

FOURTEENTH ANNUAL

Report of the State Geologist

IOWA GEOLOGICAL SURVEY,
DES MOINES, DECEMBER 31, 1905.

To Governor Albert B. Cummins and Members of the Geological Board:

GENTLEMEN:—I take pleasure in presenting a brief summary of the work carried on by the Geological Survey during the past year. I must rely upon your personal examination of the volume which contains the results of the year's work in the field, to give you a correct impression of the methods employed in the investigations of the Geological Survey, and the lines along which valuable results are obtained.

Unpublished work:—A large part of the work of the Survey, however, does not appear in its published annual report. It is to this phase of Survey activity that I would particularly direct your attention. There is a large and steadily increasing demand on the Survey made by residents of the state, for assistance in investigating problems, and examining specimens which seem to have economic significance. I have no doubt that in this way the Survey at this stage in its development will render its greatest returns to the state, and the Director and his assistants have not hesitated to give freely of their time in answering appeals for examinations of mineral localities. In the earlier history of the Geological Survey, it was of greatest importance to collect the facts, scientific and economic, which would permit of an intelligent discussion of the geology of the state, and the possibilities of industrial development based on the state's mineral resources. The Survey is now in possession of a sufficient amount of information to enable it to

speak positively with reference to most matters to which its attention may be directed. Consequently the economic aspects of its work are at present particularly important, and will become increasingly important in the future.

Portland cement:—A year ago the Survey published its first preliminary report on Portland Cement Materials, written by Eckels and Bain. This report showed that without question Iowa has an abundance of high grade material suitable for Portland cement. It was sent about the state generally, to the Industrial agents of the various railroads entering the state, and to the cement experts and engineers throughout the country. As a consequence two months had not elapsed before the Industrial agent of the Illinois Central railroad brought into the state parties who desired to locate a large cement mill in Iowa if suitable conditions could be found. Fort Dodge was first visited and careful tests were made of the limestones and shales to determine their quality and quantity. At this point material of admirable quality was found, but the quantity that could be readily obtained did not meet the requirements of the large mill that was proposed. The conditions at Mason City were later examined and all of the requirements were met by the limestones and shales that are abundant, not only at that point but at a great number of localities in Cerro Gordo county. When the Geological work on this county was completed by Professor Calvin in 1897, attention was called to the abundance of cement materials; the ease with which they could be secured; and their probable chemical fitness. At that time the dry process for making cement had not come to the front and the development of the situation has waited till this time. During the past summer Professor Beyer, who is preparing a monograph on Portland Cement for the Iowa Geological Survey, investigated the conditions at Mason City, secured material for analysis and directed the tests which enable the Survey to endorse the Mason City project.

It becomes at once evident that the Geological Survey has aided the cement plant at Mason City, in two ways; first in directing investors to the deposits of cement materials in Iowa, and bringing them into the state; and secondly in reporting

authoritatively to the public in regard to the natural conditions that exist at the point where the erection of the cement plant is proposed. In these two ways the Survey is useful to the state, not only in connection with the cement industry but in connection with all industries that are based on the mineral wealth of the state.

Portland cement material is admirably distributed through the state, and Iowa is a large consumer of the finished product. The establishment of a second mill within the state may fairly be predicted.

Peat:—The Survey has published a preliminary bulletin on the Peat Resources of Iowa and on the Tests of Iowa Coals made at the Government Testing Plant at Saint Louis. During two months of last summer Mr. Wood located 22,000,000 tons of peat, the amount being estimated on the basis of the dried peat. This probably represents less than half of the peat that exists in northern Iowa, under conditions that may render it of value. Great interest in peat exists at present, on account of the growing success connected with the mechanical methods that are being developed for putting peat on the market in the form of an acceptable fuel. A particularly interesting line of inquiry in connection with peat that is being prosecuted just now deals with the possibility of making producer-gas from peat. Experiments are now being conducted at the Government testing plant at St. Louis, and, should the results be satisfactory, an important development of Iowa peat in the near future would seem to be assured. I would recommend that the investigation of the peat beds be continued during the coming summer.

Gypsum:—The gypsum industry of Iowa has flourished during the past year, and the Survey officials have not hesitated to point out to inquirers, that this industry is still in its infancy. The new mill that was erected last year prospered from the start, and is already increasing its capacity. Two new mills are now under consideration. The extent of the gypsum beds was demonstrated by the Geological Survey in 1899, at a time when the Gypsum Trust proposed if possible to get control of the entire territory. The Survey's report indi-

cated that the beds, which had heretofore been recognized only over three or four square miles, probably could be found throughout twenty times this area. As a consequence the field has remained open for independent capital, and, although a number of mills have engaged successfully in the gypsum industry since that time, the field is still large, and the promise of good returns attractive.

Natural gas:—It would be very pleasant to make a similar report in regard to the attempts to develop gas in commercial quantities in Iowa. In this connection, however, the Survey has found it necessary to discourage an enthusiasm that was based on superficial knowledge of conditions that exist within the state. Limited quantities of gas are found near the surface, within the glacial drift, near Muscatine and elsewhere. The Survey has pointed out repeatedly that this gas is no indication of gas in the underlying rock strata. It has pointed out that the Trenton limestone, to which promoters have urged the sinking of deep wells for gas, outcrops in the northeastern part of the state, and is encountered in a number of the deep wells already existing within the state, and nowhere shows signs of either fuel gas or oil. It is hoped that the case has been made sufficiently clear and that the proposed plans for deep borings for gas will be laid aside.

Water horizons:—The Survey has been called on to give estimates in regard to the depth to which drilling should be carried and the quantity and quality of water that may be expected, at a number of points where artesian wells have been proposed. The Waterloo city well is now completed, and the estimates made by Professor Norton, in advance of the drilling, have been fully verified. The Survey's estimates were useful as a basis for letting bids for the Fort Dodge well now under construction. A careful watch is being kept on this well to determine when the water horizons that are sought have been reached.

Special assistants:—Professor Calvin has continued to act as consulting geologist for all of the members of the Survey staff. He has examined and reported on all paleontological material collected, and has gone into the field when necessary to aid in

the work of correlation. In addition to this general work he has completed the field work and prepared the manuscript for Winneshiek county, which is presented herewith. In the field work he was aided by Mr. J. H. Lees.

Professor Beyer has continued his work on Portland cement, and his work is presented in the small bulletin which the Survey is now publishing. This bulletin describes localities which seem worthy of the careful examination of any who are interested in establishing Portland cement plants in Iowa. Chemical analyses are given and a description of the beds; their structure; the amount of stripping required; nearness to railroads, towns, and fuel supply; and other economic considerations are presented.

Professor Beyer's complete report on Portland cement will be presented as the annual report for 1907.

The second volume of Professor Pammel's report on The Grasses of Iowa, has been well received by the public and by scientists in general. Professor Charles E. Bessey, in *Science*, for December 1905 says: "The two volumes must prove of great value to the farmers of the state, and the second one especially must be helpful to students and others who are interested in grasses."

Professor Shimek has a report on the Loess in preparation, and it will be available for publication at no distant date. A brief paper on this subject was planned for last year's annual report and a few plates were purchased for the purpose of illustrations. It seemed best to make the report more complete and publication has been temporarily postponed.

Annual report.—The mineral statistics appear, as usual, in the annual report for this year. In addition I take pleasure in submitting the following county reports:

Black Hawk county, prepared by Professor M. F. Arey.

Ida and Sac counties, prepared by Professor T. H. Macbride.

Clayton county, prepared by Dr. A. G. Leonard.

Winneshiek county, prepared by Professor Samuel Calvin.

Franklin county, prepared by Mr. Ira A. Williams.

Jackson county, prepared by Mr. T. E. Savage.

Bremer county, prepared by Professor W. H. Norton.

ADMINISTRATIVE REPORTS.

The reports on Black Hawk, Ida and Sac, and Clayton counties were proposed for last year's volume, but were finally held over in order that the volume might not be too large.

Educational bulletins:—I would submit for your consideration the question of the desirability of aiding the Science work in the schools of the state by publishing brief bulletins which present simply and clearly some of the more important geological phenomena that the young people in our schools may see, if their attention is once directed to them.

I take the liberty of quoting from a personal letter from Prof. Davis of Harvard. "I hope that you may find it practical to put into application in Iowa a scheme which I have long wished to see carried out by our state Surveys. This is to prepare for the especial use of school teachers brief reports, to be issued perhaps semi-annually and widely distributed, upon the more elementary and significant geological features of the state. My experience has been that the more professional geological reports, such as those issued by Iowa and other states, do not suffice to present the problems of which they treat to the average school teacher; and that inasmuch as the profession of school teaching is one of the most important under the state organization, it seems eminently proper that some part of the state Survey's report should be addressed particularly to that class of persons."

The specimens of Iowa rocks, minerals and fossils sent by the Iowa Geological Survey, to Iowa High Schools last year, were so heartily welcomed by the teachers that there is abundant ground for believing that they will gladly receive and make practical use of educational bulletins of the sort that Professor Davis recommends.

Topographic maps:—Another line of work that the Survey should carefully consider, and if means are available should undertake, is that of topographic mapping.

A topographic map presents precise information that may be grasped almost at a glance in regard to relative elevations in the area included within the map. This is accomplished by means of contour lines which connect all points on the map having a common elevation. All points in the region about Des Moines, for instance, which are 600 feet above sea level are

connected by a common line. Another line connects all other points 620 feet above the sea and so on. In Iowa the contour interval, or vertical distance between points connected by adjacent lines, is appropriately 10 to 20 feet, while in rougher country the interval is greater. The general relief of a district is made plain by the slightest inspection of a map prepared in this way, while a detailed study of such a map will throw very great light on any engineering problem into which the relative elevations of the country enter as a factor.

Some of the benefits that Iowa would derive from a topographic map may be briefly noted. If the state were covered by a series of topographic sheets drawn on the scale ordinarily used by the United States Geological Survey, viz., an inch to the mile, with the contour interval of 20 feet, the installation of electric interurban lines would be greatly stimulated. Much of the preliminary or reconnaissance survey work would be obviated, and the engineer could sit in his office with the topographic sheets before him, and virtually outline the general course that his road should take. The citizens of Iowa generally feel, I think, that one of the most promising solutions now in sight for the troublesome railroad question, is to be found in the interurban road. Certainly the happy experience of the communities along the Great Lakes, where already a net work of interurban electric roads exists, furnishes a basis for this feeling. In Iowa the interurban is still a novelty, but the experience of all cities within the state that now enjoy interurban service is thoroughly satisfactory.

The construction of sewerage plants and the choosing of reservoir sites is greatly simplified in the district that is covered by a topographic map.

In connection with the development of the natural mineral resources of Iowa, topographic maps will be of the greatest value. In Polk county, for instance, an attempt should be made to correlate the various coal beds, yet this work, important as it is, even though the attempt should show that correlation is impossible, cannot be undertaken except at very great expense, without the aid of topographic maps. A coal bed at one point, for instance, is found 200 feet below the mouth of a

given shaft. At the next mine, say five hundred feet away, the coal lies 300 feet below the surface. If the beds in the two cases are of the same general thickness and quality there is a certain sort of basis for the inference that they constitute a single bed which may be found throughout the intervening territory. The apparent difference in depth may be merely a difference in elevation of the mouths of the shafts. This fact, however, can be determined only by running levels if topographic maps are not at hand. The most thorough prospecting for coal undertaken in the state has been carried on in Lucas county during the past four years. Hundreds of holes have been put down with a diamond drill, and the level of the surface above sea at each drilling station has been accurately determined. When the log of the driller is plotted, therefore, it is possible to determine, other factors being taken into account, the persistence of the coal beds through large areas. The expense of this work would have been greatly reduced, had the elevations of the drilling stations been given on a topographic map.

The topographic map forms the most suitable base map on which to represent the distribution of rocks; minerals; soils; waters; artesian basins; undrained areas; and peat beds; and as a basis for maps for public lands and parks. The buying and selling of land for agricultural purposes are greatly facilitated by such maps, and correct inference of great importance in regard to the fitness of land for agriculture may be drawn from them. Culture details may best be shown on such a map, and the correct representation of roads and towns with reference to topographic features is of prime importance. Automobile clubs throughout the state would welcome these maps, which next to an actual improvement in the roads themselves, would do most to simplify extended country travel.

In the schools, colleges and universities these maps would be of constant use in the study of geography and geology.

Surveyors throughout the state would be greatly aided by the numerous base lines that would be established during the making of the maps, and the numerous bench marks. The laying out of ditches, highways, and other improvements which

involve the matter of relative elevations would be greatly simplified.

Admitting the desirability of such maps the practical question remains as to how they may be obtained. Their preparation involves a considerable outlay of money and requires the service of a company of expert topographers. The expense, when the benefits to be derived are considered, is not excessive. A topographic map of Iowa, with a contour interval of 20 feet and a horizontal scale of one inch to the mile, will cost about \$12 per square mile. The United States Geological Survey is already actively engaged in such work, and the benefits to be derived from such maps may best be extended to Iowa by the system of co-operation which this Survey offers to the several states. By this plan the United States Government duplicates any sum that the state appropriates for topographic work. It furnishes men from its corps of skilled topographers to direct the work and assumes the main burden of expense in connection with publication.

The following details as to methods used in mapping are quoted from the United States Geological Bulletin on Co-operation in Topographic Work between the United States and the various states.

“The appropriations made by the states for co-operative surveys are accepted chiefly for actual field work, in which are included the services of temporary employees, who are usually residents of the state, and for the living and traveling expenses of the field force. It may be used in paying office salaries only in so far as is necessary to equalize the expense of both parties to the co-operation. Thus the larger part of the amount appropriated by the state is returned to the people thereof. The appropriation of the Federal Government is devoted chiefly to paying salaries of the permanent employees, a small portion of it being expended on general administration and a considerable portion on field and office work. The field work of the co-operative topographic surveys is invariably in charge of topographers or assistant topographers of the United States Geological Survey, who are appointed, on the recommendation of the United States Civil Service Commission, by the Secretary of

the Interior. All assistant surveyors, as level-men, transit-men etc., and such helpers as rod-men, teamsters and cooks are employed under regulations of the Department of the Interior in the locality in which the work is being done, and under the terms of a signed application and agreement, which they must file when seeking such employment."

"These topographic maps are based upon geodetic determinations of position, either by means of an accurate system of primary triangulation or by primary traverse based upon astronomic locations. The fundamental positions so determined are marked by monuments of stone, or by metal posts bearing suitable bronze tablets. Spirit levels of a high degree of accuracy are run with such frequency as to permit of the establishment of permanent metal bench marks in every three linear miles, while numerous elevations of less accuracy are obtained by levels run in all directions.

The maps that result from these co-operative surveys, show in different colors, both in the manuscript and in the published edition, the following principal facts:

1. Public culture, printed in black, including roads, lanes, paths, railroads, streets, dams, public boundaries, names, etc.
2. The hydrography, or water, printed in blue, including all lakes, rivers, streams, swamps, marshes, reservoirs, springs, etc.
3. The relief of surface forms, printed in brown, including the shapes of the hills, valleys, and ravines, their elevations and depressions, and the slopes of every rise or fall in the surface of the land.

The topographic maps produced by co-operative surveys are engraved on copper and printed from stone. The co-operating states have the benefit of this publication without further expense, and the residents of the state, as well as its officials, may purchase the maps at rates of 5 cents per sheet or \$3.00 per hundred."

The following states have completed or are engaged in co-operative topographic surveys:

	DOLLARS.	SQ. MILES.
Alabama.....	\$ 51,540.00	3,455
California.....	158,360.00	1,704
Connecticut.....	4,990.00	All
Kentucky.....	40,000.00	852
Louisiana.....	45,420.00	1,110
Maine.....	33,040.00	2,614
Maryland.....	12,210.00	9,585
Massachusetts.....	8,315.00	All
Michigan.....	57,430.00	1,687
Mississippi.....	46,340.00	196
New Jersey.....	7,815.00	All
New York.....	49,170.00	34,623
North Carolina.....	52,250.00	3,637
Ohio.....	42,050.00	11,097
Pennsylvania.....	45,215.00	9,746
Rhode Island.....	1,250.00	All
Texas.....	262,290.00	1,620
West Virginia.....	28,780.00	5,534

A limited amount of topographic work has already been completed in Iowa, for the most part in the eastern portion of the state. During the past summer, at the suggestion of the State Geologist, work was begun on a quadrangle having Des Moines as its center. This area was chosen on account of the growing importance of Des Moines as an industrial center, and that the attention of the state as a whole might be more definitely directed to the work and might pass judgment on its actual value. A line of precise levels is being run from the Mississippi to the Missouri river, crossing Iowa from east to west through Des Moines.

The topographic sheets of the United States Survey lying wholly or in part within Iowa, and already published, number 36. The sheets are 16½x20 inches in size, the earlier ones being fifteen minute sheets, that is, drawn on a scale 1:62500 while the later sheets are thirty minute sheets or 1:125000. While the earlier sheets were imperfect the later sheets are models of topographic accuracy. The counties covered by these sheets are Allamakee, the greater part of Winneshiek and Fayette, Clayton, Dubuque, Delaware, the most of Buchanan and Jackson, Clinton, Scott, Cedar, Johnson, Linn and portions of Muscatine,

Iowa and Benton. In the west, portions of Pottawattamie and Mills counties are included within the Omaha sheet.

If the state would appropriate from \$3,000 to \$5,000 for co-operation with the United States Geological Survey the work of topographic mapping could be accelerated three-fold at least. The state naturally looks to the engineers of Iowa to take the initiative in matters of this sort, for they are best able to determine the value of such work to the commonwealth.

The state Geological Survey is generally entrusted with the duty of looking after the interests of the state in this co-operative work, and the organization of the Iowa Survey fits it well to assume this responsibility, since its governing board includes the Governor of the state and the Presidents of the two State Institutions where engineering is taught.

The Survey at present has no money that can be directed to this line of work. An annual increase in its income of \$3,000 would permit of an excellent beginning, and later, when the county surveys have been completed, a larger sum would be allotted to topographic mapping.

REPORT OF THE ASSISTANT STATE GEOLOGIST.

IOWA GEOLOGICAL SURVEY.
DES MOINES, DECEMBER 31, 1905.

DEAR SIR:—I have the honor to submit to you the following report of my work for the year 1905:

During this year more time than usual was taken up with proof reading and supervising the publications of the Survey. The supplementary report on the Grasses of Iowa was ready for the press early in the year. Oversight of the work of illustrating and printing this book occupied several weeks. In leisure intervals during this time the preparation of the manuscript for the report on the geology of Fayette county was completed, and was published in volume XV of the annual reports.

As early in the year as the data could be obtained, the maps and plates for the illustrations in volume XV were prepared, and that report was put through the press during the months of June and July.

The greater portion of August, September and October was spent in the field studying the geological problems presented in Jackson county. This county is of more than usual interest from the fact that here, as at no other point in the state, there is shown a strong folding of the uppermost strata of the Maquoketa shale. There is also evidence of unconformity between the deposits of the Maquoketa stage and the overlying Niagara limestone. The geology of Jackson county is also of more than usual economic interest because of the fact that

more than three-fourths of all of the lime burned and marketed in the state is produced in this county. The report on the geology of Jackson county is now in preparation, and will appear in volume XVI of the Survey reports.

During the latter part of September, in company with Dr. S. W. Beyer, an excursion was made into the counties of Jackson, Jones and Fayette for the purpose of investigating and correlating some of the different geological horizons in northeastern Iowa; and of collecting samples from such quarries as promised to furnish suitable materials for the manufacture of cement, or to become sources of other important products. Rock samples have also been collected from other points in the state that seemed likely to furnish a good quality of cement materials.

Much of the time during November and December was occupied in the preparation of a short report on the results of the tests of Iowa coals made by the Government coal-testing plant at the Louisiana Purchase Exposition, St. Louis; and of a preliminary report on the Peat Resources of Iowa, the data for which latter paper were gathered during the past summer by Mr. L. H. Wood. These two short papers were printed in December, and published as Bulletin No. 2 of the Iowa Survey.

The volume of correspondence in the office has been considerably increased during the past year, owing to the investigations which the Survey has carried on with regard to the location, in the state, of deposits suitable for manufacture into Portland cement, and of marshes containing large accumulations of peat. Interest in both of these lines is active on the part of prospective investors of capital. The location of a cement plant at Mason City is assured, and there is no doubt that, as a direct result of the efforts and investigations of the Survey, some new industries will soon be developed in our state.

As usual during the past year a large number of specimens have been sent to the office for identification, as well as numerous samples concerning the economic value of which information was desired. A very large number of letters have

also been received asking for maps and information with regard to the location of suitable beds of stone, clays and shales for various purposes, and deposits of coal and other minerals. The appropriate replies to all of these requests involved a large amount of time and labor, neither of which were spared in the endeavor to furnish to the sender of each the information for which he sought.

Belief in the presence of oil and gas in the deeper strata of Iowa still persists. Inquiries have come in with regard to the probability of finding oil and gas if deep borings were put down at certain points in the state. We have on file in the office the records of a large number of deep wells each of which is in reality a test hole for oil or gas in that locality. It has been proposed to make borings for gas at points on all sides of which we have records of deep wells within a distance of a few miles. Both our data of deep wells and our knowledge of the character and position of the sedimentary rocks of Iowa compel us to discourage any expectation of finding oil or gas in large quantities, either in the superficial deposits or in the deeper indurated strata of the state. The discouragement of efforts that promise only disappointment is one of the unpleasant phases of Survey work, but in doing this the Survey renders as real service to the people of the state as in its endeavor to promote the development of resources that give every promise of ample returns for the money expended.

During 1905 there has been collected and turned into the State Treasury from the sale of reports, as required by law, and from the sale of sets of geological specimens for High Schools, \$142.52.

The demand for the reports, maps and bulletins of the Survey is large, and is constantly increasing. This fact furnishes the best evidence as to the appreciation of the work of the Iowa Geological Survey on the part of the people of the state.

Very truly yours,

T. E. SAVAGE,

Assistant State Geologist.

TO PROFESSOR. FRANK A. WILDER,
State Geologist.

