 per cent. of lime.

KENTUCKY—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Natural gas	High-pressure gas at Warfield, Martin county; low-pressure gas in Meade county; quite a number of wells sunk and in operation; Bowling Green, Warren county.
Petroleum	Petroleum	Crocus creek, Cumberland county; upper Cumberland in Hudson rocks; Barren County wells, Devonian; Wayne, heavy lubricating oil; Pulaski and Lawrence counties.
	Sandstone, freestone	Cumberland sandstone in basin of Cumberland river, a greenish colored stone. Waverly period: Sandstones of this period have been extensively quarried; worked along the Ohio river and southeast of Mount Sterling, in Montgomery county; occurs along Licking, Kentucky, Salt, and Green rivers, also commonly known as "Buena Vista stone;" used largely in Cincinnati, Louisville, and other western cities; Bullitt's lick and Belmont furnace, Bullitt county; Triplett's creek, edge of Rowan county, building stone.
	Sandstone (2) "cement rock," ferruginous sandstone.	Mouth of Clark's river, McCracken county; Ballard's ford and others in Quaternary of McCracken, Ballard, Hickman, Graves, Fulton, Calloway, and Marshall counties.
Siderite	Carbonate ore, clay ironstone.	Red River district, stratified ore in the sub-Carboniferous limestone; Hanging Rock region in parts of Greenup, Boyd, Carter, and Lawrence counties, numerous local beds; Nolin river district in Edmonson, Grayson, Hart, Butler, and Muhlenburgh counties, near base of Coal Measures, largely undeveloped; in Whitney county near Cumberland falls.
Siderite (2)	Black band ore	Lawrence and Muhlenburgh counties; Jackson county, on top of lower coal; Green River valley.

KENTUCKY—Not Mined.

Apatite	Phosphate of lime	Phosphatic limestone in upper layers of Trenton formation in unusual quantities; in Oriskany sandstone, Clark county.
Barite	Barytes, heavy spar	Near Paris, Bourbon county; near Lexington, Fayette county; Anderson, Mercer, Owen, Henry, Franklin, Nicholas, Jessamine, Woodford, Boyle, Crittenden, and Garrard counties.
Epsomite	Epsom salt	In limestone caves in Clinton, shales of; Madison, Garrard, Lincoln, and Marion counties; in Hudson River group of Boyle county.
Fluorite	Fluorspar	Crittenden and Livingston counties, large deposits associated with galena.
Galenite	Galena, lead sulphide	Occurs sparingly at many localities in Saint Louis group of rocks; only mining done has been in western part of State; Columbia mines, Crittenden county; Anderson, Fayette, Livingston, Owen, and Cumberland counties, associated in places with barite and fluorspar; occurs in Carter county in eastern part of State, and in Boyle, Mercer, Garrard, Jefferson, Fayette, Woodford, Anderson, Franklin, Henry, and Owen counties, in center of the State.
Lignite	Brown coal	Fort Jefferson bluff and near Blandville, Ballard county; Graves and Hickman counties.
Niter	Saltpeter	Mammoth cave, Edmonson county; in small quantities in hundreds of caves in southern and central part of State, in limestones of the Trenton and Saint Louis groups.
Peridotite	Peridot	Two dikes in Elliott county; peridotite carries pyrope, olivine, ilmenite, serpentine, dolomite, magnetite, may be diamontiferous.
Sphalerite	Blende, black jack	Sulphur lick, Monroe county, with galena; Columbia mines, Crittenden county; in Lincoln, Garrard, Boyle, and Washington counties, in the Upper Silurian; in Boyle, Garrard, Mercer, and Jessamine counties, in the Trenton, associated with barytes and galena.
Witherite	Carbonate of baryta	Near Lexington, Fayette county, with barite. In Lincoln, Garrard, and Boyle counties in Upper Silurian; in Boyle county in sub-Carboniferous.

LOUISIANA—Mined.

Mineralogical name.	Common name.	Remarks.
Gypsum	Gypsum	Rayburn's salt works, southern part of Bienville parish, occurs in rounded masses in gypseous clay; Petite Anse, T. 13, R. 5 E., Vermillion parish, specimens only; boring for petroleum penetrated 148 feet of gypsum at Calcasieu parish, 13 miles from Lake Charles; near Grand View; selenitic clays 85 feet thick at Grand View, on Wachita river, Caldwell parish.
Halite	Rock salt	Petite Anse island, Saint Mary's parish, 4 miles west of Vermillion bay, Tertiary age, large deposit; worked actively during the war, and now producing.
	Marl	Montgomery, in Grant parish, "Zeuglòdon marl" contains glauconite; phosphatic and green-sand marl in bluff at Natchitoches, calcareous; Sicily islands.

LOUISIANA—Not Mined.

Calcite	Marble	Winn point, near Winnfield.
	Clay	White clay in Grand Gulf group of Tertiary; Catahoula parish; 10 miles southeast of Fort Jessup, in Natchitoches parish; Chalk hills, near Harrisonburgh, in Catahoula parish, good for pottery and brick.
Halite	Brines	Drake's salt works, artesian boring for brine, T. 12 N., R. 5 W., Winn parish; Price's T. 13 N., R. 5 W., same parish; Rayburn's salt works; also King's, in Bienville parish; old salt works in Natchitoches parish.
Hematite and limonite.	Iron ore	Rapides, Grant, Natchitoches, Sabine, Red River, Winn, Bienville, and other parishes,
Lignite	Brown coal	West Shreveport, Caddo parish; northwestern part of De Soto county, southwest of Natchitoches; T. 14, R. 3 E., in Caldwell parish; near Columbia, Caldwell parish; southeast corner Winn parish; eastern part of Bienville; near Homer, Claiborne parish (the above in Jackson group of Tertiary, others in northwestern part of State, west of Ouachita river); Coalkill creek, 6 miles east of Fort Jesup, Sabine parish.
Petroleum	Petroleum	Thirteen miles from Lake Charles, Calcasieu parish.
	Sandstone	Many localities in Grand Gulf group of Tertiary; in western central counties; in Sabine, Rapides, Grant, and Catahoula; also in eastern part of State bordering Alabama.
Sulphur	Sulphur, brimstone	Thirteen miles from Lake Charles, Calcasieu parish, 100 feet pure sulphur, then 148 feet of gypsum and sulphur at depth of 423 feet, in boring for petroleum.

MAINE—Mined.

Argentite	Sulphide of silver, silver glance.	Sullivan mines, Sullivan, Franklin, and Hancock, Hancock county, accompanying galena and ores of silver. Worked irregularly, and on a very limited scale.
Bornite	Purple copper ore, "horseflesh ore."	West Quoddy head, Lubec, Washington county, with chalcopyrite and pyrrhotite in veins; Blue Hill copper belt in Blue Hill, Hancock county, a belt of copper ores in quartzite and gneiss rocks, 4 miles long. Worked in several mines. Sparingly at all these places.
Chalcocite	Vitreous copper, "copper glance."	Blue Hill copper mine, Hancock county; occasionally with chalcopyrite and other ores of copper. Sparingly.
Chalcopyrite	Copper pyrites, yellow copper ore.	Campo Bello island, with pyrite in a vein in trap rock; Tapley and Manhattan mines, Brooksville, Hancock county, accompanying silver-lead ores; Blue Hill copper belt, on Blue Hill bay, Hancock county, in veins of granulated quartzite and gneiss; belt 4 miles long by half a mile wide; predominating ore accompanied by bornite, cuprite, and other ores of copper, several mines producing copper; Cape Rosier mine, Hancock county. Many localities in the State, notably at the Blue Hill, Brooksville, and Cape Rosier mines, where it is worked quite extensively. Immense beds of low grade ores occur in Whiting, Washington county.

MAINE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Feldspar	Extensively mined at Topsham, Sagadahoc county; Canton, Oxford county; and Brownville, Piscataquis county.
	Flagging stone	Phippsburgh, Sagadahoc county, mica schist; Acton and Lebanon, York county; Winthrop, Kennebec county; mica schists at these and other localities are available; also sandstones in northern part of State.
Gold	Gold	Gold alloyed with platinum has been mined from placers in Franklin county, near the Rangely lakes. Found *in situ* in Avon, Franklin county, now being explored. Although widely disseminated, is not supposed to be in paying quantities anywhere unless in the Rangely region of Franklin county. Gold occurs in Sullivan, Hancock county, with metallic bismuth; has been mined and milled on a small scale.
	Granite, gneiss, syenite.	Kennebunk, York county, several quarries, a dark-colored granite; Hallowell, Kennebec county, a gray gneiss quarried on west of Kennebec river, extensively quarried and widely known; Brunswick, Cumberland county; Phippsburgh, Sagadahoc county; Wiscasset, Lincoln county; Edgecombe, Lincoln county, a dark-colored granite; Seal harbor, Lincoln county, several quarries; Mount Waldo, Penobscot bay, porphyritic granite; Mosquito and Treat mountains on Penobscot bay; Blue Hill, Hancock county, several companies; Brooksville, Hancock county; Sullivan, Hancock county, immense quarries; islands in Knox and Lincoln counties; immense extent on shore of Hancock and Washington counties; also in Katahdin range, unworked; hundreds of quarries and localities along coast. Excellent black granite in Millbridge and Gouldsborough, Hancock county. Red granite equal to the Scotch is quarried near Calais, Washington county; and at Red Reach.
Graphite	Plumbago, black lead.	Georgetown, Sagadahoc county.
Hematite	Red iron ore	Katahdin mines, Piscataquis county.
	Limestone and marble.	Limestones of Rockland, Thomaston, Hope, and Camden; very many quarries worked for lime at Rockland and Thomaston; on St. George's river, Warren, and Union, several quarries; Aroostook county, T. 7, R. 6; Helderberg rocks running from Matagamon river northeast in Aroostook county.
Limonite	Brown hematite, bog iron ore.	Katahdin mines, Piscataquis county.
Muscovite	Mica	Edgecombe, Lincoln county; Topsham and Brunswick, Sagadahoc county, worked irregularly; Thomas Reynolds mine, Canton, Oxford county.
	Ocher	Lisbon, Androscoggin county.
Pyrargyrite	Ruby silver	Sullivan, Franklin, and Hancock, Hancock county, with galena, native silver, silver glance, pyrite, chalcopyrite, etc. Sparingly.
Quartz	Quartz rock and glass sand.	Mined extensively in connection with feldspar in Sagadahoc county; Paris, Woodstock, Hebron, Canton, Greenwood, and Albany, Oxford county; Auburn, Androscoggin county.
	Sandstone	Devonion sandstone, in Washington county, especially in Perry and Machiasport; small quarries; not worked steadily.
Silver, native	Silver	Sullivan mining district, Hancock county, associated with galena and silver sulphides; Byards point, Sedgwick, Hancock county, Edgemoggin silver mine. Sparingly.
	Slate (roofing)	For roofing; Brownville and Monson, Piscataquis county; Caratunk, Somerset county; thence in a belt to the Penobscot river; Foxcroft, Sebec, Barnard, and Williamsburg towns; T. 13, R. 3, Aroostook county and doubtless many other localities in this county; above Bingham and Concord on Kennebec river.
Sphalerite	Zincblende	Lead mines, Lubec, Washington county; Gouldsborough, Sullivan, and Hancock, Hancock county, accompanying galena; mines worked for silver lead. In workable quantities at

MAINE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Sphalerite (continued).	Zincblende	Deer Isle and Cape Rosier, Hancock county, with galena; and probably at Denbo point, Lubec, Washington county; Acton mining belt, Acton and Lebanon, York county; sparingly with argentiferous galena and silver lead ores in veins in granite—openings for galena and silver; Sedgwick, Hancock county; Chesterfield, Washington county, with blende very rich in silver.
Spodumene	Spodumene	Brown's ferry, Peru, Oxford county.
Stephanite	Silver glance, brittle silver ore.	Sullivan mining district, Hancock county, accompanying galena and ores of silver. Sparingly.
Talc	Steatite, soapstone	Ovis island, bed 14 feet wide; Vassalborough, Kennebec county; Harpswell; Jaquish. Deer Isle, mined and ground for paper filling.
Tetrahedrite	Gray copper ore	Blue Hill copper mines, Blue Hill, Hancock county, occasionally with ores of copper; Hampden, Harrington, and other mines; Hampden and Carmel, Penobscot county, opened for silver; occurs with galena and greenstone in a slate belt; Steuben, Washington county; ore rich in silver but in small quantity.
Tripolite	Diatomaceous earth, "fossil meal."	Occurs abundantly in Hancock county in all the pond bottoms near the coast. It is mined to some extent. Occurs in the Blue Hill ponds in a very white, fine variety, and in beds from 4 to 6 feet thick.
Wad	Bog manganese	Mined on a small scale at Blue Hill, Hancock county; and Sumner, Oxford county.

MAINE—Not Mined.

Arsenopyrite	Mispickel	Blue Hill, Hancock county, at copper mines; Owl's Head, Thomaston, Knox county; Bond's mount, Newfield, York county; Titcomb's hill, Farmington, Franklin county; Corinna, Greenwood, vein in granite; Rumford, Oxford county, in granite; Clinton and Skowhegan, in bog iron ores; Lebanon and Acton, York county, accompanying silver lead ores. Large deposit at Byard's Point, Hancock county.
Barite	Barytes, heavy spar	Deer Isle silver mine, Hancock county, in gangue of lead silver vein. Sparingly.
Cassiterite	Tinstone	Extremely doubtful whether in paying quantity. Sparingly at Paris and Rumford, Oxford county, in granite; Hebron, Black mountain, Rumford, Oxford county; Tubb's Cage, Norway, Oxford county; Winslow, Kennebec county, in thin veins in slate.
Cerargyrite	Silver chloride, horn silver.	Sparingly at Sullivan, Hancock county, with argentiferous galena, pyrargyrite, etc.
	Feldspar	Edgecomb, Lincoln county; common in granitic region of State.
Galenite	Galena	Milton, Oxford county; Lubec, Trescott, and Whiting, Washington county (argentiferous, with blende and chalcopyrite in veins in slate). Sullivan, Gouldsborough, Hancock, and Franklin townships, Hancock county (argentiferous, with argentite and stephanite). Galena occurs in very many localities in Maine, and is often argentiferous, said to average 60 ounces silver. Promising localities reported are Acton, York county; Lubec, Washington county; Deer Isle, Hancock county; and it is said that systematic mining might pay in these districts.
Graphite	Plumbago, black lead.	Belfast, Waldo county, disseminated through clay slate; Woodstock, sparingly in granite and mica slate; Rumford, Oxford county; Gardiner, on the Kennebec river, Kennebec county; Phippsburgh, Sagadahoc county.
Hematite	Red iron ore, red hematite.	T. 13, R. 4, Aroostook county, Waite plantation; Currier's, Aroostook county.

MAINE—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite	Brown hematite	Waite plantation, Houlton, Linneus, Aroostook county; Trescott, Washington county.
Limonite (2) ...	Bog iron ore..........	New Limerick, Aroostook county; Newfield; Dover, several deposits of large size; Pemaquid ledge; Rumford; Skowhegan, several large deposits.
Lollingite......	Arsenical iron........	Paris, Oxford county.
Magnetite	Magnetic iron ore	Marshall's island, Hancock county; in bed 3 feet wide; Mount Desert island, Black's island, Hancock county; Buckfield, Oxford county; Linneus, Aroostook county, impregnating slaty rock; Union, Knox county; Raymond, Cumberland county, in thin sheets or strata in epidotic gneiss.
	Marl (calcareous)	Northern part of State. Unexplored.
Molybdenite...	Sulphide of molybdenum.	Blue Hill copper mines, Blue Hill, Hancock county, occasionally with copper ores. Largely at Machias and Whiting, Washington county.
	Ocher	Occurs largely in Bridgeton, Sarmonite, and Naples, Cumberland county.
Pyrite	Pyrites, iron pyrites..	Occurs in very many localities, but nowhere in mass of sufficient purity to be burned for acid making. The largest known deposits are at Blue Hill, Hancock county.
Pyrolusite	Manganese oxide.....	Osgood's farm, Blue Hill bay, Hancock county; Dodge's mount, Thomaston, Knox county.
Quartz.........	Glass sand............	Liberty, Waldo county, pure, granular quartz; Camden, Knox county, abundant at these localities.
Sphalerite	Zincblende	Milton, Oxford county.
Wad...........	Bog manganese ore...	Dodge's mount, Thomaston, Knox county; Dover, Piscataquis county; Mount Agamenticus, York county; Hodgdon, Aroostook county.

MARYLAND—Mined.

Bornite........	Purple copper ore	Mineral Hill mine, 7 miles southwest of Finksburgh, Carroll county.
Chalcocite.....	Vitreous copper, sulphide of copper.	Mineral Hill mine, Carroll county.
Chalcopyrite ..	Copper pyrites	Mineral Hill mine, Carroll county. Bare Hill mine (in hornblendic gneiss).
Chromite	Chrome iron ore	Soldiers' Delight, Baltimore county.
	Clay (brick clay)	Neighborhood of Baltimore.
	Clay (2), kaolin clay, porcelain clay.	Near head of Big Elk creek, Cecil county, in granite; near Annapolis, Anne Arundel county; near Abingdon, Harford county, a large body; elsewhere in region of feldspathic rocks in Montgomery, Howard, Carroll, Baltimore, Harford, and Cecil counties.
	Clay (3), pottery clays, stoneware clays.	On banks of Bohemia, Cape, John, and Sassafras creeks, Cecil county.
Coal	Coal	Semi-bituminous coal, Cumberland coal, Frostburg, Westernport, Lonaconing, Alleghany county; Potomac basin, between Savage and Davis mountains (Frostburgh is in it) 32 beds of coal, each from 14 feet to a few inches thick (50 by 5 miles); Meadow mountain basin, between Meadow mountain and Negro mountain, 50 square miles; mined for local use; Youghiogheny basin, partly in West Virginia; Briery mountain on west (5 to 8 miles wide in the State), area 100 square miles; Meadow mountain and Youghiogheny coal basins are in Garrett county.

MARYLAND—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Fire clay	Mount Savage, near Frostburgh, Alleghany county, noted for excellence and widely used; northeast, in Cecil county; not now worked.
	Flagging stone	Emmitsburg, Frederick county, New Red Sandstone; Catoctin mountain, Frederick county; High Knob, near Frederick, Frederick county, tiling of variegated slates.
Gold	Gold	Gold quartz worked on a small scale on William N. Collins' farm, Potomac district, near Great Falls.
	Gneiss, granite	Granite quarried at Woodstock, Granite, and Guilford, Howard county; granite and porphyritic granite at Ellicott City, Howard county. Gneiss quarried on Jones' Falls turnpike near Baltimore and near Port Deposit (Cecil county).
Hematite	Specular iron ore	Sykesville, on Patapsco river, Howard county; Wills mountain, Alleghany county, fossil ore; between Monocacy creek and Parr's bridge, Frederick county, richest ore of kind in State; Catoctin mountain, Frederick county, in small quantities; near Mount Airy, Carroll county, mines opened; Sideling hill, Washington county; Town hill.
	Hydraulic limestone, cement rock, water lime.	Cumberland, Alleghany county; near Hancock, Washington county.
Kaolin		(See Clay.)
	Limestone	Burned for lime at Texas, etc. Abundant through northern part of Baltimore county.
Limonite	Brown hematite	Northeast village in Cecil county; Flint hill, near Elkton, Cecil county; head of Sassafras, Cecil county; Snowden's bank, Prince George's county; head of Deep run, 7 miles from Baltimore; Curtis Creek; near Joppa, near Abingdon and Bush river, Harford county; near Hereford in Baltimore county; also near Towsontown, Baltimore county; Owingsville, Anne Arundel county; Parr's Spring ridge, Carroll county; several extensive deposits, openings near Westminister; west base of Catoctin mountain, Frederick county, worked for Catoctin furnace, "pipe ore" on Potomac 2 miles above Harper's ferry, Washington county; also near North mountain and Potomac, Washington county; Sideling hill, beyond Canoloway, Washington county; Snow hill, Worcester county, large deposit of bog ore; many localities in eastern shore, greater parts of Somerset and Worcester counties, and part of Caroline.
Malachite	Green copper ore, carbonate of copper.	Bare Hills mine, Baltimore county; Mineral hill, Carroll county. In small quantity in hornblende gneiss with other copper ores.
	Marble	Valley of Monocacy river, west side Frederick county; New Market, Liberty, and Sam's creek, all in Frederick county; Texas and Cockeysville, Baltimore county, a white marble; Parr's ridge, Carroll county; Frederick county, white or light bluish, worked extensively; Mount Saint Mary's, Frederick county, a verd antique marble.
	Marls, greensand marls.	Head of Sassafras river, Kent county, elsewhere in northern and middle parts of county; heads of creeks in Cecil county; Sassafras neck, Bohemian manor, and Pond neck, all in Cecil county; head of South river, Prince George's county.
	Marls (2), shell marls.	At many localities on eastern shore; localities on Choptank river, Talbot county; also on western shore along Chesapeake bay, and on Potomac river, in counties of Prince George's, Charles, Saint Mary's, and Calvert.
Quartz	Vein quartz (white), flint.	Harford county, especially near Castleton, where a large vein is worked; material shipped to Trenton, N. J., potteries; Baltimore county, near Pikesville.
	Sandstone, freestone	Near mouth of Seneca creek, Montgomery county, extensively quarried, "Seneca sandstone;" southwest slope of Sugar Loaf mountain, Frederick county.
Serpentine	Serpentine	Northern part of Cecil county; Coopstown and Broad creek, Harford county. A variety of Williamsite serpentine abundant near Rock springs, Cecil county; Deer creek, Harford county.

MARYLAND—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Siderite	Spathic iron ore	Abundant at Fort McHenry, near Baltimore, and smelted at Canton furnaces.
	Slate (roofing)	Bush creek, Frederick county; Unionville, Frederick county, most extensive quarries in Slate ridge from Peach Bottom ferry, on Susquehanna, southwest, in Harford county, known as "Peach Bottom slates;" Gainsville, Linganore, and Hyattstown, all in Frederick county.
Smithsonite	Carbonate of zinc	Zinc mine near New Windsor, Carroll county, with blende and calamine.
Sphalerite	Zincblende	Near New Windsor (zinc mines), Carroll county, with calamine and smithsonite. In dolomite with galena at Catoctin furnace, Frederick county, Maryland.

MARYLAND—Not Mined.

Alipite	Nickel silicate	Blue Mountain house, near Pen Mar, Washington county.
Asbestus	Asbestus	Northern part of Cecil county, with talc in serpentine; old quarry north of Alberton mills, Baltimore county.
Bornite	Purple copper ore	Finksburgh, Carroll county; Dollyhide mine, Linganore copper region, Frederick county; Roop farm, near New Windsor, Carroll county.
Calamine	Silicate of zinc	Zinc mine near New Windsor, Carroll county, with blende and smithsonite.
Carrollite	Cobalt ore	Patapsco mine, near Finksburgh; Mineral hill, 7 miles southwest of Finksburgh; Springfield mine, Sykesville, localities in Carroll county. Occurs in small quantities with chalcopyrite and chalcocite.
Chalcopyrite	Copper pyrites	Dollyhide mine, Frederick county; Roop farm, Windsor county.
Chromite	Chrome iron ore	Calvert, Cecil county; Rising Sun, near Pennsylvania line, Cecil county; near headwaters of Seneca creek, Montgomery county, in beds in serpentine; Bare hills, Baltimore county, irregular masses in serpentine; Coopstown, Harford county; Gunpowder River forks, Harford county. In a belt from near New Lisbon, in Carroll county, through Montgomery, nearly to Potomac.
Chrysocolla	Silicate of copper	Sparingly in red sandstone between Middleburgh and Big Pipe creek, Carroll county.
Copper (native)	Copper	Catoctin mountains, Frederick county, specimens only.
Corundum	Emery	Twenty-one miles north of Baltimore, Baltimore county.
Galenite	Galena	Unionville, Frederick county, vein in limestone; Jones' falls, near Baltimore; Dollyhide copper mine (argentiferous), Frederick county, in small quantities. With zinc blende in dolomite, Catoctin furnace.
Gold	Gold	Montgomery county; Mineral hill, Carroll county, in small quantities; Catonsville, in Baltimore county, in quartz.
Graphite	Plumbago, black lead.	Gunpowder creek, Baltimore county.
Gypsum	Gypsum	Saint Mary's county, sparingly disseminated through Tertiary clays.
Lignite	Brown coal	In clays sparingly in Kent and Cecil counties; Chesapeake City, with pyrite in clay; Pines region, Montgomery county; on western shore, Prince George's county.
Linnæite	Siegenite, cobalt pyrites.	Mineral Hill copper mines, Finksburgh, Carroll county, with chalcopyrite, carrolite, bornite, and pyrite in chlorite slate in small quantities; Mineral hill, seven miles southwest of Finksburgh, Carroll county, in small quantity with chalcopyrite, blende, and carrollite in chlorite slate.

MARYLAND—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite	Magnetic iron ore	Deer creek, Harford county; titaniferous, not used; Bare Hills copper mine, Scott's mills, and Gunpowder Creek forks, all in Baltimore county; Springfield mine, Carroll county, ores occur in mica slates and associated with chlorite slate, worked as copper mine for a time; near Mount Airy, Carroll county.
Malachite	Green carbonate of copper.	Roop farm, near New Windsor, Carroll county; Finksburgh mine, and sparingly between Middleburgh and Big Pike creek, Carroll county; Liberty mine, Frederick, Frederick county (with chalcocite); and elsewhere in Linganore copper region.
	Manganese ore	Near Brookeville, Montgomery county, abandoned.
	Marble, Potomac marble, breccia.	Formerly quarried at several localities.
Molybdenite	Sulphide of molybdenum.	Baltimore county.
	Ocher	In clay deposits.
Pyrite	Pyrites	Cape Sable, Anne Arundel county, occurs in clay, has been worked extensively; Round bay, Anne Arundel county; Oxen creek, Prince George's county.
Pyrolusite	Black oxide of manganese.	Brookeville, Montgomery county; abandoned mine; Frederick county, near Point of Rocks.
Siderite	Clay ironstone	Many localities on western shore of Chesapeake bay, near head of same, in nodular masses in clays, following shore in a belt crossing State from Washington to Elkton. Low in sulphur and phosphorus; Polish mountain, near Potomac, Alleghany county; near Lonaconing, George's Creek coal basin, Alleghany county.
Siderite (2)	Black band ore	Koontz run and Mill run, Alleghany county, in George's Creek coal basin.
Silver	Silver	Catoctin furnace, Frederick county, in zincblende and galena.
Talc	French chalk	Rock springs, Cecil county, in serpentine; six miles from Rockville, on Darnestown road, Montgomery county.
Talc (2)	Soapstone	Patterson's, on west branch of Northeast river, Cecil county; New Leeds on Little Elk, Cecil county; near Rockville, Smell's bridge, and Clopper's mills, all in Montgomery county; Elk ridge, Anne Arundel county.
Tripolite	Tripoli, infusorial earth.	Near Nottingham, on Patuxent river, thence to Lower Marlborough and throughout greater portion of Calvert and Anne Arundel counties. A large deposit, 5 to 30 feet thick.
Zaratite	Emerald nickel	Chrome ore mines, northern part of Cecil county, in small quantities.

MASSACHUSETTS—Mined.

	Clay (brick)	Many localities.
Chalcopyrite	Copper pyrites	Davis mines, Davis, Franklin county, in pyrite vein, shipped as copper ore.
Corundum	Emery	Chester, Hampden county, with magnetite in a large vein.
	Flagging stone	Montague, red micaceous sandstone.

MASSACHUSETTS—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Granite, gneiss, syenite.	Quincy granite quarries, extensive and afford widely known stone; Gloucester quarries, north side of Cape Ann; Danvers, lighter colored; Fall river, in Troy, lighter colored than Quincy granite; Dedham, fine-grained and white; Westford, a pure granite; Fitchburgh and other localities in eastern part of State; in western part of State, in Hampshire and Hampden counties; gneiss occurs in western part of Worcester and eastern parts of Hampden, Hampshire, and Franklin counties; *e. g.*, Milbury stone used at Worcester; Monson noted for large monoliths.
Hematite	Specular ore, micaceous ore.	Montague, several beds.
	Jade	Framingham.
	Jasper	Framingham.
Limonite	Brown hematite	Extensive deposits in Berkshire county; Leet ore beds and Goodrich ore bed, West Stockbridge, Berkshire county; Cheever ore bed; Cone mine; Bank mine; Cook mine; Branch mine; Bacon ore bed, near Richmond, Berkshire county; Sherman ore bed, Lanesborough; Mason and Bliss ore bed, Cheshire, Berkshire county; ores occur with ochery clays in large bodies between walls of mica schists.
	Marble	Lee, Berkshire county, noted quarries whence stone for Capitol, Washington City, and for Philadelphia public buildings was taken.
	Peat	Numerous deposits in swamps and bogs, principally in eastern and central parts of State. Used for priming in lime-burning.
Pyrite	Iron pyrites	Davis mines, Davis P. O., near Charlemont, Franklin county, cupriferous; veins 12 to 50 feet wide. Used in sulphuric acid manufacture.
Quartz	Sand	Cheshire, Berkshire county; sandrock mined and widely used in glass manufacture; Squam, Gloucester county; Coffin tract and Keyes tract, Davis P. O., Franklin county.
Quartz (2)	Amethyst	Framingham.
Quartz (3)	Smoky quartz	Framingham.
	Sandstone	Connecticut valley, Wilbraham, Longmeadow, blood-red color and uniform grain; West Springfield, Westfield, Deerfield, coarser grained; Granby, gray and coarse grained.
	Slate	Quarries for local use at Lancaster, Worcester county; and at Somerville and Cambridge, Middlesex county.
	Topaz	Framingham.
Tripolite	Tripoli, infusorial earth.	Framingham; Stoneham. Small deposits in eastern part of State. Worked for polishing material, safe linings, and boiler coverings.

MASSACHUSETTS—Not Mined.

Agate	Agate	Amherst and Conway.
	Amber	Gay's Head, in fragments in clay.
Anglesite	Sulphate of lead	Southampton lead mine, with galena and cerussite.
Apatite	Phosphate of lime	Norwich, crystals in gray quartz; Bolton, abundant; sparingly elsewhere.
Arsenopyrite	Mispickel	Worcester, with galena in mica slate; Oxford, Worcester county; Sterling; northern vein, Newburyport lead mines, Essex county, with galena and quartz,
Asbestus	Asbestus	Blackstone, Worcester county.

MASSACHUSETTS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Barite	Barytes, heavy spar	Southampton lead mine, as gangue; Leverett, gangue formation in vein; Hatfield, small vein, containing galena, a large deposit; Greenfield copper mine, as gangue material.
Beryl	Beryl	South Royalston, in vein in coarse granite; Barre, in granite; Pearl hill, Fitchburgh.
Bornite	Variegated copper, purple copper ore.	Southampton lead mines, with galena in small quantity.
Cassiterite	Tinstone	Chesterfield; Goshen, a few crystals with albite; Norwich.
Cerussite	White lead ore, carbonate of lead.	Southampton, sparingly with galena.
Chalcopyrite	Copper pyrites	Middle vein, Newburyport lead mines, Essex county, with galena, pyrite, etc.
Chromite	Chromic iron ore	Blanford, narrow vein in serpentine; Chester.
	Clay	Alum clay, Martha's Vineyard, used on continent formerly; fire clay, Martha's Vineyard, Gay's Head.
Coal	Coal, anthracite coal	I. Anthracite; the Rhode Island coal field extends northeast into this State, and coal beds are opened in Bristol, Plymouth, and Norfolk counties; area of the field 400 square miles in the two States; mines were opened years ago in West Bridgewater, Middleborough, Wrentham, and Mansfield.
Coal (2)	Bituminous coal	II. Bituminous coal, very thin beds and nodules only a few inches in diameter, and of no economic importance, in Red Sandstone formation of Connecticut valley; Worcester and Mansfield, a graphitic anthracite.
	Flagging stone	Washington, Berkshire county (a quartz rock); Gill, Connecticut valley, a gray micaceous sandstone.
	Feldspar	Chesterfield, albite; Brimfield, adularia; Barre and South Royalston.
	Fuller's earth	Lancaster, Worcester county.
Galenite	Galena, lead ore	Newburyport mines, Essex county, a number of mines were opened and worked for the argentiferous galena several years ago; galena associated with blende, tetrahedrite, chalcopyrite, arsenopyrite, pyrite, and siderite; Southampton, old mine abandoned, a vein with quartz and barite. Malden, Middlesex county; Uxbridge, Worcester county.
Garnet	Garnet	Carlisle, in geodes with scapolite; pyrope at many localities in Worcester county; Framingham, Middlesex county.
Gold, native	Gold	Dedham, Framingham, and Abington, in small quantity.
Graphite	Plumbago, black lead.	Sturbridge, Worcester county, a bed in gneiss, long worked; Worcester and Millbury, mixed with anthracite; Berlin.
	Grindstone, whetstone, millstone.	Charlestown; Malden; Quincy, an argillaceous slate; Enfield, Bellingham, mica slate for whetstones; Norwich, mica slate; Washington, Berkshire county, employed for millstones.
Hematite	Specular iron ore, micaceous ore.	Hawley mine, Franklin county, thin but pure beds; Malden, Middlesex county, thin beds.
	Hydraulic limestone, water lime, cement rock.	Springfield limestones.
Kaolinite	Kaolin	Andover.
Lignite	Wood coal	Gay's Head, Martha's Vinyard, in clay.
Limonite	Bog iron ore	Common nearly everywhere; formerly the supply of many furnaces, especially in southeast part of State. Brown clay ironstone, Gay's Head, Martha's Vineyard, Framingham.

MASSACHUSETTS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite	Magnetic iron ore	Hawley iron mine, Franklin county, worked for a time, but narrow vein; Chester, very narrow bed in hornblende slate; Beartown mountain, Tyringham, narrow vein in quartz; Bernardstown, bed in limestone; Warwick, thin beds in mica slate.
	Marble	New Ashford, North Adams, Lanesborough, West Stockbridge, and Great Barrington, Berkshire county.
Muscovite	Mica	Common rock constituent; not very important commercially.
	Ocher	Richmond, with limonite; Williamstown, once worked; Templeton.
Pyrite	Iron pyrites	Hubbardstown, bed formerly worked; Hawley.
Pyrolusite	Gray oxide of manganese.	Plainfield, with rhodonite in small beds; West Stockbridge, with limonite at iron mines; Conway (also reported as manganese silicate, of little value), large beds with quartz gangue.
Serpentine	Serpentine	In great abundance, particularly in Hoosac Mountain range; Middlefield, Hampshire county, very extensive bed; Westfield, Blanford, Zoar, Windsor, Lynnfield, Newburyport, in eastern part of State; others in western part, in Berkshire county.
Siderite	Spathic iron ore	Sterling, with arsenopyrite in mica slate; West Stockbridge, with limonite ore; Newburyport, with galena at the silver lead mines in middle vein in small quantities; Gay's Head, Martha's Vineyard, in clay.
Sphalerite	Zincblende	Leverett, sparingly with galena; Southampton, in lead mine with galena; Norwich, southernmost veins; Newburyport lead mines, Essex county, with galena, worked prior to 1878.
Talc	Steatite, soapstone	Middlefield, Windsor, Cheshire, Savoy, Hinsdale, Blanford, Granville, Zoar, Andover, Worcester, Groton, Chester, and other places, but of small extent generally, commonly associated with serpentine; in considerable quantity at Millbury, Sutton, Oxford, Dana, and Milford.
Tetrahedrite	Gray copper ore	In middle vein lead mine, Newburyport, Essex county, in small quantities with galena, pyrite, chalcopyrite, and siderite.
Wulfenite	Molybdate of lead	Southampton lead mines in small quantities with galena, cerussite, etc.

MICHIGAN—Mined.

Coal, var. bituminous.	Coal, bituminous coal.	Coal field occupies an ellipsoidal area, extending from Saginaw bay south and southwest to Jackson and Kalamazoo. The Measures are 300 feet thick, and include several seams, varying from a few inches to 4 feet thick. The principal mines are in vicinity of Jackson; Corunna, in Shiawassee county; Owasso, same county; and at Flushing, in Genesee county. Local uses absorb nearly whole production.
Copper, native.	Copper	Lake Superior copper region, in Upper peninsula. The "copper belt" stretches from Keweenaw point southwest to Wisconsin, and thence across that State to Minnesota. Its length is 130 miles, and with an average breadth of 6 miles. It crosses the counties of Keweenaw, Houghton, Isle Royale, and Ontonagon. The native copper occurs in masses in amygdaloid trap-rock and sandstone, and also in grains distributed through amygdaloidal and conglomerate rocks. Beginning at northeast, there have been many mines opened from Keweenaw point to southwest, in Keweenaw county; the Portage Lake group of mines, including among several others the celebrated Calumet and Hecla, Tamarack, Quincy, Atlantic, Franklin, and Allonez mines, in Houghton county. The Ontonagon district covers the mines in T. 51, R. 37 and 38 W., besides others, in Ontonagon county. The Michigan mines of native copper are the most important of the kind now working in the world.

MICHIGAN—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Fire clay	Spring Arbor coal mines, Jackson county; Batcheldor place, Jackson county; worked for firebrick and sewer pipe at Jackson. Other localities in Coal Measures.
	Flagging stone	Napoleon, Jackson county.
Gold	Gold	Ropes mine, near Ishpeming, Marquette county, T. 48 N., R. 27 W., free gold with auriferous pyrite, chalcopyrite, etc.
	Granite	Montello, Marquette county, stone resembling Scotch granite, recently opened. Abundant in Upper peninsula in Archæan formation.
Gypsum	Gypsum, plaster	Grand river from Grand rapids to Grandville, Kent county, very large quarries. Thick beds in upper sub-Carboniferous. Also at Alabaster point, Iosco county, where it is largely quarried. Other localities are headwaters of Aux Gres river, Iosco county, and in borings at Bay City and Kawkawlin, in Bay county.
Halite	Common salt, brines	Saginaw valley, in counties of Iosco, Bay, Saginaw, Midland, Huron, Manistee, Mason, and Gratiot.
Halite (2)	Rock salt	Marine City, Saint Clair county.
Hematite	Specular ore, red iron ore.	Vast beds in Upper peninsula. The iron-bearing belt begins near Lake Superior and runs southwest into Wisconsin. Ores are interstratified with quartzites, jaspers, diorites, and ferruginous schists of Huronian age. The mines are grouped in the Marquette district, Teal Lake range, North range, Cascade range, Negaunee mines, Menominee range, Felch Mountain range, and the Gogebic iron range. The principal mines are in vicinity of Marquette, Ishpeming, Negaunee, Republic, Michigamme, in Marquette county; in T. 49, R. 33, in Baraga county; in T. 42, R. 28, southern part of Marquette county; along the Menominee river, in Menominee county. Important mines in T. 47 N., R. 45, 46, and 47 W., west of Lake Agogebic, in Gogebic county. Only a small part of the ore mined is known as "specular" ore; there are various local names, as "slate ore," "hard ore," "soft ore," "blue ore," etc.
	Limestone	Grand Rapids, Kent county (Carboniferous); North Rainsville, Stony creek.
Magnetite	Magnetic iron ore	Marquette region, Upper peninsula, occurs with the specular ores (see under Hematite for localities); Republic; Michigamme. As a constituent of granitic and other crystalline rocks of Archæan age, common in Upper peninsula More abundant, with specular ore, in eastward extension of the Penokie range from Wisconsin line to Lake Gogebic, in Gogebic county, with the soft hematites.
Martite	Martite	Hematite pseudomorphs after magnetite in several mines.
	Sandstone	The sandstone of Coal Measures has been quarried at Flushing Genesee county; numerous quarries in Springport, Sandstone, and Parma, Jackson county; also at Napoleon (for both building and flagging stone); these are in sub-Carboniferous. Large quarries near Marquette, Marquette county. Fine red sandstone at Portage Entry quarries, T. 53 N., R. 32 W., extensively quarried. A quarry has also been opened in T. 54 N., R. 33 W.
Silver, native	Silver	With native copper, but not alloyed with it, in many copper mines, especially in upper levels. A few thousand dollars' worth annually saved by hand-picking the copper ores. Also in Ropes gold mine.
	Slate	Michigan Slate Company's quarry Arvon, Baraga county.

MICHIGAN—Not Mined.

Mineralogical name.	Common name.	Remarks.
Amethyst	Amethyst	Keweenaw point, in trap-rock; Point aux Peaux, Monroe county.
Barite	Barytes, heavy spar	Isle Royale, Lake Superior, in large veins, in sandstone.
Chalcopyrite	Copper pyrites	Occasionally with native copper in mines in Upper peninsula.
Copper, native	Copper	A large number of mines in Keweenaw, Houghton, Ontanagon, and Isle Royale counties, now unworked, but which might be reopened in case of higher prices for copper.
Domeykite	Arsenical copper	Michipicoten island, Lake Superior, with copper nickel.
Gold, native	Gold	Emmet iron mine, Menominee county, and many vein occurrences in small quantity, usually with pyrite, chalcopyrite, etc.
Graphite	Plumbago, black lead	Near Humboldt, Marquette county.
Hematite	Red iron ore, specular ore.	Many known but unworked localities.
Limonite	Brown hematite	Many unworked localities.
	Sandstone	L'Anse (Potsdam sandstone), Baraga county; Isle Royale (red sandstone), Lake Superior.
Silver, native	Silver	In copper-bearing belt of Upper peninsula, occasionally with native copper in abandoned copper mines.
Siderite	Carbonate of iron	Along Shiawassee river; elsewhere in coal field.

MINNESOTA—Mined.

Catlinite	Pipestone	Pipe Stone county; largely worked into articles of use and ornament.
	Clay (brick)	In many localities.
	Clay (fire)	New Ulm, Brown county; Redwood falls.
	Clay (potter's)	Red Wing, Goodhue county (Cretaceous); an excellent clay for common pottery; largely used.
	Granite	Sauk rapids, Benton county; Saint Cloud and Rockville, Stearns county; along Minnesota valley from New Ulm to Big Stone lake (mostly red variety); Duluth, Saint Louis county (probably not granite, but gabbro); Motley, Cass county, large areas in central and northern part of State where granite rocks occur, but are not developed. Extensively quarried in Giant's range on Duluth and Iron Range railroad.
Hematite	Specular iron ore	Near Vermillion lake, Saint Louis county; Minnesota Iron Company's mines, extensively opened (shipped 400,000 tons in 1887).
	Hydraulic cement	Mankato, Blue Earth county (Lower Magnesian limestone).
	Limestone	Between Stillwater and Winona, in Mississippi valley, at several points quarries are opened; Caledonia, Houston county; Lanesborough and Rushford in Fillmore county; Mankato, Blue Earth county; Shakopee, Scott county; Ottawa, Kasota, and Saint Peter in Le Sueur county. At these localities in southern central part of State the stone is more quartzose, stronger, and easily cut into ornamental shapes. The Trenton limestone is quarried at Minneapolis, Saint Paul, Northfield, and Faribault. At Mantorville, Spring valley, and other points in Fillmore and Olmstead counties, quarries in Galena limestone. Devonian limestones occur suitable for quarrying at Le Roy, Mower county, and in Fillmore county.

MINNESOTA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite	Magnetic iron ore	Mesabic iron range, T. 59 and 60 N., R. 14 W., and thence northeastward to Gunflint lake on international boundary, accompanying and bordering the gabbro formation; also at Pokegama falls on Mississippi river. Magnetite as yet much less important than hematite as an ore. Iron lake, Lake county; near Grand Marais, Lake county, localities opened and partially developed.
	Quartzite (red)	New Ulm, Brown county, and in Cottonwood, Watonwan, Rock, and Pipestone counties, a very hard and durable stone, used extensively for paving and considerably for building.
	Sandstone	Red sandstone, Fond du Lac, Carlton county, similar to "Isle Royale brownstone," used in Chicago and Detroit. Freestone is quarried for heavy work at Hinckley, in Pine county. "Jordan sandstone" in lower Minnesota valley, at Jordan, Scott county, and other points. At Austin, Mower county, a Devonian sandstone is quarried. Saint Peter's sandstone at and above Fort Snelling, near mouth of Minnesota river.

MINNESOTA—Not Mined.

Barite	Barytes, heavy spar ..	Pigeon point, north shore Lake Superior, Lake county.
Chalcocite	Copper glance, vitreous copper.	Taylor's falls, Chisago county; argentiferous. Pigeon point.
Copper, native.	Copper	French river, Saint Louis county, north shore of Lake Superior, in trap-rock; near Duluth; on Kettle river, in amygdaloid and feldspathic rocks, with quartz calcite and epidote; Shakopee, Hennepin county, and in numerous other localities, in drift. Taylor's falls, Chisago county, and along Kettle river, Pine county.
	Flagging stone........	Redstone, Nicollet county, and New Ulm, Brown county, and valley of Minnesota (red quartzite); magnesian limestones on Mississippi, from Winona to Hastings, and thence to Stillwater; Ottawa, Kasota, and Mankato, on the Minnesota river.
Gold, native ...	Gold..................	Vermillion lake, Saint Louis county, in quartz in talcose state, also with pyrite. Workings abandoned. In drift in very small quantities in Fillmore, Olmsted, and other counties; also reported in small amount in several places in the Lake of the Woods region and in the gabbro belt east from Duluth.
Gypsum	Gypsum	Big Stone lake, Big Stone county. Scattering crystals in Cretaceous shales; also frequent in the drift in western Minnesota, where it is strongly impregnated with the alkaline débris of the disrupted Cretaceous; also in small quantity in the Trenton; blue and green shales.
Halite	Salt brines............	Northwestern part of State.
Hematite	Specular iron ore	Itasca county and elsewhere. In quantity on some of the upper branches of Big Fork river.
	Hydraulic limestone..	Galena limestone at Mantorville, Dodge county, has properties of hydraulic limestone.
Kaolinite	Kaolin................	Found extensively in southwestern Minnesota; forms a layer between the Cretaceous and the granites; also under similar circumstances in Sauk valley. Formed by decay of the granites.
Lignite	Brown coal	Near Redwood falls, on Cottonwood and Redwood rivers. On Crow creek in thin, irregular beds (Cretaceous); also Sauk valley, Stearns county, and numerous other localities.
Limonite	Brown hematite.......	Large quantities in contact plane of Cretaceous, on Silurian and Devonian, as in Brown, Le Sueur, Fillmore, and other counties.

MINNESOTA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Natural gas	Freeborn county (Trenton, or perhaps Cretaceous). Waseca and Big Stone counties (probably Cretaceous).
	Peat	Coon creek, Anoka county. Formerly manufactured into fuel. Many other localities.
Pyrite	Iron pyrites	Pigeon point, Lake Superior, with chalcopyrite. Vermillion lake, Saint Louis county; auriferous (?).
	Shell marl	Very frequently under the peat bog bordering many small lakes. Has been burned for lime.
Silver, native	Silver	Near Pigeon point, north shore Lake Superior.
	Slate (roofing)	Thomson, Carlton county. In favorable situations and large amount at Vermillion lake and other points in northeastern Minnesota.
Sphalerite	Zincblende	Stillwater, Washington county.
	Titanic iron ore	In immense quantities in the Misabi iron range.

MISSISSIPPI—Mined.

	Clay	White pipe clay, Tishomingo connty, in T. 5 and T. 4, R. 11 E.; Clingscales, S. 8, T. 5, R. 11 E. (answer for fire clay); White cliffs, Adams county; Woodville, Wilkinson county; yellow or cream-colored clays, common in orange sand formation. Pottery clays, Holly Springs, Marshall county; northern part of Tippah county, S. 7, T. 25, R. 7 E., Yalobusha county; Calhoun county; 2 miles north of Ox ford, La Fayette county, and generally in northern Tippah, eastern Marshall, western Pontotoc, eastern Lafayette, eastern Yalobusha, Calhoun, and western Chickasaw counties; southeast Itawamba county at S. 32, T. 10, R. 10 E.
Gypsum	Gypsum	Near Cato, Rankin county; also east and west of Rankin county.
	Hydraulic limestone	In Carboniferous formation at Eastport, Tishomingo county; along Yellow creek, same county (Billings' mill).
	Marl	Glauconitic of Cretaceous in Tippah, Pontotoc, and Chickasaw counties, fit for local use only; Tertiary, Shongala greensand marl, Carroll county, and northern Attala county; calcareous marls, Vicksburg, Warren county; northern Hinds and Madison counties, near Jackson, Canton, Calhoun, Byram station, Brandon, McNutt hills; also northern Rankin and Scott counties and Newton; yellow calcareous marls in Smith, Jasper, Clarke, and Wayne counties. These are in a belt stretching from Vicksburg easterly across State, and in Jackson, Vicksburg, and calcareous Claiborne group of Tertiary. Localities: Enterprise, Clarke county, near Quitman, and in Garland's creek. Calcareous marls of Tertiary; local deposits, *e. g.*, Homochittoo hills, Franklin county; Barnes' White bluff and Burnett's bluff, Marion county. Gypseous marls (for local use only), southern Carroll, Attala, Leake, Holmes, northern Madison, Hinds, Rankin, and Scott counties.

MISSISSIPPI—Not Mined.

Lignite	Brown coal	In northern lignitic group of Tertiary; occurs in Tippah, Marshall, La Fayette, Yalobusha, Calhoun, Kemper, Lauderdale, Panola, Choctaw, Holmes, Carroll, Winston, Madison, Lauderdale, and Yazoo counties, generally thin, not mined; Garlandsville, Jasper county; Vicksburg, Warren county.
	Limestone	Limestone of Ripley group, Cretaceous, suitable for local use only; limestone at Vicksburg of Claiborne and Vicksburg groups. Also near Brandon.
Limonite	Brown hematite	Common in orange sand, but unimportant; Iuka lake, Tishomingo county.

MISSISSIPPI—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Ocher (red)	McDouglas mill, Tishomingo county.
Quartz	Glass sand	Pearl river (recent), near Eastport, Tishomingo county, on Big Bear creek, locally known as "chalk," very fine-grained.
	Sandstone	Ferruginous sandstone of orange sand formation in Marshall, Lafayette, Tippah, Yalobusha counties; siliceous sandstone of orange sand formation; some of latter like whetstone, sandstone of Carboniferous, Big Bear creek, below Scott's mill, Gardner, Bay spring, Rock creek (these in Tishomingo county, also suitable for flagging stone); sandstones of Grand Gulf region, of inferior quality.

MISSOURI—Mined.

Barite	Barytes, heavy spar.	Southeast part of State, as gangue in lead veins; Miller, Morgan, Moniteau, Cole, and other counties in central lead region of State, in veins and vein-like deposits and in workable quantity near Muddy creek, Pettis county; Pleasant Hill, Cass county, Amos' quarry, Jackson county; T. 40, R. 3 E., Jefferson county, a large vein.
Calamine	Zinc silicate	Granby district, Newton county; Joplin Creek diggings, Jasper county; Valle mines. Jefferson county; besides other localities, generally occurring with blende and galena, the most abundant and valuable zinc ore of State.
Cerussite	Lead carbonate, white lead ore.	Granby mines, Newton county; Center Creek district, Jasper county; Valle mines, Jefferson county; Mine la Motte, Madison county. Mined as an ore of lead in southwest Missouri.
Chalcopyrite	Copper pyrites, pyritous copper, yellow copper ore.	Cornwall, Swansea, and Herzog mines, Sainte Genevieve county, with other ores of copper, in second magnesian limestone; Mine la Motte, Madison county; Hinch and Rives mines, Crawford county; Old circular diggings Cole county, besides other localities, often accompanying lead and zinc ores in lead-ore districts. Worked at a few places only.
Coal	Coal, mineral coal	Missouri Coal Measures occupy an area of 27,000 square miles, including 8,400 square miles of upper productive and upper barren measures. The productive coal field is in northern central and western central counties, extending from Missouri river to Iowa line, and on south of Missouri west of Osage river. The southwest coal field is in Bates, Vernon, and Barton counties. Principal mines are in Henry, Pettis, Johnson, Cass, Howard, Randolph, Macon, Linn, Adair, Sullivan, Livingston, Buchanan, Bates, and Vernon counties. There are small outlying patches at east in St. Louis, St. Charles, Lincoln, Warren, and other counties, and at southwest in Moniteau, Jasper, and Sabine counties. The Middle and Lower Coal Measures include eight workable seams from 1 to 4½ feet thick.
Cuprite	Red oxide of copper	Copper mines, Sainte Genevieve county, with copper pyrites, vitreous copper, and carbonates, and in quantity.
	Fire clay	Cheltenham, St. Louis county, extensively used as glass pot clay; Evans mines, Montgomery county; also in Coal Measures territory, but not developed.
	Flagging stone	Brownsville, Saline county, a siliceous rock, much used; Clinton, Henry county; Sainte Genevieve, Sainte Genevieve county, second sandstone and first magnesian limestone extensively quarried; O'Bannon's quarry, Madison county.
Galenite	Galena, lead ore	Southeast Missouri, in Franklin Jefferson, Washington, St. François, Madison, Sainte Genevieve, Crawford, and Bollinger counties; most important mines are Bonne Terre, St. François county; Mine La Motte in Madison; Valle mines in Jefferson and St. François counties. Central or middle Missouri, principally in Miller, Cole, Morgan, and Moniteau counties. Southwest Missouri lead region includes Granby mines in Newton county, Joplin creek in Jasper county, and Center creek also in Jasper county, besides lesser mines in Green, Dade, McDonald, Barry, Stone, and Christian counties.

MISSOURI—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Galenite (continued).	Galena, lead ore	Galena occurs in southern central region; also in La Clede, Dallas, Webster, Texas, and other counties. In the southeast district ore occurs in the third magnesian limestone (calciferous); in the southwestern part of State and in parts central district also it is in the Archimedes or Keokuk limestone (sub-Carboniferous). The galena occurs with calamine, smithsonite, blende, and barite, and smaller amounts of pyrite and chalcopyrite, and in flat sheets, fissures, veins, and irregular masses in the rock. Worked for lead and zinc (in places); too poor in silver for its extraction.
	Granite	Knob lick, St. François county, large quarries; Iron mountain, Iron county, a red granite; Skrainka and La Motte, Madison county; Sainte Genevieve county.
Hematite	Specular iron ore	Iron Mountain district in southeast Missouri, including among others the noted Iron mountain in northeast quarter of Saint François county (a huge vein of specular ore in porphyry), Pilot Knob, Shepherd's mountain, Cedar hill, Buford hill, and Lewis mountain, in Iron county. These occurrences are in porphyry rocks of the Archæan. The central region includes many ore banks in Crawford, Phelps, and Dent counties, besides more scattering deposits in Franklin, Maries, Washington, Miller, Camden, Pulaski, and Shannon counties. The ore occurs in second sandstone (of Lower Silurian).
Hematite (2)	Red hematite	Occurs with specular ores at Scotia bank, Crawford county; Saint James district, in Phelps county; and in T. 45 and 46, R. 10 W., in Calloway county; T. 48, R. 19 W., Cooper county; T. 43, R. 25 W., Henry county; T. 39 and 40, R. 24 and 25 W., St. Clair county; in the sub-Carboniferous, in ferruginous sandstone; also in Coal Measures in small deposits or thin seams in Linn, Adair, Sullivan, Vernon, and Barton counties; in Carboniferous rocks in St. Charles, Boone, and Montgomery counties.
	Limestone	Mine la Motte, Madison county; Amazonia and Savannah, Andrew county; many quarries opened; Kansas City, Jackson county, an oölitic stone; Pleasant hill, Cass county; Mooresville, Livingston county; Princeton, Mercer county; Chillicothe, Lincoln county; Liberty, Clay county; Forest City, Holt county, many quarries; Missouri City, Clay county; and Sainte Genevieve, Sainte Genevieve county. Many other localities in outcrops of Silurian and Carboniferous rocks in all parts of State.
Limonite	Brown hematite	Southeast district covering small deposits in Sainte Genevieve, Perry, and Cape Girardeau counties, and richer and larger bodies in Bollinger, Madison, Wayne, the southern part of Iron, Butler, and Stoddard counties. These deposits lie on the shales and limestone of Upper Silurian and partly on second magnesian limestone. Moselle, Franklin county, deposits on third magnesian limestone. Central ore region. Scattering beds in Crawford, Phelps, Dent, Pulaski, Maries, and Osage counties. On the third magnesian limestone. Osage district, the most important limonite ore district of State. Numerous banks along valley of Osage, in Osage, Miller, Camden, Morgan, Benton, and Saint Clair counties. They are on third magnesian limestone, excepting those on Upper Osage, which are on sub-Carboniferous. Southwestern ore region, in valley of White river and Ozark county. Brownsville, Saline county, and T. 34, R. 28, Cedar county, in Coal Measures.
Limonite (2)	Bog ore	In swamps and bogs, southeast counties, generally manganiferous.
Magnetite	Magnetic iron ore	Iron county, with specular ore in small quantity.
	Marble	Cape Girardeau, quarries formerly worked in Trenton and Niagara limestones; on Big creek, Marble creek, and Stout's creek, Iron county, and on Marble creek and Leatherwood creek, in Madison county; also in southeastern part of Reynold's county. These marbles are of different colors—buff, gray, flesh-colored, red, and variegated. A beautiful black marble, with buff veins, is found in Butler and Vernon counties.

MISSOURI—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Marble (continued)...	Limestones capable of high polish occur in St. Louis, St. Charles, Warren, Montgomery, Ralls, Callaway, Lincoln, Cooper, Pettis, Cass, Jackson, Clay, and Livingston counties.
	Millstone...........	Near Cedar creek, Cedar county; in Jasper and Newton counties, not utilized; White Oak mills, Vernon county, sandstone used for grindstone also; T 31, R. 31, Barton county; Forest City, Holt county; granites of Ozark range in southeastern part of State—formerly used.
Quartz........	Sand, glass sand......	"White sand cave" west of Sainte Genevieve; T. 42, R. 4, on Big river, Jefferson county; other localities in Perry, St. Charles, Warren, Lincoln, near Elston and Marion, in Cole county; Saint Louis, Franklin, and Gasconade counties.
	Sandstone............	Warrensburgh, Johnson county, extensively quarried; near Miami, in Carroll county; these are in Coal Measures; north part of Atchison county; Brownsville, Saline county; Clinton, Henry county; Sainte Genevieve.
Smithsonite ...	Carbonate of zinc, "dry bone."	Valle mines, Saint François county; Frumet mine, Jefferson county, an immense vein; Granby mines in Newton county; Joplin district and Center Creek district, in Jasper county; central lead district of State, in Moniteau, Morgan, Miller, and Cole counties. Generally associated with blende and silicate of zinc and a valuable ore in southwest part of State.
Sphalerite.....	Zincblende, "black jack."	In southeast lead district of State and also in central and southwest lead districts. In largest quantities in Granby and Joplin district in Newton county, and Valle mines in Jefferson and St. François counties. Associated minerals are calamine, smithsonite, pyrite, chalcopyrite, and barite. Worked as an ore of zinc at southwest. Other localities, where it occurs very sparingly.

MISSOURI—Not Mined.

Asbolite.......	Earthy cobalt........	Mine la Motte, Madison county, with lead ores, carrying 10-11 per cent. of nickel; St. Joe mines, St. François county.
Asphaltum....	Bitumen, mineral pitch	Joplin mines, Newton county, with galena or blende in limestone crevices; Center Creek district, Jasper county, sparingly; Barton creek, Vernon county; Bates county; also in Ray, Lafayette, Jackson, Cass, and Johnson counties, but in small quantities.
Azurite........	Blue carbonate of copper.	Lead mines, central part of State, in small quantity and accompanied by malachite; also at copper mines, with other ores of copper.
Chalcocite.....	Vitreous copper ore ..	Sainte Genevieve county copper mines, with copper pyrites, cuprite, and carbonates, in small quantity.
Cobaltite......	Cobalt glance.........	Mine la Motte, Madison county, with earthy cobalt and lead ores in clay slate; St. Joe lead mines, St. François county.
Gold............	Gold..................	In drift sands of northern part of State, sparingly.
Greenockite ...	Sulphide of cadmium.	Southwest part of State, with blende.
Gypsum.......	Gypsum..............	Vicinity of Knobnoster, Johnson county; Simsbury, Chariton county; common in blue shales of Carboniferous, sparingly.
Halite.........	Common salt, brines ..	Valley of Blackwater, Saline county; also in valley of Ferris creek and along Salt fork of Blackwater; Saline creek, Sainte Genevieve county, abandoned salt works; Meramec, Jefferson county; salt formerly made here.
	Hydraulic limestone..	Amazonia, Andrew county, limestone of Coal Measures; Saint Louis limestone in some localities. The best hydraulic limestone in Missouri is in the upper beds of the Chouteau limestone in Lewis, Boone, Marion, Benton, and Cooper counties.

MISSOURI—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Hydrozincite ..	Zinc bloom, earthy calamine.	Valle mines, Jefferson county; Granby mines, Newton county; and other localities in lead and zinc districts, with blende and smithsonite, but in too small quantity for economic working alone.
Kaolinite	Kaolin	Pilot Knob, Iron county, and elsewhere in southeast Missouri; in Coal Measures of central and northern parts of State.
Linnæite, var. siegenite.	Sulphide of cobalt and nickel.	Mine la Motte, Madison county.
	Lithographic stone....	Pike county; Ralls county.
Malachite	Green carbonate of copper.	Collins' diggings, Cooper county; Abbott and Gantt bank, Miller county, and other localities in central lead region, in small quantities; Mine la Motte, Madison county; Hinch's mine, Crawford county; Rives' mine, Crawford county; Sainte Genevieve copper mines, Sainte Genevieve county (worked with other ores of copper); also in Dade, Green, Ozark, Wright, and Shannon counties.
Niccolite	Copper nickel, arsenical nickel.	Mine la Motte, Madison county, accompanying lead ores in clay slate, and disseminated with galena in siliceous limestone; also in sandstone underlying the limestone.
Niter	Saltpeter	Caves in Pulaski, Maries, Callaway, and Ozark counties. It occurs in second and in third magnesian limestones. No longer gathered.
	Ocher	Common in Coal Measures of western part of State, near Calhoun, Henry county; Knobnoster, Johnson county. Many exposures in this vicinity. Other localities in Atchison, Daviess, Livingston, Carroll, Jackson, La Fayette, and Henry counties. A red ocher at Amazonia, Andrew county, and at Hickman mills, in Jackson county. Others in Ray, Buchanan, and La Fayette counties.
Pyrite	Iron pyrites	Southeastern Missouri lead district, with lead ores, also with copper ores; certain lead mines in the Joplin district, Jasper county, associated with bitumen; in lead mines of central Missouri, but in small quantities; cupriferous. It occurs in large masses in T. 38, R. 9 W., Maries county, and in T. 22 N., R. 15 W., Ozark county.
Pyromorphite .	Phosphate of lead, green lead ore.	Granby lead mines, Newton county, rare.
Siderite	Clay ironstone, carbonate of iron.	Near Clinton, Henry county; Grand river, Carroll county; Clear fork, Johnson county; in Vernon and Barton counties in thin seams in Coal Measures; also in Phelps county; a thin seam.
	Silver	Very sparingly in lead ores. Mine la Motte, Madison county, galena has 2 ounces of silver per ton of lead; other galenas average under 1 ounce.
Smaltite	Gray cobalt ore, speiss cobalt.	Mine la Motte, with lead ores and earthy cobalt, in clay slate; St. Joe lead mines, St. François county.

MONTANA—Mined.

Argentite	Silver glance	Silver Bow county Summit Valley district, near Butte City. Small quantity, in few mines, with argentiferous pyrites, etc.
Arsenopyrite ..	Mispickel, arsenical pyrites.	Lewis and Clarke county, Ten-mile district, mined for gold contents. Near Gardiner, Sheep-eater mining district, Park county. Massive; abundant and valuable for gold contents.
Bornite	Peacock ore	Silver Bow county, Summit Valley district, near Butte City. Massive ore, with chalcopyrite, pyrite, and native silver. Mined chiefly for copper. Highly argentiferous in a few places only.
Cerargyrite....	Horn silver, "chloride."	Silver Bow county, Summit Valley district, near Butte City. Small particles in pyrolusite, malachite, and other surface minerals of many veins.

MONTANA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Cerussite	Lead, carbonate (argentiferous).	New World district, Cooke City, Park county. Elsewhere also as decomposition product of galena.
Chalcocite	Copper glance	Silver Bow county, Summit Valley district, near Butte City. Massive; important as copper ore; also highly argentiferous in places.
Chalcopyrite	Copper pyrites	Silver Bow county, Summit Valley district, near Butte City. Massive ore, with bornite, pyrite, native silver; argentiferous. Mined for silver and copper; abundant. Beaver Head county, Trapper district. Abundant, with galena. Mined for copper and silver. Park county, New World district, near Cooke City. Highly auriferous, with some silver.
Coal, var. bituminous and lignite.	Coal	Developed in large quantity and mined in nearly all the eastern counties, Lewis and Clarke county, at Dearborn, Rock creek, Flat creek, Sun river, etc. At Sand Coulée, Deep creek, Belt creek, etc. At Muddy, Custer county. On Coal creek, Rocky fork, etc., Livingston and Cinnabar, Park county. Timberline, Gallâtin county. Bozeman, Judith basin. Large beds at Ball mountain. Leeds, Missoula county. The coal of Park and Gallatin counties is a coking coal.
Cuprite	Red copper oxide	Silver Bow county, Summit Valley district, near Butte City. Minor element in copper ores of region, but mined with the rest.
Galenite	Galena	Lewis and Clarke county, Ten-mile and Ottawa districts. Argentiferous. Jefferson county, near Wickes. Argentiferous, with sphalerite and pyrite. Smelted at Wickes. Beaver Head county, Trapper district. Argentiferous; prominent lead and silver ore of region, with chalcopyrite and other copper minerals. Deer Lodge county, Flint Creek district. Argentiferous, with sphalerite and tetrahedrite. Park county, New World district. Argentiferous.
Gold, native	Gold	Missoula county, Cedar Creek and other districts, in placers and veins. Not much developed; reason, country new. Deer Lodge county. Placers in many places; have been rich; still productive. At Cable City, in a vein associated with nagyagite (Atlantic Cable mine). Lewis and Clarke county, near Helena. Formerly rich; now moderately productive; other places; also in veins. Jefferson county. Placers; moderately productive. Cataract and other districts; near surface of pyritiferous veins. Park county, in placers in Emigrant gulch, Bear gulch, and Crevice gulch. Madison county. Placers; near Virginia City; rich; also north and northeast of Virginia City. Veins; surface of pyritiferous veins. Meagher county. Placers; extensive; little worked; new country. Beaver Head county, near Bannack. Placers and quartz veins; neither much worked.
Malachite	"Green copper," green carbonate of copper, etc.	Silver Bow county, Summit Valley district, near Butte City. Surface mineral in veins, carrying chalcopyrite, bornite, etc., below. Usually carries silver. Used as copper and silver ores.
Nagyagite	Telluride of lead (auriferous and argentiferous).	Deer Lodge county, Cable City. Atlantic Cable mine; with gold, pyrite, and chalcopyrite. Beaver Head county. Small particles impregnating the wall rock of a pyritiferous vein. Not abundant.
Psilomelane	"Manganese"	Silver Bow county. (See Pyrolusite; occurrence the same.)
Pyrargyrite	Ruby silver	Deer Lodge county, Flint Creek district. With galena and sphalerite; limited.
Pyrite (auriferous).	Iron pyrites, "white iron."	Lewis and Clarke county, several districts. In veins with quartz. Jefferson county, Cataract, Elkhorn, Cedar Plains, and other districts. Common; also argentiferous in places. Madison county. Common; in veins with quartz. Deer Lodge county. Common; in veins with quartz. Silver Bow county, Summit Valley district, near Butte City. Also argentiferous; with small quantities of rhodocrosite, calcite, and siderite. Beaver Head county, Bannack district. Massive; in veins on contact of limestone and eruptive rock. Not very rich.

MONTANA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrolusite.....	"Manganese," black oxide of manganese.	Deer Lodge county, Flint Creek district. Surface ore in a few mines; carries silver, probably as chloride. Silver Bow county, Summit Valley district, near Butte City. Common surface ore in many veins, carrying rhodonite, etc., below. Usually contains silver, and is much sought for as flux for siliceous ores.
Rhodonite.....	Manganese silicate....	Silver Bow county, Summit Valley district, near Butte City. In many veins at some depth, with rhodocrosite, pyrite, chalcopyrite, and native silver. Slightly argentiferous, and used as a flux.
Silver, native..	Silver................	Silver Bow county, neighborhood of Butte City, Summit Valley district. In veins; first type, associated with pyrite, sphalerite, rhodonite, and rhodocrosite; second type, with mass of pyrites, chalcopyrite, and bornite. Rich ore.
Sphalerite.....	Zincblende...........	Silver Bow county, Summit Valley district, near Butte City. Argentiferous; mined for silver contents. Veins with native silver, pyrite, rhodonite, and rhodocrosite; also in intimate association (chemical?) with Cu_2S, highly argentiferous; and, thirdly, with tetrahedrite.
Sphalerite.....	Zincblende...........	Deer Lodge county, Flint Creek district. Argentiferous, with tetrahedrite and galena. Lewis and Clarke, Helena district, with galena and carbonate lead and silver.
Tetrahedrite ..	Gray copper, fahlerz..	Deer Lodge county, Flint Creek district. With galena and sphalerite; argentiferous. Silver Bow county, Summit Valley district, near Butte City. With galena, pyrite, and argentite. Small quantity, but sometimes rich in silver.

MONTANA—Not Mined.

Coal...........	Lignite, soft coal, brown coal.	A large portion of the known coal area (Laramie group, Cretaceous) as yet undeveloped.
Gold...........	Gold..................	Many unworked vein deposits in Park and other counties.
	Silver ores...........	Very many prospects throughout the mining counties.

NEBRASKA—Mined.

	Clay..................	Louisville, Cass county, used for pottery; Dakota City, Dakota county; Webster county; Lincoln, Lancaster county; Beatrice, Gage county; Fairbury, Jefferson county; Pine Creek, Cherry county.
Coal...........	Bituminous coal, coal.	Nebraska City, on Missouri, Otoe county, seam 15 inches thick in a boring. Rulo, Richardson county; Nuckolls bed in Otoe, Cass, and Johnson counties, 8 to 18 inches thick, worked for local use. Aspinwall, bed 24 inches thick. T. 1. N., R. 13 E. of sixth meridian. Richardson county, seam 18 to 30 inches, opened and worked for local use.
	Limestone............	Salem, Richardson county, quarries; other localities in Richardson county; Pawnee City, Pawnee county, cream-colored stone; Gage county, siliceous limestone; Johnson county, siliceous limestone quarried near Tecumseh; Brownville, Nemaha county, opened and worked; Plattsmouth, Cass county, quarries worked; La Platte quarries, Sarpy county; Stout's quarry, on Platte, opposite South Bend; Syracus, Otoe county, large quarries for use at Lincoln. "Chalk, rock," used in Knox and Cedar counties; Cedar creek, Cass county; Chadron, Dawes county; Roca, Lancaster county; Sidney, Cheyenne county.
	Sandstone............	Brownville, Nemaha county. Fine-bedded micaceous stone. Several quarries in center of county—opened. Dakota county, quartzite quarried; Valentine, Cherry county; Chadron, Dawes county.

NEBRASKA—Not Mined.

Mineralogical name.	Common name.	Remarks.
	Fire clay	On Coal Measures of southeastern part of State.
Gypsum	Gypsum	Occurs crystallized in northern part of State, along Missouri bluffs near Niobrara on the Republican, in beds of considerable thickness and extent at Chadron, Dawes county.
Halite	Common salt	Salt creek, Lancaster county, several springs.
	Lithographic stone	Near Syracuse, Otoe county.
	Marl	Abundant in western part of the State, along Republican, and south of Culbertson, on Niobrara; on Loup river; on Pumpkin creek, near Court House rock.
	Ocher	Along Missouri from Plattsmouth to Brownville, large bodies of brown and yellow ochers; also along the Republican and on the Missouri in northwestern part of the State.
	Peat	Widely distributed. On the Loups and on their tributaries; on the Logan; along tributaries at headwaters of Elkhorn, Blue, and Stinking rivers.

NEVADA—Mined.

Anglesite	Sulphate of lead	Eureka county, with argentiferous galena and cerussite.
Azurite	Carbonate of copper, "bromide of silver."	Esmeralda and other counties.
Cerussite	"Carbonate," carbonate of lead.	Large deposits in Eureka county.
Cuprite	Copper oxide	Esmeralda and Humboldt counties.
Galenite (argentiferous).	Galena	In many counties. Principal occurrence Eureka district, Eureka county.
Gold	Gold	Quartz veins in almost every county, with ores of the silver mines forming from a trace to half their total value. The Comstock ores yielded between one-third and one-half gold in dorè bullion. Placers worked to a small extent on eastern slope of Sierra Nevada. Dry placers west flank Mount Wheeler, near Utah line.
Halite	Salt	Lincoln, Esmeralda, and other counties.
Malachite	Carbonate of copper	Esmeralda county.
	Mineral soap	Elko county; used for mixing in manufacture of soap.
Silver	Silver	Native silver sparingly, with other silver ores. Free-milling ores mainly argentite and cerargyrite. Ores requiring chloridizing before amalgamation, or lixiviation, pyrargyrite, proustite, stephanite, tetrahedrite, polybasite, pyrite, chalcopyrite, etc.
	"Trachyte"	Storey county; used as building stone.
Trona	Carbonate of soda	Esmeralda county.
Ulexite	Borate of lime	Esmeralda county.

NEVADA—Not Mined.

Azurite	Blue carbonate of copper.	Elko and Churchill counties.
Barite	Barytes, heavy spar	Humboldt county.
Cinnabar	Cinnabar	Washoe county, at Steamboat springs.
	Cobalt ore	Humboldt county.

NEVADA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Galenite	Galena	Esmeralda, Lander, and White Pine counties.
Gold	Gold	Many abandoned mines and undeveloped quartz prospects. Small dry placers not worked because of scarcity of water.
Graphite	Plumbago	Humboldt county.
	Gypsum	Storey, Humboldt, and Esmeralda counties.
Halite	Salt	Esmeralda and Churchill counties.
Hematite	Iron ore	Elko and Churchill counties.
Lignite	Lignite	Esmeralda county.
Magnetite	Magnetic iron ore	Humboldt county.
Malachite	Green carbonate of copper.	Lander, Elko, Esmeralda, and Humboldt counties.
	Nickel ore	Esmeralda, Humboldt, and Churchill counties.
Silver	Silver	Many abandoned mines and undeveloped prospects. Some old waste dumps available.
Pyrite	Iron sulphurets	Lander and many other counties.
Pyrolusite	Manganese dioxide	Dun Glen and near Golconda, Humboldt county.
	Roofing slate	Esmeralda county.
Stibnite	Sulphide of antimony.	Humboldt and other counties.
Sulphur	Sulphur	Humboldt county, formerly worked to a considerable extent; Washoe county; Columbus, Esmeralda county.
Thenardite	Sulphate of soda	Esmeralda county.
Thinolite		Humboldt county.
Trona	Carbonate of soda	Churchill county.
Turquois	Turquois	Candelaria, Esmeralda county.
Ulexite	Borate of lime	Humboldt county.

NEW HAMPSHIRE—Mined.

Bornite	Purple copper ore	Wheeler hill, Littleton and Dalton in Grafton county, with chalcopyrite, opened for copper; Jackson, Carroll county, associated with copper pyrites and tin ore; Shelburne, Coos county, in copper and zinc ores in small quantities only.
Chalcopyrite	Copper pyrites, pyritous copper, yellow copper ore.	Gardner's mountain copper mines; Lyman, Bath, Lisbon, and Littleton, in Grafton county, with argentiferous galena, blende, and pyrite in massive bunches, with quartz. Ore belts are in upper Huronian rocks, Milan, Coos county, with pyrite, galena, and blende. Several openings for copper; Croydon, Sullivan county, large mass of copper and iron pyrites in gneissic rocks, opened. Neal mine, Unity, Sullivan county, with pyrite.
	Flagging stone	Slates and schists quarried for local use at localities in Connecticut valley.
Galenite	Galena	Near Madison and Wakefield, Carroll county, argentiferous galena and zincblende; Shelburne lead mine, Shelburne, Coos county. Galena associated with blende and pyrite. Gardner's mountain copper mines, Lyman. Galena highly argentiferous, blende and pyrite in fissure veins; gold mine at Lyman, Grafton county, in veins of quartz in clay slate, argentiferous; has been worked irregularly in a small way at foregoing localities. Also with blende at Warren, Grafton county.

NEW HAMPSHIRE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gold	Gold	Headwaters of Indian stream, Pittsburgh, Coos county, in alluvial sands. Ammonoosic gold field; occurs with galena in quartz veins traversing Cambrian clay slates. Mines have been opened and worked in eastern Lyman; also in Bath, Grafton county. Occurs in quartzose conglomerate rock of same formation at Lisbon and Landaff. Gold mining has been spasmodic, and on limited scale.
	Granite	Near Concord, Merrimack county, large quarries supplying a wide market. Stone known as "Concord granite." Hookset quarries, Merrimack county; Salem, Rockingham county; Gage's mill, near Pelham, Hillsborough county, several quarries; Nashua, Hillsborough county; Milford, Hillsborough county, several quarries; Fitzwilliam, Cheshire county, a number of quarries; Troy, Cheshire county; Roxbury, Cheshire county, large quarries; Swanzey, Cheshire county; Plymouth, Grafton county; Manchester, Hillsborough county; Mason, Hillsborough county; Sunapee, Sullivan county; Farmington, Haverhill, Grafton county, quarries worked for nearly 100 years; Lebanon, Grafton county; Colebrook, Coos county; Stark, Coos county, a red granite worked at Saint Johnsbury mountain; immense undeveloped localities in White mountain region.
Graphite	Plumbago, black lead.	On Sunapee mountain, Goshen, Sullivan county; bed in mica schist has been worked for many years. Antrim, Hillsborough county, bed irregular thickness; Chester, Rockingham county, in veins in mica slate; Sutton, Merrimack county, in quantity; Mount Monadnock. Other localities of occurrence are towns of Barrington, Bedford, Troy, Walpole, Washington, Hillsborough, Keene, Wentworth, Oxford, etc.
Malachite	Green carbonate of copper.	Gardner Mountain copper mines, Littleton, Lyman, and Bath, Grafton county; very sparingly with azurite and copper pyrites.
Muscovite	Mica	Isinglass hill, Grafton county; a number of openings, which are worked steadily; Alstead, Cheshire county, long worked; Hoyt Hill, Orange county. Other mines are opened in Alexandria, Grafton county; New Hampton, Belknap county; Wilmot, Merrimack county; Marlborough, Cheshire county; Acworth, Sullivan county; Groton, Grafton county; Springfield, Sullivan county. Mining carried on regularly in Grafton county, but only spasmodically in other counties.
	Ocher	Hookset, Merrimack county. Other localities of bog iron ores of nature of ochers, not developed.
Quartz	Quartz	Lyndeborough, Hillsborough county; used for glass making. Abundant in range through Hillsborough, Rockingham, and Strafford counties; also from Cheshire to Grafton on west side of State.
Talc	Steatite, soapstone	Francestown, Hillsborough county; a large quarry, and worked for a long time actively. Weare, Hillsborough county; Warner, Merrimack county; Canterbury, Merrimack county, quarries here; Haverhill, Grafton county. These localities have been opened and worked. Other localities are in Richmond, Swanzey, and Orford.
Tripolite	Infusorial earth	Fitzwilliam, Cheshire county; a large deposit worked; Umbagog lake, Coos county; Stark, Coos county; Stamp Act island, Wolfborough, Carroll county; Tamworth, Carroll county. Other and smaller deposits are: Bemis lake, Livermore, Littleton, Laconia, Bristol, Chalk pond, in Newbury, Epsom, Bow, Concord, Manchester, Durham, Grafton, and Exeter.

NEW HAMPSHIRE—Not Mined.

Mineralogical name.	Common name.	Remarks.
Amethyst	Amethyst	Surry, Mount Crawford, Waterville, Westmoreland.
Arsenopyrite	Mispickel	Jackson, Carroll county, with pyrites. In several towns along Connecticut river; in quartzites and schists in Francestown, Haverhill, Lebanon, Weare, Groton, Lisbon, Lyman, Middleton, and Alton.
Azurite	Blue carbonate of copper.	With other copper ores; Gardner's Mountain mines, Grafton county, in small quantities.
Beryl	Beryl	Grafton, Grafton county; Acworth, Sullivan county; East Wakefield, Carroll county.
Bismuth	Bismuth	Native; Sunapee mountain, near Newbury, Merrimack county.
Cassiterite	Tinstone, tin ore	Jackson, Carroll county, in veins traversing mica schist; sparingly; ores associated with chalcopyrite, arsenopyrite, fluorite, molybdenite, and native copper; Lyme, in minute quantities.
Copper, native	Copper	Eastman's hill, Jackson, with copper ores; in small quantity (Carroll county); Lyman and Oxford, in dendritic forms.
	Feldspar	Common in granite rocks, particularly in range extending from Surry to Easton; in large masses; common. In workable quantity in Grafton county.
Fluorite	Fluorspar	Westmoreland, Cheshire county; vein of considerable size; elsewhere of mineralogical importance only.
Galenite	Galena	Silverdale mine, Pittsfield, Merrimack county, with blende and pyrites in a quartzose vein; in gneissic rocks; argentiferous. Loudon, Merrimack county; Rumney, Grafton county, with blende, following veins of quartz; argentiferous. Other localities in North Woodstock, Hookset, Bath, Haverhill, Epsom, Nashua, Lyndeborough, Dunbarton, Tamworth, Sandwich, Lyme, etc.
Garnet	Red garnet	Hanover, Acworth, Grafton; all in granite, suitable for cutting.
Garnet (2)	Cinnamonstone	Franconia, Haverhill, Unity, Warren, Lisbon.
Hematite	Specular iron ore, red hematite.	Piermont, Grafton county; disseminated through quartzite and lean. Black hill, Benton, Grafton county; Bartlett, Carroll county, with magnetite; mines opened; apparently in small pockets. Franconia (formerly extensively worked) and Lisbon, in Grafton county, and Rindge, in Cheshire, are localities of occurrence.
Limonite	Brown hematite, bog ore.	Bedford, Hillsborough county, once worked; Amherst, Hillsborough county, once worked; Merrimack, Hillsborough county, once worked; Black mountain, Haverhill, Grafton county; and in small deposits at many other localities.
Magnetite	Magnetic iron ore	Ore hill, Franconia mine, Lisbon, Grafton county, in gneiss; Piermont, Grafton county; Iron mountain, in Bartlett, Coos county, with hematite in veins in granite rock; Swanzey, Cheshire county, in granite, sparingly; Winchester, Cheshire county, beds of lean ore in gneiss; Jackson, Carroll county, veins in granite; Berlin, Coos county, Lebanon, Benton, and many other localities in small quantities as rock constituents.
	Marls	Lime pond, in Columbia, Coos county; Hollis, Hillsborough county.
Molybdenite	Sulphide of molybdenum.	Westmoreland, Cheshire county, in micaceous gneiss. Workings abandoned, though mineral is apparently abundant; Landaff, Grafton county; Franconia, Grafton county; and other localities of occurrence.
	Peat	Numerous localities, especially in northern part of State. A bog in Rochester, Stafford county, worked during war for manufacture of fuel.

NEW HAMPSHIRE—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrite	Iron pyrites	Croydon, Sullivan county. Long vein of mixed pyrite, pyrrhotite, and copper pyrites in gneiss. Neal mine, in Unity, Sullivan county; a long outcrop of iron and copper pyrites in gneiss. Gardner Mountain copper mines, in Littleton, Bath, and Lyman, in Grafton county. Several of the above localities, though unworked, are promising.
Pyrolusite	Oxide of manganese	With rhodonite (silicate of manganese) in Winchester and Hinsdale, Cheshire county. In small quantity. Rhodonite bed large.
Pyrrhotite	Magnetic pyrites	Croydon, Sullivan county; a large deposit associated with chalcopyrite and blende. Milan, Coos county. Enfield, Orford, Haverhill, East Hanover, Lyman, and Grafton, all in Grafton county.
	Slate	Quarries opened in Littleton, Hanover, and Lebanon, in Grafton county; also in Croydon mountain, Cornish, Sullivan county.
Sphalerite	Zincblende	Madison lead mine, Carroll county, with galena in quartzite; Warren mine, Warren, Grafton county, worked for a long time for zinc ore; Gardner's mountain, Lyman, Grafton county, with galena; Shelburne lead mine, Coos county, also a black blende. Other localities are: Haverhill, Rumney, and Munroe, all in Grafton county; Croydon, Sullivan county, with copper and iron pyrites.
Wad	Bog manganese	Occurs in some of bogs, with limonite.

NEW JERSEY—Mined.

Calamine	Silicate of zinc	Sterling hill, near Ogdensburgh, Sussex county.
	Clay (brick)	In many localities.
	Clay (fire)	Woodbridge, north shore of Raritan, Perth Amboy, South Amboy, Sayreville in Middlesex County clay district; along Delaware river; Florence, Burlington county; Pensauken creek, Camden county, and generally in belt crossing State, from Raritan bay and Staten Island sound to Delaware river in Burlington and Camden counties.
	Conglomerate and sandstone.	The Green-pond mountain conglomerate is a most durable and beautiful building material, and is abundant in Passaic and Morris counties. Potsdam sandstone is quarried at Oxford furnace, near Washington and Danville in Warren county, and at Franklin furnace in Sussex county.
	Flagging stcne	Quarried at Flagstone hill, Sussex county; Milford on the Delaware; Bearport mountain, Passaic county.
Franklinite	Franklinite	Sterling hill and Mine hill, Sussex county; important ore of zinc mines.
	Granite, gneiss	Common in Archæan highlands. Quarries—Dover, Morris county, near Franklin and near Lockwood in Sussex county; Bloomingdale and Charlotteburgh, Passaic county; near Port Murray and Washington in Warren county.
Hematite	Red iron ore, red hematite.	Marble mountain and Bridgeville, Warren county; Edsall, Simpson and Cedar hill mines, Sussex county, not worked; also in some magnetic ore mines.
	Limestone	Limestone (hydraulic of Water-lime group occurs in Nearpass bluff, Montague, Sussex county. Limestone for building quarried in Hunterdon, Morris, Warren, and Sussex counties.
Kaolinite	Kaolin	See localities under "fire clay."
Limonite	Brown hematite	Mines in Sussex, Warren, and Hunterdon counties, at numerous localities; Beatyestown and Carpentersville; the most important ore occurs in and near magnesian limestone. Bog iron ore in many localities in southern part of State. Near Mount Hope, Morris county.

NEW JERSEY—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite	Magnetic iron ore	Many mines in Passaic, Morris, Sussex, Warren, and Hunterdon counties. Ore occurs in beds interstratified with gneissic rocks (Archæan). Large mines at Ringwood, Hibernia, Mount Hope, near Dover, Chester, Hurdtown, near Danville, Oxford, West End, etc.
	Marble	Rose-crystal marble, Jenny Jump mountain. White marble, Marble mountain, Upper Harmony, Warren county. Verd antique, near Montville, Morris county; Augusta, Sussex county.
	Marl	Greensand marls are found throughout a belt 90 miles long from Sandy Hook and the Atlantic to Salem on Delaware bay. They are dug everywhere in this belt and used as a fertilizer. Calcareous marls occur in Cumberland county, on Stow creek; also at many places in Warren and Sussex counties in form of shell marl.
	Sandstone or freestone	Quarries in Red Sandstone district at many localities. More important at Paterson, Little Falls, Belleville, Newark, Orange, Washington Valley, Princeton, Wilburtha, Martinsville, Stockton, and Milford. (Potsdam sandstone. See "Conglomerate.")
	Slate	Several quarries opened and worked for a time in Sussex and Warren counties. Most important are at La Fayette and Newton, Sussex county, and Delaware water gap, Warren county.
Smithsonite	Carbonate of zinc	Coating on zincite in zinc mines, Franklin, Sussex county.
Willemite	Silicate of zinc (troostite).	Zinc mines, Stirling hill and Mine hill, Sussex county.
Zincite	Red oxide of zinc	Zinc mines, Stirling hill and Mine hill, Sussex county.

NEW JERSEY—Not Mined.

Apatite	Phosphate of lime	Hurdtown, Morris county, with magnetite and pyrrhotite; Mine hill near Dover, with magnetite, Morris county; elsewhere in small quantity in Archæan rocks.
Arsenopyrite	Mispickel	Jenny Jump mountain, Warren county.
Asbestus	Asbestus	Montville, Morris county.
Azurite	Carbonate of copper, blue carbonate of copper.	Copper mines, Belleville, Essex county, with other ores of copper; Raritan mine; Bridgewater mine; Griggstown copper mine, Somerset county, and other mine holes and copper mines in the Red Sandstone district.
Barite	Barytes, heavy spar	Near Newton, Sussex county; Hopewell, Mercer county; near New Brunswick, openings; deposits too small for profitable working.
Brucite	Hydrate of magnesia	Hoboken.
Chalcopyrite	Copper pyrites	Belleville, Essex county; Somerville, Griggstown, and other places in Red Sandstone district; also, Jenny Jump mountain, Warren county, in gneissic rocks.
Chrysocolla	Silicate of copper	Copper mines in Red Sandstone district.
Coal, var. bituminous.	Soft coal	Few localities, in thin seams, not workable.
Coal, var. lignite.	Brown coal	Jacksonville, Middlesex county, bed 4 feet thick in clay. Elsewhere in clays, but probably not in sufficient quantity for mining.
Copper (native)	Copper	Copper mines in Red Sandstone district; New Brunswick, in shale; Somerville, in shale.
Cuprite	Red oxide of copper	Copper mines in Red Sandstone district.
Erubescite	Variegated copper	Copper mines in Red Sandstone district.
Galenite	Lead ore, galena	Sussex lead mine and Andover iron mine, Sussex county, in small quantities. German valley, Morris county, with limonite.

NEW JERSEY—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Garnet	Garnet	Franklin, Sussex county.
Graphite	Black lead, plumbago.	Near Bloomingdale, Passaic county; mine near Peapack, Somerset county, abandoned; in gneiss at Chester, Morris county; High Bridge, Hunterdon county, localities near works, but idle. Elsewhere common in gneiss, sparingly disseminated.
Magnesite	Carbonate of magnesia, brown spar.	Hoboken, with serpentine.
Malachite	Green copper ore, carbonate of copper.	Copper mines of Red Sandstone district; Pahaquarry, Warren county, mine now abandoned.
Molybdenite	Sulphide of molybdenum.	Hude mine, Sussex county, in small quantities.
Muscovite	Mica	Mine near Broadway, Warren county, abandoned; near Uniontown, Warren county. Also common as rock constituent.
Pyrite	Pyrites, iron pyrites	Many localities, but nowhere worked. Brasscastle, Warren county, carrying traces of nickel; Jenny Jump mountain, Warren county, etc.
Pyrrhotite	Magnetic pyrites	Hurdtown, Morris county, unimportant.
Sapphire	Sapphire	Blue variety near Sparta, Franklin, and Vernon, Sussex county.
Serpentine	Serpentine	Montville, Morris county, with chrysotile; Marble mountain, Warren county; other localities with calcite, in Archæan.
Silver, native	Silver	Occurs in copper ores in Bridgewatar, Belleville, and other copper mines of the Red Sandstone formation. Too minute quantities for extraction profitably.
Sphalerite	Blende, zincblende	Andover mine, Sterling hill, Sussex lead mine, Sussex county; near Oxford, Warren county; at none in workable quantities. German valley, Morris county. Near Belvidere, Warren county.
Succinite	Amber	In greensand marl, southern part of State.
Talc	Steatite, soapstone	Marble mountain, Warren county; other unimportant localities.
Tripolite	Infusorial earth	Drakesville, Morris county, used formerly for manufacture of giant powder; near Andover, Sussex county; neither locality now worked.

NEW MEXICO—Mined.

Argentite	Silver glance	Socorro county, Black Range mountains. Thin veins or films in quartz, with some cerargyrite. Grant county, near Silver City; a frequently occurring ore in small quantity. Sierra county, Kingston, Tierra Blanca, and other districts.
Azurite	Blue carbonate of copper.	Grant county, Santa Rita (see Malachite). Santa Fé county, Lunto mountains; in considerable quantities with other copper ores, and in small quantities elsewhere in the Territory.
Bornite	Peacock copper ore	Socorro county, Mogallon mountains; with chalcopyrite, chalcocite, and native silver in quartz matrix; argentiferous. Santa Fé county and elsewhere with other copper ores. Lincoln county, Nogal mountains. In quartz veins traversing slate; argentiferous.
Cerargyrite	Horn silver, "chloride."	Near Socorro, with embolite in barite gangue. Sierra county; Lake valley; a very rich and important ore. Pinos Altos, and near Silver City. Santa Fé county, San Ysidro mountains; in small stringers; very rich, but slightly developed. To a considerable extent at Kingston.
Cerussite (argentiferous).	"Carbonate," lead carbonate, etc.	Socorro county, Magdalena mountains, Kingston. Cook's Peak district, Grant county.

NEW MEXICO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcocite (argentiferous).	Copper glance	Socorro county, Mogallon mountains. Occurs with chalcopyrite, bornite, and native silver; Black Range mountains, Mineral Creek district; argentiferous in varying degree. Santa Fé county, Lunto mountains; in small quantities. Grant county, Carlisle district, near Steeple rock. With chalcopyrite and malachite in quartz matrix; argentiferous.
Chalcopyrite	Copper pyrites	Santa Fé county, Lunto and Santa Fé mountains. Argentiferous and auriferous. Socorro county, Mogallon mountains. With chalcocite, bornite, and native silver; argentiferous. Grant county, Carlisle district; argentiferous.
Chrysocolla	Silicate of copper	Grant county, Burro mountains. Associated with malachite and cuprite; now used as copper ore. Socorro county, Oscura mountains, in large quantity; mining recently begun. Santa Fé county, Santa Fé mountains. Said to be argentiferous. Also in Lunto mountains, carrying both gold and silver in paying quantities.
Chrysocolla (variety).	Tile ore	Socorro county. Under this head may be mentioned the "tile ore," "mahogany ore," or "coffee copper," which is a mixture of chrysocolla, cuprite, limonite, etc., and which is worked as a copper ore; is a fine smelting ore. Oscura mountains. In Lunto mountains, carrying gold and silver.
Coal, var. anthracite.	Anthracite	Mined in considerable quantities side by side with bituminous coal in the Celrillos district.
Coal, var. bituminous.	Lignite, soft coal	Colfax county, Raton hills. The continuation of the Trinidad (Colorado) coal fields; workable beds said to exist in nearly all the cañons as far south as Poñil cañon; extensively worked near the Colorado State line, near Atchison, Topeka and Santa Fé railroad. Gallup, Valencia county, important mines; Santa Fé county, Galisteo coal field, exposed on Galisteo creek westward for 15 miles from Galisteo; worked at Cerillos. Socorro county, western base of the Oscura mountains. Taos county, adjoining the Colorado State line; extension of the coal fields of La Plata county, Colorado.
Copper (native)	Copper	Grant county, Santa Rita mines. In thin sheets, with cuprite, malachite, and azurite; worked with other copper minerals.
Cuprite	Ruby copper	Grant county, Santa Rita copper mines. With copper malachite, etc.
Fluorite	Fluorspar	Grant county, near Silver City. In a vein; somewhat used as a flux.
Galenite (argentiferous).	Galena	Socorro county, Magdalena mountains, in quartz. Low grade silver ore. Grant county near Silver City, with barite (argentiferous). Santa Fé county, Los Cerillos district, mined for lead and silver. At base of Lunto mountains; worked to some extent. Organ district, Doña Anna county. Bonita district, White mountains, Lincoln county.
Gold	Gold	Taos county placers; not greatly developed. Colfax county, extensive and rich placers; lack of water prevents work in some places; veins near Old Baldy mountains. Santa Fé county, placers on east slope of Placer mountains; in Placer district; much worked by Mexicans fifty years ago (very productive; still worked in a small way to profit); not much developed in the new localities owing to lack of water; veins little open. Sierra county, Hillsborough district, both placers and quartz veins; moderately productive. Lincoln county, Nogal and White Oaks districts, placers and quartz veins; both being opened at present. Grant county, Piños Altos, Georgetown, and Carlisle districts, placers and quartz veins; productive.
Gypsum	Gypsum	Bernalillo county; used for whitewash.
Halite	Salt	Santa Fé county, 40 miles east of the Sandia mountains. In salt marsh; rather impure, but used locally for table salt. North and west of "White Sands," Doña Anna and Socorro counties.
Limonite	Hydrated iron oxide	Occurs in several places in too impure condition to serve as an ore of iron; used as a flux.

NEW MEXICO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Malachite	Green copper carbonate.	Grant county, Santa Rita mines. With azurite, cuprite, and native copper; Burro mountains; not largely developed as yet. Lunto mountains, Santa Fé county.
Massicot	Oxide of lead	Socorro county, Magdalena mountains. Argentiferous, but of low grade. Less prominently in other places, associated with galena.
Muscovite	Mica	Worked to a small extent in Santa Fé mountains, Santa Fé county.
Pyrargyrite	Ruby silver	Grant county, Bullard's Peak district. Gold Hill, near Silver City. With sphalerite, argentite, and native silver. Sierra county, Kingston,
Pyrite (auriferous).	Iron pyrites, pyrites of iron.	Grant county, Pinos Altos, and Georgetown districts. Important in Ortiz mountains, Santa Fé county. White Oaks district, Lincoln county.
Silver, native	Silver	Socorro county, Mogallon mountains. With chalcopyrite, bornite, and chalcocite. Grant county, near Silver City; in an argillaceous shale, and in veins, with pyrargyrite, argentite, and sphalerite. Burro mountains, little developed. Sierra county, various districts,
Sphalerite (argentiferous.)	Zincblende	Socorro county, Black Range mountains; Turkey creek district. Mined for silver contents. Grant county, near Georgetown, mined for silver. Kingston and Cook's Peak, Sierra county.
Tetrahedrite	Gray copper, fahlerz.	Socorro county, near Pueblo springs. In quartz veins with chalcopyrite; highly argentiferous. Kingston, Hermosa, and Chloride, Sierra county.
Turquois	Turquois	Santa Fé county, Los Cerillos, small veins in a trachytic rock; long mined by Indians and Mexicans; still productive, chiefly of inferior quality.

NEW MEXICO—Not Mined.

Bornite and erubescite.	Peacock ore	Rio Arriba county, Abiquiu district. Caballos mountains, east side of Rio Grande, Sierra county, with other copper minerals.
Chalcocite	Copper glance	Rio Arriba county, Abiquiu district, with bornite. Both minerals formerly worked for copper by Mexicans; not argentiferous.
Coal, var. bituminous and lignite.	Soft coal	Many undeveloped localities.
Gypsum	Gypsum	Valencia county, Zuni mountians, as selenite. Used for window panes by Indians, also to make whitewash; extent unknown. Socorro county, 10 miles west of Socorro. In beds sometimes 14 feet thick; mined and used as whitewash by Mexicans. San Miguel county, near Pecos. Said to occur in large beds, pure, near line of Atlantic and Pacific railroad. Doña Anna county, large deposits. Lincoln county, western part.
Hematite	Hematite, red oxide of iron.	Santa Fé county, Placer mountains. Almost wholly undeveloped. Grant county, Santa Rita, near copper mines. Bed 3 feet thick; somewhat explored; not mined. Lincoln county, with limonite.
	Limestone	Lincoln county, near White Oaks, silicious.
Magnetite	Magnetic iron	Santa Fé county, Placer mountains. Unknown extent; said to be of good quality; Los Cimarron mountains, 22 miles south of Santa Fé. Colfax county, near Cimarron, Cito creek; undeveloped in both places. Lincoln county, with hematite,
	Marble	Lincoln county, White Oaks district (white and black).

NEW MEXICO—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Muscovite	Mica	Rio Arriba county, near Abiquiu. In large sheets in pegmatitic veins; good quality, clear; undeveloped. White mountains, Lincoln county; San Miguel county; Taos county.
Niccolite	Kupfernickel	Grant county, Bullard's Peak district, in Burro mountains. Recently discovered, with several cobalt and silver minerals.
Siderite, var. sphærosiderite.	Nodular iron ore, "clay ironstone."	Colfax county, nodules in Fort Pierre shales of Colorado Cretaceous, from Colorado State line south to Oscate creek. Santa Fé county, Galisteo region. Same formation as in Colfax county, but nodules less pure. Same substance, less pure, and in shales of Laramie group in both Colfax and Santa Fé counties. Some of this may be pure enough to serve as iron ore.
Turquois	Turquois	Lincoln county, Nogal district.

NEW YORK—Mined.

Asbestus	Asbestus	Near Tompkinsville, in Serpentine hill, Staten Island (fibrous serpentine, not amphibole), worked at intervals for a long time; also found at Stony point, Rockland county; on Hudson; Phillipstown, Putnam county; Patterson, Putnam county; near Greenwood furnace, Orange county; near Paulding, Dutchess county.
Corundum	Emery	Mined in small quantity near Congress station, N. Y. C. R. R., Westchester county, in eruptive diorite.
	Clay (brick)	In many localities. Large establishments on Hudson river.
	Clay (fire)	Near Rossville, Staten Island, used largely in manufacture of firebrick; near Glen Cove, Roslyn, and Northport, on north shore of Long Island.
	Feldspar	Chester, Warren county; High Island, near Alexandria, Jefferson county; Bedford, Westchester county; at numerous other localities in crystalline rock.
	Flagging stone	(See under "Sandstone.")
Garnet	Garnet	Johnsburgh, Warren county; Minerva, Essex county.
	Granite	Highlands of Hudson, and in Adirondack region of northern New York. Quarries on Hudson river at Jones Point; north of Cold Spring, Break Neck mountain, Putnam county; large quarry on Grindstone island, Jefferson county. Inexhaustible amount in Adirondack region undeveloped. Iona island (Hudson river), Rockland county, quarries for paving stone. Storm King mountain, Orange county. Near Westport and Keeseville, Essex county.
Graphite	Plumbago, black lead.	Mines in Hague, Warren county; Ticonderoga, Essex county, a noted locality and long worked; Johnsburgh, Warren county; south of Fishkill Landing, Dutchess county; near Peekskill, Westchester county; near Saranac river, Clinton county; localities opened and worked. Others are: Duck Cedar pond, Orange county; near Carmel, Putnam county; Fort Ann, Washington county; common in crystalline limestones of Archæan.
Gypsum	Gypsum, plaster	Quarries south of Erie canal, in Lenox, Sullivan, and Smithfield, and Stockbridge townships, Madison county; near Camillus, Manlius, Marcellus, and De Witt, in Onondaga county; very large quarries, and worked actively; Brutus Mentz, and Springport towns in Cayuga, also large quarries; Seneca Falls, Seneca county; in towns of Le Roy, Stafford, and Elba, in Genesee county; in Phelps, and near Victor in Ontario county; Lockport, Niagara county; also in southern part of Monroe, in Wayne, Livingston, Tompkins, Oneida, and (Stark) Herkimer counties. In Onondaga and Water-lime groups.
Halite	Common salt, rock salt, brine springs.	Rock salt in Warsaw district, Wyoming county. Brine springs or salines are known from Oswego county west to Niagara

NEW YORK—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Halite (cont'd)	Common salt, rock salt, brine springs.	river, at numerous localities. Most celebrated are at Syracuse, Salina, Geddes, and Liverpool, Onondaga county. Others are at Montezuma, Cayuga county; Galen, Wayne county; Elba, Genesee county; and in Orleans, Monroe, and Livingston counties. A total thickness of 350 feet of rock salt in five different strata is proved by a recent well to exist beneath Ithaca, Tompkins county, between 2,200 and 2,700 feet below the surface.
Hematite	Specular iron ore, red hematite.	Gouverneur, Fullerville, Saint Lawrence county; Philadelphia and Antwerp, Jefferson county; productive mines. Occurs in Hermon, Edwards, Fowler, and Canton, in Saint Lawrence.
Hematite (2). ..	Fossil ore, lenticular clay iron ore.	Verona, Westmoreland, New Hartford, and Clinton, Oneida county; Ontario, Wayne county; working mines. Also occurrences in Madison county, in thin beds.
	Hydraulic limestone, cement rock.	Very large quarries (and mines) in Kingston, near Rosendale, at Lawrenceville, Whiteport, and High Falls, along valley of Rondout creek, in Ulster county. Quarries at Howe's cave, Schoharie county; Fayetteville, Manlius, and Jamesville, Onondaga county; Akron and Buffalo, Erie county. The formation crops out in many localities from Schoharie west to Niagara river and eastward in Herkimer, Montgomery, and Albany counties.
Kaolinite	Kaolin, porcelain clay.	East Fishkill, Dutchess county; Athol and Johnsburgh, Warren county; near McIntyre, Essex county; and near Southold furnace, Orange county. First named is only one worked.
	Limestone..........	Kingston, Ulster county, extensive quarries; Catskill, Greene county; Glens Falls, Warren county; Sandy Hill, Washington county; Crown Point and Burlington, Essex county; Amsterdam, Tribes Hill, and Canajoharie, in Montgomery county; Howe's Cave and Cobleskill, Schoharie county; Prescott, Oneida county; Lowville, Lewis county; Fairmount, Manlius, Onondaga, Onondaga county; Auburn and Union Springs, in Cayuga county; Waterloo, Seneca county; Rochester, Monroe county; Lockport, in Niagara county; Buffalo and Williamsville, in Erie county; Leroy, in Genesee county. The quarries in Montgomery, Saratoga, Warren, Essex, Clinton, and Lewis counties are in Trenton limestone; the Niagara limestone is the horizon for the quarries of Monroe and Niagara counties; the Onondaga, in Onondaga, Cayuga, and Seneca counties; the Lower Helderberg, in Schoharie county. The magnesian limestone (calciferous) is quarried for local use at many points in Orange county, and the Helderberg in the Hudson valley. Immense quarry of blue limestone, probably Cambrian age, at Tomkins cove, Rockland county, on the Hudson. Also opposite on Verplanck's point, Westchester county; used for ballast, concrete, etc.; very hard, siliceous. (For other limestones see "Marble.")
Limonite	Brown hematite	East Fishkill, Sylvan lake, Beekman, Bowling, Dover, Unionvale, Amenia, Sharon, Millerton, and Mount Riga, in Dutchess county; Copake, Ancram, and Boston Corners, in Columbia county; mines at these localities producing largely. Townsend mine, Cornwall, Orange county; Castleton, Four Corners, New Dorp, and Todt Hill, Staten Island.
Limonite (2) ...	Bog iron ore	Numerous localities and many small deposits in northern and eastern parts of State. Formerly worked to small extent.
Magnetite	Magnetic iron ore ...	Two principal districts—(1) Highlands or southeastern, (2) northern New York or Adirondack. In the first, mines largely worked at Sterling, near Greenwood, and Forest of Dean, besides many smaller mines in Orange county; numerous openings in northern part of Westchester and southwestern and central part of Putnam, on east of the Hudson (Croft's, Mahopac, Theall, Brewster's, etc.). In northern part of State ore occurs at many localities in Washington, Saratoga, Warren, Essex, Clinton, Franklin, St. Lawrence, Lewis, Herkimer, and Fulton counties. Mines worked at Mount Hope in Washington, near Crown Point, Paradox lake, in vicinity of Port Henry in Essex county, with very large deposits unworked at Adirondack and in Westport; Palmer hill, Arnold ore bed, and Chateaugay in Franklin county; Clifton (idle) in Saint Lawrence county; occurrences are noted in Jefferson county

NEW YORK—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite (continued).	Magnetic iron ore	also. Magnetic iron sand is found to some extent on northern shore of Long Island, on western shore of Lake Champlain, and on Hudson and smaller streams in northern part of State. An aluminous magnetic iron ore occurs near Peekskill, Westchester county; self-fluxing; not now worked, though in large deposits.
	Marl..................	Calcareous marls occur in many localities and widely diffused. Dutchess, Columbia, Orange, Ulster, Greene, and Albany counties have many small deposits; in central and western New York large deposits are in Onondaga and Madison counties, particularly the Conasalon swamp; in Cayuga, Wayne, Seneca, Ontario, Monroe, Genesee, and Niagara counties material at a very few points used as a fertilizer. Marl of fine quality is dug near Cortlandt, Cortlandt county, and used as polishing powder and for lime.
	Marble	Tuckahoe, Pleasantville, Sparta, and Hastings, Westchester county, largely worked; Sing Sing, on Hudson; Towner's, Putnam county; Dover, Dutchess county; Becraft's mountain, near Hudson ("coral shell marble"); Glens Falls, Warren county, a black marble; Plattsburgh, Essex county; Gouverneur, St. Lawrence county, quarried in large amount for "western trade"; quarries formerly worked at Kingsbridge, New York. The white crystalline limestones of the Highlands and of northern New York afford many outcrops.
	Natural gas...........	Many localities.
Petroleum	Petroleum	Four-mile district, Cattaraugus county; northeast extension of the Bradford oil region. Richburgh and Allegany fields, Allegany county.
	Peat..................	Widely distributed localities; not utilized excepting as a fertilizer.
Quartz.........	Quartz................	Fort Ann, Washington county, quarried for manufacture of wood filling; large, massive outcrops in Shawangunk mountains, Ulster and Orange counties; Bedford, Westchester county; Chatham, Columbia county.
Quartz (2)	Sand..................	Cleveland and Bernhard's bay, Oswego county; and near Durhamville, Verona, and Dunbarton, in Oneida county, all on or near shore of Oneida lake.
	Sandstone	Nyack, Rockland county (Triassic beds); Haverstraw, Rockland county (Triassic beds); Aqueduct quarries, near Schenectady; Moira and Bangor, Franklin county; Potsdam and Hammond, Saint Lawrence county (noted Potsdam sandstone), extensively quarried; Oneonta, Otsego county; Gifford and Smithville, Chenango county; New Hartford, Oneida county; Brockport, Monroe county; Albion, Hulburton, and Medina, in Orleans county, producing the widely known "Medina sandstone"; Lockport, Niagara county; Warsaw and Castile, Wyoming county; Jamestown, Chautauqua county; Olean, Cattaraugus county; Belfast, Allegany county; Corning, Steuben county; Watkins, Schuyler county; Ithaca and Trumansburgh, Tompkins county.
	"Bluestone"	Very many quarries in the Hudson River valley, in Kingston, Woodstock, Hurley, Olive, Marbletown, Shandaken, and Saugerties township, Ulster county; and in Catskill, Greene county; Rochester, Monroe county. They yield a large aggregate of the well-known "Hudson river bluestone." The same formation is worked in vicinity of Middleburgh, in Schoharie county, and in the Helderberg mountain, in western part of Albany county. Near the Delaware it is quarried near West Brookville, Sullivan county; at Pond Eddy and Barryville, same county. Other localities are in the Catskill region; in Delaware county, along line of Ulster and Delaware railroad. Flagging stone is obtained from the Potsdam group, at Potsdam and Hammond, Saint Lawrence county; at Atwater, Cayuga county; Covert, Seneca county; Warsaw, Wyoming county, and Olean, Cattaraugus county. Other stones are employed for flagging also, *e. g.*, the Medina sandstones, the Lockport sandstones, etc.
Siderite.......	Spathic iron ore, carbonate of iron.	Near Catskill station and Linlithgo, Columbia county, an immense deposit; Napanock, Ulster county, formerly worked; in Dutchess county in small quantity; Antwerp, Jefferson county, in crystals only.

NEW YORK—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Slate	Granville, Washington county, and Hampton and Salem, same county, several quarries.
Talc	Steatite, soapstone	Fowler and near Gouverneur, St. Lawrence county, quarries; near Tompkinsville, Staten Island, in serpentine.
	Trap rock	Quarries for Belgian paving stone, Graniteville, Staten Island; Rockland lake, Rockland county.

NEW YORK—Not Mined.

Apatite	Phosphate of lime	Hammond, St. Lawrence county, crystalline, with calcite, zinc ore, and feldspar; near Gouverneur, St. Lawrence county, crystals in calcite; Vrooman lake, Jefferson county; Greenfield, Saratoga county; near Hammondville, Essex county; with magnetite in some of iron ores near Port Henry. Other localities of occurrence.
Arsenopyrite	Mispickel, arsenical iron.	Near Edenville, Orange county, with arsenical iron and orpiment, in a vein in white limestone; near Pine pond in Kent, and near Boyd's corner, Putnam county. These localities have been opened, but not worked for arsenic.
Barite	Barytes, heavy spar	Ancram, Columbia county; near Schoharie court-house, with strontianite, in Water-lime group; Carlisle, Schoharie county; near Little falls and Fairfield, Herkimer county; near Syracuse, Onondaga county; Pillar point, Jefferson county, in large veins; Hammond and De Kalb, St. Lawrence county.
Calcite	Calcareous tufa, travertine.	Vicinity Schoharie court-house, Schoharie county; Sharon springs, a large deposit; Howe's cave, Schoharie county; near Catskill, Greene county; head of Otsquaga creek, Stark and Mohawk, Herkimer county, Saratoga Springs; near Syracuse and in Onondaga valley, Onondaga county; between Camillus and Canton, same county; near Arkport, Steuben county; near Ellicott's mills, Erie county; and many lesser deposits.
Cerussite	Carbonate of lead, white lead ore.	Rossie, Robinson, Ross, and other lead mines, in St. Lawrence county; Martinsburgh, Lewis county; near Sing Sing, on Hudson, associated with galena, in small quantity.
Chalcopyrite	Copper pyrites, pyritous copper.	Ancram lead mine, Columbia county; Bockee mine, Columbia county; near Edenville, Orange county, with arsenopyrite; near Wurtsborough, Sullivan county, with galena, in considerable abundance; Ellenville and Red Bridge lead mines, Ulster county; near Rossie, and also near Canton, in St. Lawrence county, once worked. Many additional occurrences are reported where it is in small quantity.
Chromite	Chrome iron ore	In serpentine, Phillipstown, Putnam county; Wilk's mine, Monroe, Orange county. Abundant in the serpentine of New Rochelle, Westchester county.
Coal	Coal	Woodstock, Ulster county, thin vein in Catskills, worked out; in the seams interstratified with shales, in Chautauqua, Erie, Livingston, and Seneca counties.
Cuprite	Red oxide of copper	Near Ladentown, Rockland county, in thin seams, in traprocks.
Fluorite	Fluorspar	Muscalonge lake, Alexandria, Jefferson county, very fine crystals; Lowville, Lewis county; Niagara county; at Lockport; Auburn, Cayuga county; Rossie and Mineral point, Saint Lawrence county. Nowhere in quantity to be of much economic importance.
Galenite	Galena	Otisville, Orange county; Ellenville and Red Bridge, Ulster county, with copper pyrites and blende in a gangue of quartz in Oneida conglomerate; mines no longer worked; Wurtsborough, Sullivan county; near Sing Sing in Westchester county; Northeast township, Dutchess county; Ancram, Columbia county (strings of galena, blende, and pyrites in limestone); White creek, Washington county; Martinsburgh, Lewis county; Spraker's basin, Montgomery county; Rossie and vicinity, Saint Lawrence county (mines largely worked years ago; ore occurs in vein with blende, pyrites, and copper pyrites). These mines have all been idle for several years.

NEW YORK—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Lignite	Brown coal; wood coal	Near Rossville, Staten Island, thin seam in clay. Also in Suffolk county in clays.
Magnesite	Carbonate of magnesia	New Rochelle and near Rye, Westchester county; Warwick, Orange county; Stony Point, Rockland county; Serpentine hills, Staten Island; everywhere in thin seams and strings.
Menaccanite	Titanic iron	Edenville, Monroe, and Greenwood, Orange county, in small quantity; associated with magnetite in some of magnetic iron ore beds in Essex and Clinton counties.
Millerite	Sulphide of nickel	Sterling iron mine, Antwerp, Jefferson county, famous for crystalline forms.
Molybdenite	Sulphide of molybdenum.	West Point and near Warwick, Orange county; Phillip mine, Putnam county; Clinton county, but sparingly, in granitic rocks.
Muscovite	Mica	As a rock constituent common. In large plates near Warwick and at Greenwood at Mount Basha pond, in Orange county. Pleasantville, Westchester county; once opened and mined; Henderson, Jefferson county; Potsdam and Edwards in Saint Lawrence county.
Petroleum	Rock oil, "Seneca oil"	Seneca oil spring, Cuba, in Allegany county; Fredonia and Laona in Chautauqua county; Cayuga creek, Erie county; oil-bearing territory in parts of Chautauqua, Cattaraugus, Allegany, and Steuben counties.
Pyrite	Pyrites, iron pyrites, "sulphur."	Anthony's Nose, Montgomery, Westchester county, mine formerly worked; Phillip ore bed, Phillipstown, Patterson, southeast of Carmel and near Ludington mills, in Putnam county; with galena at Wurtsborough lead mine, Sullivan county; Flat creek, Montgomery county; near Canton, St. Lawrence county, in extensive beds; Duane, Franklin county, large bed; Martinsburgh, Lewis county, Eighteen-mile creek, Erie county; and many other localities, sparingly in rocks.
Serpentine	Serpentine	Staten Island, Richmond township; Tompkinsville, Staten island; near New Rochelle and near Rye, Westchester county; Phillipstown, Putnam county; near Amity, Orange county. Johnsburgh and Warrensburgh, Warren county; Shelving rock, Lake George, Washington county; Gouverneur, Fowler, Edwards, and Pitcairn townships, in St. Lawrence county; other localities of occurrence in small quantity.
Sphalerite	Zincblende	Associated with galena at lead mines in Sullivan, Ulster, and Orange counties; Ancram, Columbia county, Flat creek, Montgomery county; Salisbury, Herkimer county; Martinsburgh, Lewis county; Cooper's Falls, Mineral Point, and in Fowler, Saint Lawrence county. Generally not in sufficient quantity to be worked as an ore.
Tourmaline	Tourmaline	Newcomb, Essex county.
Wad	Earthy manganese, bog manganese.	In town of Austerlitz, Columbia county, are several localities; also in Hillside and Canaan, same county; smaller deposits near Houseville, Lewis county, and southeast of Warwick, Orange county.

NORTH CAROLINA—Mined

Agalmatolite	"Soapstone"	In Huronian rocks in a range crossing Chatham, Montgomery, and Cherokee counties. Worked for use in wall paper, soaps, etc.
Agate	Agate	Moss agate near Hillsborough, in Orange county; agates near Harrisburgh and Concord in Cabarrus county; also in Mecklenburgh county. In small quantity.
Allanite		Madison, Mitchell, and Iredell counties.
Asbestus	Asbestus	Near Bakersville, Mitchell county, very fine; southern part of Jackson county, fine and fibrous; near Baker mine, in Caldwell county; Nantahalah river, Macon county; Brushy mountains; near Brindleton and Warlick's mills, Burke county, and many other localities.

NORTH CAROLINA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Barite	Barytes, heavy spar	Crowder's mountain (two localities), Gaston county, in a bed 7 feet thick; King's mountain, Gaston county (four localities); Chandler's, near Marshall, Madison county; Latta mine, near Hillsborough, Orange county; localities in Cabarrus, Union, Wilkes, and other western counties.
Beryl	Beryl and aqua marine.	In various mica mines. Good gems from Ray mine, Yancey county; the emerald and hiddenite mine in Alexander county; several localities in Mitchell, Yancey, and Macon counties.
Bornite	Variegated copper ore, purple copper ore.	Clegg's mine, Chatham county; Peach Bottom mine, Alleghany county; Gap Creek mine, Ashe county; near Concord, Cabarrus county; Gardiner Hill mine, Guilford county. At these localities with other copper ores.
Chalcocite	Vitreous copper, copper glance.	Ore Knob mine, Ashe county, Gap mine creek, Ashe county; Waryhut and Wolf Creek mines, in Jackson county, Gillirs and Mill Creek mines, in Person county; Pioneer Mills mine, Cabarrus county; Nichol's, Swain county; Granville, Person, and Chatham counties. Irregularly mined.
Chalcopyrite	Copper pyrites, yellow copper ore, pyritous copper ore.	The principal copper ore of copper mines in the State. Occurs with pyrite and other sulphurets in gneissic and hornblende slate rocks in copper belt of Ashe and Alleghany counties; Gardiner Hill mine, Guilford county, in the gold mines of Guilford, Cabarrus, Mecklenburgh, and Davidson counties; also those of Union, Rowan, and Gaston counties; Macpelah church, Lincoln county; near Hillsborough and Chapel Hill, in Orange county; near Raleigh, Wake county; in Granville, Surry, Yadkin, Macon, Mitchell, Wilkes, Swain, and other counties, but sparingly; Clegg mine, Chatham county; Waryhut, Cullowhee, Savannah, and other mines in a copper belt in Jackson and Haywood counties; Elk Knob and Gap Creek mines, in Watauga county; Ore Knob mine, Ashe county; Peach Bottom mines, Alleghany county.
Corundum	Emery	Near Franklin, on Culsagee hill (called Corundum hill); Jacob's and Hassett's mines, on Ellijay creek; at Robinson's mine, on Sugartown fork, in Macon county. In large beds; worked extensively. Buck creek, Clay county; near Bakersville, in Mitchell county; many localities in the chrysolite rock range in western counties; in Guilford titaniferous magnetite range.
Emerald	Emerald	Emerald and hiddenite mine, Alexander county.
Galenite	Galena, lead ore	Silver hill, Davidson county, with blende, native silver, etc. Argentiferous, and worked for silver. Hoover and Boss mines, Randolph county; McMakin and other mines, Cabarrus county, Long mine, Union county; with blende, argentiferous, also limonite mine, same, King's mountain, Causler, Shuford, and Long Creek mines, in Gaston county, with blende; with gold ores, Murphy, Cherokee county; Beech mountain, Watauga county, several localities. Highly argentiferous: Flint knob, Wilkes county; other localities in Caldwell, Burke, Union, Chatham, Alleghany, Macon, Swain, Surry, and Montgomery counties.
Garnet	Garnet	Near Morganton, Burke county, for abrasive purposes.
Gold	Gold	Many localities. It occurs in quartzose veins, with limonite, pyrite, chalcopyrite, and other minerals in gneissic, granitic, chloritic, talcose, and other crystalline rocks of Laurentian and Huronian ages; also in soils, decomposed rocks, and gravels. The principal gold-bearing belt traverses the central part of the State and the counties of Guilford, Randolph, Davidson, Rowan, Cabarrus, Mecklenburgh, Stanley, and Gaston are in it. The Gold Hill mine, in Rowan county; King's Mountain mine, in Gaston county; North State mine, in Randolph county; the mines about Lexington, in Davidson county; the Rhymer, Bullion, Dunn Mountain, Southern Belle, and Yadkin mines, in Rowan county; the Concord mines, in Cabarrus county; the Charlotte district, in Mecklenburgh county, are the more important localities. Many of them are now working. Auriferous gravels occur over large areas in Franklin and Nash counties at the east, and in the western part of the State in Montgomery, Burke, McDowell, and Rutherford counties. The Portis mine, Nash county, and the gravel deposits on

NORTH CAROLINA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Gold (cont'd) ..	Gold	the headwaters of First and Second Broad rivers, Muddy creek, and Silver creek, in Rutherford, Burke, and McDowell counties, are the most noted localities. Gold-bearing gravel districts are also worked in Caldwell county, Polk county, and on the west slope of the Blue Ridge, in Cherokee, Jackson, and Watauga counties. Boylston mine, Henderson county.
	Granite	Common except in eastern section of State. Many localities where quarried. Near Raleigh, Wake county; Hendersonville quarry, Granville county; along Wilmington and Weldon railroad, in Edgecomb and Wilson counties; Dunn's mountain, near Salisbury, Rowan county, a white granite and of great extent; large quarries. Other quarries along railroad lines in the granite belt of Piedmont and mountain sections in Henderson, McDowell, Caldwell, Iredell, Gaston, Richmond, Anson, and other counties.
Graphite	Plumbago, black lead.	Widely distributed in Laurentian and Huronian rocks. Wake county, beds 2½ miles west of Raleigh; a range 16 to 18 miles long, from northeast to southwest; two beds each, from 2 to 4 feet thick. Eastern one is worked extensively. Graphite occurs in quartzitic and talco-argillaceous slates; impure beds in a range in Gaston, Lincoln, and Catawba counties opened near Catawba station, in Catawba county; near Briar's springs, Cleveland county; others in Stokes, Person, Yancey, Alleghany, and Johnston counties.
Hematite	Specular iron ore, red iron ore.	Near Gaston, Halifax county, beds in Huronian slates, opened and of considerable extent; Evans' and Kelley's ore beds, Ore Hill; Buckhorn mines, in Chatham county; the latter a large deposit of manganiferous iron ore; near Haywood, Chatham county, beds in red sandstone and with limonite; Chapel Hill, Orange county, large veins in grey granite and syenite, opened but idle; Mount Tirzah, Person county, vein worked during the war; near Franklinville, Randolph county; near Ashborough, Randolph county; near Troy, Montgomery county; Hopewell, Mecklenburgh county, much loose ore on surface. Hematite (non-specular) in Lincoln, Catawba, and Gaston counties.
	Limestone	Belt crossing Stokes, Catawba, Lincoln, and Gaston counties. Quarries for local use. Nantahalah river and Valley river, in Cherokee county.
Limonite	Brown hematite	Large beds at Ore hill, Chatham county; near Smithfield, Johnston county; High shoals, Gaston county; in Lincoln and Catawba counties; Cherokee county at Nottla and along Valley river; many valuable beds in a northeasterly direction from Jacobi fork of Catawba river, in Burke county, to Brushy mountains, in Wilkes county. Many localities have been worked; Linville mountains, McDowell county; Mitchell, Buncombe, Watauga, McDowell, Surry, Burke, Caldwell, Gaston, Haywood, Macon, Henderson, Transylvania, Davidson, Wake, and other counties; Ore Knob copper mines, Ashe county, accompanying copper lodes in upper part.
Limonite (2)...	Bog iron ore	Many deposits in eastern part of State, in New Hanover, Duplin, Jones, Nash, Pender, and other counties.
Magnetite	Magnetic iron ore	Magnetite occurs in the Laurentian and Huronian formations in central and western parts of State at many localities. Those important are: Near Gaston, Halifax county, with specular ore; near Tar river, Granville county, beds in Huronian rocks; Pegram mine, Chatham county; ore belt from headwaters of Abbott's creek, in Davidson county, northeast through Guilford county to Haw river, in Rockingham county, titaniferous magnetic ore opened at several points; Mecklenburgh and Cabarrus counties; ore range from King's mountain, on southeast border, to Anderson mountain on Catawba river, in Catawba county; Ferguson, Ellison, and Costner, and other ore banks in Gaston, Lincoln, and Catawba counties; ore ranges from near Danbury, in Stokes county, and from near Virginia line in Surry county, southwest to Yadkin and Davie counties; Hobson mines, Big ore bank, and others in it; near Patterson, Caldwell county; Cranberry ore bank, on western slope of Iron mountain, in Mitchell county, a great extent of rich ore long worked in open quarries; Rock creek, foot of Roan mountain, Mitchell county; near Jefferson, Helton's, and Horse creek, Ashe county; western slope of Black mount-

NORTH CAROLINA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnetite (continued).	Magnetic iron ore	ain, and Marshall, and near mouth of Joy river, in Madison county; Wilkins creek in Haywood county; also in large beds in Jackson, Macon, Iredell, and Swain counties.
	Marls, greensand, or glauconitic marls.	Southeast counties, from Neuse river to Cape Fear river, along Cape Fear river; Livingstone's creek, Black river, South river, Neuse river and its tributaries; Contentnea, Moccasin, and on Tar river; Brunswick, New Hanover, Bladen, Sampson, Duplin, Jones, Lenoir, Wayne, Johnston, Wilson, Nash, Halifax, and Franklin counties.
	Marls (2), calcareous marls.	Occur in limited patches on beds in all the eastern counties from South Carolina to Virginia throughout an area equal to one-fourth of the State. Used locally in many places.
	Millstone	Sandstone of Anson county quarries used as grindstones during the war; Triassic conglomerates, McLennan's creek, Moore county, used for millstones for a long time; Laurel river, Madison county, quartzite, used for millstone; granite and gneisses also used; shell rock, silicified, in eastern section.
Monazite	....	South mountains, Burke county.
Muscovite	Mica	Granitic ledges on waters of Nolachucky, between Black and Roan mountains, in Mitchell and Yancey counties. Mines near Bakersville, Mitchell county; Burnsville, in Yancey county; Richland creek, in Haywood county; near Jefferson, Ashe county, and in Jackson and Macon counties; on east side of Blue Ridge, quarried in Burke, Cleveland, Catawba, and Buncombe counties. Many localities in granitic regions of western counties.
Novaculite.....	Whetstone	Few miles west of Chapel Hill, Orange county, extensively quarried; near Roxborough, Person county; near Wadesborough, Anson county. These quarries in Huronian belt. Other quarries elsewhere for local uses.
	Phosphatic nodules...	In Brunswick county, eleven miles from Wilmington, opened.
Pyrite....	Iron pyrites....	Mined for gold contents in all the deeper gold mines.
Quartz.........	Rock crystal..........	Alexander and Ashe counties.
Rutile..........	Titanic acid ore.......	Alexander and Cherokee counties, for dental purposes.
Samarskite	Yttria ore	Wiseman mica mine, Mitchell county.
Siderite........	Black band ore and ball ore.	Beds in the coal and shales series of Deep river, opened at Egypt, Farmville, Gulf, etc., in Chatham county.
	Sandstone......	I. Sandstone of Triassic periods, Wadesborough quarries, Anson county; Chatham, near Egypt, in Chatham county; near Durham, in Orange county, used at Raleigh; other quarries in the Dan river belt; Rockingham and Stokes counties, and in narrow belt stretching from Granville county, southwest through Durham, Chatham, Moore, Richmond, and Anson counties. II. Sandstones of Huronian belt, also used to limited extent.
Serpentine.....	Serpentine...........	Patterson, Caldwell county, quarried, very fine and dark colored and admits of fine polish; Baker mine, Caldwell county; Buck creek, Coumdentine, Clay county; Asheville, Buncombe county; also in Wake and Forsythe counties; yellowish green variety occurs in Caldwell, Wilkes, Surry, Yancey, Stokes, Orange, and Wake counties; also in chrysolite beds of western part of State.
Spodumene	Hiddenite............	Near Hiddenite station, Alexander county, deep green crystals introduced as gems; only locality for hiddenite.
Talc............	Soapstone, steatite....	Cherokee and Macon counties, on Nantahalah river, Valley river, and Nottla, extensive beds; in South mountains, Burke county; near Waynesville, Haywood county; Belts bridge, near Iredell county; north part of Wake county; Ashe county; and in many places west of the Blue Ridge, noted in thirty counties as occurring.
Zircon	Zirconia ore......	Green River station, Henderson county; auriferous gravels of Burke, Rutherford, McDowell, and Mecklenburgh counties.

NORTH CAROLINA—Not Mined.

Mineralogical name.	Common name.	Remarks.
Arsenopyrite	Mispickel	Gold mines in Union, Gaston, Cabarrus, and Watauga counties, but only sparingly with other ores.
Asbestus	Asbestus	Old Fort and Henry's, McDowell county.
Azurite	Blue carbonate of copper.	Less common than the green carbonate. Clegg's mine, Chatham county; Cheek mine, Moore county; copper mines in Mecklenburgh, Cabarrus, and Gaston counties; rarely at copper mines in copper region in northwest part of State.
Barnhardtite	Copper ore	Barnhardt's and Pioneer Mills mines, Cabarrus county; Cambridge, Guilford county; McGinn and Wilson mines, Mecklenburgh county; Elk knob, Watauga county; Davidson county.
Bitumen	Oil shales	In Triassic rocks in Egypt.
Bornite	Purple copper ore	Several localities in Granville, Person, and Union counties.
Cassiterite	Tin ore	King's mountain, Gaston county.
Cerussite	Carbonate of lead	Silver hill, Davidson county, with galena and silver ores; Murphy, Cherokee county; Baker mine, Caldwell county; Rowan county.
Chromite	Chrome iron	Associated with titaniferous iron ore in Guilford county, in small quantities; in chrysolite beds at Culsagee, Higdon's, Ellijay creek, Moore's mine, Macon county; near Webster, Jackson county; Hampton, Yancey county, in quantity in at least two localities; also in Clay, Mitchell, Burke, and Watauga counties.
Chrysocolla	Silicate of copper	At many of copper mines, with other copper ores. Unimportant as an ore of copper.
Coal, var. anthracite.	Coal	Evans' mills.
Coal, var. bituminous and semi-bituminous.	Soft coal	Chatham, Moore, Rockingham, and Stokes counties.
Copper, native	Copper	Very sparingly, in Person, Jackson, Ashe, and Mecklenburgh counties.
Corundum	Emery	Undeveloped localities in Jackson, Macon, Clay, Madison, Buncombe, Haywood, Gaston, Lincoln, Iredell, Burke, McDowell, and Wilkes counties.
Cuprite	Red oxide of copper	Sparingly in Caldwell, Lincoln, Alleghany, Ashe, Chatham, Jackson, Mecklenburgh, and Guilford counties.
Diamond	Diamond	Brindletown Creek ford, Burke county; Twitty's mine, Rutherford county; Cottage house, Lincoln county; Todd's branch, Mecklenburgh county; Portis mine, Franklin county; headwaters of Muddy creek, and near Dysartville, McDowell county.
	Feldspar	Many localities as constituent of granite and gneiss, and abundant as a by-product in mica mines.
	Fire clay	On coal series Deep River coal field; also in some of eastern counties in Tertiary and Quaternary formation. (?)
Halite	Common salt, brines	Brine wells in Chatham, Orange, and Buckingham counties, in Triassic beds.
Kaolinite	Clays, kaolin	Near Greensborough, Guilford county; near Newton, Catawba county; at mica mines in Mitchell, Yancey, and Macon counties; also in Lincoln and Burke counties; Spout Springs, Harnett county; Shoe Heel depot, Robeson county; near Clayton, Johnston county. Other localities in Chatham, Ashe, and Wake counties, and many sedimentary clays in Tertiary and Quaternary formations of eastern part of State.
Lignite	Brown coal	In marl beds in the eastern counties, common; in Triassic rocks on Tar river, Granville county; Brown creek, Anson county.

NORTH CAROLINA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Magnesite....	Carbonate of magnesia	Webster, Jackson county; Hampton's, Yancey county; McMakin's mine, Cabarrus county.
Malachite......	Green carbonate of copper.	In small quantity with other copper minerals.
	Marble..............	Cherokee and adjoining counties of southwest North Carolina.
Melaconite....	Black oxide of copper.	Sparingly, with other copper minerals.
Molybdenite...	Sulphide of molybdenum.	Pioneer Mills mine, Cabarrus county; Peach Bottom mine, Alleghany county; Hackett's, Macon county; sparingly, in small scales, at these localities; Yancey county.
	Peat..................	Abounds in eastern part of State, particularly in the seaboard counties.
Psilomelane ...	"Black hematite"....	Near Lenoir, Caldwell county, in a vein 4 feet wide, in gneissic rocks; Danbury, Stokes county, thin seam; Buckhorn iron mine, Chatham county, interlaminated with hematite; Beck's ore bank, Gaston county; Bakersville and Gillespie's gap, in Mitchell county; Cove creek and Richland creek, Haywood county.
Pyrite.........	Pyrites, iron pyrites..	Common almost everywhere in the State, with copper pyrites at copper mines (see localities of chalcopyrite); also in gold-bearing belt in auriferous quartz ore veins. Large veins of massive pyrite occur in Gaston county; Lincoln county.
Pyrolusite.....	Black oxide of manganese.	Murphy's, Cherokee county; Hickory, Catawba county; McMakin's silver mine, Cabarrus county, and at localities of psilomelane, but nowhere in large quantity; also associated with wad.
Siderite.......	Spathic iron ore, carbonate of iron.	Halifax, Davidson, and Granville counties, in grayish-brown nodules; common in veins as gangue material at gold mines, also at some copper mines; other localities of mineralogical notice.
Silver, native..	Silver................	Silver hill, Davidson county, in considerable quantities; Baker mine, Caldwell county; Scott's hill, Burke county, in veins of gold-bearing quartz; Gap Creek mine, Ashe county, with copper ores; McMakin mine, Cabarrus county, with tetrahedrite and zincblende; Asbury mine, Gaston county; also alloyed with gold in gold-bearing belt.
	Slate..................	In Huronian belts of rocks; near Asheville, Buncombe county.
Sphalerite.....	Zincblende...........	Silver hill, Davidson county, with galenite and silver ores; McMakin mine, Cabarrus county, with galenite and silver ores; Stewart, Long, Lemmond, and Moore gold mines, Union county; Dobson mine, Cedar cove, McDowell county, in limestone; Macon, Gaston, Madison, Montgomery, and Alleghany counties, in small quantities.
Tetradymite...	Tellur-bismuth.......	Beck's mine, west of Silver hill, and Allen mine in Davidson county; also in minute scales at copper mines in Cabarrus county, Gaston county, Burke county, and McDowell county.
Tetrahedrite ..	Freibergite, argentiferous fahlerz.	McMakin mine, Cabarrus county, with silver, zincblende, galena, etc.; Sudwick's mine, Cabarrus county, with copper pyrites, etc., arsenical ores.
Wad...........	Bog manganese.......	Murphy, Cherokee county, with pyrolusite; other localities in small quantity in western part of State.

OHIO—Mined.

Mineralogical name.	Common name.	Remarks.
	Clay (brick and tile)..	For common brick abundant. Fine brick at Youngstown. A variety of fire clay in Mahoning county, used for vitrified paving brick. Jackson and Berlin townships, for drain tile. Stoneware made in Berlin, etc. Terra-cotta works at Youngstown.
	Clay (fire)	Dover and Mineral Point, Tuscarawas county, a flint clay, in Coal Measures, used at Dover, Mineral point, and Akron; Springfield, Summit county, largely mined for ware; Holmes county, in Coal Measures; New Lisbon, Liverpool, Smith's Ferry, on Ohio river; Achor, Carbon Hill mines, near Palestine, Leetonia, in Columbiana county, mostly from beneath coal seams Nos. 3 and 5, and furnishing material for potteries at East Liverpool and Wellsville; along Yellow Creek valley, at Elliottsville, Croxon's run, and Sloan's station, in Jefferson county, largely used in manufacture of firebrick; Symmes creek, Muskingum county; Holmes county, thick beds, undeveloped; Atwater township, Portage county, and at many other localities in Coal Measures territory. The fire-clay bed under seam No. 3 is usually thick and of excellent quality. Under coal in Smith and Jackson townships, Mahoning county, used for making vitrified brick for paving.
Coal	Coal, bituminous coal.	The Appalachian coal field, which extends into the eastern part of Ohio, covers an area of 12,000 square miles in that State, from Trumbull county on the north to the mouth of the Scioto river on the south. Twenty-one counties are wholly within its limits, and fourteen are partly in it or have outliers, or small, detached coal basins. The Coal Measures include (in an ascending order) coal seams Nos. 1 to 7, inclusive, in a thickness of 400 feet; then barren measures with local seams, 400 feet; and beginning with the Pittsburgh seam, coals Nos. 8 to 13, inclusive, in 350 feet, making in all 1,150 feet. The aggregate thickness of the coal seams at the southeast is about 50 feet. At the north, coal seam No. 1 is very extensively worked in Geauga, Portage, and Summit counties; in the Mahoning valley, Trumbull and Mahoning counties; Tuscarawas valley, Stark county. It is locally known as "Briar hill," "Mahoning valley," and "block coal." The higher seams are the basis of coal mining to southward. Mines are worked on Yellow creek and on the Ohio, in Columbiana county; Leesville, Harlem, etc., in Carroll county; near Zoar and at Mineral point, Tuscarawas county (coal No. 5); coal Nos. 3 and 6 in Coshocton and Holmes counties; Straitsville, Moxhala or Upper Sunday creek districts in Perry county, and the Lower Sunday Creek and Nelsonville districts, Athens county, forming the Hocking Valley field, and working the "great seam," or "Nelsonville seam," 11 to 13 feet thick; Fultonville and Short Creek valley, and Rush run, in Jefferson county (coal No. 8, or "Pittsburgh seam"); "Wheeling" or "Bellaire" seam on Wheeling creek, Belmont county; "Cambridge seam" in southern part of Guernsey county; Jefferson Township mine, Noble county; "Pomeroy seam" in Homer and Marion townships, Morgan county; besides very many other groups and districts.
	Flagging stone	Berea, Cuyahoga county, the "blue stone" of Cleveland; Thompson, Geauga county; Amherst and La Grange, Lorain county; Lima, Allen county (from Water-lime group); Eaton, Preble county; Belle Centre, Logan county; Greenfield, Highland county (curbstones and crosswalks from limestone of Helderberg group); Waverly sandstone of Scioto valley; Greene and Clarke counties (the "Springfield stone"), a magnesian limestone. Extensively quarried at Warren, Trumbull county.
	Grindstones and whetstones.	Berea and Independence, Cuyahoga county, extensive quarries; Amherst quarries, Lorain county, producing the "American Wickersley stone;" Mesopotamia, Trumbull county (scythe stones); Warren and Dunham townships, on Ohio river, Washington county (Coal Measures sandstones); Massillon, Stark county; Manchester, Summit county (whetstones).
Gypsum	Gypsum	Plaster Bed peninsula, Put-in bay, Lake Erie, Ottawa county (in Water-lime group); West Sister island, Lucas county; Ellsworth, Mahoning county; Sandusky, Erie county.

OHIO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Halite	Common salt, brines	Salt is made from brines obtained in borings in Meigs, Athens, Perry, Morgan, Muskingum, Noble, and Guernsey counties. Formerly made in Scioto and Jackson counties. Brines come mainly from Waverly sandstone (Carboniferous). Salt works on Ohio river, in Meigs county; on Hocking and Monday creek, Perry county; on Muskingum, in Morgan and Muskingum counties; Scott works, Guernsey county, and in Olive township, Noble county. Brines are also found in Aurelius township, Washington county; Canal Dover, Sugar creek, and Goshen, in Tuscarawas county; Salineville and Little Beaver valley, Columbiana county; along Ohio river, East Liverpool to Wellsville, in Jefferson county.
	Hydraulic limestone, cement-rock.	South point of Put-in bay, Lake Erie; Belle Centre, Logan county; Wayne township, Fayette county; Concord township, Ross county; Genoa, Ottawa county, and Fremont, Sandusky county (magnesian limestones), extensively used, even to east; New Lisbon, Columbiana county; Defiance, "black slate" of Huron shales, making the well-known "Auglaize cement;" Barnesville, Belmont county, from bed overlying coal seam No. 9.
	Limestone	Building stone is obtained from the widespread limestone areas of the State at very many localities. The Corniferous limestone is quarried at Sandusky, Erie county; Marblehead, Ottawa county, and Kelley's island, in Lake Erie. It is known as "Sandusky stone," and is used in Toledo, Sandusky city, and Cleveland. Same rock is quarried at Bucyrus, Crawford county, and at Charloe, Paulding county. The Water-lime group affords limestone at Lima, Allen county, and at Tiffin, Seneca county. The Niagara limestone, also, is quarried in Bellevue and Fremont, in Sandusky county. In Thompson and Bloom townships, Seneca county; Marion, Marion county; White House, Sylvania, Providence, Lucas county, and Columbus, Franklin county, there are quarries in the Upper Corniferous. The Cincinnati group furnishes good stone in many southwestern counties. There are quarries in it, at Cincinnati; at Point Pleasant, Clermont county; in Montgomery county (many localities), and in Preble and Warren counties. The Springfield quarries, Clarke county, are in the Niagara, as is also the Piqua stone, Miami county, and the celebrated "Dayton stone," quarried in vicinity of Dayton, and in the Miami valley, and at Xenia and along Mossie creek, in Greene county. The Helderberg group is worked extensively at Greenfield and near Lexington, in Highland county. Extensive beds, largely worked in lower Mahoning valley, Mahoning county, used as flux for iron furnaces.
Limonite	Brown hematite	Occurs in Coal Measures as result of oxidation of the carbonate (siderite). In southeast part of State, from Ohio river north to Hocking valley. Mined in Perry, Athens, Muskingum, and other counties, with the carbonate ore.
	Millstone, buhrstone	Richland and Clinton, Jackson county; Muskingum, Licking county; and Elk, Athens county.
	Natural gas	Many localities.
	Ochers (paints)	Near Germantown, Montgomery county; Idaho and Grassy fork, Pike county (ochery travertines and small deposits); Springfield, Clarke county; Miamisburgh, Montgomery county. These are properly clay beds, but are worked for paint.
Petroleum	Petroleum	Grafton (first sandstone, Berea grit), Lorain county; Liverpool, Medina county; springs and wells in first and second sand rocks; along outcrop of Cleveland shales in Trumbull county, producing wells at Mecca in Trumbull county (superior lubricating oil); Preble county, springs at base of Clinton limestone; wells not successful. Tar spring, Pike county, springs out of Waverly sandstone; Bluerock township, Muskingum county, wells; Buck run, Morgan county, several wells; Kokosing district, Knox and Coshocton counties, gas and oil wells; Duck Creek valley and Cow run, Washington and Noble counties, many productive wells; Newport on Ohio river, wells; eastern part of Adams and western Scioto counties, oil springs in black slates. A small quantity of oil similar to Mecca oil, at Frederick, Mahoning county.

OHIO—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Quartz	Sand for glass manufacture.	Near Fulton, Stark county, a sandrock, used at Pittsburgh, Pa.; Sylvania, Lucas county; Chester, Geauga county, friable sandrock.
	Sandstone	"Berea sandstone"; noted quarries at Berea, Independence, Chagrin falls, and Gates' mills in Cuyahoga county; large quarries at Peninsula, Summit county; Windsor mills, Ashtabula county, and in Munson and Thompson townships in Geauga county, "Amherst sandstone," or "Ohio sandstone"; also from the Berea grit. "Blue Amherst," from base of this grit. Very large quarries at Amherst and Elyria, in Lorain county; also quarried at Columbia, Carlisle, La Grange, Pittsfield, and French creek, in Lorain county; in southeast part of Crawford county; Iberia, Mount Gilead, and Cardington in Morrow county; Sunbury and eastern part of Delaware county; Black Lick, in Franklin county; Mahoning valley, Mahoning county. Waverly sandstone in southern Ohio, in Scioto valley. Quarries at Waverly and Jasper, Pike county, and along Scioto river, in Ross county. The "Buena Vista" stone is from Waverly group, also (above the black shale and Waverly quarry stone) Pike county, along the Scioto river, northeast of Waverly. A sandstone (Waverly ?) is quarried at Sugar grove and Lithopolis, in Fairfield county. The Massillon sandstone is quarried in Massillon, Fulton, and Bridgeport, Stark county (from Coal Measures). In Warren and Dunham townships, Washington county, sandstone (Carboniferous) is quarried, which is known as "Constitution stone." Sandstone quarries at Plymouth, Huron county; Mansfield, Richland county, and Grand Rapids, Wood county (last named is Oriskany). The Carboniferous conglomerate is quarried at Akron and at Cuyahoga falls, Summit county; and at Russell and Newbury townships, Geauga county. Waverly conglomerate at Ashland, Ashland county.
Siderite	Carbonate of iron, clay ironstone, var. "limestone ore."	In Coal Measures of eastern Ohio; Baird ore. on Monday creek, below the "great seam" or Nelsonville coal; also between Monday creek and Hocking river, on Upper Sunday creek; Shawnee and Moxhala; all these localities in Perry county. At Bessemer, Athens county; other localities in Muskingum, Hocking, Vinton, Jackson, Scioto, and Lawrence counties. Hanging Rock region ores are carbonates mainly; limited outcrops observed in Washington, Jefferson, Holmes, Summit, and other counties in eastern part of State.
Siderite (?)	Black band ore	Tuscarawas valley, Tuscarawas, Stark, and Carroll counties. Occurs above coal No. 7, with "limestone ore" and "kidney ore" at some localities. Mines at New Cumberland, Canal Dover to Fairfield, Zoar, Clover hill, Junkin, Auburn, and Salem, in Tuscarawas county; Osnaburgh and Paris in Stark county, and in northern part of Muskingum county; other localities of occurrence in Coal Measures area of State. Mined with coal at Miner and Ridge, Trumbull county; and in Austintown, Mahoning county.

OHIO—Not Mined.

	Alum	Copperas mountain, Bainbridge, Ross county.
Celestite	Sulphate of strontia	Green or Strontian island, Put-in bay, Lake Erie, in fine crystals and in large masses, filling fissures in the Water-lime rock; with calcite, White House, Lucas county; West Sister island, Lucas county, with gypsum.
	Copperas	Copperas mountain, Bainbridge, Ross county.
Galenite	Galena	Coshocton county, in Waverly rocks, in small quantity.
Gold	Gold	Belleville, Knox county; near Brownsville and near Newark, Licking county; Warren and Clermont counties. In drift clays, sands, and gravels very sparingly.
Halite	Salt brines	Met in boring for natural gas in wells at several localities, as at Youngstown, Mahoning county.

OHIO—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Hematite	Fossil ore, dyestone ore.	Sinking springs, Adams county; most important deposit of this ore in the State; Todd's ford, near Wilmington, Clinton county; near Zanesville, Muskingum county.
Limonite	Brown hematite	Vicinity of Zanesville, Muskingum county; near Maxville, Perry county, in Coal Measures; Plymouth township, Richland county, a large bed with calcareous tufa; Licking county, siliceous ores.
Limonite (2)	Bog iron ore	Northwestern part of State, in small deposits, Amanda, Hancock county; Putnam county; Tiffin and Seneca, Seneca county; Palmer township, Washington county; a large body, ore manganiferous; Lorain county.
	Marls	Calcareous shell marls occur in lakes and marshes in Hudson and Northampton, in Summit county; in Brighton and Camden, Lorain county; in marshes in Williams and Fulton counties; in Rush Creek lake, Logan county. At Sinking spring, Highland county, there is a marly magnesian limestone, and in Ashtabula county calcareous tufa occurs in Erie shales.
	Peat	Summit county, large deposits; Bloomfield township, Trumbull county, several thousand acres in extent; near Painesville, Lake county; Brighton and Camden, Lorain county; Williams and Fulton counties. Many other smaller deposits in northern part of State.
Petroleum	Petroleum	Medina, Summit, Cuyahoga, and other counties, partially developed.

OREGON—Mined.

Calcite	Limestone	Rock Point, Jackson county.
Cinnabar	Quicksilver ore	Elk Head and near Oakland, Douglas county.
Coal, var. lignite	Coal	Coos county.
Gold	Gold	In quarry veins and placers in Baker and Union counties, in the northeastern portion of the State, and in all the counties the southwestern portion.
Halite	Common salt	Warner's valley, Lake county. in ponds.
Limonite	Brown iron ore	Oswego, Clackamas county.
Magnetite	Magnetic iron ore	Jackson county; used as flux.

OREGON—Not Mined.

Barite	Barytes, heavy spar	Josephine county.
Calcite	Limestone	Baker, Union, and Josephine counties, abundant, and in less quantity in several other counties.
Chalcopyrite	Copper pyrites	Near Waldo, and other points in Josephine county; Clackamas county.
Coal, var. lignite	Coal	In many counties in the western portion of the State.
Garnierite	Nickel ore	Riddle's, Douglas county.
	Infusorial earth	Near Linkville, Klamath county.
Limonite	Brown iron ore	Multnomah, Columbia, and Marion counties.
Mirabilite	Glauber salt	Lake county, in ponds, and layers near the surface.
Natron	"Soda"	Lake county, in lakes and ponds.
Platinum	Platinum	Coos, Curry, and Josephine counties, in beach sands and gold placers.

OREGON—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrrhotite (nickeliferous).	Magnetic pyrites, nickel ore.	Douglas county, on upper Dad's creek; near Rock Point. Jackson county.
Ulexite........	Borate of soda and lime.	Warner's valley, Lake county.

PENNSYLVANIA—Mined.

Asbestus	Asbestus	Rockdale, Delaware county, worked to slight extent; Mineral hill and other localities in same county; in West Nottingham, East Nottingham, East Bradford, and Goshen townships, Chester county; near Lafayette, Montgomery county, with steatite; Chestnut hill near Easton, long opened and worked; and at Gap mine, Lancaster county.
Azurite........	Blue carbonate of copper.	Cornwall, Lebanon county, with chalcopyrite and malachite in magnetic iron ore; Fritz island, near Reading, sparingly; Jones' mine, near Springfield, Berks county, with copper ores and magnetic iron ore; Perkiomen mine, near Shannonville, Montgomery county.
Cerussite......	Carbonate of lead, white lead ore.	Silver-lead mines of Chester county, and Ecton mine, Montgomery county; in small quantities at Phœnixville lead mines, Pequea mine, and Lancaster zinc mines, in Lancaster county.
Chalcopyrite...	Copper pyrites, pyritous copper ore.	Jones' mine, Berks county; Cornwall, Lebanon county; Fritz island mine, near Reading; mines near Knauretown, Chester county, with other ores of copper in irregular seams in magnetite; Gap (nickel) mine, Lancaster county; Chester, Delaware county; in gneiss at Frankfort and Wissahickon, Philadelphia county; near Lafayette, Montgomery county; Wheatley mine, Chester county, and in small quantities at copper mines in Triassic sandstone. Collected with other copper ores at Cornwall; elsewhere unimportant as an ore.
Chromite	Chromic iron ore	Wood's and Texas mines, Little Britain township, Lancaster county, an old and famous mine, country rock serpentine; Low's, Linepit, and Jenkin mines in Fulton township, Lancaster county; Elk, East Nottingham, and West Nottingham townships, Chester county; Middletown and Marple townships, Delaware county; nearly all abandoned. Occurs in lenticular deposits in serpentine and in form of "sand" in gravel.
Coal, mineral coal.	Anthracite coal.......	1. Northern or Third coal field, Wyoming valley. The principa collieries are at Carbondale, Archibald, Oliphant, in Dunsmore, Scranton, Lackawanna township, in Lackawanna county; and Pittston, West Pittston, Plainsville, Wilkes Barre, Kingston, Ashley, Sugar notch, Plymouth, and Nanticoke, in Luzerne county. 2. Eastern middle coal field, or Lehigh coal basins, in southern part of Luzerne and adjoining parts of Carbon, Schuylkill, and Columbia counties. The localities of larger collieries are: Upper Lehigh, Drifton, Jeddo, Eckley, Harleigh, Milnesville, Ebervale, Hazleton, Buck mountain, Beaver Meadows, and Audenried. 3. Western middle coal field, or Second coal field, in Schuylkill, Columbia, and Northumberland counties. In it are, among others, the following localities: Mahanoy City, Shenandoah, Girardville, West Mahanoy township, Gilberton, Ashland, in Schuylkill county; Centralia, in Columbia county; and Mount Carmel and Shamokin, in Northumberland county. 4. Southern or First coal field, mostly in Schuylkill county. The more prominent localities are: Nesquehoning, at the northeast, in Carbon county; Coaldale, Tamaqua, Pottsville, Minersville, Tremont, and Lykens valley, in Schuylkill county; and a few collieries in southwest extension of the field, in Dauphin county. 5. Loyalsock basin, or Bernice mines coal field, Sullivan county; Forkston, Wyoming county (semi-anthracite). Small beds in York county.

PENNSYLVANIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Coal (2), semi-bituminous.	Bituminous coal......	Towanda or Barclay district, and Long Valley mines, near Barclay, in Bradford county; Little Pine creek, in Lycoming county; Blossburgh region, in Tioga county, opened largely at Fall Brook, Morris run, and Blossburgh; Gaines basin, western part of Tioga county; Snowshoe basin, in western part of Centre county; Philipsburgh coal field, in the counties of Centre and Clearfield, on the Moshannon creek and its tributaries; Johnstown field, Cambria county; Broad Top Mountain coal region, partly in Bedford and partly in Huntingdon counties; Forksville mines, Sullivan county.
Coal (3), bituminous.	Bituminous coal......	In the portion of the State lying west of the Alleghanies, including twenty-seven counties in whole or in part, and having an area of about 12,000 square miles. The Upper Coal Measures are confined to southwestern part of State, having Allegheny, Beaver, Armstrong, and Indiana counties for their northern limit. Seams A-I, inclusive, are worked besides thin seams in the Upper Barren group in Washington and Greene counties. The Pittsburgh seam (H) is the most widely developed and most productive. It is the seam in the Connellsville coke region. The Lower Freeport bed of the Lower Productive group is also largely developed, being the mining bed of the Clearfield and Punxsutawney districts, and also present in excellent condition in the recently opened fields in northern and eastern Cambria county. Another important bed is known as the Sharon bed (a block coal) in Mercer county.
Corundum.....	Corundum, emery	Near Unionville, Newlin township, Chester county; a large bed. opened and worked up at Kennett Square; in vicinity of Media and in Aston township, Delaware county, in small quantity. Other occurrences in Chester, Delaware, and Lancaster counties, very sparingly.
	Feldspar..............	(See Albite and Orthoclase.)
	Fire clay	Sandy Ridge, Centre county; Clearfield, Blue Ball station; Woodland, in Clearfield county; Johnstown, Cambria county; Indiana county, many localities; Brookville and Bellport, Jefferson county; near Kittanning, Armstrong county; Big Beaver township, Beaver county; Bolivar, Salina, and Ligonier, Westmoreland county; Londonderry township, Somerset county; Springbill township, Fayette county; Benezette, Elk county; Forks township, Sullivan county; Queen's run and Farrandsville, in Clinton county, are some of more important localities of general occurrence in Coal Measures in central and western parts of State. Quarried at these and other localities.
	Flagging stone	Numerous quarries in grits and sandstones of Hamilton group in Shohola, Lackawaxen, Greene, and Westfall townships, near Delaware river and Lackawaxen creek, in Pike county; also in Barrett, Price, and Paradise townships, Monroe county; Nicholson, Wyoming county; Auburn, Susquehanna county; New Era, Bradford county; Dushore, Sullivan county. In northwestern and western counties the sub-Carboniferous and Carboniferous formations yield a flagstone for local uses.
Galenite.......	Galena................	Phœnixville mines, Chester county; mines near Shannonville, Montgomery county; Pequea mine, Lancaster county (argentiferous); New Britian, Bucks county; Sinking valley, Blair county, accompanying zinc ores; with pyrite in sandstone, Bradford county; and, near Pottsville, mines of Chester and Montgomery counties have been long worked.
	Granite...............	Granitic, gneissic, and mica schist rocks are quarried in the eastern part of the State. The South Mountain range, from Delaware river to Lebanon county, and the gneissic rock region of the southeastern part of the State in Bucks, Philadelphia, Montgomery, Chester, Delaware, and Lancaster counties afford many outcrops. These stones are quarried in many places for building material.
Halite.........	Common salt, brines..	Salt wells, Saltsburgh, Indiana county; along Kiskiminetas river, Armstrong county; Bayard salt works, Long run, on Sewickley creek, Westmoreland county; on Youghiogheny, Fayette county; Tarentum, Allegheny county; Brighton and Industry, Beaver county; Boyd's Hill, Pittsburgh, and in Bradford county, in oil district. Manufactured on small scale at several of these places and for local uses only. Salt water in lower sands in oil region.

PENNSYLVANIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Hematite	Fossil ore, dyestone ore.	In the Clinton group, from Bloomsburgh and Danville, Montour county, traceable through Northumberland, Snyder, Union, Mifflin, Centre, Juniata, Fulton, Perry, and Huntingdon counties, of middle Pennsylvania, and thence through Bedford to the State line on the south. Fossil ores of the Chemung formation are mined in the north, in Bradford and Tioga counties, also in Lycoming county.
Hematite (2)...	Specular iron ore, red hematite.	Not nearly so abundant as the fossil ore. Near Durham, Bucks county; near Hanover, at Dillsburgh and Wellsville, the Codorus region, York county (micaceous hematite); with magnetic iron ores in Lebanon and Chester counties. Some scattering exposures in the York county basin. Micaceous iron ore in Catholic valley, southeast ridge of South mountain, near Chambersburgh.
Kaolinite	Kaolin	Common in southeastern part of State. Dug in Concord and Birmingham townships in Delaware county, and in New Garden, Kennett, and East Nottingham, in Chester county. Near Douglassville, Berks county.
	Limestone	The Siluro-Cambrian limestone of the Great valley, and of the valleys included between the ranges northwest of it, is quarried at very many localities and extensively. It affords building stone in Northampton, Lehigh, Berks, Lebanon, Dauphin, Cumberland, and Franklin counties. The Lancaster and York county limestones furnish some quarry stone. In the central part of the State the Lower Helderberg and Upper Helderberg outcrops are quarried at a few localities. To the west and northwest the limestones in the Coal Measures occur at many localities.
	Limestone (2), hydraulic limestone.	Coplay and Egypt, Lehigh county—manufactured into Portland cement; Hokendaqua creek, Northampton county, and near Siegfried's bridge (horizon of Trenton limestone); Johnstown, Cambria county, and Putneyville, Armstrong county.
Limonite	Brown hematite	Very extensively developed in the Great valley from the Delaware to the Maryland line. Many scattered ore banks in Northampton, Lehigh, Berks, Lebanon, Dauphin, Cumberland, and Franklin counties, associated with the Siluro-Cambrian formation. Also in Montgomery and Chester counties, in a narrow belt crossing the Schuylkill at Spring Mill on southern margin of Limestone valley. In Lancaster county the noted Chestnut hill and other ore banks, in limestone (Formation II). York county ore banks, west of Susquehanna. In Kishacoquillas, Nittany, Sinking, Canoe, and Morrison's Cove valleys in middle Pennsylvania. The Oriskany and Lower Helderberg formations carry limonites in Huntingdon, Blair, and Perry counties. In the Juniata region, in Mifflin and Huntingdon and Bedford counties, resulting from alteration of carbonate ores. The Marcellus shale is ore-bearing in Yellow Creek district, in Blair county, and on the affluents of the Juniata in Juniata and Perry counties. Brown hematites abound in the Coal Measures also, and particularly along the outcrop of the "ferriferous limestone." They occur in western Indiana county, in northern Armstrong, Clarion, Jefferson, Butler, Lawrence, and Beaver counties, in large deposits. Other localities are worked in Centre, Clearfield, and the Coal Measures territory of southwestern part of the State.
Limonite (2)...	Bog iron ore..........	Widely distributed; in small deposits generally. Mercersburgh and other localities in Franklin county extensively developed and worked. Concentrated in the eroded outcrops of Silurian and Siluro-Cambrian limestones, and are rather siliceous. The limonites in the less siliceous limestones (Trenton) are softer.
Magnetite	Magnetic iron ore	In the South Mountain belt; large mines at Durham, Northampton county; Topton, near Reading; Fitz island, near Springfield, Boyertown; Jones mine, near Morgantown, in Berks county; Cornwall iron mountain, in Lebanon county; Dillsburgh, in York county; near Knauertown and the Warwick mines, in Chester county. Many additional localities of mines, and of occurrences in small quantities could be given.

PENNSYLVANIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Malachite......	Green carbonate of copper.	Cornwall iron mines, Lebanon county; Jones mine, near Morgantown, Berks county; Fritz mine, near Reading; mines near Knauertown, Chester county; Millerstown to Maryland line, Adams county. Not mined alone as an ore, but with other copper compounds.
	Marble..............	Large quarries along the Schuylkill, near Conshohocken; King of Prussia and Henderson station, in Montgomery county. Marbles occur in Chester and Lancaster counties to limited extent.
	Marl................	Harmonsburgh, Crawford county; Greencastle, Franklin county.
Millerite.......	Capillary pyrites, sulphide of nickel.	Gap nickel mine, Lancaster county with copper-bearing pyrrhotite, copper pyrites, etc.
	Natural gas	Important fields.
	Ocher................	Clinton shales near Lehigh gap. In many places the clay from ponds where limonite has been washed is burned and used for paint.
Orthoclase.....	Feldspar..............	Concord township, Lower Providence township, Ridley township, near Chester, near Upland, Delaware county; Pennsbury township, near Unionville, Newlin township, Poor Ho, quarries in West Bradford township (chesterlite), in Chester county; Mineral hill, Middletown, and Upper Providence, Delaware county; near Feisterville, Bucks county; Seissholzville, near Alburtis, Lehigh county; and many other places. Common as rock constituent. A few localities worked.
Petroleum	Petroleum	Pennsylvania oil region is comprised within the limits of McKean, Warren, Crawford, Venango, Mercer, Clarion, Butler, Lawrence, Beaver, Allegheny, and Washington counties. Some of the more important oil centers are Tidioute, West Hickory, Titusville, Shamburgh, Pithole, Petroleum Centre, Oil City, Bradford; in southwestern part of State, on Dunkard's creek, Greene county. Oil is found in small quantities in Fayette and Westmoreland, and probably in other counties in western part of State.
Quartz.........	Quartz................	Of general occurrence.
Quartz (2)	Sand..................	For glass manufacture, near Lewistown, McVeytown, and Vineyard station, Mifflin county; Hamilton township, Monroe county; Belvernon, on Monongahela river; Godfrey's ridge, near Stroudsburgh, Monroe county; Chester county.
	Sandstone	The red sandstone of the Triassic age affords a building stone at a few points in the belt crossing the State from the Delaware to Harrisburg, and thence to the Maryland line. The more extensive outcrops of the Silurian, Devonian, and Carboniferous sandstones in the Appalachian and trans-Appalachian regions are much more largely used, and very many localities obtain stone for construction from the various members of these geological series. At the southeast the primal sandstone (of Rogers) is quarried at a very few places. Potsdam sandstone is a quartzite, extensively used at Bethlehem, Hillertown, etc., north and south slopes of South mountain.
Serpentine.....	Serpentine............	Southeast part of State, quarries near Springfield and Lafayette, Montgomery county; West Nottingham, Chester county; Media, Delaware county; used for building. Precious serpentine near Easton; Tredyfferin, Easton, and East Goshen townships, Chester county; Fritz island, near Reading, Berks county; near Yellow springs, Radnor township, Delaware county. Other localities of serpentine in Lancaster, York, Montgomery, and Lebanon counties.
Siderite.......	Carbonate of iron, carbonate ore, clay ironstone.	In eastern Pennsylvania, in Siluro-Cambrian formations, with limonites. In the Devonian (Formation VIII) in Huntingdon, Mifflin, Bedford, and Fulton counties. In the Mauch Chunk, red shale (XI) carbonate ores occur in the Lackawanna valley and at Scranton; Ralston, Lycoming county; in Clearfield, Cambria. Huntingdon, Somerset, and Fayette counties. The Coal Measures carbonates are found in all the counties of the anthracite and bituminous coal basins.

PENNSYLVANIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Siderite (2)	Black band ore	In Coal Measures at Pottsville. Black band ores also occur throughout the northern coal field, but are not persistent, though occurring at the same horizon.
	Slate..........	Bangor (Chapman's quarries) in Northampton county, Slatington, in Lehigh county, are centers of large quarrying operations for roofing slate. Peach Bottom slate district, York county, chiefly about Delta, Bangor, and Slate Hill post-office. In Lancaster county slate is quarried near Peter's Creek Station.
Talc	Steatite, soapstone....	Quarries near Lafayette, Montgomery county; West Goshen township, near Unionville, West Nottingham township, Chester county; near Texas, Lancaster county; near Easton, besides many other localities, in serpentine belts of southeastern part of state.

PENNSYLVANIA—Not Mined.

Albite	Feldspar..............	Chester, Delaware county; Mineral hill, near Media, East Bradford and Unionville, Chester county.
Amethyst	Amethyst	East Bradford, Pocopson, Sadsbury, Providence, Aston, Middletown, and Birmingham, Chester county. Occasionally stones suitable for gems.
Apatite.........	Phosphate of lime	Numerous localities in Berks, Montgomery, Philadelphia, Chester, and Delaware counties, but not to workable extent.
Asbolite	Earthy cobalt.........	Near Albertis, Lehigh county; in drift, opposite Fairmount, Philadelphia.
Barite	Barytes, heavy spar..	West of New Hope, Bucks county, several old mine holes; at Phœnixville mines, Chester county; Jug Hollow mine, Montgomery county, and other localities in southeastern part of State. Fort Littleton, Fulton county, mined to some extent; Waynesborough, Franklin county; Sinking valley, Blair county.
Bornite	Purple copper ore ...	In Triassic rocks, York county. Other localities in Montgomery, Chester, Adams, and (in Devonian rocks) in the northern central counties.
Calamine	Zinc silicate	Friedensville, Saucon valley, Lehigh county, with blende in limestone (stopped because of expense of pumping); Espy, Northumberland county; Sinking valley, Blair county; Lancaster zinc mines. The Pennsylvania zinc works obtain their material mainly from New Jersey and other States.
Celestite.......	Sulphate of strontia ..	Near Frankstown, Huntingdon county; in thin seams.
Chalcolite	Copper glance, vitreous copper.	Phœnixville, Chester county; Woods's mine, Lancaster county; with bornite in northern counties, sparingly.
Chrysocolla ..	Silicate of copper.....	Cornwall mines, Lebanon county; Jones mine, Morgantown, Berks county; Phœnixville, Chester county; Perkiomen mine, Montgomery county; Frankford, and on Wissahicken; nowhere in quantity to be considered as an ore.
Coal, var. lignite.	Lignite	In several caves, South mountain, Franklin county.
	Copper	Cornwall mines, Lebanon county; Jones iron mine, Berks county; Knauertown, Chester county; Gap (nickel) mine, Lancaster county; copper mines, South mountain, Millerstown to Maryland line, Adams county, and at various places along the Loyalsock and Muncy creeks in Sullivan and Lycoming counties. At no one of these localities, of itself, in workable quantities.
Cuprite........	Red oxide of copper ..	Cornwall, Lebanon county (a considerable percentage of the copper ores here separated from iron ore); Chestnut hill, near Easton; Perkiomen mine; copper mines in Adams county, near Maryland line.

PENNSYLVANIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Fluorite	Fluorspar	Newlin, Chester county; in gneiss, Frankford; near Delaware water gap, very small quantities in all localities.
Garnet	Garnet	Darby creek and Concord township, Delaware county; near Unionville, Chester county, widely disseminated in Philadelphia gneiss, and other localities in southeastern part of State. Some suitable for cutting as gems.
Gold	Gold	Franconia, Montgomery county, sparingly in quartz and pyrite; in copper pyrites, Phœnixville; Gap mine, Chester county; sands of Delaware river and clays of Philadelphia scarcely traces. None of economic importance.
Graphite	Plumbago, black lead	Bustleton, Bucks county, mine worked for nearly 100 years; Chestnut hill, near Easton; Robinson's hill, on Schuylkill, near Philadelphia; Pughtown, South Coventry, Chester county; near Jones mine, Berks county; and other localities in gneissic and metamorphic rocks of Lehigh, Northampton, and Chester counties—generally sparsely disseminated in rock.
Greenockite	Sulphide of cadmium	Friedensville zinc mines, Lehigh county, incrustation upon blende, in small quantity.
Hydrozincite	Carbonate of zinc	Friedensville, with zincblende.
Magnesite	Carbonate of magnesia	Magnesia quarries, Goat hill, West Nottingham, Chester county, formerly worked. Large deposits at Low's chrome mine, Wood's chrome mine, etc., in Lancaster county, and at Scott's mines in Chester county. Other localities in Delaware, Chester, and Lancaster counties, of occurrence in small masses.
Melaconite	Black oxide of copper	Perkiomen mine, Montgomery county; silver-lead mines, near Phœnixville, Chester county.
Molybdenite	Sulphide of molybdenum.	Frankford, in gneiss; Chester, Delaware county; Alsace township, near Reading; sparingly.
Muscovite	Mica	Pennsbury township, Unionville, Newlin township, Chester county; Leiperville, Delaware county, and many localities in southeastern part of State.
Psilomelane	Oxide of manganese	Occurs with limonite in ore banks, Kittatinny valley, and in small quantities in gneiss, near Bustleton, Bucks county.
Pyrite	Iron pyrites	Gap mine, Lancaster county (nickeliferous); Cornwall, Lebanon county, cupriferous, and also cobaltiferous. Many localities; not mined except when bearing valuable metals, or for paint manufacture, as at Jamestown, Mercer county.
Pyrolusite	Black oxide of manganese, manganese ore.	Edge Hill and near Spring mill, Montgomery county; with limonite frequently, especially in Saucon and Williams townships, Northampton county.
Pyrrhotite (nickeliferous).	Magnetic pyrites, nickle ore.	Gap mine, Lancaster county (nickeliferous); also in Alsace township, near Reading, Berks county; in small quantities at several other localities.
Silver (native)	Silver	Wheatley mine, near Phœnixville, Chester county· Pequea mines, Lancaster county.
Smithsonite	Carbonate of zinc, "dry bone."	Friedensville zinc mines, with calamine and blende; Sinking valley, Blair county; Lancaster zinc mines. Not worked alone as an ore.
Sphalerite	Zincblende	Friedensville zinc mines, Saucon valley, with blende and smithsonite in limestone; Lancaster zinc mines and Pequea mine, Lancaster county, with galenite; Sinking valley, Blair county, with galenite and (in places) smithsonite in limestone, mines worked irregularly; New Britain, Bucks county, with galena; Espy, Columbia county, in limestone; Phœnixville mines, Chester county, with lead ores and in considerable quantity; Ecton mine, near Shannonville, Montgomery county.
Wad	Bog manganese	With limonite, Northampton, Lehigh, Berks, and other counties.

PENNSYLVANIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Wulfenite	Molybdate of lead	Lead mines near Shannonville, Montgomery county; Wheatley lead mines, Phœnixville, Chester county; Pequea mines Lancaster county.
Zaratite	Emerald nickel	Wood's mine, near Texas, Lancaster county, with chromite, in considerable quantity.

RHODE ISLAND—Mined.

Coal	Coal, anthracite coal, graphitic coal.	Coal Measures extend from south to north across State; Newport, Kent, and Providence counties; Portsmouth mines (not worked); Cranston, mines worked; Newport neck, Newport county, seams 1 to 3 feet thick; Quaker hill, Newport county, mine opened years ago. Several beds, varying from 2 to 23 feet thick, but irregular. Some of coal graphitic, and worked for graphite. Production limited to local use mainly. Rhode Island anthracite contains about the same fixed carbon as average Pennsylvania anthracites and has little sulphur; adapted for iron smelting, but not a very useful steam or domestic coal.
Dolomite	Dolomite	Quarried and burnt for lime, Lincoln, Providence county.
	Granite	Nipmuck granite quarried in South Scituate, Providence county; Kingston, Washington county, a porphyritic granite; Beacon Pole hill, in Cumberland, a syenitic granite; large quarries at Westerly, worked for monumental and statuary purposes, the refuse being used for curbing, flagstones, and paving stone.
Graphite	Plumbago, black lead.	Cranston coal mines.

RHODE ISLAND—Not Mined.

Actinolite		Cumberland.
Agate	Agate	Diamond hill, Cumberland.
Asbestus	Asbestus	Cranston.
Chalcedony	Chalcedony	Diamond hill, Cumberland.
Chalcopyrite	Copper pyrites	Near Sneech pond, Cumberland.
	Clay	Newport neck, Newport county, suitable for pottery; Block island.
	Flagging stone, sandstone.	Pawtucket.
Cyanite		Foster, Providence county.
Galenite	Galena	Cumberland and Lincoln.
Garnet	Garnet	Cumberland; Foster, Providence county.
Graphite	Plumbago, black lead.	Tower hill, Kingston, Washington county; also beneath hill on which Providence is built.
Hematite	Hematite	Cranston, Providence county.
Ilvaite, yenite		Sneech pond, Cumberland.
	Jasper	Green and gray (red hematite), Cumberland.
Limonite	Bog iron ore	Foster, Providence county, small deposits.
Magnetite	Magnetic iron ore	Cumberland iron hill, 12 miles from Providence and near Massachusetts line; ore lean, but free from sulphur and phosphorus; deposits large; a porphyritic, magnetic iron ore. Gloucester, in chlorite.

RHODE ISLAND—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Molybdenite	Sulphide of molybdenum.	Near Sneech pond, Cumberland hill, with chlorite, epidote, and magnetite.
Serpentine	Serpentine	Newport; Smithfield; Johnston; Lincoln; Cumberland.
Talc	Steatite, soapstone	On Mohassuc, Smithfield, Providence county, delicate green, white, and dendritic; Cumberland and Johnston.
Wad	Bog manganese	Sneech pond, Cumberland.
	Whetstone	Woonsocket, in Providence county, micaceous sandstone worked for scythe-stones and grindstones. Smithfield, mica slate.

SOUTH CAROLINA—Mined.

	Fire-clay	Wells' place, King's mountain, York county, clays in kaolin district in central belt of State.
Gold	Gold	The gold belt extends from the North Carolina border, southwest across the counties of York, Lancaster, Chesterfield, Kershaw, Fairfield, Chester, Union, Spartanburgh, Greenville, Pickens, and Abbeville. The principal mines at work are: Brewer mine in Chesterfield; Haile and Dixie mines, Lancaster; Magnolia in York, and Lockhart and Glendale, Spartanburgh county. Many old mines in the gold belt abandoned; auriferous gravels are found at many localities, but chiefly in York, Union, and Spartanburgh counties.
	Granite	In Abbeville, Fairfield, Lexington, and Newberry counties, Union C. H., Union county (several quarries opened), Winnsborough quarry, Fairfield county.
Itacolumite	Flexible sandstone	Grindstone ridge, in Spartanburgh county (for grindstones mainly).
Kaolinite	Kaolin, porcelain clay	Numerous localities, some of which are worked in Aiken, Barnwell, Livingston, Richland, Abbeville, Chester, Sumter, and York counties.
	Limestone (marble in part).	Spartanburgh and Laurens counties; Limestone springs in northeastern part of Spartanburgh county.
	Marl	Post-Pliocene—Wadmalaw, and Edisto island, Colleton county; Saint Thomas, Berkeley county; along Santee, Ashley, Cooper, Edisto, and Savannah rivers. Belt along shore. Pliocene—Waccamaw, Horry county; Darlington, Sumter, and Marlborough counties also contain deposits of these calcareous marls.
	Phosphate rock	River deposits—Stono, Wando, Cooper, and Ashley rivers (Charleston and Berkeley counties); Edisto and Pow-pow rivers (Colleton county); Bull, Coosaw, Morgan, Ashepoo, Johnson, Beaufort, and Broad rivers, Battery and Parrott creeks (Beaufort county). Land deposits—Berkeley, Colleton, and Beaufort counties.
	Sandstone	Sandstone in Buhrstone formation—Little Horse creek, Edgefield county; Platte springs. New Red sandstone—Hornsboro, Chesterfield county.

SOUTH CAROLINA—Not Mined.

Asbestus	Asbestus	Near Glenn springs, and near Cedar springs, Spartanburgh county; associated with steatite, in dike formation; Hagood mine, Pickens county.
Bismuthite	Bismuth ocher	Brewer mine, northern part of Chesterfield county (in small quantity only).

SOUTH CAROLINA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcopyrite...	Copper pyrites........	Darwin's mine, northern part of Union county; Mary mine, York county; Dickey place, Tiger river, northeastern part of Greenville county; Cherokee mine, northwestern part of Pickens county; Wilson mine, Chesterfield county.
Cuprite........	Red oxide of copper ..	Mary mine, York county.
	Feldspar..............	Veins in gneiss near Pickens C. H., Pickens county, associated with bluish quartz, in large crystalline matter.
Galenite	Galena.................	Parson's mountain (in gold mines), Abbeville county; Cherokee valley, Laurens county; Cameron mine, 2 miles south of Limestone springs, in Spartanburgh; in mica slate, argentiferous; Cherokee (gold) mine, in thin vein (argentiferous), in northwestern part of Pickens county.
Graphite.......	Plumbago, black lead.	Northeast corner of Spartanburgh (near Cowpens furnace); Paris mountain, Greenville (thin vein, not worked).
Hematite	Red hematite, specular iron ore.	Whitaker's mountain, northwestern part of York county; (Harding bank, Bird bank); northern slope of King's mountain, York county, to Gelkey's mountain, in Union; Heady hill bank, near Cooperville, Spartanburgh; Jackson bank; near Cowpens furnace, northeastern part of Spartanburgh county; near Greenville C. H., Greenville county; thin superficial deposits, formerly worked. (See also Itabiryte, which contains both magnetite and hematite.)
Itabiryte	Specular schist.......	"Red ore"—Critses, Cooperville, Union county; Ellen furnace, near Union line, in Spartanburgh county; Bird's mine, and silver mountain, York county; Gibson's mine, Spartanburgh. Ores in a narrow and short belt—York, Union, and Spartanburgh counties. Occurrence in itacolumite.
Lignite	Brown coal	Whortleberry branch, north of Cheraw, Chesterfield county; near Mount Craghan, Marlborough, same county; Savannah river, Edgefield county; Pickens county.
Limonite	Brown hematite	Nanny's mountain, York county (northeast of Yorkville); Pacolet iron works, Spartanburgh county; near Cowpens, and Cherokee ford, Spartanburgh county; McCord's mountain in Greenville county; Abbeville county; Ruff's mountain, Lexington; Crooked creek, Pickens county; also in Chesterfield county. (But mainly confined to mica slate of Spartanburgh and Pickens counties.)
Magnetite	Magnetic iron ore, "gray ore."	Lee and Parker bank, northwestern part of York county; Sweedish Iron Manufacturing Company's mine, corner of Union county; Hardin's bank, Whitaker's mountain, York county; Hogue bank, York county; Fields, Susan furnace; Blockley, in Spartanburgh. Ore occurs in itacolumite and talcose slate rocks, in a belt stretching from northeast to southwest through York, Union, and Spartanburgh counties.
Malachite......	Carbonate of copper..	Cameron mine, near Limestone springs, in Spartanburgh county.
	Ocher.................	Yellow, at Lang-Syne, Orangeburgh; also in Chesterfield county.
Psilcmelane....	Manganese ore	Has been mined near McCormick, Abbeville county.
Pyrite	Iron pyrites	Nilson mine, 7 miles northeast of Yorkville, York county; Sutton mine, northeast corner of York county; Hagin mine, Bellair, Lancaster county; Brewer and Edgeworth mines near Hornsboro, Chesterfield county; abundant in Spartanburgh and York counties.
Pyrolusite.....	Oxide of manganese ..	Hard Labor creek, Edgefield county.
Pyromorphite .	Phosphate of lead.....	Cameron copper mine, Limestone springs, in Spartanburgh county.
Quartz.........	Glass sand............	Near Aiken C. H., Aiken county.
Siderite........	Spathic iron ore.......	Bird bank, King's mountain, York county.

SOUTH CAROLINA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Silver	Silver	In galena, Cameron mine, 2 miles south of Limestone springs, Spartanburgh county; Cherokee mine, northwestern part of Pickens county.
Talc	Steatite, soapstone	On Wateree creek, Lexington; Sandy river, Chester (worked to a limited extent); in Abbeville county, several beds; Anderson county, Cedar springs, in Spartanburgh; near Glenn springs, Spartanburgh; western part of Union county; Salubrity post-office, Pickens county.
	Whetstone	Abbeville county; Turkey creek, Edgefield county.

TENNESSEE—Mined.

Azurite	Blue carbonate of copper.	Ducktown copper mines, Polk county.
Barite	Barytes, heavy spar	Mulherrin creek, Smith county, gangue of lead vein; gangue of lead vein near Haysborough, Davidson county, associated with blende and galena; 12 miles from Greeneville, Greene county, in veins in Knox dolomite; Whetwell, near Mouse creek, McMinn county, a large deposit; many other localities in small quantities.
Calamine	Silicate of zinc	Stiner's zinc mine, Powell's river, Union county, with smithsonite in irregular veins in the Knox dolomite; Mossy creek, Jefferson county, associated with smithsonite and blende in the Knox dolomite; other localities in Jefferson, Knox, Cocke, Loudon, Monroe, Moore, and Bradley counties in valley of east Tennessee.
Chalcocite	Copper glance	Ducktown copper mines, Polk county.
Chalcopyrite	Copper pyrites	Ducktown mines, Polk county, most abundant ore at mines, excepting black and red ores.
	Clay	Potters' clay; Sulphur fork of Beaver dam, Hickman county, and many places in Hickman, Perry, and other counties along Tennessee river. Cumberland iron works, Stewart county, 4 miles southwest of Cumberland City, Stewart county. These have been worked for local uses; McMinnville, Warren county; fine clay near Cleveland (works on R. & O. R. R., near Powell's station).
Coal	Coal, bituminous coal	Bituminous Coal Measures co-extensive with Cumberland table land, area 5,100 square miles, extending across the State, including counties of Scott, Morgan, Fentress, Van Buren, Bledsoe, Sequatchee, Marion, Claiborne, Campbell, Anderson, Rhea, Hamilton, Overton, Putnam, White, Franklin, Warren, Coffee. 1. Sewanee division, or southern division; Sewanee coal banks near Tracy City, in Marion county; the main Sewanee seam varies from 3 feet to 7 feet thick; there are several beds, thickness very irregular, but aggregate of coal large. 2. Walden's ridge and Raccoon mountain division; Ætna mines, in Marion county; main Ætna vein 18 inches to 7 feet or more thick, of good quality, cokable, not highly bituminous; above it are "Kelly coal," "Slate vein," and "Walker coal," each 2 to 6 feet thick; Upper Elk valley, mines near station. 3. Northern division, at Scarborough's mill, on Caney fork, seam 4 to 6 feet thick. Principal mining localities: Tracy City, Marion county; Victoria mines; Cold Creek mines, in Anderson county; Rockwood mines, Roane county; Sodden mines; mines near Chattanooga; Caryville, Campbell county; large mines near Newcomb and Gellico, Lower Elk valley, in Gellico district.
Cuprite	Red oxide of copper	Ducktown copper mines, Polk county, the rich ore of second zone at mines, associated with black oxide of copper.
	Flagging stone	Near Montgomery, Morgan county; near Knoxville, Knox county, blue flags (limestone); Lebanon, Wilson county. Sandstone of the mountain limestone, Overton and White counties.

TENNESSEE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Galenite	Galena	In iron ore, Bompass cove, Washington county; Carter's furnace, Carter county; with copper ores at Ducktown mines, Polk county (small quantities); Caldwell's mine, on Powell's hill, Union county; occurs in scattered grains and lumps in Knox dolomite, and as vein, filling a vertical fissure, worked; Hambright's mine, Chatata valley, Bradley county, in Knox dolomite; Carter mine, 3 miles east of Sweetwater, Monroe county; Montgomery mine, 2 miles northeast of Cartertown. Galenite occurs at many localities in Knox dolomite in East Tennessee valley. In limited quantities, Mulherrin creek, Smith county, and elsewhere in central basin of Trenton, in Tennessee and Nashville series (Trenton and Hudson). Poplar Creek mines, Oliver springs, Anderson county.
Gold	Gold	Coca creek, Monroe county, Whippoorwill Mining Company. Gold-bearing quartz vein in semi-talcose clay slate; Coca creek, Monroe county, in sandstone gravels, worked a little every year; east of Montvale springs, Blount county; in water of Citico creek, Monroe county; in bed of Cane creek, Monroe county; headwaters of Tellico creek, Monroe county; Polk county also; veins of gold-bearing quartz in Ocoee group of slates.
Hematite	Solid or hard ore, red hematite.	Cannon bank, 7 miles from Elizabethtown, Carter county, massive bed in Knox sandstone, worked; Crockett bank, 1 mile west of Holston river and in eastern part of Sullivan county; Sharp bank, near Sullivan county; a bed in Knox dolomite; Thomson bank southeast of Bristol, Sullivan county. Stony Creek valley or hillside between Knox and Pottsdam formations. Sporadically in the red knobs southeast of E. T., V. and G. R. R.
Hematite (2)	"Drystone ore," "block ore."	Hills bank, eastern part of McMinn county, stratified large bed in Trenton series. This ore occurs on eastern border of Cumberland table land in Hancock, Claiborne, Grainger, Campbell, Anderson, Roane, Rhea, Meigs, and Hamilton counties. Used by furnaces in valley of East Tennessee. Occurs in ridges or ranges. 1. Mountain range almost continuous from Virginia to Georgia, 160 miles, and of average thickness of 20 inches; usually more than one ore bed. 2. Lookout Dyestone ridge, near Chattanooga, Hamilton county, extending north to Rhea county. 3. Half-moon Island range, in Roane, Rhea, and Meigs counties; excellent and extensive beds of ore. 4. Big valley and White Oak mountain ranges—a broken range extending across the State east of above ranges, 5. Powell's and Lone mountain ranges, in Hancock and Claiborne counties. 6. Elk fork, northwest of Campbell county, and Sequatchee valleys, in Bledsoe, Sequatchee, and Marion counties. A range northwest of above mentioned. Ore abundant; used on a small scale. In 1880, 71,657 tons were mined. Ore used at South Pittsburgh, Chattanooga, Rockwood, and Oakdale furnaces. Largest and most productive mines are Stringer's hill, north of Chattanooga, and Shin Bone ridge, in Hamilton and Rhea counties, and near the Tennessee river, and from Rockwood to Emory gap, in Morgan County; also Ooltewah and White Oak mountain, in Hamilton, James, and Bradley counties; Iron hill, Red Cloud mine, and Half-moon Island mine, all in Rhea county; Ironton, Roane county. Isolated deposit in Hardin county, middle Tennessee.
	Limestone	Knox dolomite. Chattanooga, Hamilton county; Trenton (Carter's creek) limestone. Maury county; Nashville series, blue and dove-colored limestone, Nashville, Davidson county; Caryville, Campbell county; Wells Creek basin, Houston county.
Limonite	Brown hematite	Eastern iron ore regions across State from Virginia to Georgia, in Johnson, Carter, Washington, Sullivan, Greene, Cocke, Sevier, Blount, Monroe, and Polk counties. They occur in banks or deposits in matrix of clay, sand, chert, and débris of disintegrated rocks of Knox group (Potsdam) mostly in Knox dolomite; 1880—8,630 tons of ore mined in this belt. At Crockett bank, eastern part of Sullivan county, with hematite; also other localities of the hematite in Sullivan county; Crockett's, Sharp's, and other banks, Johnson county, south foot of Holston mountain; Laurel Creek

TENNESSEE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite (continued).	Brown hematite	valley and Butler furnace banks; Carter county, Dove River cove banks; Washington county, deposits in Bompass cove, Greasy cove; Greene county, several banks manganiferous ore near Unaka furnace; Cocke county, Whitehall, Peck's mountain and others; Sevier county; Blount and Monroe counties, almost inaccessible; McMinn county, Tellico plains, several deposits; Ducktown copper mines in "gossan," Polk county. Western iron region: A belt 50 miles wide, crossing the State in counties of Lawrence, Wayne, Hardin, Lewis, Perry, Decatur, Hickman, Humphrey, Benton, Dickson, Montgomery, and Stewart. Occurs in irregular lumps or hollow concretions called "pots," also "honeycomb" and "pipe," in the sandy matrix. "Ore region gravel" of Safford (alluvium), Hickman county, has several noteworthy localities, *e. g.*, at Ætna furnace (2 square miles of ore ground, 10 feet to 100 feet deep); next come Dickson and Stewart counties, *e. g.*, beds of Cumberland iron works, in Stewart county, Bear spring, Morgan banks owned by it. Steele's bank, Montgomery county. These ores of excellent quality, but not fully developed as yet. Same ores on east side of Highland river in Warren, Coffee, White, and other counties. Knox ore is under various local names, according to structure, "Pipe" "Pot," "Blackjack," "Honeycomb," "Shot," "Bog" (30,000 tons of ore raised in 1880).
	Lithographic stone	Overton, Clay, Jefferson, and McMinn counties.
Magnetite	Magnetic iron ore	Crab orchard, Carter county, not a well defined vein, but with sahlite, in metamorphic group. Worked at a bloomary. An extension of Cranberry range of North Carolina; eastern part of Johnson county, far from transportation.
Malachite	Green carbonate of copper.	Ducktown copper mines, Polk county, in "gossan."
	Marble	Variegated marbles are quarried extensively at Knoxville, Concord, and other localities in Knox county; at the National quarry and Rogersville, in Hawkins county. The quarries are in the Trenton limestone, and the stone is known as "Tennessee marble." Other localities are: Near Athens, McMinn county; on Tellico river, Monroe county; Morristown, Hamblen county; Jefferson county; Loudon county; Rockport, in Benton county; Decatur county. The "Chattanooga marble" comes from the upper part of the Knox dolomite and from East Tennessee valley. Black marbles are found in the Knox group, in Sevier, Polk, and McMinn counties. Brecciated and conglomerate marbles have been quarried on the Little Tennessee, in Monroe and Blount counties, and occur in Knox and Ococe groups in Greene, Cocke, Sevier, and Unaka counties.
	Marl, green sand marl.	Western Tennessee; McNairy and Hardin counties.
Melaconite	Black copper	Ducktown copper mines, Polk county.
	Millstone	Chert of Knox dolomite, localities, Big spring, Claiborne county; also of other rocks for local uses; Big creek, Campbell county, and other places.
	Sandstone	Chilohowee sandstones of East Tennessee (freestones of the Coal Measures). White Oak mountain (Clinton and Ooltewah).
Siderite	Clay ironstone, carbonate of iron.	In shales of the sub-Carboniferous formation. Willey's bank on Coal creek, Anderson county, Coal creek and Caryville. Wells Creek basin, Houston county. Beersheba springs, Grundy county; Coal creek, Anderson county; Caryville, Campbell county; and other Coal Measures localities.
Smithsonite	"Dry bone," carbonate of zinc.	Stiner's mine, on Powell's river, Union county, associated with calamine, in irregular veins in Knox dolomite; Mossy creek, Jefferson county, with calamine, ore abundant. Claiborne and Hancock counties. Other localities in valley of East Tennessee.

TENNESSEE—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Sphalerite	Zincblende, "black-jack."	In small quantities at Ducktown copper mines, Polk county; Stiner zinc mine on Powell's river, Union county; Mossy creek, in Jefferson county, occurs with smithsonite and calamine, ore abundant. Other localities in Jefferson county, Knox county, and Cocke county, in valley of East Tennessee; also in central Tennessee, with galena. (See Galenite and Barite.) Bald Hill mine, Union county; Claiborne county; Straight Creek mines; Beech creek, Johnson county.

TENNESSEE—Not Mined.

Alum..........	Alum..................	In the black shale formation under the Coal Measures; Alum cove, Sevier county, in shales.
Bitumen.......	Asphalt	Perry's, on fork of Blue Buck creek, Hickman county, in seams (vertical), in limestone.
Cerussite	Carbonate of lead.....	Occurs with galenite at several localities of latter mineral.
Epsomite	Sulphate of magnesia.	Alum cove, Sevier county, in Ococe shales.
	Fire clay	Under beds of coal in many localities; Actua, Marion county; Chattanooga, Hamilton county.
	Granite................	Occurs in East Tennessee.
Gypsum	Gypsum	Gray's cave, north part of Sumner county, and many other localities; not anywhere in workable amount.
Halite	Common salt, brines..	Salt works 3 miles from Sparta, White county; Obey river, Overton county, establishment here. Brine has been found in most of borings for petroleum in middle Tennessee, in Warren, Van Buren, Overton, and Jackson counties.
	Hydraulic limestone..	Brown shale of Trenton and Nashville series, east of Knoxville, Knox county, have been used; Horse creek, east of Savannah, Hardin county; Saltillo ledge, Hardin county; occurrences of hydraulic rock in Ortties bed of Nashville series, near Clifton, Wayne county, worked before the war.
Lignite	Brown coal	Quite common in Bluff lignite formation (Tertiary), in western part of State, near Mississippi river, usually 3 feet to 4 feet thick, rarely 5 feet to 6 feet; occurring with clay, lignite of no value; not in demand; once worked. Raleigh, Shelby county; Old Fulton, Lauderdale county.
Magnetite	Magnetic iron ore	Eastern Blount county, float; Cocke, Carter, and Unicoi counties.
Malachite	Green carbonate of copper.	Buck Miller mine, Monroe county; north of Coco creek, Polk county.
(?)	Manganese, black oxide of manganese. (?)	Jones' valley, Cocke county; Boatman's ridge, between Morristown and Beau's ridge, Cocke county; occurs in considerable masses; mines in Johnson county, worked for a time; Carter county, extensive beds; south of Madisonville, Monroe county; Starr's mountain and other places, Polk county.
	Marble	Near Charleston, Bradley county; Big Sandy river, Henry county; White county, and elsewhere.
Niter	Niter, saltpeter.......	Many caves in limestone formations, and especially in Cumberland table land; not of much account.
Petroleum	Petroleum rock oil...	Oil spring, Liepers creek, Maury county; Mill creek, near Cumberland river, Jackson county, several points, on Obey's river, Overton county; Montgomery's mills, Piney river; Spring creek, southern part of Overton county; several wells bored near the last locality yielded oil; Jones' creek, Dickson county, several wells bored, unproductive; Eagle creek, Overton county, three wells, some oil; wells in Fentress county, no longer pumped. Possibly in Elk valley, Campbell county; Stinking creek, same county.

TENNESSEE—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrite	Iron pyrites	At Ducktown mines (copper), Polk county, abundant with pyrrhotite (magnetic pyrites); near Greeneville, Greene county; in shaly (Knox) limestone, and other localities in Knox group of rocks. On Stony creek and at Taylorsville, with lead and silver. Many occurrences, but apparently not pure or large enough for working
Quartz	Glass sand	Knoxville, Knox county, once used; in counties west of Tennessee river.
	Slates	In eastern part of State, but undeveloped. Fine roofing, slate, Abram's creek and Hiawassee river.
Tetrahedrite	Gray copper ore	Buck Miller mine, Monroe county; mouth of Coco creek on Hiawassee river. Argentiferous.

TEXAS—Mined.

	Clay	Tom Green county; Concho county southwest to Rio Grande Brazos county.
Coal, var. bituminous.	Coal, bituminous coal.	Bituminous (Carboniferous formation) extends from Llano county northward, to Red river, in Wichita county, many outcrops; Honey Creek cove, Llano county, bed 2 feet thick; northeastern part of Concho county, southwestern part of Coleman county, 3 feet thick, of good quality; on east of Rio Grande, 60 miles below Presidio; Fort Belknap, Young county; along Whisky creek, north of Fort Belknap; on Coal creek, northern part of Young county, bed 5 to 6 feet thick, mined for local use; Graham, opposite falls of the Salt fork; Clear fork of Brazos, northern part of Stephens county, local use only; Hubbard's creek, Stephens county; 2½ miles southeast of Henrietta, Clay county; on Sandy creek, southwest corner of Montague county, outcrops; Home creek, Coleman county; near the Colorado, Coleman county; Little Bull creek and Santa Anna mountain, Coleman county; north of San Saba river, in San Saba county; near Liberty hill, Williamson county, thin seam in Cretaceous limestones; Clear fork, northern part of Stephens county; Fort Belknap, Young county, upper (Belknap coal bed), 2½ to 4 feet thick; lower (Brazos coal bed), 4 to 6 feet, extensively protected. Brazos coal field extends south to Colorado river, coals high in ash and sulphur, not thoroughly tested; cannel coal on Nueces river, Kinney county, several beds 3 to 4 feet thick.
Coal, var. lignite	Brown coal	Robertson county, used at Dallas; Bastrop, Bastrop county (almost continuous outcrops of coal from Little river, in Milam county, northeast to Herndon, on the Brazos). Two beds: upper, 4 to 6 feet thick; lower, 6 to 8 feet thick (Tertiary). Barclay's, 8 miles east of Bremond; Head's prairie, Limestone county, outcrops similar to Brazos bed; Bear Grass, Leon county, bed 9 feet thick; 7 miles west of Centreville, Leon county; on the bank of Trinity river, Leon county; northern part of Anderson county; 4 miles northeast of Henderson, Rusk county; 30 miles south of Marshall, on Sabine river, at Coal ferry, Panola county; Sulphur Creek bluffs, Cass county, proved to be good; near Jourdan salines, Van Zandt county; northwestern part of Grayson county, near Whitesborough, Burleson county. Tertiary coal beds extend from near Rio Grande, southwest of San Antonio, southeast to Bowie county, near northeast boundary of State; larger beds are near boundary of Cretaceous. Tertiary lignites in Rusk, Harrison, Cass, Grayson, Bastrop, Fayette, Caldwell, and Guadalupe counties. Lincoln Company coal fields, at White Oaks.
Halite	Common salt, brines, rock salt.	Along Upper Pecos river; Salt lake, near Horsehead, on Pecos river; water of lagoons west of Corpus Christi, towards Brownsville; Jordan's or Grand Saline, Van Zandt county, salt wells at work (Cretaceous); Graham, southern part of Young county, wells for salt water; salt worked; salt made in south part of Wise county; Swenson's saline, west part Lampasas county; rock salt in Red river country.

TEXAS—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Kaolinite	Kaolin	(See clay.)
	Limestone	Austin, Travis county; used at Austin, Paris, Sherman, etc.
	Sandstone	Northeastern part of San Saba county, used for grindstones; 8 miles west of Weatherford, Parker county, manufactured into grindstones and monuments; Milam, Robertson, and Cherokee counties, reddish brown sandrock, used for railroad construction, fine grained and compact. Bluff of Trinity river, near Trinity station (Grand gulf group), used for railroad ballast, etc.
	Silver	Padre mine, in Franklin, El Paso county, vein a fissure in Carboniferous limestone, ore argentiferous galena; Mason, Mason county, calcite vein a galena; Llano county, argentiferous copper ore in a fissure vein, bornite-erubescite; Presidio county, recent discoveries of horn silver. Cibolo and Presidio mines, Shafter P. O., Presidio county, ore embolite in quartz. calcite, and iron oxide; found in "chamber deposits" and pockets in limestone and on contact.

TEXAS—Not Mined.

Agate	Agate	Near Van Horn's well, with carnelian and chalcedony.
	Alum shales	Copperas branch, 4 miles north of Whitesborough, Grayson county.
Amethyst	Amethyst	Llano county; Burnet county, in granite.
Asbestus	Asbestus	Near Sandys, Llano county, not in abundance to be worked.
Asphaltum	Bitumen	North of Austin and in Travis county; near Burnet, Burnet county, of no commercial value; Gordon mountain, Montague county, small beds in Cretaceous limestone.
	Bismuth ore	Near Little Wichita, Archer county, specimens.
Chalcedony	Chalcedony	Near Van Horn's well.
Chalcocite	Sulphate of copper, vitreous copper.	Northwestern part of State; also with copper pyrites and copper carbonates carrying silver at Carrigo, 40 miles east of El Paso.
	Feldspar	Near Packsaddle mountain, Llano county, 2 to 4 feet thick; near Anderson copper mine, Chinati mountains, southeast part of Presidio county, extensive beds 20 to 50 feet thick.
Galenite	Galena	Near Blufton, Burnet county, in Potsdam, mine abandoned, ore disseminated in rock; old mine, abandoned, near Honey Creek cove, Llano county, both lead and silver; specimens from Silurian rocks of Llano and San Saba counties. Sierra Blanca, 30 miles east from El Paso, an argenitferous galena. Spencer mine (argentiferous), Presidio county; also at Sierra Blanca, etc.
Garnet	Garnet	Near Sandys, Llano county, in mica schists.
Gold	Gold	Headwaters Little Llano, 8 miles south of Fort Mason, Llano county, specimens; Sandy creek, Llano county, found in washing sands; same county, in vein of copper ore, specimens only. In small quantities in Presidio county.
	Granite	Burnet, Llano, and San Saba counties.
Gypsum	Gypsum	Between Fort Quitman and Hot springs, on the Rio Grande; eastern part of El Paso county; northern part of Presidio county; gypseous formation extends for hundreds of miles on headwaters of Red river.
Ilmenite	Titanic iron	Occurs in Llano county.
Jasper	Jasper	Near Fort Davis, Bexar county, Barilla springs.

TEXAS—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Limonite	Brown hematite	Five miles east of Calvert, Robertson county, appear to be in large beds; Milam county, opposite coal of Herndon, Robertson county; Young's iron works, Cherokee county, both brown and red hematites, abundant; 8 miles south of Rusk, Cherokee county, ore inexhaustible; near McLain's works, northern part of Nacogdoches county; Nash's mine, at works, Cass county; Kelly's iron works, 5 miles north of Jefferson, Cass county; 3 miles south of Palestine, Anderson county, extensive bed; Whitesborough, Grayson county; Mount Enterprise, Rusk county; Jacksonville to Rusk, in Cherokee county. Iron ores occur in nearly every county in State where older Tertiary rocks prevail.
Magnetite	Magnetic iron ore	Burnet, Burnet county, thence southwest extend into Llano county, occurring in thick beds in granites; largest bed 12 miles west of Llano, Llano county; another large body 8 miles northwest of latter; none of these deposits developed to any extent.
	Marble	White, black, flesh-colored, clouded, in Lower Silurian rocks of Burnet, Llano, and San Saba counties.
(?)	"Molybdenum ore"	Llano county, Burnet county, in gneissoid rocks.
Niter	Niter	In caves in Burnet, San Saba, and other counties to west of them.
Obsidian	Obsidian	Near Muerto springs, Presidio county, in large veins.
	Ocher	Near Young's works, north part of Cherokee county, in clays, tried for local use.
	Opal	Near Van Horn's well, abundant; also in igneous rocks of western Texas.
Petroleum	Petroleum	Oil springs, 6 miles south of Melrose, Nacogdoches county, at base of Tertiary sandstones; springs western part of Bell county, not abundant; springs near Sabine pass, Jefferson county; Sour lake, few miles north of last locality.
Pyrite	Iron pyrites	On Copperas branch, 4 miles north of Whitesborough, Grayson county, in alum shales. Copperas and alum formerly made here.
Pyrolusite	Black oxide of manganese, manganese dioxide.	Spiller mine, eastern part of Mason county, vein 10 inches thick.
	Slate	Near base of Packsaddle mountain, Llano county, outcrops; Chinati mountains, southeastern part of Presidio county.
Talc	Steatite	On the Hondo, Llano county; on the Sandys, Llano county, in large quantities, massive and light-colored.
Tourmaline	Tourmaline	Llano county, in granite.

UTAH—Mined.

Anglesite	Sulphate of lead	Mined for lead and silver.
Arsenopyrite	Mispickel	Mined for gold and silver contents.
Asphaltum	Asphaltum	Near Thistle, Utah county, in large quantity. Works erected for refining. (See, also, Gibsonite.)
Azurite	Copper carbonate, often called "bromide of silver."	Is found in some silver ores; not worked for copper, Tintic district, Juab county; Beaver county.
Barite	Barytes, heavy spar	Gangue of silver and lead at Horn silver mine, and Mammoth mine, Tintic.
Calcite	Limestone	Gangue and flux in every mining county.
Cerargyrite	Horn silver, chloride	In the ore of various mines, especially in Beaver, Summit, and Salt Lake counties.

UTAH—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcopyrite	Copper pyrites	Mined for gold and silver contents.
Cerussite	Carbonate of lead, "crystallized lead."	Mined for silver, lead, and gold; most frequent in Bingham mines.
Chrysocolla	Silicate of copper	Is found in some silver ores; not worked for copper.
	Clays	For common brick and firebrick.
Cuprite	Copper oxide	Found in some silver ores; not worked for copper. Mammoth mine, Tintic district.
Dolomite	Magnesian limestone	Wall rock of many silver-bearing veins, and a common gangue.
Erubescite	Purple copper ore	Rare.
Galenite	Galena	Mined for lead and silver; in all silver-lead mines.
Geocerite, ozocerite.	Mineral wax, native paraffine.	Contains much paraffine; of growing importance. Utah, Emery, and Uintah counties.
Gibsonite or Uintahite.	"Asphaltum," "dry asphalt."	Near Fort Duchesne; White river; Strawberry creek. In large quantities at several points. A small amount has been shipped East for manufacture into varnishes, lacquers, etc.
Gold	Gold	Free, and associated with complex minerals. Small placers in West Mountain district; San Juan and Garfield counties.
	Granite	Coming into common use as building stone; abundant in most counties.
Gypsum	Gypsum, plaster of paris.	Mined and milled at Nephi; of good quality.
Halite	Rock salt and lake salt.	Mined as rock salt, and also collected by solar evaporation and boiling of water of salt springs. Principal source Salt lake; by solar evaporation. Large deposits of rock salt in Juab, Sevier, and Washington counties.
Hematite	Iron ore	Flux in lead smelting. Mines opened in Iron, Juab, Morgan, Summit, and Weber counties. Will be worked for iron.
Lignite	Coal	Mined largely for steam and domestic use. Pleasant Valley and Coalville mines extensive; others being opened. Coal lands cover a large area in the following counties: Emery, Uintah, Summit, Morgan, Iron, Washington, and San Pete.
Limonite	Brown hematite	Used as flux in lead smelting. Extensive deposits in Juab, Iron, Morgan, and Uintah counties.
Limonite (2)	Ocher, often called "chloride."	For flux.
Malachite	Green copper carbonate.	Mined for copper and silver. Found in some silver ores; not worked for copper. Tintic district.
Molybdenite	Sulphide of molybdenum.	Rare.
Orpiment	Yellow sulphide of arsenic.	Limited quantity in one silver mine in Bingham cañon. Several mines in Tintic district, and near Frisco. With silver ores; not worked for arsenic.
	"Porphyry"	Sometimes used as building stone. (All rocks not called granite, limestone, sandstone, or slate are usually known as "porphyry.")
Pyrargyrite	Dark ruby silver	With other silver ores.
Pyrite	Iron pyrite	Mined for gold and silver contents. Frequently accompanies other ores.
Pyrolusite	"Manganese," binoxide of manganese.	Tintic and other districts; with silver and lead ores.
	Sandstone	Vast quantities. Sometimes used as building stone. Gangue of silver ores at Silver Reef.

UTAH—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Sphalerite	Blende, zincblende, "black jack."	Mined for silver contents in Tintic district, but rare.
Stibnite........	"Antimony," sulphide of antimony.	In large quantities at Marysvale, Pi Ute county. Often associated with galena.
Sulphur	Sulphur	Very extensive deposit worked at Cove creek. Factory makes both ground and sublimated sulphur.
Tetrahedrite ..	Fahlerz, gray copper .	Mined for silver.
	Tufa..................	Used as lining for lead furnaces.
Wulfenite	Molybdate of lead....	Occurs with silver ores.

UTAH—Not Mined.

	Bismuth ore..........	Tintic district, with silver-lead ores.
Calcite	Marble	Juab, Summit, Beaver, San Pete, Salt Lake, Utah, and several other counties.
Cervantite, or stibconite.	Antimony ocher......	Limited quantities.
Cinnabar	Cinnabar, sulphide of mercury.	Marysvale, Pi Ute county
Gypsum	Alabaster	
Gypsum (2)....	Gypsum, plaster-of-paris.	Abundant, but not developed because of lack of demand and want of transportation facilities.
Hematite	Iron ore	Large quantities; not worked for iron because of lack of capital and means of transportation. Largest deposits in Iron county not now worked.
Kalinite	Alum, potash alum, alum shales.	
Kaolinite	Kaolin................	In Tintic district and many other localities.
Kaolinite (2)...	"Gunnison paint"....	Near Gunnison.
Lignite	Lignite, coal.........	Many beds not worked.
Magnetite	Iron ore	Large deposits in Iron county not now worked.
Muscovite	Mica..................	No large bodies developed.
Niter..........	Saltpeter, nitrate of potash.	Near Fillmore, Millard county; several small beds near Parowan, etc., Iron county.
Sulphur	Sulphur, brimstone...	Several unworked deposits besides the one mined in Millard county.
Tiemannite....	Selenide of mercury ..	In Ohio district.

VERMONT—Mined.

Chalcopyrite...	Copper pyrites	Strafford, Orange county, in pockets in mica schist, with pyrite; Vershire, large deposits, with pyrite in mica schist, very extensively worked; Corinth, with pyrite in mica schist, extensively worked; Shrewsbury, Cuttingsville, at copperas mine; Wolcott, Lamoille county; Brighton and Concord, Essex county.
Copper (native)	Copper	Vershire and Strafford, Orange county, with copper ores; Bridgewater, in small quantity.
Galenite	Galena	Argentiferous, Brandon, Rutland county.

VERMONT—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Granite	Barre, Coble hill, and Millstone hill quarries, fine-grained, used in State houses; Black mountain, Dummerston, Windham county; Ascutney mountain, Chester, Cavendish, Pomfret, and Berlin. Extensively quarried at Brunswick, Essex county, known as "Nulhegan granite"; Hardwick and Ryegate, Caledonia county, "Blue mountain granite"; Victory, Essex county; Brownington and Derby, Orleans county; and Woodbury, Washington county.
Kaolinite	Clay	Pownal, Bennington county, Bennington, associated with iron ore, used for ware. Shaftsbury, Bennington county; Brandon, Rutland county, a large deposit used for fire-brick and paper. Wallingford, Rutland county; Monkton, Addison county, a large deposit, used quite extensively in manufacture of paper. Plymouth, Windsor county, and Chittenden, Rutland county, kaolin or clay of State associated with limonite.
Limonite	Brown hematite	Henry mine, near North Bennington, large deposit of rich ore; Bennington mine, near Bennington, rich and manganiferous ore; near Manchester, Bennington county; Plymouth, Windsor county, in connection with ocher and kaolin.
Malachite	Green carbonate of copper.	Vershire, Orange county, copper mines.
	Marble	I. Vermont marble; extensive quarries on western side of Green mountains, in Addison, Bennington, and Rutland counties. Most noted quarries in towns of Middlebury, Sudbury, Brandon, Pittsford (several quarries), Rutland (a dozen or more quarries), Clarendon, Wallingford, Tinmouth, Danby, Dorset, and Arlington—a belt 65 miles long, north to south. These are white saccharoidal marbles. Vermont Italian marble from Dorset. Most extensive quarries in Rutland county, Addison county; at Swanton, Franklin county, dove-colored marbles. Black marble quarried at Orwell, Addison county. II. Winooski marble, worked to a limited extent in northwestern part of State—Chittenden and Franklin counties; also, localities at Mallett's bay, Colchester, near Burlington, and in Swanton. III. Plymouth marble, Plymouth, Windsor county, a variegated marble. IV. Isle la Motte marble, Isle la Motte, Lake Champlain; and in Champlain valley, a black marble.
Pyrite	Iron pyrites	Strafford (Copperas Hill mine), Orange county, a very large deposit interstratified with mica schist, associated with chalcopyrite; Cuttingsville, Rutland county, with chalcopyrite in gneiss; Vershire, Orange county, large bed with chalcopyrite; Corinth, with chalcopyrite; Brighton, Baltimore, and Brookfield, Orange county.
Serpentine	Verd antique marble	Cavendish, Windsor county, for ornamental work; Roxbury, Washington county, quarries formerly worked; many other and large mountain masses in and near the talcose schist belt from Massachusetts to Canada—others in the gneiss; Newfane, Windham county; Plymouth, Windsor county; Troy and Westfield, Orleans county.
	Slate	Three ranges of roofing slate: I. Eastern, clay slate near Connecticut river, from Massachusetts line to Essex county; found in Guilford, Windham county; Thetford, Orange county; Waterford, Caledonia county, and other localities and small quarries. II. Middle range of clay slate extends from Memphremagog lake to Barnard slate quarries in Northfield, Montpelier, and elsewhere of uniform shade and black. III. Western, Vermont slate quarried largely in Castleton; also in Fairhaven, Poultney, Wells, and Pawlet, Rutland county; generally of a dark purple color, with occasional blotches of green; very compact and fissile. Large quarries near West Castleton, Hydeville, Scotch hill, and Fairhaven.
Talc	Steatite, soapstone	Abundant mostly on east side of Green mountains, near talcose slate, and found in a belt whole length of State. Marlborough, Windham county, known as "chalkstone;" Newfane, Chester, Grafton, and Athens, large quarries; also in Bridgewater, Plymouth, Cavendish, Weathersfield, Bethel, and Rochester, Windsor county, thence north in Washington, Lamoille, Franklin, and Orleans counties.

VERMONT—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Whetstone, oilstone, scythestone.	"Magog oilstone" (novaculite), near Canada line; Lake Memphremagog, Fitch's island quarry, honestones; Northfield, Washington county, talcose schist, scythestones; Ludlow, Rutland county, and Stockbridge, Windsor county, scythestones.

VERMONT—Not Mined.

Asbestus	Asbestus	Lowell, Troy, Jay, Cavendish, Roxbury, and Mount Holly.
Arsenopyrite	Mispickel	Brookfield, Waterbury, Stockbridge, and in Vershire, with pyrite and chalcopyrite.
Braunite	Manganese ore	Brandon, Bennington, Plymouth, and Chittenden in small quantities.
Chalcopyrite	Copper pyrites	Wolcott, Lamoille county; Brighton and Concord, Essex county.
Chromite	Chromic iron ore	Jay, Troy, Westfield, and Newfane, in several narrow veins in serpentine.
	Feldspar	Corinth, Strafford, Norwich, Chester, Newfane, and Saxton's river.
	Flagging stone	Cavendish (gneiss); between Hartford and Rockingham, Windsor county, small quarries, in clay slate.
Galenite	Galena	Thetford, Orange county, old mine in vein of quartz, calcite, etc., in talcose slate (argentiferous); Norwich, Windsor county, small vein in talcose slate; Morristown, Lamoille county; Bridgewater and Plymouth, Windsor county, and Chittenden, Rutland county, occurrences only.
Gold	Gold	Bridgewater, Windsor county, sparingly in quartz veins in talcose slate at lead mine; Plymouth, Windsor county, in drift; Newfane, Windham county. Some of these localities may be worked a little (?).
Graphite	Plumbago, black lead	Brandon, Halifax, Hancock, Huntington, Newberry, Norwich, Pittsford, and Swanton.
Hematite	Red oxide of iron	Milton, near Lake Champlain, worked to slight extent; Fairfield, of small extent; Weathersfield, Windsor county.
	Infusorial earth	Peacham, Caledonia county, and many other places.
Lignite	Brown coal	Brandon, in and upon clay beds; Tertiary age.
Magnetite	Magnetic iron ore	Rochester, sparingly in chlorite slate; Plymouth and Ludlow, sparingly; Somerset, worked several years ago; Troy, Orleans county, a titaniferous ore in small beds; Bridgewater, Windsor county, and Chittenden.
	Marl	Abounds in most of towns bordering Lake Champlain; also in Windsor and Orange counties.
	Ocher	Brandon, Rutland county, limonite ores and ochers for yellows, browns, reds, and umbers; Bennington, red and yellow ocher; North Dorset, a vein between walls of calcareous quartz, manufactured into paint; and Watsfield.
	Peat, "muck"	Numerous localities, Champlain valley, etc.
Psilomelane	Black manganese ore, black hematite.	Brandon, with pyrolusite; Bennington, Chittenden, Bristol, Colchester, Plymouth, Pittsford, Stamford, Wallingford, and Irasburgh.
Pyrolusite	Manganese dioxide	Brandon, with limonite and psilomelane; Bennington, Bristol, Chittenden, Colchester, Plymouth, Pittsford, Stamford, Wallingford, and Irasburgh.
Quartz	Sand rock	East Dorset, Bennington county, disintegrated quartz rock, once used for glass; Plymouth, Windsor county, associated with kaolin; elsewhere in western Vermont.

VERMONT—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Siderite	Spathic iron ore, carbonate of iron.	Plymouth, in talcose slate, with magnetite and pyrite.
Silver	Silver	Traces in galenite at Thetford mine. Argentiferous galena, East Middlebury, Addison county.
Sphalerite	Zincblende	In lead mine, Thetford, Orange county; Norwich and Morristown, sparingly, with galenite; Bridgewater, Windsor county, contains cadmium.
Zaratite	Emerald nickel	South Troy, Orleans county, very sparingly.

VIRGINIA—Mined.

Asbestus	Asbestus	Bartons and Singers, Floyd county; near northern copper lode, Grayson county; on Little river, below Hampton mine; lead and zinc mines, Painter's branch, Wythe county; Barnet's mills, Fauquier county; Pittsylvania county; Goochland county; Willis mountain, Buckingham county; Chula, Amelia county, near Appomattox River to Amelia county, near Franklin C. H.
Barite	Barytes, heavy spar	Frye's marble quarry, Wytheville, Wythe county, in small quantities; Brown hill, Wythe county, near lead and zinc ore deposits, in large masses; Kitchen farm, near Speedwell; near Marion, Smyth county, mined, in Silurian limestone; Cavitt's creek and Baptist valleys, Tazewell county; and Russell county, along Clinch river; Lee county; Eldridge's gold mine, Buckingham county; near Lexington, Rockbridge county; several localities near Lynchburgh, Campbell county; Beaver creek, Campbell county, bed of fine granular variety; near Saint Stephen's and in lower Fauquier county; between Marshallville and Upperville, Fauquier county; Prince William county; near Pittsville, Pittsylvania county.
Calamine	Silicate of zinc	Wythe and Pulaski counties, with galena, blende, etc.; Bertha mines, Wythe lead and zinc mines, and Falling Cliff property.
Cerussite	White lead ore, lead carbonate.	Wythe lead mines, Austinville, Wythe county, with galena, blende, etc., in magnesian limestone, in small quantities; Quesenbury and Kitchen mine, Wythe county.
Chalcocite	Copper glance, copper sulphide.	Near Max meadows, Wythe county; Mount Airy, Smyth county; Toncray mine, Floyd county, with magnetite and pyrite; copper ranges or lodes in Carroll county, west and northwest of Hillsville; occurs in upper part of deposits with melaconite and chalcopyrite.
Chalcopyrite	Copper pyrites, yellow copper ore.	Toncray mine, Floyd county, with chalcocite, pyrite, and magnetite; northeastern part of Floyd county; on north fork of Roanoke, with pyrrhotite; Peach Bottom copper lode, or range, Carroll county; northern copper range, at Great outburst; Chestnut creek, Copperas hill, Cranberry plains, and other localities. Continues southwest into Grayson county. Common in many localities in the "gold belt." Phœnix copper mine, Fauquier county; Ford's mine, Buckingham county; gangue in gold mine; mine near Herndon, Fairfax county; Madison county; Fairfax gap; head of Naked run, Greene county; Guilford, Loudoun county; Richard's mine, Page county; near Tolersville, Louisa county.
Coal	Coal, bituminous coal, and semi-anthracite.	The coal industry of Virginia has developed rapidly and extensively of late, especially in southwest Virginia. The principal coal areas are: 1. Richmond field (Triassic sandstone), in vicinity of Richmond. 2. Middle fields (Pocono or Vespertine), in western part of Virginia along the "Appalachia" region. 3. Pocahontas field (Lower Productive and Pottsville Coal Measures), in parts of Tazewell, Dickinson, Wise, and Lee counties. The Flat Top and other mines of the Pocahontas field produce a coking coal. A little semi-anthracite is mined at the New River division stations and Vicker's station on N. and W. R. R., near West Virginia boundary.
Cuprite	Red oxide of copper	Linden, Warren county, with melaconite and native copper.
	Flagging stone	Slate on Hunt's creek, Buckingham county; Amherst county.

VIRGINIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Galenite	Galena, lead sulphide	Wythe county lead mines: occurs with blende, smithsonite, and calamine in magnesian limestone; worked for a century; Bertha zinc mine, eastern part of Wythe county, with blende; Little Reed Island creek (Sayers), Wythe county; Forney mine, and property of New River M. Co., at Ivanhoe furnace, Wythe county, with blende; New river, near mouth of Reed Island creek, Pulaski county, galena and blende, with other lead and zinc minerals; Tract mountain and Big Walker mountain, Pulaski county; Sugar Grove, South Fork valley, Rich valley, Bear creek, localities in Smyth county; Giles county, in Lower Helderberg rock, in small quantities; near Sharon, Bland county, also in Garden and Flat Top mountains; on Clinch river near mouth of Maiden Spring fork, Russell county; Floyd county, at McAlexander's, on Little river, and in this range with quartz and pyrites, argentiferous; Peach Bottom copper lode, Carroll county and Grayson county, argentiferous; Stafford, Nelson, and Franklin counties, argentiferous.
Gold	Gold	Brush creek, Montgomery county, in gravel; Little river, Floyd county; "gold belt" of Virginia from Potomac to Halifax county, 200 miles long and 15-25 miles wide, gold-bearing quartz in crystalline rocks, many mines opened, principally in Fauquier, Stafford, Culpeper, Spottsylvania, Orange, Louisa, Fluvanna, and Buckingham counties; Booker mine, Buckingham county; Rappahannock mine, Randolph mine, Whitehall mines, Pocahontas mine at Andrews, in Spottsylvania county; Louisa county mines; Chicago and Virginia Gold Mining Company, Orange county; Snead mine, Fluvanna county; Tellurian gold mine, Goochland and Fluvanna counties; eastern part of Culpeper county, several localities; Culpeper gold mine, Culpeper county; Eagle mine, Stafford county; Franklin, Liberty, and other mines in Fauquier county.
	Granite	Richmond, Petersburgh, Fredericksburgh, gray granites; Richmond, Henrico county; Tuckahoe district, Henrico county; Westham granite quarries, Manchester, Old Dominion quarry at Granite, Chesterfield county; Namozine district, Amelia county; Lynchburgh, Campbell county; Columbia, on James river (a gneiss), Fluvanna county; Willis mountain, Buckingham county (a pink gneiss); Cumberland county, quarries in gneiss: Boorman, on Cedar run, Fauquier county, near Delaplaine, Fauquier county; Burkeville, Nodaway county; Verdon, Hanover county; Occoquan, Prince William county (red veined).
Gypsum	Gypsum	Buena Vista plaster beds. Buchanan's plaster cove, and other localities on north fork of Holston river, Smyth county and Washington county; extensive beds, associated in places with rock salt.
Halite	Common salt	1. Rock salt—Saltville, Smyth county, valley of north fork of Holston river. 2. Brines—Saltville, Smyth county and Washington county; on Clinch river, southwest part of Lee county.
Hematite	Red hematite, specular iron ore.	In lower slates of Potsdam, in Warren, Augusta, Rockbridge, Botetourt, Bedford, Wythe, and Smyth counties; Overall station, Warren county; Arcadia furnace, Botetourt county; Pollard cut, same county; specular ore at Cundiff creek, in Bedford county, and on Clinch mountain range, Washington county; also on south slope of Iron mountain, Grayson county. On James river, below Lynchburgh. Traceable through Nelson, Amherst, Appomattox, Buckingham, Albemarle, Orange, and Culpeper counties; several mines opened near James river. Loudoun county; Stafford county; east foot of Bull Run mountain, Prince William county.
Hematite (2)	Fossil ore, dyestone ore.	South flank of Big Walker mountain, Wythe county; same range and also on Poor Valley ridge and Clinch mountain; in Flat Top, Buckhorn, and East River mountains, in Giles county; same ranges in Bland county, and also at Wolf creek and Round mountain, in Tazewell county; Russell county; Powell's mountain and south face of Clinch mountain, Scott county; Poor Valley ridge, Waldin's ridge, and Powell mountain, in Lee and Wise counties; Cripple creek and New river region, southwest Virginia; Rich Patch mountain, at Clifton forge, Alleghany county. Numerous ore banks in red hematite worked in great valley of Virginia from Augusta to Smyth county.

VIRGINIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Hydraulic limestone..	Balcony falls, James river, Rockbridge county, (a gray magnesian stone, noted "Balcony Falls cement"); Madison run, Orange county.
	Limestone	Valley of Virginia and Piedmont district. Outcrops at many localities. Fauquier county. Cripple Creek district, Pulaski and Wythe counties.
Limonite	Brown hematite	Occurs in Potsdam sandstone, in Page, Rockingham, Augusta, Rockbridge, Botetourt, Montgomery, Pulaski, Wythe, and Smyth counties; many deposits along western foot of Blue ridge. In magnesian limestone of great valley in counties above enumerated; also in Oriskany sandstone and Hamilton shales, mainly in Rockingham, Augusta, Bath, Alleghany, Craig, and Bland counties. Ore banks at many localities in this valley quite to the Tennessee line. Limonite in extensive beds opened in Oriskany and Upper Helderberg formations, in Paint Lick mountain, Rich mountain, Nye's cove, and other localities in Tazewell county; in Clinch mountain and Kent's ridge, in Russell county; in Powell's mountain, Clinch mountain, Fossil and Big ridges, in Scott county; Bowling Green forge, Lee county. Large deposits with belts of magnetite and specular ore occur in a range near James river, in Nelson, Amherst, Campbell, Appomattox, Buckingham, thence northeast into Fluvanna, Orange, and Culpeper, and terminating in Fauquier. Many openings on this range. Brown hematites, with fossil and "limestone" ores in Cripple Creek region, southwest Virginia.
Limonite (2) ...	Bog iron ore	In tidewater part of State, in Tertiary formation; ores generally lean.
Magnetite	Magnetic iron ore.....	In great valley of Virginia, at Ripplemead mine, near Pearisburgh; also near Newport, and other localities, Giles county; Wytheville, Wythe county, with hematite; near Abingdon, Washington county; Toncray mine, Hylton mine, and Bear beds, in Floyd county; Carroll county; Billing's mine, near Independence, thence to New river, in Grayson county; several localities. James river belt: Mount Athos, Riverville, Appomattox county, with belts of specular and limonite ores; also in Buckingham, Culpeper; near Paris and Markham, in Fauquier and Spottsylvania counties; Stewart's knob, Patrick county; Rocky mountain, Franklin county; Albemarle county; in Chesterfield coal basin, at Tarbue's, with hematite and limonite in southwest Virginia.
Malachite	Green copper ore, carbonate of copper.	Peach Bottom copper range, Carroll county; northern copper lodge or range, Carroll county, with limonite and ores of copper; near Overall's station, Warren county, with gray sulphide; near Catlett's station, and Linden, Fauquier county. Near Nelurin station, Prince Edward county.
	Marble	Near Wytheville, Wythe county; Frye's hill, southwest of Wytheville, Wythe county; Craigsville, Augusta county; "encrinal marble" and black marble from Lower Helderberg formation, Campbell county; near Marion, Smyth county; valley of north fork of Holston river, Washington county; Giles county (Rye hollow), etc.; Estillville, Scott county; Rockbridge county; in Blue ridge, Fauquier county; Toddsburg, near Madison run, Orange county. Loudoun county. Brecciated or Potomac marble, near Leesburgh, Loudon county, also in Fauquier county.
	Marl, green sand marl.	In Lower Tertiary or Eocene near head of tidal waters (average 16 miles wide). Greensand marls, principally in Prince George, Henrico, Hanover, and King William counties.
	Marl, calcareous......	In Middle Tertiary or Miocene, of tidewater area of State. Localities: Gloucester county; New Kent county; on Acquia creek, Stafford county.
Melaconite	Black oxide of copper.	In upper portions of copper lodes, Carroll county, with chalcocite, chalcopyrite, and malachite; also Floyd and Grayson counties; Linden, Warren county.
	Millstone	Price's mills, Montgomery county; southern part of Carroll county, granites used for millstones; Campbell county, syenitic rock used for millstones.

VIRGINIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Ocher	Keezletown, Rockingham county, near Massanutton mountain; near Alma and Marksville, Page county; Bermuda Hundred, on Appomattox river; Bon Air, Chesterfield county; hematites near Madison run, Orange county; Carysbrook, Fluvanna county. Rockbridge county.
Psilomelane	Manganese ore	Crimora, with pyrolusite. Houston mine, Botetourt county. Near Marion, Smythe county.
Pyrite	Iron pyrites	Common in many localities. Graham's, New river, Wythe county, with brown hematite outcrop; disseminated in proto-Carboniferous slates, Smyth county; Brush creek, Montgomery county; Floyd county, Toncray mine with copper sulphurets; southern copper lode, northern or Dalton lode, in Carroll county, immense deposits of pyrite, pyrrhotite, arsenopyrite, and chalcopyrite, underlying gossan and the deposits of melaconite and chalcocite; Grayson county—southeast corner of county in copper lodes with pyrrhotite and chalcopyrite. Western part of Grayson county in east slope of Balsam (Mt. Rogers) and White Top mountains. Many localities in "gold belt" and often auriferous, particularly in Amherst and Buckingham counties. Large deposit at Tolersville, Louisa county, occurs in chloritic slates.
Pyrolusite	Black oxide of manganese.	Crimora and Old Dominion manganese mines, Augusta county, extensive deposit and worked steadily; Midvale, Rockbridge county; near Marion, Smyth county; near Wytheville, Wythe county; Piedmont mine, near Warminster, Nelson county. Also, many localities in Giles, Floyd, Campbell, Appomattox, Pittsylvania, Louisa, and other counties. Many of the Virginia iron ores are manganiferous.
	Sandstone, "brownstone."	Quarries in Triassic sandstone areas of middle Virginia; freestone quarries near mouth of Acquia creek; near Manassas, Prince William county, a brownstone of Triassic; Thoroughfare gap, Prince William county, a quartzite.
Serpentine	Serpentine	Between Difficult creek and Stillhouse creek, near the Potomac, Fairfax county, heavy beds and containing chrome ore, and talc and magnetite.
	Slate	For roofing: On Hunt's creek, Buckingham county; Albemarle county; Baldwin quarry, Amherst county; near James river, Bedford county, and near Balcony falls, near Staunton, Augusta county; Newcastle, Craig county; Keswick, Albemarle county, near Rappahannock river; near White Sulphur springs, Fauquier county.
Smithsonite	Zinc carbonate, "dry bone."	Wythe and Pulaski counties, lead and zinc mines with blende, galena, etc.
Sphalerite	Zincblende, "black jack."	Austinville, Wythe county, lead and zinc mines; occurs with galena and other ores of lead and zinc, in dolomite; Bertha mine, Wythe county; Falling Cliff mine, and Forney, Wythe county; on New river, near mouth of Red Island creek, Pulaski county, with galena; near Sharon and on Garden and Flat Top mountain, Bland county, scattered in dolomite.
Talc	Steatite, soapstone	Barton's, Floyd county; near Toncray mine, Floyd county; near Peach Bottom mountains, on north, Grayson county, in great masses. Wytheville, Wythe county, 2 miles west of Lynchburgh, Campbell county, belt traceable for miles; near Amelia C. H., Amelia county; Spencer's store, Henry county; Vallena, Fluvanna county; Madison county, northwest base of Buffalo ridge, Amherst county, and Nelson county; near Cartersville, Cumberland county; Dranesville, near the Potomac, Fairfax county, with serpentine. Brunswick county.

VIRGINIA—Not Mined.

Allanite	Allanite	Amherst county, in considerable quantity.
	Alum shale	Devonian valleys, along Chesapeake and Ohio railroad, from Buffalo gap to White Sulphur springs, and elsewhere.

VIRGINIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Arsenopyrite	Mispickel, arsenical iron pyrites.	Purgatory, Floyd county, large vein, argentiferous; southern copper lode in Carroll and Grayson counties.
Bornite	Purple copper ore	Near Leesburgh, Loudoun county.
Carbonite	Natural coke	Chesterfield coal basin, Chesterfield county (Triassic).
Cassiterite	Tinstone	A number of occurrences in Rockbridge and other counties.
Chromite	Chrome iron ore	In serpentine, Dranesville, near the Potomac, in Fairfax county.
Copper, native	Copper	Toncray mine, Floyd county; native copper lode, Carroll county, near Hillsville, etc.; near Linden, Warren county, with cuprite and melaconite.
Dufrenite	Iron phosphate	South mountain, 10 miles east of Lexington, Rockbridge county.
	Feldspar	Common in middle Virginia. Nelson, Amelia, and Amherst counties.
	Fire clay	Under coal seams in southwest angle of State, Lick mountain, Wythe county; Bon Air, Chesterfield county; near Court-house, Powhatan county; also in counties of Cumberland, Buckingham, and Appomattox; near mouth of North river, Rockbridge county; Madison run, Orange county. Fluvanna county.
Graphite	Plumbago, black lead.	Winterham, Amelia county; Halifax, Amherst, Louisa, and Goochland counties.
Kaolin	Clay	Augusta county; Prince Edward county; near Cumberland court-house, Cumberland county, a belt of clay; kaolin or Sherando station, Augusta county; near Warrenton, Fauquier county; Stafford county; Lick mountain, Wythe county, in large quantities; near Rye valley, Smyth county. Amherst, Nelson, Nodaway, and Amelia counties.
Massicot	Lead ocher	Austin mines, Wythe county, in small quantities with galena and other lead ores.
Muscovite	Mica	Hanover county; near Court-house, Goochland county; Louisa county; near New London, Bedford county; near Amelia court-house, Amelia county.
Pyrrhotite	Magnetic pyrites	Northeast part of Floyd county, with chalcopyrite; a thick bed; southern copper lode, and northern or Dalton copper lode, Carroll county, deposits of great extent, with pyrite, chalcopyrite, and arsenopyrite; Clifton mine, near Chestnut creek, Cranberry plains, etc., Carroll county. Extends southwest into Grayson county.
Quartz	Quartz, sand	Quartzite near Leesville, Bedford county; Thoroughfare gap, Prince William county. Sand, for glass making, near Greenville, Augusta county; Balcony Falls, Rockbridge county.
Silver	Silver	(See Galenite and Arsenopyrite.) Occurs alloyed with gold in gold-bearing rocks of central part of State.
Sulphur	Sulphur	On Potomac, 25 miles above Washington, in small masses in limestone.
Tetradymite	Tellur-bismuth	Whitehall gold mines, Spottsylvania county; Monroe mine, Stafford county; Tellurium mine, Fluvanna county.
Tripolite	Infusorial earth	An extensive deposit traceable from the Patuxent river, in Maryland, to the Meherrin in Virginia. Exposed at Richmond and other points.
	Umber	Overall station, Warren county. Piedmont mine, Nelson county.

WASHINGTON—Mined.

Calcite	Limestone	Throughout Stevens and other counties; for flux and lime burning.

WASHINGTON—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Cerussite	Lead carbonate	Argentiferous. Cleveland, Colville, and Summit mining districts, Stevens county.
Coal, var. lignite.	Lignite	Important mines in King county and neighborhood of Puget sound, shipping largely to San Francisco and other points.
Galenite	Galena	Argentiferous. Mining districts of Stevens and Okanogon counties.
Gold	Gold	A few small placers worked.
Limonite	Brown hematite	Stevens county.
	Silver	In Colville, Cleveland, Little Dallas, Summit, and Pend d'Oreille districts, Stevens county, with lead and copper minerals.

WASHINGTON—Not Mined.

Coal, var. lignite	Lignite	Many known occurrences still undeveloped.
Gold	Gold	Quartz veins at Gold hill, near Colville, Stevens county, and elsewhere. Placers on banks of the Columbia river and elsewhere. Beach sands.
Limonite	Brown hematite	Several unworked deposits.
	Plastic clay	Tacoma county.

WEST VIRGINIA—Mined.

	Bromine	Made from salt brines of Kanawha and Ohio River salt region.
Coal	Anthracite coal	Berkeley county, thin seams worked for local use only.
Coal (2)	Bituminous coal	Carboniferous formation has an area of 16,000 square miles. Lower Coal Measures and sub-conglomerate seams are worked in the southern part of State; in northeastern the Upper Coal Measures afford the working seams. Potomac basin, opened in Mineral and Grant counties; Preston County basin worked at Newburgh, Austin, and Decker's creek, Monongalia county. Blue Stone Flat Top coal field, extensively worked in places, extends into Mercer, McDowell, Raleigh, and Summers counties. In Randolph, Upshur, and Marion counties the Upper Freeport seam is thick, and worked in last named largely. The Great Kanawha basin is noted for its various seams of bituminous, splint, and cannel coals. Nowhere are the Lower Coal Measures better developed than in it. Cannelton, Fayette county, Peytonia, Boone county, afford cannel coal. The "splint" coals are found in Braxton, Webster, Clay, Nichols, Fayette, Kanawha, Boone, Logan, Lincoln, and Wayne counties, often with more or less bituminous coals. Mines of splint coal at Coalburgh, East bank, and Paint creek, in Kanawha county. Principal mining districts are along the Ohio river, valley of Kanawha, and along lines of Baltimore and Ohio railroad, from Preston county west to Ohio.
	Fire clay	Nuzum's mills in Marion county. Used for firebrick. Lost run, Taylor county; Tunnelton, Preston county; near Morgantown, Monongalia county; near Cassville, in Wayne county; near Savageville, in Braxton county; Hancock county. Several firms make firebrick. Other localities in Coal Measures.
Halite	Common salt, brines	Brine wells. Principal points are: Charleston, Kanawha county; West Columbia to Hartford, on Ohio river, Mason county; Bulltown, on Little Kanawha, Braxton county; Louisa, on Big Sandy river, Wayne county; New river, Mercer county; Birch, on Elk creek; mouth of Otter creek, on Elk river, Clay county; Cheat river, Decker's creek, and Scott's run, Monongalia county, in borings for oil. Mason County salt works most extensive, and make nearly all of State product.

WEST VIRGINIA—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Hematite	Fossil ore	North slope of East River mountain, Bluestone river, on Black Oak mountains, and Flat Top mountains, Mercer county; Little mountain, Monroe county; Anthony's creek and Howard creek, Greenbrier county, both fossil and black ore; South Fork mountains, Pendleton county; middle, and also on north mountain ranges, Hardy county, large bodies developed; vicinity of Greenland gap, Grant county, 5 feet thick, parallel seams.
	Hydraulic limestone, water lime.	Near Shepherdstown, Jefferson county, quarry in bluff on Potomac.
Limonite	Brown hematite	Near court-house, Raleigh county; Peter's mountain, Monroe county; South Fork mountains, and near Franklin, Pendleton county, with fossil ores; Salt Spring Run knob, Cunningham tract, south of Moorfield, Hardy county, large deposits; North or Capon mountain, Hardy county, have long been mined, associated with red hematites; Walker's ridge and Knobly mountain, Grant county; Bloomary, Capon mountains, Hampshire county, long worked; Sandy ridge, Morgan county; Martinsburgh, Berkeley county; along Potomac, opposite Antietam creek, Jefferson county; near Bolivar heights, Harper's ferry; Maltby's ore bank, Jefferson county. Some of these localities are not now worked.
Niter	Saltpeter, "peter dirt."	Cave in Greenbrier county; Monroe and Pocahontas counties.
Petroleum	Petroleum	Horse neck, Pleasants county; Cow creek and French creek, Pleasants county; Oil rock and California house, Ritchie county; Volcano and Sand hill, "heavy oils;" Burning springs, Wirt county; near Morgantown, Monongalia county, and at points on a line thence to Charleston, Kana wha county.
Quartz	Sand	Sandy ridge, at Alpines, Morgan county, large deposits of white sand, worked for glass manufacture in Philadelphia.
	Sandstone	Near Morgantown, Monongalia county (Mahoning), sandstone is quarried; Grafton sandstone is quarried in Taylor county; Weston, Lewis county; Ronceverte, Greenbrier county; Charleston, Kanawha county, Mahoning sandstone is quarried for local use; Upper Kanawha, sand; stones of Coal Measures are quarried for local purposes. Hansford, on Kanawha river, Kanawha county; near Kanawha, on Elk river, Kanawha county; East Wheeling, Ohio county.
Siderite	Carbonate of iron, clay ironstone.	Mineral county and Grant county, thin seams at several localities; Three Forks creek, Reedsville, Tunnelton, and Muddy creek, Preston county; Decker's creek, Scott run, Booth creek, and Cheat river, east part of Monongalia county; Fairmount, Marion county; near mouth of Lasrun, Taylor county; near Phillippi, Barbour county; Standting Rock run, worked by the Elk Railroad Iron Company; Clay county, Braxton county; near Charleston, Kanawha county; on Big Sandy river, at Cassville, Wayne county, eight seams 1 to 3 feet thick. Workable beds in Lower Coal Measures and Lower Barren Measures.
Siderite (2)	Black band ore	Black band iron ore, near Big Sandy river, Wayne county; Davis and Briar creeks, Kanawha county; Bell creek, Fayette county; Little Elk run, Nicholas county; Little Sycamore creek of Elk river, Clay county.

WEST VIRGINIA—Not Mined.

Barite	Barytes, heavy spar	Jefferson county; Mercer county, on north slope of East River mountain.
	Calcareous tufa, travertine, calcareous marl.	Patterson's creek, Grant county; Hardy county, Hampshire county, and other counties, in large deposits; Jefferson county.

WEST VIRGINIA—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Dufrenite......	Phosphate of iron	South mountain, 10 miles east of Lexington, Stockbridge county.
	Fire clay.............	Two-mile creek of Elk river, Kanawha county; Kanawha river, above and below Charleston.
Fluorite.......	Fluorspar.............	Shepherdstown, Jefferson county.
Grahamite.....	Asphalt	Filling fissures in sandstone (Carboniferous) near Cairo, in Ritchie county. Has been worked.
	Limestone	Jefferson and Berkeley counties.
	Manganese ore	Anthony's creek, Greenbrier county.
	Ocher................	Yellow ocher, near Weston, Lewis county; South Branch valley, Hardy county; Lost river, near Harper's ferry, Jefferson county; near Shepherdstown, Jefferson county; Cline's cross-roads, Pendleton county; on Guyandotte river, Cabell county; near Ceredo, Wayne county.
Quartz.........	Sand..................	Blue gap, Short mountain, Hampshire county, cliffs of white sand rock; near Morgantown, Monongalia county, very soft sandstone; Sir John's run, in Morgan county.

WISCONSIN—Mined.

Galenite	Galena.................	That part of Wisconsin in the upper Mississippi lead district, in counties of La Fayette, Grant, Iowa, and Green. Principal districts or groups of mines are: Butown, T. 4, R. 4 W.; Grant county; Potosi, T. 3, R. 3 W., Grant county; Fairplay, T. 1, R. 2 W., Grant county; Hazel Green district, in Grant and La Fayette counties; Shullsburgh, La Fayette county; Benton and vicinity, La Fayette county; Plattville district, Grant county; Mifflin, Iowa county; Highland and vicinity, Linden, Mineral Point district, Dodgeville, Iowa county; Calamine and Vista, in La Fayette county; Monroe, Green county. Galena occurs in vertical crevices and in flat sheets in galena limestone and in blue and buff limestones of Trenton group. With it are often found blende, pyrite, chalcopyrite, and other compounds of lead, zinc, and copper. Ores worked in some mines for both lead and zinc.
	Granite and other massive rocks.	Near Dexter, on Yellow river, Wood county, several quarries. Granite porphyry: Berlin, Green Lake county. Granite: Montello, Marquette county. Quartz porphyry: Marcellon, Columbia county; Moundville, Marquette county; Markesan (Utley), Green Lake county. Quartzite: Waterloo, Jefferson county.
Hematite	Specular iron ore, red hematite.	I. Specular iron ore. Menominee range. The western extension of this ore range is worked extensively at Commonwealth and Florence mines in T. 40, R. 18 E., in Florence county. Beds of great thickness in Huronian schistose rocks. Specular ore accompanied by some limonite. II. Penokee-Gogebic range, Ashland county. Large deposits, upon which a number of mines are working in eastern side of the county. The deposits are in a series of lenses which occur at a definite horizon in the Huronian series. Strata strike about N. 60° E. Ore is mostly a soft red or brownish red hematite, at times somewhat hydrated. Associated with this soft ore is a little hard, steely, specular hematite. III. Clinton or "fossil ore." Iron ridge, Hubbard, Dodge county; Maryville, Hubbard, Dodge county, in thick beds of great extent and largely worked.
	Hydraulic limestone, water lime, cement rock.	Near and north of Milwaukee, on Lake Michigan, an impure dolomite of Hamilton formation. Extensively quarried and made into "Milwaukee cement rock." Ripon, limestone; Poygan, Winnebago county.
Kaolinite	Kaolin, porcelain clay, and fire clay.	Along junction of Laurentian and Potsdam rocks in Jackson and Wood counties. Well exposed at Grand Rapids, Wood county, and worked for fire-brick manufacture.

WISCONSIN—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
	Limestone	Many localities in southern and central parts of State. Westport, Dane county, a cream-colored limestone; near Madison, quarries in the Mendota limestone, a yellow, fine-grained rock; Boscobel, Grant county; Wauwatosa; Waukesha, Waukesha county (Niagara group); Cedarburgh, Genesee, Manitowoc; near Fond du Lac (Niagara). Other localities: Beloit and Janesville, Rock county; Neenah, Menasha, and Oshkosh, Winnebago county; Watertown, Jefferson county; Waupun, Eden, Oak Center, Taycheedah, Fond du Lac county; Deer Creek quarries near Green Bay, Brown county; Sylvester, Green county; Milwaukee, Grafton, Sheboygan, Racine, and Cedarburgh, Ozaukee county; Clifton, Monroe county; Vernon, La Crosse, Trempealeau, Buffalo, Pepin, and Pierce counties.
Limonite	Brown hematite	Accompanies specular ore at Commonwealth and Florence mines, Florence county; Westfield and Ironton, Sauk county. Worked for local supply to furnaces.
	Ocher	Red and yellow, at Clintonville, Iowa county. Brown, in Juneau county.
	Sandstone	Basswood island, Lake Superior, Ashland county, a large quarry. "Lake Superior brown sandstone"; Houghton point, Ashland county; Baraboo, Sauk county; Packwaukee, Marquette county; Wautoma, Waushara county; near Grand Rapids, Wood county; Black River falls, Jackson county; Stevens' Point, Portage county; Madison, Dane county. These are Potsdam rocks. Also quarried at many other points in central and southern Wisconsin.
Smithsonite	Carbonate of zinc, "dry bone."	In lead district of southwest Wisconsin, with blende. More abundant in northern and central parts of district. Mines in Iowa county; generally contain both lead and zinc ores, and worked for both ores.
Sphalerite	Zincblende, "black jack."	Common in the lead district, as associate vein material with galena. Principally in northern and central parts of district. Mifflin, Centreville, Highland, and Linden, all in Iowa county, and east of Dodgeville, Iowa county; Mineral Point mines, Iowa county; worked for zinc.

WISCONSIN—Not Mined.

Azurite	Blue carbonate of copper.	Mineral Point copper mines, Iowa county, with chalcopyrite.
Barite	Barytes, heavy spar	In lead region abundant.
Chalcocite	Vitreous copper ore, copper glance.	Mineral Point copper mines, with chalcopyrite and carbonates.
Chalcopyrite	Copper pyrites	Common in the lead region; ore at Mineral Point mines, Iowa county; Richland and Vernon counties, in Potsdam sandstone, sparingly.
Copper, native	Copper	On Montreal and Bad rivers, Ashland county; Brule, Amnicon, and Black rivers, Douglas county. In veins and scattered through epidote. Float bowlders common in eastern Wisconsin.
Limonite	Bog iron ore	Near Necedah, Juneau county; Grand Rapids, Wood county; other localities in marshes of central and northern Wisconsin.
Magnetite	Magnetic iron ore	Penokee range, Ashland and Bayfield counties (in quartzites and slates of the Huronian. Specular ore also common with magnetite). Penokee gap, along Chippewa river, Chippewa county, and Black River falls (mixed magnetic and hematite ores; ferruginous schists).
Malachite	Green carbonate of copper.	Mineral Point copper mines, Iowa county, with other copper ores.
	Peat	Underlying many of bogs and swamps.

WISCONSIN—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Pyrite	Iron pyrites	Lead district, southwest part of State. Common as vein material, with galena and blende.
Quartz	Sand for glass manufacture.	Saint Peter's sandstone at many localities; Waukau, Winnebago county.

WYOMING—Mined.

Aragonite	Dolomitic marble	Laramie county, east flank Laramie range; Albany county, west flank Laramie range; east flank Medicine Bow range, Albany county; 100-foot ledge of good quality, Cooper Lake station, Albany county; Rattlesnake mountains, Fremont county; Big Horn mountains, Johnson county; west flank Black hills, Crook county, abundant in the Carboniferous.
Calcite	Limestone	Albany county, 3 miles northeast Laramie City, used in making window glass. The limestones of the sub-Carboniferous, Carboniferous, and Jurassic afford an abundance of good lime for plasterer's use in each county; some of these limestones are hydraulic. For building stone, etc.: Laramie county (Carboniferous), Granite cañon, Horse creek; Albany county (Jurassic), Laramie plains; Sweetwater county (oölitic), Green river.
Cassiterite	Tin ore, black tin	Crook county; mines being developed along head of Sand creek and on west slope of Black hills in Nigger Hill district. Found in veins of quartz, feldspar, and mica in slate formations near contact with granite and porphyry.
Cerargyrite	Silver chloride, horn-silver.	Black Butte mines, Warren's peaks, Crook county; Big Horn mines, Johnson county. Associated with other ores in Wind River Mountain mines, Fremont county.
Cerussite	Lead, carbonate (argentiferous).	Black Butte mines, Crook county (hard and soft carbonates in Carboniferous).
Chalcocite	Copper glance	Laramie county, with cuprite, malachite, etc.; at Sunrise, Michigan, and Green Mountain Boy (argentiferous) mine, Platte Cañon district; King David mine (argentiferous), Silver Crown district.
Chalcopyrite	Copper pyrites	Silver Crown district, Laramie county; Seminoe district, Carbon county; South Pass City, Fremont county. With other ores.
Chrysocolla	Copper silicate, "blue copper."	Near Hartville, Laramie county, with cuprite, etc. Rawhide buttes and Whalen Cañon district.
Coal (bituminous, semi-bituminous, cannel, and lignite.)	Soft coal, lignite	Coal of the Laramie group (Cretaceous) widely distributed. Chiefly developed in neighborhood of the Union Pacific railroad. Twin creek, Alma, etc., Uinta county; Rock Springs, Sweetwater county; Carbon, Carbon county; Glen rock, on line of Elkhorn and Missouri Valley railroad. Total coal area, 11,865 square miles.
Cuprite	Red oxide of copper	Near Hartville, Laramie county, with chrysocolla and other copper minerals. Whalen cañon, Muskrat cañon, and Rawhide buttes, Crook county. Associated with hard carbonate ores at Black buttes, Inyankara peak.
	Flagging stone	Common in same localities as marbles, limestones, and sandstones.
Galenite (argentiferous).	Galena, lead sulphide	Ferris, Carbon county, in fissure veins with quartz, cerussite, anglesite, etc. Black buttes, Crook county.
Gold	Gold	Small placers and quartz veins. Big Horn mountains, Johnson county; Crook county, in carbonate ores at Black buttes; milling ores, west flank Black hills; Douglas, Bramel, and Centennial districts, Albany county, placers and free milling; placers and free milling at Miner's Delight, Atlantic City, South Pass City, and Lewiston, Fremont county; placers on Sand creek, Crook county; at Seminoe, Carbon county, in fissure veins with quartz and pyrite.
	Granite	Granite cañon, Laramie county. Every county contains granite, which is used in a small way locally.

WYOMING—Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Halite	Common salt	Salt springs numerous in counties where Jurassic and Triassic are exposed, Crook county. Salt creek near Stockade, Uinta county; Salt River valley. Important occurrences, but small product.
Hematite	Red oxide of iron	Three miles north of Rawlins, Carbon county; used as red paint.
Malachite	Green carbonate of copper.	With other ores in Laramie, Carbon, Albany, and Crook counties.
Mirabilite, thenardite.	Sodium sulphate, "soda."	Albany county, 14 miles southwest of Laramie City (deposits extensive, 11 to 15 feet thick, maximum thickness over 40 feet, very pure), owned by Union Pacific railroad, used to make salt cake, soda ash, and caustic soda, by Laramie chemical works. Downey lakes, 8 miles south of Union Pacific lakes, used when dried in making window glass at Laramie. Sweet river, Independence rock, Fremont county (400 acres, deposit 45 feet thick).
Muscovite	Mica	Whalen cañon, Laramie county; east of South Pass City, Fremont county. Wind River range.
Ozocerite	Mineral wax, native paraffine.	Sweetwater and Uinta counties, near Colorado line, in Tertiary and Cretaceous. Shipped east.
Petroleum	Petroleum	Many occurrences of illuminating and lubricating oil. Development work in Crook, Johnson, Carbon, Fremont, and Uinta counties.
Pyrite (auriferous).	Iron pyrites	With gold in quartz veins in Sweetwater and other counties. Little worked.
Quartz	Glass sand	Three miles east of Laramie City, Albany county.
	Sandstone	Fine white building stone, 3 miles south of Rawlins, Carbon county (Laramie group?). Common throughout Territory in Tertiary and Cretaceous, and used locally.
Silver	Silver	In carbonate ores of Black Butte mines, Crook county. Elsewhere in association with gold in small quantity.
Tripolite	Infusorial earth	Crook county, 35 miles west of Sunndance, on Wind river. Also on Skull creek, near Stockade. For polishing purposes. Deposits extensive.
Trona	Sodium carbonate, "soda."	Near Independence rock, Sweetwater county. Numerous deposits of halite, thenardite, epsomite, etc., contain bicarbonate and carbonate of soda.

WYOMING—Not Mined.

Anglesite	Lead sulphate	Ferris, Carbon county, with galena, cerussite, and quartz.
	Alum	Alum creek, Crook county; Uinta county, Cretaceous, along John's river; streams near Colorado line in Sweetwater county.
Argentite	Silver sulphide, silver glance.	Laramie county, with other ores, Laramie peak.
Asbestus	Asbestus	Seminoe mountains, Carbon county; Laramie range, Albany county; Black hills, Crook county; Big Horn mountains, Johnson county.
Asphaltum	Bitumen	In nearly all the oil districts.
Azurite	Blue carbonate of copper.	Seminoe district, Carbon county; Cummings City and Tie Siding, Albany county; Big Horn mountains, Johnson county; Warren's peaks, Crook county; Laramie peak, Laramie county.
Barite	Barytes, heavy spar	Crook county; Medicine Bow mountains, Albany county.
Bismuthinite	Bismuth sulphide	Near Cummings City, Albany county.
Calcite	Marble	Laramie county, 20 miles west of Wheatland; pure white.
Cerussite	Lead carbonate	Ferris, Carbon county, with galenite and quartz.

WYOMING—Not Mined—Continued.

Mineralogical name.	Common name.	Remarks.
Chalcopyrite ..	Copper pyrites	With other copper ores, Laramie county, 20 miles west of Cheyenne; Seminoe mountains, Carbon county; numerous other localities.
Chrysocolla....	Copper silicate	Michigan mine, 5 miles west of Rawhide butte, Laramie county.
Coal (bituminous and lignite).	Coal, lignite	Many undeveloped localities.
	Copper	In copper minerals (chalcopyrite, cuprite, chrysocolla, azurite, malachite, etc.), with silver ores.
Corundum	Emery	Wind River range, Fremont county.
Epsomite	Magnesium sulphate, epsom salts.	Rock Creek station, Albany county; 3 miles east of Wilcox, Carbon county.
	Feldspar	Independence rock, Carbon county. In tin mines of Crook county.
Graphite	Plumbago, black lead	Albany county, 18 miles east of Laramie City; Black hills, Crook county.
Gold	Gold	Many small placers and pyritous quartz veins unworked.
Gypsum	Gypsum	Extensive beds throughout Wyoming, especially in the Triassic and Jurassic, as in Laramie, Albany, Crook, Fremont, and Uinta counties.
Halite	Common salt springs .	Undeveloped localities in Crook county.
Hematite	Red oxide of iron.....	Near Rawlins, Carbon county.
	Hydraulic limestone, cement rock.	Carboniferous, along most of the ranges.
Ilmenite	Titanic iron ore	Iron mountain, Albany county.
Kaolinite	Kaolin	Carbon county, near the soda lakes, pure and in quantity.
Kieserite	Magnesium sulphate .	Rock Creek station, Carbon county.
Limonite	Brown hematite	On Rock creek and near Douglas, Albany county; on Little Popoagie creek, Fremont county.
	Lithographic stone ...	Fair quality, gray, in Cretaceous on west side of Black hills near Cañon springs.
Magnetite	Magnetic iron ore	With hematite near Rawlins, Carbon county.
(?)	Manganese ore	West side of Laramie peak, Albany county.
	Marl	Sweetwater county.
Melaconite	Black oxide of copper.	Michigan mine, Laramie county.
	Millstone	Potsdam sandstone and some of the Dakota Cretaceous sandstones, Crook county.
Natron	Carbonate of soda.....	Near Independence rock, Sweetwater county, with other soda salts.
Petroleum	Petroleum	Many undeveloped localities.
	Plastic clay...........	In Cretaceous rocks of almost every county.
Pyrite	Pyrites, iron pyrite...	Sweetwater district, Sweetwater county, in metamorphic schists. Crook county.
Quartz.........	Moss agate	Near Sweetwater river, Carbon county; common in other localities.
Saponite.......	Mineral soap	Pine ridge, Crook county, and on Skull creek.
Siderite........	Spathic iron ore	Elk mountain, Carbon county; in schists south of Atlantic City, Fremont county.
Sulphur	Sulphur	Southeast of Evanston, Uinta county, near Colorado line.
Zircon	Zircon	In Archæan schists near Camp Stambaugh, Fremont county.

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