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Annual report of Smithsonian Institution, 1886, pt. 1

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ANNUAL REPORT

OF THE

BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION,

SHOWING

THE OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION

FOR THE

YEAR ENDING JUNE 30, 1886.

PART I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

LETTER

FROM THE

SECRETARY OF THE SMITHSONIAN INSTITUTION,

ACCOMPANYING

The annual report of the Board of Regents of that Institution to the end of June, 1886.

SMITHSONIAN INSTITUTION,
Washington, D. C., July 1, 1886.

SIR: In accordance with section 5593 of the Revised Statutes of the United States, I have the honor, in behalf of the Board of Regents, to submit to Congress the annual report of the operations, expenditures, and condition of the Smithsonian Institution for the year ending June 30, 1886.

I have the honor to be, very respectfully, your obedient servant,

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

Hon. JOHN SHERMAN,
President of the Senate, pro tem.

Hon. JOHN G. CARLISLE,
Speaker of the House of Representatives.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION TO THE END OF JUNE, 1886.

SUBJECTS.

1. Proceedings of the Board of Regents for the session of January, 1886.

2. Report of the Executive Committee, exhibiting the financial affairs of the Institution, including a statement of the Smithson fund, and receipts and expenditures for the year 1885–'86.

3. Annual report of the Secretary, giving an account of the operations and condition of the Institution for the year 1885–'86, with the statistics of collections, exchanges, etc.

4. General appendix, comprising a selection of miscellaneous memoirs of interest to collaborators and correspondents of the Institution, teachers, and others engaged in the promotion of knowledge.

The report of the National Museum for the year 1885–'86 will be published in a separate volume.

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REPORT OF THE SECRETARY.

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THE SMITHSONIAN INSTITUTION.

MEMBERS EX OFFICIO OF THE "ESTABLISHMENT."

(January, 1886.)

GROVER CLEVELAND, President of the United States.
JOHN SHERMAN, President of the United States Senate.
MORRISON R. WAITE, Chief-Justice of the United States.
THOMAS F. BAYARD, Secretary of State.
DANIEL MANNING, Secretary of the Treasury.
WILLIAM C. ENDICOTT, Secretary of War.
WILLIAM C. WHITNEY, Secretary of the Navy.
WILLIAM F. VILAS, Postmaster-General.
LUCIUS Q. C. LAMAR, Secretary of the Interior.
AUGUSTUS H. GARLAND, Attorney-General.
MARTIN V. MONTGOMERY, Commissioner of Patents.

REGENTS OF THE INSTITUTION.

(Full list given on the following page.)

OFFICERS OF THE INSTITUTION.

SPENCER F. BAIRD, *Secretary*,
Director of the Institution, and of the U. S. National Museum.

WILLIAM J. RHEES, *Chief Clerk.*

REGENTS OF THE SMITHSONIAN INSTITUTION.

By the organizing act approved August 10, 1846 (Revised Statutes, title LXXIII, section 5580), "The business of the Institution shall be conducted at the city of Washington by a Board of Regents, named the Regents of the Smithsonian Institution, to be composed of the Vice-President, the Chief-Justice of the United States [and the Governor of the District of Columbia], three members of the Senate, and three members of the House of Representatives, together with six other persons, other than members of Congress, two of whom shall be resident in the city of Washington, and the other four shall be inhabitants of some State, but no two of the same State."

REGENTS FOR THE YEAR 1886.

	Term expires.
The Vice-President of the United States:	
JOHN SHERMAN (elected President of Senate Dec. 7, 1885).	
The Chief-Justice of the United States:	
MORRISON R. WAITE.	
United States Senators:	
SAMUEL B. MAXEY (appointed May 19, 1881)	Mar. 3, 1887
JUSTIN S. MORRILL (appointed February 21, 1883)	Mar. 3, 1891
SHELBY M. CULLOM (appointed March 23, 1885)	Mar. 3, 1889
Members of the House of Representatives:	
OTHO R. SINGLETON (appointed January 12, 1886)	Dec. 28, 1887
WILLIAM L. WILSON (appointed January 12, 1886)	Dec. 28, 1887
WILLIAM W. PHELPS (appointed January 12, 1886)	Dec. 28, 1887
Citizens of Washington:	
JAMES C. WELLING (appointed May 13, 1884)	May 13, 1890
MONTGOMERY C. MEIGS (appointed December 26, 1885)	Dec. 26, 1891
Citizens of a State:	
JOHN MACLEAN, of New Jersey (first appointed in 1868)	Dec. 26, 1891
ASA GRAY, of Massachusetts (first appointed in 1874)	Dec. 26, 1891
HENRY COPPÉE, of Pennsylvania (first appointed in 1874)	Dec. 26, 1891
NOAH PORTER, of Connecticut (first appointed in 1878)	Mar. 3, 1890

MORRISON R. WAITE, Chancellor of the Institution and *President of the Board of Regents.*

Executive Committee of the Board of Regents.

JAMES C. WELLING. HENRY COPPÉE. MONTGOMERY C. MEIGS.

JOURNAL OF PROCEEDINGS OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION.

WASHINGTON, *January* 13, 1886.

In accordance with a resolution of the Board of Regents of the Smithsonian Institution fixing the time of the annual session on the second Wednesday in January of each year, the Board met this day at 10 o'clock A. M.

Present: The Chancellor, Chief-Justice MORRISON R. WAITE; Hon. SAMUEL B. MAXEY, Hon. JUSTIN S. MORRILL, Hon. OTHO R. SINGLETON, Hon. WILLIAM L. WILSON, Hon. WILLIAM W. PHELPS, Dr. ASA GRAY, Dr. NOAH PORTER, Dr. HENRY COPPÉE, Dr. JAMES C. WELLING, General MONTGOMERY C. MEIGS, and the Secretary, Prof. SPENCER F. BAIRD.

Excuses for non-attendance were read from Dr. John Maclean and Senators Sherman and Cullom.

The Chancellor announced the election of Senator John Sherman as President *pro tempore* of the Senate on the 7th December, 1885, which placed his name on the Board of Regents as acting Vice-President of the United States.

He also announced the appointment by the Vice-President (Hon. Thomas A. Hendricks), on the 23d of March, 1885, of Hon. Shelby M. Cullom, of Illinois, *vice* Hon. N. P. Hill, whose term as a Senator had expired.

The Chancellor announced the re-appointment as Regents, by joint resolution of Congress, December 26, 1885, of Dr. J. Maclean, Dr. A. Gray, and Dr. H. Coppée, whose terms had expired, and the appointment of General M. C. Meigs, *vice* General Sherman, whose term had expired, and who was no longer a citizen of Washington.

He also announced the appointment by the Speaker of the House of Representatives (Hon. J. G. Carlisle), on the 12th January, 1886; of Hon. O. R. Singleton, Hon. W. L. Wilson, and Hon. W. W. Phelps, as Regents for the term of the Forty-ninth Congress.

The Secretary stated, in accordance with the rules of the Board during its recess, the remaining members of the Executive Committee had filled the vacancy occasioned by the expiration of the term of service as a Regent of General Sherman, by the appointment, in June, 1885, of Dr. Coppée.

On motion of Mr. Singleton, it was—

Resolved, That Dr. Henry Coppée be elected to fill the vacancy in the Executive Committee.

The following letter was read:

PRINCETON, N. J., *January* 9, 1886.

To the Chancellor and Board of Regents of the Smithsonian Institution:

GENTLEMEN: The undersigned, having been for seventeen years a member of the Executive Committee, most respectfully requests of you the favor to be released from further service on this committee.

He makes this request with the less reluctance, as he is confident that his place upon the committee can be readily supplied.

With the highest respect, yours,

JOHN MACLEAN.

On motion of Mr. Singleton, it was—

Resolved, That the resignation of Dr. Maclean from the Executive Committee be accepted, and that General Montgomery C. Meigs be elected to fill the vacancy.

On motion of Dr. Gray, it was—

Resolved, That Dr. James C. Welling be, and he hereby is, appointed chairman of the Executive Committee.

Dr. Welling presented the report of the Executive Committee for the six months ending 30th June, 1885, which was read.

On motion of Dr. Gray, it was—

Resolved, That the report of the Executive Committee be accepted.

The Secretary presented his report of the operations and condition of the Institution for the six months ending 30th June, 1885, which, in accordance with the instructions of the Board at its last meeting, had been printed and distributed to the Regents.

On motion, it was—

Resolved, That the report of the Secretary be received.

The Secretary presented an exhibit of the finances of the Institution for the year 1885, showing the receipts to have been $67,560.84, the expenditures $45,102.77, leaving a balance on the 1st of January, 1886, of $22,458.07.

Dr. Welling stated that it was the understanding of the Executive Committee that the Board required hereafter an annual report for the fiscal year terminating on the 30th of June of each year, and that while it had carefully examined all the accounts of the Institution to the beginning of the year 1886 and had verified the statement exhibited by the Secretary, it was not considered that a further report was called for at the present time.

The following letter was read:

WASHINGTON, D. C., *September* 1, 1885.

Prof. SPENCER F. BAIRD,
Secretary Smithsonian Institution:

DEAR SIR: I am desirous of placing at least a portion of my property, essentially all which is an inheritance from my father, in a position in which it may be of permanent service for the advancement of knowledge. I have always devoted so much of it as I did not need for my maintenance and education to that purpose. It occurs to me that if

I could make an arrangement with the Smithsonian Institution by which I might not sacrifice my own needs while living and my duty to my wife or to my children (if I should have any), after my death, I might accomplish the end which I desire. I throw out the following as a sketch of what I think might be feasible: As the Institution receives, and I suppose will always receive, 6 per cent. for its investments with the Government, I might transfer to it a sum of money for which I should receive an income of say 5 per cent. during my life and the life of my wife, or until my children (if I had any) arrived at an age such that they might provide for themselves. The other 1 per cent. would accrue to the Institution in the mean time, and the whole eventually, as compensation for the making of this arrangement. Whether that should be devoted to a specific object or to the general purposes of the Institution might be a matter for further consideration.

Respectfully,

B. PICKMAN MANN.

The Chancellor and several of the Regents having expressed their opinion that such a proposition could not be accepted by the Institution, on motion of Mr. Wilson the communication was referred to the Executive Committee.

The Secretary presented a statement relative to the bequest of the late Rev. Alex. G. Mercer, of Newport, R. I.

This gentleman died on the 3d November, 1882, and left property to the amount of about a million dollars. After the decease of certain beneficiaries the property is to be divided into three parts, of which one part is to be administered by a board consisting of the President of Harvard University, the President of Yale College, and the Secretary of the Smithsonian Institution, together with three other individuals mentioned in the will, or their survivors, "to establish scholarships or foundations in such colleges as they may select, for the benefit of such poor students as have passed through some of the public schools with the best reputation for character and ability."

The Chancellor presented a letter from the family of the late Professor Henry relative to the publication of his scientific writings.

On motion of Dr. Porter, the communication was referred to Dr. Gray and the Executive Committee.

Dr. Gray called attention to the fact that provision had not yet been made for the estimates and appropriations for the ensuing year.

On motion of Dr. Welling, it was—

Resolved, That the income of the Institution for the six months ending 30th June, 1886, and for the twelve months ending 30th June, 1887, be expended by the Secretary, with full discretion as to the items, subject to the approval of the Executive Committee.

On motion, the Board adjourned *sine die*.

REPORT OF THE EXECUTIVE COMMITTEE OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION.

The Executive Committee of the Board of Regents of the Smithsonian Institution respectfully submits the following report in relation to the funds of the Institution, the appropriations by Congress for the National Museum and other purposes, and the receipts and expenditures for the Institution and the Museum, for the year ending June 30, 1886.

Condition of the fund July 1, 1886.

The amount of the bequest of James Smithson deposited in the Treasury of the United States, according to the act of Congress of August 10, 1846, was $515,169. To this was added, by authority of Congress, act of February 8, 1867, the residuary legacy of Smithson and savings from annual income and other sources, $134,831. To this $1,000 was added by a bequest of James Hamilton, $500 by a bequest of Simeon Habel, and $51,500 as the proceeds of the sale of Virginia bonds owned by the Institution, making, in all, as the permanent Smithson fund in the United States Treasury, $703,000.

Statement of the receipts and expenditures of the Smithsonian Institution, July 1, 1885, *to June* 30, 1886.

RECEIPTS.

Cash on hand July 1, 1885		$23, 746. 82	
Interest on the fund, July 1, 1885, to July 1, 1886		42, 180. 00	
			$65, 926. 82

EXPENDITURES.

Building:			
Repairs and improvements	$1, 526. 83		
Furniture and fixtures	1, 847. 73		
		3, 374. 56	
General expenses:			
Meetings of the Board	287. 50		
Postage and telegraph	280. 06		
Stationery	433. 20		
General printing, blanks, etc	267. 84		
Incidentals, gas, etc	475. 28		
Books, periodicals, and binding	1, 174. 09		
Salaries—Secretary, clerks, and labor	19, 310. 33		
		22, 228. 30	
Publications and researches:			
Smithsonian Contributions to Knowledge	2, 378. 03		
Smithsonian Miscellaneous Collections	5, 260. 86		
Smithsonian Annual Report	3, 971. 47		
Explorations	1, 724. 52		
Apparatus	199. 11		
		13, 533. 99	

Exchanges:		
Literary and scientific exchanges (in addition to $10,000 appropriated by Congress)	$2,005.80	
Total expenditures		$41,142.65
Cash on hand July 1, 1886		24,784.17

The Institution has received from individuals certain funds for conducting special researches or making collections, namely:

From M. K. Jesup, of New York, for collection of fish casts	$727.00	
Of which have been expended		$712.71
For collection of building stones	2,500.00	
Of which have been expended		2,427.08
	3,227.00	3,139.79
Leaving balance, July 1, 1886		87.21
From Jed. Hotchkiss, of Virginia, for special research on coke		150.00
Of which have been expended		112.72
Leaving balance July 1, 1886		37.28

REPAYMENTS.

The Institution, as in former years, has made temporary advances for the payment of freight on Government collections, etc., the repayments of which, together with the amount received from sales of the publications of the Institution, etc., have been deducted from the several items of the foregoing expenditures, as follows:

From cost of books	$3.45	
From exchanges	4,090.68	
From explorations and researches	907.57	
From furniture	4.16	
From general printing	.90	
From incidentals	140.90	
From postage and telegraph	48.54	
		$5,196.20
From sales of publications:		
Contributions to Knowledge	177.90	
Miscellaneous Collections	349.64	
Reports	14.92	
		542.46
		5,738.66

Exhibit of the condition of the appropriations by Congress for the Smithsonian Institution and National Museum, July 1, 1886.

Smithsonian Institution.	Balances July 1, 1885.	Appropriation for 1885–'86.	Expended to June 30, 1886.	Balances, July 1, 1886.
International exchanges, 1886		$10,000.00	$10,000.00	
Ethnological researches, 1885	$1,358.92		1,358.82	
Ethnological researches, 1886		40,000.00	39,130.87	$869.13

An appropriation of $40,000 was made by Congress for the fiscal year ending 30th June, 1886, for the prosecution of ethnological researches under the direction of the Secretary of the Smithsonian Institution. The actual conduct of these investigations has been placed by the Secretary in the hands of Maj. J. W. Powell, Director of the Geological Survey. The abstracts of expenditures and balance sheets have been exhibited to us; the vouchers for the expenditures are, however, transmitted, after approval by Professor Baird, to the accounting officers of the Treasury Department for settlement.

The balance available to meet outstanding liabilities on the 1st of July, 1886, as reported by the official disbursing agent, is $869.13.

National Museum.	Balances July 1, 1885.	Appropriation for 1885–'86.	Expended to June 30, 1886.	Balances July 1, 1886.
Preservation of collections, 1885	$4,855.56		$4,853.56	$2.00
Preservation of collections, 1885–'86		$7,500.00	7,446.12	53.88
Preservation of collections, 1886		104,000.00	102,158.39	1,841.61
Armory building, 1885	8.25			8.25
Armory building, 1886		2,500.00	2,285.46	214.54
Furniture and fixtures, 1885	1,786.40		1,786.24	.16
Furniture and fixtures, 1886		40,000.00	35,987.16	4,012.84
New building, sidewalk, 1885	1,000.00		898.62	101.38

RECAPITULATION.

The total amount of the funds administered by the Institution during the year ending 30th of June, 1886, appears from the foregoing statements and the account-books to have been as follows:

Smithsonian Institution.

From interest on the Smithson fund	$42,180.00	
From balance of last year	23,746.82	
		$65,926.82
From M. K. Jesup for collections		3,227.00
From J. Hotchkiss for research		150.00
From repayments for freight, exploration, etc		5,196.20
From sales of Smithsonian publications		542.46

APPROPRIATIONS COMMITTED BY CONGRESS TO THE CARE OF THE INSTITUTION FOR THE YEAR 1886, AND BALANCES FOR 1885.

International exchanges	10,000.00
Ethnological researches	41,358.92
Preservation of collections	116,355.56
Preservation of collections, Armory	2,508.25
Furniture and fixtures	41,786.40
Museum building, sidewalk	1,000.00
	287,551.61

ittee has examined the vouchers for payments made from ı income during the year ending 30th June, 1886, all of e approval of the Secretary of the Institution, and a cer- ιnat the materials and services charged were applied to the purposes of the Institution.

The committee has also examined the accounts of the National Museum, and find that the balances above given correspond with the certificates of the disbursing officers of the Interior and Treasury Departments.

The quarterly accounts-current, the vouchers, and journals have been examined and found correct.

Respectfully submitted.

JAMES C. WELLING,
HENRY COPPÉE,
M. C. MEIGS,
Executive Committee.

WASHINGTON, *December* 3, 1886.

REPORT OF PROFESSOR BAIRD,

SECRETARY OF THE SMITHSONIAN INSTITUTION:

For the year ending June 30, 1886.

To the Board of Regents of the Smithsonian Institution:

GENTLEMEN: I have the honor to present herewith the report of the operations and condition of the Smithsonian Institution for the year 1885–'86. In accordance with the resolutions adopted by the Board at its meeting held January 21, 1885, that the fiscal year of the Institution shall hereafter terminate on the 30th day of June in each year, and the annual report of the Secretary shall hereafter be prepared, printed, and sent to each member of the Board on or before the 1st day of December in each year, the present report covers the period from July 1, 1885, to the close of June, 1886.

As heretofore, this report includes, in addition to the account of the operations of the Institution itself, a summary of the work performed by the branches of the public service placed by Congress under its charge, namely, the National Museum and the Bureau of Ethnology. To this will be added a sketch of the work of the United States Fish Commission, which is also under my charge, and of that of the United States Geological Survey (kindly furnished by its Director), which, although entirely independent of the Smithsonian Institution, is yet in close relation with it by reason of its field of exploration, and especially through the valuable accessions of material furnished by it to the National Museum.

THE SMITHSONIAN INSTITUTION.

INTRODUCTORY.

No event of special importance has occurred during the year, the usual operations of the Institution having been steadily carried on, but with a marked increase in routine work. The system of international exchanges formerly conducted with only two assistants has lately required the constant labor of nine and at times of several more employés. The correspondence which at one time was carried on by the

Secretary and one clerk now occupies a great part of the time of five persons. The accounts in like manner have gradually demanded more attention, as have all the other departments of work.

THE BOARD OF REGENTS.

Senator George F. Edmunds having ceased to be President *pro tempore* of the United States Senate, Hon. John Sherman was elected on the 7th December, 1885, to that office, and in accordance with the precedents established, was placed on the list of Regents as Acting Vice-President.

On the 26th of December, 1885, a joint resolution of Congress was approved by the President of the United States re-electing as Regents for six years, Dr. John Maclean, of Princeton, N. J., Dr. Asa Gray, of Cambridge, Mass., and Dr. Henry Coppée, of Bethlehem, Pa. The same resolution elected General Montgomery C. Meigs, of Washington, D. C., in place of General William T. Sherman, whose term had expired, and who was no longer eligible as a Regent from Washington on account of his change of residence to Saint Louis, Mo.

The vacancy in the Executive Committee, occasioned by the expiration of General Sherman's term, was filled by resolution of the Regents on the 13th of January, 1886, by the election of Dr. H. Coppée; and Dr. Maclean having resigned from his place on the committee, the Regents at the same meeting elected General Meigs to fill the vacancy.

Dr. James C. Welling was made chairman of the Executive Committee.

On the 12th of January, 1886, the Speaker of the House, Hon. J. G. Carlisle, re-appointed as Regents, Hon. Otho R. Singleton, of Mississippi, Hon. William L. Wilson, of West Virginia, and Hon. William Walter Phelps, of New Jersey.

Portraits of the Regents.—Efforts have been made during the year to complete the collection of likenesses of all who have served as its Regents, and there have been added to the collection a crayon portrait of Prof. Alex. D. Bache, by H. Ulke, a fine lithograph of Hon. John W. Maury, formerly mayor of the city of Washington, and a photograph of Hon. Walter Lenox, also mayor of Washington.

We still desire likenesses of the following Regents:

Hon. G. E. Badger, of North Carolina, 1856–1863; Hon. R. M. Charlton, of Georgia, 1852–1853; Hon. W. F. Colcock, of Georgia, 1850–1853; Hon. Shelby M. Cullom, of Illinois, 1885–1886; Hon. D. Davis, of Illinois, 1881–1883; Hon. Garret Davis, of Kentucky, 1863–1872; Hon. Henry W. Davis, of Maryland, 1863–1865; Hon. Gideon Hawley, of New York, 1846–1855; Hon. William I. Hough, of New York, 1846–1847; Hon. George P. Marsh, of Vermont, 1847–1849; Hon. Benjamin Stanton, of Ohio, 1856–1861; Hon. David Stuart, of Michigan, 1853–1855.

FINANCES.

There is no change to be reported in the financial condition of the Institution. The fund remains the same, viz, $703,000, permanently deposited in the Treasury of the United States according to the acts of Congress of August 10, 1846, and February 8, 1867.

The receipts and expenditures for the year ending 30th June, 1886, are as follows:

RECEIPTS.

Cash on hand, July 1, 1885	$23,746 82	
Interest received, July 1, 1885, to July 1, 1886	42,180 00	
		$65,926 82

EXPENDITURES.

Building, furniture, and fixtures	$3,374 56	
General expenses, salaries, &c	22,228 30	
Publications and researches	13,533 99	
Literary and scientific exchanges	2,005 80	
Total expenditure		41,142 65
Balance, cash on hand		$24,784 17

This balance will be required for the current operations of the Institution for the ensuing six months.

The necessity for compliance with the usual requirements of Government service does not exist in the operations of the Institution, for the accounts are audited only by its executive committee and all expenditures are controlled by the Secretary. It has been deemed proper, however, to throw all the safeguards possible around the financial operations, so that anything like defalcation or peculation should be rendered impossible.

The appropriations made by Congress for the Museum, international exchanges, &c., in charge of the Smithsonian Institution have been disbursed as usual by officers of the Interior and Treasury Departments, the vouchers receiving examination and approval of the proper Auditor and Comptroller. A full account of the expenditures of the Institution is given in the report of the Executive Committee.

BUILDINGS.

There is not much to say in regard to the subject of the buildings in charge of the Smithsonian Institution. No material alterations have taken place in the series, consisting of the Smithsonian central building, the National Museum building, the Armory building, the Laboratory building, and the Annex building. The last-mentioned edifice was constructed for the purpose of making up the exhibit for the New Orleans Exposition, and has been necessarily continued in use in the lack of other accommodations for the offices housed therein; especially that of the chief taxidermist and his assistants; the chief osteologist and his assistant; and other persons connected with the work of preparing and mounting specimens; and the preparators of the Ethnological Bureau charged with the reproduction of miniature models of the various Pueblo villages in Arizona and New Mexico. This building is also used for the storage of vast numbers of collections, including hundreds of tons of fossils collected by the United States Geological Survey.

The erection of a building for the accommodation of the Library, Museum, and Records of the Medical Department of the Army, renders it very desirable that provision should be made elsewhere for the service of this Annex building, as it is extremely combustible, and should it take fire, with the wind blowing from the westward, the flames would actually come in contact with the Army Medical Museum, and could not fail to penetrate the windows and doors, with great danger to its contents. Unfortunately such is the present crowded condition of all our receptacles, that it is impossible to find quarters elsewhere, either for the offices mentioned or for the collections.

Some years ago, the Board of Regents authorized the application to Congress for an appropriation for the construction of a second Museum building, to be placed on the west side of the Smithsonian reservation, and to correspond with the present building on the east side - the object being to accommodate, in part at least, the enormous accumulations of valuable material partly acquired at the Centennial, and in part obtained at the New Orleans Exposition, and under other circumstances. A new building equal in size to the present one would scarcely furnish the accommodations needed; and, as the Government collections are increasing year by year, by donations of foreign governments, &c., it is difficult to express with sufficient force the necessity for additional quarters.

The National Museum building was erected within the original estimate, at a cost of $250,000. It would be impossible at the present time to duplicate this building at that figure, and as special provision is desired for laboratories and offices, and to give suitable quarters to the U. S. Geological Survey and Ethnological Bureau, an estimate has been made of the sum of $250,000 for the purpose of constructing one wing and pavilion to accommodate the collections, leaving the remainder to be constructed hereafter, should Congress so approve it, at a cost of, perhaps, an additional $250,000.

An estimate has been presented to Congress for several years, without receiving any attention, for the construction of a fire-proof building for the accommodation of the alcoholic collections of fishes, reptiles, &c., belonging to the National Museum.

Within a few years past the principal museums of Europe have been putting up such buildings, in view of the danger of destruction, not only of the specimens themselves, but of the other collections, should fire break out among them. The new Museum building can, however, be so arranged as to furnish such accommodations and not involve any general danger.

In this same connection it may be proper to state that strenuous efforts are now being made, and with apparent prospect of success, looking towards an exposition in 1892—the four hundredth anniversary of the discovery of America by Columbus—of a complete illustration of the New World at that date, and of its progress in the arts and industries in the four hundred years intervening. The collections of the National Museum for the most part tend towards such a display, and if the new building in question were at our command it would be a very easy matter to organize and arrange it with this object in view, without unnecessary labor or great expense, and by the date mentioned, as the result of the current work of the Museum, without any spasmodic or unusual effort.

EXPLORATIONS.

There is not so much to record in the way of explorations for the year 1886 as has been the case in some previous years, due mainly to the fact of the completion of work in many of the districts, and of the lack of sufficient means to inaugurate new enterprises of any magnitude. The closing and withdrawal from the outposts in Alaska and elsewhere of the U. S. Signal Service stations, have also cut off a large field of labor, many of the most important explorations having been conducted by the Smithsonian Institution in co-operation with that establishment. Confining itself, as it has done in the main, to North America as a field of research, the unknown portion, of course, has in the nearly forty years of effort on the part of the Institution become greatly reduced. It is quite safe to say that to no establishment or agency is the knowledge of the geography, ethnology, natural history, &c., of the continent more due than to the labors of the Smithsonian Institution.

Congress having directed the preparation and submission to it annually of a separate and special report on the National Museum, a full statement of the agencies of explorations and exchange by which accessions have been made will be found in the report of Mr. G. Brown Goode, the assistant director, and therefore a briefer mention than usual will be sufficient for the present occasion.

Arctic America.—The last collections made by Mr. L. M. Turner, of the U. S. Signal Office, at Ungava Bay, in Northern Labrador, have been received, and he is now busily occupied in preparing his report on the region visited. It is safe to say that we owe more to Mr. Turner for our knowledge of Northern Labrador than to any other explorer or naturalist, and the results of his labor will be found to be of the highest interest. Not content simply with making collections of natural history, he has devoted much time to the study of the language and manners of the people, and his vocabularies and philological records are of the utmost possible interest and importance.

Alaska.—One of the most productive explorations of Alaska for some time past was that by Mr. Charles H. Townsend, sent out by the U. S. Fish Commission to make some investigations into the fur-seal fisheries on the Pribyloff Islands, where he arrived in June, 1885. While there he accepted an invitation from Captain Healy, commander of the U. S. revenue steamer *Corwin*, to accompany that vessel on its more northern voyage, by way of Saint Michael's and other points, and through Bering's Strait, finally entering Hotham Inlet in July. Here the steamer remained, while the steam launch, commanded by Lieutenant Cantwell and accompanied by Mr. Townsend, went on to the mouth of the Kowak and up the river to the head of navigation, a distance of about 350 miles. Abundance of pine fuel was found all along the route with which to supply the boilers of the launch.

A large collection of fishes, birds, mammals, and plants, with interesting objects of ethnology, was secured on this occasion. Mr. Townsend states that Lieutenant Cantwell found the source of the Kowak in a large lake among the mountains, nearly 450 miles from the sea—a lake swarming with lake trout of the same species as that in the northern parts of the United States and Canada. To the surprise of all, the region was found to be well wooded, and abounding in many kinds of fur-bearing animals. About eighteen species of fish were secured.

The *Corwin* was rejoined at Kotzebue Sound on September 1.

Mr. Townsend's full report was transmitted to Captain Healy, to accompany his report to the Secretary of the Treasury, of the cruise of the *Corwin.*

By authority of the Treasury Department, and with the kind co-operation of the Alaska Commercial Company, ever ready to be extended in the interest of science, Mr. Townsend obtained five complete sets of the fur seals, in all stages of sex and age.

Captain Healy has continued, on his own account, the record of previous years, by devoting such time as could conveniently be expended in his northward cruises, to the gathering of collections of fishes, &c., for the National Museum, all of which have come duly to hand.

Mr. Henry D. Woolfe, in the employ of the Pacific Steam Whaling Company, has utilized his residence at Cape Lisburne, in gathering collections in ethnography and natural history, and has transmitted some very acceptable contributions which have been received, leaving others yet to come to hand.

Mr. J. W. Johnson, United States signal observer at Nushagak, on Bristol Bay, in continuation of the highly valued labors of Mr. C. L.

McKay, has supplied much that was desirable in the way of bird-skins, Eskimo clothing, stone relics, &c. By the withdrawal of most of the signal stations from Alaska, Mr. Johnson has been transferred to Port Huron, Mich., although it is expected that contributions will still be received from the station through the kind assistance of Mr. Clark, the resident officer of the Alaska Commercial Company.

Mr. Grebnitsky, in charge of the Commander Islands off the coast of Kamchatka, whose kind assistance to Dr. Stejneger, during his stay in that region has been gratefully acknowledged, has continued to make quite extended transmissions of collections, including skeletons of mammals, alcoholic preparations of mammals, birds, crustaceans, &c., which are very much valued.

From Capt. H. E. Nichols, commander of the U. S. S. *Pinta*, and Dr. T. H. Streets, surgeon of the same vessel, stationed at Sitka, many important collections in natural history have come to hand, while from Lieut. T. Dix Bolles, of the same service, have been received a number of ethnological objects of much interest.

Washington Territory.—Mr. James G. Swan, the veteran correspondent of the Smithsonian Institution at Puget Sound, has continued his investigations and contributions through the year, the latter including numbers of articles prepared and used by the Indians for domestic purposes.

Rocky Mountain Region.—A large collection of skins and eggs of birds was received from Capt. Charles Bendire.

As explained elsewhere, this gentleman has been retired from actual service in the Army, after the proper term of service, at his own request, and is now devoting himself as voluntary curator of oölogy to the building up and thorough organization of the collection of nests and eggs of birds, after presenting to the Museum his own magnificent cabinet, perhaps the largest in the United States. He has the aid of all his correspondents towards completing the series, as also that of Dr. J. C. Merrill, who has likewise presented his entire cabinet of eggs.

Montana.—The attention of the Smithsonian Institution has been called very impressively to the impending extinction of the buffalo, and to the fact that the localities which, a few years ago, abounded in these animals are now almost without them. Indeed, the reduction in number has been so rapid as to render it probable that it is a question of months rather than of years before they become extinct.

Realizing the fact that neither the National Museum nor the other museums of the country possess well-prepared specimens of the buffalo, and, desirous of securing a series before it is too late, the Institution determined to send its chief taxidermist, Mr. William T. Hornaday, with a party of assistants, to localities where the buffalo were still supposed to occur in small numbers, with the view of securing enough for the purposes in question.

By the courteous aid of the Secretary of War and of the Adjutant-General, instructions were given to the commanders of military posts at Fort Keogh and Fort Maginnis, Mont., and Fort McKinney, Wyo., to render Mr. Hornaday all the aid in their power towards his laudable object; and the expedition left in June for the field of operations. Although a number of skeletons and skulls were found on the plains, it was with great difficulty that one buffalo bull was killed; this proving to be in a condition scarcely fit for mounting, the party reluctantly returned to Washington with the intention of starting again in the autumn when the chances would be somewhat better.

A number of good skins of antelopes, mammals, and birds were obtained by the party.

California.—A considerable amount of work has been done in California, especially by Lieut. P. H. Ray, U. S. Army, formerly in charge of the Point Barrow expedition. This officer, with a thorough knowledge of what is desired, made an extremely valuable collection, illustrating the manners and customs of the Hoopa Indians, of whom he had charge, and his contribution is one of the most interesting yet made to the galleries of the National Museum.

A somewhat similar collection, though not so extensive, was made by Mr. Loren W. Green, of the fish-hatching station at Baird, Cal. This includes especially a number of Indian bows and arrows, &c., with the apparatus used in constructing them, including a full set of implements for making stone arrow points.

Mr. Townsend, whose explorations in Alaska have been referred to, also made extensive explorations on the coast of California, especially at Humboldt Bay, in the northern part of the State. He obtained valuable statistics in regard to the fisheries of that region, and made many important collections for the National Museum. He then proceeded southward to the whaling stations along the southern coast of the State, with special reference to the California gray-whale fisheries. He found that so far from approaching extermination this species is re-establishing itself, and is becoming quite abundant in the lagoons of Lower California.

Arizona.—A large collection in ethnology was made by Dr. Palmer in this Territory in continuation of previous operations.

Extensive collections in addition to former gatherings were made, partly in Arizona and partly in New Mexico, by Mr. E. W. Nelson. These including very fine pottery of a somewhat novel type obtained from the graves, as also a number of interesting specimens of mammals, birds, &c.

New Mexico.—Very interesting contributions in zoology, &c., have been received from Dr. R. W. Shufeldt, since his detail as medical officer at Fort Wingate; his labors as a collector being supplemented by his thorough accomplishment as a naturalist and investigator. The result has been to furnish to the Institution much information of great interest in connection with the region in question.

The researches of the Ethnological Bureau conducted in the region of Arizona and New Mexico, have been made principally by Col. James Stevenson and the Messrs. Mendeleff, full reference to which will be found in the accompanying report of the Director of the Bureau of Ethnology. The explorations of the mounds throughout the country have been carried on under the direction of Prof. Thomas.

Mr. E. W. Nelson has also contributed many interesting specimens, both of zoology and of ethnology, gathered in New Mexico.

From Mr. Thomas Keam, of Keam's Cañon, a very hearty co-worker of the Ethnological Bureau and of the U. S. Geological Survey, large collections have been received on deposit, which add materially to the value of the present ethnological display.

No explorations of any special magnitude have been made in the older parts of the United States, with the exception of what has been prosecuted in the line of geology and palæontology by the U. S. Geological Survey. Many thousands, however, of specimens have been gathered by the Survey in Florida, Alabama, Texas, and elsewhere, which will be dwelt upon hereafter.

Atlantic coast of the United States.—As in previous years, the U. S. Fish Commission has been the principal contributor from this part of the coast and the adjacent high seas, and the continued researches of the steamers *Albatross* and *Fish Hawk* are noteworthy in their results.

The completion of the schooner *Grampus*, for the service of the U. S. Fish Commission, will doubtless add to the yield, especially as this vessel is well fitted for making collections of all kinds. It did not, however, get fairly into commission until about July 1.

Mexico and Central America.—For a number of years past the Institution has had a much valued correspondence with Prof. A. Dugès, an eminent Mexican naturalist, resident at Guanajuato, and especially interested in determining accurately the animals and plants of his neighborhood. This gentleman has, for a long time, sent to the Institution all the specimens that he has been unable to identify, with permission to the Institution to retain the greater part of them, and this has resulted in adding to the cabinet many specimens of great rarity.

From Governor A. R. Shepherd, of Batopilas, collections of minerals have been received; also from Mr. M. E. Wilkinson, specimens in alcohol of mammals, reptiles, and fishes.

Some ancient pottery has been supplied by Rev. David A. Watkins, of Guadalajara.

George F. Gaumer, formerly United States consul to Yucatan, now engaged in special explorations in that and adjacent regions, has contributed quite a number of species of birds, many of them new to the Institution.

Scattering collections have come to hand from various points in Central America and the West Indies, the most important of the latter being the collection of fishes made by the Natural History Museum of Kingston, Jamaica, and sent for the purpose of identification, which work was promptly done.

Mr. L. Guesde, of Guadaloupe, has furnished some specimens of birds for identification, and has also contributed a number of stone implements of Carib origin.

Prof. F. Poey has continued his contributions of Cuban fishes in alcohol; thus adding to the very extensive donations already made by him, principally of types of his published species.

A large ethnological collection made by Dr. Edward Palmer, in the vicinity of Guadalajara, is especially valuable as containing illustrations of the entire series of the processes of making the celebrated earthenware of that district.

A series of contributions relating to the natural history, ethnology, and archæology of Costa Rica, begun many years ago by Mr. José C. Zeledon, and continued year by year, has been sent us in 1886, and includes many rare and new species of birds. The Institution has seldom had a correspondent and collaborator of longer continuance in his relationships, nor any one furnishing objects of greater value; and it is to him—a pupil of the late Dr. von Frantzius—that we owe the greater part of our knowledge of the natural history of that most interesting of countries.

During the winter the U. F. Fish Commission steamer *Albatross* was engaged in prosecuting hydrographic researches at the request of the Navy Department, and incidentally devoted such time as could be spared to the investigation of the natural history of the Bahaman region. Many islands were visited, and their land fauna investigated; while the marine objects were also secured by means of the dredge and trawl. As a result, there have been several new species of birds added to our knowledge, and many rare fishes collected. Of marine invertebrates, &c., large gatherings have been secured.

Asia.—The Institution has been very fortunate in having, in Japan and Corea, gentlemen interested in the U. S. National Museum, and, officially, or otherwise, able to make explorations and collections in natural history and ethnology; and to no one is it more indebted in this connection than to Mr. P. L. Jouy, formerly an employé of the National Museum. This gentleman has been for some time in the civil service of the Corean Government, and has made large gatherings, none of which have, as yet, come to hand. The collections actually received are nine boxes, obtained by Ensign J. B. Bernadou, U. S. Navy, mainly in

Corea; including large numbers of ethnological objects and specimens in alcohol almost entirely new to the Museum.

A very important collection illustrating the life history of the Japanese has been received from the department of education of Japan, and is suitably displayed in one of the main halls of the Museum, where it fills a case of about 60 feet in length, and attracts much interest.

The Japanese series is rapidly acquiring a distinguished pre-eminence, and every year becomes more and more complete.

PUBLICATIONS.

Of the different classes of works issued by the Institution, the first place is naturally assigned to the quarto "Contributions to Knowledge."

Second in order are the octavo "Miscellaneous Collections," which, by reason of their various sources, form the most voluminous series The classes of productions going to swell the same may be specified as follows: 1st, the numerous collections of physical, statistical, chemical, biological, and ethnological researches prosecuted directly by the Institution itself or under its immediate auspices; 2d, the occasional "Toner Lectures," *delivered* under the encouragement of the fund established by Dr. Joseph Toner, but *published* by this Institution; 3d, the special annual reports on the latest advances in the leading departments of science, maintained at the expense of the Institution, though first given to the public through the medium of the official annual reports of the Regents. These are all issued separately in pamphlet form; and probably will ultimately be collected in volumes, each devoted to its particular subject; 4th, the "proceedings" of various societies for the advancement of science, stereotyped and published by the Institution; including at present the Bulletins of the Philosophical Society of Washington, the Transactions of the Anthropological Society of Washington, and the Proceedings of the Biological Society of Washington; 5th, the Bulletins, Proceedings, Circulars, and Instructions of the U. S. National Museum, published primarily under the direction of the honorable Secretary of the Interior, but re-issued by the Institution.

The third series comprises the annual reports of the Regents of the Institution to Congress, in octavo volumes.

The fourth series comprises the publications of the Bureau of Ethnology, under the auspices of the Smithsonian Institution. This is issued in larger or imperial octavo volumes.

Smithsonian Contributions to Knowledge.—A work entitled "Researches upon the venoms of Poisonous Serpents," by S. Weir Mitchell, M. D., and Edward T. Reichert, M. D., has been printed during the past year, and will soon be ready for distribution. This is a continuation of the investigations on this important subject undertaken by Dr. Mitchell some twenty-five years ago, and published by the Institution, in the same series, at the beginning of the year 1861. The present supplementary memoir by the joint authors embraces an examination into the physical and chemical characteristics of the venoms of various rattle-snakes (*Crotalidæ*), of the moccasin (*Ancistrodon*), and also of the hooded viper (*Cobra*), of India; the re-actions of various agents on the venom, the physiological effects of the venoms on serous surfaces, on the nervous system, on the circulation, on respiration, &c., and the general pathology of the subject. In an appendix of 21 pages is given a very full bibliography of the literature of the subject, brought down to date. The work forms a quarto volume of x + 186 pages, illustrated by 4 figures or wood cuts in the text, and 5 chromolithographic plates.

Smithsonian Miscellaneous Collections.—Of this series there are already on hand published articles sufficient to form a number of volumes; although such formal collection and issue of numbered volumes has been unavoidably postponed by other pressing requirements, fully employing the available funds of the Institution. The new publications in this series during the past year have been as follows:

512. "List of Institutions in the United States receiving publications of the Smithsonian Institution." This list comprises the titles of 1,838 domestic institutions, not including a considerable number of libraries and individuals receiving various special publications irregularly. The catalogue forms an octavo pamphlet of 72 pages.

514. "A Catalogue of Scientific and Technical Periodicals (1665 to 1882), together with Chronological Tables, and a Check-List." By Henry Carrington Bolton. As stated by the compiler, in his preface: "This catalogue is intended to contain the principal periodicals of every branch of pure and applied science, published in all countries, from the rise of this literature to the close of the year 1882." What are known as professional journals (those relating specially to theology, law, and medicine), as well as those relating to music and the fine arts, have been omitted. "While medicine has been excluded, anatomy, physiology, and veterinary science, being related to zoology, have been admitted. With a few exceptions, serials published by learned societies have been omitted; those admitted either form part of a series begun or ending in an independent periodical, or are presumably not exclusively devoted to the proceedings of the societies by which they are edited. The admission of society publications to this catalogue would swell the volume to an inconvenient size; and has been rendered unnecessary by the publication of the 'Catalogue of Scientific Serials,' by Mr. S. H. Scudder." This very complete list of the periodicals indicated, numbering over 5,000 titles, is arranged alphabetically, and extends to 615 pages.

The catalogue is followed by 91 pages of "Chronological Tables," in smaller type, arranged in columns by years, giving a synchronal conspectus of all those periodicals having any considerable number of volumes, and showing the precise number of the volume published in any given year. This definite correlation of date and volume is ofttimes a matter of some importance to those not having access to the volumes themselves. To this succeeds a concise index of subjects (under 94 heads, alphabetically arranged), citing the classified periodicals simply by their number in the general catalogue.

The volume concludes with a "Library Check-List," of 54 pages, in which, following the number belonging to a periodical, is given the library or libraries where such periodical may be found; each of the 127 principal libraries of the United States and Canada being designated by a symbolic abbreviation. In many cases the number indicating a given periodical is followed by but a single reference. This directory to the locality, where possibly a rare journal may be consulted, is a valuable feature of the catalogue, and efforts will be made to add to its fullness and accuracy in future editions. The whole work forms an octavo volume of x + 773 pages, and is one highly creditable to the zeal and industry of its author; who, though assisted by such facilities and means of communication as were within the reach of the Institution, devoted to its compilation his leisure for many years, without any remuneration, excepting his consciousness of performing a useful labor.

550. "The Scientific Writings of Joseph Henry." This important work is now entirely stereotyped, and will be put to press as soon as conveniently may be. The size of the collection (exceeding 1,000 pages) has required its division into two volumes. Volume I, comprising 68 papers and abstracts, chronologically arranged, contains 535 pages, including introductory note and index, and is illustrated by 46 wood-cut figures. Volume II, comprising 25 papers and abstracts, contains 559 pages, including index, and is illustrated by 48 wood-cut figures. In order not to separate Professor Henry's Meteorological Essays, published successively through a period of five years (1855–1859), and extending to 400 pages, it was judged expedient to so far interrupt the chronological order otherwise maintained, as to carry the entire series over to the second volume. And in like manner it became necessary, in order to secure a comparative equalization in the sizes of the two volumes, to transfer the connected series of researches on sound in relation to fog-signaling (published during the four years 1874–1877) back from their natural place to the end of the first volume. Although this dislocation of the natural or historical order is in some respects to be regretted, it yet enables the reader to have a more connected view of the longer series of papers, without the inconvenience of alternate reference to different volumes.

It is designed to have printed two editions of the work; one in royal octavo size, to correspond with the "Memorial Volume" issued by order of Congress; and the other in ordinary octavo size, to correspond with the "Miscellaneous Collections."

627. "Price-List of Publications of the Smithsonian Institution." This list includes only those publications on hand, down to July, 1885, which can be furnished to applicants, and gives the price at which each is held. Many of the earlier publications being out of print, these have been omitted from the list. It forms an octavo pamphlet of 27 pages.

628. "Index to the Literature of Uranium, 1789–1885." By H. Carrington Bolton. This is one of a series of bibliographies especially directed to the indexing of chemical literature. The first part is a chronological list of memoirs or papers published on the subject, with references to sources of publication; the second part is an alphabetical list of authors of the same; and the third part is a subject-matter index, comprising the various treatments, reactions, characteristics, sources, &c., of uranium and its compounds. It forms an octavo pamphlet of 36 pages.

629. "Report of Prof. Spencer F. Baird, Secretary of the Smithsonian Institution, for six months ending June 30, 1885." In consequence of the adoption by the Regents, of the fiscal year instead of the previous calendar year, this report embraces the period of only half a year. It forms an octavo pamphlet of 46 pages.

630. "Transactions of the Anthropological Society of Washington, Vol. III (November 6, 1883–May 19, 1885)." An octavo volume of xxii + 204 pages.

632. "An Account of the Progress in Geography in the year 1885." By J. King Goodrich. 8vo. 36 pp.

633. "An Account of the Progress in Chemistry in the year 1885." (With a bibliography). By H. Carrington Bolton. 8vo. 50 pp.

634. "An Account of the Progress in Vulcanology and Seismology in the year 1885." (With a bibliography.) By Charles G. Rockwood, jr. 8vo. 23 pp.

635. "List of Foreign Correspondents of the Smithsonian Institution." To July, 1885. By George H. Boehmer. 8vo. 190 pp.

636. "Bulletin of the Philosophical Society of Washington. Vol. VIII. Containing the Minutes of the Society and of the Mathematical Section, for the year 1885 (January 3, 1885–December 19, 1885)." Octavo volume of xlvii + 68 pp.

638. "An Account of the Progress in Physics in the year 1885." (With a bibliography.) By George F. Barker. 8vo. 60 pp.

639. "An Account of the Progress in Mineralogy in the year 1885." (With a bibliography.) By Edward S. Dana. 8vo. 26 pp.

640. "An Account of the Progress in Anthropology in the year 1885." (With a bibliography.) By Otis T. Mason. 8vo. 56 pp.

641. "An Account of the Progress in Astronomy in the year 1885." (With a bibliography.) By William C. Winlock. 8vo. 114 pp.

642. "Record of North American Invertebrate Palæontology for the year 1885." By John Belknap Marcou. This forms a descriptive bib-

liography of the subject by alphabetical arrangement of the writers. 8vo. 47 pp.

643. "An Account of the Progress in Zoology in the year 1885." By Theodore Gill. 8vo. 53 pp.

644. "Observations on Volcanic Eruptions and Earthquakes in Iceland, within Historic Times." Translated and condensed from a history by Th. Thoroddsen. By George H. Boehmer. 8vo. 47 pp.

Bulletins of the National Museum.—This series and that of the Proceedings, illustrating the material of the U. S. National Museum, are issued in the first instance under the authority of the honorable Secretary of the Interior, as prepared by the Smithsonian Institution.

"Bulletin U. S. National Museum, No. 23. The published writings of Isaac Lea." By Newton P. Scudder. This is the second of a proposed series of bibliographies of American naturalists who have contributed to the National Museum. The great value of such bibliographies is fully appreciated by all engaged in natural-history studies or investigations. Dr. Lea has for more than half a century contributed to various scientific journals the result of his extensive mineralogical and biological researches; commencing with an account of local minerals, published in the Journal of the Academy of Natural Sciences of Philadelphia, in 1818, and giving, in 1876, a study of "Inclusions" in gems. Perhaps his most important labor has been the series of investigations in the land and fresh-water mollusks, and especially in the family of the *Unionidæ:* the earliest of which was published in the Transactions of the American Philosophical Society, in 1827. Dr. Lea has contributed largely of his collections to the National Museum, and at the advanced age of ninety-four still enjoys good health and complete intellectual vigor.

Of the present Bulletin the first 53 pages are occupied with a biographic sketch of the subject. The bibliography proper extends to 171 pages, giving in full the titles and sources of 279 memoirs and other publications in chronological order. The compilation concludes with a list of the genera and species discussed and described by Dr. Lea, which occupies 100 pages. The work forms an octavo volume of lix + 278 pages (including the index), and is illustrated by an engraved portrait of Dr. Lea.

"Bulletin U. S. National Museum, No. 28. A Manual of American Land Shells." By W. G. Binney. This work presents an enlarged and revised edition of the "Land and Fresh-water Shells of North America:" Part I; by W. G. Binney and T. Bland; published by the Smithsonian Institution in 1869, and included in the eighth volume of the Miscellaneous Collections. Mr. Thomas Bland, Mr. Binney's former coadjutor, is no longer with us, having died August 20, 1885. This treatise, as a separate volume, has been for some time out of print. The present work has been entirely re-written and re-arranged, occupying 200 more pages than the earlier work. "Subsequently described species are added. Fuller attention is given in separate chapters to the subjects of geographical distribution, organs of generation, jaw and lingual dentition, and classification. In the descriptive portion of the work the species are grouped geographically rather than systematically." The subject is treated under the following heads: 1st. Habits and Properties (9 pp.); 2d. Geographical Distribution (24 pp.); 3d. The Generative apparatus (2 pp.); 4th. The Jaw and Lingual Membrane (6 pp.); 5th. Classification (7 pp.); 6th. Systematic Index (3 pp.); and 7th, constituting the bulk of the volume, Description of Species (412 pp.). Following this is a tabular list (with specified localities and sources) of the Binney Collection of the Land Shells of North America, presented by the author to the U. S. National Museum (25 pp.). The work forms an octavo volume of 528 pages, and is illustrated by 516 wood-cut figures in the text.

"Bulletin U. S. National Museum, No. 29. Results of Ornithological Explorations in the Commander Islands and Kamtschatka." By Leonhard Stejneger. The work is divided into three parts: 1st. Review of the species of birds collected or observed by the author on the Commander Islands, and at Petropaulski, Kamtschatka, 1882–1883 (300 pp.); 2d. Synopsis of the birds reported to inhabit Kamtschatka (20 pp.), and 3d. Conclusions drawn by the author respecting the probable derivation of this avifauna, and the limitation of its forms. As the result of his explorations, he maintains "that the peninsula forms a very well circumscribed ornitho-geographical province, remarkable not only for a number of peculiarly modified forms, but also for a surprising absence of many of the most characteristic forms of the palæarctic and circumpolar ornis." Regarding Kamtschatka as one of the most typical and well-defined peninsulas, the conditions of which "are such as to make it a true island, zoologically speaking," the author ventures the suggestion, "there seems to be reason to assume that it has been a real island at no very distant period." The work forms an octavo volume of 390 pages, and is illustrated by 7 wood-cut figures in the text, a sketch map of Kamtschatka and adjacent countries, 1 relief-cut plate, and 7 chromo lithographic plates.

"Bulletin U. S. National Museum, No. 30. Publications relating to Fossil Invertebrates." By John Belknap Marcou. This forms the third volume of the Bibliographies of American Naturalists, and is devoted entirely to a catalogue of the writings of those who have labored in the field of invertebrate palæontology, in connection with the researches and collections made by the Institution and the National Museum. The list of memoirs embraces: 1st. The published writings of Fielding B. Meek, numbering 105 titles of papers (of which one was in conjunction with Prof. James Hall, 17 in conjunction with Mr. F. V. Hayden, and 25 in conjunction with Mr. A. H. Worthen), and occupying 100 pages; 2d. The published writings of Charles A. White, numbering

151 papers (of which 2 were in conjunction with H. A. Nicholson and 2 in conjunction with O. H. St. John), and occupying 66 pages; 3d. The published writings of Charles D. Walcott, numbering 27 papers and occupying 15 pages; 4th. A collection from fifteen authors of "Publications based upon the Palæontological Collections of the United States Government," including the titles of 3 papers by Jacob W. Bailey, 12 papers by T. A. Conrad, 5 papers by James D. Dana, 2 papers by Christian G. Ehrenberg, 7 papers by James Hall (1 in conjunction with F. B. Meek, above referred to), 2 papers by Angelo Heilprin, 3 papers by Alpheus Hyatt, 10 papers by Jules Marcou, 2 papers by John S. Newberry, 1 paper by I. N. Nicollet, 4 papers by David Dale Owen, and 5 by Owen and Shumard, 2 papers by Hiram A. Prout, 1 paper by James Schiel, 7 papers by Benjamin F. Shumard, and 5 in conjunction with Owen (above referred to); and lastly, 5 papers by Robert P. Whitfield; these occupying 72 pages. An index of genera and species of invertebrate fossils occupies 52 pages. The work is supplied with a general index of subjects and authors, and forms an octavo volume of 333 pages.

Proceedings of the National Museum.—Of this series a prompt distribution is made, signature by signature, as fast as each 16 pages of matter is printed, thus giving the publication somewhat the character of a periodical.

Volume VIII of the Proceedings of the U. S. National Museum for 1885 has been completed. It contains descriptive papers by Tarleton H. Bean, Charles W. Beckham, H. G. Beyer, R. A. Brock, W. H. Dall, Carl H. Eigenman, Walter Faxon, Walter J. Fewkes, J. M. Flint, S. Garman, G. Brown Goode, V. Havard, O. P. Hay, David S. Jordan, Frank H. Knowlton, George N. Lawrence, Frederic A. Lucas, John Belknap Marcou, Otis T. Mason, Seth E. Meek, George P. Merrill Charles R. Orcutt, Edward Potts, Richard Rathbun, Robert Ridgway, C. V. Riley, John A. Rider, R. W. Shufeldt, Sidney I. Smith, Silas Stearns, Leonhard Stejneger, Charles H. Townsend, Frederick W. True, Lucien M. Turner, A. E. Verrill, and José C. Zeledon. The volume contains 762 8vo pages, including introduction, index, and explanatory pages, and is illustrated by 15 wood-cut figures in the text and 25 plates of relief cuts.

The Smithsonian Annual Report.—Reference was made in the last report (pages 337, 338) to an act of Congress approved March 3, 1885, directing that "the annual reports of the Smithsonian Institution shall be hereafter printed at the Government Printing Office, in the same manner as the annual reports of the heads of Departments are now printed for submission in print to the two houses of Congress." The Smithsonian reports had previously been submitted to Congress in manuscript, requiring a special resolution each year to secure their printing.

This act, however, did not provide for the printing of any extra copies for distribution by members of Congress or by the Institution. The usual resolution was therefore introduced in the Senate, and passed February 12, 1886. Action on this was not taken, however, by the House of Representatives for five months; when, on July 17, the Senate resolution was agreed to, as follows:

Resolved, &c., That there be printed of the last annual reports of the Smithsonian Institution, and of the National Museum, in two octavo volumes, 16,000 extra copies of each, of which 3,000 copies shall be for the use of the Senate, 6,000 copies for the use of the House of Representatives, and 7,000 copies for the use of the Smithsonian Institution.

In consequence of the growing importance of the National Museum, placed by law under the charge of the Smithsonian Institution, the annual report of the latter for 1884 is for the first time printed in two parts, or separate volumes, the first part confined to the work of the Institution itself, showing its operations, expenditures, and condition; and the second part to the progress and condition of the National Museum.

The first volume—the report of the Institution proper for 1884—was not delivered until April, 1886; and the second volume—the report of the National Museum for the same period, not till several months later. The first volume contains the Journal of Proceedings of the Board of Regents of the Institution at the annual meeting held January 21, 1885; the report of the Executive Committee of the Board of Regents, for the year 1884, showing in detail the receipts, appropriations, and expenditures of the Institution and of the Museum, and their present financial condition; the report of the Secretary of the Institution for the year; together with subordinate reports on the operations of international exchanges, &c. This strictly business portion is followed by the usual "General Appendix," in which is given a record of the principal scientific progress for the year, namely, in astronomy by Edward S. Holden; vulcanology and seismology, by Charles G. Rockwood; geography, by F. M. Green; meteorology, by Cleveland Abbe; physics, by George F. Barker; chemistry, by H. Carrington Bolton; mineralogy, by Edward S. Dana; bibliography of North American invertebrate palæontology, by J. B. Marcou; zoology, by Theodore Gill; and anthropology, by Otis T. Mason. In conclusion are given miscellaneous papers relating to the archæology of Northern and Central America, by Charles E. Vreeland, J. F. Bransford, Otis T. Mason, M. T. Leach, Charles M. Smith, and E. T. Wiltheiss. This part forms an octavo volume of 943 pages, including introductory matter and index, and is illustrated by 7 relief-cut plates and 243 relief-cut figures in the text.

The second volume, "Report of the United States National Museum for the year 1884," contains, Part 1, the report of the assistant director; Part 2, reports of the curators and acting curators; Part 3, papers relative to particular collections or objects in the Museum, by Otis T. Mason, John Murdoch, Frederick W. True, and F. A. Lucas; Part 4, Bibliography of the Museum, including publications of the Museum, papers by officers of the Museum, and other papers based on Museum material; and lastly, as an appendix, Part 5, a list of accessions to the Museum during the year, occupying 44 pages. This report forms an octavo volume of ix + 458 pages, and is illustrated by 105 relief-cut plates.

I regret to state that no copies of the Report of 1885 (though for some time stereotyped) have yet been received from the Public Printer.

Publications of the Bureau of Ethnology.—During the past year has been issued the "Third Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution," by J. W. Powell, Director. In addition to the report of the Director, occupying 62 pages, are given as accompanying papers "Notes on certain Maya and Mexican Manuscripts," by Cyrus Thomas; "On Masks, Labrets, and certain aboriginal customs," by William H. Dall; "Omaha Sociology," by J. Owen Dorsey; "Navajo Weavers," by Dr. Washington Matthews; "Prehistoric Textile Fabrics of the United States, derived from impressions on Pottery," by W. H. Holmes; concluding with "Illustrated catalogue of a portion of the collections made during the field season of 1881," by W. H. Holmes; and "Illustrated catalogue of the collections obtained from the Pueblos of New Mexico and Arizona in 1881," by James Stevenson.

The work forms an imperial octavo volume of lxxiv + 606 pages, illustrated by 200 wood-cut figures in the text, and 44 full-page plates, of which 2 are printed in colors.

INTERNATIONAL EXCHANGES.

The system of free exchanges of the scientific productions of learned societies and of individuals, including their distribution to public libraries and universities throughout the world, early established by this Institution as one of its most important interests and services, continues to increase annually, with the extending recognition at home and abroad of its great utility in promoting "the increase and diffusion of knowledge among men."

Statistics.—For the year ending June 30, 1886, the receipts for foreign transmission were 94,093 packages, weighing 195,404 pounds. The transmissions filled 764 boxes, having an aggregate bulk of 5,208 cubic feet.

For domestic exchanges the number of parcels received and distributed during the fiscal year was 14,496, of which 2,533 parcels (or about one-sixth), were received for the library of the Institution.

For Government exchanges in the same time were received 29 boxes containing 56,229 packages, and 114 boxes were sent abroad.

As compared with the receipts at quinquennial periods for the past 15 years the steady increase is well shown in the following table:

Receipts.	1871. (Civil year.)		1876. (Civil year.)		1881. (Civil year.)		1886. (Fiscal year.)	
	Packages.	Pounds.	Packages.	Pounds.	Packages.	Pounds.	Packages.	Pounds.
Foreign exchanges...	7,730	28,950	13,000	50,750	14,161	50,155	26,162	112,901
Domestic exchanges...	3,952	14,800	4,853	18,130	7,890	33,291	11,702	39,579
Government exchanges.	....	....	....	30,000	15,550	34,200	56,229	42,924
Total...	11,682	43,750	17,853	98,880	37,601	117,646	94,093	195,404

In 1871 and 1876 the exchanges of Government publications were not separately registered; the aggregate weight for the year 1876 has been approximately estimated. Notwithstanding the extraordinary stimulus given to the foreign exchanges in 1876, by reason of the Centennial Exhibition held that year, the years immediately succeeding showed no falling off in the total amount of material presented, but on the contrary a continual enlargement of the work.

Assistance by the Government.—In view of the great public and national services rendered by the exchange system, in the distribution of Government publications, and in the large accessions of valuable works annually made through its instrumentality to the Congressional Library, an appropriation has for some years past been granted by Congress in aid of this enterprise. And without this support the operations of the exchange service would be very seriously restricted. The usual appropriation of $10,000 was granted to the Institution by the last Congress. The total expenses of conducting the international exchanges, for the last few years, are shown in the following table;

Expenses of exchanges.	1883. (Civil year.)	1884. (Civil year.)	1885. (First 6 months.)	1886. (Fiscal year.)
By the Institution...	$6,192 34	$2,510 71	$3,307 59	$2,005 80
By appropriation....	7,500 00	10,000 00	5,000 00	10,000 00
Total cost.....	13,692 34	12,510 71	8,307 59	12,005 80

The column for 1885, comprising only the first six months of the year, in the transition from the former civil year in use by the Institution to the present fiscal year, one-half only of the Congressional appropriation is credited to that year.

Transportation facilities.—The liberal encouragement of the Smithsonian exchange operations afforded by the leading steamship companies in granting the Institution free freight for its packages and boxes, which has existed for many years, still continues; and it is my pleasant duty annually to renew the expressions of grateful acknowledgment for the generous policy which has so greatly favored and advanced the system of exchanges. The following is a list of the companies favoring the Institution with the concessions mentioned, and to whose offices I desire, on behalf of the Regents, to return their hearty thanks.

Allan Steamship Company (A. Schumacher & Co., agents), Baltimore.
Anchor Steamship Line (Henderson & Brother, agents), New York.
Atlas Steamship Company (Pim, Forwood & Co., agents), New York.
Bailey, H. B., & Co., New York.
Bixby, Thomas E., & Co., Boston, Mass.
Borland, B. R., New York.
Boulton, Bliss & Dallett, New York.
Cameron, R. W., & Co., New York.
Compagnie Générale Transatlantique (L. de Bébian, agent), New York.
Cunard Royal Mail Steamship Line (Vernon H. Brown & Co., agents), New York.
Dennison, Thomas, New York.
Florio-Rubattino Line, New York.
Hamburg American Packet Company (Kunhardt & Co., agents), New York.
Inman Steamship Company, New York.
Merchants' Line of Steamers, New York.
Monarch Line (Patton, Vickers & Co., agents), New York.
Muñoz y Espriella, New York.
Murray, Ferris & Co., New York.
Netherlands American Steam Navigation Company (H. Cazaux, agent), New York.
New York and Brazil Steamship Company, New York.
New York and Mexico Steamship Company, New York.
North German Lloyd (agents, Oelrichs & Co., New York; A. Schumacher & Co., Baltimore).
Pacific Mail Steamship Company, New York.
Panama Railroad Company, New York.
Red Star Line (Peter Wright & Sons, agents), Philadelphia and New York.
White Cross Line of Antwerp (Funch, Edye & Co., agents), New York.
Wilson & Asmus, New York.

The thanks of the Institution are also due, and are hereby tendered, to the foreign ministers and consuls of the various Governments for their assistance in taking charge of the transmission of boxes to the countries which they respectively represent.

Government Exchanges.—The Smithsonian Institution, as is well known, has been made by law the agent of the United States Government for conducting the international exchanges of public official documents between it and foreign Governments. By joint resolution of Congress (approved March 2, 1867), it was ordered that "fifty copies of all documents hereafter printed by order of either house of Congress, and fifty copies additional of all documents printed in excess of the usual number, together with fifty copies of each publication issued by any Department or Bureau of the Government, be placed at the disposal of the Joint Committee on the Library, who shall exchange the same, through the agency of the Smithsonian Institution, for such works published in foreign countries, and especially by foreign Governments, as may be deemed by said committee an equivalent; said works to be deposited in the Library of Congress." And by supplemental joint resolution to carry the same into better effect (approved July 25, 1868), the Congressional Printer, whenever he shall be so directed by the Joint Committee on the Library, is required to print fifty copies in addition to the regular number of all documents hereafter printed by order of either house of Congress, or by order of any Department or Bureau of the Government, and whenever he shall be so directed by the Joint Committee on the Library, one hundred copies additional of all documents ordered to be printed in excess of the usual number; said fifty or one hundred copies to be delivered to the Librarian of Congress, to be exchanged under the direction of the Joint Committee on the Library, as provided by joint resolution approved March 2, 1867.

Since the international movement, commencing with the Paris convention of 1875, for promoting the free reciprocal exchange of public documents, there has been a growing interest in the subject manifested abroad. International conferences, for agreeing upon details, were held at Brussels, Belgium, in 1880, in 1883, and finally in 1886—March 15. There are now thirty-seven Governments in exchange with the United States, or, counting the duplicate sets sent to the Dominion of Canada (deposited at Ottawa and Toronto), there may be said to be thirty-eight foreign recipients. These are: The Argentine Confederation, Bavaria, Belgium, Brazil, Buenos Aires, Canada, two sets (one for the parliamentary library at Ottawa, the other for the legislative library at Toronto), Chili, Colombia (United States of), Denmark, France, Germany, Great Britain, Greece, Hayti, Hungary, India, Italy, Japan, Mexico, Netherlands, New South Wales, New Zealand, Norway, Portugal, Prussia, Queensland, Russia, Saxony, South Australia, Spain, Sweden, Switzerland, Tasmania, Turkey, Venezuela, Victoria, and Würtemberg.

During the past year boxes 24, 25, and 26 of the series of United States official publications have been sent to each of the above Governments.

The Library of Congress.—By the joint resolutions of 1867 and 1868, above referred to, the "works published in foreign countries, and especially by foreign Governments," that may be obtained by our international exchanges, are directed "to be deposited in the Library of Congress." This great national institution thus becomes the beneficiary of this branch of the service, and it is a matter of public interest that such returns should be placed on their broadest basis.

From the last annual report of the Librarian, Mr. A. R. Spofford (for the calendar year 1885), the following remarks are quoted as here eminently appropriate:

"Under the authority of these acts [above cited] the publications of the United States have been sent regularly each year to thirty-eight foreign Governments, whose officers responded favorably to overtures for regular exchanges. Very *inadequate returns*, however, have been received from some countries, while from others very rich and important stores of documents, including legal, political, historical, and scientific publications, have come to hand. Repeated efforts have been made by correspondence conducted with foreign Governments, through the Smithsonian Institution and the Department of State, to secure more adequate returns from the Governments to which the publications of the United States (an extensive and costly series) have been so liberally supplied through a long series of years. Very *slight results, however, have attended these endeavors.* A few desultory returns were occasionally received, followed by an entire stoppage of the transmission of documents. The results of the exchanges thus far has been to supply the Library with many publications of permanent value and with many more fragmentary sets of laws, journals, reports, and miscellaneous publications, the principal value of which to the collection depends upon the completeness of the series. The deficiencies in all these series are very extensive, thus depriving Congress of that full access to the current legislation and condition of foreign countries which is so important to those seeking official information thereon.

It has long been apparent that no permanent improvement in the very defective operations of these international exchanges can be expected until some special agency is organized in Europe to give personal attention to the practical business of securing full returns of all Government publications. The distribution of documents is scattered in most Governments among different bureaus, with no common head. Moreover, most Government publications are issued by arrangement with private publishing houses, instead of by Government presses, thus rendering the books to a partial extent publications to which a commercial value is attached, and complicating the question of exchange with that of a pecuniary valuation of publications given and received. In very few countries is there any general law regulating this matter, while the various international conferences held at Paris and at Brussels with a view to the adoption of a uniform system of exchanges have failed to enlist the co-operation of several of the most important European Governments. Moreover, there are issued many special publications which can be obtained only by special efforts. An agent of the United States, either constantly upon the ground, or visiting periodically at regular intervals the bureaus of the Government in the various countries, supplied with full lists both of our wants and of the publications, regular and special, of the Government presses, would furnish a permanent and, it may be added, the only efficient guarantee of realizing from the system of international exchanges what we have a right to expect.

An initiatory step was taken during the last Congress, when an agent in the employ of the Smithsonian Institution, in charge of its exchange system, was sent to Europe, one-half of his expenses being paid by the Institution and one-half out of the Library funds. The results of the experiment, although a first attempt in a new field, were most gratifying. In the few months devoted to the labor, there were secured by diligent effort, backed by the requisite official authority from the Secretary of the Smithsonian Institution, the Department of State, and the Librarian of Congress, very extensive returns of public documents and miscellaneous publications. These returns comprised forty-four cases and one hundred and sixty packages of books, numbering about 7,000 volumes, received in 1884–'85, and were collected from the Governments of Great Britain, France, Germany, Italy, Belgium, the Netherlands, Sweden, Norway, Denmark, Hungary, Saxony, Würtemberg, Bavaria, and Switzerland, fourteen Governments in all. Vienna was also visited, but affairs were not in a state favorable to the success of negotiations, and no result was reached as to the publications of the Austrian Government. Several other Governments from which returns were thus secured, have also failed to continue sending the series of their parliamentary and other documents, the value of which is largely dependent upon their continuity.

The experience of years has amply proved the impossibility of securing any complete or adequate return from foreign Governments for the full and costly series of American Government publications so long furnished them, without direct and persistent effort, through an agency upon the ground, furnished with adequate credentials, to attend personally to the whole business. One of the chief benefits of the initial effort already made has been the discovery of the practical obstacles in the way of a thoroughly successful system of exchanges. These, it is believed, could be removed by following up the work with each Government, while, if neglected, or left to the very uncertain medium of correspondence, the United States will continue to reap very inadequate returns for our publications sent abroad. It is recommended that the Joint Committee on the Library consider the expediency of providing an appropriation to defray the necessary expenses of an agent of international exchanges, to be sent abroad for a term of at least six months during the present year.

It is also recommended that the act directing the printing of fifty copies of each publication ordered by any Department or Bureau, to be devoted to international exchanges, be so amended as to render its provisions more effective."

LIBRARY.

The fact should constantly be borne in mind that the distribution of the publications of the Institution secures in return a large amount of valuable material which is deposited in the Library of Congress. Whatever cost, therefore, there may be to our Government for Smithsonian or Museum reports, &c., is many times repaid by the exchanges received, in addition to which the returns for the many volumes of publications printed entirely at the expense of the Smithsonian fund find the same depository.

The following table will show the extent of the additions to the Library of Congress from this source for the last ten years:

Deposit of books, &c., in the Library of Congress by the Smithsonian Institution from 1875 *to* 1886.

	Volumes.	Parts.	Pamphlets.	Maps.	Total.
1846–1874	26,629	50,225	20,403	5,555	102,812
1875	1,120	4,016	1,797	114	7,047
1876	1,017	4,315	1,878	375	7,585
1877	1,889	4,327	2,184	326	8,726
1878	1,263	4,976	2,416	74	8,729
1879	1,949	5,852	2,219	183	10,203
1880	1,143	5,180	2,095	152	8,570
1881	1,867	7,505	2,399	188	11,959
1882	1,296	8,039	2,302	152	11,789
1883	1,754	8,134	2,568	219	12,675
1884	1,567	8,826	2,323	143	12,859
1885	1,942	8,824	6,471	474	17,711
Total	43,436	120,219	49,055	7,955	220,665

Subsequently to this period the enumeration will be made by fiscal years (July to July), instead of by calendar years; the last six months of the year 1885 being included in the following statement for the past year.

Statement of the books, maps, and charts received by the Smithsonian Institution during the year ended June 30, 1886, and transferred to the Library of Congress or to that of the National Museum:

Volumes:		
Octavo or smaller	1,428	
Quarto or larger	510	
		1,938
Parts of volumes:		
Octavo or smaller	4,293	
Quarto or larger	6,728	
		11,021
Pamphlets:		
Octavo or smaller	2,315	
Quarto or larger	613	
		2,928
Maps and charts		379
Total		16,266

UNITED STATES NATIONAL MUSEUM.

Five years have elapsed since (the latter part of 1881) the work of moving into the new Museum building was begun. Two years ago I reported that the packing boxes, several thousand in number, containing the accumulations of many previous years, had for the most part been unpacked, and that the entire floor space of the building would be soon occupied by exhibition collections. During the current year this hoped-for result has been finally attained, and (with the exception of one corner of one of the central halls still occupied by one or two collections received at the close of the New Orleans exhibition, and which have not been opened on account of delay in preparation of cases for their reception) the entire floor space of about 100,000 square feet is open to the public, and the collections arranged in accordance with the provisional plan of installation. The work of mounting and labelling is still in progress, and each month shows marked advances. From this time forward, however, it will be impossible to develop the collections satisfactorily without additional space. The laboratories and workshops are entirely inadequate for the storage of the unexhibited collections and the accommodation of the preparators and mechanics, and the exhibition halls do not afford suitable opportunity for the display of the materials already in order for public examination. Each collection, and above all each department, should have a hall of its own, more or less completely isolated from those which adjoin it. When several collections are placed side by side in the same department much is lost in respect to effect and convenience of study, not to mention the still greater disadvantage of overcrowded space.

As soon as Congress shall see fit to provide another Museum building, the collections being now so completely under control, and the force of curators, assistants, and preparators so well organized and so thoroughly prepared for the task, within eighteen months, or at the most two years, a space twice as large as that now occupied can be filled with cases of specimens thoroughly mounted for exhibition.

The development of the Museum during the past year has been unexpectedly great, as may be judged from the fact that about fifteen hundred separate lots of specimens have been received. A certain proportion of these were obtained from Government expeditions and surveys and material of perhaps equal value through exchange, but by far the largest part of the increase, both in quantity and value, has been in the form of gifts.

It is perhaps too early in the history of the Museum to take into consideration the question of the extent and nature of its future development. Such institutions are most successful and useful when the result of natural processes of growth.

We may profit to a certain extent by the experience of other nations, but the National Museum of the United States will of necessity have features peculiar to itself, developed in response to the peculiar needs of the people of this continent. It should be remembered that the national collections of every principal European nation are divided into several groups, each under separate administration, though often under the general control of some central authority. In France, for instance, most of the museums are under the Ministry of Public Instruction, and in England, to a less extent, under the Department of Science and Art.

In London, in Paris, in Berlin, and in Vienna the public collections are scattered through various parts of the city, in museums with distinctive names and more or less independent organizations, and by no means always harmonious with each other. Much of the work which should properly be done by these museums is omitted, because none of them have seen fit to undertake it, and, on the other hand, much work is duplicated, which is perhaps equally unfortunate, collections of similar scope and purpose being maintained in different parts of the same city. One of the chief objections to such division of effort is that much of the value of large collections in any department is lost by failure to concentrate them where they may be studied and compared side by side. In Washington the national collections are all, without exception, concentrated in one set of buildings. The Army Medical Museum will soon occupy a building side by side with those under the control of the Smithsonian Institution, and this proximity and the long established policy of co-operation between the two institutions will render them, for all practical purposes, united.

It is possible that, in the future, museums of specialties, occupying buildings of their own, may grow up under the control of other Executive Departments of the Government, but it is not likely that they will be very remote from the chain of museum buildings already in process of formation, and a harmonious system of co-operation will doubtless always be practicable. In the mean time the Smithsonian Institution, as the legal custodian of Government collections, should undoubtedly preserve everything which may be serviceable for the development in Washington of one of the greatest museums in the world. It will be neither practicable nor desirable to gather together in Washington collections of ancient and mediæval art, such as those which adorn the capitals of Europe; but a representative series of such objects will undoubtedly grow up which shall be sufficiently large and well selected to enable Americans to understand these subjects in a general way, to educate the public taste, and to promote, so far as possible, the study of the elements of art and the history of civilization, as well as to forward the growth of the arts of design. This having been accomplished, a large part of the attention of the Museum would naturally be directed toward the exhibition of the geology and natural history of America, and at the same time its natural resources, to the preservation of memorials of its aboriginal inhabitants, and the exposition of the arts and industries of America.

In referring to the industries of America it is not intended to recommend that anything similar to what is generally understood as an "industrial exhibition" should be attempted. The element of competitive display should not be admitted, and no two objects of *precisely* similar import should ever be placed side by side, least of all, if of modern manufacture. Such has hitherto been the policy of the Museum, and should it ever be interfered with, it is to be feared that much of the usefulness of the Museum would be destroyed, both from a scientific and educational standpoint.

The principal European museums have been carefully studied by officers of the Museum, and we have already profited largely by the knowledge thus gained of their successes and their failures. A report upon the great museums of the world is in preparation and will probably be published next year.

It must be remembered that the "National Museum" is actually of recent origin, although the *idea* has been under consideration for many years. As recently as 1877 the appropriation made by Congress for its support was only $10,000. The "National Museum" was not recognized by that name in the Congressional appropriation bills until 1876, although the term was used in the reports of the Secretary of the Smithsonian Institution as early as 1868,* and although the national collections were transferred to the custody of the Institution in 1858, in accordance with the act of incorporation passed in 1846, by which it is provided that "all objects of art and of foreign and curious research, and all objects of naturul history, plants, and geological and mineralogical specimens belonging or hereafter to belong to the United States, which may be in the city of Washington," shall be delivered to the Regents of the Smithsonian Institution, and, together with the new specimens obtained by exchange, donation, or otherwise, shall be so arranged and classified as best to facilitate their examination and study.†

Nearly half a century has passed since the United States, by the provisions of the will of James Smithson, first became proprietor of a scientific collection, in the shape of the Smithson minerals and meteorites; it is forty-five years since the National Institute was founded, with great prestige and influence, for the avowed purpose of organizing a National Museum of Natural History; forty since Congress threw upon the Regents of the Smithsonian Institution the responsibility of caring for the so-called "National Cabinet of Curiosities;" twenty-nine since this responsibility was finally accepted and these collections were transferred to the Smithsonian building; thirty-seven since the Institution began to make collections of its own; ten since Congress formally adopted

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* See Report Smithsonian Institution, 1867, p. 55.

† An act to establish the "Smithsonian Institution" for the increase and diffusion of useful knowledge among men. (Approved August 10, 1846; Revised Statutes, title lxxiii, sections 5579-5594.) See also Revised Statutes, section 5586, and Statutes Forty-fifth Congress, third session, chap. 182, p. 894.

the National Museum as its ward, and five since the Museum has had a shelter exclusively its own and an appropriation in any way adequate to the necessities of its administrative work. With the year 1880 began an epoch in the history of the Museum, since at this time Congress saw fit to recognize the claims of the Museum by increasing the appropriations for its preservation and installation from $45,000 to $145,000.

Their responsibility in the matter they had, however, recognized in 1879 by appropriating $250,000 for the construction of a fire-proof building. The claims of the Museum to increased support had been before them for three or four years, ever since, indeed, by their own act, in connection with the preparations for the participation of the Government Departments in the International Exposition in Philadelphia, and the valuable gifts of foreign Governments upon that occasion, the Smithsonian building had been filled to overflowing with unassorted material of the highest value for educational and scientific uses.

Thirteen years ago, as Assistant Secretary, I pointed out in my report to the Secretary of the Institution that the annual growth of the Museum was undoubtedly greater than that of any other in the world; that is, so far as the accession of great masses of material was concerned. The increase at present is much greater than formerly, but the accessions are much more manageable, owing to the larger number of assistants employed. For twenty years the Assistant Secretary of the Smithsonian Institution, with the help of one or two laborers and such students as happened to volunteer their aid, performed all the duties of curatorship of the national collections. It was not until 1874 that a special staff of Museum assistants was recognized, with duties apart from the executive work of the Institution, and not until 1875 that the office of curator was established, that office being held by the assistant secretary from 1875 to 1878. Up to 1880 there was still but one curator, with a number of "assistants," but during that year an executive officer, with the grade of assistant director, was appointed, and the five principal assistants in the Museum were designated curators. The present organization of the personnel, then, dates back only five years, to the time when preparations were being made for taking possession of the new building.

The staff, as now organized, consists of two classes, the scientific officers or curators, and the administrative officers; the former reporting to the Director of the Museum, the latter to the assistant director, who also has general supervision of the administrative work of the curators.

There are at present 28 curatorships, some of which are divided, so that the number of heads of departments or sub-departments is 26, and the total number of men in the scientific staff 30, of whom 13 are in the pay of the Museum, and the others are honorary, some being detailed for this duty by the Director of the Geological Survey, by the Director of the Bureau of Ethnology, others by the Commissioner of Fish and Fisheries, and by the Secretary of the Navy, two being volunteers. It may be stated that these details are in every instance made in the interests of co-operation by those Bureaus of the Government engaged in work closely connected with that of the Museum. The paleontologists of the Geological Survey find it so much to their advantage to have access to the paleontological collections of the Museum and the use of the laboratories, storage cases, and general administrative appliances of the Museum, that they are permitted by their chief to assume the responsibilities of curatorships and perform a general work of supervision. In nearly every case, however, the Museum supplies the honorary curators with assistants, who relieve them of much of the routine work.

Very few important changes or additions have been made during the fiscal year covered by this report.

In the departments of mollusks and of entomology, an assistant curator has been appointed, the honorary curators of these departments having found it impossible to attend to the routine work as well as identify, classify, and arrange the specimens for exhibition and study purposes.

A brief review of what has been accomplished in each department during the year will be, perhaps, the most satisfactory mode of bringing before the Regents the present methods and tendencies of the work in the Museum. I shall not however attempt to discuss the additions of the year, except so far as these are incidentally referred to as the results of explorations made under the direction, or with the co-operation of the Institution. A list of these, with geographical and topographical indices, and a list of donors, will be found in the second part of this report, in connection with the detailed reports of the Assistant Director and curators of the Museum upon its current work.

A census of the collections made in 1884 showed an estimated total of 1,471,000 "lots" of specimens in the Museum. The number at the present time is 2,420,934. The total number of "lots" of specimens received during the year and separately entered on the record of accessions is 1,496, including 6,890 separate packages. The construction of cases has been constantly in progress, and during the year there have been received and fitted for use and placed in the exhibition halls 84 cases, chiefly of the standard patterns. Forty-five storage cases have been made for use in the laboratories, 5,400 wooden drawers and trays, and 54,000 pasteboard trays. There have also been purchased 3,504 glass jars, for storage and exhibition of alcoholic specimens, and 24 barrels (1,115 gallons) of 98 per cent. alcohol.

The chief clerk of the Museum recently appointed has given much of his time during the past year to reorganizing and supervising the department of property and supplies; methodizing and formulating rules and regulations for governing the same. The changes that have been made have already proven of great practical benefit, simplifying, as they do, methods of procedure in purchase of supplies and payment of bills, and of locating responsibility for kind and quality of articles furnished and for their proper use and care.

The distribution of duplicates has been much the same as in previous years. About twenty-four thousand specimens have been sent out to 118 institutions and societies; those to institutions in the United States are generally gifts, though many were sent in the way of exchange. For all foreign sendings, equivalents in the way of exchange have been received or promised.

The total number of visitors to the Museum building has been 174,225, to the Smithsonian building 88,960; the total number considerably exceeding 200,000. Over 1,000,000 persons are estimated to have visited the Museum since the completion of the new building.

The publications of the Museum have been carried on with greater activity than usual during the year, Bulletins numbered 23, 28, 29, and 30 having been published.

In addition to these Bulletins the manuscript of No. 31 was put in type during the year. Volume VII of the Proceedings of the Museum for 1884 was published in its complete form, and the printing of Volume VIII for 1885 was completed, and an edition of 200 copies distributed in signatures. This form of publication has been adopted to secure the rapid promulgation of the work of the Museum, and the signatures are placed at once in the hands of the principal scientific institutions and of specialists who are directly interested in the work in progress in the Museum. The remainder of the edition of 1,000 copies is published in bound volumes, and in time appears for general distribution in the miscellaneous collections of the Smithsonian Institution.

An order for the publication of Volume IX of the Proceedings (for 1886) was not obtained from the Secretary of the Interior until after the close of the fiscal year, and for six months the Museum was without any means of publishing the results of its current work. Several papers which properly should have been published in this serial were sent elsewhere to be printed. The Proceedings of the Biological Society (published with the co-operation of the Smithsonian Institution) was employed to relieve this temporary lack of publishing facilities. Important papers by Mr. Ridgway upon the Birds of the Island of Cozumel, and other papers by Messrs. Bean, Dresel, Dall, Riley, and Rathbun were made public through this medium.

The total number of pages published by the Museum during the year was 1,642, and that of papers 48; the total number of labels printed was about 6,000. It has not been found necessary to introduce any changes in the general style of type or form of the labels. The number of labels now on file is about 25,000, and requires the constant attention of one person to care for and store them in proper condition for ready reference. They are arranged in standard unit drawers, about 100 in number, and are delivered to the curators of the several departments as may be required. There is still much work to be done in labelling specimens, and it has been found necessary, on account of the time required in printing, to prepare written labels for temporary display with many of the exhibits.

The work of the Museum library has been developing on the old lines of administration, and in addition to the central reference library, which now includes volumes and pamphlets, sectional libraries have been established in the scientific departments, each under the control of the curator, and including the works especially needed by him in his daily work. All the sectional libraries are, of course, under the supervision of the librarian.

One of the principal improvements of the year has been the placing of temporary covers on the collection of pamphlets (of which there are over 2,000) constituting that part of the library which is most frequently consulted.

The operations of the staff of preparators are discussed at length in their proper place. The amount of work accomplished has been equal to that of previous years, and it is a source of satisfaction to know that the standard of excellence is improving, not only in respect to individual excellence but in the manner of labeling and displaying the collections in the exhibition cases. We are constantly called upon for plans of the cases and fittings in use in the Museum, and also to allow officers of other museums opportunities to study our methods of administration. At no time during the year have there been less than six or eight students thus engaged. In response to such applications, as well as to the letters which are almost daily received, making inquiries into our methods of work, it is our policy to make a cordial response. It is considered germane to the objects of a national museum to render the results of its labors useful to similar institutions throughout the country, and to encourage in this way, as well as by the distribution of specimens, the growth of the museum idea in the United States.

For the purpose of encouraging the new school of taxidermists and giving encouragement to the movement for the improvement of mounted animals in the Museum, a space has been allotted in one of the exhibition halls to the Society of American Taxidermists, and already a very creditable collection has been placed on view, the object of which is to explain the improved methods of modern taxidermy, and to show examples of what is considered the highest artistic and mechanical perfection in the art. A number of prize pieces from the annual exhibitions of the Society of Taxidermists have been given or lent by their authors. This collection is under the charge of Mr. Hornaday, chief taxidermist of the Museum.

The collections sent to the New Orleans Exposition, were all returned to the Museum shortly after the beginning of the year, and have long since been restored to their proper places in the exhibition or reserve series. A considerable number of duplicates thus returned have been placed in storage subject to future calls of similar nature. The assistant director, who represented the Smithsonian Institution in the Government Board in charge of exhibition work, has completed and handed in to the chairman of the Board his portion of the official report, and (so far as we have been informed) the work of the Board has been completed. A number of exhibits obtained by the State Department for the second New Orleans Exhibition have, since its close in April, been turned over to the Museum by Mr. C. S. Hill, the representative of that Department.

I. *The Department of Arts and Industries.*—In this department, which is under the curatorship of the Assistant Director of the Museum, Mr. G. Brown Goode, are assembled together for convenience a number of special collections mainly of recent origin which may very possibly in future be grouped in quite different relations. The scope is necessarily general and indefinite, and I shall simply call attention to the present condition of some of the most important groups of objects which it contains.

The section of textiles already includes a very full series of the animal and vegetable fibers used throughout the world, together with good representations of devices for spinning and weaving, and of the various products of the textile industries. This collection is nearly all permanently installed, provided with printed labels, and illustrated by diagrams. For lack of room, fully half of the material ready for exhibition has been stored away, and the cases prepared for its display are in boxes in the Armory building. The space assigned to the exhibition series is still so crowded that the objects cannot be satisfactorily examined. Work upon this and other allied technological sections under the charge of Mr. Romyn Hitchcock, being so greatly impeded for lack of accommodation, he applied for and obtained a furlough of two years, and, having accepted a professorship in the University of Osaka, in Japan, is making a special study of Oriental technology.

To the collection of food substances, also under the charge of Mr. Hitchcock, is assigned a large quantity of unassorted material. The few cases now on exhibition contain the foods of the North American Indians, of Japan and China, and some of the more curious and unusual articles of diet. There are also two cases of educational importance which exhibit graphically the composition of the human body and its daily expenditure of tissues and the manner in which this is compensated for by daily rations of food. This collection is modeled after the famous collection of similar character prepared by Dr. Lankester and others for the Bethnal Green Museum in London. It is however based upon an entirely new series of analyses, and upon a revised plan prepared by Prof. W. O. Atwater, of Wesleyan University, and corresponds to the latest views in physiological chemistry.

The collections in chemical technology already have a good nucleus, and the chemical manufactures and their products and methods should ultimately occupy a prominent position in the plan of the Museum. The material now on hand is only incidentally displayed, and a considerable portion of it is temporarily appropriated with the materia medica collection.

The collections of materia medica are still under the charge of Dr. H. G. Beyer, U. S. Navy, detailed by the Surgeon-General of the Navy for this special duty. Its increase during the year has been greater than during any previous year except the first, when the nucleus of the collection was formed from the collections received from different national departments at the Centennial, and the gifts of W. H. Schieffelin & Co., of New York, the accessions having been remarkable for their interest and value. Amongst the most important accessions may be mentioned those received from the Governments of Jamaica, Japan, and Mexico; the collection of Dr. Edward Palmer from the States and Territories of the Southwest; and the gifts of F. Stearns & Co., of Detroit, Mich., and W. S. Thompson, of Washington, D. C.

There are 3,326 specimens on exhibition, to 1,457 of which are attached printed labels. The entire collection now includes 4,850 specimens, and 409 entries have been added to the catalogue during the year. A descriptive catalogue of the collection is now in preparation and will probably be completed in the coming year.

The attention of the curator has been devoted especially to perfecting and completing the collection in accordance with the very elaborate plan which is presented in Part II, of the Museum Report.

In addition to the work upon the collection the curator has been carrying on important investigations on the physiological action of drugs. Seven original papers embodying the results of his investigations have been published, two are in press, and others are in progress.

Since the hall containing the fisheries collection was opened to the public, in May, 1884, there has been constant improvement in the condition of the material exhibited, and a number of important additions have been made, although from the fact that the collections are already so complete, its growth has been comparatively less extensive than that of the other departments. The fisheries of North America are already so thoroughly represented that there can be but little necessity for extending this portion of the department except by keeping it abreast of the time, by exhibiting modern improvements in apparatus, and by the building up of certain local series of slight importance, such as the Chinese fishery apparatus from the Pacific coast. There are still wanting illustrations of the foreign fisheries, some of which have been filled since this department has been referred to in this report. Important collections have been received from the Government of Siam, through Minister Halderman; from the Government of Japan; and the extensive collections from Great Britain, Sweden, Spain, France, Holland, and Greece, acquired at the close of the London Exhibition, have been since incorporated in the exhibition series.

No department of the Museum is perhaps more at a disadvantage from the limited space which it occupies than this. In the recent exhibition at London, the American section alone occupied nearly three times the space which is here occupied by fishery exhibits from all parts of the world. Many important things cannot be displayed, others of interest are suspended from the wall at so great a height that they are seen by but few, and cannot be examined by those who know of their existence, while it is impossible to group together by countries, properly, series of specimens which would be much improved by this kind of installation. Furthermore, the cases are so closely massed that the availability of the collection is interfered with. The section of fish-culture is almost entirely crowded out, many of the most important objects having been sent elsewhere for storage. The fisheries collection has been for the past two years under the curatorship of R. Edward Earll, who also has in hand the collection of animal products, which, since the return of the collections from the New Orleans Exhibition, has been installed in a very effective manner in one of the large central halls. This collection, which was begun in connection with the Philadelphia Exhibition and greatly extended for that of New Orleans, is of great popular interest, as well as of considerable economic importance. The 1,597 specimens now on exhibition illustrate the applications of all products derived from the animal kingdom in the arts and industries. Not more than half the material available for the purpose is now displayed to the public, though this collection like that of fisheries is one which derives much of its value from having each class represented by a large number of specimens, since every additional well selected object adds to the interest of the objects exhibited. The total number of specimens is 2,793.

The collection of historic relics includes objects of national interest relating to the history of soldiers, statesmen, and important events, and includes several hundred objects. This collection has been increased during the year by the addition of many manuscript papers, including letters, military orders, and other official papers, pertaining to the colonial Government and to the periods of the Revolutionary and later wars. The most prominent exhibit is that of the Washington relics, transferred to the Museum in 1883 by the Commissioner of Patents, and consisting of several hundred objects, including many articles of household use, that belonged to Washington, besides his tents and camp equipage, used by him during the Revolutionary war. There are also many relics of other soldiers and naval officers, presented to them by foreign Governments. Among these may be mentioned swords and guns presented to President Jefferson, Commodore Perry, General Ripley, General Grant, and others. There are also memorials of many of the Arctic expeditions sent out by the United States and English Governments during the last forty years, including relics of Sir John Franklin, McClintock, Kane, Hall, and De Long's expeditions. There have been added during the year a number of relics of the Southern Confederacy, and it is hoped to largely increase this interesting collection by the addition of similar memorials of the Northern armies. The collection of coins and medals is receiving some additions, and already about 2,000 specimens have been placed on exhibition. The medals pertaining to the history of the United States were deposited in the Museum by the Director of the Mint, and include bronze copies in duplicate of all the medals that have been struck at the Mint since its organization. Numerous foreign medals, presented to the Smithsonian Institution at various times, are also arranged in this collection. The coin series is fast increasing, and much work has been done in classifying and labeling about 2,000 specimens of ancient Greek and Roman coins, recently presented to the Museum. It is intended to arrange a series of the coins by countries, showing with them also paper currency and postage stamps, giving, as far as possible, the history of each coinage. Mr. A. Howard Clark has been placed in charge of this specialty.

Closely related to the historical collection is the series illustrating the history of steam transportation, under the charge of Mr. J. E. Watkins, of Camden, N. J. The John Bull engine, imported from England in 1831, the model after which all subsequent American engines have been constructed, has been given to the Museum by the Pennsylvania Railroad Company and placed on exhibition; and adjoining this is a case in which there are already assembled about forty objects illustrating the beginnings of the American railroad system. It is greatly to be hoped that this important subject may be given an opportunity to grow.

The collection of scientific instruments owes its interest at present chiefly to the historical associations of most of the apparatus displayed, including as it does instruments used by Priestly, Henry, and Hare. The original telegraphic instrument of Morse and Vail is also here shown.

The collections of musical instruments, modern pottery, and porcelain, lacquer, and the process of engraving are partially displayed, and when cases and floor space shall become available, will soon develop into important features.

II. (A) *Department of Ethnology.*—The growth of the department of Ethnology during the year has been very great. The principal efforts of the curator, Prof. O. T. Mason, are still in the direction of reducing material to systematic order and arranging it in a manner available for future study and exhibition. Much more space is necessary for the proper prosecution of this work. Owing to this fact, as well as to delay in construction of cases and printing of labels, several series nearly ready for final display cannot at present be exhibited.

The department, although one of the largest, is one of the youngest in the Museum. To the science of ethnology have not been applied hitherto those rules of strict classification long prevalent in the other natural sciences, and it has fallen to the lot of the new curator to develop a detailed system of arrangement in connection with the preliminary handling of the collections. With this object in view, certain rooms and areas have been assigned, and in these have been grouped, with special reference to their final installation, certain large classes of objects, such as the weapons of war and the chase, implements of agriculture, and other primitive industries. In addition to these great series of objects, classified according to function, other groups of objects have been arranged in accordance with another idea of classification, which is deemed of equal importance, namely, that of race.

The Eskimo collection, for instance, has been arranged in table cases in one of the exhibition-halls, in accordance with the ethnic idea, although in the minor details of classification function and form, as well as geographical distribution, have been followed.

A preliminary study of the collection of basketry has been completed. A paper upon the baskets of uncivilized peoples, with numerous illustrations, was published in the Museum report for 1884, and a representative series placed on exhibition with provisional labels. The throwing-sticks and sinew back-bows have been the subject of papers, and are now on exhibition. The curator has in progress investigations upon several groups of objects, notably the history and technology of archery; upon transportation as effected by man without the aid of domestic animals or mechanism; upon the peculiar industries of several handicrafts; upon the Hoopah Indians of California.

The underlying ideas in these investigations, a first installment of which was published in the last report of this Museum, are (1) that the methods of strict classification and nomenclature already applied in the other natural sciences are equally applicable to anthropology; (2) that a trustworthy and minute study of modern savage and barbarous technique is absolutely requisite to the archæologist and technologist in reconstructing the history of civilization.

II (B). *Department of American Aboriginal Pottery.*—The collections in this department have continued to increase with astonishing rapidity, and the extensive accessions which have been received through the Bureau of Ethnology, and from other sources, have been of the greatest scientific importance and popular interest. One of the four large central halls of the Museum is devoted entirely to this subject, and the removal of the collections of South American aboriginal pottery and of the extensive collections from the mounds which have for many years been accumulating in the Archæological Hall of the Smithsonian building, have filled it up to such an extent that it is difficult to find room for the new material as it comes in.

During the year a portion of the hall has been thrown open to the public, although it has been necessary to retain one-half of the floor space as a work room. The exhibition case surrounding the walls of this room is probably the largest in existence in any museum, being 260 feet in length, 4 feet 9 inches in depth, and, being double throughout, its entire length is virtually 520 feet. Double the space now allotted this department is necessary for its proper display, and the value of the material here concentrated is practically inestimable, since even the modern tribes, who are still making pottery similar in its general character to that which is here preserved, have deteriorated to such a degree in their artistic capacity or skill, that their products are not therefore an exponent of their original artistic capabilities. So exhaustive and monographic is this collection that it is impossible that any thorough work can be done upon the American aboriginal pottery which shall not in great part be based upon this collection.

The detail from the Bureau of Ethnology of Mr. William H. Holmes as honorary curator of this department has been continued.

In addition to his administrative work, he has been engaged in the preparation of a monograph of a number of collections from the province of Chiriqui in Colombia.

The collections made under the direction of the Bureau of Ethnology in the Mississippi Valley by Dr. Cyrus Thomas, are deserving of special mention, as well as those of Col. James Stevenson and Mr. E. W. Nelson in the Pueblo country of the Southwest.

III. *Department of Antiquities.*—The report of the curator, Dr. Rau, for the current year, is an exhaustive geographical review of the accessions, some of the most important of which are illustrated by drawings. The total number of accessions has been 2,751; all excepting 84 were of sufficient importance to be added to the exhibition and study series, which now include over 40,000 specimens. In the arrangement of the archæological collections, Dr. Rau is taking advantage of the additional space placed at his command by the removal of the ethnological collections to the new building, to display his material in a manner more instructive to the public and more useful to the special investigator.

The general collection is now, and was in the past, arranged primarily by material; all objects of stone are together, as are also those of copper, bone, horn, shell, clay, and wood; secondarily by form and function, stone pestles, arrow-heads, or knives are placed together, the rudest and most primitive beginning the series, the most perfect at its close, the locality of each specimen being clearly indicated upon its label. Stone celts are arranged, and similar groups are made of hammered knives, &c.; thirdly, a progressive arrangement is adopted, the rudest and most primitive of the celts, for instance, being at the beginning of the series, and the most perfect and elaborate at the end.

During the year one hundred and nineteen of these special collections have been placed on exhibition. This form of special collection is becoming of great importance in this department as well as in the department of ethnology which has already been referred to. The rapid increase at the present time in the department of archæology is due to the work done by the parties sent out for exploration by the Bureau of Ethnology. This policy, although more thoroughly carried out than has been practicable hitherto, dates back to the early history of the Museum. Certain monographic collections of this sort have been on exhibition since 1870 or longer.

Dr. Rau is engaged upon the preparation of an illustrated work on North American prehistoric objects, which is designed to serve as a guide for visitors to the department and as an explanation of the terminology of North American archæology. This will bear the title, "A Classification of the North American Prehistoric Relics in the United States National Museum." This book will be fully illustrated and it is hoped will be published in the ensuing year.

IV. *Department of Mammals.*—The most important accessions to this department in this, as in previous years, have been in the shape of single specimens sent from zoological gardens and menageries, which have shown a great deal of liberality to the Museum in this respect.

The administrative work of the department has been directed chiefly to the preparation for an entire rearrangement of the exhibition series, when the promised new cases shall have been completed. Many of the most valuable specimens in the mounted series are of such a large size that it has not hitherto been practicable to inclose them under glass or to protect them from mutilation. The larger laboratory rooms into which the department moved just before the beginning of the year have been utilized for an entire rearrangement of the collection which hitherto has been stored in the bases of the cases in the exhibition hall. The entire collection has been carefully studied and identified with the exception of the *Soricidæ*, and good progress was made in the preparation of the card catalogue of the collection.

The curator, Mr. F. W. True, has in progress extensive investigations on American cetaceans, and is at present engaged upon a revision of the dolphins of the world. During the yearhe visited various points on the coast of North Carolina, in behalf of the Fish Commission, to secure material for his work. A report was prepared during the year upon the mammals collected by E. W. Nelson and C. L. McKay in Alaska.

V (A). *Department of Birds.*—The growth of the department during the year has been very satisfactory, the number of specimens added to the collection being 4,147. The largest single accession was the collection made by the U. S. Fish Commission steamer *Albatross* in the Bahamas, of 1,000 specimens and about 75 species, of which 5 were new to science. Another valuable collection, 243 specimens, 81 species, 1 new to the fauna of North America, was obtained in Alaska by Mr. Charles H. Townsend while on a mission for the Fish Commission. Mr. Henry Seebohm, of London, has given to the Museum 171 specimens, 68 species, chiefly from Siberia, and of great value to the collections.

An important part of the administrative work of the curator has been the extension of the collections through exchange, and several of the most important accessions have been thus acquired. Among the most important exchanges have been those with the Musee d'Histoire Naturelle, of Paris, 86 specimens, 79 species, from Madagascar and Cochin China; with the British Museum, 225 specimens, 179 species, from India and Europe; with the Mexican Geographical Exploring Expedition, 135 specimens, 75 species, and with Count Hans Von Berlepsch, of Münden, Germany, 60 specimens, 50 species, of South American birds. Two thousand five hundred and eighty-one specimens have been sent out in exchange and a full equivalent received. The routine work has been pushed forward as rapidly as possible, the exhibition series having been entirely arranged and twelve additional exhibition cases filled. More than half of the mounted collection has been transferred to exhibition stands of the improved standard, recently adopted. The final labeling of the exhibition series has been deferred by delays at the Government Printing Office, and advantage has been taken of the delay to revise the labels, in order that they may accord with the order of classification adopted by the American Ornithologists' Union. The "Code and Check-list of North American Birds," adopted by the American Ornithologists' Union, which has been published during the year, was prepared by a committee of the Union holding its sessions in the Ornithological Laboratory of the Museum, and the systematic work involved was based upon the national collections. The almost universal adoption of this check-list in America, and the consequent harmony of arrangement between the national collections and those in museum collections throughout the country, will not only greatly facilitate the work of this department in the future, but will be of great advantage to the progress of ornithology.

The curator, Mr. Ridgway, and the assistant curator, Dr. Stejneger, have published about fifty papers upon the collections during the year, occupying about 500 octavo pages.

Among the investigations in progress are Mr. Ridgway's studies of *Empidonax*, *Puffinus*, *Larus*, *Æstrelata*, *Colinus*, and *Lagopus*. Mr. Ridgway has also in preparation a manual of North American birds for the use of naturalists and sportsmen. Dr. Stejneger has in preparation a monograph of the birds of Japan, for use in the preparation of which the Japanese Government has sent out a large number of specimens.

Another important research completed during the year was that by Professor Ferrari-Perez, of the Geographical Exploring Expedition of Mexico, upon the birds of Mexico, the entire collection of birds among the national collections having been brought to Washington for determination and comparison, and his paper being based upon the studies of the two national collections.

The number of specimens in the collection is now 55,945, 7,000 of which have been set apart for the exhibition series. The universal cry for more space is especially loud from the ornithologists, who might readily fill it with material suitable for exhibition.

V (B). *Department of Oology.*—The collection of eggs and nests of birds has been under the honorary curatorship of Capt. Charles E. Bendire, U. S. Army, and very much has been accomplished during the year in its classification and arrangement. The total number of specimens added is 2,556 in 253 lots, and there are now more than 44,000 specimens in the collection, of which 1,491 are in the exhibition and 31,124 in the reserve collection, the remainder having been set aside as duplicates. The most important accession of the year was obtained in exchange from Capt. B. F. Goss, of Pewaukee, Wis., 641 specimens, 111 species. Captain Bendire has continued his own gifts to the Museum. Another important accession is the collection obtained by the *Albatross* in the Bahamas in 1886. The oological collections are arranged in an inconvenient apartment in the Museum, and, if space allowed, should be assigned an apartment at least twice as large, in proximity to the ornithological collections.

VI. *Department of Reptiles.*—The department has continued under the honorary curatorship of Dr. H. C. Yarrow. The collections are massed together in a small basement room, and a series of painted casts of the largest species of snakes and turtles of North America is the only portion of the collection displayed to the public. This collection is exceedingly rich, nearly every species of North American reptiles and batrachians being included, and the total number of specimens being estimated at 25,334. An exhibition series of 750 specimens has been selected, but there is no room for its display. During the year Prof. E. D. Cope, of Philadelphia, who has been occupied, under the direction of the Smithsonian Institution, in the preparation of a report upon the reptiles of North America, has completed the identification of the Museum collection of batrachians, and has identified and described in Museum publications collections made by the various correspondents of the Museum in Mexico and Central and South America.

VII. *Department of Fishes.*—In no department of the Museum perhaps is there so great a discrepancy between the extent of the collections and the amount of space available for their administration, and the progress toward an ideally satisfactory arrangement is therefore greatly retarded. Good progress has been made during the year, however, and the curator, Dr. T. H. Bean, reports that all the material under his charge, except recent collections made by the U. S. Fish Commission in the deep-sea regions of the Atlantic, has been catalogued, the total number of entries at the end of the year being 37,893, of which 662 have been made during the year. The work of preparing illustrations of the most important of the American species has been carried forward by the curator, and drawings of 78 species have been made.

The card catalogue of the reserved series, which has been in preparation for several years, has now been completed, and this card-catalogue, it is needless to say, proves to be invaluable as an aid to speedy access to the specimens, as well as being a readily available systematic index to the entire collection.

A large amount of duplicate material, including at least 15,000 specimens, has been set aside for distribution, and is ready for exchange or distribution as soon as time can be spared to separate it into lots and packages.

The entire collection has been overhauled and put in the best possible condition. An idea of its extent may be given by the fact that in order to fill up bottles that have become partly empty by evaporation and replace the alcohol, which had become unfit for use, twenty-five barrels of alcohol were required.

The bulk of the larger specimens is still necessarily kept in copper tanks; but everything that could be conveniently transferred to glass has been placed in jars during the year, thus securing greater accessibility and safety from destruction.

Heavy drafts have been made upon the time of the curator through his occupation as editor of the publications of the Museum, and it is hoped for the good of the Department that he may be relieved of this extra service. He has, however, carried on the customary amount of special research, having identified and reported upon a collection of fishes from Jamaica, forwarded by the public museum of that colony; on a collection of fishes from Alaska, sent in by Lieut. Commander H. E. Nichols, U. S. Navy, besides a collection of fishes from Central Mexico sent in by Professor Dugès.

Much of the research work of the curator has, however, in connection with Mr. Goode, been directed towards the preparation of a report upon the extensive deep-sea collections of the U. S. Fish Commission, and those obtained by Mr. Alexander Agassiz in connection with the work of the U. S. Coast Survey.

The work of this department was, during the months of August and September, 1885, transferred to the Fish Commission headquarters at Wood's Holl, where all the deep-sea collections were concentrated, overhauled, classified, and catalogued, and systematic investigations carried on—a portion of the results of which has already been made public, and the remainder of which it is hoped will soon appear in a monograph of the deep-sea fish fauna of the Eastern Atlantic, which has been for some years in preparation.

The ease with which this extensive collection was handled in the large rooms which were available for the purpose at Wood's Holl, offers an illustration of the great need for the better accommodation of the fish collection in Washington. Work was finished in a few weeks at Wood's Holl which it would have required four or five months to have accomplished in the cramped work-rooms in Washington. The collections which under these more favorable conditions had been overhauled, identified, properly catalogued, and arranged were returned to Washington in October and November, and replaced upon the shelves in systematic order, where they are now being worked up as rapidly as possible.

IX. *Department of Mollusks.*—The department of mollusks under the curatorship of Mr. W. H. Dall and Mr. R. E. C. Stearns, has made extensive progress during the year, especially in the matter of cataloguing and arranging the accumulations of past years. The amount of work accomplished is well shown by the number of catalogue entries, which is 18,638, representing between fifty and sixty thousand individual specimens. Only three times as many entries were made in the catalogue of this department during the preceding twenty years. The number of entries does not represent the accessions of the year which contained, however, much that was valuable and interesting. The classification and systematic arrangement of the accessions of previous years, especially the Jeffreys collection and the Stearns collection, have made extensive demands upon the attention of the staff. It may fairly be said that there never has been an exhibition collection of mollusks, although many years ago a few cases of shells were incidentally displayed. A beginning has been made by the curator in the work of developing this collection, and one experimental case containing the chief types of cephalopods, pearls and pearl formations, cameo shells, and sections showing the internal structure of various large and ornamental species, has been placed on exhibition. A provisional display is also made of the principal economic mollusks of North America. There is, however, no space available for exhibition of molluscan collections, and the laboratory rooms are inadequate and inconvenient, so that even the task of making the collections available for the use of students is much more difficult than it should be, and what is being done may be looked upon as preparatory to the occupation of more suitable apartments when such shall have been provided.

The main features of the work of the year may be stated as follows: The identification of specimens for teachers and others in various parts of the United States; the identification and classification of the recent or living mollusks of the Atlantic coast of North America, as well as those of the Antillean-Caribbean region, in order to facilitate comparison and investigation of the later fossils with related living forms; the arrangement of land, pond and fluviatile gastropods, as well as the fresh-water acephala for the purposes of comparison and investigation in the matter of geographical distribution and variation of species as related to and affected by environment and environmental conditions.

The foregoing, as a whole, bears directly or indirectly upon the geological phenomena and physical conditions, present and past, of the continent of North America, &c., and the connection of the latter with the Asiatic and European continents. Ultimately by means of the ample collection of Jeffreys in Great Britain and Northern Europe, of Dall in Alaska and the North Pacific, of Stearns' West American and general collection, and the accumulations of molluscan forms received from the U. S. Fish Commission, the student will be enabled to pursue the biological history and connections of the two great oceans which bound the North American continent, as well as the opposite regions of Europe and Asia.

Among the most important investigations in progress is that of Mr. Dall upon the deep-sea mollusks, and his studies upon the Quaternary molluscan fauna of the United States, and the continuation of previous investigations by Mr. Stearns on the geographical distribution of the land and fresh-water mollusks of North America and the variation of the same, as related to and affected by the physical characters of their environment.

X. *Department of Entomology.*—Although the department of insects in the National Museum was organized three years ago, little has hitherto been attempted beyond the care-taking necessary for the preservation of the material already on hand; the honorary (or unpaid) curator of the department, Dr. C. V. Riley, having had comparatively little aid from the Museum appropriation in the matter of construction of cases or the employment of assistants. At the beginning of the present fiscal year a salaried assistant-curatorship was established, to which Mr. John B. Smith was appointed. Additional accommodations in the laboratory and exhibition hall had been provided, and the study-collections and the exhibition series are now being rapidly extended.

In October, Dr. C. V. Riley formally presented to the Museum his private collection of North American insects, representing the fruits of his own labors in collecting and study for over twenty-five years. This collection contains over 115,000 pinned specimens, and much additional material unpinned and in alcohol.

This generous gift to the Government has long been contemplated by Dr. Riley, whose ambition it is to be, so far as possible, instrumental in forming a national collection of insects, and who is satisfied that his collection will form an excellent nucleus for future accumulations. In his letter of presentation he remarks:

"While the future of any institution dependent on Congressional support may not be so certain as that of one supported by endowment, I make this donation in the firm belief and full confidence that the National Museum is already so well established in public estimation that it must inevitably grow until it shall rival and ultimately surpass other institutions in this country, or the world, as a repository of natural-history collections.

"If there shall in the future result the concentration here at the national capital of the extensive entomological material which naturally comes here, and which in the past has been scattered among specialists in all parts of the country, so that in the future the student may find valuable material to further his work in any order, I shall feel amply rewarded for the action I have taken."

A recent census of the national collection of insects has been taken, the results of which are published in the curator's report for the year.

XI. *Department of Marine Invertebrates.*—The U. S. Fish Commission has continued to be the principal contributor to this department, which is in charge of Mr. Richard Rathbun. The steamer *Albatross* remained in active service during the most of the year, making explorations along the entire eastern coast of North America, from the Grand Bank of Newfoundland to Southern Florida and the Bahamas. A large part of the region visited, and especially the important fishing banks located off the coast of the British provinces and the deep-water areas about the Bahama Reefs, had never been systematically investigated before, and the biological results were, therefore, of the greatest value. Over two hundred and fifty successful hauls were made with the dredge, beam trawl, and tangles, the deepest cast having been in 2,731 fathoms, or considerably over 3 miles. The amount of material obtained was very large, and many of the groups of marine invertebrates are now in the hands of specialists for study. Important contributions were also received from other sources: notably a fine series of deep-sea soundings from the southern Atlantic and Pacific Oceans, made by the U. S. S. *Enterprise*, and large collections from the Western and Northwestern coasts off America and Siberia. One of the most interesting accessions consists of microscopical preparations of nearly two hundred species of British sponges, mainly described or identified by the late Doctor Bowerbank, and supplied by Canon A. M. Norman, a distinguished English naturalist, to whom the Museum was previously indebted for important exchanges.

The west hall of the Smithsonian Institution, which has served as a work-room for this department during most of the past three years, has been permanently opened to the public, although no considerable changes have recently been made in the arrangement of the display collections. The northwest gallery of the main hall is now used for the storage and examination of the dried specimens of marine invertebrates, and an additional large store-room has been fitted up in the basement for alcoholic collections which have had an unparalleled growth during the past few years. The work of identifying the collection of Echini has been completed, and that group is now conveniently arranged for reference and study. It contains 152 species, many of which are represented by extensive series of specimens covering a wide range of distribution. A list of all the specimens has been prepared for publication. The Hon. Theodore Lyman has continued his work upon the collection of Ophiurans belonging to the Museum, and is now engaged in studying the specimens obtained by the steamer *Albatross* south of Cape Hatteras, and those from the western coast of North America, including Alaska. Prof. A. E. Verrill, Prof. S. I. Smith, and several other naturalists are still engaged as collaborators upon Fish Commission collections, some of which have been transferred to the Museum during the past year, while others are expected at an early date. Large numbers of duplicate specimens have been distributed to institutions of learning throughout the country.

XII. *Department of Comparative Anatomy.*—The work in this department, of which Mr. F. W. True is curator, is at present confined to a development of the osteological collection which is already of considerable dimensions and occupies one of the entire exhibition halls. The additions to this department have been comparatively few, the steady increase in the exhibition series of material being the result of cleaning and mounting skeletons which had come into the Museum in previous years. Attention has been directed especially to obtaining skeletons of thoroughbred domestic animals, and a considerable number of specimens representing the important breeds of dogs, have been obtained during the year. In this series a single case is devoted to the comparison of the vertebræ of the different groups of vertebrates. Of the cervical vertebræ a considerable number of typical forms have been placed side by side; in another series the dorsal, in another the caudal vertebræ. Another part of the series shows the limbs of the vertebrates arranged so that their parts can be readily compared. In still another case is exhibited the structure of bones and the teeth, and so on through the entire structure of the skeleton.

A card catalogue of the skeletons of the mammals, which constitute the greater bulk of the collection, has been completed.

XIII. *Department of Invertebrate Fossils*—(A) *Paleozoic Section.*—Mr. C. D. Walcott, of the Geological Survey, honorary curator, reports that the collection now contains over 80,000 specimens, of which 7,833 have been added during the year, a large portion of this material having been transferred from the Geological Survey. The collection has been personally arranged by him during the two years of his connection with the Museum, and is now contained in sixteen table-cases in one of the principal halls of the Museum. Nothing has yet been exhibited, but as soon as cases shall have been provided, a very interesting series already selected may be placed upon view. Mr. Walcott's attention is at present especially directed to the formation of a systematic collection of the Cambrian fossils of the United States, as well as for securing a study collection from typical localities in the Lower Silurian and Devonian formations.

The special research upon which Mr. Walcott is engaged in behalf of the Geological Survey is the study of the stratigraphy and paleontology of the Cambrian system of North America. During the past year the results of a preliminary study of the Middle Cambrian was published as Bulletin 30 of the U. S. Geological Survey.

(B) *Mesozoic Section.*—Dr. C. A. White, of the U. S. Geological Survey, honorary curator, reports a total of 1,563 entries in the catalogue during the year. The principal additions are those which have been sent by the U. S. Geological Survey. The work of arranging and classifying the collections has progressed steadily, and they are now accessible for purposes of study. The provisional arrangement is purely stratigraphical, only a broad biological classification having been attempted under each geological period. The type specimens have been re-identified by Mr. J. B. Marcou, who has published a catalogue of the same in the Proceedings of the Museum.*

(C) *Cenozoic Section.*—This department, organized since the change of Mr. Dall from the Coast Survey to the Geological Survey, in which he is officially serving as paleontologist in charge of the later formations, is practically incorporated with the department of mollusks.

XIV and XV. *Departments of Fossil and Recent Plants.*—The botanical collections are under the honorary curatorship of Prof. Lester F. Ward, of the U. S. Geological Survey, and Mr. F. H. Knowlton, one of the assistants of the Museum. The attention of the curator is chiefly directed toward the study of the fossil plants, a subject upon which he is now the principal American authority. His sketch of the history and present condition of fossil botany, published during the year as one of the bulletins of the Geological Survey, gives an excellent idea of the character of the work he has undertaken to accomplish in connection with the national collections. The number of specimens added during the year has not been great, attention having been chiefly concentrated upon the preliminary work of classification and arrangement. The herbarium of recent plants contains now not less than 30,000 specimens. The largest and most valuable accessions during the year were the collections from Texas and the adjacent States and Territories, gift of Dr. V. Havard, U. S. Army, the types of his paper upon "the Flora of Texas," published in the Proceedings of the Museum. An important piece of routine work accomplished has been the completion of the card-catalogue of the Joad collection of Old World plants, recently acquired from the Botanical Gardens at Kew, through the Harvard Herbarium. This collection contains about 10,000 species, 9,000 of which were new to the herbarium. The card-catalogue system, as applied to the arrangement of the American herbarium, has proved to be of great practical value, since it renders it possible to ascertain the presence or absence of any species without going through cases.

"This," remarks the curator, "is believed to be the only large herbarium in this country in which this system has been adopted, and the labor of keeping it up will be very slight compared with what it would be to prepare such a catalogue after the accumulation of a great mass of material. No species is considered as belonging to the collection

* Vol. VIII, pp. 290–344.

until its card has first been written and entered. Besides convenience of consultation, this system possesses another point of advantage in that it furnishes the source of a record, easily accessible, of the exact status and magnitude of the collections, a matter which is open to much speculation when no such data are at hand.

"The poisoning of specimens newly received has occupied much time. About 5,000 specimens have been permanently protected from the ravages of insects. A complete immersion of the specimens in a saturated alcoholic solution of strychnine has been found most efficacious.

"The work which has required the largest amount of time has been the selection of material for mounting. Instead of mounting indiscriminately the mass of duplicate material which constantly comes to a collection of this character, a careful comparison is always made in order to be certain that the specimens will actually add to the ones already in hand; either a different phase of the plant or a new and interesting locality. In this manner pure duplication is checked and the growth of the herbarium made to accommodate itself, as nearly as possible, to the present somewhat restricted space. As rapidly as the specimens selected can be mounted, they are added to their systematic place to the herbarium, so that no large amount of this new material is allowed to accumulate and remain inaccessible."

XVI. *Department of Minerals.*—The department of minerals, so long in a quiescent condition, is now making rapid progress under the direction of Prof. F. W. Clarke, of the U. S. Geological Survey, who is its honorary curator, assisted by Mr. W. S. Yeates. An extensive system of exchanges has been carried on during the year with private collectors and with a number of public museums, among which may be mentioned the École des Mines in Paris, the museum at Annecy in Savoy, the University of Sydney, Australia, and Amherst College, Massachusetts, and an unusual number of gifts have been received from individuals and institutions.

The total increase in the number of specimens during the year has been nearly 800. The number of specimens in the collection, including duplicates, is 18,401, about 4,500 of which are on exhibition. The exhibition space of the department is already overcrowded and the collection for public display cannot be increased until more cases can be provided. Much has been accomplished, however, in the improvement of the arrangement of both study and exhibition series, and the classification is more perfect than before. The collection of gems and ornamental stones has received its full share of attention, and a description of this will be printed in the Museum report during the coming year. Special attention has been given to the enlargement of the meteorite collection. The proper growth of this collection is greatly impeded, perhaps more so than any other, by a lack of funds for the purchase of valuable specimens which now invariably fall into the hands of dealers and foreign museums.

The scientific work upon the collection has been mostly done in connection with the work of the Geological Survey. Professor Clarke is engaged in an investigation of the chemical structure of the silicates, and there are also in progress in his laboratory in the Museum building a revision of the borates and a full series of analyses of the mineral tourmaline.

XVII. *Department of Lithology and Physical Geology.*—The increase of the department, though not so large as in the previous years, has been healthy and symmetrical. Among the more important accessions may be mentioned a collection of rocks and building stones of Mexico, obtained by exchange from the Mexican Geographical Exploring Expedition; a series of the rocks of continental Europe, obtained by exchange from the museum at Annecy, Savoy; a series of typical marbles from Pickens County, Georgia, gift of the Georgia Marble Company, and a series of building stones obtained from the State commissioner of South Carolina at the New Orleans Exposition, and a vertical column representing the proportional thickness of the Archean, Cambrian, and Silurian rocks of New Hampshire, obtained by exchange from Prof. C. H. Hitchcock.

The exhibition series has continued to increase, and all the available cases are already filled, and much material ready for display as soon as others are constructed. The time of the curator and his assistant has been fully occupied in the development of the exhibition series, in the preparation of copy for labels, and in the completion of classification of the study series. A number of beautiful and instructive relief maps, placed in the Museum by the U. S. Geological Survey, have been provided with cases and put on exhibition. Chief among these are the models of Mount Taylor, New Mexico; Washoe District, Nevada; Eureka District, Nevada; Uinta and Wasatch Mountains, Utah; Leadville and vicinity, Colorado; the same in sections; High Plateaus of Utah; Henry Mountains, Utah; stereogram of the Henry Mountains, Utah; Elk Mountains, Colorado; Yosemite Valley, California, and the Yellowstone National Park. Of the various exhibition series in process of preparation, the collections of rock-forming minerals, the structural series, lithological series, and the building and ornamental stones only are in condition approximating completion. Others, now under way, though in a less advanced stage, are the three series classed under the head of dynamical, structural, and historical geology. A portion of the materials belonging to these series are already on exhibition, being of themselves sufficiently striking in appearance to excite interest, though not occupying their proper places in the systematic collection.

The investigations of the curator, Mr. G. P. Merrill, have been directed chiefly toward the mineralogy of the District of Columbia, the origin and nature of fulgurites, the durability of building stones, besides studies on local petrograpy which are not yet ready for publication. The curator has also prepared a catalogue of the building stone collection now in the Museum, which will be published in the Museum report for the coming year. He has also in preparation a general work on economic petrography for the use of students, quarrymen, architects, and builders. The curator calls especial attention to the desirability of allowing the head of the department annually a certain sum of money to be expended in filling gaps in the exhibition series.

The total number of rock specimens in the collection is given as 20,647, 17,647 of which belong to the reserve series. Of the latter number, 5,313 are on exhibition, 2,730 of which are building and ornamental stones, and 1,829 belong to the educational series and rock-forming minerals.

XVIII. *Department of Metallurgy and Economic Geology.*—The attention of Prof. F. P. Dewey, curator of this department, has been devoted to classifying and arranging the mass of unassorted material which has been referred to in previous reports, especially the material received from the Institute of Mining Engineers, part of which was received during the year. It has not been the policy of the department to solicit accessions, owing to the fact that there is so much material already on hand which, owing to the lack of space, it has been impossible to bring under control. During the year work upon the preparation of the exhibition series has gone steadily forward, and as soon as the exhibition cases shall have been provided a large amount of material can be displayed. A preliminary display has been made of a portion of this collection, especially the systematic collection, the beginnings of which were exhibited at New Orleans. This material exhibited at New Orleans was intended to illustrate (1) the geological distribution of the ores of the United States and (2) the processes used in the extraction of the metals from the ores. A descriptive catalogue of the systematic collections has been prepared by the curator for publication in the Museum report during the coming year as a guide for visitors and as a foundation for future collections.

The curator has for three years been engaged upon the investigation of the physical properties of coke, and has already published a paper upon the porosity and specific gravity of different kinds of coke. In the prosecution of this work the department is aided by Maj. Jed. Hotchkiss, who has provided necessary apparatus. In connection with this work especial attention has been paid to the devolopment of the Museum collection of the cokes of the world, which is already of considerable extent and constantly increasing.

The curator called attention to the especial need of the Museum for special systematic collections gathered with reference to showing, first, the nature and the methods of occurrence of the various ores in different portions of the United States; second, the methods of mining, and third, the methods and processes of smelting. In connection with these collections of a scientific and technological character, it is desirable to illustrate in the Museum the condition of miners and their modes of life. This has already been done for the anthracite coal miners of Pennsylvania, and the screens of photographs, instruments, and clothing already on exhibition are of great interest. We hope that similar collections may be obtained in connection with other kinds of miners.

The total number of specimens in the collection is estimated at 48,000, of which 17,000 are on exhibition. During the year 5,506 entries, including 8,552 specimens, have been made.

BUREAU OF ETHNOLOGY.

The prosecution of ethnologic researches among the North American Indians, under the Smithsonian Institution and in compliance with law, was continued during the fiscal year 1885–'86 under the charge of Maj. J. W. Powell, who, as Director of the Bureau of Ethnology, has furnished the following account of its operations:

The account of the work for the six months ending June 30, 1885, as published in the report of the Secretary of the Smithsonian Institution for that period, being meager, for the reasons therein stated, some portions of the operations in the latter part of the year 1884–'85 are now included to preserve continuity.

The report may be conveniently divided into the two general heads of Field Work and Office Work, the latter to a large extent being the supplement to, and discussion of, the former, and executed by the same officers who had previously obtained materials and information in the field.

I. FIELD WORK.

This heading may be divided into: first, Mound Explorations; second, Explorations in Ancient and Modern Stone Villages; and, third, General Field Studies, embracing those in institutions, linguistics, and other divisions of anthropology.

Mound Explorations.—The work of the mound exploring division, under the charge of Prof. Cyrus Thomas, was carried on during the year with the same success reported for former years.

Messrs. James D. Middleton, John P. Rogan, and John W. Emmert were engaged during the year as regular assistants; Mr. Charles M. Smith, Rev. S. D. Peet, and Mr. H. L. Reynolds were also employed for short periods as temporary assistants.

At the commencement of the year Messrs. Middleton and Emmert were at work on the mounds and ancient monuments of Southwestern Wisconsin, where they remained until cold weather set in, when they were transferred to East Tennessee, where Mr. Emmert continued at work throughout the remainder of the year.

It was deemed advisable to commence the preparation of a complete report of the work of the division, with a view of having it ready for publication by the close of the fiscal year ending June 30, 1887. Mr. Middleton was called to the office, where he remained, preparing maps and plats and cataloguing the collections, until the latter part of April, 1886, when he again entered upon field work in the southern part of Illinois.

Mr. Rogan was in charge of the office from the 1st of July to the middle of August, Professor Thomas being in the field during that time. He was engaged the remainder of the year in exploring the mounds of Northern Georgia and East Tennessee.

Rev. S. D. Peet was employed for a few months preparing a preliminary map showing the localities of the antiquities of Wisconsin and the areas formerly occupied by the different Indian tribes which are known to have inhabited that region. In addition he prepared for use in the report notes on the distribution and character of the mound and other ancient works of Wisconsin.

Mr. Smith was engaged during the month of June in exploring mounds in Southwestern Pennsylvania; and Mr. Reynolds during the same time in tracing and exploring the monuments of Western New York. The amount of field work done was substantially the same as in previous years. About 3,500 specimens were obtained; all of which, collected before June 30, 1886, have been numbered, catalogued, and turned over to the National Museum.

Explorations in Ancient and Modern Stone Villages.—During the summer the Director, accompanied by Mr. James Stevenson, revisited portions of Arizona and New Mexico in which many structures are found which have greatly interested travelers and anthropologists, and about which various theories have grown. The results of the investigation have been so much more distinct and comprehensive than any before obtained that they require mention.

On the plain to the west of the Colorado River and north of the San Francisco Mountain there are many scattered ruins, usually having one, two, or three rooms each, all of which are built of basaltic cinders and blocks. Through the plain a valley runs to the north, and then east to the Little Colorado. Down the midst of the valley there is a wash, through which, in seasons of great rainfall, a stream courses. Along this stream there are extensive ruins built of sandstone and limestone. At one place a village site was discovered, in which several hundred people once found shelter. To the north of this and about 25 miles from the summit of San Francisco Peak, there is a volcanic cone of cinder and basalt. This small cone had been used as the site of a village, a pueblo having been built around the crater. The materials of construction were derived from a great sandstone quarry near by, and the pit from which they were taken was many feet in depth and extended over 2 or 3 acres of ground. The cone rises on the west in a precipitous cliff from the valley of an intermittent creek. The pueblo was built on that side at the summit of the cliff, and extending on the north and south sides along the summit of steep slopes, was inclosed on the east, so that the plaza was entered by a covered way. The court, or plaza, was about one-third of an acre in area. The little pueblo contained perhaps sixty or seventy rooms. Southward of San Francisco Mountain many other ruins were found.

East of the San Francisco Peak, at a distance of about 12 miles, another cinder cone was found. Here the cinders are soft and friable, and the cone is a prettily shaped dome. On the southern slope there are excavations into the indurated and coherent cinder mass, constituting chambers, often 10 or 12 feet in diameter and 6 to 10 feet in height. The chambers are of irregular shape, and occasionally a larger central chamber forms a kind of vestibule to several smaller ones gathered about it. The smaller chambers are sometimes at the same altitude as the central or principal one, and sometimes at a lower altitude. About one hundred and fifty of these chambers have been excavated. Most of them are now partly filled by the caving in of the walls and ceilings, but some of them are yet in a good state of preservation. In these chambers, and about them on the summit and sides of the cinder cone, many stone implements were found, especially metates. Some bone implements also were discovered. At the very summit of the little cone there is a plaza, inclosed by a rude wall made of volcanic cinders, the floor of which was carefully levelled. The plaza is about 45 by 75 feet in area. Here the people lived in underground houses—chambers hewn from the friable volcanic cinders. Before them, to the south, west, and north stretched beautiful valleys, beyond which volcanic cones are seen rising amid pine forests. The people probably cultivated patches of ground in the low valleys.

About 18 miles still farther to the east of San Francisco Mountain another ruined village was discovered, built about the crater of a volcanic cone. This volcanic peak is of much greater magnitude. The crater opens to the eastward. On the south many stone dwellings have been built of the basaltic and cinder-like rocks. Between the ridge on the south and another on the northwest there is a low saddle in which other buildings have been erected, and in which a great plaza was found, much like the one previously described. But the most interesting part of this village was on the cliff which rose on the northwest side of the crater. In this cliff are many natural caves, and the caves themselves were utilized as dwellings by inclosing them in front with walls made of volcanic rocks and cinders. These cliff dwellings are placed tier above tier, in a very irregular way. In many cases natural caves were thus utilized; in other cases cavate chambers were made; that is, chambers have been excavated in the friable cinders. On the very summit of the ridge stone buildings were erected, so that this village was in part a cliff village, in part cavate, and in part the ordinary stone pueblo. The valley below, especially to the southward, was probably occupied by their gardens. In the chambers among the overhanging cliffs a great many interesting relics were found of stone, bone, and wood, and many potsherds.

About 8 miles southeast of Flagstaff, a little town on the southern slope of San Francisco Mountain, Oak Creek enters a cañon, which runs to the eastward and then southward for a distance of about 10 miles. The gorge is a precipitous box cañon for the greater part of this distance. It is cut through carboniferous rocks—sandstones and limestones—which are here nearly horizontal. The softer sandstones rapidly disintegrate, and the harder sandstones and limestones remain. Thus broad shelves are formed on the sides of the cliffs, and these shelves, or the deep recesses between them were utilized, so that here is a village of cliff dwellings. There are several hundred rooms altogether. The rooms are of sandstone, pretty carefully worked and laid in mortar, and the interior of the rooms was plastered. The opening for the chimney was usually by the side of the entrance, and the ceilings of the rooms are still blackened with soot and smoke. Around this village, on the terrace of the cañon, great numbers of potsherds, stone implements, and implements of bone, horn, and wood were found; and here, as in all of the other ruins mentioned, corncobs in great abundance were discovered.

In addition to the four principal ruins thus described many others are found—most of them being of the ordinary pueblo type. From the evidence presented it would seem that they had all been occupied at a comparatively late date. They were certainly not abandoned more than three or four centuries ago.

Later in the season the Director visited the Supai Indians of Cataract Cañon, and was informed by them that their present home had been taken up not many generations ago, and that their ancestors occupied the ruins which have been described; and they gave such a circumstantial account of the occupation and of their expulsion by the Spaniards, that no doubt can be entertained of the truth of their traditions in this respect. The Indians of Cataract Cañon doubtless lived on the north, east, and south of San Francisco Mountain at the time this country was discovered by the Spaniards, and they subsequently left their cliff and cavate dwellings, and moved into Cataract Cañon, where they now live. It is thus seen that these cliff and cavate dwellings are not of an ancient, prehistoric time, but that they were occupied by a people still existing, who also built pueblos of the common type.

Later in the season the party visited the cavate ruins near Santa Clara, previously explored by Mr. Stevenson. Here, on the western side of the Rio Grande del Norte, were found a system of volcanic peaks, constituting what is known as the Valley Range. To the east of these peaks, stretching far beyond the present channel of the Rio Grande, there was once a great Tertiary lake, which was gradually filled with the sands washed into it on every hand and by the ashes blown out of the adjacent volcanoes. This great lake formation is in some places a thousand feet in thickness. When the lake was filled, the Rio Grande cut its channel through the midst to a depth of many hundreds of feet. The volcanic mountains to the westward send to the Rio Grande a number of minor streams, which in a general way are parallel with one another. The Rio Grande itself and all of these lateral streams have cut deep gorges and cañons, so that there are long, irregular table-lands, or mesas, extending from the Rio Grande back to the Valley Mountains, each mesa being severed from the adjacent one by a cañon or cañon valley; and each of these long mesas rises with a precipitous cliff from the valley below. The cliffs themselves are built of volcanic sands and ashes, and many of the strata are exceedingly light and friable. The specific gravity of some of these rocks is so low that they will float on water. Into the faces of these cliffs, in the friable and easily-worked rock, many chambers have been excavated; for mile after mile the cliffs are studded with them, so that altogether there are many thousands. Sometimes a chamber or series of chambers is entered from a terrace, but usually they were excavated many feet above any landing or terraces below, so that they could be reached only by ladders. In other places artificial terraces were built by constructing retaining-walls and filling the interior next to the cliff with loose rock and sand. Very often steps were cut into the face of a cliff and a rude stairway formed by which chambers could be reached. The chambers were very irregularly arranged and very irregular in size and structure. In many cases there is a central chamber which seems to have been a general living-room for the people, and back of which two, three, or more chambers somewhat smaller are found. The chambers occupied by one family are sometimes connected with those occupied by another family, so that two or three or four sets of chambers have interior communication.

Usually, however, the communication from one system of chambers to another was by the outside. Many of the chambers had evidently been occupied as dwellings. They still contained fire-places and evidences of fire; there were little caverns or shelves in which various vessels were placed, and many evidences of the handicraft of the people were left in stone, bone, horn, and wood, and in the chambers and about the sides of the cliffs potsherds are abundant. On more careful survey it was found that many chambers had been used as stables for asses, goats, and sheep. Sometimes they had been filled a few inches, or even two or three feet with the excrement of these animals. Ears of corn and corn-cobs were also found in many places. Some of the chambers were evidently constructed to be used as storehouses or caches for grain. Altogether it is very evident that the cliff houses have been used in comparatively modern times, at any rate since the people owned asses, goats, and sheep. The rock is of such a friable nature that it will not stand atmospheric degradation very long, and there is abundant evidence of this character testifying to the recent occupancy of these cavate dwellings. Above the cliffs, on the mesas which have already been described, evidences of more ancient ruins were found. These were pueblos built of cut stone rudely dressed. Every mesa had at least one ancient pueblo upon it, evidently far more ancient than the cavate dwellings found in the face of the cliffs. It is then very plain that the cavate dwellings are not of great age; that they have been occupied since the advent of the white man, and that on the summit of the cliffs there are ruins of more ancient pueblos. Now, the pottery of Santa Clara had been previously studied by Mr. Stevenson, who made a large collection there two or three years ago, and it was at once noticed that the potsherds of these cliff dwellings are, both in shape and material, like those now made by the Santa Clara Indians. The peculiar pottery of Santa Clara is readily distinguished, as may be seen by examining the collection now in the National Museum. While encamped in the valley below, the party met a Santa Clara Indian, and engaged him in conversation. From him the history of the cliff dwellings was soon discovered. His statement was that originally his people lived in six pueblos, built of cut stone, upon the summit of the mesas; that there came a time when they were at war with the Apaches and Navajos, when they abandoned their stone pueblos above, and for greater protection excavated the chambers in the cliffs below; that when this war ended, part of them returned to the pueblos above, which were rebuilt; that there afterward came another war, with the Comanche Indians, and they once more resorted to cliff dwellings. At the close of this war they built a pueblo in the valley of the Rio Grande, but at the time of the invasion of the Spaniards their people refused to be baptized, and a Spanish army was sent against them, when they abandoned the valley below and once more inhabited the cliff dwellings above. Here they lived many years, until at last a wise and good priest brought them peace, and persuaded them to build the pueblo which they now occupy—the village of Santa Clara. The ruin of the pueblo, which they occupied previous to the invasion of the Spaniards, is still to be seen, about a mile distant from the present pueblo.

The history thus briefly given was repeated by the governor, and by other persons, all substantially to the same effect. It is therefore evident that the cavate dwellings of the Santa Clara region belong to a people still extant; that they are not of great antiquity, and do not give evidence of a prehistoric and now extinct race.

Plans and measurements were made of some of the villages with sufficient accuracy to prepare models. Photographic views and sketches were also procured, with which to illustrate a detailed report of the subject, to be published by the Bureau.

After the investigations made in company with the Director, Mr. Stevenson proceeded with a party to the Province of Tusayan, in Arizona, to study the ethnologic characteristics of its inhabitants, and to make collections of such implements and utensils as would illustrate their arts and industries. Several months were spent among the villages, resulting in a large collection of rare objects, all of which were selected with special reference to their anthropologic importance. This collection contains many articles novel in character, and for different uses from any heretofore obtained, all of which will form an important addition to the collections in the National Museum.

A study of their religious ceremonials and mythologic beliefs was made, of which full notes were taken. Sketches were made of their masks and other objects which could not be obtained for the collection.

Mrs. Stevenson was also enabled to secure a minute description of the celebrated dance, or medicine ceremony, of the Navajos, called the Yéi-bit-cai. Mrs. Stevenson made complete sketches of the sand altars, masks, and other objects employed in this ceremonial.

Mr. Victor Mindeleff, who has in past years been engaged in investigating the architecture of the pueblos, and the ruins of the Southwest, commenced work shortly before the beginning of the fiscal year. A short visit was paid to the Moki villages, securing drawings of some constructional details, and also traditions bearing on the ruins in that vicinity. The main camp was established near Mashongnavi, one of the Moki villages. A large ruined pueblo, formerly occupied by the Mashongnavis, was here surveyed. No standing walls are found at the present time, and many portions of the plan are entirely obliterated. Typical fragments of pottery were collected.

Following this work, four other ruined pueblos were surveyed, and such portions of them as clearly indicated dividing walls were drawn on the ground-plans.

Many of the ruins in this vicinity, according to the traditions of the Mokis, have been occupied in comparatively recent times—a number of them having been abandoned since the Spanish conquest of the country. In several cases the villages now occupied are not the same as those first visited by the Spaniards, although probably retaining the same names.

While the work of surveying was in progress, in charge of Mr. Cosmos Mindeleff, Mr. Victor Mindeleff made a visit of several days at Keam's Cañon, there to meet a number of the Navajo Indians to explain the purpose of the work and allay the suspicions of these Indians, a necessary precaution, as some of the proposed work was laid out in Cañon de Chelly, in the heart of their reservation. Recent restrictions to which they had been subjected, as a consequence of new surveys of the reservation line, had made them especially distrustful of parties of Americans equipped with instruments for surveying. Incidental to such explanations of the purpose of the work, an opportunity was afforded of securing a number of mythologic notes, and also some interesting data regarding the construction of their "hogans," with the rules prescribing the arrangement of each part of the frame, &c. A number of ceremonial songs are sung at the building of these houses, but of these only one could be secured, this one, however, both in the original and translated. Whenever opportunity occurred, during the progress of the work, photographs and diagrams of construction of "hogans" were secured.

On August 17, the ceremony of the snake-dance took place at Mashongnavi, similar in every detail to that performed at Wolpi, and differing only in the number of participants. A number of instantaneous negatives of the various phases of the dance were secured. On August 18, the following day, the same ceremony was performed at Wolpi, the easternmost of the Moki villages, on a larger scale.

While the surveys of the ruins were in progress many detailed studies of special features were made in the modern villages, particularly among the "kivas," or religious chambers. In several instances the large roofing timbers of the "kiva" were found to be the old beams from the Spanish churches, hewn square, and decorated with the characteristic rude carving of the old Spanish work. A number of legends, connected with the ruined pueblos, were recorded.

On closing this work in the vicinity of the Moki villages, late in August, the party moved into Keam's Cañon, *en route* for Cañon de Chelly. A day was devoted to the survey of a small pueblo of irregular elliptical outline, situated about 18 miles northeast from Keam's Cañon. This ruin is in an excellent state of preservation and exhibits in the masonry some stones of remarkably large size. The early part of September was employed in making a close survey of the Mummy Cave group of ruins in Cañon de la Muerte, this work including a 5-foot contour map of the ground and the rocky ledge over which the houses were distributed. Detailed drawings of a number of special features were here made, particularly in connection with the circular ceremonial chambers. The latter were so buried under the accumulated débris of fallen walls that much excavation was required to lay bare the details of internal arrangement. A high class of workmanship is here exhibited, both in the execution of the constructional features and in the interior decoration of these chambers. Later the White House group in the Cañon de Chelly, comprising a village and cliff houses, was examined and platted in the same manner.

The drawings and plans were supplemented with a series of photographs. Some negatives of Navajo houses were also made.

On closing this work the party went into Fort Defiance, *en route* for Zuñi, and thence to Ojo Caliente, a modern farming pueblo of the Zuñis, about 12 miles south of the principal village. Here two ruins of villages, thought to belong to the ancient Cibola group, were platted. One of these villages had been provided with a circular reservoir of large size, partially walled in with masonry. Here, also, can be seen the well-preserved walls of a stone church. The other also contains the remains of a large church, built of adobe. A series of widely scattered house clusters, occurring about 2½ miles west of Ojo Caliente, was also examined, but the earth had drifted over the fallen walls and so covered them over that the arrangement of rooms could scarcely be traced at all.

The modern village of Ojo Caliente was also surveyed and diagrams and photographs made.

Towards the end of September camp was moved to the vicinity of Zuñi. Here we examined four other villages of the Cibola group and the old villages on the mesa of Ta-ai-ya-lo-ne. Camp was then moved to Nutria, a farming pueblo of Zuñi. From this camp Nutria was surveyed and photographed, and also the village of Pescado; the latter is occupied only during the farming season. Both of these modern farming pueblos appear to be built on the ruins of more ancient villages, the remains of which were especially noticeable in the case of Pescado, where the very carefully executed masonry, characteristic of the ancient methods of construction, could be seen outcropping at many points.

Mr. Cosmos Mindeleff was ordered to report at the Moki towns, Arizona, for field duty, and left Washington July 6. He was placed in charge of the surveying work necessary in the Stone Village region, and his work is included in the general report of that division.

He assisted in collecting from the present inhabitants of the region legendary information bearing upon the ruins and in observing the snake-dance of the Moki Indians, a description of which was prepared for publication.

Following the return of the main party to Washington some preliminary exploration was carried on by Mr. E. W. Nelson, who made an examination of the headwaters of the South Fork of Salt River, but did not find any ruins. Thence the Blue Ridge was crossed and the valley of the Blue Fork of the San Francisco River visited. Here ruins were plentiful, increasing in number towards the south. Farther south three sets of cliff ruins were also located.

General field studies.—Dr. Washington Matthews, assistant surgeon U. S. Army, was stationed in the Navajo country as post surgeon of Fort Wingate, N. Mex., from 1880 to 1884, during which time he devoted himself to studying the language, customs, &c., of this tribe as much as his official duties would permit.

In the autumn of 1884 he was given an opportunity, under the auspices of the Bureau of Ethnology, to return to the Navajo country and devote himself for a considerable time entirely to the anthropologic study of the people.

He first visited the Navajoes who dwell in the neighborhood of the San Mateo Mountains, the Tsotsildine, or people of the Great Peak, a local division or subtribe, living much farther to the east and having longer and more intimate associations with Mexicans and Americans than the main body of the nation. While at this place he ascended the peak of San Mateo, or Mount Taylor—a mountain held sacred by the Navajos—to observe the various places on the mountain mentioned in the Navajo myths.

Leaving San Mateo he proceeded to Fort Wingate, and, learning that one of the most important of the Navajo rites was about to be celebrated at a place called Nihotlize (Hard Earth), north of Fort Wingate, on the Navajo Reservation, he repaired thither without delay. The ceremony was that of Dsilyidje qatal, or "chant upon the mountains." It is called Ilnasjingo qatal, or "chant in the dark circle of branches," from the great corral of evergreens, in which the public rites of the last night are performed. It is known to the white men who live among these Indians as the Hoshkaun dance, from one of the public dances of the last night in which the Indian jugglers pretend to grow and develop the hackan or *Yucca baccata.* This last night's performance is varied and interesting, and all persons, including whites and Indians of other tribes, are permitted to witness it; but previously, for several days, in the medicine lodge, mystic rites are celebrated, to the most of which only the initiated are admitted. Dr. Matthews remained in the Indian camp at Nihotlize ten days, during which time the shamans admitted him into their medicine lodge and allowed him to observe their rites and practices.

His most interesting discovery on this occasion was of their system of mythic dry-paintings, by which they represent with dry pigments, on the sanded floor of the medicine lodge, various legends or traditions. These pictures are from 10 to 12 feet in diameter, and are drawn with scrupulous care after long-established patterns, which are retained only in the memories of the initiated. The drawing of some of the more elaborate pictures occupies the time of about a dozen men for eight or more hours. Half an hour after the work is completed it is, with song and ceremonial, entirely obliterated, and even the sand which formed the ground work of the picture is removed from the lodge and thrown away. Only one picture is painted in a day. Dr. Matthews made accurate colored copies of these pictures, which will be represented by chromo-lithographic plates to illustrate a detailed report prepared by him for publication by the Bureau.

When the ceremony at Nihotlizi was over he proceeded to a locality in Arizona called by the whites "The Haystacks," from the peculiar appearance of the rock formations there. At the Haystacks another great ceremony, probably the second in importance of the Navajo rites, was to take place. Here he again encamped with the Indians, and remained until the work of the shamans was done. The ceremonial observances witnessed on this occasion are, collectively, called by the Navojos Kledje quatal, or "chant of the night." They are called by the whites the "Yay bichy dance," from the name of the principal masked character Yéibitcai or Gebitcai, the grand uncle of the gods. Like the

Hoshkaun dance, it has several days of secret rites with elaborate symbolic sand pictures, and one night of public dances, less varied and interesting than those of the Hoshkaun. Dr. Matthews was permitted to witness the whole performance and to take as many notes and sketches as were necessary.

From the Haystacks Dr. Matthews went to the Indian agency at Fort Defiance, Ariz., where he secured the services of one of the oldest, and most learned (in their own peculiar lore) of the Navajo priests, and from him he obtained full explanations of all these rites, and of the symbolism of the pictures and masked characters, with a complete recital of the long and elaborate myths on which the ceremonies depend, and the text and translations of the very numerous songs which form the ritual of the ceremonies.

During the summer and fall of 1885, Dr. H. C. Yarrow, acting assistant surgeon U. S. Army, visited interesting points in Arizona and Utah. In the vicinity of Springerville, Apache County, Arizona, in company with Mr. E. W. Nelson, he visited a number of ancient pueblos and discovered that the people formerly occupying the towns had followed the custom of burying their dead just outside the walls of their habitations, marking the places of sepulcher with circles of stones. The graves were 4 or 5 feet in depth, and with the dead had been deposited various household utensils. Mr. Nelson, who had made a careful search for these cemeteries, informed him of the whereabouts of hundreds of them. Unfortunately for anthropometric science, most of the bones are too much decayed to be of practical value. The places of burial selected at these pueblos are similar to the burial places discovered in 1874 near the large ruined pueblo of Abiquiu, in the valley of the Chama, New Mexico. He also visited the Moki pueblos in Arizona, and obtained from one of the principal men a clear and succinct account of their burial customs. While there he witnessed the famous snake-dance, which occurs every two years, and is supposed to have the effect of producing rain. From his knowledge of the reptilian fauna of the country he was able to identify the species of serpents used in the dance, and from personal examination satisfied himself that the fangs had not been extracted from the poisonous varieties. He thinks, however, that the reptiles during the four days that they are kept in the estufas are somewhat tamed by handling, and possibly are made to eject the greater part of the venom contained in the sacs at the roots of the teeth, by being teased and forced to strike at different objects held near them. He does not think that a vegetable decoction in which they are washed has a stupefying effect, as has been supposed by some. He also obtained from a Moki high priest a full account of the attendant ceremonies of the dance. Through the hospitality of Mr. Thomas V. Keam, of Keam's Cañon, Arizona, and Mr. A. M. Stephen, he was able to procure from a noted Navajo wise man, an exact account of the burial customs of his people, as well as valuable information regarding their medical practices, especially such as relate to obstetrics.

From Arizona Dr. Yarrow proceeded to Utah, and made an examination of an old rock cemetery near Farmington, finding it similar to the one he discovered in 1872 near the town of Fillmore. The bodies had been carried far up the side of the mountain; cavities had been prepared in a rock slide, and the bodies placed therein. Branches of cottonwood were then laid over and large bowlders piled on top. In several of these graves the skeletons were in fair preservation, and were removed, as well as the articles found with them.

Through the kindness of Mr. William Young, of Grantsville, a skeleton of a Gosi-Ute, in excellent preservation, was obtained, which has been presented to the Army Medical Museum. It may be stated that the examination of the rock cemetery at Farmington showed that the inhabitants of the eastern slope of the Wahsatch Range, in Great Salt Lake Valley, followed that mode of sepulture from this, the most northern point visited, to below Parowan, a distance of at least 200 miles to the southward, and it seems that these people occupied the valley long subsequent to those living near the water courses who constructed the small mounds on top of which were the rude adobe dwellings, and in some instances used these huts for burial purposes.

In the spring of 1886 Mr. James C. Pilling made a trip to Europe in the interest of his work on the Bibliography of the Languages of the North American Indians, and spent many days in the library of the British Museum, the Bibliothèque Nationale at Paris, and several extensive private libraries in England and France. The results of this trip are highly satisfactory and valuable.

Mr. Jeremiah Curtin continued to collect vocabularies and myths in California. The whole number of myths obtained in California and Oregon was over three hundred. The number of vocabularies was eight, being the Yana, Atsugëi (Hat Creek), Wasco, Mflé-hlama (Warm Spring), Pai Ute, Shasta, Maidu, and Wintu. Texts were also obtained in Yana, Wasco, Warm Spring, and Shasta.

II. OFFICE WORK.

Prof. Cyrus Thomas was engaged during the year, except the few weeks he was in the field, in the preparation of his general report, a paper on the Maya Codices, and a special paper on the Burial Mounds of the Northern Sections of the United States. The latter will appear in the Fifth Annual Report of the Bureau.

Mrs. V. L. Thomas, in addition to her duties as clerk, has been employed in preparing a catalogue of the ancient works in that part of the United States east of the Rocky Mountains. This catalogue, now nearly complete, is intended to give the localities and character of all the antiquities in the section indicated that have been heretofore discovered and notice thereof published, as well as those mentioned in the reports of work done under the Bureau.

The "Bibliography of the Languages of the North American Indians," by Mr. James C. Pilling, which has been adverted to in previous reports, has received a large share of his time and attention throughout the year. The advance "proof-sheets" noted under the head of publications, and distributed to collaborators, have been the means of securing the active co-operation of many persons throughout this and other countries who are interested in linguistic and bibliographic science, and have thus elicited a large number of additions, corrections, suggestions, and criticisms, all of which have received careful consideration.

Mr. Frank H. Cushing worked, when his health permitted, upon the large amount of Zuñi material collected by him during several years, in preparation of papers upon the language, mythology, and institutions of that people.

Mrs. Erminnie A. Smith continued her study of the Iroquoian languages. The first part of her final contribution on the subject was intended to be a Tuscarora grammar and dictionary. The first portion of the dictionary was completed, and had been forwarded to the Bureau when her sudden and lamented death occurred on June 9, 1886, at her home in Jersey City. Her former assistant, Mr. J. N. B. Hewitt, of Tuscarora descent, has been engaged to complete the work she so successfully began, and it is expected that the results of her long labors in the field will be published without delay.

Mr. Charles C. Royce resigned his connection with the Bureau in the early part of the year, thereby delaying the completion of his work upon the primal title of the Indian tribes to lands within the United States and the methods of securing their relinquishment. This work, the scope and value of which have before been explained, will be published with its accompanying atlas. Mr. Royce, before his departure, completed a paper on the "Cherokee Nation of Indians," which will appear in the Fifth Annual Report.

Dr. H. C. Yarrow was still engaged in preparing the material for the final volume upon the Mortuary Customs of the North American Indians, in the prosecution of which the large amount of information received and obtained from various sources has been carefully classified and arranged under proper divisions, so that the manuscript is now being rapidly put into shape for publication.

Dr. Washington Matthews, U. S. Army, continued the preparing for publication of the copious notes obtained by him during former years in the Navajo country, his chief work being upon a grammar and dictionary of the Navajo language. He also wrote several papers, one of which, a "Chant upon the Mountains," will appear in the Fifth Annual Report.

Mr. W. H. Holmes continued his work in the office during the year, superintending the illustration of the various publications of the Bureau. His scientific studies have been confined principally to the field of American art archæology. Two fully illustrated papers have been finished and will appear in the Sixth Annual Report of the Bureau. They are upon "Ancient Art of the Province of Chiriqui, Colombia," and "A Study of the Textile Art in its Relations to the Development of Form and Ornament." Mr. Holmes has, in addition, continued his duties as curator of aboriginal pottery in the National Museum.

The office work of Mr. Victor Mindeleff for the year has consisted of the preparation of reports on the Tusayan and Cibola architectural groups. These, when completed, are to be fully illustrated by a series of plans and drawings now being prepared from the field-notes and other material. In this work it is proposed to discuss the architecture in detail, particularly in the case of the modern pueblos, where many of the constructional devices of the old builders still survive. The examination of these details will be found to throw light on obscure features of many ruined pueblos whose state of preservation is such as to exhibit but little detail in themselves.

In connection with the classification and arrangement of new material from Cañon de Chelly, a paper on the cliff-ruins of this region was prepared.

The modeling-room during the past year has been in charge of Mr. Cosmos Mindeleff. Upon his return from the field a series of models to illustrate the Chaco ruins, architecturally the most important in the Southwest, was commenced. Two of these, viz, the ruin of Wejegi and that of a small pueblo near Pueblo Alto, have been finished and duplicates have been deposited in the National Museum. The third, a very large model of Peñasco Blanco, is still uncompleted. All of these models are made from entirely new surveys, made in the summer of 1884. The scale used in the previous series—the inhabited pueblos and the cliff-ruins—though larger than that usually adopted for this class of work, has shown so much more detail and has proven generally so satisfactory, that it has been continued in the Chaco Ruin group, bringing the entire series of models made by the Bureau to a uniform scale of 1.60, or 1 inch to 5 feet. In addition to this the work of duplicating the existing models of the Bureau for purposes of exchange was commenced. Three of these have been completed, and two others are about half finished.

Mr. E. W. Nelson was engaged upon a report of his investigations among the Eskimo tribes of Alaska. A part of this report consisting of an English-Eskimo dictionary, he has already forwarded.

As hereinafter explained, the year was principally devoted to the synonomy of the Indian tribes, the special studies of several officers of the Bureau being suspended so that their whole time should be employed in that direction. In the early part of the year 1885, however, and at subsequent intervals, their work was as follows:

Col. Garrick Mallery, U. S. Army, continued the study, by researches and correspondence, of sign language and pictographs. A paper on the latter subject has been printed in the Fourth Annual Report.

Mr. Albert S. Gatschet continued to revise and perfect his grammar and dictionary of the Klamath language, a large part of which work is in print. He also took down vocabularies from Indian delegates present in this city on tribal business, and thus succeeded in incorporating into the collections of the Bureau of Ethnology linguistic material from the Alibamu, Hitchiti, Creek, and Seneca languages.

Rev. J. Owen Dorsey pursued his work on the Dhegiha language. Having the aid of a Winnebago Indian for some time he enlarged his vocabulary of that language and recorded grammatical notes. He also reported upon works submitted to his examination upon the Tuscarora, Micmac, and Cherokee languages.

Synonymy of Indian Tribes.—The Director has before reported in general terms that the most serious source of perplexity to the student of the history of the North American Indians is the confusion existing among their tribal names. The causes of this confusion are various. The Indian names for themselves have been understood and recorded in diverse ways by the earlier authors, and have been variously transmitted by the later. Nicknames arising from trivial causes, and often without apparent cause, have been imposed upon many tribes. Names borne by one tribe at some period of its history have been transferred to another, or to several other distinct tribes. Typographical errors and improved spellings on assumed phonetic grounds have swelled the number of synonyms until the investigator of a special tribe often finds himself in a maze of nomenclatural perplexity.

It has long been the intention of the Director to have prepared a work on tribal names, which so far as possible should refer their confusing titles to a correct and systematic standard. Delay has been occasioned chiefly by the fundamental necessity of defining the linguistic stocks or families into which all tribes must be primarily divided, and to accomplish this long journeys and laborious field and office investigations have been required during the whole time since the establishment of the Bureau. While a few points still remained in an unsatisfactory condition, it was considered that a sufficient degree of accuracy had been attained to allow of the publication for the benefit of students of a volume devoted to the subject. The preparation of the plan of such a volume was intrusted to Mr. H. W. Henshaw late in the spring of 1885, and in June of that year the work was energetically begun in accordance with the plans submitted. The preparation of this work, which to a great extent underlies and is the foundation for every field of ethnologic investigation among Indians, was considered of such prime importance that nearly all the available force of the Bureau was placed upon it to the suspension of the particular investigation in which the several officers had been engaged. In addition to the general charge of the whole work, Mr. Henshaw gave special attention to the families inhabiting the Northwest coast from Oregon northwards, including the Eskimo, and also several in California. To Mr. Albert S. Gatschet the tribes of the Southeastern United States, together with the Pueblo and Yuman tribes, were assigned.

The Algonkian family in all its branches—by far the most important part of the whole, so far as the great bulk of literature relating to it is concerned—was intrusted to Col. Garrick Mallery and Mr. James Mooney. They also took charge of the Iroquoian family. Mr. J. O. Dorsey's intimate acquaintance with the tribes of the Siouan and Caddoan families peculiarly fitted him to cope with that part of the work, and he also undertook the Athapascan tribes. Dr. W. J. Hoffman worked upon the Shoshonian tribes, aided by the Director's personal supervision. Mr. Curtin, to whom was assigned the California tribes, also gave assistance in other sections.

Each of the gentlemen named has been able to contribute largely to the results by his personal experience and investigations in the field, there being numerous regions concerning which published accounts are meager and unsatisfactory. The main source of the material to be dealt with has, however, been necessarily derived from books. A vast amount of the current literature pertaining to the North American Indians has been examined, amounting to over one thousand volumes, with a view to the extraction of the tribal names and the historical data necessary to fix their precise application.

The work at the present time is well advanced toward completion. The examination of literature for the collation of synonyms may be regarded as practically done. The tables of synonymy and the accounts of the tribes have been completed for more than one-half the number of linguistic families. It is hoped that the volume will be ready for the printer by the end of the next fiscal year.

Archæologic Symbols.—The geographic distribution of archæologic phenomena being of great importance, and the statute having provided for general archæologic research in the United States, it was thought best by the Director to prepare a system of archæologic symbols to be used in the cartography of the subject. In the preparation of such a scheme of symbols those used in Europe were examined, for the purpose of adopting the same where possible; but on careful study of the subject it was found that the phenomena of the two continents differ so widely that no European scheme could be utilized in North America. A new scheme was therefore prepared, adapted to the phenomena observed in North America, and especially in the United States, as follows:

SCHEME OF CONVENTIONS FOR THE ARCHÆOLOGIC CARTOGRAPHY OF NORTH AMERICA.

Indian village.
Wood lodge.
Group or village of wood lodges.
Earth lodge.
Group or village of earth lodges.
Stone lodge.
Group or village of stone lodges.
Cliff lodge.
Group or village of cliff lodges.
Cavate lodge.
Group or village of cavate lodges.
Subterranean lodge.
Group or village of subterranean lodges.
Igloo lodge.
Group or village of Igloo lodges.
Inhabited stone village (Pueblo).
Assembly lodge of wood.
Assembly lodge of earth.
Assembly lodge of stone.
Cliff assembly lodge.
Cave assembly lodge.
Subterranean assembly lodge.
Tower.
Mound.
Group of mounds.
Assembly mound.
Effigy mound.
Group of effigy mounds.
Domiciliary mound.
Burial mound.
Mound with single stone grave.
Mound with stone graves.
Grave or single burial.
Cemetery.
Stone grave.
Stone grave cemetery.
Ossuary.
Inclosure.
Inclosure with interior mound.
Inclosure with exterior mound.
Excavation.
Reservoir.
Canal.
Copper mine.
Flint mine or quarry.
Soapstone mine.
Mica mine.
Cave deposit.
Cave burial.
Refuse heap.
Shell heap.
Sculpture.
Group of sculptures.
Petroglypt.
Group of petroglypts.
Cache.
Cairn.
Trail.

It is believed that the above scheme requires no general discussion for its explanation. The mnemonic system embraced therein is perhaps sufficiently obvious.

As the work of investigation extends southward through Mexico and Central America, it may be found necessary to add somewhat to the above plan.

UNITED STATES GEOLOGICAL SURVEY.

In compliance with the custom which has grown up of including a summary of the yearly operations of the Geological Survey in the annual report of this Institution, a statement furnished by Maj. J. W. Powell, the Director of the Survey, is appended hereto.

The last report which was made was for the calendar year 1884; and the present account is for the following eighteen months.

During each of the years under review, the appropriations for the Survey were substantially the same, and the organization was practically unchanged.

As heretofore, detailed statements of the operations of the Survey will be found under the headings of Geography, Geology, Paleontology, and Miscellaneous Work, the latter including chemistry and physics, mining statistics and technology, and library and documents.

GEOGRAPHY.

At the date of the last report a statement was made under the various subdivisions of this heading of the areas which had been surveyed in the different States and Territories. Including those, and the areas subsequently surveyed during the fiscal year ending June 30, 1885, the chief geographer of the Survey, Mr. Henry Gannett, reports a total of 57,508 square miles. A glance at the appended table will show the distribution of these areas, the scale of publication adopted, and the contour interval:

Area.	Scale of publication.	Contour interval.	Area.
		Feet.	*Sq. m.*
Massachusetts	1 : 62500	20	1,250
New Jersey	1 : 62500	20	1,268
Appalachian region	1 : 125000	100	17,640
Missouri-Kansas	1 : 125000	50	13,600
Texas	1 : 125000	50	4,000
Plateau region	1 : 250000	200	15,000
Yellowstone Park	1 : 125000	100	1,000
Northern California	1 : 250000	200	3,750
Total			57,508

The average cost of the work for the year was about $3 per square mile.

Similar information respecting the geographic work done in the following year, ending June 30, 1886, will be found in the subjoined table:

Region.	Scale of publication.	Contour interval.	Area.
		Feet.	*Sq. m.*
Massachusetts	1 : 62500	20	2,500
New Jersey	1 : 62500	20	1,843
Southern Appalachian region	1 : 125000	100	23,686
Missouri-Kansas	1 : 125000	50	21,400
Texas	1 : 125000	50	8,000
Arizona	1 : 250000	200	8,000
Gold Belt, California	1 : 125000	100	2,400
Northern California and Southern Oregon	1 : 250000	200	10,400
Yellowstone National Park and Northwestern Wyoming	1 : 125000	100	3,600
Total			81,829

The average cost of the work during the year was approximately $2.75 per square mile.

Under the Division of Geography the work in the northeastern section is divided into two sub-sections, namely, those of Massachusetts and New Jersey. In the former the work is carried on at the joint expense of the State of Massachusetts and the United States. In this State the entire area reported for the two years during which work has been going on, amounts to 3,750 square miles, or nearly one-half the area of the State.

Work in the New Jersey sub-section was, as heretofore, under the general supervision of Prof. George H. Cook, State geologist. The work has been continued on the basis indicated in the last report, and an area of 3,111 square miles has been completely surveyed in the past two years, while a considerable amount of preliminary work has been done on other portions of the State. At the present time nearly all the area of the State has been completed.

Appalachian Section.—The intricacy of geologic phenomena in this region has led to the adoption of a larger scale for the maps than that which has been used in other cases; as the country is perhaps the most difficult for the surveyor to be found upon the continent, the rate and cost of work will not bear favorable comparison with other less difficult areas. However, notwithstanding these drawbacks, the large force concentrated on the area has enabled the geographer in charge of it, Mr. Gilbert Thompson, to complete 41,326 square miles in the two years under consideration.

Western Section.—During the year ending June 30, 1885, work was prosecuted in the Missouri-Kansas, Texas, and Arizona sub-sections, and in the following year, to this section were added the Gold Belt and Cascade sub-sections. It was found that in those States which had been surveyed by the public land system, use might be made of the plats of the General Land Office, whereby without sacrificing accuracy the work might be greatly facilitated. For the control and correction of the surveys of the General Land Office it was decided tentatively to use astronomic locations, and these Mr. R. S. Woodward, formerly of the U. S. Lake Survey, was directed to determine. As shown by the table already given, an area was surveyed in this sub-section, during the two years, of 37,000 square miles. In continuing the work in the Missouri-Kansas sub-section during the last fiscal year, closing June 30, 1886, it was decided to substitute a gridiron system of triangulation, utilizing as far as possible the trans-continental belt of the U. S. Coast and Geodetic Survey, in place of astronomic determinations, for the correction of accumulated error in the surveys of the General Land Office. Satisfactory progress was made in the Texas and Arizona sub-sections, but work was impeded in the Gold Belt and Cascade sub-sections by unfavorable at mospheric conditions during the latter part of the last season. Notwithstanding these drawbacks an area of more than 50,000 square miles was surveyed during the last fiscal year.

Yellowstone Section.—During the two years under review topographic work was continued in the Yellowstone National Park, and an area of 1,000 square miles was surveyed in the first year, and 3,600 in the second, the latter figure including a portion of Northwestern Wyoming.

Engraving.—The manuscript of seventy-six sheets of the General Atlas of the United States, now in preparation by the Geological Survey has been furnished to the engraver, and of these fifty-seven have been engraved, comprising about 125,000 square miles. In the Seventh Annual Report of the Director of the Survey to the Secretary of the Interior a list is given of the sheets thus far engraved.

GEOLOGY.

The present organization of geologic work in the Survey will be apprehended from an examination of the following condensed account of the work of each of the divisions:

Division of Archean Geology.— Prof. Raphael Pumpelly devoted his time in the field to a study of the structure of the Green Mountains, believing that range to contain the key to the geology of New England. The structure of a long and important stretch of the Hoosac Mountain in Massachusetts and Vermont was worked out, and Professor Pumpelly hopes by the end of another season to be in a position to solve this great geologic problem. A large part of his office work was upon the "Mining Industries" volume of the Tenth Census.

Atlantic Coast Division of Geology.—In his study of the geology of the Atlantic coast Prof. N. S. Shaler has addressed himself especially to problems whose solution promises to have important economic value. After making a preliminary inquiry into the geology of the Cobscook Bay district, he began a study of the district adjacent to Narragansett Bay, the coal-fields of which he compares in character with those of Pennsylvania, and hopes to see rendered commercially important. Another inquiry to which he has given attention is the amount of salt-water marshes on the eastern coast of the United States, the extent to which these are reclaimed, and the most feasible means of bringing them into tillable condition. The experience of other countries he found to be of such a character as to justify the hope that at least 20,000 square miles, and possibly twice that area, may be easily won to agriculture. Professor Shaler publishes a report on the "Salt Marshes of the United States" in the Sixth Annual Report of the Director of the Survey, and a report on the "Geology of Martha's Vineyard" in the seventh.

Appalachian Division of Geology.—Mr. G. K. Gilbert continued, with a corps of assistants, the investigation of the geology of the Appalachian Mountains in the States of Maryland, Virginia, West Virginia, Kentucky, Tennessee, North Carolina, Georgia, and Alabama. In the systematic conduct of this work he proposes to survey and measure with great care four sections, crossing the belt at right angles. The rocks to be studied being much disturbed, a simple linear section does not afford a sufficient guarantee of accuracy, and he substitutes for it the complete structural survey of a strip of country 20 miles broad. When this is finished it is believed that the structure of the entire belt can be unraveled with comparative ease and rapidity. Of Mr. Gilbert's assistants, Mr. Bailey Willis was engaged on the French Broad section, Mr. I. C. Russell on the Alabama section, Mr. H. R. Geiger on the Potomac section, and Prof. I. C. White made an investigation of the stratigraphy of the coal-measures in the valley of the Great Kanawha. The geologic literature of the Appalachian district being very copious, and Mr. Gilbert being unwilling to pass by without acknowledgment the work of his predecessors, a subject bibliography of this literature has been undertaken, and 6,000 bibliographic cards have been prepared, which contain each a reference to the pages in a specific volume in which any particular subject is treated. The memoirs relative to the investigation of the "Quaternary History of the Great Basin" are in substantially the same condition as last reported.

Lake Superior Division of Geology.—In this division Prof. R. D. Irving is engaged in a general investigation of those formations of the Northwestern States which underlie the basal fossiliferous or Potsdam sandstone of the Mississippi Valley. A large portion of the field work of Mr. Irving's assistants was spent in replacing the collections which they were so unfortunate as to lose by the fire that occurred in the science building of the University of Wisconsin in December, 1884. In his administrative report for the year 1886 he gives a summarized statement of the results which have been reached by the studies in which he and his associates have been engaged.

Among these the following may be mentioned: (1) The origin of the ferruginous schists of the Lake Superior region and their accompanying iron ores is attributable to the silicification of ferruginous carbonates in some degree analogous to those of the coal-measures. (2) The Archean formations of Lake Superior are divisible into two discordant members, to which the terms Huronian and Laurentian should be applied. (3) Such chloritic schists as present themselves at the falls of the Menomonee River, on the boundary between Wisconsin and Michigan, are the result of metasomatic alteration, accompanying great pressure, of some sort of eruptive greenstone. (4) The upper mica schists of the iron-bearing series have been developed in both the Penokee and the Marquette regions from entirely fragmental rocks, composed mainly of quartz and feldspar, by a simple, easily traced process of metasomatosis.

Division of Glacial Geology.—Prof. T. C. Chamberlin and his assistants, Prof. R. D. Salisbury, Prof. J. E. Todd, Mr. Warren Upham, Prof. G. H. Stone, Prof. G. F. Wright, and Mr. I. M. Buell, were engaged in a comprehensive study of the manifold features of glacial geology, particularly as recorded in the rocks of the northwestern section of the United States. To the discussion of this question, Professor Chamberlin has contributed two extended articles, one appearing in the Sixth Annual Report, under the heading of the "Driftless Area of the United States," and the other in the seventh, under the title of the "Rock Scorings of the Great Ice Invasion." His assistant, Mr. Upham, after making an extended investigation of the area of the extinct lake (Agassiz), submitted the manuscript for a bulletin, which will appear among the publications of the Survey hereafter. In company with Prof. Salisbury, Prof. Chamberlin undertook a reconnoissance of the drift margin from the vicinity of Bismarck, Dak., to the national boundary line at the foot of the Rocky Mountains. No attempt was made to trace the drift-border in detail, but it was sought to determine a sufficient number of points to fix beyond question the general course and character of the drift in Northwestern Dakota and in Montana. After about a month spent in this examination, Prof. Chamberlin studied the valley-drift of the Yellowstone River, at Billings, and in the vicinity of Glendive, with a view to distinguishing this semi-local drift from that of the northeast, as well as to determining the ancient fluvial conditions of the region. He also spent about a month in the study of drift phenomena in Montana, Idaho, and British Columbia. Professor Todd's time was devoted to field study in southern Dakota, and the preparation of a bulletin on his results. Professor Stone, under the direction of Prof. Chamberlin, continued his special investigations of the gravels of

Maine, particularly its remarkable osars, and Prof. G. F. Wright studied the glacial border in Pennsylvania and the terraces of the Upper Alleghany River. Prof. W. M. Davis, of Harvard University, working under Prof. Chamberlin's direction, made a careful study of the striation of Mount Monadnock, one result of which was a very satisfactory demonstration of the incurving of the currents in the lee of that mountain. He also made an examination of two recent gorges near Canajoharie, N. Y., with reference to the time and method of their production; but his chief attention was directed to the study of the remarkable parallel and dolphin-backed drift ridges of Wayne and Cayuga Counties in the same State. Mr. Buell continued his study of the bowlder trains of the south central Wisconsin. Prof. Chamberlin was assisted both by Mr. Gilbert and Prof. Shaler in a number of his glacial studies, and the latter carried out an extended scheme of study of the glacial drift on the islands of Nantucket, Martha's Vineyard, and Mount Desert.

Montana Division of Geology.—Dr. F. V. Hayden, with his assistant, Dr. A. C. Peale, continued his study of the geology of Montana, his inquiries chiefly relating to the Gallatin Valley, particular attention being paid to the southern end of the Bridger Range and the extension of its beds on the southern side of the Gallatin Valley. In addition to this work Dr. Peale prepared a statistical paper on the Mineral Waters of the United States, which was published as Bulletin No. 32 of the Survey series.

Yellowstone Park Division of Geology.—Notwithstanding the limited character of the field season in the Yellowstone Park, Mr. Arnold Hague was able to reach tolerably definite conclusions respecting the more remarkable of its geological features. The work in the field was supplemented by detailed studies in the laboratory, Dr. F. A. Gooch confining himself almost exclusively to chemical questions connected with the thermal waters of the geyser basins and Mammoth Hot Springs, and Dr. Hallock continuing his investigations on the physics of geyser action. Mr. J. P. Iddings, in investigating the acidic lavas of the park, prepared for the Seventh Annual Report of the Director a paper entitled "Obsidian Cliff of Yellowstone Park," which not only gives a description of Obsidian Cliff, but presents a résumé of all that is known as to the eruptions of obsidian in other parts of the world. Mr. Hague dwells upon the need of Congressional action to settle the definite boundaries of the Park, and reiterates his previous suggestions as to the limits which should be adopted. He also adverts to the great importance of the Yellowstone Park as a forest reservation, stating that he is acquainted with no tract in the Rocky Mountains where the necessity for the conservation of the forests appears so urgent or the direct advantage to be gained so immediate.

Colorado Division of Geology.—The field work in this division since the date of the last report has been mainly carried on by Mr. Emmons' assistants, he himself having been principally engaged in the preparation of material for publication. Such field work as was done under his direction was mainly in the Gunnison or Crested Butte region and in the Denver Basin region. His assistants, Messrs. Cross and Eldridge, made large collections of specimens, and the former, in the course of his work, made a number of important contributions to petrography.

California Division of Geology.—Resuming his field studies of the geology of the quicksilver deposits of the Pacific slope, Mr. G. F. Becker brought his investigation to a conclusion, and devoted himself to the preparation of a monograph on the results. This monograph is now in an advanced state, and will soon be placed in the hands of the printer. In his observation of the stratigraphy of California Mr. Becker was led to consider a number of the physical and chemical questions involved, and his work upon these resulted in the disclosure of certain novel laws of mechanics and physics that are believed to have a high value. Thus, in considering the fundamental shape of volcanic cones, Mr. Becker found that the form of such cones could be determined mathematically with all possible definiteness, and that this form coincides in the most remarkable way with photographs of actual volcanic cones in America and Japan. A contribution to the general law of mechanics which grew out of his investigation of quicksilver is called a theorem of maximum dissipativity, according to which there is in every system a tendency to motions of a shorter period, this tendency being the greatest possible when the motions of the system have periods which differ considerably.

Division of Volcanic Geology.—Captain C. E. Dutton, with his assistant, Mr. J. S. Diller, devoted his field work to a study of the Cascade Range and its geological relation to the Coast Ranges. The belt of country between the shore of the Pacific and the Cascade Range he finds to be occupied by mountains which do not group themselves into distinct ranges, but which are crowded closely together and present forms altogether peculiar by reason of their irregularity, want of definite trend, and absence of anything approaching structural axes. The attitudes of the older rocks in this region disclose a scene of stratigraphic confusion, displacement, and distortion without a parallel in his experience. The most striking feature of the Cascade Range is undoubtedly Crater Lake, of which Captain Dutton made a thorough examination. The occurrence of several notable earthquake tremors in the Atlantic States in the summer and autumn of 1884, and the fact that such disturbances are more numerous than is generally supposed, led to some preliminary measures under the direction of Captain Dutton looking to the establishment of systematic observations of such phenomena. A consultation was held between several members of the Geological Survey corps and Prof. C. G. Rockwood, of Princeton, Mr. W. M. Davis, of Harvard, Prof. Cleveland Abbe, of the Signal Service, and Mr. H. M. Paul, of the Naval Observatory. It was determined that the only practicable scheme would be to rely upon the voluntary and unpaid co-operation of individual observers and upon the aid which might be gained from the assistants of the Signal Service and other Government bureaus having permanent stations scattered throughout the country. Mr. C. F. Marvin, of the Signal Service, undertook to devise an instrument, inexpensive and simple, and requiring a minimum of care and attention, which could be used by volunteers in making their observations. Numerous responses have been received to the circulars that were sent out asking for assistance in this work.

Potomac Division of Geology.—Mr. W J McGee continued his geologic investigation of the District of Columbia and contiguous territory as the condition of the topographic survey of the area under discussion permitted. He gave special attention to the Potomac formation, both as disclosed in the District of Columbia and elsewhere, and, in the absence of fossil faunas characterizing the formation, he availed himself of the assistance of Professors Ward and Fontaine in reaching some conclusions as to its taxonomy through a study of its fossil flora. A large amount of miscellaneous office work is intrusted to the chief of this division, and the most important subjects of this character which have engaged his attention during the period under review are briefly referred to below. Mr. McGee continued to assist the Director in developing a cartographic system, which, while sufficiently comprehensive to represent the rock masses in the entire dominion of the United States, is at the same time sufficiently definite to be intelligible to all users of the geologic maps published by the Survey and sufficiently elastic to permit the employment of classifications of rocks now in vogue or such as may be hereafter evolved. The work has led to the preparation of a bulletin entitled "A Contribution to the Areal Geology of the United States," which is now nearly ready for the press. A meeting of the Congrès Géologique International was held at Berlin in September and October, 1885, and Mr. McGee represented the Director of the Survey in its deliberations, presenting to it a formal communication on his behalf. The principal function of this Congress, which was organized largely through the instrumentality of American geologists, is the improvement and unification of conventions employed in geologic cartography. Under Mr. McGee's direction a bibliography of the geology of Texas has been prepared and is nearly ready to send to the press. The Survey having undertaken to compile a history of American State surveys, from data contributed as far as possible by those who have engaged in the work, the material has been placed in Mr. McGee's hands, and a manuscript history of American State surveys is now substantially complete. To the gentlemen who have generously turned aside from other duties and interests and prepared material for this proposed history, the profound obligations of the Survey are warmly extended.

Louisiana Division of Geology.—Owing to the importance of the iron ores of Northern Louisiana, a division of geology was established with Mr. Lawrence C. Johnson at its head, to investigate the localities in this region in which iron ores were known or supposed to be deposited. Mr. Johnson has performed a large amount of preliminary work, but his material is not yet in such a condition as to permit of publication.

PALEONTOLOGY.

Division of Vertebrate Paleontology.—In continuing his systematic work of collecting fossils in the West, Prof. O. C. Marsh states the two objects he has had especially in view, as follows: First, to determine the geologic horizon of each locality where large series of vertebrate fossils were found, and, second, to secure from these localities collections of the more important forms sufficiently extensive to disclose, if possible, the life history of each. With the paucity of remains of plants and invertebrates in many regions of the West, the value of vertebrate fossils, especially of the higher types, in enabling us to get a more accurate and detailed geologic record, is manifest. It is hoped that the collections of the remains of the vertebrate life throughout the Rocky Mountain region in past ages, now being made, will afford the means of solving many profound problems, since some of the most important chapters in the history of life on the globe are recorded here alone.

The success of Professor Marsh and his assistants in their field work has been most gratifying, and the more difficult work of classifying the extensive collections secured has been systematically and rapidly carried on.

Paleozoic Division of Invertebrate Paleontology.—The field operations of Mr. C. D. Walcott, the chief of this division, were directed as follows: (1) The continuation of the study of the Devonian strata and contained faunas in Southern and Western New York; (2) the study of Cambrian strata in Alabama, Georgia, and Tennessee, and the collection of fossils from numerous localities; (3) the examination of a number of sections of Cambrian strata in Central Nevada and Northern Utah and the collection of fossils; (4) the taking of a section of the Permian formation in Southern Utah and the collecting of fossils from three localities in the section, and (5) the examination of certain Middle Cambrian rocks from Columbia County, New York, and the collecting of Lower Silurian fossils in Central New York. In these operations he was assisted by Prof. H. S. Williams, who is preparing a monograph on the Devonian faunas, and by Messrs. Cooper Curtice, A. M. Gibson, S. W. Ford, W. P. Rust, and others. With the data now in his possession, Mr. Walcott believes that most of the Paleozoic fossils heretofore collected in the entire Rocky Mountain region can be referred to their true stratigraphic horizons, but further study will be needed on the faunas that preceded the Middle Cambrian fauna. During the year he prepared a paper on the Middle Cambrian faunas of North America, which was published as Bulletin 30 of the Survey series.

Mesozoic Division of Invertebrate Paleontology.—Dr. C. A. White, the chief of this division, carried on field operations chiefly in Utah and Wyoming. The work he planned for the season was the stratigraphic and paleontologic study of the later Cretaceous and early Tertiary formations. As results of his studies in the field it is shown that a portion of the fresh-water molluscan species which characterize the Laramie group survived their brackish-water contemporaries and became a part of the purely fresh-water molluscan faunas of the Wasatch group. This indicates that there was a continuity of congenial aqueous habitat for those mollusks from the Laramie to the Wasatch epoch, and the observed character of the strata also indicates that sedimentation was continuous from the one group to the other. The observations upon the Jurassic strata and their fossil contents which he was able to make during the past season, together with those previously made, seem to justify the opinion that a large continental area existed upon the site of the present North American continent during the latter part of the Jurassic period. An important feature of Dr. White's office work during the past fiscal year was the transfer of all the fossils belonging to the Survey and in charge of his division to the newly allotted space in the northeast balcony in the second story of the National Museum building, where all the specimens were cleansed, numbered, and stored away in cases for convenient reference.

Cenozoic Division of Invertebrate Paleontology.—On being placed in charge of this division Mr. W. H. Dall's first efforts were directed to putting into shape for ready reference and the identification of species as they should come in, the Quaternary fossils of North America that have come into the possession of the Geological Survey. The land and fresh-water forms of the ancient lake basins of the West and the loess of the Mississippi Valley, and the marine forms from the southern and southeastern portions of the United States bordering on the sea, being by far the most important, the classification of these was first undertaken. It is gratifying to be able to state that the large collections of Quaternary fossils and allied recent forms have been suitably classified and conveniently arranged for study. In the year ending June 30, 1886, 18,638 lots of specimens, including not less than 60,000 individuals, have been labeled, registered, and put in order, about one-half as much as during the whole of the previous twenty-five years since the beginning of the work. A small amount of field work was done in South Carolina and in Louisiana and Texas.

Division of Paleobotany.—In the year following that for which a report was last made, Prof. L. F. Ward devoted himself almost exclusively to office work. As a result of this he prepared for the Sixth Annual Report of the Director a paper entitled "Synopsis of the Flora of the Laramie Group," profusely illustrated. Early in the present fiscal year Prof. Ward prosecuted field work along the bluffs of the Potomac and Rappahannock Rivers. He also made an expedition down the James to City Point and up the Appomattox to Petersburg. In these trips he was accompanied at different times by Prof. W. M. Fontaine, Mr. W J McGee, and Mr. F. H. Knowlton. In the office he prepared technical descriptions of the species figured for publication without description, in the Sixth Annual Report of the Director, and drew them up in the form of a bulletin of the Survey, entitled "Types of the Laramie Flora," and numbered 37 of that series. Prof. Ward is making satisfactory progress in the extensive bibliographic work he has undertaken in connection with his subject. Prof. Leo Lesquereux has undertaken the preparation of a volume of descriptions and illustrations of Cretaceous and Tertiary plants.

Prof. Fontaine devoted the period which has elapsed since the date of the last report to the continuation of the study of the younger Mesozoic, or Potomac, formation, both in field and office. He discusses the plant material which has been collected from both a geological and botanical point of view, since the plants fill a most important gap in geologic records. Both the geologic and paleontologic reports will soon be ready for the printer.

Division of Fossil Insects.—At the beginning of the present calendar year Prof. Samuel H. Scudder, the greatest living authority on the subject of fossil insects, was appointed to a position on the Survey, and placed in charge of a division designated "The Division of Fossil Insects." He has devoted his time thus far (1) to the collection of insects from the peat deposits of Nantucket; (2) to a determination of insects from the interglacial clays of our northern border; and (3) to a systematic study of the *Carabidæ* of the Oligocene beds of the Florissant. Mr. Scudder also prepared for publication as a bulletin of the Survey a review of our present knowledge of fossil insects.

MISCELLANEOUS.

Division of Chemistry and Physics.—In this division Prof. F. W. Clarke reports slight changes in the force and equipment for the present year; but a few additions have been made in each direction. A large portion of the work done by Prof. Clarke and his assistants, Messrs. Chatard, Hillebrand, Gooch, Whitfield, and Riggs, in the chemical laboratory, was of a routine nature, and grew out of applications for the determination of rocks, minerals, and waters submitted by the various heads of geological divisions or by the other branches of the Government. But some attention has been given to original research. In the latter work, the chemical division has profitably co-operated with Mr.

J. S. Diller, of the division of volcanic geology. From an investigation of the waters of the Yellowstone National Park, made by Messrs. Gooch and Whitfield, it is learned that all the hot waters of that region contain arsenic in quite appreciable quantities. Mr. Gooch having been elected professor of chemistry in Yale College, has severed his connection with the Survey.

In the physical laboratory Messrs. William Hallock and Carl Barus, the latter assisted by Prof. Strouhal, of Prague, have continued physical investigations. Dr. Barus studied the internal structure of steel, and he and Dr. Hallock jointly investigated the constancy of temperature attainable in metallic vapor baths and constructed apparatus for the convenient calibration of thermo-electric pyrometers.

Division of Mining Statistics and Technology.—Since the last report was made another volume on the mineral resources of the United States has appeared under the direction of Mr. Albert Williams, jr., chief of this division. Somewhat fuller than its predecessor, it has been in much greater demand. While these volumes record with great care the production of minerals in the United States for each year, the accompanying text relating to the various industries is different in character from volume to volume.

Mr. Williams having resigned, Dr. D. T. Day, of the Johns Hopkins University, has been placed in charge of this work.

Division of Forestry.—Since the date of the last report a division of forestry has been established in the Geological Survey, and Mr. George W. Shutt placed in charge thereof. Field investigations have been made of the forestry of Virginia, North Carolina, and Kentucky, and a large amount of material that has been received from volunteer observers in response to inquiries is in course of preparation for publication by the Survey.

Division of Illustrations.—Mr. W. H. Holmes, in charge of the division of illustrations, presents a detailed report of the work which has been done under his direction. In his administrative report for the year ending June 30, 1885, he discusses the various methods employed for the production of illustrations, and the most judicious ways of applying them. During the two years covered by his administrative reports illustrations have been transmitted through him for three monographs, two annual reports, and eighteen bulletins.

Division of the Library and Documents.—From the reports of Mr. C. C. Darwin, chief of this division, it is learned that there has been a steady and very considerable growth in the library, and that satisfactory progress has been made in the work of cataloguing. The facilities for exchange have been increased, and the rapid growth of the library is due almost entirely to this feature. Although no attempt is made to stimulate sales of Survey publications, yet as they become better known the desire for them becomes more general, and the sales during the present fiscal year have amounted to double those of the previous year.

U. S. FISH COMMISSION.

As already explained, the Secretary of the Smithsonian Institution exercises the functions of chief officer of the U. S. Fish Commission for which, of course, he receives no salary. It has therefore been his duty to report, year by year, what the Commission has been doing, and, in its interest to the public service, to justify the action taken upon the subject.

The history of the Commission, since its organization in 1871, has shown a gradual expansion of scope and increase in magnitude, in proportion to the increasing appropriations made by Congress. The appropriation for the first year was $5,000, while for the year just closed it amounts to nearly $250,000. The work, as heretofore, has been divided mainly into two sections: one, the investigation of the statistics and natural history of the fishes and other products of the water and their relationships to each other, including the various methods of capture and utilization, form of apparatus required, &c.; the other, the increase in the supply of food fishes, &c., either by artificial propagation or by transportation. The addition, within recent years, of several vessels to the means of investigation on the part of the Commission has been of great service, especially through the work of the steamer *Albatross*. More recently, Congress has authorized the construction of a small schooner of special device, to be used particularly in securing the ripe parent sea fish at distant points and bringing them to stations on the coast, especially to Wood's Holl, Mass. This vessel, although completed at the end of the fiscal year, is not yet in commission. An account of her work will therefore be deferred until the next report.

Referring to the detailed account of operations in the Report of the U. S. Fish Commission, it may be briefly stated that the usual researches have been prosecuted during the year, resulting in the acquisition of a large amount of important information, which will be duly reported upon at the appropriate time. Complete statistics of the fisheries of the coast have been gathered for the service of the Government in the international question arising between the United States and Canada; and these have already been called for by the Congressional committees of investigation.

As on several previous occasions, the services of the steamer Albatross were secured by the Navy Department for the purpose of continuing hydrographic research in the Caribbean and West Indian seas, and during the past year the vessel was assigned to labor off the Bahaman Islands, where she was engaged for several months in making soundings, dredgings, temperature observations, &c.

The "fish-culture" work of the Commission has also been carried on on a very extensive scale, the different stations having all been engaged in the work to the measure of their capacity, and many hundreds of millions of eggs have been taken, hatched out, and distributed to various points, among them being whitefish, salmon, land-locked salmon, California trout, brook trout, lake trout, grayling, shad, fresh-water herring, codfish, Spanish mackerel, lobsters, &c.

The principal station of the Commission—that at Wood's Holl, Mass.—has been adapted especially for the hatching of sea fish, chiefly of the cod and of the lobster; and while considerable work has been done there during the past winter, preparations have been under way through the summer for the purpose of renewing the work on a wholesale scale the coming winter.

The completion of the schooner *Grampus* now allows its use in bringing spawning fish from the distant banks, and it is hoped that the interruption last winter in the supply of parent fish will not again occur.

An additional function of the Wood's Holl Station is that of furnishing the means of biological investigation and research to specialists, many of whom availed themselves of the advantages afforded them during the past fiscal year.

Another subject that has largely occupied the attention of the Commission of late years is the artificial production of the oyster, and experiments already made have shown that the general principles of fish culture may be applied to this animal to great advantage. Work in this direction is now in progress at the sea-coast station at Saint Jerome's, Md., near the mouth of the Potomac River, as well as at Wood's Holl, and with quite satisfactory results.

Respectfully submitted.

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

WASHINGTON, *December* 1, 1886.

APPENDIX TO THE SECRETARY'S REPORT.

REPORT ON SMITHSONIAN EXCHANGES FOR THE FISCAL YEAR ENDING JUNE 30, 1886.

By GEORGE H. BOEHMER.

When, towards the close of the year 1880, you intrusted the charge of the exchange service to my keeping, no very definite system had been established, though the records kept may have been sufficient for the extent of the business at that time.

As the work expanded I ventured to make some suggestions whereby the service might be established on more business principles, involving the organization of the Record, Foreign, Domestic, and Government Exchange Divisions.

At present the office force is worked to its full capacity, and an increase in the work would require a corresponding increase in the force.

The Record Division.—One of the improvements introduced in 1881 was a system of card catalogues as ledger accounts, which has been found very useful. We have at present 4,513 cards, representing the accounts kept with societies; and 3,340 cards, representing the accounts with individuals.

These cards, arranged in geographical series (and under each country alphabetically), are numbered as in the "List of foreign correspondents." They represent a double-entry ledger, showing to the left the books and packages received for the party represented, together with the date of reception, transmission, and acknowledgment of receipt by the recipient, and to the right the nature and character of any sending received from that party. The number of the page on which each entry is recorded on the day-book and the number corresponding to each item on the incoming or invoice book complete the record.

The manner of proceeding in posting the cards was fully described in the report for 1885, as also the duties of the (two) assistants employed in this division. The work performed by them during the present year is shown in the following statement:

Description.	Number.	Total.
Foreign cards in use:		
Societies	3,664	
Individuals	2,523	
		6,187
Domestic cards in use:		
Societies	849	
Individuals	817	
		1,666
		7,853
Foreign entries made		52,324
Domestic entries made		28,546
Invoices written		14,217
Letters recorded		1,049
Acknowledgments recorded		10,930

Foreign Exchange Division.—The operations of this division during the year exceed those of any previous year, the receipts being 94,093 packages, with a weight of 195,404 pounds. These were shipped in 764 cases, representing a bulk of 5,208 cubic feet. A detailed statement will be given in the general statistics, but a condensed table of the receipts and transmissions in this division may not be without interest:

	1881.	1882.	1883.	1884.	First six months 1885.	1885–'86.
Receipts:						
Number of packages	37,051	58,047	63,894	65,170	43,600	94,093
Weight in pounds	107,946	143,374	155,650	153,814	97,032	195,404
Transmissions:						
Boxes	407	422	495	684	345	764
Bulk in cubic feet	2,800	2,950	3,288	4,550	2,355	5,208
Weight in pounds	100,750	105,500	122,265	172,197	85,603	189,580

The above table shows almost a doubling of the receipts and transmissions since the beginning of the present decade.

The work of this division is performed by two clerks and one packer. Two temporary clerks have been employed so as not to interrupt the regular transmissions during the sending off of the annual reports for 1883, but their services were discontinued upon accomplishment of the work for which they were detailed.

Domestic Exchange Division.—In this division, too, an increase of about 20 per cent. over the work of the past two years is noticeable, the number of parcels received and distributed during the year comparing with previous years as follows:

	1881.	1882.	1883.	1884.	First six months 1885.	1885–'86.
Total number of parcels..	8,438	8,359	11,000	10,237	5,138	*14,496

* This includes 2,533 parcels addressed by mail to the library of the Institution.

Government Exchange Division.—This division is not fully established yet, all the active work, the receiving and shipping, being performed by the assistants of the Foreign Exchange Division. Only one clerk is employed in recording the books delivered by the Public Printer; and when not occupied with this work in assisting the foreign exchange division by addressing labels or envelopes.

Twenty-nine boxes and 56,229 packages have been received and 114 boxes shipped in this division.

My own services during the year, in addition to the general supervision of the above work, have consisted in the writing of about 1,200 letters or memoranda for letters, including some extensive reports for the use of the Joint Library Committee of Congress; the preparation of a new list of foreign correspondents of about 4,000 titles; of a list of existing astronomical observatories, American and foreign; of a paper on Norske Naval Architecture for the Proceedings of the National Museum and the translation of a paper on Observations of Volcanic Eruptions and Earthquakes in Iceland, accompanied by a complete bibliography on the subject for the Smithsonian annual report for 1885.

RECEIPTS.

1. *For foreign distribution.*

Whence received.	1885–'86.	
	Packages.	Weight.
(*a*) From Government Departments:	*Number.*	*Pounds.*
Agricultural Department	277	685
Bureau of Ethnology	496	3,289
Bureau of Education	116	233
Bureau of Statistics	1	2
Comptroller of the Currency	700	895
Department of the Interior	912	6,550
Department of State	7	42
Engineer's Bureau, U. S. Army	16	274
Nautical Almanac	371	504
Ordnance Office, U. S. Army	6	60
Surgeon-General's Office	69	926
Treasury Department	10	33
U. S. Coast Survey	2	56
U. S. Court of Claims	3	8
U. S. Fish Commission	694	4,282

1. *For foreign distribution*—Continued.

Whence received.	1885-'86.	
	Packages.	Weight.
(*a*) From Government Departments—Continued.	*Number.*	*Pounds.*
U. S. Geological Survey	5,151	23,285
U. S. National Museum	124	4,015
U. S. Naval Observatory	1,108	1,917
U. S. Patent Office	253	6,845
U. S. Signal Office	1,379	7,816
War Department	29	94
	11,724	61,811
(*b*) From Smithsonian Institution	6,205	24,059
(*c*) From scientific societies:		
Academy of Natural Sciences, Philadelphia	318	549
American Academy of Arts and Sciences, Boston	616	1,685
American Association for the Advancement of Science, Salem, Mass	173	714
American Geographical Society, New York	1	26
American Journal of Science, New Haven	185	67
American Oriental Society, New Haven	1	6
American Philosophical Society, Philadelphia	939	1,092
Anthropological Society, Washington, D. C	209	208
Austria-Hungary legation, Washington, D. C	19	5
Boston Society of Natural History, Boston	299	619
Buffalo Society of Natural History, Buffalo	92	28
Bureau of Agriculture, Frankfort, Ky	1	2
California Academy of Science, San Francisco	408	500
Cincinnati Observatory, Cincinnati, Ohio	98	46
Cincinnati Society of Natural History, Cincinnati	3	2
Commissioners, District of Columbia	1	12
Commonwealth of Massachusetts	2	8
Connecticut Academy of Sciences, New Haven	13	58
Connecticut State Board of Health, New Haven	1	4
Elliott Society of Science and Arts, Charleston, S. C	72	13
Executive department, State of Maine	8	22
Executive office, State of Iowa	7	14
Executive office, State of Florida	3	5
Executive office, Cheyenne, Wyo	2	2
Franklin Institution, Philadelphia, Pa	10	12
Geological Survey of New Jersey, New Brunswick	84	256
Georgetown College, D. C	1	10
Harvard College, Cambridge, Mass	5	49
Historical Society of Pennsylvania, Philadelphia	72	63
Illinois State Historical Society, Springfield	3	35
Iowa Weather Bureau, Iowa City	8	538
Johns Hopkins University, Baltimore	38	502
Maryland Historical Society	1	4
Michigan State Board of Agriculture, Lansing	62	195
Minnesota Academy of Natural Sciences, Minneapolis	62	22
Minnesota Geological Survey, Minneapolis	45	411
Missouri State Board of Agriculture, Columbia	2	2
Museum of Comparative Zoology, Cambridge	54	106
National Academy of Sciences, Washington, D. C	1,083	1,464
New England Medical Monthly, Sandy Hook, Conn	1	1
New York Academy of Medicine, New York City	1	30
New York Academy of Sciences, New York City	444	668
New York State Library, Albany	1	12
New York State Museum of Natural History, Albany	153	1,295
Peabody Academy, Salem, Mass	79	325
Peabody Institute, Baltimore, Md	6	33
Pennsylvania Board of Agriculture, Harrisburg	1	1

1. *For foreign distribution*—Continued.

Whence received.	1885–'86. Packages.	1885–'86. Weight.
(c) From scientific societies—Continued.	*Number.*	*Pounds.*
Philosophical Society, Washington, D. C	4	14
Second Geological Survey of Pennsylvania, Philadelphia	641	10,837
Trenton Natural History Society, Trenton, N. J	211	21
Virginia Historical Society	1	110
Washburn Observatory, Madison, Wis	703	798
Miscellaneous societies	35	71
	7,282	23,572
(d) From individuals	951	3,459
Grand total	26,162	112,901

2. *From foreign establishments for domestic distribution.*

From—	1885–'86. Boxes.	1885–'86. Packages.	1885–'86. Weight.
	Number.	*Number.*	*Pounds.*
Africa		20	8
Belgium	14	685	2,852
Brazil	2	66	262
Canada		118	1,046
China		3	3
Denmark	2	106	324
France	11	517	2,970
Germany	40	2,841	8,350
Great Britain and Ireland	64	1,674	11,420
Greece		4	3
Iceland		11	8
India		7	4
Italy	10	612	2,221
Japan	18	127	5,423
Java	1	143	70
Mail *		3,105	1,274
Mexico	3	344	345
Netherlands	6	333	1,237
New South Wales	2	113	152
Norway	2	114	377
Nova Scotia		3	1
Peru		10	4
Russia	3	353	744
Sandwich Islands		35	2
San Salvador		24	33
South Australia	1	22	70
Spain		2	5
Sweden	2	113	11,810
Switzerland	9	2,516	1,496
Tasmania		4	27
Victoria		2	8
West Indies		8	22
Total	190	14,035	42,579

* For the Smithsonian Institution, both foreign and domestic.

3. *For Government exchanges.*

For what and whence received.	1885–'86.		
	Boxes.	Packages.	Weight.
(*a*) For Library of Congress from—	*Number.*	*Number.*	*Pounds.*
Austria-Hungary	2	9	205
France	1	73	180
Germany	2	2	462
Great Britain	19	93	4,355
Norway	3	3	800
Sweden	1	60	160
Victoria	1	1	37
Miscellaneous*	....	2,533	3,000
(*b*) For foreign governments from—			
Public Printer	....	53,455	33,725
Total	29	56,229	42,924

* To be deducted from No. 2 table.

RECAPITULATION.

For what and whence received.	1884–'85.		1885–'86.	
	Packages.	Weight.	Packages.	Weight.
1. For foreign distribution from—	*Number.*	*Pounds.*	*Number.*	*Pounds.*
(*a*) Government Departments	9,381	70,340	11,724	61,811
(*b*) Smithsonian Institution	4,821	17,578	6,205	24,059
(*c*) Scientific societies	5,592	19,117	7,282	23,572
(*d*) Individuals	888	3,405	951	3,459
	20,682	110,440	26,162	112,901
2. From foreign establishments for distribution	8,591	36,526	11,702	39,579
3. For Government exchanges	50,229	38,514	56,229	42,924
Total	79,502	185,480	94,093	195,404

DISTRIBUTION.

The 762 boxes sent during the fiscal year ending June 30, 1886, were distributed as follows:

Country.	Government boxes.	Smithsonian boxes.	Total.
Africa:			
Algiers	......	2	2
Cape Colony	......	2	2
Egypt	......	1	1
Liberia	......	1	1
Mauritius	......	1	1

County.	Government boxes.	Smithsonian boxes.	Total.
America:			
British America	6	10	16
Mexico	3	11	14
Central America:			
Costa Rica	......	2	2
Guatemala	......	1	1
Nicaragua	......	1	1
West Indies:			
Cuba	......	2	2
Guadeloupe	......	1	1
Hayti	3	......	3
Nassau	......	1	1
Porto Rico	......	2	2
South America:			
Argentine Confederation	6	8	14
Brazil	3	6	9
Chili	3	4	7
Colombia, United States of	3	1	4
Uruguay	......	1	1
Venezuela	3	1	4
Asia:			
China	......	4	4
India	3	10	13
Japan*	3	13	16
Philippine Islands	......	2	2
British Burmah	......	1	1
Australasia:			
New South Wales	3	5	8
New Zealand	3	9	12
Queensland	3	1	4
South Australia	3	1	4
Tasmania	3	1	4
Victoria	3	3	6
Europe:			
Austria-Hungary	3	31	34
Bavaria*	3	......	3
Belgium	3	25	28
Denmark	3	7	10
France	3	92	95
Germany	3	116	119
Great Britain	3	119	122
Greece	3	2	5
Italy	3	44	47
Netherlands	3	17	20
Norway	3	8	11
Portugal	4	6	10
Prussia*	3	......	3
Russia	3	28	31
Saxony*	3	......	3
Spain	4	5	9
Sweden	3	20	23
Switzerland	3	17	20
Turkey	3	1	4
Würtemberg*	3	......	3
Polynesia:			
Sandwich Islands	......	1	1
Grand total	116	648	764

* The Smithsonian exchanges are included in the 116 cases for Germany.

RECAPITULATION.

Country.	Government boxes.	Smithsonian boxes.	Total.
Africa	......	7	7
America	30	52	82
Asia	6	30	36
Australasia	18	20	38
Europe	62	538	600
Polynesia	......	1	1
Total	116	648	764

Table showing number of packages distributed to domestic societies and individuals during the year ended June 30, 1886:

States and Territories.		Establishments.	Individuals.	Total.
Alabama		8	1	9
Arkansas		4	......	4
California		137	34	171
Colorado		5	1	6
Connecticut		232	153	385
Dakota		......	1	1
Delaware		4	......	4
District of Columbia:				
Library of Congress	2,774			
Smithsonian Institution	4,641			
Other establishments	1,336			
		8,751	570	9,321
Florida		2	......	2
Georgia		16	......	16
Illinois		123	28	151
Indiana		36	9	45
Iowa		113	16	129
Kansas		16	3	19
Kentucky		11	7	18
Louisiana		23	2	25
Maine		20	5	25
Maryland		115	19	134
Massachusetts		978	242	1,220
Michigan		68	8	76
Minnesota		47	5	52
Mississippi		4	......	4
Missouri		190	23	213
Montana		1	......	1
Nebraska		4	2	6
New Hampshire		19	2	21
New Jersey		59	30	89
New Mexico		......	4	4
New York		788	210	998
North Carolina		5	1	6
Ohio		165	28	193
Oregon		4	......	4
Pennsylvania		663	162	825
Rhode Island		47	33	80
South Carolina		19	7	26

State and Territories.	Establishments.	Individuals.	Total.
Tennessee	11	4	15
Texas	7	1	8
Utah	2	....	91
Vermont	19	....	82
Virginia	28	10	3
Washington Territory	1	....	1
West Virginia	2	....	2
Wisconsin	122	6	128
	12,869	1,627	14,496

The following table shows the whole number of shipments for foreign exchanges from 1850 to 1886:

Year.	No. of boxes.	Bulk in cubic feet.	Weight in pounds.	Year.	No. of boxes.	Bulk in cubic feet.	Weight in pounds.
1850	40	200	6,900	1870	121	1,189	31,383
1851	40	240	7,920	1871	108	772	28,950
1852	46	263	9,885	1872	179	954	26,850
1853	48	392	12,200	1873	196	1,476	44,236
1854	38	365	9,791	1874	149	933	27,990
1855	33	358	10,481	1875	208	1,503	45,300
1856	70	586	18,271	1876	323	2,261	80,750
1857	40	384	14,248	1877	406	3,276	117,000
1858	56	672	22,674	1878	309	2,160	69,220
1859	82	1,054	29,480	1879	311	2,177	69,975
1860	61	767	20,029	1880	268	1,976	60,300
1861	73	625	16,958	1881	407	2,800	100,750
1862	114	1,006	28,836	1882	422	2,950	105,500
1863	61	447	10,286	1883	495	3,288	122,265
1864	63	546	20,500	1884	684	4,550	172,197
1865	77	557	18,630	1885 (6 months)	345	2,355	85,603
1866	83	571	18,050	1885–'86 *	764	5,208	189,580
1867	113	975	22,523				
1868	104	1,057	31,171	Total	7,049	51,926	1,730,058
1869	112	1,033	23,376				

* In 1885 the fiscal year was adopted for the operations of the Smithsonian Institution; hence in the above and in the following tables an account is given of the transactions during the first six months of 1885, and followed by those of the entire fiscal year ended June 30, 1886.

The following chronological table shows the whole number of books and parcels received by the Institution for its own library (by exchange) and for domestic distribution:

Year.	Received for the Smithsonian library.				For institutions and individuals in the United States and British America.	
	Volumes.	Parts and pamphlets.	Maps and engravings.	Total.	Addresses.	Packages.
1846–1850	470	624	4	1,098	....	....
1851	549	618	....	1,167	....	....
1852	1,481	2,106	1,749	5,336	96	637
1853	1,440	991	125	2,556	160	1,052
1854	926	1,468	434	2,826	149	987
1855	1,037	1,707	26	2,770	219	1,445
1856	1,356	1,834	140	3,330	189	1,245
1857	555	1,067	138	1,760	193	1,273
1858	723	1,695	122	2,540	243	1,539
1859	1,022	2,540	40	3,602	293	1,933
1860	1,271	4,180	220	5,671	335	1,908
1861	821	1,945	120	2,886	274	1,406
1862	1,611	3,369	55	5,035	273	2,111
1863	910	3,479	200	4,589	273	1,522
1864	823	2,754	109	3,686	299	2,482
1865	767	3,256	183	4,206	345	2,368
1866	1,243	4,509	121	5,873	329	2,703
1867	1,557	3,946	328	5,831	347	971
1868	1,770	3,605	134	5,509	436	2,394
1869	1,234	4,089	232	5,555	501	4,130
1870	1,113	3,890	179	5,182	567	3,705
1871	936	3,579	82	4,597	573	3,952
1872	1,262	4,502	198	5,962	587	4,635
1873	889	4,354	454	5,697	689	4,782
1874	863	4,521	162	5,546	750	4,326
1875	1,120	5,813	114	7,047	610	4,661
1876	1,017	6,193	375	7,585	644	4,853
1877	1,889	6,511	326	8,726	766	4,962
1878	1,263	7,392	74	8,729	662	5,292
1879	1,949	8,071	183	10,203	785	6,971
1880	1,143	7,275	152	8,570	945	5,587
1881	1,867	9,904	188	11,959	1,054	8,433
1882	1,296	10,341	152	11,789	947	8,359
1883	1,754	10,702	219	12,675	894	11,000
1884	1,567	11,149	143	12,859	770	10,236
1885 (six months)	910	9,077	354	10,341	1,208	5,119
1885–'86 (fiscal year)	1,938	13,949	379	16,266	1,666	14,496
Total	44,342	177,005	8,214	229,561	18,771	143,975

AGENCIES.

Transportation companies.—The rapid extension of the Smithsonian exchanges soon became a heavy tax upon the resources of the Institution, and the conduct of its principal function ("the increase of knowledge among men" by the promotion of original research and discovery) was threatened with being crippled and overridden by the demands of a service regarded as incidental and subordinate thereto. With a view to diminish, if possible, the expenses involved, the Institution, in 1855, addressed several of the leading transatlantic steam-ship companies, unfolding its methods, and asking, in consideration of the great public benefit of the system, the favor of reduced rates of freight upon this particular service.

With a liberality and public spirit which can not be too highly admired, the companies addressed agreed to carry the freights of the Smithsonian Institution not merely at an abatement, but without charge, and thus generously enabled the Institution to maintain the growing magnitude of the operations, when otherwise the system must have broken down by its own weight.

The first privilege of free freight was extended during the year 1855 by the following companies:

United States Mail Steamship Company, M. O. Roberts, president.

Pacific Mail Steamship Company, W. H. Aspinwall, president.

South American Mail Steamship Company, Juan Metteson, president.

Mexican Gulf Steamship Company, Harris & Morgan, agents.

Panama Railroad Company, David Hoadley, president.

California and Panama Steamship Company.

In 1857 the line of sailing vessels between New York and the west coast of South America, belonging to Mr. Bartlett, 110 Wall street, also engaged to carry all the Chilian exchanges free of freight.

In 1858 Hon. R. Schleiden, the minister from Bremen, offered his services in trying to procure for the Smithsonian Institution the advantage of free or reduced freight on exchanges for the port of Bremen, and he announced his success in a letter, dated January 25, 1859, in which he said:

It affords me great pleasure now to inform you that, according to a letter of the president of the Lloyd, dated the 5th instant and just received, the said Bremen Steamship Company (*North German Lloyd*) have resolved henceforth, and until further notice, to forward by their steamers all the packages of books and specimens of natural history which the Smithsonian Institution may be pleased to send to Germany, or which may be sent from Germany to the Smithsonian Institution, free of charges between New York and Bremerhaven.

The *North Atlantic Steamship Company* (J. W. Raymond) also granted free freight in 1859.

On the 25th of February, 1860, in reply to a request of Professor Henry, of the 16th of February, Mr. Cunard, of the *Cunard Line of Steamers*, replied:

I beg to inform you that I shall have much pleasure in conveying in our steamers from New York to Liverpool, every fortnight, one or more cases from the Smithsonian Institution to the extent of half a ton, or 20 cubic feet measurement; the cases to be addressed to your agent in Liverpool, or to his care. The arrangement of free cases is intended only to apply to those shipped by you from this side of the water.

In 1861, in response to an application, the *Hamburg-American Packet Company*, in a letter of Messrs. Kunhardt & Co., dated New York, October 21, 1861, granted for their line of steamers the privilege of free freight, be they specimens of natural history, books, or other articles, irrespective of bulk.

The privilege of free freight was furthermore accorded the Smithsonian Institution by the following-named companies:

In 1864. *Leffman and Gutheil*, Vera Cruz.
1868. *Compagnie Générale Transatlantique*, L. de Bébian, agent.
Inman Steamship Company.
California and Mexico Steamship Company.
Union Pacific Railroad Company.
United States and Brazil Steamship Company.
North German Lloyd, Baltimore Branch.
Atlantic Mail Steamship Company.
1870. *Anchor Line*, Henderson & Brother, agents.
1872. *Baltic Lloyd Steamship Company.*
1875. *Atlas Steamship Company*, Pim, Forwood & Co., agents.
1879. *Merchants' Line of Steamers.*
Netherlands-American Steam Navigation Company, H. Cazaux, agent.
White Cross Line of Antwerp, Funch, Edye & Co., agents.
Murray, Ferris & Co.'s steamships, for Bahamas.
1881. *Red Star Line*, Peter Wright & Sons, agents.
1883. *Monarch Line*, Patton, Vickers & Co., agents.
American Colonization Society, Washington, D. C.
Bailey, H. B., & Co., New York.
Beadle, E. R., Philadelphia.
Bixby, Thomas E. & Co., Boston.
Bland, Thomas, New York.
Borland, B. R., New York.
Cameron, R. W., & Co., New York.
Dallett, Boulton & Co., New York.
Dennison, Thomas, New York.
Muñoz y Espriella, New York.
Spinney, Joseph S., New York.
Wilson & Asmus, New York.
1885. *Florio-Rubattino Line*, New York.

Shipping List.—The following is the shipping list at present used in the transmission of the Smithsonian exchanges:

Country.	Shipping agent.
Algeria	Compagnie Générale Transatlantique, New York. Transfer made by the French Commission of Exchanges, in Paris.
Argentine Confederation	Consul-General Carlos Carranza, New York. Shipments to the United States are made through either Lewis & Co., Portland, Me., or George F. Brown, New York, representing Samuel B. Hale & Co., of Buenos Ayres.
Antigua	Thomas Dennison, New York.
Austria-Hungary	North German Lloyd, Baltimore. Transfer made by Dr. Felix Flügel, Leipsig.
Bahamas	Murray, Ferris & Co., New York.
Belgium	Red Star Line, New York.
	White Cross Line, New York.
Bolivia	Consul-General Melchor Obarrio, New York.
Brazil	Consul Charles Mackall, Baltimore.
	R. B. Borland, New York.
British America	Baltimore and Ohio Express Company.
	Adams Express Company.
British Colonies	Monarch Line to London. Transfer made by Crown agents for the colonies, London, England.
British Guiana	Monarch Line, New York. Transfer made by W. Wesley, London, England.
Cape Colonies	Monarch Line, New York. Transfer made by agent-general for Cape Colonies in London, England.
Chili	Consul D. de Castro, New York.
China	Salter & Livermore, New York, direct to Shanghai.
	Monarch Line, New York. Transfer made through Crown agents for the colonies, London, England.
Colombia, United States of	Consul-General Lino de Pombo, New York.
Costa Rica	Muñoz y Esprilla, New York.
	Pacific Mail Steamship Company, New York.
Cuba	Consul-General Hipolito de Uriarte, New York.
Denmark	Consul-General Henrik Braem, New York.
	Consul Thomas Schmidt, New York.
Dutch Guiana	Thomas Bixby & Co., Boston, Mass.
Ecuador	Consul Francis Spies.
Egypt	S. L. Merchant & Co., New York.
Finland	North German Lloyd, Baltimore. Transfer made by F. A. Brockhaus, Leipsig, Germany.
France	Compagnie Générale Transatlantique, New York.
Germany	North German Lloyd, New York or Baltimore.
	Hamburg-American Packet Company, New York.
Great Britain	Monarch Line of Steamers, New York.
	North German Lloyd, New York.
	Cunard Royal Mail Steamship Company.
	Inman Steamship Company.
Greece	Consul D. W. Botassi, New York.
Guatemala	Consul Jacob Baez, New York.
Hayti	Atlas Steamship Company, New York.
Iceland	Consul Henrik Braem, New York. Transfer made by K. Danske Videnskabernes Selskab, Copenhagen.
India	Monarch Line, New York. Transfer made by Secretary of State for India, India Office, London, England.
Italy	Consul-General M. Raffo, New York. Florio-Rubattino Line, New York.
Japan	Consul Samro Takaki, New York.
Liberia	American Colonization Association, Washington, D. C.
Madeira Malta Mauritius Mozambique	Monarch Line, to Smithsonian agent, London.
Mexico	Consul, Juan N. Navarro, New York.

Country.	Shipping agent.
Netherlands Netherlands India	Consul R. C. Burlage, New York.
New Caledonia	Monarch Line, New York. Transfer made by Gordon & Gotch, London, England.
New South Wales	R. W. Cameron & Co., New York.
New Zealand	R. W. Cameron & Co., New York.
Nicaragua	Consul-General Alex. I. Cotheal, New York.
Norway	Consul Christian Bórs, New York.
Paraguay	Consul John Stewart, Washington, D. C.
Peru	Joseph S. Spinney, New York.
Philippine Islands	Spanish consul, San Francisco.
Polynesia	Consul Severance, San Francisco.
Portugal	Consul Gustav Amsink, New York.
Queensland	Monarch Line, New York. Transfer made by Queensland department, London, England.
Russia	Hamburg-American Packet Company, New York. Transfer made by Russian consul-general, Hamburg, Germany.
St. Helena	Monarch Line, New York. Transfer made by William Wesley, London, England.
Siam	Consul Isaac T. Smith, New York.
South Australia	R. W. Cameron & Co., New York.
Spain	Consul-General Hipolito de Uriarte, New York.
Straits Settlements	Monarch Line, New York. Transfer made by William Wesley, London, England.
Sweden	Consul Christian Bórs, New York.
Switzerland	North German Lloyd, Baltimore. Transfer made by Consul von Heyman, Bremen.
Syria	Presbyterian Rooms, New York.
Tasmania	Monarch Line. New York. Transfer made by Crown agents for the colonies, London, or by G. W. Wheatley & Co., 156 Leadenhall street, London, England.
Turkey	Ottoman legation, Washington, D. C.
Turk's Island	Wilson & Asmus, New York.
Uruguay	Charge d'Affaires Enrique Estrázulas, Brooklyn, New York.
Venezuela	Dallett, Boulton & Co., New York.
Victoria	R. W. Cameron & Co., New York.
West Indies	H. B. Bailey & Co., New York.

Foreign Centers of Distribution.—In carrying on the exchanges of the Smithsonian Institution it was necessary to appoint a number of agents, and authority for this was given by the Board of Regents in their meeting of February 27, 1851, when, on motion of Mr. Bache, it was resolved, "That the secretary be authorized to appoint an agent abroad to conduct the exchanges of the Institution.

The agencies established were:

Hector Bossange, Paris, France; for France, Italy, Spain, and Portugal.

Dr. John G. Flügel, United States consul at Leipsig, Germany; for the rest of continental Europe except Turkey and Greece.

Henry Stevens, of London, England; for England, Scotand, and Ireland.

The Hon. George P. Marsh, United States minister at Constantinople, took charge of exchanges for Turkey, Greece, and northern Africa, and the United States consuls at other places undertook, in most cases, to transact the business free of charge, only the actual expenses being refunded.

These agencies being established, other exchanges could be carried on through them, and the means of conveyance, at the slight additional expense owing to the increase of freight.

The duties of the agents of exchange consisted in the distribution of all the parcels sent them by the Smithsonian Institution and the receiving and transmitting of return exchanges, together with any information which the Institution might desire, and their duties with an increase of the service became so great as to justify the recommendation of an increase of salary, most especially in the case of Dr. Flügel, in Leipsig, which recommendation was granted by the Board of Regents in their meetings of May 1, 1852, and February 12, 1853. In 1854 the secretary had again occasion to remark on the foreign agencies as follows:

I would beg to call your attention to the zeal and fidelity with which the agents of the Institution in London, Leipsig, and Paris have discharged their duties. The thanks of the Institution are most especially due to Dr. Flügel, of Leipsig, whose efforts in the great cause of tightening the bonds of union between the literary and scientific men and institutions of the two worlds are beyond all praise.

In 1855 the Institution was informed of the death of its agent in Leipsig, Dr. Flügel. On this occasion Professor Henry, the Secretary of the Institution expressed himself:

It becomes my duty to announce the loss which the Institution has experienced in the death of one of its warmest friends and most active agents, Dr. J. G. Flügel. After a residence of several years in this country he returned to Germany as United States consul, in which capacity he was unremitting in his efforts to render service to American travelers, and by his untiring industry and zeal in behalf of the Institution contributed more than any other person to make it known through northern and central Europe. His son, Dr. Felix Flügel, has been appointed his successor, and has evinced a desire and given evidence of his ability to carry on the system with promptness and efficiency.

In 1861 the Royal Society of London attended to the distribution and collection of packages for and from Great Britain and Ireland.

In 1862 Mr. William Wesley, of London, was appointed agent for Great Britain and Ireland.

In 1863 Mr. Frederick Müller, of Amsterdam, was appointed agent for Holland and Belgium.

In 1865 the firm of Hector Bossange changed to Gustave Bossange & Co.

In 1867 the Hon. George P. Marsh consented to take charge of exchanges between the United States and Italy, and the duty of distribution and collecting of parcels was assumed by the Imperial Royal Institute of Milan.

In 1868 the Royal Swedish Academy of Sciences assumed charge of the agency for Sweden, the Royal University of Christiania for Norway, and the Royal Academy of Sciences of Copenhagen for Denmark.

In 1869 the University of Melbourne, Victoria, offered to receive and distribute exchanges for Australia and New Zealand, and a bureau of international exchanges was established by the Government of the United States of Colombia in Bogota.

In 1871 the following were added to the list of Smithsonian exchange agencies:

L. Watkins & Co., St. Petersburg, for Russia.

Royal Academy of Sciences, Lisbon, for Portugal.

Royal Academy of Sciences, Madrid, for Spain.

Parliamentary Library, Wellington, for New Zealand.

Mr. William Wesley, London, England, for the English colonies in Asia and Africa.

In 1873 the Royal Institute of Milan intrusted Mr. Ulrico Hoepli, of Milan, with the work of exchanges, and he assumed the duties of the Smithsonian agency.

In 1874 Prof. E. H. von Baumhauer, of the Scientific Institute of Harlem, offered his services for Holland, which were accepted by the Institution.

In 1876 the representatives of the various Australian colonial governments, at the Centennial Exhibition at Philadelphia, arranged for distributing and collecting agencies in their colonies: New South Wales, New Zealand, Queensland, South Australia, Tasmania, and Victoria, respectively.

The Eidgenossensche Bundes-Canzlei, Bern, Switzerland;

The Museo Nacional, Mexico City, Mexico;

The Universidad, Santiago, Chili;

The Museo Público, Buenos Ayres, Argentine Republic;

The Minister of foreign affairs, Port au Prince, Hayti;

The Minister of foreign affairs, Tokio, Japan;

The University of Caracas, Venezuela;

as recipients of Government exchanges, assumed the duties of collecting and distributing Smithsonian exchanges.

Dr. Felipe Poey, for the university at Havana, Cuba, and the Geological Survey of Canada, in Montreal, volunteered their services as agents.

In 1877 the agency in Lisbon, Portugal, was changed from the Royal Academy of Sciences to the Escola Polytechnica, and the Bibliothèque Nationale, of Athens, Greece, as recipient of the official publications, assumed the duties of a distributing agency.

In 1878 the Smithsonian Institution availed itself, in its scientific and literary intercourse with Belgium, France, Brazil, Italy, Russia, and Switzerland, of the following agencies, appointed by their respective governments in compliance with the stipulations of the exchange convention of Paris, in 1875:

Belgium, Commission Belge des Échanges Internationaux, Brussels.

Brazil, Brazilian Commission, etc., Rio Janeiro.

France, Commission Française, etc., Paris.
Italy, Italian Commission, etc., Rome.
Russia, Commission Russe, etc., St. Petersburg.
Switzerland, Conseil fédéral, Bern.

In 1884 the Argentine Republic established an office for the deposit and distribution of official publications, which, however, has not yet been employed by the Smithsonian Institution as agency, its exchanges still being in the hands of Professor Burmeister, of the Public Museum, where they were placed in 1876. Arrangements were also effected by me during my official visit in London with the Crown agents of the colonies to take charge of the Smithsonian exchanges for all the colonies under their immediate charge.

In 1885, by the death of Professor von Baumhauer, of Harlem, Holland, the agency for Holland was placed in the hands of Dr. Hoek, of Leiden. The Government of Uruguay established an exchange bureau in Montevideo.

In 1886 the agencies of the Smithsonian Institution are found in every part of the civilized globe. The following is a complete list of establishments and individuals representing the Smithsonian Institution abroad:

Countries.	Agencies.
Algeria	M. Carette, chef d'état major du génie, service météorologique, Algiers.
Argentine Confederation	Museo Público, Buenos Ayres. Office for the deposit and distribution of publications. [Department of Public Instruction.]
Antigua	
Austria	Dr. Felix Flügel, Leipsig, Germany.
Bahamas	
Belgium	Commission Belge des Échanges Internationaux, Brussels.
Bolivia	
Brazil	Commissão Central Brazileira de Permutações Internacionaes, Rio Janeiro.
British America	McGill College, Montreal; Geological Survey, Ottawa.
British Guiana	Observatory, Georgetown.
British colonies	Crown agents for the colonies, London, England.
Cape colonies	Agent General for Cape Colony, London, England.
Chili	Universidad, Santiago.
China	Crown agents for the colonies, London, England. United States consul-general, Shanghai.
Colombia, United States of.	Central Commission of Exchanges, National Library, Bogota.
Costa Rica	Universidad, San José.
Denmark	K. D. Videnskabernes Selskab, Copenhagen.
Dutch Guiana	Surinaamsche Koloniaale Bibliotheek, Paramaribo.
Ecuador	Observatorio del Colegio Nacional, Quito.
Egypt	Institut Egyptien, Cairo.
Finland	Kejserliga Alexanders Universitet, Helsingfors.
France	Commission Française des Echanges Internationaux, Paris.
Germany	Dr. Felix Flügel, Leipsig.
Great Britain	William Wesley; London.
Greece	National Library, Athens.
Guatemala	Sociedad Economica de Amigos del Pais, Guatemala.

Countries.	Agencies.
Hungary	Präsidium des Königlich Ungarischen Ministerium, Budapest.
Iceland	Islands Stiptisbokasafn, Reykjavik.
India	Secretary to Government of India, Home Department, Calcutta.
Italy	Biblioteca Nazionale Vittorio Emanuele, Rome.
Japan	Minister of foreign affairs, Tokio.
Liberia	Liberia College, Monrovia.
Madeira	William Wesley, London, England.
Malta	William Wesley, London, England.
Mauritius	Agent-general for Cape Colony, London, England.
Mozambique	Agent-general for Cape Colony, London, England.
Mexico	Señor Ministro de Justicia y Istruccion Pública, Mexico.
Netherlands Netherlands India	Bureau Scientifique Central Néerlandais, Leiden.
New Caledonia	Gordon & Gotch, London.
New South Wales	Royal Society of New South Wales, Sydney.
New Zealand	Parliamentary Library, Wellington, New Zealand.
Nicaragua	Government of Nicaragua, Managua.
Norway	K. N. Frederiks Universitet, Christiania.
Paraguay	Government of Paraguay.
Peru	Biblioteca Nacional, Lima.
Philippine Islands	Royal Economic Society, Manila.
Polynesia	Royal Hawaiian Agricultural Society, Honolulu.
Portugal	Esola Polytechnica, Lisbon.
Queensland	Government Meteorological Observatory, Brisbane.
Russia	Commission Russe des Échanges Internationaux (Bibliothèque Impériale Publique), St. Petersbourg.
St. Helena	Crown agents for the colonies, London, England.
South Australia	Astronomical Observatory, Adelaide.
Spain	R. Academia de Ciencias, Madrid.
Straits Settlements	Crown agents for the colonies, London, England.
Sweden	K. S. Vetenskaps Akademien, Stockholm.
Switzerland	Eidgenossenche Bundes-Canzlei, Bern.
Tasmania	Royal Society of Tasmania, Hobarton.
Turk's Island	Public Library, Grand Turk.
Uruguay	Bureau de Statistique, Montevideo.
Venezuela	University, Caracas.
Victoria	Public Library, Melbourne.
West Indies:	
Cuba	R. Universidad, Havana.
Hayti	Sécrétaire d'État des Rélations Extérieures, Port-au-Prince.
Trinidad	Scientific Association, Port of Spain.

The entire cost of the exchange system to the Institution since its establishment is shown in the table, which is followed by a statement of the assistance rendered by the Government during the last six years:

1846–1850	$1,603.00	1870	$4,165.62
1851	2,010.49	1871	4,201.50
1852	4,178.33	1872	5,870.32
1853	2,807.38	1873	6,251.74
1854	2,738.65	1874	5,589.89
1855	1,930.78	1875	6,748.80
1856	1,517.54	1876	10,199.10
1857	2,500.24	1877	9,790.73
1858	1,326.90	1878	10,250.41
1859	2,027.94	1879	9,554.47
1860	2,348.04	1880	9,996.05
1861	1,499.47	1881	10,467.84
1862	2,724.88	1882	9,981.19
1863	1,735.31	1883	13,692.34
1864	3,779.61	1884	12,510.71
1865	2,807.76	1885 (first 6 months)	8,307.59
1866	2,252.60	1885–'86	*12,005.80
1867	3,701.93		
1868	4,870.72	Total	200,806.61
1869	4,860.94		

Of these amounts the following payments were made by the United States Government, on account of the Government Document Exchange, authorized by acts of Congress, March 2, 1867, and July 25, 1868, viz:

1881	$3,000	1884	$10,000
1882	5,000	1885	10,000
1883	7,500	1886	10,000

GOVERNMENT DOCUMENTS.

The first action by Congress relating to an international exchange of official publications was a joint resolution, July 20, 1840 (*Statutes at Large*, vol. v, p. 509), authorizing the Librarian of Congress, under the direction of the Committee on the Library, "to exchange such duplicates as may be in the library for other books," and to exchange, in the same manner, public documents, of which "fifty additional copies" were ordered to be printed for the purpose. Supplementary acts were passed March 4, 1846; June 26, 1848; June 30, 1848; March 2, 1849; August 31, 1852; August 18, 1856; March 2, 1867.

The last Congressional action was taken on July 25, 1868, in the following terms:

"(No. 72) *A resolution to carry into effect the resolution approved March 2, 1867, providing for the exchange of certain public documents.*

"*Resolved by the Senate and House of Representatives of the United States in Congress assembled*, That the Congressional Printer, whenever he shall be so directed by the Joint Committee on the Library, be, and

*The apparent decrease in the cost of exchanges for the fiscal year 1885–'86 is due to the re-imbursement during that year of a check for $2,498 lost in the mails in the year 1884–'85. It was charged to the first six months of 1885, and thus increases the cost of exchanges for that period and diminishes that for the year 1885–'86 by credit for re-imbursement.

he hereby is, directed to print fifty copies, in addition to the regular number, of all documents hereafter printed by order of either house of Congress, or by order of any Department or Bureau of the Government, and whenever he shall be so directed by the Joint Committee on the Library one hundred copies additional of all documents ordered to be printed, in excess of the usual number; said fifty or one hundred copies to be delivered to the Librarian of Congress, to be exchanged, under direction of the Joint Committee on the Library, as provided by joint resolution approved March 2, 1867."

"Section 2. *And be it further resolved*, That 50 copies of each publication printed under the direction of any Department or Bureau of the Government, whether at the Congressional printing office or elsewhere, shall be placed at the disposal of the Joint Committee on the Library, to carry out the provision of said resolution."

By this joint resolution fifty extra copies are ordered from the Public Printer of all executive as well as Congressional documents, including, 1st. The Congressional issue, journals, committee reports, and miscellaneous documents; 2d. The Annual Reports of the Executive Departments and the several Bureaus; and 3d. The Memoirs, Monographs and Special Reports published by the Executive Departments and the several Bureaus.

Owing to the failure of the Public Printer to comply with those portions of the law relating to the second and third series of the United States official publications—the annual reports and the memoirs, monographs, and special reports published by the Executive Departments and Bureaus of the Government (although occasionally some few of the works of these classes have been received)—a circular letter was addressed by the Smithsonian Institution on the 15th of February, 1884, to all the Departments and Bureaus of the Government, soliciting co-operation in compliance with the existing laws, so as to enable the Institution, as agent of the Government, to carry out the provisions of the Congressional resolutions.

Among the replies received that of the honorable Secretary of State says:

"I have ventured to suggest to the Joint Committee on the Library the desirability of a permanent provision for the printing of these desired copies."

On March 7, 1884, Professor Baird addressed a communication to the Hon. John Sherman, chairman of the Joint Committee on the Library, suggesting:

"I would therefore ask you respectfully to consider the several enactments upon the subject of international exchange with which this Institution is charged, and that such supplementary legislation be provided as will enable us to surmount the difficulties referred to."

Appended to this letter a list was given of the more important documents not furnished to the Smithsonian Institution, although they are included in the series included by Congress for exchange purposes.

Among such documents the following may be mentioned (assuming

Series I, the Congressional issue, as delivered complete, although even herein too many deficiencies occur):

Series II. *The Annual Reports* of the Executive Departments and Bureaus of the Government, together with the papers accompanying such reports (section 3796, Revised Statutes, and resolution 72, second session Fortieth Congress.

Series III. *The Memoirs, Monographs, or Special Reports* published by the Executive Departments or Bureaus of the Government, whether printed at the Government Printing Office or elsewhere (section 2, resolution 72, second session Fortieth Congress).

This last series comprises, among many others, the following most valuable publications:

Patent Office.

Official Gazette.

Specifications and Drawings.

Growth of Industrial Art.

Of this last-named work only fifty copies were printed, although the law (section 2, resolution 72, second session Fortieth Congress, Statutes at Large, Vol. XV, p. 261) distinctly provides that "fifty copies of each publication - - - whether printed at the Congressional Printing Office or elsewhere, shall be placed at the disposal of the Joint Committee."

U. S. Geological Survey.

Bulletins.

Monographs.

A letter was addressed to the Director of the Geological Survey February 15, 1884, claiming fifty copies of all the publications of that office for exchange purposes under the law. In reply, the Director stated, February 26, 1884:

"Under the law of March 2, 1867, fifty copies of everything published by us should be sent to the Library of Congress and thence to the Smithsonian Institution, by the Public Printer, and such copies are reserved for that purpose and do not come into our possession.

Under the statutes relating to the publication of the Monographs of the Survey it would be impossible to spare any copies from the three thousand received by this office, from the fact that it is necessary for the Survey to render an account of its publications, either as sold, exchanged, or on hand."

Tenth Census of the United States.

Monographs.

Not a single volume of these has been received under Section III of the Government publications, as prescribed by law.

Fish Commission.

Bulletins, volumes 1 to 5.

State Department.

Consular Reports.

Of these only the numbers 1 to 22 have been received.

Coast and Geodetic Survey.

Publications.

American and Foreign Claims Commissions.

As those relating to France, Hayti, Spain, the Alabama, etc., none of which has been received; nor in fact any of the publications of the Departments and Bureaus of the Government.

No action having been had on the subject, a further request was addressed to the Library Committee on the 21st of September, 1885, and again to the Hon. W. J. Sewell, Chairman of the Joint Library Committee, on the 18th of January, 1886, and although no definite result has yet been accomplished, it is to be hoped that Congress, through the Library Committee, may take such action as will secure to the Smithsonian Institution, as the agent of the Government, fifty copies of each of the three distinct series specified in the acts of March 2, 1867, and July 25, 1868, so as to enable the Government, to obtain for its Library the entire fruit of the wise provision of Congress in establishing this exchange of official public documents.

INTERNATIONAL PROCEEDINGS.

The Brussels Convention on International Exchanges.

As a result of the proceedings of the conference held at Brussels in April, 1883, a draft of articles of agreement was adopted, to be submitted to the contracting powers for final ratification, as already set forth in the annual report on exchanges for 1883. The date appointed for this ratification was March 15, 1886, and the further proceedings in the matter are fully exhibited by the following correspondence with the Department of State:

From the Secretary of State, March 3, 1886, *to the Smithsonian Institution.*

SIR: I have the honor to transmit to you herewith, for your information and consideration, a translation of a note from the minister of Belgium at this capital, notifying this Government that the diplomatic conference for the signing of the convention relative to the international exchange of official documents and of scientific and literary publications will meet at the ministry of foreign affairs at Brussels on Monday, the 15th day of the present month.

I should be pleased to have your views as to the expediency of this Government becoming a party to the convention in question.

I have the honor to be, sir, your obedient servant,

T. F. BAYARD.

[Inclosure.]

From the Belgian minister at Washington, February 18, 1886, *to the Secretary of State.*

MR. SECRETARY OF STATE: I have the honor to inform your excellency that the diplomatic conference for the signing of the conventions relative to the international exchange of official documents and of scientific and literary publications will meet at the ministry of foreign affairs at Brussels on Monday, the 15th day of March next, at 2 o'clock.

Belgium, Brazil, Spain, Italy, Portugal, Servia, and Switzerland have adopted the arrangement drafted by the conference of 1883 for general exchanges. (Protocol A.)

Switzerland has not adhered to Draft B, concerning the direct and immediate transmission to the legislative chambers of the Official Journal and of the reports of Parliamentary proceedings. That special convention will, however, be concluded by all the other States that I have just named.

Your excellency had the kindness to inform me, under date of October 16, 1885, that you had not yet reached a decision on this subject, but that, meanwhile, you reserved to the Government of the United States of America the privilege of adhering thereafter.

My Government hopes that the United States Government will be represented at that conference and has instructed me to make inquiry of your excellency's intentions in this matter. I shall therefore be grateful to you if you will have the kindness to make me acquainted with them as soon as may be convenient.

It is proper for me to add that Greece and Roumania have likewise just been requested to communicate their intentions.

I gladly avail myself of this occasion to renew to your excellency the assurances of my highest consideration.

THEO. DE BOUNDER DE MELSBROECK.

From the Smithsonian Institution, March 5, 1886, *to the Secretary of State.*

SIR: Your letter of the 3d instant is received, but owing to the short notice given us of the proposed diplomatic conference for "the signing of conventions relative to the international exchange of official documents and scientific and literary publications," to be held at Brussels on, as you state, March 15, we are unable to meet definitely or in detail your invitation for our "views as to the expediency of this Government becoming a party to the conference in question."

We beg to say, however, that the Smithsonian Institution, as the agent for international exchange on the part of the United States, will be happy to comply with the stipulations of the conferences as far as may be in its power, including the sending of daily reports of Congressional proceedings to the several governments.

I have the honor to be, very respectfully, your obedient servant,

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

From the Secretary of State, April 9, 1886, *to the Smithsonian Institution.*

SIR: I have the honor to transmit to you, herewith, a copy of a dispatch to this Department from Mr. Tree, our minister at Brussels, concerning the two conventions, A and B, for the exchange of public documents, which were signed by him on the 15th ultimo.

I beg to inquire whether you have any views to make known before the conventions are submitted to the Senate with a view to their ratification.

I have the honor to be, sir, your obedient servant,

T. F. BAYARD.

[Inclosure.]

From the United States minister at Brussels, March 23, 1886, *to the Secretary of State.*

SIR: I have the honor to transmit herewith--

(1) The original instrument of the convention concerning the international exchange of official documents and scientific and literary publications.

(2) The original instrument of the convention concerning the immediate exchange of the official journal as well as of parliamentary annals and documents.

(3) A certified copy of the *procès-verbal* of the sitting held at the department of foreign affairs the 15th of March, 1886.

I also send translations which I have made of each of the documents. In consequence of their detention at the department of foreign affairs to await the signature of the Prince de Caraman, I only received them to-day.

I have the honor to be, sir, your obedient servant,

LAMBERT TREE.

[Inclosure.]

1. The original instrument of the convention concerning the international exchange of official documents and scientific and literary publications.
2. Translation of No. 1.
3. The original instrument of the conventions for the immediate exchange of official journal as well as the parliamentary annals and documents.
4. Translation of No. 3.
5. A certified copy of the *procès-verbal.*
6. Translation of No. 5.

The above documents were duly returned to the Department of State, with the following letter:

From the Smithsonian Institution, April 27, 1886, *to the Secretary of State*

SIR: In returning, as I do herewith, the documents relative to the Exchange Convention, held at Brussels on the 15th of March last, and which were inclosed with your letters of April 9 and 17, I beg to state that, upon mature consideration, I have no further suggestions to make as to the acceptance of the terms proposed at the Brussels Conference.

I entertain the view, however, that the expectations of the Belgian Government in proposing exchange relations beyond those at present existing will be but indifferently realized, since all the prominent governments have declined to participate in its propositions, only those of Spain, Italy, Portugal, Servia, and Belgium, of European, and the United States and Brazil, of American nations, having expressed a desire to ratify the convention.

The Smithsonian Institution, as agent of the Government of the United States for the exchange of its official publications, having thus far obtained satisfactory results by dealing individually with governments whose publications are desirable, it would appear to me doubtful whether additional benefits could be derived by adhesion to a treaty with a few of the more unimportant governments of Europe.

I have the honor to be, very respectfully, your obedient servant,

S. F. BAIRD.

CORRESPONDENCE WITH THE ARGENTINE REPUBLIC.

In acceptance, on the part of the Argentine Government, of the terms of exchange proposed by the Smithsonian Institution on behalf of the Government of the United States, the first transmission for that country, of six boxes, was made on November 18, 1875, through the Argentine ambassador, Mr. G. Videla Dorna, in New York.

In 1876 an application for a set of these official publications for the Government of the province of Buenos Ayres was favorably considered, and on November 21, 1876, the first installment of seven boxes forwarded to its destination. Both sets have since been increased to twenty-six boxes each.

On November 25, 1884, Mr. Marcus F. Gutiérez, director of the office for the deposit and distribution of the publications of the Argentine Government in Buenos Ayres, addressed the Smithsonian Institution with the request for a copy of the United States official publications for deposit in his office.

On December 18, 1884, the Secretary of the Smithsonian Institution replied that the official publications of the United States are already represented in two copies in the city of Buenos Ayres, and regretting his inability of furnishing a third copy.

On October 20, 1885, Mr. Gutiérez addressed to the Smithsonian Institution a letter of which the following is a translation:

SIR: The undersigned, director of the office for the deposit and distribution of the publications of this Government, has the honor to address to you a copy of the Superior Decree of July 25, A. C., specifying the rules and regulations adopted by his excellency the Minister of Justice, Worship, and Public Instruction, Dr. Edward Wilde, for the government of this office, which is to promote the international exchange of publications.

From this decree you will learn the conditions under which this office can undertake the exchange of publications with governments, libraries, and foreign establishments, and if these are agreeble to you I would thank you for your opinion how this exchange is best to be instituted. It is hoped that this arrangement will result in a full and mutually valuable exchange of the intellectual productions of our respective countries.

MARCUS F. GUTIÉREZ.

[Translation.]

Decree and regulations concerning the international exchange of publications.

ARGENTINE REPUBLIC,
Department of Justice, Worship, and Public Instruction,
Buenos Ayres, July 25, 1885.

In order to provide in the best manner possible, in accordance with the intentions of the decree of May 2, 1870, for the mutual exchange of publications between the Republic and the other countries with which it maintains amicable relations the President of the Republic decrees:

ARTICLE 1. The "Office for the Deposit and Distribution of Publications" shall have henceforth a special department, charged with the business of international exchange.

ART. 2. Under the immediate jurisdiction of the Department of Public Instruction the office named will be charged with the duty of beginning and maintaining an exchange with the governments, official or public libraries, and scientific or literary societies of the countries which accept or solicit it.

ART. 3. In order that the office named may attend properly to the interchange which may be established, all the offices of the nation will send it at least 20 per cent. of the publications which they may have or which they may receive in virtue of aid or subsidy granted them.

ART. 4. The Department of Public Instruction will regulate the execution of this decree.

ART. 5. The decree shall be communicated to all concerned, published, and inserted in the R. N.

REGULATIONS FOR THE "OFFICE FOR THE DEPOSIT AND DISTRIBUTION OF PUBLICATIONS" IN ACCORDANCE WITH THE DECREE OF THE 25TH OF THE PRESENT MONTH ESTABLISHING THE EXCHANGE OF PUBLICATIONS.

BUENOS AYRES, *July* 26, 1885.

ARTICLE 1. In compliance with the order contained in the decree of the 25th of the present month of July, the "Office for the Deposit and Distribution of Publications" will, by means of the department charged with the international exchange, establish an interchange of publications of the Republic with the governments, public and private libraries, and scientific or literary societies of the countries which accept or solicit it, said office giving account in each case to the Department of Public Instruction, without whose previous approbation it can not proceed.

ART. 2. The "Office for the Deposit and Distribution of Publications" will keep a day-book in which it will note the number, title, and condition of the publications received from the national offices.

ART. 3. Before complying with the requests for books, memorials, or other publications, which may be made to it by the governors of provinces, departments of the Government, or other public or private offices, or with those which it may receive from abroad, the "Office for the Deposit and Distribution of Publications" must obtain the consent of the Department of Public Instruction.

ART. 4. The office will carry out directly the orders of the departments referring to their respective deposits, having first deducted the 20 per cent. of the publications intended for international exchange.

ART. 5. In the monthly report of operations which the office must remit to the Department of Public Instruction, it will include a statement of the works received as exchange during the month, in order that the department may assign them to their proper destination.

ART. 6. Applications from individuals must be made on common paper, and the office will send them to the Department of Public Instruction for its decision.

ART. 7. The office may apply to the governors of provinces, official and private corporations, and to the editors of the Republic, soliciting in the most respectful terms the remission or exchange of the works they may publish, aid, or edit.

ART. 8. The office will take care to distribute among the ministers and consuls residing in the Republic and among the Argentine ministers and consuls residing in foreign countries all official publications whose circulation may promote the interests of the nation.

ART. 9. The office will publish once a month in at least two daily papers of the capital the monthly report of its operations referred to in article 5.

ART. 10. The organization heretofore existing in the "Office for the Deposit and Distribution of Publications" shall remain in force so far as it is not inconsistent with the present.

ART. 11. The present regulations shall be communicated to all interested and the chief of the "Office for the Deposit and Distribution of Publications" is authorized to order it to be printed in suitable form.

E. WILDE.

Attest:

JUAN IGARZÁBAL.

In a second letter of the same date (October 20, 1885) Mr. Gutiérez announces the sending of publications. "A delay was caused," he continued, "by the difficulties inherent in a newly created office; moreover, I desire to make the sending of some importance to correspond in a measure with your kindness."

On the 26th December, 1885, the Secretary of the Institution replied to Mr. Gutiérez:

SIR: I have the honor to acknowledge the receipt of your communications of October 20, 1885, and to say that we await with pleasure the receipt of the important sending to which you refer, on the part of the Argentine Republic, in return for the official publications of the United States Government, of which two sets have been contributed to Buenos Ayres, one for the Government of the Republic, and one for the government of the Province.

I am, your obedient servant,

S. F. BAIRD.

CORRESPONDENCE WITH AUSTRIA-HUNGARY.

From the Smithsonian Institution, October 12, 1885, to Count Lippe Weissenfels, chargé d'affaires of Austria-Hungary.

SIR: On October 9, 1884, Mr. George H. Boehmer, a delegate of the Smithsonian Institution, the authorized agent of the Government of the United States, had the honor of being introduced by the United States embassador in Vienna, to his excellency the Count Szögyenyi, first section chief in the I. R. foreign office, for the purpose of arranging for an exchange of official public documents between the Government of the United States and the Imperial Government of Austria.

His excellency the Count Szögyenyi being favorably impressed with the proposition of such exchange placed the preliminary steps of arrangements into the hands of M. de Plason, a councilor in the foreign office with whom the Smithsonian representative was placed in communication. After various consultations with this gentleman, Mr. Boehmer was officially introduced by the foreign office to the chiefs of the various departments of the Imperial Government, most of whom were favorably inclined conditionally to enter into an exchange on the proposed basis.

The exchange proposed by the Smithsonian Institution includes all publications made by Congressional order since January 1, 1868, and comprises the parliamentary proceedings, projects at law, reports, and scientific works of the departments and bureaus of the Government, representing at present a bulk of twenty-three boxes of about $6\frac{1}{2}$ cubic feet each, with a total weight of about 5,500 pounds.

These works, the titles of which are specified in the accompanying documents, have been offered in one copy, for deposit in one general library, as a complete set of the United States publications as ordered printed by Congress, and an equally exhaustive return has been asked for from the Imperial Government.

While now the chiefs of the various departments approve of the establishment of exchange relations, there is a tendency among them to discard a centralization of the works, and rather express a desire of each selecting from the books thus offered such as may be of interest and value to their respective departments, and in exchange for such they are willing to make equivalent returns.

While now, on the part of the United States Government, no special objection could be had to such a distribution of their documents, such course would have a tendency of complicating matters, and require of some works a number of copies to supply the demands made for them by various departments all equally interested in the acquisition of any particular work, while the Smithsonian Institution as agent of the Government, can, under the law, only offer one single copy.

Furthermore, there has been in existence for a number of years an independent exchange between corresponding departments and bureaus of the two nations, and many documents have been received by them and thereby render a division of the documents to be received under the proposed exchange unnecessary; neither has the Smithsonian Institution, as the agent of the Government, the power of discriminating which of the books to send, but is compelled to furnish one copy of every document received to any of the contracting powers.

From these considerations the Smithsonian Institution could not possibly consent to the proposition made by the chiefs of the respective departments, to select from the list of works such as may be of interest to the department, but we would have to send *one complete* collection to the foreign office, or any place of deposit designated by the Imperial Government for the reception of the publications, to be distributed as may be deemed most advantageous by the Imperial Government.

All this was stated by Mr. Boehmer in his conferences with M. de Plason, and the suggestion made by him that the individual exchange now existing between the corresponding bureaus be continued uninterruptedly, while the foreign office charge itself with the collecting, from the various bureaus of the Imperial Government, of one copy each of their respective publications in direct response to the system of exchanges to be inaugurated between the Governments.

In acceptance by the Imperial Government of a former proposition of the United States Government, the first two boxes of books had already been sent to Vienna in 1875, where they were deposited in the Imperial library, but further sendings were declined by the librarian as *too bulky and incomplete.* The *bulk* of valuable books should be a rather favorable consideration for a librarian, while completeness can not be expected in the contents of two boxes of official publications from various delays which may occur during the process of issue.

Another point of disagreement in the establishment of the proposed exchange relation is found in the transmission of exchange boxes, "there being no funds available in the Imperial foreign office for such expenditure."

The custom of the Smithsonian Institution in its intercourse with foreign nations has been for each to prepay their sendings to the nearest seaport, from whence the charges for ocean freight, etc., are assumed by the recipient. Should, however, the Imperial government prefer having all exchanges delivered to any representative in Washington, those intended for the United States might be delivered to Dr. Felix Flügel, in Leipsic, the agent of the Smithsonian Institution.

I have the honor to be, sir, your obedient servant,

S. F. BAIRD.

CORRESPONDENCE WITH GREAT BRITAIN.

From the Department of State, April 16, 1886, *to the Smithsonian Institution.*

SIR: Application having been made through our legation at London for certain publications of this Government for the use of the library of the British Museum, I have the honor to request you to inform this Department as to the practical working of the exchange of Government publications between this country and Great Britain. Information is particularly desired as to whether or not the publications of the British Government are received regularly in exchange for those of our Government which are sent to London; and also as to what library or libraries in Great Britain receive the publications of this Government which are forwarded to that country through the exchange bureau of the Smithsonian Institution.

I have the honor to be, sir, your obedient servant,

T. F. BAYARD.

From the Smithsonian Institution, April 22, 1886, *to the Secretary of State.*

SIR: I have the honor to acknowledge the receipt of your letter of the 16th instant, relative to an application made by the British Museum in London for certain publications of the United States Government and requesting information as to the practical working of the exchange of official publications between this country and England, and as to the number of copies of official publications sent through the exchange bureau of the Smithsonian Institution to libraries in Great Britain.

In reply I beg to state that the Smithsonian Institution, on behalf of the United States Government, has sent to the British Government a full series of all the documents ordered to be printed by order of either House of Congress and beginning with the 1st of January, 1868, as specified in the accompanying pamphlets. By direction of Lord Granville all transmissions are made to the British Museum.

In addition to these official publications the Smithsonian Institution has furnished the British Museum with the following series of its own publications: Contributions to Knowledge, vols. 1 to 25; Miscellaneous Collections, vols. 1 to 27; annual Reports, 1846 to 1883; annual Reports, Bureau of Ethnology, vols. 1 to 3; Proceedings of the National Museum, vols. 1 to 7; Bulletins of the National Museum, Nos. 1 to 27.

And to the natural history division of the British Museum: Contributions to Knowledge, vols. 1 to 25; Miscellaneous Collections, vols. 1 to 27; annual Reports, 1851 to 1883; Bulletins National Museum, Nos. 1 to 27.

The returns on the part of the British Museum have been confined to the series of its own publications, which are sent in two copies for the libraries of the Smithsonian Institution and National Museum, respectively.

On the part of the British Government the promise of a complete set of English publications for the use of the United States Government was made by Lord Granville on the 20th of March, 1883, in a letter to Mr. Lowell, in which he refers to former correspondence on the subject. The publications offered are:

(1) Papers of all kinds printed for or presented to either house of Parliament.

(2) Historical, scientific, or antiquarian works published by the Government, such as record publications.

(3) Maps or charts published by the Government.

(4) Departmental publications which are placed on sale.

In 1883 the Secretary of the Smithsonian Institution, on behalf of the Librarian of Congress, made application to the British Government through the Department of State for certain works required to fill deficiencies in the series on file in the Congressional Library. This request was granted by the lords of Her Majesty's treasury, who directed the superintendent of Her Majesty's stationery office in London to deliver the same as far as possible to the agent of the Smithsonian Institution. These were received by Mr. George H. Boehmer, the gentleman in charge of the exchange division of the Smithsonian Institution, in November, 1884, on occasion of a visit to London on exchange business. These, together with a few volumes of the Challenger Expedition reports, form the only publications received from the British Government in exchange for the official documents sent by the United States Government.

A second set of United States official publications was ordered by my predecessor, the late Prof. Joseph Henry, on the 6th of December, 1876, to be sent to the Royal Society of Edinburg, Scotland. These sendings, comprising eleven boxes, were discontinued in 1878.

If the negotiations now pending should be concluded to the satisfaction of the United States Government, the continuation of this set, now representing fifteen boxes, might be placed at the disposal of the British Government for use in the library of the House of Lords or that of the House of Commons.

I have the honor to be, sir, your obedient servant,

S. F. BAIRD.

ADDITIONS AND CORRECTIONS TO THE LIST OF FOREIGN CORRESPONDENTS TO JULY, 1886.

By George H. Boehmer.

AFRICA.

ALGERIA.

Oran.

22. College.

CAPE COLONY.

Cape Town.

28. Botanic Gardens.
28*a*. Commissioners of Crown Lands and Public Works.
38. South African College.

Graham Town.

44. Cape Law Journal.

EGYPT.

Abbesich.

45*a*. Laboratoire Khédivial.

Alexandria.

46. Egyptian Society.
47. Ministère de l'Intérieur. (In Cairo.)

Cairo.

51. Bibliothèque Khédiviale.
51*c*. Direction Générale de la Statistique.
52. General Staff Library.
53*a*. Ministère de l'Intérieur.
59. Société Égyptienne. (Dead.)
62. Topographical Office. (Department of War.)

MOZAMBIQUE.

Mozambique.

85. Sociedad de Geografia. (Does not exist.)

NATAL.

Natal.

86. The Observatory.

AMERICA (NORTH).

BRITISH AMERICA.

BRITISH COLUMBIA.

Victoria.

90. Provincial Museum.

CANADA.

Clifton (*Ontario*).

98. Toronto News Company.

Coburg (*Ontario*).

100. Victoria University.

Kingston (*Ontario*).

108. Royal Military College.

London (*Ontario*).

112. Western University.

Matapedia (*Quebec*).

112*a*. Ristigouche Salmon Club.

Montreal (*Quebec*).

114. Canada Citizen.
116. Canadian Record of Science.
116*b*. Canadian Society of Civil Engineering. [i]
126. Montreal Botanic Garden.
128. Observatory.
136. United Science Institute.

Ottawa (*Ontario*).

137. Academy of Natural Sciences. (Does not exist.)
144. Institut Canadien Français.
147*a*. Minister of Justice.
148. Patent Office.

Quebec (*Quebec*).

154. Department of Education.
157*a*. Literary and Philosophical Society.
158. The Observatory.

Sherbrooke (*Quebec*).

162. Sherbrooke Free Reading Room.

St. Catherine (*Ontario*).

163. Fruit Growers' and Forestry Association. (Now in Grimsby, Ont.)

Toronto (*Ontario*).

164. Board of Health.
171. Government of Canada. (In Ottawa see 145.)
173. Legislative Library. [i]
186. Toronto Baptist College.

NEWFOUNDLAND.

St. John's.

222. St. John's Athenæum.

NORTHWEST TERRITORY.

Regina.

222a. Government House. [i]

NOVA SCOTIA.

Halifax.

228. Kings County Library.
235. Nova Scotia Medical Society. [i] (Now Provincial Medical Board of Nova Scotia.)

Wolfville.

246. Canadian Postal College of the Natural Sciences.

CENTRAL AMERICA.

COSTA RICA.

San José.

248. Ministerio de Relaciones Exteriores.
248*c*. Museo Nacional.

GUATEMALA.

Guatemala.

250*a*. Anales Estadísticas de la República.
250*b*. Direccion General de Estadística.
254. Museo de Historia Natural.
256. Secretaría de Relaciones Exteriores.
256*a*. Société Économique.

NICARAGUA.

Managua.

258. Government of Nicaragua.

MEXICO.

Aguas Calientes.

260. Institute of Science.

Guadalajara.

262. Institute of Science.
266. Sociedad Médico-Farmacéutica Pablo Gutierrez.

Mazatlan.

270. Meteorological Observatory.

Merida.

270*a*. Registro Civil del Estado Yucatan.

Mexico.

278. Asociacion Médica "Pedro Escoledo." [i]
280. Chamber of Commerce.
286. El Observador Médico.
288. Escuela de las Minas.
294. Geographical Exploring Commission.
306. Secretaría de Hacienda y Crédito Público de los E. U. Mexicanos. Departamento de Biblioteca y Compilacion. [i]
310. Sociedad Farmacéutica Mexicana.
313. Sociedad Humboldt. (No longer exists.)
323. University of Mexico. (Same as 285.)

Morelia.

323*a*. El Monitor Médico-Farmacéutico é Industrial.

323*c*. Museo Michoacano.

Puebla.

324. Catholic College.

326. University.

San Jacinto.

326*d*. Escuela Nacional de Agricultura y Veterinaria.

Zacatecas.

332. Observatorio Astronómico-Meteorológico.

WEST INDIES.

BARBADOS.

Bridgetown.

334. Barbados General Agricultural Society.

CUBA.

Habana.

342. Crónica Médico-Quirúrgica de la Habana.

343. Administracion General de Comunicaciones de la Isla de Cuba.

HAITI.

Port-au-Prince.

360. Société de Sciences et de Géographie. [i]

JAMAICA.

Kingston.

360*a*. Government House. (Botanical Department.)

360*c*. Jamaica Institute.

360*e*. The Victoria Institute. [i]

TRINIDAD.

Port of Spain.

364. Botanic Garden.

AMERICA (SOUTH).

ARGENTINE REPUBLIC.

Buenos Aires.

373. Biblioteca Pública. (Same as 371.)
374. Círculo Médico Argentino.
374*a*. Department of Public Instruction.
374*e*. Instituto Agronómico y Veterinario.
385*a*. Oficina de Canje Internacional de Publicaciones.
386. National College.
386*a*. Revista Médico-quirúrgica.
388*c*. Sistema de Medidas y Pesas de la República Argentina.

Concepcion.

402. National College.

Cordoba.

410. University.

Parana.

412. Bureau de Statistique Générale entre Rios.

Santa Catalina.

412*h*. Instituto Agronómico-Veterinario de la Provincia de Buenos Aires.

BRAZIL.

Bahia.

414. Gazeta Médica da Bahia.

Rio Janeiro.

426. Club de Engenharia.

BRITISH GUIANA.

Berbice.

460. Asylum Journal.

Georgetown.

467*c*. "Timehri" (A journal pub. by 467.)

CHILE.

Santiago.

468. Anales de la Sociedad de Farmacia.
473*b*. Comision Central Meteorólogica.
474. Deutscher Wissenschaftlicher Verein. [i]
475. El Plano Topográfico. (A section of 473.)
490. Revista Médica de Chile.

COLOMBIA.

Bogota.

502. Library Meteorological Office. Department of Agriculture.
502*c*. Museo Nacional.
508. Société Economique.

ECUADOR.

Quito.

530. University.

PERU.

Lima.

535*b*. Academia Libre de Medicina.
536. Ateneo de Lima.
540. Escuela de Minas.
546. Sociedad Amantes de la Ciencia.
548. Sociedad Union Fernandina.

URUGUAY.

Montevideo.

554. Department of the Interior.
560. Public Library.
563*b*. Universidad de Montevideo.

VENEZUELA.

Caracas.

564. Academia Venezolana.
570. Museo Nacional.

ASIA.

CHINA.

Pekin.

582*a*. American Mission College.
582*b*. Imperial Russian Observatory.

Saigon.

586. Société des Etudes Indo-Chinoises de Saigon.

Shanghai.

592. Compagnie de Jésus.

INDIA.

Allahabad.

606. Government of the Northwestern Provinces.

Bombay.

614. Bombay Natural History Society.
619. Government Central Museum. [i] (Now Victoria and Albert Museum.)
624. Inspector-General of Civil Hospitals.
626. Medico-Physical Society.
636*c*. Victoria Natural History Institute.
636. Under Secretary to the Government, Revenue, Finance, and General Departments.

Calcutta.

638. Army Medical Department of India.
640. Calcutta Medical College.
642. Department of Finance and Commerce of the Government of East India.
644. His Highness the Viceroy of India.
645. Imperial Indian Museum. (Same as 649.)
650. Inspector-General of Civil Hospitals.
662. University of Calcutta.

Lahore.

678. The Punjab Government.

Madras.

684. Government of Madras.
684*a*. Inspector General of Civil Hospitals.
688. Madras Medical College. [i]
690. Presidency College.

Poonah.

695. Civil Engineering College. (Now College of Science.)

JAPAN.

Hakodate.

708. Museum of Natural History.

Kioto.

708*a*. Doshisha School.

Osaka.

708*aa*. Daigaku Bunko.

Sapporo.

708*b*. Agricultural College.

708*c*. Haitakushi Shiba Collection.

Tokio.

714. Chirikioku (Meteorological and Trigonometrical Survey Department.)

719. Department of Law, Science, and Literature in the Tokio Daigaku. (See 739.)

721*h*. Geographical Bureau.

721*j*. Geological Society of Japan.

721*n*. Imperial Agricultural College.

721*s*. Japanese Educational Society.

722. Japanese Society of Health.

724. Meteorological Observatory.

726. Mining Office. Department of Public Works.

728. Patent Office.

738. Suisankwai. (Fishery Society.)

739. Tokio Daigaku, now Teikoku-Daigaku (Imperial University), including College of Law (Hōka-Daigaku), College of Medicine (Ika-Daigaku), College of Engineering (Kōka-Daigaku), College of Literature (Bunka-Daigaku), College of Science (Rika-Daigaku).

Yokohama.

743. Deutsche Gesellschaft für Naturwissenschaft und Heilkunde. (Same as 721.)

PHILIPPINE ISLANDS.

Manila.

768. Royal and Pontifical University of St. Thomas.

AUSTRALASIA.

AUSTRALIA.

NEW SOUTH WALES.

Sydney.

783. Australian Medical Gazette.
784. Board of Technical Education.
787. Department of Public Instruction.
800. Mechanics' School of Arts.
802. Natural History Society.
802*b*. New South Wales Zoological Society. (3 O'Connell street.)
806. State Children's Relief Department.
807. Sydney College Library. (Does not exist.)
810. Technological, Industrial, and Sanitary Museum of New South Wales.

QUEENSLAND.

Brisbane.

818. Geographical Society of Australia, Queensland Branch.

SOUTH AUSTRALIA.

Adelaide.

836. Adelaide Philosophical Society.
844. Public Library, Museum, and Art Gallery of South Australia. [i]

VICTORIA.

Collingwood.

865. Field Naturalists' Club of Victoria. (Does not exist.)

Melbourne.

870. The Australian Wine Association of Victoria.
872. Chamber of Commerce.
872*a*. Chamber of Manufactures.
882. Geological Society of Australasia. [i] (17 Queen street.)
894. Osmond College.
901. Royal Philosophical Society of Victoria. (Amalgamated with the Royal Society of Victoria.)
908. South Melbourne Mechanics' Institute.
910. Victoria Institute.
910*a*. The Vigneron.

NEW ZEALAND.

Christchurch.

922. Canterbury Agricultural College.
924. Christchurch Public Library.

Invercargill.

937. Southland Institute.

Nelson.

939. Nelson Association for the Promotion of Science and Industry. (Does not exist.)
942. Nelson Philosophical Society. [i]

Wellington.

960. Minister of Mines.
966. General Assembly Library.
967*a*. Registrar-General of New Zealand.
967*h*. Wellington and Wairarapa District Acclimatization Society.

POLYNESIA.

SANDWICH ISLANDS.

Honolulu.

976. Scientific Society. (Dead.)
976*a*. Surveyor-General's Office.

EUROPE.

AUSTRIA-HUNGARY.

Agram [Zagreb] (*Croatia*).

979. Handels- und Gewerbe-Kammer für Kroatien. (Same as 993.)
986. Mineralogical and Geological Museum.
990. Société d'Histoire Naturelle Croate à Zagreb.
993. Trgovačko Obrtnička Komora (Chamber of Commerce).

Budapest (*Hungary*).

1033*a*. K. Ungar. Ministerium für Kultus und Unterricht.
1034. Ungarische Revue.
1051. Pestváros Statisztikai Hivatal. (Same as 1007.)
1057. Société Hongroise de Géographie. (Same as 1037.)
1067. Commission Européenne du Danube. (Same as 7164*c*. in Galacz, Roumania.)

Gratz (*Styria*).

1090. Steiermärkisches Landwirthschaftliches Joanneum.

Hall (*Styria*).

1094. Verein zur Geologischen Durchforschung.

Herény (*Hungary*).

1094*d*. Astro-physikalisches Observatorium. [i]

Kalocsa (*Hungary*).

1107. Erzbischof Haynald's Observatorium.

Kloster-Neuburg (*Austria*).

1132. K. K. Chemisch-Physiologische Versuchs-Station für Wein und Obstbau.

Krakau (*Galicia*).

1137. Galizischer Fischerei-Verein. (Dissolved.)

Kronstadt (*Transylvania*).

1146. Die Handels-und Gewerbekammer in Kronstadt.

Laibach (*Illyria*).

1155. Landes-Museum. Should be Krainsches Landesmuseum "Rudolfinum."

Lobositz (*Bohemia*).

1176. Agricultural Station.

Pola (*Illyria*).

1188. Observatory.

Prag (*Bohemia*).

1218. Prag Library.

1222. Statistische Commission.

Trent (*Tyrol*).

1251. Società degli Alpinisti Tridentini. Headquarters established in Rovereto for 1887 and 1888.

Trieste (*Illyria*).

1260. Zeitschrift für die gesammte Ornithologie.

1262. Gazetta del Tribunale.

Wien (*Austria*).

1280. Allgemeine Oesterr. Gerichtliche Zeitung.

1290. Congrès International d'Hygiène et de Démographie.

1293. Entomologischer Verein. (Does not exist.)

1297*c*. Jahrbücher für Psychiatrie.

1298. Juridical Society.

1337. K. K. Naturhistorisches Hofmuseum, Geologisch-Paläontologische Abtheilung.

1360. K. K. Staats-Gewerbe-Schule.

1376. Militair-wissenschaftlicher Verein.

1382. Oesterreichischer Alpen-Verein.

1384. Oester. Berg.-und Hüttenmännische Zeitung.

1384*c*. Oesterreichischer Fischerei-Verein.

1392. K. K. Patent-Amt. (Privilegien-Departement des K. K. Handels-Ministeriums.)

1398. Redaktion: Illustr. Zeitschrift "Amerika."

1410. Redaktion der Statistischen Monatsschrift.

1436. Wiener Entomologische Zeitschrift.

1438. Wiener Pädagogische Gesellschaft.

BELGIUM.

Arlon.

1474. Institut Archéologique de Luxembourg.

Bruxelles (*Brussels*).

1497. Association Internationale pour l'exploration et la civilisation de l'Afrique Centrale. (Now called État Indépendent du Congo. Département de l'Intérieur.)

1499. Athénée Belge. (No longer issued.)

1518. Commission pour la Publication des anciennes Lois et Ordonnances de la Belgique.

1520. Congrès International Pharmaceutique.

1527. Institut Géographique de Bruxelles. (Now Institut National de Géographie.) [i]

1528. Jardin botanique de l'État.

1538. Musée Royal de l'Industrie. (Patent Office.)

1544. Société Belge d'Électriciens.

1562. Société Paléontologique.

1574. Société Royale des Sciences.

Dinant.

1585*c*. Société des Naturalistes Dinantais.

Enghien.

1586. Cercle Archéologique.

Forest.

1586*b*. Agricultural and Horticultural Union.

Gand (*Ghent*).

1592. Revue de l'Horticulture Belge et Étrangère.

1596. Société de Médecine Mentale de Belge.

Gembloux.

1604. Agricultural School.

Hasselt.

1605. Société des Mélophiles.

Liège.

1610. Académie Royale.

1620. Observatoire.

Louvain.

1644. Athénée Oriental.

1646. Société des Lettres et des Sciences.

Melle (*near Ghent*).

1655. Muséum Commercial et Industriel. (Is part of 1653, which also has an Ethnog. or Geog. Museum, and a Museum of Natural History.)

Mons.

1660. L'École de l'Industrie et des Mines.

St.-Nicolas.

1676. Administration Communale.

Termonde.

1680. Bibliothèque Publique de la Ville de Termonde.

DENMARK.

Kjöbenhavn (*Copenhagen*).

1734. "Hygiea."

1752. Kongelige Sundheds-Kollegium.

1756. Medicinalberetning for Kongeriget Danmark.

1765. Naturhistorisk Tidsskrift. (Discontinued.)

1768. Royal Museum of Ethnography.

1770. Tidsskrift for Sövesen.

1774. Topographical Bureau.

1782*k*. Zoologisk Have.

Viborg.

1786. Nordisk Tidsskrift for Fiskeri.

FRANCE.

Alençon.

1806. Société Philologique.

Allier.

1807. Société des Sciences Médicales de Gannat. (Same as 2127.)

Annecy.

1836. Musée d'Annecy.

Avignon.

1872. Académie de Nauchuse.

Bayeux (*Calvados*).

1890. Société d'Horticulture et de Botanique du Centre de la Normandie.

Biarritz.

1918. Biarritz-Association. Société des Sciences, Lettres et Arts.

Bordeaux.

1930. Commission Météorologique de la Gironde.
1944. Société d'Apiculture.
1963. Société de Médecine de Bordeaux. (Same as 1965.)
1967. Société Médico-Chirurgicale des Hôpitaux et Hospices de Bordeaux. (Same as 1965.)

Bourges.

1988. Société d'Horticulture et Viticulture du Cher.

Caen.

2001. Association d'Agriculture et d'Horticulture des Instituts de la Zone Campandré-Valcongrain. (Dissolved.)
2014. Société Française d'Archéologie pour la Conservation et la Description des Monuments Historiques. (Same as 2072.)

Cannes.

2024. L'Académie Nationale des Sciences. (Dissolved.)

Clermont-Ferrand.

2066. Société d'Émulation de l'Auvergne.

Compiègne.

2072. Société Française d'Archéologie pour la Conservation et la Description des Monuments Historiques. [i]

Digne.

2080. Société Scientifique et Littéraire des Basses-Alpes. [i]

Dijon.

2086. Comité Central d'Agriculture de la Côte-d'Or.

Fontainebleau.

2124. École d'Application de l'Artillerie et du Génie. [i]

La Rochelle.

2148. Société des Sciences Naturelles.

Le Havre (*Seine-Inférieure*).

2163. (Correct title.) Société des Sciences et Arts Agricoles et Horticoles du Havre.

Le Mans.

2174. Société Philotechnique du Maine.

Lille.

2178. Bulletin Scientifique, Département du Nord.
2198. Société Industrielle du Nord de la France.

Lisieux.

2210. Société d'Émulation de Lisieux.

Lyon.

2222. Archives de l'Anthropologie Criminelle et des Sciences Pénales.
2226. Chambre de Commerce.
2227. Commission Hydrométrique de Lyon. (Same as 2229.)
2230. Faculté de Médecine et de Pharmacie de l'Université.
2231. Musée Guimet. (Now in Paris, 2626.)
2253. Société d'Études Scientifiques. (Was merged into Soc. 2259 in 1885.)

Mantes.

2276. Société Agricole et Horticole de l'Arrondissement de Mantes.

Marseilles.

2278. Association Horticole Marseillaise.
2290. Société d'Étude des Sciences Naturelles.

Monnaie.

2324. Société des Antiquaires.

Montpellier.

2336. Agricultural School.
2351. Société de Géographie. (Same as 2355.)

Nantes.

2390*a*. Comice Agricole Central du Département de la Loire-Inférieure.
2402. Société de Géographie Commerciale de Nantes. [i]

Nice.

2408. Observatory.

Nîmes.

2418. Agricultural Station.
2421. (Correct title.) Société d'Agriculture du Gard.

Nozay.

2428. National School of Agriculture.

Paris.

2452. Annales d'Hygiène et de Médecine Légale.
2452*c*. Annales Médico-psycologiques.
2462. Annales Télégraphiques.
2465*d*. Archives de Neurologie.
2466. Archives Slaves de Biologie. [i]
2466*h*. Archives de la Tocologie.
2472. Association Scientifique de France. [i]
2501. Bureau International des Poids et Mesures. (Is in Sèvres.)
2502. Chambre des Députés.
2502*b*. Chambre des Ingénieurs Typographiques. [i]
2510. Comptoir Géologique de Paris. (15 Rue de Tournon).
2516. Dépôt des Cartes et Plans de la Marine. (Now called Service Hydrographique.)

Paris—Continued.

2526. École des Sciences Politiques.
2538. École Supérieure de Pharmacie.
2538*c*. "Encéphale."
2542. Gazette Géographique et Exploration. Revue Hebdomadaire.
2543. (Full title.) Gazette Hebdomadaire de Médecine et de Chirurgie.
2546. Informateur Commercial.
2562. Journal de L'Anatomie et de La Physiologie.
2566. Journal des Débats.
2572. Journal de Micographie.
2582. "L'Astronomie."
2582*a*. L'Électricien.
2583. "L'Exploration." (Same as 2542.)
2586. "La France."
2590*a*. La Sorbonne. (Université.)
2592. Le Figaro Illustré.
2592*b*. Le Jardin. Journal d'Horticulture Générale. [i]
2596. "Le Naturaliste."
2623*c*. Moniteur Industriel.
2624. Moniteur Scientifique Quesneville. [i]
2626. Musée Guimet, Ministère de l'Instruction, etc. [i]
2632. National Agricultural Station.
2632*c*. Nouvelles Archives d'Obstétrique et de Gynécologie.
2636. Musée Pédagogique et Bibliothèque Centrale de l'Instruction Primaire.
2636*c*. Polybiblion: Revue Bibliographique Universelle. [i]
2650. Revue Critique.
2652. Revue Française de l'Étranger et des Colonies.
2660*a*. Revue Internationale de l'Électricité.
2665*d*. Revue Médicale.
2666. Revue de Médecine.
2668. Revue Philosophique de France.
2674. Service Hydrométrique du Bassin de la Seine.
2678. Société Académique Indo-Chinoise.
2706. Société contre l'Abus du Tabac. [i] (Rue Jacob, 38.)
2715. Société d'Ethnologie. (Dissolved.)
2728. Société Française de Tempérance.
2729. (Full title.) Société Franklin pour la Propagation des Bibliothèques Populaires.
2730. Société Générale des Prisons.
2746. Sociedad Latino-Americana Biblioteca Bolivar.
2754. Société Médico-Psychologique.
2758. Société Mycologique de France. [i]
2781. Société de Typographie. (Same as 2502*b*.)
2783*h*. Thérapeutique contemporaine.

Pau.

2784. Société d'Éducation et d'Instruction Populaires des Basses, Pyrénées.

Pic-du-Midi.

2795. Observatoire. (Same as 1879.)

Rouen.

2850. Conseil Central d'Hygiène Publique et de Salubrité.

Saint-Cyr.

2875. (Correct title:) École Spéciale Militaire.

Saint-Germain-en-Laye (*Seine-et-Oise*).

2884. Musée de St.-Germain.

2886. Société Malacologique de France.

Sèvres.

2920. Bureau International des Poids et Mesures.

Toulouse.

2931*a*. École Préparatoire de Médecine.

2931*c*. Laboratoire d'Anthropologie.

2932. "Matériaux pour l'Histoire Primitive et Naturelle de l'Homme." [i]. (A monthly review published by 2931*c*.)

2937. (Correct title.) Société Académique Franco-Hispano-Portugaise.

Tours.

2952. Observatoire.

2957. Société Française d'Archéologie pour la Conservation et la Description des Monuments Historiques. (Same as 2072.)

Versailles.

2982. Observatoire.

GERMANY.

Altenburg (*Saxe Wiemar*).

3014. Agricultural Academy.

3014*a*. Agricultural Station.

Altona (*Prussia*).

3022. Königl. Kommerz-Kollegium.

Apolda (*Saxe Wiemar*).

3030. Grossherzogliche Zimmerman's Realschule.

Aschaffenburg (*Bavaria*).

3041. (Correct title.) Königliche Bayerische Forstlehranstalt.

Augsburg (*Bavaria*).

3043. Deutscher Apotheker-Verein. (Same as 4941.)

Berlin (*Prussia*).

3072. Academia Litterarum Regiæ Borussicæ.

3075. Allgemeine Deutsche Ornithologische Gesellschaft. [i]

3125. (Correct title.) Central-Direction der Monumente Germanice.

Berlin—Continued.

3139*a*. Commission für die Beobachtung des Venus-Durchgangs. (A. Auwers, President.)

3140. Committee of the International Geological Congress.

3163. Deutsche Ornithologische Gesellschaft. (Same as 3075.)

3171. Deutsche Zoologische Gesellschaft. (Dissolved.)

3195. Deutscher Verein zur Förderung von Luftschifffahrt. [i]

3237. Horticultur-Gesellschaft. (Same as 3705.)

3311. (Correct title.) Königliches [Preussisches] Geodätisches Institut [Central-Bureau der Internationalen Erdmessung].

3371. Königliches Recheninstitut zur Herausgabe des Berliner Astronomischen Jahrbuches.

3376. Land Improvement Survey.

3376*a*. Landwirthschaftlicher Club.

3473. (Correct title.) Redaktion: "Berliner Astronomisches Jahrbuch."

3481*a*. Redaktion: "Berliner Presse."

3482. Redaktion: "Berliner Tagsblatt."

3497*b*. Redaktion der Entomologischen Nachrichten.

3498. Redaktion: "Der Export."

3540. Redaktion: "Gartenflora."

3558. Redaktion: "Industrie-Blätter." [i]

3609. Redaktion: "Der Naturforscher." (Same as 5060).

3612. Redaktion: "Naturwissenschaftliche Rundschau."

3628. Redaktion: "Der Sammler." [i.]

3658. Redaktion: "Zeitschrift für Psychiatrie."

3660. Redaktion: Zeitschrift für wissenschaftliche Landwirthschaft.

3691. Verein für die Deutsche Statistik. (Dissolved.)

3704. Verein für Psychiatrie.

Bonn (*Prussia*).

3728. Bergischer Geschichts-Verein.

3739. Naturwissenschaftlicher Verein. (Same as 3737.)

Brandenburg (Prussia).

3758. Botanischer Verein.

Braunschweig (Brunswick).

3766. Braunschweiger Thierschutz-Verein.

3769. Deutsche Ornithologische Gesellschaft. (Has transferred its library to 3075 in Berlin.)

3776. Herzogliche Technische Hochschule.

Bremen (*Germany*).

3785. Bibliothek des Museums. (Same as 3801.)

Breslau (*Prussia*).

3832. Verein Deutscher Studenten.

Danzig (*Prussia*).

3870. West-Preussischer Botanisch-Zoologischer Verein.

3870*c*. West-Preussischer Fischerei-Verein.

3872. West-Preussisches Provinzial-Museum.

Darmstadt (*Hesse*).

3875. (Full name.) Grossherzogliche Centralstelle für die Gewerbe und den Landesgewerbverein.

3885. Grossherzoglich-Hessischer Gewerbeverein. (Same as 3875.)

3890. Grossherzogliches Ministerium des Innern. Abtheilung für öffentliche Gesundheitspflege.

3890*c*. Grossherzogliches Ministerium des Innern und der Justiz.

Donaueschingen (*Baden*).

3904. Grossherzogliche Progymnasium.

Dresden (*Saxony*).

3911. Afrikanische Gesellschaft. (Same as 3071 in Berlin.)

3920. Entomologischer Verein "Iris." [i]

3927. Gesellschaft für Botanik und Zoologie. (Dissolved.)

3938. Königliches Mathematisch-Physikalisches Institut.

3939. Königliches Mineralogisch und Naturhistorisches Museum. (Correct name: Königliches Mineralogisch-Geologis[illegible] und Prähistorisches Museum.)

3972. Redaktion: "Das Schiff." [i]

3974. Redaktion: "Hedwigia."

Eberswalde (*Prussia*).

3996. Königliche Forst-akademie. (Same as 4867, Neustadt-Eberswalde.

Eldena (Prussia).

4010. Landwirthschaftsschule.

Frankfurt-am-Main (*Germany*).

4045. Allgemeine Deutsche Patent- und Musterschutz-Ausst[illegible]-lung. (Does not exist.)

Frankfurt-an-der-Oder (*Germany*).

4086. Naturwissenschaftlicher Verein des Regierungs-Bezirk[illegible] Frankfurt a. O.

4086*d*. Redaktion der "Monatl. Mittheilungen." (Dr. E. Huth.)

Freiburg-im-Breisgau (*Baden*).

4103. Gesellschaft zur Beförderung der Naturwissenschafte[illegible] (Same as 4107.)

Friesdorf.

4122. Landwirthschaftliche Schule.

Gnadau (*Prussia*).

4145*a*. Unitäts-Buchhandlung.

4146. Universität.

Göttingen (*Prussia*).

4168. Geologisches Museum der Königlichen Universität.

Halle-an-der-Saale (*Prussia*).

4248. Königliches Sächsisches Meteorologisches Institut. (Same as 3849 in Chemnitz.)

4250. Liebig's Annalen der Chemie.

4257. Politisch-Oekonomisches Seminar. (Correct name: Staatswissenschaftliches Seminar.)

Hamburg (*Germany*).

4276. Alsterdorf Institute for Demented Children.

4292. Handelsstatistisches Bureau.

4296. Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten.

4299. Museum Godeffroy. (Ceased to exist July 14, 1886.)

4306. Physikalisches Staats-Laboratorium.

4306*a*. Redaktion: "Aus Allen Welttheilen."

4306*b*. Redaktion der "Hamburgischen Börsen-Halle."

4315. Verein für Handelsfreiheit. (No longer exists.)

4322. Zoologische Gesellschaft.

Hanau (*Hesse*).

4329. (Correct name.) Wetterauische Gesellschaft für die gesammte Naturkunde.

Hannover (*Prussia*).

4334. Centralblatt für Elektrotechnik.

4336. Gesammt-Verein der Deutschen Geschichts- und Alterthums-Vereine.

4337. Gesellschaft für ältere Deutsche Geschichtskunde. (Same as 3125 in Berlin.)

Heidelberg (*Baden*).

4364. "Friend of the Insane."

4364*c*. Gymnasium.

Jena (*Saxe Wiemar*).

4430. Zoologische Jahrbücher.

Karlsruhe (*Baden*).

4448. Grossherzoglich-Badisches Ministerium des Innern.

4454. Grossherzoglich-Badisches Staats-Ministerium.

4455. (Correct name.) Grossherzoglich Badisches Statistisches Bureau.

4477. Zeitschrift für Wissenchaftliche Geographie. (Same as 5074 in Weimar.)

Kassel (*Prussia*).

4480. Centralblatt für Bacteriologie und Parasitenkunde. [i]

4487. Paleontographica. (Same as 5026*b* in Stuttgart.)

Köln (*Prussia*).

4540. "Gaea, Natur und Leben."

4542. Historischer Verein für den Niederrhein.

4547*a*. Selenographisches Observatorium.

4548. "Sirius."

Königsberg (*Prussia*).

4550. Beiträge zur Kunde der indogermanischen Sprachen.

Landshut (*Bavaria*).

4578. Mineralogischer Verein.

Leipzig (*Saxony*).

4582. Annalen der Physik und Chemie.
4594. Comenius Stiftung.
4596. Deutsche Monatsschrift für Zahnheilkunde (the organ of soc. 4591).
4610. Intelligenzblatt zu den Jahrbüchern der in- und ausländischen gesammten Medicin.
4610*c*. Journal für Praktische Chemie.
4630. Rath der Stadt Leipzig.
4633. Redaktion: "Annalen der Chemie und Pharmacie." (Same as 4250 in Halle.)
4644. Redaktion: Centralblatt für Nervenheilkunde.
4649. Redaktion: "Gaea, Natur und Leben." (Same as 4540 in Köln.)
4652. Redaktion: "Jahrbücher für Klassische Philologie."
4673. Redaktion: "Zeitschrift für wissenschaftliche Zoologie." (Same as 4199 in Göttingen.)
4674. Rheinisches Museum für Philologie.

Lüneburg (*Prussia*).

4719. Museum-Verein. (Its library has been united with that of 4721.)

Magdeburg (*Prussia*).

4736. Wetterwarte der Magdeburgischen Zeitung.

Marburg (*Prussia*).

4744. Jahresberichte über die Fortschritte der reinen Chemie.
4745*a*. Naturforschende Gesellschaft.

Meissen (*Saxony*).

4770. Fürsten- und Landesschule St. Afra in Meissen.

München (*Bavaria*).

4796. Bayerischer Fischerei-Verein.
4797*c*. Deutscher und Oesterreichischer Alpen-Verein.
4798. Europäischer Botanischer Tauschverein.
4811. (Correct name.) Königlich-Baierische Meteorologische Centralstation.
4844. Redaktion: "Der Gerichtsaal."

Münster (*Prussia*).

4856. Royal Theological and Philosophical Academy.

Nürnberg (*Bavaria*).

4872. Friedrich's Blätter für Gerichtliche Medicin.
4880. Verein für Geschichte der Stadt Nürnberg.

Ober-Lahnstein (*Prussia*).

4880*d*. Lahnsteiner Alterthumsverein.

Poppelsdorf (*Prussia*).

4900. Königliche Landwirthschaftliche Akademie.

Potsdam (*Prussia*).

4914. Redaktion: "Ahoi." [i]

Regensburg (*Bavaria*).

4932. Naturwissenschaftlicher Verein.

4933. Zoologisch-Mineralogischer Verein. (Same as 4932.)

Rostock (*Germany*).

4940. Landwirthschaftliche Versuchs-Station.

4941. Deutscher Apotheker-Verein. [i]

Rufach (*Bavaria*).

4944. Agricultural Station.

Sondershausen (*Schwartzburg-Sondershausen*).

4953. Botanischer Verein für das Nördliche Thüringen. (Correct name: Thüringische Botanische Gesellschaft "Irmischia.")

4954. Deutsche Botanische Monatsschrift.

Stettin (*Prussia*).

4968. Entomologische Zeitung.

4972. Verein für Erdkunde.

Strassburg (*Prussia*).

4984. Société Vétérinaire d'Alsace-Lorraine.

Stuttgart (*Würtemberg*).

4991. Anthropologische Gesellschaft. (Full name: Gesellschaft für Anthropologie, Ethnographie und Alterthumskunde.)

5026*b*. "Palæontographica."

5034. Verein für Mineralogie, Geologie und Paläontologie.

5048. Würtembergischer Verein für Handels-Geographie.

Tübingen (*Würtemberg*).

5052. Botanisches Institut.

5060. "Der Naturforscher." [i]

Ulm (*Würtemberg*).

5066. Verein für Mathematik und Naturwissenschaften.

Weihenstephan (*Bavaria*).

5068. (See 4115, Freising.)

Weimar (*Saxe Wiemar*).

5072. Gewerbekammer für das Grossherzogthum Sachsen-Weimar-Eisenach.

5074. Zeitschrift für wissenschaftliche Geographie.

Wiesbaden (*Prussia*).

5080. Chemisches Laboratorium von Prof. Dr. R. Fusenius.

5089. Zeitschrift für Analytische Chemie. [i] (Published by 5080.)

Würzburg (*Bavaria*).

5098. Medicinische Klinik zu Würzburg.

GREAT BRITAIN.

Barrow-in-Furness. (*Lancashire*).

5123*d*. Free Public Library.

Bath.

5124. Agricultural Society. (Same as 5125.)

5132. Journal of Microscopy and Natural Sciences. The Journal of the Postal Microscopical Society.

Birmingham.

5142. Birmingham Philosophical Society.

5158. "The Post."

Buckhurst Hill.

5168. Essex Field Club. [i]

Camborne.

5170. Mining Association and Institute of Cornwall. [i]

Cambridge.

5184. Cambridge Scientific Instrument Company.

5190. Morphological Laboratory, New Museum. [ii]

5198. Syndics of the Cambridge Press.

Cheltenham.

5214. Geological Record.

Chesterfield.

5219. (Now called) Chesterfield and Midland Counties' Institution of Engineers.

Coteswold.

5223. Coteswold Naturalists' Field Club. (Same as 5266*d*, in Gloucester.)

Downton.

5238. Wilts and Hants Agricultural College.

Duffield.

5240. "Reliquary."

Dumbarton.

5241. Pree Public Library. (Same as 6100*h*, in Dumbarton, Scotland.)

Epping.

5249. The Epping Forest and County of Sussex Naturalists' Field Club. (Same as 5168 in Buckhurst Hill.)

Folkestone.

5265*a*. Free Public Library.

5266. Natural History Society.

Gloucester.

5366*d*. Coteswold Naturalists' Field Club. [i]

Greenwich.

5268. "Observatory."

Kew.

5292. Royal Herbarium.

5293. Kew Observatory. (Same as 5910, in Richmond, Surrey.)

Leyton.

5318. "The British Mail."

Liverpool.

5322. "Daily Courier."
5322*a*. "Daily Mercury."
5342. Liverpool Journal of Commerce.
5345*k*. Liverpool Welsh National Society.
5346. Mayer Museum.

London.

5368. American Colonization Company.
5370. Anglo-American Agency.
5383*a*. "Asclepiad."
5384. Association of American Physicians in Great Britain. (Dr. C. J. Fowler, Hon. Sec'y, 13 Wye st., S. W.)
5385. Astronomical Register. (Discontinued.)
5396. Botanical Gazette.
5496*a*. Botanical Journal.
5397*a*. "Brain."
5398. British and Foreign Bible Society.
5410. British Medico-Psychological Association.
5438. Commercial Gazette.
5444. "Cosmos."
5446. Crystallogical Society.
5448. "Daily Telegraph."
5448*a*. Department of Practical Art.
5490. General Board of Lunacy. (Same as **5441.**)
5500. Gresham Angling Society.
5504. Guildhall Library. (Same as 5555.)
5506. Hampstead Public Library.
5508. Harlein Society.
5528. Institute of Bankers.
5538. International Health Exhibition Library.
5538*a*. International Meteorological Committee.
5542. "Ironmonger." (42 Cannon street.)
5542*b*. Journal of Mental Science.
5545. (Now called) Journal of Science and Annals of Astronomy, Biology, Geology, Industrial Arts, Manufactures, and Technology.
5564. Lincoln's Inn Library.
5574. London Chamber of Commerce.
5576. "London Graphic."
5582. London Law Magazine and Review.
5592. "Machinery Market."
5593*e*. "Mechanical Progress."
5594. Medical and Chirurgical Society.
5596. "Medical Record."

London—Continued.

5599. "Medical Times and Gazette." (Discontinued.)
5600. "Meteorological Magazine." (62 Camden Square, N.W.) [i]
5601. Meteorological Office. [iii]
5618. National Indian Association in aid of Social Progress and Female Education in India.
5622. Nemological Society of London.
5624. North Riding of Yorkshire Record Society. [i]
5636. "Pall Mall Gazette."
5642. "Philosophical Magazine."
5648. "Quarterly Journal of Microscopical Science."
5692. Royal School of Mines and Normal Schools of Science.
5705*b*. "Sanitary Record."
5706. "Saturday Review."
5707*a*. Science Society of King's College.
5707*b*. "Scientific News." [i]
5708. "Scientific Roll."
5710. Short-hand Writers' Association.
5712. Society for Study and Cure of Inebriety.
5720. Society for Psychical Research.
5732. Society of Science, Letters, and Art of London.
5738. "Standard."
5738*a*. Stationary Office.
5744. The Agent General for Tasmania.
5745*a*. The Ballad Society.
5746. "The Daily Chronicle."
5762. "The Globe."
5763*a*. "The Insurance Spectator."
5764. "The Iron and Coal Trades' Review."
5764*c*. "The Jurist."
5766. "The Miller."
5766*a*. "The Practitioner."
5781*a*. "Warehouse and Drapers' Trade Journal." [i]
5781*b*. Wandsworth Public Library.
5782. "Westminster Review."
5783. Willoughby Society for the Reprinting of Scarce Ornithological Works. (Dissolved in 1886.)
5787. Zoological Record Association. (Dissolved.)

Lyme Regis (*Dorset*).

5794. Rousden Observatory.

Macclesfield.

5795. Macclesfield Society for Acquiring Useful Knowledge. (Now called Macclesfield Scientific Association.)

Manchester.

5800. Field Naturalist and Scientific Student.
5802. Lancashire and Cheshire Antiquarian Society. (Care of George C. Yates, Salford, Manchester.)

Manchester—Continued.

5806. Manchester Association of Employers, Foremen, and Draughtsmen.
5806*b*. Manchester City News.
5808. Manchester Geographical Society.
5808*b*. Manchester Grammar School Library.
5814. Manchester New College.
5814*b*. Manchester Technical School Library.
5815. Numismatic Society. (Dissolved.)
5817*b*. Society of Chemical Industry.
5818. "The Guardian."

Plymouth.

5898. Marine Biological Association.

Redruth.

5907. The Mining Association and Institute of Cornwall. (Same as 5170, in Camborne.)

Richmond (*Surrey*).

5910. Kew Observatory. [iii]

Southport.

5941. Free Public Library. (Called also Atkinson Free Library.)

Shrewsbury.

5944. Free Library.

Woolhope.

5980. Woolhope Naturalists' Field Club.

IRELAND.

Dublin.

6018. Board of Lunacy Commissioners for Ireland.
6032. French College.
6034. General Register Office.
6036. Historical and Archæological Association.
6044. "Irish Law Times."
6045. Irish Medical Association. (Dissolved.)
6048. King and Queen's College of Physicians. [i]
6050. Lord Mayor.
6072. Science and Art Museum.

SCOTLAND.

Aberdeen.

6096. Public Library.

Banff.

6100. Banffshire Field Club.

Dumbarton.

6100*a*. Free Public Library. [i]

Edinburgh.

6116. Challenger Expedition Office.
6125. Edinburgh Watt Institution and School of Arts. (Now called Heriot Watt College.)

Edinburgh—Continued.
6138. Journal of Anatomy.
6138c. Journal of Jurisprudence and Scottish Law Magazine.
6146. Philosophical Institute.
6166. Scottish Meteorological Office.
6173. University Fleming. (Defunct.)

Glasgow.
6179. Anderson's College. (Now called Glasgow and West of Scotland Technical College.)
6182. Athenæum.
6182d. City Chamberlain's Office. [i]
6186. Glasgow Herald.
6192. Lord Prevost, Glasgow.
6200 Scottish Law Review.

Kirkcudbright.
6204. Museum and Natural History Society.

WALES.

Aberystwith.
6216. University College.

Bangor.
6216a. University College.

Cardiff.
6216aa. Free Library and Museum.
6216b. Naturalists' Society.
6216c. University of South Wales and Monmouthshire.

GREECE.

Athens.
6226. Bureau of Statistics.
6230. Hellenikos Didaskalikos Syllogos.
6230c. Hygienic Society.

ICELAND.

Reykjavik.
6256. Bókasáfn Alpingis. (Librarian of the Legislature of Iceland.)

ITALY.

Arezzo.
6281. Accademia Petrarca. (Correct name: R. Accademia Petrarca di Scienze, Lettere ed Arti.)

Bologna.
6305. Repertorium Italianum di Bianconi. (Defunct.)
6306. Revista Chimica di Bologna.

Caltagirone.
6316a. School of Agriculture.

Camerino.
6316c. Bullettino Numismatico e Sfragistico.

Caserta.

6318. Agricultural Station.

Como.

6322. Collegio Gallio.

Firenze.

6339. Istituto Topografico Militare. (Same as 6337.)
6340. Italian Asiatic Society.
6360. Revue Internationale.
6361. R. Comitato Geologico d' Italia. (Same as 6681, in Rome.)
6365. (Correct name.) Società Italiana d' Antropologia.
6366. Società Malacologica Italiana.

Forlì.

6367. Direzione dell' "Industriale Italiano." (Discontinued.)

Genova.

6384. R. Scuola Superiore di Applicazione di Studi Commerciali.

Messina.

6401. "La Scienza Contemporanea." (Discontinued.)

Milano.

6410. Agricultural Station. (A dependence of 6449.)
6412. Archivio Italiano per le Malattie Nervose, etc.
6418. Consiglio degli Istituti Ospitalieri.
6421. Direzione del "Bollettino Scientifico." (Discontinued.)
6424. Direzione della "Natura." (Discontinued.)
6426. Giunta Municipale di Milano.
6428. "L' Elettricità."
6456. Società di Freniatria.

Modena.

6481. Società Meteorologica Italiana. (Dissolved.)

Modica.

6485. Osservatorio Meteorologico. (Defunct.)

Moncalieri.

6488. Italian Meteorological Association.

Napoli.

6514. La Psichiatria e la Neuropatologia.
6538. Société Helvétique de Bienfaisance.

Padova.

6545. "Gazzetta Medica Italiana." (Discontinued.)

Palermo.

6564. L' Archivio per lo studio delle tradizioni popolari.
6574. Società Siciliana per la Storia Patria.

Parma.

6577. (Correct name.) Bullettino di Paleontologia Italiana.
6580. R. Deputazione di Storia Patria.

Pavia.

6590. Bollettino Scientifico.

Pisa.

6598. Archivio Giuridico.

Roma.

6625*c*. Accademia L' Unione Universale di Lettere, Scienze ed Arti.
6626. Agricultural Station.
6626*a*. Biblioteca Casanatense.
6641. Corrispondenza Scientifica in Roma. (Discontinued.)
6647. Direzione del "Periodico di Numismatica e Sfragistica per la Storia d' Italia." (Same as 6316*c*, in Camerino.)
6650. Direzione Generale del Debito Pubblico.
6650.[c] Direzione Stato Civile della Città di Roma.
6672. North American College.
6676. Osservatorio dell' Università Campidoglio.
6678. R. Istituto Botanico.
6682. Real Mineria.
6686. Royal Patent Office.
6688*d*. Regia Università.
6689. Revista di Filologia Romana. (Discontinued.)
6694. Società Geologica Italiana.

San Marino.

6698*d*. Museum of Antiquities.

Sienna.

6706. Società fra i Cultori delle Scienze Mediche.

Torino.

6712. Archives Italiennes de Biologie.
6722. Musei di Zoologia ed Anatomia comparata della R. Università di Torino.
6730. R. Museo Geologico di Torino.
6742. Revista di Filosofia Scientifica. [i]
6742*b*. Revista di Medicina Legale.
6748. Società di Geografia ed Etnografia.

Venezia.

6769. Biblioteca Marciana. (Same as 6771.)
6774. Observatory of the Parochial Seminary.
6778. Redazione della "Notarisia."

NETHERLANDS.

Amsterdam.

6794. De Indische Mercur. [i]
6802. Maandblad voor Telegraphie.
6806. Nederlandsche Koloniale Vereeniging.
6814. Vereeniging tot Bervodering der Zoetwater-vischerij in Nederland.

Exaeten (*near Roermond*).

6832. "Stimmen aus Maria Laach."

's Gravenhage.

6837. Commission Géodésique Néerlandaise. (Now in Delft.)
6853*a*. Minister of the Colonies.
6854. Minister of Public Instruction.

s' Gravenhage—Continued.

6854*a*. Minister of the Waterstaat, Commerce, and Industry.

6856. Société de Statistique des Pays-Bas.

Groningen.

6858. Genootschap ter Bevordering der Natuurkundige Wetenschappen.

Leiden.

6882. Haagsch Genootschap tot Verdediging van de Christelijke Godsdienst.

6904. Sixième Congrès International des Orientalistes.

6909. Zoologisch Station der Nederlandsche Dierkundige Vereeniging. (Same as 6889.)

Maastricht.

6910. Musée Ubaghs.

Nijmwegen.

6918. Nederlandsche Botanische Vereeniging.

Rotterdam.

6925. Société Néerlandaise de Zoologie. (Same as 6889 in Leiden.)

Schiedam.

6926. Natuurkundige Vereeniging "Martinet." (Dissolved.)

Zwolle.

6942. Maandblad voor den Nederlandschen Landbouwer.

Wageningen.

6950. Universiteit.

NORWAY.

Bergen.

6956. Laerde Skoles Bibliothek.

6962. Selskab for Videnskabernes Fremme.

Christiania.

6966. "Biologiske Meddelelser."

6979*a*. Departementet for Norges Fiskerier.

6980. De Skandinaviske Naturforskeres Selskab.

7028. Naturhistorisk Forening.

PORTUGAL.

Coïmbra.

7078. Botanic Garden of the University.

7082. Journal des Sciences Mathématiques et Astronomiques.

7084. Sociedade Broteriana.

Lisböa.

7096. Bureau Central de Statistique.

7099. Commissão Central Permanente de Geographia. (Incorporated with 7135, August 12, 1880.)

7103. Direcção General dos Trabalhos Geologicos (a section of 7101).

7116. Minister of Justice.

7134. Revue du Portugal et de ses Colonies.

Oporto.

7155*f*. Reale Bibliotheca Publica do Porto.
7156. Sociedade de Geographia Commercial do Porto. [i]

ROUMANIA.

Bukarest.

7160. Academia Roumania.
7160*a*. Directiunea Biuroului Geologicu.
7160*b*. Institutul Meteorologic al Romänici.
7161. Société Roumaine d'Agriculture. (Dissolved.)
7164. Topographic Bureau.

Galatz.

7164*c*. Commission Européenne du Danube.

RUSSIA.

Derpt.

7168. Archiv für die Naturkunde Livlands, Esthlands, und Kurlands.

Elisavetgrad.

7190. Meteorological Station.

Helsingfors.

7190*c*. Astronomical Observatory of the Imperial Alexander University.
7194. Finska Fornminnesföreningen.
7194*a*. Finska Forstföreningen. [i]
7200. Folkupplysnings-sällskapet.
7203. (Correct name.) Finska Vetenskaps Societetens Meteorologiska Central Anstalt.
7206. Pedagogiska Föreningen i Finland.
7208. Société Finno-Ougrienne.

Kishener.

7238. Société d'Agriculture.

Moskva.

7300. Statistical Bureau of the City of Moscow.

Odessa.

7316. Observatory.

Pavlofsk.

7326. Central Astronomical Observatory.

Petrowskoye Rasumowskoye (*near Moscow*).

7328. Land- und Forstwirthschaftliche Akademie. (Same as 7297 in Moscow.)

Polotsk.

7328*a*. Metrological and Magnetic Station.

Sankt-Peterburg.

7348. "Annuaire du Journal des Mines de Russie."
7350. "Artillery Journal." [i]
7358. Department of Telegraphs.
7419*e*. "Journal of Legal and Clinical Psychiatry and Neuropathology."

Sankt-Peterburg—Continued.

7420. L'Électricité Russe.
7424. Messenger of Neurology and Forensic Psycho-Pathology.
7458. Russian Society of Fish and Fisheries.
7464. Russian Society of Booksellers and Publishers.
7473*a*. "Household and School."
7474. Service de Santé de l'Armée.
7476. Society of Psychiatry.
7491. Agronomical Institute. (Defunct.)
7493. Agricultural Museum of the Ministry of State Domains. (Defunct.)

Vilna.

7535. Astronomical Observatory. (Defunct.)

Vladimir.

7539. Imperial School of Marine Jurisprudence. (Defunct.)

SPAIN.

Badajos.

7543*a*. El Folk Lore Bético Extremeno.
7544*c*. Asociacion de Excursiones.
7546. Gazeta Médica Catalana.
7552. Real Academia de Ciencias Naturales y Artes.

Madrid.

7570. Agricultural School.
7570*a*. Anales de la Real Academia de Medicina.
7580. Direccion General de Aduanas.
7580*a*. El Folk-Lore Bético-Extremeno.
7582. Gazeta del Constructor y Revista de la Arquitectura Nacional y Extranjera. [i]
7582*a*. Government of Spain.
7605*k*. Revista de los Progresos de las Ciencias Exactes, Físicas y Naturales.
7606. Revista de Telégraphos.
7617. Spanish Minister of State.

Zaragoza.

7632. Universidad Literaria de Zaragoza.

SWEDEN.

Stockholm.

7643*a*. "Acta Mathematica."
7654. Hydrographic Office.
7658. Kongliga Kommerce Kollegium.
7662. Kongliga Tekniska Högskolan.
7669*f*. Nationalekonomiska Förening.
7670. Nautisk Meteorologiska Byrån.

Stockholm—Continued.

7672. Nordiska Museet. [i & Eth.]
7674. Polytechnicum.
7674*a*. Royal Museum of Natural History.
7674*b*. Royal Patent Office.
7674*e*. Skandinaviske Naturforskers Forsamling.
7684. Technologisk Institute.

Vesterås.

7698. Vesterås Högre Allmänna Läroverk.

SWITZERLAND.

Aarau.

7706. Mittelschweizerische Geographisch - Commercielle Gesellschaft. [i]

Basel.

7716. Physikalische Anstalt im Bernoullianum.

Bern.

7721. Allgemeine Schweizerische Gesellschaft für die Gesammten Naturwissenschaften. [iii]
7742. Journal Télégraphique de Berne.
7761. Société des Sciences Naturelles. (Same as 7721.)

Genève.

7811. Société Suisse de Topographie et d'Arpentage. [i] (Correct title.)

Grand Saint-Bernard.

7812. Hospice du Grand St.-Bernard.

Le Locle.

7823*a*. Société Neuchâteloise de Géographie. [i]

Luzern.

7828. Schweizerische Naturforschende Gesellschaft.

Neufchâtel.

7828*d*. Commission Pénitentiaire Internationale.
7834. Société Neuchâteloise de Géographie. (Same as 7823*a*.)

Zurich.

7858. Antiqua. Unterhaltunagblatt für Freunde der Alterthums kunde. Herausgegeben von einem Consortium Schweizerischer Alterthumsfreunde.
7870. Schweizerische Geodätische Commission.
7876. Statistical Bureau.

TURKEY.

Constantinople.

7898. Bibliothèque Générale Ottomane.
7912. Ministère des Affaires Étrangères.
7912*a*. Ministère de l'Instruction Publique.

Sophia (*Bulgaria*).

7920. Bulgarian Government.

MISCELLANEOUS.

1290. International Congress of Hygiene, Vienna.
1520. International Congress of Pharmacy, Brussels.
3140. International Congress of Geological Sciences, Berlin.
5538. International Health Exhibit, London.
6907. International Congress of Orientalists, Leiden.
7828*d*. International Penitentiary Commission, Neuchatel.
7952. International Medical Congress, Berlin, 1890.

SYSTEMATIC ARRANGEMENT OF THE LIST OF FOREIGN CORRESPONDENTS, JULY, 1886.

Prepared by GEORGE H. BOEHMER.

In the Annual Report for 1885 a "List of Foreign Correspondents" of the Smithsonian Institution was published, and a supplement to it is given in the present report, under the title "Additions and Corrections to the List of Foreign Correspondents, corrected to July, 1886."

The paper now submitted represents a systematic arrangement of the two lists, under the following classification:

I. Academies of Arts, Letters, Science, etc.
II. Commissions, Committees, International Conferences and Congresses.
III. Governments and Government Departments.
IV. Hospitals and Hospices.
V. Institutes and Institutions of Learning.
VI. Journals and Periodicals.
VII. Laboratories.
VIII. Libraries.
IX. Museums.
X. Observatories.
XI. Societies.
XII. Surveys.
XIII. Universities, Colleges, and Schools.
XIV. Establishments receiving the Smithsonian Annual Reports.
XV. Establishments receiving the Smithsonian Miscellaneous Collections and the Annual Reports.
XVI. Establishments receiving the Smithsonian Contributions to Knowledge, the Miscellaneous Collections, and the Annual Reports.

I.—ACADEMIES.

Agriculture.

6353 6595

Agriculture, Manufactures, and Commerce.

2441.

Physical and Mathematical Sciences.
6525.

Plastic Art.
1303.

Sciences.
564 1041 1135 1299 1610 1859 1872 1975 1995 2057 2129 2143 2369 2371 2417 2429 2549*a* 2549*c* 2767 2817 3295 4025 4153 4173 4243 4611 4805 4931 5695 6067 6281 6291 6399 6403 6495 6497 6623 6711 6797 6869 6881 7059 7073 7089 7160 7371 7597 7661 7677 7687.

Sciences and Belles-lettres.
1821 6407.

Science and Letters.
6523 6557.

Sciences, Agriculture, Arts, and Belles-lettres.
1795 2961 6787.

Sciences, Arts, Belles-lettres, and Geography.
2273.

Sciences, Inscriptions, and Belles-lettres.
2931.

Sciences, Arts, and Female Industries.
7544.

Sciences, Arts, Letters, Agriculture, and Industry.
2903.

Sciences, Letters, and Arts.
1493 1809 1847 1909 1923 1999 2035 2063 2081 2145 2221 2277 2845 6281 6371 6397 6473 6549 6611 6625*c* 6755.

Scientific Research and Acclimation.
19.

Spanish and Portuguese.
2937.

Three Noble Arts.
7567.

II.—Commissions, Committees, International Conferences and Congresses.

Agriculture.
1217 2086 2181 2329 2390*a* 3329 3375 6321 6395 6470 7937.

Americanists.
7925 7935.

Amortizement.
7369.

Anthropology.
7949.

Antiquities or Archæology.
1845 1897 2027 2085 2849 2951 2981 2993 6637 7375 7949.

Publication of Ancient Laws.
1518.
Red Cross.
3123 6499.
Sanitary. (See Health.)
School.
3271.
Scientific Exploration of the German Sea.
4507.
Scientific of the Navy.
7441.
Silk Culture.
7965.
Solar Physics.
5439.
Statistics.
1222 1359 1513 3363 7513 7967.
Teachers of the Blind.
2999.
Technical Committee of the Navy.
3275.
Telegraphy.
7969.
Testing of Ordnance.
3297.
Trade.
3669 5553.
Transit of Venus.
3139*a*.
Trawling.
5773.
Weights and Measures.
2501 7355 7943.

III.—GOVERNMENTS AND GOVERNMENT DEPARTMENTS.

Governments.
49 145 222*a* 258 295 417 435 477 501 555 606 615 644 661 663 678 684 709 795 817 839 849 885 953 1275 1521 1731 3037 3069 3787 3909 4129 4227 4453 4945 4959 4989 5349 6229 6231 6331 6855 7347 7543 7729 7891 7921.
Agriculture.
139 153 207 611 711 1301 2605 4459.
Agriculture, Domains, and Forests.
3347.
Agriculture and Industry.
1043.

Finance and Public Works.
527.
Fisheries.
5475 5705 6043 6129 6163 6833 6979*a* 7644.
Foreign Affairs. (See State.)
Forests.
836*c* 5009.
Fortifications.
1331 3331 5525.
General Agents of Governments.
5359 5361 5363 5365 5367 5445 5744.
General Staff.
3309 3369 3377 3403 5265 7451.
Geography.
721*h* 2517 7019.
Geology.
1033 1317 2510 3313 3879 4605 4977 5491 6681 7103 7160*a* 7651.
Health.
164 1752 2850 3251 3890 3951 7474 7893.
Home.
3249 5515.
Hydrography.
489 1187 1769 2495 2516 3245 4441 5523 6393 7363 7654.
Hydrometry.
2674.
India.
5563.
Interior.
47 379 481 554 974 1343 1533 1757 2613 3259 3343 4448 5017 6233 6661 6853 7019 7433 7589 7731.
Interior, Colonization, Industry, and Commerce.
297.
Interior and Justice.
3890*c*.
Industry.
3875.
Justice.
147*a* 3265 3319 5013 7116.
Justice and Public Instruction.
299.
Justice, Worship, and Education.
4449.
Light-Houses.
6111.
Longitudes.
2499 2507.

Water Supply, Commerce, and Industry.
6854*a*.

Weights and Measures.
388 943 2501 2920.

Worship, Education, and Medicine.
3341.

Worship and Instruction.
1033*a*.

Zoological Garden.
3721 6909.

City Governments.
281 383 429 785 873 1417 1479 1481 1676 2637 3383 4630 5555 5571 5923 6050 6182*d* 6287 6426 6429 6650*c* 7465 7829.

IV.—Hospitals and Hospices.

624 650 684*a* 773 1967 2749 3133 3137 3201 3205 3241 3277 3279 3281 3283 3285 3287 3395 3429 4181 5098 5577 5613 5699 5701 5703 6437 6673 7043 7713 7812.

V.—Institutes or Institutions.

Acclimatization.
3121.

Actuaries.
5527.

Agriculture.
374*e* 412 440 2111 2547 4615 7115 7491 7547.

Anatomy.
3241 4377 4405.

Anthropology.
5373.

Archæology.
1474 1621 5659 6651.

Archæology and Natural History.
5169.

Architecture.
5681.

Art.
6125.

Artillery.
5981.

Bankers.
5528.

Blind.
1003 3301 3809 3937 4097 4117 4281 7419 7815.

Botany.
5052 6678.

Oriental Languages.
7483.
Paleontology.
4185.
Pathological Anatomy. (See Anatomy.)
Pharmacy.
4187.
Philology, Geology, and Ethnography.
6847.
Philosophy.
927 6146.
Pomology.
4937.
Physics.
4193.
Physiology.
3823 4195 4373 4627.
Physico-Pathology.
6679.
Science.
136 144 165 193 260 262 360*c* 360*e* 910 917 929 935 937 941 963 1163 2549 4594 5049 5255 5283 5581 5683 5933 5993 6017 6207 6209 6219 6653 7081 7621 7631 7785.
Science, Arts, and Letters.
6777.
Science and Letters.
327 6441.
Statistics.
6811.
Technology.
3671 6383 6445 6487 6567 7409 7684.
Topography.
6841.
United Service.
5697.
Zoology.
2187 4521.
Zoological Anatomy. (See Anatomy.)
Zoological Zootomy.
4145 4203 5107.

VI.—Journals and Periodicals.

Aeronautics.
2445.
Agriculture.
1409 2087 2341 2559 3467 3513 3593 3660 4421 5759 6369 6423 6942 6947 7587.

Agriculture and Chemistry.
3579.

Agriculture and Forestry.
4559.

Agriculture, Industry, Literature and Art.
2973.

Anatomy.
5191 6138.

Anatomy and Physiology.
2562 5189.

Anatomy, Physiology and Medical Sciences.
4637.

Anthropology.
2643 2932 3764 4109.

Anthropology and Ethnology.
6323.

Antiquarian.
635 5375 7858.

Anti-phylloxera.
1133.

Archæology.
2647 3447 3573 3643 5240 5375 5377 5655.

Architecture.
2591 3641 5379 7582.

Army.
3505.

Army and Navy.
3567.

Art. (See Agriculture.)
3453 4353.

Art and Collections.
3565.

Art and Numismatics.
113.

Artillery.
7350 7579.

Artillery and Engineering.
3449.

Asiatic.
2557.

Astronomy. (See Mathematics.)
2507 2582 3374 3473 3611 4495 4548 5385 5545 5627 6075 7079.

Astronomy and Meteorology.
4547.

Auriculist.
3603.

Bacteriology.
4480.
Bibliography.
2636*c* 3553 7783.
Biology.
2466 4845 5545 6712 6966.
Book Trade.
5397.
Botany.
2649 3483 3563 3571 4261 4439 4479 4653 4954 5396 5396*a*.
Chemistry. (See Physics.)
2491 3489 3491 4250 4582 4610*c* 4744 5419 5423 6306 6507 6561.
Chemistry and Pharmacy.
4633.
Chirurgy. (See Clinical Chirurgie and Medicine.)
Civil Engineers.
2457 6645.
Classical Philology.
4652.
Clinical Chirurgie.
3455.
Coal and Iron Trade.
5749 5764.
Colonial. (See Shipping.)
2652 5750 6808 7134.
Commerce.
2546 3531 5342 5438 6801.
Communications.
355.
Conchology.
2561 5299.
Consular..
3511.
Crystallography and Mines.
4671.
Debats.
2566.
Dental.
2467 4645.
Diplomatic.
5449 5767.
Drapers. (See Warehouse.)
Economist.
5749.
Education.
185.

Hydrography.
3437.

Hygiene. (See Public Hygiene and Legal Medicine.)

Industry. (See also Agriculture and Science.)
421 2623*c* 2659 3558 4661 4843 5545 6365.

Industry and Chemistry.
3489.

Insanity.
4364 4381 4383.

Insurance.
5763*a*.

International Geography.
2655.

Iron.
5541 5542

Iron Trade. (See Coal, etc.)

Language, Indo-German.
4159 4550.

Language, Modern, and Literature.
3765.

Legal.
44 1262 1280 1589 3507 3521 3545 3591 3657 4844 5582 5764*c* 6044 6138*c* 6200 6598 6778 7033 7419*e*.

Linguistics.
2663 4651.

Linguistics and Comparative Philology.
2661 3561 3659.

Literature. (See Agriculture, Language, and Science.)
1797 3515 3597 4086*e* 4657 4667.

Machinery.
5592.

Malacology.
4485.

Mathematics.
3551 3575 3587 5195 7643*a*.

Mathematics and Astronomy.
2489.

Mathematics and Natural Science.
6963.

Mathematics and Physics.
4635.

Mechanics.
5461 5593*a*.

Medical Sciences. (See Anatomy.)

Psychology and Nervous Diseases. (See Medicine.)
3461.
Psycho-pathology. (See Neurology.)
Public Instruction.
121 2567.
Public Hygiene.
4445.
Public Welfare.
3439.
Public Works. (See Mines; Railroads.)
Publishers.
185 633 2483 3783 4207 4343 4587 4601 5351 5775 5783 6427 7681.
Railroad.
3441.
Railroad and Public Works.
2565.
Sanitary.
5705*b*.
Science.
116 305 567 907 1499 1895 2178 2509 2515 2555 2575 2581 2589 2595 2624 2671 3627 4263 4296 5027 5355 5387 5443 5444 5461 5481 5489 5503 5507 5545 5547 5549 5619 5707*b* 5707*c* 5769 6345 6401 6421 6424 6590 6601 6641 6719 6865 6885 7027 7545.
Scientific Botany. (See Botany.)
Scientific Geography. (See Geography.)
Science and Industry.
591.
Science and Literature.
2581.
Science, Literature and History.
167.
Science and Zoology. (See Zoology.)
Shipping and Colonial.
2665.
Shipping and Mercantile.
3972 5447.
Skin Diseases. (See Syphilis.)
Smelting. (See Mining.)
Statistics.
250*a* 1410 3629.
Stenography.
3487 3501 3599.
Syphilis and Skin Diseases.
3469.
Technology.
1219 5545.

Telegraphy.
2462 7606 7742.

Theology.
2841 3453 6832 7055.

Theosophy.
691.

Therapeutics.
2783*h*.

Tocology.
2466*h*.

Vegetarian.
3475.

Veterinary.
1773 3465.

Warehouse and Drapers.
5781.

Zoology.
409 1782 4081 4199 4430 4673 5787 5791.

VII.—LABORATORIES.

Agricultural Stations.
1176 2390 2418 2632 3014*a* 4940 4944 6318 6410 6626.

Anthropological.
2931*c*.

Chemical.
45*a* 5080.

Chemical and Chemico-Agricultural and Physical.
7 1713 4163 4179 5053 6475 6575 6761 6935 6989.

Chemico Physical.
1132.

Morphological.
5190.

Physical.
4306.

VIII.—LIBRARIES

Commerce.
4283.

Imperial Libraries. (See National Libraries.)

Legislative Libraries. (See Parliamentary Libraries.)

Medicine.
2337 4279.

National Libraries (including Imperial and Royal Libraries.)
51 65 279 371 423 471 503 545 1083 1275 1503 1719 2477 3055 3069 3881 3909 3945 4209 4347 4463 4489 4759 4819 4975 4989 5021 5077 5349 5559 5561 6051 6231 6249 6269 6327 6331 6415 6501 6559 6579 6629 6713 6771 6843 7021 7095 7347 7389 7543 7573 7657 7723 7891 7921.

Parliamentary.

145 159 173 197 203 219 229 821 843 851 895 966 1501 2502 3165 3289 3317 4489 5559 5561 6851 7051.

Public.

3 43 71 75 89 162 181 215 228 333 337 367 373 415 425 525 560 677 693 775 789 844 859 861 897 924 967 969 1119 1153 1173 1185 1218 1243 1453 1473 1475 1477 1483 1581 1585 1587 1605 1607 1643 1657 1667 1675 1677 1680 1681 1685 1689 1695 1705 1791 1811 1925 1991 2095 2337 2373 2473 2479 2481 2827 2847 3009 3777 3807 4047 4279 4283 4307 4571 4675 4715 4767 4777 4973 5117 5119 5123*d* 5139 5149 5157 5159 5171 5175 5231 5241 5265*a* 5303 5309 5325 5345*k* 5483 5485 5504 5506 5551 5553 5555 5557 5559 5563 5564 5565 5781*b* 5799 5811 5831 5849 5859 5867 5879 5887 5895 5901 5905 5909 5921 5941 5943 5944 5949 5991 6023 6077 6096 6100*h* 6105 6193 6216*aa* 6217 6225 6253 6265 6275 6279 6325 6329 6503 6543 6626*a* 6627 6751 6769 6783 6789 6813 6825 6831 6873 6917 6923 6955 6956 7061 7063 7069 7075 7087 7165 7241 7251 7277 7309 7333 7351 7507 7511 7537 7543 7697 7781 7783 7817 7879 7898 7911.

Royal. (See National Libraries.)

School.

5808*b* 5814*b*.

Staff.

52.

University Libraries. (See Universities.)

IX.—MUSEUMS.

Unclassified, or General.

39 55 90 248*c* 259 285 323*c* 359 361 385 445 485 570 619 649 683 707 775 781 855 887 891 897 919 923 931 949 987 999 1039 1125 1155 1175 1199 1245 1345 1836 1873 2629 2884 3353 3727 3785 3872 3891 4201 4299 5171 5187 5203 5253 5313 5323 5325 5346 5411 5849 5859 5887 5905 5921 5927 5949 5961 5971 6105 6123 6204 6216*aa* 6225 6297 6515 6867 6910 6953 7077 7119 7121 7253 7279 7337 7445 7447 7672 7789.

Anatomy.

5191 5613 6295 6993.

Anthropology.

1045 3959 6341.

Antiquities.

1535 1747 3837 4517 4445 4801 4873 6698*d* 6897 6999 7071 7443 7537.

Archæology.

5193 6435 7593.

Art.

1351 3109 3327 3435 3925 5325 5737 5859 6051 6072 6143.

Botany.
855 4821 5292 6235 6901 6995.

Colony.
7121.

Commerce.
1655.

Economy.
5959 7473.

Education.
727.

Ethnography.
1768 2625 2626 6671 6893 6997 7253 7672.

Ethnology.
4589 6997 7637.

Ethnology and Geography.
1653.

Geology.
1337 4168 5615 6299 6730.

History.
2381 3233 3935 4873 4981.

Industry.
1351 1509 1538 1655 3109 3327 3435 4871 6731.

Medicine.
2631.

Mineralogy.
1781 6723 3401 3735 3938 4409.

Mineralogy and Geology.
986.

Mining Engineers.
7479.

Natural History.
708 708*c* 823 1121 1259 1337 1537 1653 1937 2005 2097 2151 2189 2233 2283 2627 2819 3775 3938 4301 4979 5067 5413 5873 6239 6271 6375 6431 6433 6587 6733 7155 7674*a*.

Numismatic.
6237 6987.

Oriental.
1389.

Paleontology.
1337.

Pedagogy.
2636 3196.

Philology.
4065 4674.

Physical and Natural History.
6537.

Physical Geography.
7353.
Physical Astronomy.
1353.
Prehistoric.
1939 3939 6671.
Science and Art. (See Art.)
Technology, Industry and Sanitary.
810.
Zoology. (See also Anthropology and Ethnology.)
1373 1873 3723 3959 4143 4201 5191 5415 6541 6735 7001 7071 7791.
Zoology and Comparative Anatomy.
6722.

X.—Observatories.

Astronomy.
11 35 57 213 261 405 447 463 487 505 507 529 623 665 689 705 729 797 813 835 889 951 955 1019 1107 1139 1145 1161 1209 1361 1539 1775 1941 1993 2235 2285 2393 2633 2933 3365 3753 3757 3805 3831 3869 3991 4175 4211 4309 4563 4689 4746 4825 4857 4985 5091 5137 5179 5245 5267 5271 5273 5285 5293 5317 5885 5889 5890 5915 5969 5989 6007 6053 6073 6087 6091 6109 6153 6197 6203 6241 6301 6347 6349 6377 6447 6471 6489 6531 6547 6569 6583 6602 6675 6676 6701 6737 6899 6933 6959 6985 7123 7125 7127 7173 7190*c* 7221 7237 7239 7287 7307 7326 7329 7453 7455 7517 7535 7595 7623 7643 7673 7693 7763 7793 7831 7877 7889.
Astronomy and Meteorology.
332 1257 5227.
Astro-physical.
1179 1353 2321 4911.
Magnetic.
175.
Magnetic and Meteorology.
73 87 347 597 755 853 6597 7083 7203 7327 7328*a* 7495 7505.
Meteorology.
25 69 70 253 269 270 303 325 349 581 603 665 689 724 769 819 959 1031 1257 1879 2217 2393 2635 2791 2795 2811 2833 2897 2899 4736 4857 5910 6089 6203 6533 6763 7129 7167 7179 7187 7190 7203 7247 7307 7549 7555 7557 7619 7627 7694 7907.
Naval (Nautical).
447 1188 4305 7127 7239 7623.
Physical.
349 3427 6591 7479 7716.

Selenographic.
4547*a*.

Tellurian.
7765.

Unclassified.
86 128 158 582*a* 1248 1620 2408 2952 2982 5268 5794 7316.

XI.—Societies.

Aborigines Protection.
5353.

Acclimatation. (See also Agriculture, Naturalists, Zoology.)
81 815 921 967*h* 2677 3073 3121 3191 6571 7289.

Æronautic.
2439 2445 2725 3195 5357.

African.
1277 1497 3071 3159 6505.

Against Abuse of Tobacco.
2706.

Agriculture. (See also Chemical, Agriculture, Horticulture, Industry, and Science.)
13 27 334 395 779 983 1079 1101 1117 1151 1171 1177 1241 1255 1355 1551 1743 1943 1987 1997 2049 2069 2111 2173 2181 2209 2287 2307 2349 2383 2421 2679 2761 2887 2939 2967 3033 3039 3047 3185 3376*a* 3379 3733 3799 3819 3841 3845 3865 4215 4217 4249 4349 4365 4399 4483 4515 4555 4613 4705 4763 4831 4851 4905 4913 4961 5057 5124 5289 5657 6003 6057 6135 6309 6321 6453 6457 6757 7238 7267 7527 7819.

Agriculture and Arts.
2983.

Agriculture and Botany.
1597 1703.

Agriculture and Commerce.
2009.

Agriculture and Forestry.
5087.

Agriculture and Geography.
1063.

Agriculture and Horticulture.
637 1469 1693 2131 2275 2276 6913 7881.

Agriculture, Archæology, and Natural History.
2893.

Agriculture, Commerce, and Industry.
2103 4951 6553.

Agriculture, Horticulture, and Acclimation.
2409.

Agriculture, Industry, and Arts.
2003 2317.

Agriculture, Industry, Science, Arts, and Belles-Lettres.
2879.

Agriculture, Natural History, and Geography.
1001.

Agriculture, Natural History, and Useful Arts.
2239.

Agriculture, Science, and Arts.
1793 1831 1977 2099 2165 2199 2207 2787 2805 2971 2995 4983.

Agriculture, Science, Arts, and Belles-Lettres.
1889 1979 2121 2431 2797 2835 2953 2961.

Agriculture, Science, Arts, and Commerce.
1833 2029 2175.

Agriculture, Science, and Literature.
2793.

Alpine.
1240 1249 1251 1382 3143 3815 3919 4597 6979 7749.

Americans.
2681.

Anatomo-Pathology.
1541.

Anatomy.
2683.

Anthropology. (See also Natural Science.)
357 1285 1543 2241 2685 4157 4277 4693 4880*d* 4991 5319 7609.

Anthropology and Geography.
7683.

Anthropology, Ethnology, and Comparative Psychology.
6365.

Anthropology, Ethnology, and Primitive History.
3091 3767 4835 4991.

Antiquarian. (See also German Language, History, Natural History, and Numismatics.)
977 1749 1813 1989 2011 2324 2759 2799 2901 3981 5173 5713 5827 7031 7635 7663 7691 7857 7860.

Apothecaries.
1279 1783 3043 3083 4235 4403 4927 4941 5715 7869.

Aquarium.
3085 5745 5939.

Arboriculture. (See Pomology.)

Archæology. (See also Agriculture, Architecture, Arts, Horticulture, Languages, Naturalists' Field Club, Natural Sciences, Paleontology, Science.)
21 981 1283 1447 1586 1621 1659 1673 1679 1683 1699 1871 1875 1945 2014 2043 2072 2076 2325 2347 2381 2397 2813 2815 2829 2915 2919 2941 2955 2957 3079 3755 4093 4391 4397 4535 4549 4757 4793 5041 5315 5399 5573 5659 5717 5725 5741 5797 5841 6013 6041 6167 6181 6243 6259 7015 7139 7194 7281 7301 7393.

Bee Culture and Entomology.
2693.

Belles-Lettres. (See Agriculture, Sciences, and Belles-Lettres.)

Benevolence.
1421 4493 4497 4700 6538 7471 7553.

Bibliophilist.
1663 1951 2401 2853.

Bibliography.
1949.

Biology.
2689 5898 6029.

Blind.
1435 2999 3301 3809 4097 4117 4511 4557 7023 7419 7815.

Booksellers.
3677 4585 4691 7464 7681.

Botany. (See also Agriculture, Horticulture, Zoology.)
105 223 1567 1711 1855 2243 2691 3111 3145 3758 4291 4575 4727 4798 4929 4953 5665 6113 6455 6815 6887 6918.

Botany and Zoology.
1371 3870 3927.

Brick and Lime.
3719.

Charts.
7865.

Chemical Agriculture.
5997 6575 6761.

Chemical Industry.
5817*b*.

Chemicals and Drugs.
5979.

Chemico-Physics.
1289.

Chemistry.
1189 2703 3147 5337 5421 6021 7463.

Chirurgy. (See also Natural Science, Medicine.)
2705 3153 3217.

Choral, Dramatic and Literature.
1459.

Civil Engineers. (See also Mineralogy.)
116*b* 2741 5531 6037.

Civil and Mechanical Engineers.
5429.

Climatology, Physical and Natural Sciences.
15.

Colonization.
3183 3995 4051 5068 5671 6806.

Commerce. (See also Agriculture, Arts, Industry, Internal Commerce, Literature.)
2451 3179 5369 5405 5519.

Commerce and Manufactures.
2861.

Commerce and Trade.
4885.

Commercial Geography.
1955 2155 2402 2733 3127 5048.

Comparative Geography.
7156.

Comparative Psychology. (See also Anthropology.)

Competition.
1787 1905 1911 1979 2023 2066 2117 2149 2210 2213 2329 2365 2843 2861 2873.

Conchology.
5297.

Conversation. (See Lectures.)

Cremation.
3695.

Criminal Psychiatry. (See Psychiatry.)

Criticism. (See Science.)

Cruelty to Animals. (See Protection.)

Crystallogy.
5446.

Deaf and Dumb.
2697 4017 4119 4685 4753 4755 4827 5237 6039 6071 6381 6921 7321 7411.

Debate. (See Literature.)

Dentistry.
3103 4591.

Drugs. (See Chemicals.)

Economico-Patriotic.
4401.

Economy. (See also Political, Popular, Natural Sciences.)
256*a* 351 508 573 771 1445 3993 7177 7217 7313 7415 7503 7559 7629 7747.

Education. (See also Social Education.)
345 721*s* 2247 2784 3089 3221 4699 6230 7157.

Electricians.
877 1444 1557.

Electrotechnics.
3197.

Engineers. (See also Telegraph and Railroad Engineers.)
263 426 1611 3685 5339 5729.

Engineers and Architects.
1385 1425 3975 4331 4677 6977.

Literature and History,
157 1591 1691.
Literature and Philosophical.
157*a* 5129 5281 5301 5311 5331 5805 5833 5851 5931 5937 5971.
Literature and Science.
147 327 1687 1801 5211 5391.
Literature, Science, and Arts.
1841 2021.
Literature, Science, Commerce, and Industry.
1653.
Malacology.
1561 2886 4049 6366 6605.
Manufactory. (See also Arts, Commerce, Engineering, Industries.)
Mathematics.
3387 5585 7227 7283.
Mathematics and Natural History.
5066.
Mechanical Drawing.
2249.
Mechanical Engineers. (See also Mineralogy.)
5529.
Mechanics. (See also Civil Engineers.)
3847 5587 5853.
Mechanics and Optics.
3155.
Medicine. (See also Natural History, Natural Science, Practical Medicine.)
265 278 311 315 329 369 374 493 561 735 751 903 1141 1211 1443 1461 1547 1595 1596 1633 1745 1865 1963 2017 2039 2127 2171 2193 2263 2269 2295 2387 2747 2749 2803 2823 2863 2883 3095 3117 3235 3701 3751 3961 4619 4783 5403 5509 5521 5597 6247 6706 7003 7145 7319 7497 7529 7807 7813 7915.
Medicine and Natural Sciences.
513 1575 4137 4357 4415 4899.
Medicine, Chirurgy, and Pharmacy.
2947.
Medical Chirurgy.
277 1489 1635 1965 1967 2297 3393 5594 5685 6139 6311 6479.
Medical Legal.
2751.
Medical Pedagogy.
3397.
Medical Pharmacy.
266 271 1903 2133 2185 2205.
Medical Physics.
651 4033 4063 5099 7255.

Naturalists.
1005 1233 1585*c* 4013 4069 4107 4151 4251 4623 4765 5115 5165 5207 5266*d* 5307 5845 6483 6980 7169 7223 7229 7235 7259 7315 7339 7469 7674*e* 7705 7715 7745 7773 7805 7828 7853 7867.

Naturalist and Acclimatation.
970.

Natural and Economic Sciences.
6573.

Naturalists' Field Club.
141 879 5168 5223 5259 5277 5343 5800 5807 5823 5825 5839 5911 5965 5980 5995 6100.

Natural History. (See also Agriculture, Anthropology, History, Horticulture, Physics.)
83 127 179 211 319 491 515 614 753 802 865 893 990 1047 1593 1763 2037 2403 2945 3019 3027 3049 3059 3223 3737 3863 3901 4125 4231 4355 4493 4531 4781 4879 4893 5035 5111 5127 5155 5205 5247 5835 5899 5913 5955 5965 5977 5985 6025 6093 6195 6391 6465 6823 6861 7028 7207 7211 7613 7841.

Natural History and Antiquarian.
5287 5893 6101 6205 7317 7341.

Natural History and Ethnology.
721.

Natural History and Language.
1737.

Natural History and Medicine.
1103.

Natural History and Microscopy.
5141.

Natural History and Philosophy.
6001.

Natural and Medical Sciences.
743 2991 3741 3929 6795.

Naturalists and Physicians.
3005.

Natural Sciences. (See also Geology and History, Legal Medicine, Mathematics, Pharmacy, Physical and Natural Sciences.)
1023 1087 1095 1213 1229 1267 1377 1433 1629 1917 2033 2059 2113 2148 2419 2825 2851 3739 3779 3801 3851 3867 3965 3983 4007 4086 4103 4131 4223 4251 4253 4303 4329 4357 4467 4509 4579 4721 4729 4743 4745 4883 4891 4907 4932 4935 5063 5085 5113 5217 6211 6555 6607 6779 6861 6926 7189 7705 7721 7761 7769 7771 7823 7833 7843 7847 7851 7853 7867.

Nautical Engineers. (See Hydrometric Engineers.)

Naval.
7065.

Promotion of Studies.
2709 2717 2719 5723 5725.

Protection of Animals.
1439 1573 2773 3025 3675 3766 3917 4043 4239 4311 5047 7561.

Protection of Patents.
3189.

Psychiatry.
3704 7476.

Psychiatry and Forensic Psychology.
1431.

Public Analysts.
5731.

Public Health.
737 2183 2723 3157 3743 4319 4363 4735 6463.

Public Instruction.
1867.

Public Library. (See Propagation of 2729.)

Public Welfare.
3129 4700 6273 6943 7047 7707 7753 7797.

Publishing.
5379.

Railroad.
3683 4057.

Railroad Engineering.
3693.

Record.
5624.

Science. (See Humanitarian, Literature, Industry, Letters, Geology, Horticulture, Art, Anthropology, Agriculture, Physiology.)
46 91 131 222 307 309 363 365 389 449 474 536 546 548 805 827 845 847 857 905 1197 1441 1443 1463 1577 1579 1584 1594 1639 1644 1649 1739 1827 1869 1881 1975 1995 2077 2079 2143 2253 2363 2389 2395 2469 2472 2729 3717 3729 4089 4099 4123 4153 4173 4297 4317 4475 4603 4611 4771 4865 4869 4901 4931 5143 5243 5383 5389 5401 5695 5707*a* 5795 5813 6061 6159 6182 6277 6315 6539 6617 6695 6767 6785 6821 6858 6869 6915 6962 7007 7073 7183 7199 7208 7441 7687 7759 7909.

Science and Archæology.
2105.

Science and Arts. (See Arts and Sciences.)

Sciences, Arts, Agriculture, and Horticulture.
2163.

Sciences, Arts, Belles-lettres, Agriculture, and Industries.
2903.

Sciences, Arts, and Literature.
5257 6285.

Teachers.
1553 3225 7757.

Technology.
7345 7399 7409.

Telegraph Engineers.
5733.

Temperance.
2728.

Theology (including Missionary Societies and Missions).
2225 2739 3433 4105 4169 4275 5398 5589 5717 5723 5727 6011 6257 6265 6418 6839 6882 7053 7067 7351 7911.

Therapeutics.
2777.

Topography. (See History, Anthropology.)
1367 2763 2779 6339 7811.

Tourist.
1249 1251 1382 2503 3143 3919 4079 4597 4797*c* 6717 6979 7544*c*.

Translation of Japanese.
731.

Typography.
2781.

Useful Knowledge.
5795 6805

Useful Research.
5051 6765 7045.

Vegetarian.
3173 5819.

Veterinary.
2093 4984.

Veterinary Surgeons.
3703 4749 5045.

Wine.
870.

Wine Culture.
4997.

Zoology. (See Botany.)
397 1471 2187 2783 3171 4061 4322 5789 6069 6541 6779 6799 6889 6909 6925.

Zoology and Acclimatation.
911.

Zoology and Botany.
1371 6849.

Zoology and Mineralogy.
4933.

XII.—SURVEYS.

Archæology.
679.

Art and Historic Monuments.
1309.
Coast and Geographic Survey.
6967.
Ethnology.
1497.
Geography.
294.
Geology. (See also Geology and Natural History.)
31 217 461 643 717 829 883 925 949 961 971 1094 3313 4605 4977 5497 6035 6133 6969 7195 7651.
Geology and Natural History. (See also Natural History.)
143.
Land Improvement.
3376.
Meteorology and Trigonometry. (See also Trigonometry.)
714.
Natural History.
1193.
Scientific.
4507 6116 7029 7323.
Topography.
3321 4829 7477 7725.
Trigonometry.
671 5935.

XIII.—UNIVERSITIES.

22 38 99 100 107 112 125 161 191 209 237 241 249 323 326 353 401 410 413 495 517 530 551 563*b* 575 583 662 708*aa* 739 768 811 831 909 933 995 1025 1061 1081 1105 1129 1143 1159 1201 1205 1369 1505 1603 1641 1651 1777 2067 2083 2271 2361 2509*a* 3307 3749 3829 4037 4111 4141 4197 4225 4247 4375 4427 4519 4561 4687 4747 4847 4943 4975 5055 5105 5201 5777 5867 6027 6097 6106 6171 6173 6187 6215 6216 6216*a* 6216*c* 6249 6313 6387 6477 6537 6551 6585 6593 6609 6688*d* 6703 6749 6813 6863 6903 6941 6950 6983 7085 7175 7201 7215 7225 7233 7257 7405 7521 7565 7617 7632 7641 7685 7717 7767 7879.

COLLEGES AND SCHOOLS.

Anatomy.
6307.
Agriculture.
101 287 708*b* 721*n* 922 1090 1323 1604 1753 2336 2428 3014 3333 4010 4122 4177 4389 4917 5068 5238 6316*a* 6449 6613 6707 6949 7570 7659.

Agriculture and Forestry.
7297 7328.
Agriculture and Veterinary.
326*d* 374*c* 412.
Architecture.
2535 3291.
Artillery Schools. (See Military Schools.)
Art.
800.
Arts and Manufactures.
2519.
Civil Engineering.
697 2533 6687 6739.
Commerce.
1011 1071 1263 1437 3022 3853 3969 4625 6384 7271 7658.
Designs and Mathematics.
2523.
Divinity.
6257 7887.
Education.
239 2429 6351.
Engineering.
291 539 739 1853 2533 5213 5947 7385 7569.
Engineering and Architects.
6417.
Fine Arts.
2281 5855 6511.
Forestry.
2375 3041 4849 4867 7467.
Gymnasium.
1027 1075 1181 1247 1347 3035 3904 3997 4325 4364*c* 4461 4681 4741 4861 4897 4921 4957 5093.
High School.
1237 1239 2525 6335 6603 7827.
Industry.
997 1360.
Industry and Mines.
1660.
Law.
739.
Literature.
739.
Medicine.
289 541 565 640 688 739 1211 2185 2230 2333 2379 2391 2521 2931*a* 6183 6267.

Medicine and Pharmacy.

2282 2377 2391.

Medico Chirurgery.

673 3389 3391 6373 6521 6709 7107 7151 7381 7523.

Military Engineering Schools. (See Military Schools.)

Mines.

288 431 540 1165 1617 2527 3318 5692 5973 7365.

Military (including Artillery, Engineer, and Staff Schools).

108 469 539 1313 1365 2124 2475 2517 2518 2537 2875 3325 3373 3661 5265 5981 5983 6337 6339 6743 6745 6827 7105 7383 7385 7387 7417 7451 7485.

National Economy.

4257.

Natural Sciences.

246.

Naval Schools.

1065 1263 3805 4015 4214 4228 5269 6383 6385 6396 7109 7435.

Normal.

119.

Oriental Languages.

1349 2529.

Pharmacy.

2185 2230 2339, 2538.

Political Economy.

4257.

Political Sciences.

2526.

Polytechnic.

1053 1203 1207 1363 1767 2531 3007 3371 3776 3846 3859 3883 4351 4451 4813 5023 6179 6255 6316 6383 6445 6487 6527 6567 6753 6759 6829 7111 7409 7662 7674.

Preparatory.

293.

Real.

1029 1091 1183 1357 4679 4897 4909 4955.

Sanscrit.

609.

Science. (See also Universities.)

7 45 63 67 135 183 189 191 201 225 243 257 267 386 459 465 495 583 621 657 675 690 695 708*a* 739 745 807 894 975 1119 1153 1173 1185 1243 1933 2505 3030 4770 5145 5185 5197 5209 5243 5251 5305 5501 5692 5777 5803 5817 5829 5861 5863 5871 5925 5929 5967 6001 6005 6015 6019 6049 6079 6083 6085 6106 6179 6263 6285 6315 6425 6441 6653 6672 6767 6773 7913.

Staff Schools. (See Military Schools.)

Theology.

186 324 582.

Theology and Philosophy.

4856.

Veterinary Medicine.

1753 6451 6535 6741 6939 7231.

XIV.—Establishments receiving the Smithsonian Annual Reports.

Africa.

1 3 5 9 11 13 15 17 19 21 25 27 35 39 41 43 45 49 51 53 55 57 61 65 67 69 71 73 75 77 79 81 87 89.

British America.

95 101 109 111 116*b* 117 119 123 125 127 129 133 139 143 145 147 148*a* 151 155 157 161 163 165 173 175 177 191 197 199 209 211 217 222*a* 225 227 231 233 235.

Central America.

249 251.

Mexico.

261 265 267 271 275 277 278 285 287 289 291 293 295 297 303 306 307 309 311 315 317 319 321 327 329 331.

West Indies.

333 335 337 339 343 347 349 351 353 357 359 360 360*a* 363 365 367.

South America.

369 371 375 385 389 391 393 395 397 399 401 403 405 407 413 417 421 423 425 435 439 445 447 449 451 463 465 467 469 471 473 474 477 483 485 487 489 491 493 495 501 503 515 517 523 525 529 537 545 549 551 553 557 559 561 563 565 567 573.

Asia.

579 583 593 597 599 603 607 609 613 615 619 621 623 627 629 630 631 633 635 637 639 641 642*b* 643 647 649 653 655 660 661 663 665 667 669 671 673 675 677 681 683 685 688 689 690*b* 693 697 703 705 709 713 715 721 727 729 739 745 749 751 753 755 757 761 765 767 769 771 773 775 777.

Australasia.

779 781 783 784 785 787 789 791 795 797 799 800 801 805 811 813 815 817 819 821 831 835 837 839 841 843 844 845 847 849 853 857 859 861 863 867 869 871 873 875 877 881 882 885 889 891 893 897 899 903 905 909 911 913 915 917 921 923 925 927 929 931 935 941 942 943 945 947 949 951 953 955 959 961 963 965 966 967 968 969 970.

Austria-Hungary.

977 979 983 985 987 989 991 993 995 997 999 1001 1003 1005 1007 1009 1011 1013 1015 1017 1023 1025 1027 1029 1031 1033 1039 1041 1043 1061 1063 1065 1069 1071 1073 1075 1077 1079 1081 1083 1087 1089 1091 1093 1094*c* 1094*d* 1095 1097 1099 1101 1103 1105 1109 1111 1115 1117 1119 1121 1125 1131 1131*b* 1135 1139 1141 1143 1145 1147 1149 1151 1155 1157 1161 1163 1165 1169 1171 1175 1177 1179 1181 1183 1185 1187 1189 1191 1193 1195 1197 1199 1205 1209 1211 1213 1217 1219 1221 1223 1225 1227 1229 1231 1235 1237 1239 1241 1243 1247 1249 1251 1255 1259 1263 1265 1267 1271 1273 1275 1279 1281 1285 1297 1298 1299 1301 1307 1311 1315 1317 1319 1321 1325 1327 1329 1333 1339 1341 1343 1345 1347 1351 1355 1357 1359 1361 1369 1371 1375 1379 1383 1385 1389 1391 1395 1407 1411 1415 1423 1433 1435 1439 1441 1445.

Belgium.

1447 1449 1453 1455 1457 1461 1467 1469 1471 1473 1475 1477 1479 1483 1487 1489 1491 1493 1495 1501 1503 1505 1509 1511 1513 1517 1519 1521 1523 1527 1533 1535 1537 1539 1545 1547 1549 1551 1553 1559 1561 1563 1565 1567 1569 1571 1573 1575 1577 1581 1583 1585 1587 1589 1591 1593 1595 1597 1599 1601 1603 1605 1607 1609 1611 1613 1615 1619 1621 1623 1625 1627 1629 1631 1635 1637 1639 1641 1643 1647 1651 1653 1657 1659 1661 1663 1665 1667 1669 1671 1673 1675 1677 1679 1681 1683 1685 1687 1689 1691 1695 1697 1701 1703 1705 1707.

Denmark.

1711 1715 1719 1723 1727 1735 1737 1739 1741 1743 1745 1747 1749 1751 1753 1763 1767 1769 1771 1773 1775 1777 1779 1781 1783.

France.

1787 1793 1795 1799 1801 1809 1811 1813 1815 1817 1819 1821 1823 1825 1827 1829 1831 1833 1835 1837 1841 1843 1845 1847 1851 1857 1859 1861 1863 1865 1869 1871 1873 1875 1877 1879 1881 1883 1885 1891 1893 1899 1905 1907 1909 1911 1915 1917 1919 1921 1923 1925 1927 1929 1931 1935 1937 1939 1941 1943 1945 1947 1951 1955 1957 1959 1961 1965 1969 1973 1975 1977 1979 1983 1985 1987 1991 1995 1997 1999 2003 2005 2009 2011 2013 2015 2017 2021 2023 2025 2027 2029 2031 2033 2035 2039 2041 2043 2045 2047 2049 2051 2053 2055 2057 2059 2061 2063 2065 2069 2071 2072 2073 2075 2077 2079 2080 2081 2085 2089 2091 2093 2097 2099 2101 2103 2105 2109 2115 2117 2121 2124 2125 2127 2129 2131 2133 2135 2137 2141 2143 2149 2150 2153 2157

2159 2161 2163 2165 2167 2171 2175 2177 2179 2189 2193 2197 2199 2201 2203 2205 2207 2209 2211 2215 2221 2223 2229 2233 2235 2237 2239 2243 2249 2255 2259 2261 2263 2265 2267 2269 2273 2277 2279 2281 2285 2287 2291 2293 2295 2297 2299 2301 2305 2307 2309 2311 2313 2315 2317 2319 2321 2323 2325 2327 2329 2331 2333 2335 2341 2343 2347 2353 2355 2357 2359 2365 2367 2369 2371 2377 2383 2387 2389 2395 2397 2399 2401 2402 2405 2407 2409 2411 2415 2417 2419 2421 2423 2425 2427 2429 2431 2433 2435 2443 2453 2455 2457 2459 2461 2463 2465 2465*e* 2466 2469 2471 2473 2475 2477 2479 2481 2493 2494 2499 2502*b* 2503 2505 2507 2513 2517 2519 2527 2529 2531 2533 2535 2537 2539 2541 2543 2545 2547 2549 2549*c* 2551 2553 2559 2561 2563 2569 2575 2577 2579 2585 2589 2592*b* 2599 2605 2609 2611 2615 2617 2619 2621 2624 2624*a* 2626 2627 2633 2635 2636*c* 2643 2655 2659 5665 2671 2677 2679 2681 2683 2685 2687 2689 2691 2693 2695 2697 2699 2701 2703 2705 2707 2709 2711 2713 2717 2719 2721 2723 2725 2727 2729 2731 2735 2737 2739 2741 2743 2745 2747 2749 2751 2755 2757 2758 2759 2761 2765 2769 2771 2773 2775 2777 2783 2785 2787 2789 2793 2797 2799 2801 2803 2805 2809 2815 2817 2819 2821 2823 2825 2829 2831 2835 2837 2839 2841 2843 2845 2847 2849 2851 2855 2857 2859 2861 2863 2865 2867 2869 2871 2873 2875 2877 2879 2881 2883 2885 2889 2891 2893 2895 2901 2903 2905 2907 2909 2911 2913 2915 2917 2919 2921 2923 2925 2927 2929 2931 2932 2933 2937 2939 2941 2945 2947 2949 2953 2955 2961 2967 2969 2971 2975 2977 2979 2983 2987 2989 2991 2993 2995 2997.

Germany.

3001 3003 3005 3007 3009 3015 3019 3021 3023 3025 3027 3029 3035 3039 3045 3047 3049 3051 3053 3055 3059 3063 3065 3069 3071 3075 3081 3085 3091 3093 3095 3111 3123 3129 3133 3147 3149 3151 3165 3167 3171 3175 3177 3195 3206 3213 3221 3223 3243 3245 3257 3273 3291 3295 3299 3301 3307 3309 3311 3313 3323 3325 3327 3333 3337 3343 3345 3347 3353 3361 3365 3367 3371 3373 3383 3421 3423 3431 3433 3457 3459 3523 3540 3558 3567 3571 3583 3585 3589 3593 3611 3623 3631 3639 3645 3665 3667 3675 3683 3685 3693 3697 3705 3707 3711 3719 3721 3723 3727 3733 3737 3741 3745 3749 3753 3755 3757 3759 3771 3775 3777 3779 3783 3787 3789 3791 3793 3795 3797 3799 3801 3803 3805 3807 3809 3817 3819 3823 3825 3827 3829 3831 3837 3839 3841 3845 3847 3849 3851 3853 3855 3857 3859 3861 3863 3865 3867 3869 3873 3875 3877 3881 3883 3887 3891 3893 3899 3901 3905 3909 3920 3921 3925 3929 3933 3935 3937 3939 3945 3949 3951 3955 3959 3961 3963 3965 3969 3971 3972 3975 3977 3981 3983 3991 3999 4005 4007 4009 4011 4013 4015 4017 4019 4025 4027 4029 4031 4033 4037 4047 4049 4053 4055 4061 4069 4071

4075 4081 4083 4085 4095 4097 4107 4111 4115 4117 4119 4125
4127 4131 4137 4139 4141 4143 4147 4149 4151 4153 4155 4157
4171 4173 4175 4197 4201 4203 4205 4207 4209 4211 4213 4215
4217 4221 4225 4231 4233 4235 4237 4243 4245 4247 4249 4251
4253 4255 4263 4269 4273 4277 4281 4283 4289 4293 4297 4303
4305 4307 4309 4311 4313 4317 4327 4329 4331 4335 4339 4341
4343 4345 4347 4351 4355 4365 4367 4369 4375 4385 4389 4391
4399 4401 4403 4413 4417 4419 4421 4423 4425 4427 4429 4441
4443 4445 4451 4453 4455 4459 4461 4463 4465 4467 4471 4480
4485 4489 4491 4493 4494 4495 4501 4505 4507 4509 4511 4513
4515 4517 4519 4521 4527 4529 4531 4537 4545 4551 4553 4555
4557 4561 4563 4569 4571 4575 4577 4579 4581 4583 4584 4587
4589 4591 4601 4603 4605 4609 4611 4613 4615 4619 4621 4623
4625 4627 4629 4631 4635 4637 4647 4653 4657 4665 4675 4679
4681 4683 4685 4693 4695 4697 4699 4700 4701 4703 4705 4709
4713 4715 4717 4721 4723 4725 4727 4729 4737 4739 4741 4743
4745 4747 4755 4757 4769 4771 4775 4779 4781 4783 4785 4789
4795 4799 4801 4803 4805 4807 4811 4813 4815 4817 4819 4821
4825 4831 4833 4835 4837 4841 4845 4847 4849 4851 4855 4857
4859 4861 4863 4865 4869 4871 4873 4875 4877 4879 4881 4883
4885 4887 4889 4891 4893 4895 4897 4899 4905 4907 4909 4911
4913 4914 4921 4923 4925 4927 4929 4932 4935 4937 4939 4941
4943 4945 4947 4949 4951 4955 4957 4961 4963 4965 4967 4969
4973 4975 4979 4981 4983 4985 4989 4991 4993 4995 4997 4999
5001 5003 5005 5011 5021 5023 5025 5033 5035 5037 5041 5043
5049 5051 5055 5057 5060 5063 5065 5067 5069 5071 5073 5075
5077 5079 5081 5083 5085 5087 5089 5091 5093 5095 5097 5099
5101 5105 5109 5111 5012 5113

Great Britain.

599 643 857 5115 5117 5119 5121 5123 5125 5127 5131 5133 5137 5139
5141 5143 5145 5147 5149 5151 5155 5157 5159 5161 5163 5165
5167 5168 5169 5170 5173 5175 5177 5179 5181 5183 5185 5187
5190 5193 5195 5197 5199 5201 5203 5205 5213 5215 5217 5219
5221 5225 5227 5229 5233 5235 5237 5239 5245 5247 5251 5253
5255 5259 5261 5263 5265 5266*d* 5269 5271 5273 5275 5277 5279
5281 5283 5285 5291 5297 5299 5301 5303 5305 5307 5309 5311
5313 5315 5317 5321 5323 5325 5327 5329 5331 5333 5337 5339
5341 5343 5345 5347 5349 5351 5353 5355 5357 5359 5361 5363
5365 5367 5369 5371 5373 5375 5377 5379 5381 5383 5387 5389
5391 5393 5395 5397 5399 5401 5403 5405 5407 5411 5413 5419
5421 5423 5427 5429 5431 5433 5435 5437 5439 5445 5449 5451
5453 5455 5461 5463 5465 5467 5469 5475 5477 5479 5481 5483
5485 5487 5491 5493 5495 5497 5499 5501 5503 5505 5506 5507
5509 5511 5512 5515 5519 5521 5523 5525 5527 5529 5531 5533
5537 5539 5541 5547 5549 5551 5553 5555 5557 5559 5561 5563

5565 5567 5569 5571 5573 5575 5577 5579 5581 5583 5585 5587
5589 5591 5597 5600 5601 5603 5607 5609 5611 5613 5615 5617
5619 5621 5623 5624 5625 5627 5629 5631 5633 5635 5637 5639
5641 5643 5645 5647 5649 5651 5653 5655 5657 5659 5661 5663
5665 5667 5669 5671 5673 5675 5677 5679 5681 5683 5685 5687
5689 5691 5693 5695 5697 5699 5701 5703 5705 5707 5707*b* 5713
5715 5717 5721 5723 5725 5727 5729 5731 5733 5737 5739 5741
5743 5745 5747 5749 5751 5755 5757 5759 5761 5767 5769 5771
5775 5777 5781 5781*a* 5785 5789 5791 5793 5795 5797 5799 5801
5802 5803 5805 5807 5811 5813 5815 5817 5821 5823 5825 5827
5829 5831 5833 5835 5837 5838 5839 5840*a* 5841 5843 5845 5847
5849 5853 5855 5857 5865 5867 5871 5873 5879 5881 5885 5887
5889 5893 5895 5897 5899 5901 5903 5907 5910 5911 5913 5915
5919 5921 5923 5925 5929 5931 5933 5935 5937 5939 5941 5943
5945 5947 5951 5953 5955 5957 5959 5961 5963 5965 5967 5969
5971 5975 5977 5981 5983 5985 5985*a* 5987 5989 5991 5993 5995
5997 5999 6001 6003 6005 6007 6015 6019 6021 6025 6035 6037
6039 6048 6049 6051 6053 6055 6057 6061 6065 6067 6071 6073
6075 6079 6081 6083 6085 6089 6091 6093 6095 6097 6099 6100*h*
6101 6103 6105 6106 6111 6115 6119 6125 6127 6131 6133 6135
6139 6141 6143 6145 6147 6149 6151 6153 6155 6157 6159 6161
6165 6167 6169 6171 6179 6181 6182*d* 6183 6185 6187 6189 6191
6193 6195 6197 6199 6203 6205 6207 6209 6211 6215 6219 6221.

Greece.

6227 6229 6231 6235 6239 6241 6243 6245 6247 6249.

Iceland.

6253 6255 6256 6257 6259 6261 6265 6267 6269 6275 6277 6279.

Italy.

6281 6283 6285 6287 6289 6291 6293 6295 6299 6301 6302 6307 6309
6311 6313 6315 6316 6316*c* 6319 6321 6325 6327 6329 6331 6335
6337 6341 6343 6347 6349 6351 6353 6355 6357 6363 6365 6367
6371 6373 6375 6377 6379 6381 6383 6385 6387 6389 6391 6393
6395 6396 6397 6399 6403 6405 6407 6413 6415 6417 6423 6427
6429 6431 6433 6437 6439 6441 6443 6445 6447 6449 6451 6453
6461 6463 6465 6467 6469 6470 6471 6473 6475 6477 6479 6483
6487 6489 6491 6493 6495 6501 6503 6507 6511 6515 6517 6519
6521 6523 6525 6527 6529 6531 6533 6535 6537 6537*c* 6539 6541
6543 6547 6549 6551 6553 6555 6557 6559 6560*c* 6563 6565 6567
6571 6573 6575 6579 6581 6583 6585 6589 6593 6595 6597 6599
6603 6605 6607 6609 6611 6615 6617 6621 6623 6625 6627 6629
6631 6633 6635 6637 6639 6643 6645 6649 6651 6653 6655 6657
6659 6661 6663 6665 6667 6671 6673 6675 6677 6679 6681 6683
6685 6687 6688 6691 6693 6695 6697 6698 6699 6701 6703 6705

6707 6709 6711 6713 6715 6719 6721 6725 6727 6729 6731 6733 6735 6737 6739 6741 6742 6743 6745 6747 6749 6753 6757 6759 6761 6763 6767 6771 6773 6775 6777 6779 6881 6783 6787 6789.

Netherlands.

6791 6794 6795 6797 6799 6803 6805 6807 6808 6809 6811 6813 6817 6821 6823 6825 6827 6829 6831 6835 6839 6843 6845 6847 6849 6855 6857 6859 6861 6863 6865 6867 6869 6871 6873 6875 6877 6879 6881 6883 6887 6889 6891 6893 6895 6897 6899 6901 6903 6905 6913 6915 6917 6919 6921 6927 6929 6931 6933 6935 6937 6939 6941 6943 6945 6947.

Norway.

6951 6953 6959 6961 6963 6965 6967 6969 6971 6973 6975 6977 6979 6981 6983 6985 7003 7005 7009 7011 7015 7019 7021 7023 7025 7027 7029 7031 7037 7039 7041 7047 7049 7051 7053 7055 7057 7059 7061 7063 7065 7067 7069 7073 7077.

Portugal.

7079 7081 7083 7085 7087 7089 7091 7093 7095 7101 7103 7105 7107 7109 7111 7113 7115 7117 7119 7121 7123 7125 7127 7129 7131 7135 7137 7141 7143 7145 7147 7149 7151 7153 7155 7157.

Roumania.

7164*c*.

Russia.

7167 7169 7171 7173 7175 7177 7179 7181 7183 7185 7187 7194*c* 7195 7197 7199 7201 7203 7205 7207 7209 7211 7213 7215 7217 7221 7223 7225 7229 7231 7233 7235 7237 7239 7241 7243 7245 7249 7251 7253 7255 7257 7259 7261 7263 7265 7267 7269 7271 7273 7279 7281 7283 7287 7289 7291 7293 7295 7297 7299 7301 7303 7305 7307 7309 7313 7321 7323 7325 7329 7331 7333 7335 7337 7339 7341 7343 7345 7347 7349 7350 7353 7357 7359 7361 7363 7365 7367 7371 7373 7375 7377 7379 7381 7383 7385 7389 7391 7393 7395 7397 7399 7403 7405 7407 7409 7411 7415 7417 7419 7421 7423 7425 7429 7431 7435 7437 7439 7441 7443 7445 7447 7449 7751 7453 7455 7457 7461 7463 7469 7471 7473 7475 7477 7479 7481 7483 7485 7487 7495 7497 7499 7501 7503 7505 7507 7511 7513 7515 7517 7519 7521 7523 7225 7529 7531 7533 7537.

Servia.

5743.

Spain.

7545 7547 7551 7559 7561 7563 7565 7567 7569 7573 7582 7583 7585 7587 7591 7593 7595 7597 7599 7601 7603 7605 7609 7611 7613 7615 7617 7623 7625 7629.

Sweden.

7633 7639 7641 7643 7643*a* 7644 7645 7651 7655 7657 7659 7661 7663 7665 7667 7672 7673 7675 7677 7679 7685 7687 7689 7691 7694.

Switzerland.

7699 7703 7705 7706 7707 7709 7711 7715 7717 7721 7723 7729 7731 7733 7735 7737 7739 7741 7743 7745 7747 7749 7751 7753 7755 7757 7759 7761 7763 7767 7769 7771 7773 7775 7777 7779 7781 7783 7785 7789 7791 7793 7794 7795 7797 7799 7801 7803 7805 7807 7809 7811 7813 7815 7717 7819 7821 7823 7823*a* 7825 7827 7831 7833 7837 7839 7841 7843 7847 7849 7851 7853 7857 7859 7861 7863 7865 7867 7869 7871 7873 7875 7879 7881 7885.

Turkey.

7891 7893 7897 7899 7901 7903 7905 7907 7909 7911 7913 7915 7917 7919 7921.

XV.—ESTABLISHMENTS RECEIVING THE SMITHSONIAN MISCELLANEOUS COLLECTIONS AND ANNUAL REPORTS.

35 43 53 65 67 125 143 145 161 165 191 199 209 249 251 285 291 317 319 351 363 385 417 423 471 495 503 545 573 599 613 629 639 643 669 685 697 727 739 749 753 771 805 811 857 897 909 963 966 1005 1009 1023 1025 1041 1061 1081 1095 1099 1143 1185 1197 1199 1205 1217 1273 1275 1299 1315 1317 1325 1327 1345 1359 1369 1371 1493 1503 1537 1539 1559 1603 1639 1651 1665 1719 1739 1749 1821 1923 1961 1999 2011 2015 2029 2057 2059 2081 2099 2165 2199 2221 2239 2259 2277 2307 2333 2335 2347 2371 2417 2431 2473 2475 2477 2527 2549 2553 2611 2615 2617 2633 2699 2709 2717 2731 2735 2759 2761 2817 2845 2931 2953 3019 3059 3069 3151 3213 3295 3299 3313 3353 3705 3737 3749 3783 3807 3829 3867 3881 3909 3925 3945 4013 4037 4069 4095 4111 4137 4141 4151 4153 4197 4207 4209 4225 4231 4243 4247 4251 4253 4283 4303 4307 4347 4375 4463 4489 4519 4553 4561 4571 4581 4587 4601 4611 4675 4745 4747 4771 4775 4805 4819 4847 4879 4887 4943 4967 4973 4975 4983 5021 5035 5055 5077 5085 5099 5105 5139 5145 5179 5183 5201 5253 5263 5271 5301 5325 5331 5349 5373 5389 5393 5399 5401 5411 5413 5421 5451 5463 5485 5495 5527 5531 5553 5555 5559 5567 5581 5583 5601 5615 5641 5657 5659 5661 5663 5669 5673 5677 5683 5689 5695 5707 5713 5721 5739 5789 5805 5811 5817 5835 5867 5889 5910 5933 5981 5983 5989 5991 6001 6005 6015 6019 6049 6061 6067 6079 6083 6085 6097 6106 6127 6143 6153 6159 6167 6171 6187 6193 6199 6215 6231 6249 6265 6291 6315 6319 6327 6357 6371 6387 6397 6415 6441 6501 6503 6519 6523 6549 6557 6609 6623 6627 6629 6655 6677 6695 6711 6771 6773 6777 6781 6797 6799 6803 6813

6821 6843 6845 6847 6863 6869 6873 6903 6915 6919 6929 6937 6941 6943 6953 6983 7073 7089 7095 7175 7183 7199 7215 7249 7259 7339 7347 7363 7371 7375 7389 7395 7407 7415 7475 7479 7573 7597 7599 7603 7633 7641 7657 7661 7663 7685 7687 7711 7715 7721 7745 7767 7781 7805 7833 7857 7863 7867 7891 7913.

XVI.—Establishments receiving the Smithsonian Contributions to Knowledge, the Miscellaneous Collections, and the Annual Reports.

35 43 53 65 67 125 143 145 161 165 191 199 209 249 251 285 291 317 319 351 363 385 417 471 495 503 545 573 599 613 629 639 643 669 685 697 727 739 749 753 771 805 811 857 897 909 966 1005 1009 1023 1025 1041 1061 1081 1095 1099 1143 1185 1197 1199 1205 1217 1273 1275 1299 1315 1317 1325 1327 1359 1369 1493 1503 1539 1603 1639 1651 1665 1719 1739 1749 1821 1923 1961 1999 2011 2015 2029 2057 2059 2081 2099 2165 2199 2221 2239 2259 2277 2307 2333 2335 2347 2371 2417 2431 2473 2475 2477 2527 2549 2553 2611 2615 2617 2633 2699 2709 2717 2731 2735 2759 2761 2817 2845 2931 2953 3019 3059 3069 3151 3213 3295 3299 3313 3353 3705 3737 3749 3783 3807 3829 3867 3881 3909 3925 3945 4013 4037 4069 4095 4111 4137 4141 4151 4153 4197 4207 4209 4225 4231 4243 4247 4251 4253 4283 4303 4307 4347 4375 4463 4489 4519 4553 4561 4571 4581 4587 4601 4611 4675 4745 4747 4771 4775 4805 4819 4847 4879 4887 4943 4967 4973 4975 4983 5021 5035 5055 5077 5085 5099 5105 5139 5145 5179 5183 5201 5253 5263 5271 5301 5325 5331 5349 5373 5389 5393 5399 5401 5411 5413 5421 5451 5463 5485 5495 5527 5531 5553 5555 5559 5567 5581 5583 5601 5615 5641 5657 5659 5661 5663 5669 5673 5677 5683 5689 5695 5707 5713 5721 5739 5789 5805 5811 5817 5835 5867 5889 5910 5933 5981 5983 5989 5991 6001 6005 6015 6019 6049 6061 6067 6079 6083 6085 6097 6127 6143 6153 6159 6167 6171 6187 6193 6199 6215 6231 6249 6265 6291 6315 6319 6327 6357 6371 6387 6397 6415 6441 6501 6503 6519 6523 6549 6557 6609 6623 6627 6629 6655 6677 6695 6711 6771 6773 6777 6781 6797 6799 6803 6813 6821 6843 6845 6847 6863 6869 6873 6903 6915 6919 6929 6937 6941 6943 6953 6983 7073 7089 7095 7175 7183 7199 7215 7249 7259 7339 7347 7363 7371 7375 7389 7395 7407 7415 7475 7479 7573 7597 7599 7603 7633 7641 7657 7661 7663 7685 7687 7711 7715 7721 7745 7767 7781 7805 7833 7857 7863 7867 7891 7913.

GENERAL APPENDIX

TO THE

SMITHSONIAN REPORT FOR 1886.

ADVERTISEMENT.

The object of the GENERAL APPENDIX is to furnish summaries of scientific discovery in particular directions; occasional reports of the investigations made by collaborators of the Institution; memoirs of a general character or on special topics, whether original and prepared expressly for the purpose, or selected from foreign journals and proceedings; and briefly to present as (fully as space will permit) such papers not published in the "Smithsonian Contributions" or in the "Miscellaneous Collections" as may be supposed to be of interest or value to the numerous correspondents of the Institution.

PAPERS RELATING TO ANTHROPOLOGY.

THE RAY COLLECTION FROM HUPA RESERVATION.

BY OTIS T. MASON.

"The thing that hath been it is that which shall be, and that which is done is that which shall be done, and there is no new thing under the sun."

This axiom having commended itself to a wise man of antiquity, finds a new and wider verification in the court of modern science.

Could we glean from each or any savage tribe of earth its apparatus for administering to its every desire, and discard therefrom the perishable portions, we should have a technological exhibit not unlike our smaller cabinets of antiquities collected in a circumscribed area.

Reversing the process, if we add to our ancient stone implements all the wooden, textile, leather, bone, and horn accompaniments of such things, as they are now found in a savage camp, we shall not be far from a correct picture of the industries which that ancient people practiced, and we could easily guess the sort of life they led. We ought to proceed with the utmost caution in this matter, for the following reason: Human inventions, like natural objects, go in companies and affect one another by contact and mutual action according to a law of mutual modification. Just as the bees and the honey-producing orchids have become mutually modified, so have man's devices in each department of industry acted and reacted upon one another to produce change of form and structure. It is not enough, then, to compare an arrow-head of the past with an arrow-head of the present. The student should thoroughly exhaust the archæology of a mound, tomb, camp-site, etc. He should also thoroughly scrutinize the industries, sociology, beliefs, and ceremonies of each modern tribe, in order to arrive at a broad generalization of past human history.

The older archæologists and technologists did not foresee the drift of modern studies, and consequently did not attend to this matter with the minutiæ now demanded.

This fact is far from rendering all their treasures now in our possession worthless. It only enjoins upon their successors the necessity of supplementing their work, and adding fourfold value to their collections by a little cautious gleaning.

The United States National Museum possessed a fine collection of ethnological material from northern California, gathered by Wilkes and later explorers down to the centennial work of Stephen Powers (Cont. to N. Am. Ethnol., III). In order to bring this material into shape to illustrate the whole life of the Klamath River tribes, Lieut. P. H. Ray, U. S. Army, undertook while at Fort Gaston in 1885 to collect material for this supplementary work. Most of the pieces described in this paper are from Lieutenant Ray's collection and bear testimony to the obligation the ethnologist may be under to an army officer who will thus occupy economically the leisure of post duties.

Hoopa Valley Reservation, established in 1864 (Ind. Aff. Report, 1864, 1865, 1866), is 16 miles long and 12 miles wide. The valley contains 1,200 acres of arable land, which lies on both sides of the Trinity River 8 miles above its junction with the Klamath.

This romantic spot is reached by two days of mule travel from Arcata, in Humboldt County, 40 miles away. The whole distance presents an unchanging wildness of mountain scenery, varied with somber forests of redwood, and occasional patches of grazing land.

In all this journey the traveler's communion with nature is little interrupted with signs of human habitation until his eye rests on Fort Gaston, at the south side of Hoopa Valley.

In the northern part of California, west of the Coast range, dwelt formerly the following stocks of Indians, speaking languages so radically different that philologists are unable to ascribe to these languages a common origin:

(1) The Pacific slope branch of the Athapascan or Tinnéan stock, in the extreme northwestern corner and far northward into Oregon.

(2) Ehnikan, or Karok, between 123° west and Klamath River.

(3) Shastian, 41° to 43° north, 122° to 123° west, in round numbers.

(4) Weitspekan, or Yurok, around the lower Klamath.

(5) Weeyotan, or Wishoskan, on lower Eel River.

(6) Kopean, or Wintun, west side of Sacramento River.

Upon the Hoopa Reservation were placed by the Government, in 1864, a number of bands scattered around Trinity River. To them were added subsequently, the Redwoods, Seaws, Mad Rivers, and others from the neighborhood. These bands have been at various times named as follows (Spalding's Rept., 1870):

Hoonsolton (*Ath.*) = Hunsating (Powers).

Miscolt (*Ath.*) = Miskut (Powers).

Sawmill (Perhaps Cernalton).

Hostler (*Ath.*) = Hosler (Powers).

Cernalton.

Matilden (*Ath.*) = Mitilti (Powers).

Kentuck (*Ath.*) = Alăăkût. Niyañkéteteni, Youtochetts; Yahnihkahs (Dorsey and Mooney).

Redwood.

Tishtangatang (*Ath.*)=Tishtanatan; Siaws (*Ath.*)=Saiaz (Ind. Aff. Rept.); Humboldt.

The Indian Affairs reports of the last ten years have given Hunsatung, Hoopa, Klamath River, Miskut, Redwood, Saiaz, Sermalton, Tishtanatan.

Mr. Powers: (Cont. to N. Am. Ethnology, Vol III, 73) enumerates the Hunsatung, Miskut, Hosler, Mitilti, Tishtanatan, Waykat, Chailkulkaitúk, Chantakoda, Wissomanshuh, Miskeloitok, Hasslintung.

Commencing with 1865, the population of this reservation has been reported as follows: (5) 650; (6) 623; (7) 550; (8) 725; (9) 975; (1870) 874; (1) 750; (2) 725; (3) 725; (4) 666; (5) 716; (6) ——; (7) 427; (8) 427; (9) 415; (1880) 414; (1) 480; (2) 510; (3) 508.

Although a great majority of these bands belong to the Athapascan stock their arts have been so long in the leading-strings of this salmon prolific, acorn and redwood abounding region, that in houses, dress, implements, and products of industry they do not differ from their immediate neighbors. Lieutenant Ray gathered his specimens from the Natano (Tishtanatan) and Kenuck (Klamath Rivers), both assigned by Mr. Dorsey and Mr. Mooney to the Athapascan or Tinnéan linguistic stock.

The Hupa of former times are said by Mr. Powers: (Cont. N. Am. Ethnology, III, 72) to have been the finest race in all that region next after the Karok on the lower Klamath, whom they excel in statecraft. "They were the Romans of northern California in valor and the French in language. They hold in a state of semi-vassalage (I speak always of aboriginal acts) most of the tribes around them, except their two powerful neighbors on the Klamath, exacting from them annual tribute in the shape of peltry and shell money, and they compel all their tributaries to this day, to the number of about a half dozen, to speak Hupa in communication with them.

"Although they originally occupied only about 20 miles of the lower Trinity, their authority was eventually acknowledged about 60 miles along that stream, on South Fork, on New River, on Redwood Creek, on a good portion of Mad River, and Van Dusen's Fork; and there is good reason to believe that their name was scarcely less dreaded on lower Eel River, if they did not actually saddle the tribes of that valley with their idiom." This language applies to the Hupas before the mad hunger for gold had peopled California with human wolves. It is a startling but eloquent commentary upon their treatment and education to read later on: "The Hupas are not to-day any more enlightened, advanced, progressive, industrious, or better off in any way than they were when the reservation was established about twenty years ago." (Ind. Aff. Rep., 1881, 6.)

HABITATIONS AND WOOD-WORKING.

The hills skirting the Trinity and Klamath Rivers are covered with redwood trees, most grateful wood to savage artisans. Their soft trunks have had much to do with the manner in which houses, boats, etc., have been made. On the southward slopes of those hills habitations are built to catch the more direct rays of the sun and to shield the inhabitants from the merciless north winds (Fig. 1). With the art of the house-builder two implements in the Ray collection are intimately connected, the stone hammers (Figs. 2, 3, 4) and the elk-horn wedge (Plate X, Fig. 79).

The hammers are of dark, heavy schist or basalt, bell-shaped, and frequently with greatly expanded tops or pommels. While the specimens agree in general outline, there is not the same conventionalism and finish that are found farther north.

These hammers are still used by the old men among the Hupas, but none of them are able to make one. Those now in possession are much battered, have been handed down for generations, and are highly venerated.

The wedges are made of the antler of the wapiti or American elk (*Cervus canadensis*, Estleben), and are extremely hard. A close inspection of any collection of so-called bone implements will reveal a large percentage made of this substance. These antler wedges are used by canoe and house builders to split the redwood logs. By means of stone axes and fire a tall straight redwood was felled or one already fallen cut the proper length. By means of a row of antler or wooden wedges and the stone hammer just described, deftly administered, slabs and puncheons of required size were removed, and when necessary adzed down to a tolerable evenness.

Especial care should be taken to distinguish these bell-shaped hammers from pestles (Fig. 52*d*). The latter are designed to mash, triturate, or macerate something in a mortar of wood or stone. Coming in contact with the mortar chiefly at the edge of its base, the pestle must necessarily have a rounded bottom, and it may be safely asserted that no savage ever flattened or hollowed the bottom of an implement and carefully squared its base for the purpose of knocking the rim off the next moment.

The mallet or stone hammer is designed to strike a wedge or handle of wood, bone, antler, etc. Coming in contact with these softer substances in the middle of its base, that part of the mallet is usually flattened or convex. The edge may be fractured, but it is seldom worn away.

Houses of the Yurok and Karok were sometimes constructed on level earth, but generally they excavated a round cellar 4 or 5 feet deep and 12 to 15 in diameter (Fig. 1). Over this they built a square cabin of split poles or puncheons, planted erect in the ground and covered with a flattish puncheon roof. They ate and slept in the cellar (it being only a pit, not covered, except by the roof), squatting in a circle around the fire, and stored their supplies on the bank above next to the walls of the cabin. For a door they took a puncheon about 4 feet wide, set it up at one corner of the cabin, and with infinite scrapings of flints and elk-horns bored a round hole through it, barely large enough to admit the passage of an Indian on all fours. The cabin being built entirely of wood and not thatched accounts partly for the healthy looking eyes of the Klamath tribes. A space in front of the cabin was kept clean-swept, and frequently paved with cobbles, with a larger one placed each side of the door holes, and on this pavement the squaws sat weaving baskets.

The assembly chamber of the Karoks in California is wholly underground and oblong, the dimensions being 10 feet by 6 feet and about 7 feet high. The roof is flattish and level with the earth. It is puncheoned up inside and air-tight, except the hatchway at the side.

This structure is used as club-room, council-house, dormitory, sudatory and medical examination room. No squaw may enter on penalty of death, except to stand her examination for M. D.

During cold weather perpetual fires burn, and there are enough in each village to furnish sleeping room for all adult males thereof. The wood is gathered by the men. (See Powers' Cont. N. A. Ethnol., III, p. 25, for curious manner of cutting this wood. Also his frontispiece for a picture of the sweat-house).

Another style of lodge very seldom seen was as follows: A circular cellar 3 or 4 feet deep and 12 feet wide was dug and the side walled up with stone. Around this cellar, at a distance of a few feet from the edge of it, was erected a stone wall. On this wall they leaned up poles, puncheons, and broad sheets of red wood bark, covering the cellar with a conical-shaped inclosure.

Sometimes the stone wall, instead of being on the inside of the wigwam, supporting the poles, was on the outside, around the end of the poles, and served to steady them.

Shiftless Indians neglected to wall up the cellars either with stone or wood, leaving only a bank of earth. In the center of the cellars was a five-sided fire-pit, walled with stone, as in the common square cabin. This cellar was both dining-room and dormitory; a man lying with his head to the wall had his feet in comfortable position for toasting before the fire. Under his head or neck was a wooden pillow a little rounded out on top. (Fig. 5, Powers', p. 74.)

The most humble dwelling of all is called the "wickiup," which is little more than a booth, with wind-break on the north side, awning overhead, and the minimum of comfort and safety everywhere.

The Hupa houses are said to have been half cellars, half shanties, the eaves of the roof only a foot or two from the surface, in which they slept on the ground, formerly on skins, latterly on blankets, their pillow-blocks of wood 12 inches long at the top, 3 inches wide, and four inches high, resembling the neck part of an ox-yoke inverted (Fig. 5). The North American Indians did not generally use such head-rests, which are very common in China and Japan and among the two Oceanic races—the Malayo-Polynesians and the Papuans. Lieutenant Ray says that many of the old people still use these pillows. Stephen Powers also mentions them, and sent an example to the National Museum in 1876. (Cont. to N. Am. Ethnol., III, 74).

Another article of furniture in this meagerly-furnished household is the low stool of wood in form of a truncated cone, 11 inches wide and 3 inches high (Fig. 6). There are no tables, neither carpets nor hangings, except as the well-tanned buck-skins and pelts on floor and wall perform the functions of tapestry and curtains.

DRESS AND ADORNMENT.

The native dress for every-day wear among the northern Californian Indians was formerly very meager and little varied (Powers, Cont. N. A. Ethnol., III, Figs. 2, 3, 5, 6, 8, 23, 28, 30, 31). For the body, the robe of tanned deer-skin or of pelts sewed together (Fig. 7) sufficed for both sexes. Among Lieutenant Ray's collection is a man's cloak of deer-skin, made of two hides of young deer sewed together, or rather each side consists of three-fourths of a skin so united that the two tails hang down below and the two necks extend around the shoulders of the wearer, fastening in front.

The ordinary head covering for the men was formerly a hood of skin or leather ornamented, but the women wore the daintiest cap in the world, a hemispherical bowl of basketry made of a tough fiber twined with the greatest nicety and embroidered in black, brown, and yellow. (Plates I, II, III, Figs. 8–25.) The body weaving is done with the brown fiber, showing on the inside and occasionally on the outside in narrow bands, figures, and diaper work. Most of the outer side is ornamented by overlaying each strand of the brown with a strip of tough grass in natural color or dyed, or with a strip of the black stalk of the maiden-hair fern. In twining her weft, the savage weaver managed to keep these colored grass strips outward, although she would for variety occasionally hide the grass and reveal the body brown. The patterns are produced by a never-recurring variety of fillets, bands, triangles, and parallelograms which please the eye by their form and color, but which are the easiest of all to produce, requiring only careful attention to counting stitches.

The shoes of the Hupas and of the other Indians of this region are made high like gaiters and are cut from a single piece of buckskin (Plate IV, Figs. 26–31) sewed up at the back rather carelessly by a buckskin cord as in basting. Down the instep a curious seam is formed as follows (Fig. 29): The two edges of the leather are slightly split, they are then brought together as in joining the edges of a carpet. A loose cord of sinew is laid along the two edges and a whipped stitching of sinew made to join the two inner margins of the edges of the buckskin, inclosing at the same time the loose cord of sinew.

When the shoe is rounded out, the two outer margins of the leather come together on the outside of the shoe and conceal the sewing altogether. A coarse sandal of the thick portion of the elk-hide or of twined matting is worn by some tribes (Fig. 30), and also a nicely woven legging of soft basketry (Fig. 31). The latter, however, belong to full or ceremonial dress.

The ceremonial costume of all the Indians in the region under consideration is most elaborate, free use being made of pelts, buckskins, and paint, and of feathers especially. A few pieces of costume gathered by Lieutenant Ray will be described in detail.

Hats of elk-skin, tanned and painted, are made in the following manner (Fig. 32): A strip of elk-skin about 7 inches wide is cut in shape of a right trapezoid, measuring 19 inches along the upper edge and 22 inches along the lower. The two ends are sewed together with two-ply sinew thread by a row of blind stitches, visible on the inside and not on the outside of the hat. The body of the hat is painted red. Four panels or cartouches are bounded by blue lines, from which extend inwardly points and wavy lines. The interior of the spaces is in white pipe-clay. A tall goose-feather plume arises in front, and a pendant owl feather hangs behind. The strings are of calico rag. Such hats are worn by young men at a dance which is given when they attain the age of 20 years, at which they are admitted to the councils of the bands.

Head bands of soft deer skin are worn, 14½ by 5 inches, ingeniously ornamented with rows of different material recalling certain types of Eskimo embroidery. (Fig. 33.) Along the bottom will be a stripe 1 inch wide formed of deer-skin with the hair on, pointed upwards, and shorn straight above. Over this may be a broad stripe 3½ inches wide formed by many breasts of blue jays. This, too, is succeeded by another band, perhaps of deer-skin. Further up a stripe formed of black and white triangle alternating, the former of feathers, the latter of deer hair. Above all a row of nearly a hundred pompons of wood-pecker's crest. The back is stiffened with several vertical splints set in like modern whalebone. Along the sides two buckskin flaps lap over at the back of the head. Lieutenant Ray says that such articles are used as money. They are worn by men at festal dances, and used as a medium of exchange. In traffic the value is about $30, and Stephen Powers speaks of an inferior one for which the owner refused $60.

Hair ornaments for the dance are made of strips of *haliotis* shell (varying from 4½ to 1 inch in length and oblong, though irregular in outline) and pierced at one end. Through this hole a loop of leather string is passed and wrapped in three places with a strip of yellow grass for ornament. Two bunches of these pendants, nine in each bunch, are connected by a string just long enough to reach over the head and permit the pendants to hang gracefully on either side. When shaken these bunches produce a pleasing sound.

Every attractive object is laid under contribution in the Hupa head-dress, otter-skin, wings, crests, necks, tail feathers of flickers, woodpeckers, ducks, blue jays, fox-skin, pretty shells, dyed grass, quail-skins, etc. (Plates V, VI, Figs. 34–41.)

The neck ornaments of the women in this region are very pretty and of great variety, being wrought chiefly from nuts, shells, beads, grass, feathers, and leather. Necklaces are frequently made of the seed of the *piñon* tree by grinding off both ends, removing the fleshy portion and stringing. When the ends are ground off diagonally and the seeds strung, alternately leaning to right and left, they form a pretty zigzag effect on their strings. Smaller pine seeds are formed into necklaces variegated here and there with white beads or shells. A valuable specimen in this line is a necklace of nine hundred shells of *Olivella biplicata* strung by grinding off the apexes.

A very pretty kind of woman's necklace is made of bunches of grass cord and several cords in each bunch. Each cord consists of a bunch of grass leaves, sewed with a delicate cord of grass thread and at intervals with bands of yellow, red, and black yarn, the cord when served being less than one-eighth inch thick. Hanging on the neck, this crescent-shaped object forms a very attractive ornament. The shell necklaces are of three varieties, *dentalium* and *olivella* strung lengthwise, disks of *olivella* strung as wampum, and cylindrical necklaces of clam-shell disks.

Dance dresses of deer-skin are worn by women on occasions of ceremony. There are three of these of extraordinary elaborateness in Lieutenant Ray's collection, in general outline alike, and differing only in details. (Fig. 42.) They are made of soft deer-skin, a little over 3 feet long, 2 feet 9 inches wide at bottom, and widening upward. At the top two strips are left about a foot long, to come over the shoulders as lapels. The lower 9 inches of the bottom are slit into strings one-eighth inch wide. To increase the fringe a series of holes is made across the bottom, 2 inches above the top of the fringe, ⅛ inch apart. Into the first pair of holes two long strings of buckskin are looped making four strands of fringe. The inner one of these holes and the next hole receive two more strings, and so on. Excepting the two end ones, each hole has four strands passing through it. Hereby we have a very heavy fringe of buckskin, sometimes hanging down 18 inches. The body of the cloak or cape is plain. The upper part, forming a turn-down collar and lapel, is very gracefully decorated, thus:

About 6 inches are slit into much narrower strands than those at the bottom. Each strand is wrapped with the grasses used in basketry and with maiden-hair fern to produce patterns. All of these strands are gathered at the top of these wrappings by a row of twined weaving with the cord used in making nets. Then half an inch of naked leather strings is left, succeeded by a row of twined weaving, half an inch of wrapped strands, half an inch of naked strands, 1 inch of wrapping, 2 inches of naked strands, half an inch of wrapping, a narrow strip of naked strands, 1 of wrapping, 1 of naked strands, half an inch of wrapping, and finally the ends of the strands as fringe. In one case a brass sewing thimble is attached to each strand to make a jingling sound. The alternation of bands of straw and leather of different widths, the triangular gradines wrought by serving adjacent strands with a different number of wraps, and the graceful appearance of the fringe make of these dance cloaks very attractive objects. No two of these are alike in the sequence of colors, the width of stripe, or depth of fringe.

The cinctures worn by women, and many other specimens in the museum from this region, are constructed on the same plan, so that the description of one of the most complicated will include all the rest (Fig. 43). A whole buckskin is folded in the middle. At the creased portion about 3 inches are left whole. The tailor slits the rest of the skin into "shoe-strings." Then she folded the skin three ply, as you would a sheet of letter paper for a long envelope, and sewed the under-cut strip together so as to keep the skin from unfolding. Commencing at one side she gathered twelve strings into a cable, taking four strands from each fold of the skin, and wrapped these for about 3 inches into a cylinder with broad strips of yellow grass. Continuing all the way across she made series of these cables, inclosing in each twelve strands. With buckskin string by twined weaving she united all these cylinders together at their lower ends, wrapping each strand with yellow grass. She introduced here and there the beads and *piñon* seeds so as to form bands across the cincture. About 5 inches of the bottom of each strand were served with a kind of braiding now to be described. A very long, tough strip of straw folded by its middle around one of the buckskin strands, crossing at the opposite side, the ends are alternately turned back and tucked through the last fold, giving the appearance of a rough four-ply braid. This ingenious trick of imitating braid in the administration of one or two strands has been elsewhere noticed on the borders of basket-work bowls. (Smithsonian Report, 1884, Pt. II, pl. XXXI.)

A girdle or sash made of grass and buckskin is also worn by women. The mode of manufacture is so entirely aboriginal as to demand a minute description. (Fig. 44.) Take a strip of buckskin about 3 feet long and 3 inches wide and cut all but a short piece at one end into strings, which should be rolled. Provide a quantity of fine, shredded sinew and strands of yellow grass. Stretch the eight leather strands so as to be about one-eighth of an inch apart. Begin at the end where the strings are not cut apart, lay a thread of sinew across the leather strings at right angles and pass a strand of grass between each pair of strings, around the sinews, and back. Now bring the sinew around the outside string and across as before and double all the straws over it, and back between the strings. The straws are carried back and forward between the strings in a zig-zag manner around the sinew laid across each line. In this weaving with three elements Brussels carpet is somewhat anticipated. There is also a curious dance wand made of basket-work, which is carried in the hand during the dance. (Fig. 45.) This is a mat of twined grass cloth about 18 inches square woven in bands and triangular patterns, black and red. A rod is sewed into each of two opposite ends of this cloth and these rods brought together so that the rods lie parallel, their ends projecting like the boom of a vessel. The ends of the wallet thus formed are closed by bits of cloth and the ends of the rods covered with red cloth, one end having a plume of bird feathers. Among the Wilkes collections from this region is a carved bone nose-plug, with feather ornaments at the ends. (Fig. 49.) This form of adornment is not common at present, as no specimens occur in the collections of later explorers.

The necessary accompaniment of the dance costume is the toilet of the hair and face. Tattooing is done with the soot of the pine tree, macerated in deer's marrow. The juice of herbs is also employed. Then, again, there are vermin tools, consisting of a paddle-shaped scraper and a crusher. (Figs. 46, 47.) One of the former in this collection (77197) is of cedar, 13 inches long, made very smooth, and polished at the end by long use. The other is of the white portion of elk horn, resembling ivory, diamond shaped, with one end rounded, 7½ inches long, and nowhere over one-quarter of an inch thick. It has the appearance of old Eskimo ivory implements, amber-colored by long use. The rounded side is covered with the triangular markings so much affected by this people and apparently transferred from basketry. The crusher is a cylindrical section of an elk's femur, 6¼ inches long. The *modus operandi* is to stir up the vermin with the paddle and to crush them and their eggs by placing the crusher under the hair and pressing it with the paddles.

The hair-brushes of the Hupa are made of rigid vegetable threads and root fibers about 6 inches long (Fig. 48), by doubling the strands and inclosing them like the hairs of a white-wash brush in a handle or grip of elk skin sewed fast. The ubiquitous paint mill is made of granite or schistose rock, napiform, about 4 inches in the long diameter, with a globose depression from 2 to 3 inches wide at top. The cup is coated with ocher and becomes extremely smooth from constant mulling.

PREPARATION AND SERVING OF FOOD.

As late as 1850 all the bands of Indians now on the Hupa Valley Reservation were living in pristine simplicity of social structure, arts, and ceremonies, which even now survives to a large extent among the old and conservative. Dr. Moffatt, the surgeon of the reservation in 1865, says: "Their food varied with the season of the year; each successive month furnished its own peculiar staple articles."

Autumn supplied the all-important acorn, large quantities of which were collected and kept in store for use during the winter and ensuing spring. Winter was the great hunting time. Then they chased the *manwitch* (deer), and small game over the hills, bow in hand, or laid in wait for them in the thickets. Grouse, quails, and small birds were hunted and shot with arrows or caught in rude snares set for them. The fruit of the chase, with the acorns, thus constituted the winter supply of food almost exclusively.

Spring brought new viands. Early vegetation furnished abundance in the form of young leaves and stems of succulent plants, with their roots attached, and various species of clover, which were gathered in large quantities and eaten. This was the season when the squaws might be seen setting out in procession, each with a basket swung upon her back, furnished with a piece of wood about 3 feet in length and sharpened to a point at both extremities to dig up roots, worms, etc. This was the season also when fishing commenced, sometimes earlier, sometimes later, according to the subsidence of the high water and other circumstances.

The summer months prolonged the same supply, with the addition of Indian potatoes, or soap-root, as it is called by the whites, a large and nutritious bulb which grows abundantly upon the hills, and various kinds of wild fruits and nuts, together with the rich, fat salmon. This was the feasting time par excellence of the California Indian. (Ind. Aff. Rept., 1865, 116.)

Both the land and the water yield an abundant supply of food to the natives in this region.

The vegetable food is gathered chiefly by the women, while it falls to the lot of the men to ransack the forests and the waters for game and fish. The outfit of the primitive gleaner, miller, and cook is worthy of special description, inasmuch as we are able to follow her steps from the beginning to the end of her laborious journey. While no edible root or fruit was despised, the oaks furnished the chief breadstuff. The acorns were gathered in an osier hamper, about 16 inches high and 20 inches in diameter (Plate VII, Fig. 50), built up by fastening the osier warp by means of a twined cord of the same material, the meshes about $\frac{3}{4}$ths by $\frac{1}{8}$th inch, quite uniform in size. Around the top ran six or seven rows of close-twined weaving with brown rush and grass, in which the brown and the grass color alternately covered one another. That is, by using two colors the weaver could bring either one into view *ad libitum.* This form of basketry is used by the women in carrying loads, supported by a band across the forehead. Filled with acorns this hamper was placed on the back and held in position by means of the carrying pad (Plate VIII, Fig. 51), consisting of a disk of mat 5 by 4 inches, made by coiling loose, native-made rope, and sewing the coil with thread of grass. To each end of this pad is fastened, by a two-pronged attachment, the band of rope which passes around the back of the head to hold the pad in place. This consists of rope served with fine native twine. A collection of this type of pads from different tribes of men, as worn by the human beast of burden, would be an instructive chapter in the progress of our race, marked by the passage of the pad from the forehead to the crown, and of the carrier from a half-prone savage harvester to an arrow-straight Italian water-carrier. About the middle of October the Indians of northern California beat the acorns from the trees with long poles, and carry them home in deep conical baskets. The squaws remove the hulls by holding an acorn on a stone and giving it a slight tap with a stone pestle. The nuts are then dried and beaten to powder in a hollow of a rock. The flour is soaked a few hours in a large hollow scooped in the sand. The water draining off carries away the bitterness. It is then cooked into a kind of mush in baskets by means of hot stones, or baked into bread in an underground oven. (Cont. N. A. Ethnol. III, 421.) If the harvest is of seeds rather than of acorns, they must be winnowed. This is done in a shallow bowl tray of the closest twined basketry, which the good woman has not failed to decorate with geometric patterns, following that incomparable artistic instinct which is the heritage of all the people who breathe the air from the Pacific Ocean. Further inland among the Ute tribes a hot stone is trundled around in this tray to partially roast the seed as well as to consume the chaff.

If the harvest of seeds or acorns is not immediately needed, it is stored in close granaries or in open-work baskets. (Plate VII, Figs. 53 and 54.

The miller's apparatus is the most intricate in the evolutionary series short of the quern, and consists of five parts, the mat or tray at the bottom (Plate VII, 52*a*), the mortar-stone (52*b*), the hopper (52*c*) the pestle (Fig. 56 and 52*d*), and the grass-root broom for sweeping up the grist (52*d*). This affair is quite widespread, including the territory of two classes of basket-weavers, those that twine and those that coil their work. (See paper on basketry, Sm. Rep. 1884, II.)

The basket-tray plays the part of the cloth under the hand-mill to receive the grist when the hopper and stone are not glued together.

The bowl-shaped basket hoppers vary slightly in size and much in adornment. But Ray's specimen is 10 inches wide at the top and has an opening 3½ inches in the bottom. (Plate VII, Fig. 55, also Fig. 52*c*.) The weaving of this specimen is very intricate. The warp is of osier radiated. Commencing at the lower edge the weft proceeds as follows: Two rows of plain twined osier; four rows of three-ply twine, commencing with two strands of osier and one of brown bast, and ending with three of brown. The greater part of the body is made of brown and black bast twined in two-ply, but the white color is produced by overlaying either of these two colors with a strip of grass leaf which the weaver knows how to reveal or conceal on the outer portion. The geometric figures are in black, brown, and grass color. The margin is very curiously wrought, as follows: The ends of the warp osiers are bent downward and plaited into an eight-ply braid and the ends cut off on the inside. As the braid passes each warp osier it is plaited in and one cut off. This braid forms a margin at an angle of 45 degrees. Under the cut ends, a hoop of willow is bound. This hopper is used as follows: A large shallow basket is placed on the ground, and a flat stone placed on the basket. The hopper rests on the stone to hold acorns, manzanita, berries, etc., in place. The margin is held in the left hand while with the right the pestle is brought to bear upon the acorns or grain. In more southern portions of California the basket is glued to the stone with pitch. A full outfit consists of one hopper, one stone pestle, one large shallow basket, and a smooth flat stone from 12 to 18 inches in diameter. A larger hopper, more plainly ornamented, measures 18 inches in diameter at top, with an opening at the bottom of 6 inches diameter. In the two-ply and three-ply twine, in the deft handling of grass lining, the strengthening rods and plaited margin, this specimen resembles the last, excepting the black color. Here we have only the osier, brown and grass color. Mr. Livingston Stone collected two very similar specimens from the McCloud River Indians living in the vicinity of the Hupas, and Mr. Powers others from the Tule River country. These last are similar in form, but the stitch of the basket is entirely different, being the very beautiful coiled stitch of the Yuroks and other tribes of central and southern California. (Smithsonian An. Rep. 1884, Pt. II, pl. XIX.)

A basket forming part of the outfit of the acorn grinder is 21 inches in diameter and 6 inches deep. It is closely woven by twining in brown and grass color, forming a trefoil pattern.

The rudest pestles are formed by knocking off the edges of a piece of hard rock with a flint hammer-stone. These may be ground down to symmetrical form upon a flat sandstone kept constantly wet. (Fig. 56.)

Mr. Powers tells us that bread or mush is made from the acorns of the chestnut oak (*Quercus densiflora*), which are first slighly scorched and then pounded up in stone mortars. (Plate VII, 52.) The meal thus prepared is wet with water and the mixture poured into little sand pools scooped in the river beach, around which a fire is made until the stuff is cooked, when the outside sand is brushed off and the bread is ready to be eaten. (Powers Cont. III, 50.)

The Hupa cook their mush in a basket pot not unlike a "dinner-pot" in shape. (Fig. 57.) Smooth, clean bowlders are heated and dropped into the mush, which is stirred with a strong mush-stick or paddle. (Fig. 58.)

Frying-pans of *lapis ollaris* are also used in cooking cakes. These are carelessly rectangular in shape, say about 10 inches long, half as wide, and an inch thick. In addition to these are many small baking dishes of *lapis ollaris*, like the so-called individual pans in which civilized cakes are baked. This form should be especially noticed. The Hupa Indians use them for cooking a kind of bread made of acorn-meal. (Wheeler VII, 102.) Among the so-called paint dishes in archæological collections are many of soapstone and other soft material not at all suited to rubbing up paint. We have here a much more rational explanation of the proper function.

For eating their mush the Hupas employ a rather pretentious spoon of horn (Fig. 59), bowl-shaped like that of a large kitchen spoon. The handle is short and zigzag with a spoon-shaped grip at the upper end. The typical characteristics are the zigzag or notched handle, the projections like *quillons* near the bowl, and the spoon-shaped grip. Quite a number of spoons from the Klamath area present these marks. For savage spoons these are small specimens, but they are much larger than ours. It must be remembered, however, that the Indian dips his food from a common pot, and that his spoon is rather more of a ladle and soup plate than a mere conveyer from a dish to his mouth. The eater holds his spoon near his mouth in his left hand and alternately conveys a morsel therefrom to his mouth, sipping the liquid portion from the rim as from a porridge bowl.

On the testimony of both Mr. Powers and Mr. Purcell, a species of food not enticing to civilized stomachs is relished by the California savages. When the rain falls in autumn enough to give the earth a thorough soaking and the angle-worms begin to come to the surface, then the Yuki housekeeper turns her mind to a good bowl of worm soup. Armed with her "woman stick," the badge of her sex, which is a pole about 6 feet long and 1½ inches thick, sharpened and fire-hardened at one end, she seeks out a piece of rich moist soil and sets to work. Thrusting the pole into the ground about a foot she turns it around in every direction and so agitates the earth that the worms come to the surface in large numbers for a radius of 2 or 3 feet around. She gathers and carries them home and cooks them into a rich and oily soup.*

Mr. Purcell says: "The Indians of Round Valley go out when the ground is wet to catch angle-worms. They take a pole, sharp at one end, and punch it as deep as possible in the earth. They then work it back and forward and in a short time the fish worms, made uncomfortable by the extra pressure, will begin to crawl out. These worms are eaten raw or made into soup."

While treating of the food customs it may be well to speak of the closely woven food or table mats, the pretty salmon dishes of twined openwork basketry in osier. (Fig. 60.) For the warp six osier rods are overlaid by six others at right angles, and held in place by an osier wrapped around the outside of the crossing. The warp rods are then separated radially and held by three coils of close twined weaving. The coil is then continued in open work, each turn removed farther as it passes outward. New warp rods are added at each turn to keep the meshes at a uniform width. There is no fastening off at the margin, the twine clasping the ends of the soft osier sufficiently to hold. These tray-like baskets are about 1 foot or more in diameter and 3 inches deep. They are used to serve up salmon.

Salmon baskets of open willow work, 10 and 11 inches wide, 3½ deep, are formed by a series of warp-sticks one-sixteenth of an inch thick and

*Frequently the worms are brought to the surface by the Indians dancing over the ground to make the game uncomfortable below.

the same distance apart, held firmly in place by a continuous coil of twined osier about three-fourths of an inch between the turns. Four radial bars of black break the monotony of the fabric and produce a pretty effect.

PIPES AND SMOKING.

The Indians of northern California smoked formerly a wild tobacco, *Nicotiana quadrivalvis* (Gray), *N. plumbaginifoliæ* (Bolander). It was smoked alone or mixed with dry manzanita leaves (*Arctostaphylos glauca*). Mr. Powers says that it has a pungent, peppery taste in the pipe, which is not disagreeable.

The pipes are conoidal in shape, and are either of wood alone, stone alone, or latterly of stone and wood combined, as will appear further on. (Plate VIII–IX, Figs. 61–73.) The beginning of such a pipe would be a hollow reed, or pithy stem, with the tobacco deposited in one end. A plain cone of wood fitted for smoking starts the artificial series. (Fig. 61). Rude pipes are cut out of one piece of laurel or manzanita and shaped like a fisherman's wood maul or one of the single-handed war-clubs of the Pueblo Indians. (Fig. 62.) The length of stem is about 11 inches; length of bowl, $2\frac{1}{4}$ inches; diameter of bowl, 2 inches; of stem, $\frac{3}{4}$ of an inch. The bowl is a cup-shaped cavity, very shallow. The whole specimen is very rude, looking as though it had been chipped out with a hatchet or heavy fish-knife.

The next grade of pipes are of hard wood resembling the last described in type, but very neatly finished. The stem is about 14 inches long and $\frac{9}{16}$ths of an inch thick. The head is spherical, $1\frac{3}{4}$ inches in diameter. The bowl is cup-shaped and the cavity nearly 1 inch in diameter. (Fig. 64.)

A small pipe of soapstone is also used, in which the straight pipe is presented in its simplest form. (Fig. 65.) Length, $2\frac{5}{8}$ inches.

There are also pipes of fine-grained sandstone of graceful outline, resembling in shape a ball bat, 7 inches long, $7\frac{1}{8}$ inches wide in the thickest part. A very noteworthy thing about this pipe is the extreme thinness of the walls. (Fig. 63.) At the mouth part, where it is thickest, the stone does not exceed one-eighth of an inch, while through the upper portion it is less than one-sixteenth of an inch in thickness. The cavity does not present the series of rings which appear in stone that has been bored out, but innumerable longitudinal scratches fill the inner surface.

The only solution of this appearance is that the interior was excavated by the use of a file or other hard tool. By the great size of its interior, this pipe is connected with the tubular objects from the mounds called telescopes by some, sucking tubes by others, and pipes by others. (See Dr. Abbott's paper in Wheeler's Survey West of One Hundredth Meridian, Vol. VII, pl. VII and text.)

The stone pipes were taken from old graves, and this kind are now no longer in use.

We have, again, a little pipe no larger than some cigarette holders. (Fig. 66.) Except in its diminutive size and simplicity it might have served as a model for the three to be next described, or for the type specimen mentioned at the head of this list. Length, $2\frac{3}{8}$ inches; greatest width, three-fourths of an inch; depth of bowl, $\frac{7}{8}$ths of an inch. (See Powers, Fig. 43.)

They likewise use a tapering pipe of hard wood, $12\frac{1}{4}$ inches long, $1\frac{5}{8}$ inches wide at the larger end. What may be called the stem is $7\frac{3}{8}$ inches long. The other portion is carved by a series of octagons and chamfers which give to the specimen quite an ornamental appearance. (Fig. 69.) The bowl is $\frac{7}{8}$ths of an inch wide and 2 inches deep. This example has been smoked a great deal, being charred very much in the bowl. (Collected by Livingston Stone. Compare Figs. 2 and 5, Plate IX, Dr. Abbott's paper in Wheeler's Survey West of One Hundredth Meridian, Vol. VII.)

Other beautifully finished pipes of the same type, evidently turned in a lathe to please the Hupa fancy, are kept with the greatest care in leather pouches made for the purpose. (Figs. 71, 73.) They are made of different woods highly polished. The remarkable feature is the bowl of serpentine set in a tapering shouldered socket at the wide end of the stem, and the whole turned and polished. The bowl is a conical cavity in serpentine.

The next example consists of a pipe and case. The pipe has a stem shaped like a club or ball bat, and a bowl of compact steatite. In general features pipes of this class resemble the cigarette holder, and they are found among the Utes and Mohaves, as well as in the mounds.

When it is remembered that many Indians recline while smoking, it will be seen that this is the only sensible form of the pipe for them.

Their tobacco pouches of basket-work are ovoid in form and hold about 1 quart. (Plate VIII, Fig. 67.) They are made of twined weaving in bands of brown and checkered grass, so common in the basketry of the Klamaths as to be typical. Six buckskin loops are attached to the rim of this basket in such a manner that their apexes meet in the center of the opening. A long string is fastened to the apex of one loop and passed through all the others serially to close the mouth of the pouch. Height, 6 inches; width of mouth, $2\frac{1}{2}$ inches.

BASKET-MAKING.

The basket-making of these Indians belongs exclusively to the twined pattern of weaving, as that of the more southern California tribes belongs to the coiled type. (Fig. 74.) (Smithson. An. Rep. Pt. II. p. 299, and pl. XVIII, XIX.)

From willow twigs and pine roots, says Mr. Powers, they weave large round mats for holding acorn flour; various sized, flattish, squash-shaped baskets, water-tight; deep conical ones of about a bushel capacity, to be carried on the back, and others to be used at pleasure as drinking-cups or skull-caps (Plate ——, Fig. —), for only the squaws ordinarily wear anything on their heads, in which latter capacity they fit very neatly. (Powers, Cont., III, 47.)

In carrying her baby or a quantity of acorns, the squaw fills her deep conical basket and suspends it on her back by a strap which passes loosely around it and athwart her forehead. (Powers Cont., III, 47.)

The Round Valley Indians make their baby cradles of splints running up and down. A hood-shaped awning covers the face and also keeps the baby from rolling out. Formerly new-born children declared defective by the medicine man were put to death. On the birth of a male child the father goes on a hunt and does not return until he has secured much game. This is to make a mighty hunter of the baby boy. The basketry at Round Valley Reservation is made of the root of a shrub which grows in swampy land. Mr. N. J. Purcell says that they gather great bunches of this root, which they keep soaked in water until it is needed for use. The roots are deftly split, and the inside scraped with a sharp stone or, recently, with a knife. The ribs are formed of a tough twig, and the coiled sewing is done by means of a needle made of antler or bone. This form of coiled weaving is unknown at Hupa Reservation, the twined pattern being used exclusively. It should be noted that the Northern Tinné or Athapascan employs the coiled method altogether.

Mr. Purcell narrates a tradition of the Ukie Indians of Round Valley Reservation which is connected with their basketry.

Once upon a time everything was a vast body of water, over which all was darkness. Hovering over this expanse in the darkness was a large white feather, the embodiment of one of their spiritual beings, that finally becomes weary and lights down into the water. Here was a whirlpool in which the feather is carried around so rapidly that a great foam is formed, which grows larger and larger until a floating mass is aggregated; of this the feather spirit forms the land.

Still all was dark, and the feather goes around among all the worlds to look for light. On visiting one of these he was taken sick and was carried by the hospitable inhabitants to the sweat-house. Here his eyes became dazzled by the brilliant light, and on looking up he beheld several beautiful suns hanging from the roof. The inhabitants one day going off on a great hunt left two old men to wait on the sick visitor.

These nurses fell asleep and the feather spirit carried off one of the suns in a basket. Though hotly pursued he arrived safely home with his prize. He carried it far to the east and set it low on the ground, but this position did not suit him. So he moved it again and again, and continued to move it about until our day.

The pretty jar-shaped baskets in our collections, covered all over with feathers, are made by coiling and catching in the shaft of a bright-colored feather under each stitch. It was in one of these baskets the sun was carried off by the feather spirit.

TOOLS OF GENERAL USE.

The common tools of the aborigines were such as were naturally attached to their life and habits, plus the natural refinement of the people.

The leaf-shaped blades of the jasper knives found in graves closely resembles those now in use (Plate x, Figs. 75–78), but the handle of pine is very much decayed, being partially protected by a covering of pitch. The blade is fastened in place with pitch, and the color is brown, striped with green.

These specimens, with those before described, afford a probable explanation of the method of hafting the whole class of implements commonly called leaf-shaped spear-heads.

There are eight specimens of this kind in the collection, the material varying from a dark-brown to a dull bluish chalcedony color, some brown striated with light blue. All of them are set in handles by means of pitch. The following tabular statement will characterize them:

No.	Blade.	Length, blade.	Width.	Thickness.	Handle.	
					Length.	Description.
		Inches.	*Inches.*	*Inches.*	*Inches.*	
1	Brown, veined with blue	4	$2\frac{1}{4}$	$\frac{7}{16}$	$4\frac{1}{2}$	Pine, of one piece, blade glued.
2	Brown	$5\frac{1}{4}$	$2\frac{3}{8}$	$\frac{5}{16}$	$4\frac{1}{2}$	Do.
3	Brown, veined with blue	$5\frac{3}{4}$	$2\frac{1}{2}$	$\frac{7}{16}$	$4\frac{1}{2}$	Do.
4	do	4	$1\frac{3}{8}$	$\frac{5}{16}$	$5\frac{1}{2}$	Do.
5	Green and brown mixed	$4\frac{1}{8}$	$2\frac{1}{8}$	$\frac{5}{16}$	$4\frac{5}{8}$	Do.
6	Brown	$2\frac{3}{4}$	2	$\frac{3}{8}$	$6\frac{1}{4}$	Pine, of one piece, blade lashed.
7	Brown, striped with blue	$4\frac{3}{8}$	2	$\frac{3}{8}$	$4\frac{3}{8}$	Pine, of two pieces, lashed at both ends.
8	Blue-gray	$5\frac{1}{4}$	$2\frac{3}{8}$	$\frac{1}{8}$	$4\frac{5}{16}$	Pine, of two pieces, lashed at one end.

Compare these hafted knives with Wheeler (Vol. VII, Plate VII).

There is in the Ray collection an obsidian knife, wrapped around one end with a strip of otter skin (Plate x, Fig. 78). The blade is of mottled obsidian, black and brown, $7\frac{1}{4}$ inches long, $1\frac{7}{8}$ inches wide, and $1\frac{1}{16}$ inches thick. The Indian who gave this knife to Lieutenant Ray informed him that this particular kind of stone is held in great veneration, and is brought from a great distance.

The mottled obsidian is not found in the Hupa Valley. The use of this form as a talisman is paralleled by the veneration in which stone implements are held all over the world when their active normal use is lost.

Among the articles paraded or worn in the ceremonial dance is a flake or knife of obsidian or jasper, some of which are 15 inches or more in length, and about $2\frac{1}{2}$ inches wide in the widest part. These are wrapped with skin or cloth to prevent the rough edges from lacerating the hand. But the smaller ones are mounted on wooden handles and glued fast. The large ones can not be purchased at any price, but Mr. Powers procured some about 6 inches long at $2.50 apiece. These are not properly knives, but jewelry for sacred purposes, passing current also as money.

The fire-drill is of the simplest type, consisting of two pieces of soft cedar or redwood. The opinion is commonly held that the fire-drill must consist of a soft bed and a hard drill-piece. In this example both are of soft wood. Among the Pueblo Indians sand is placed in the cavity of the lower stick to increase by friction both the heat and the pulverization of the wood.

Elk-horn wedges, sharpened by rubbing on stones, are indispensable to the woodmen (Plate x, Fig. 79). Selecting a fallen redwood, straight and free from knots, they hack a notch a few inches deep reaching a third or more of the way around the tree.

By means of the wedges and stone hammer (Fig. 2–4) they split off a kind of jacket slab long enough for the height of the wigwam, 2 or 3 inches thick and 4 or 5 feet wide. This puncheon observes the curvature of the tree, but on being exposed to the sun for a few days it warps out flat. They then dress it smooth with elk-horn or flint axes. (Powers, 101.)

SPECIAL INDUSTRIES.

The special industries of the California Indian men were connected with hunting and fishing.

The Walakki method of capturing deer is to run them down afoot. These animals have very much the habit of running in certain trails and the Indians make these trails a study; they post relays of men at points where the animal is apt to pass, and so give him continual chase until he is out of his range and thus get him so blown that he either stands at bay or takes to the water.

An old hunter narrates that he has seen them often capture a fine buck in this manner. Then again they construct two slight lines of brushwood fence converging to a point where a snare is set, and chase the animal into this snare.

Besides this, they often run down hare and rabbits. This is more easily done. A company of Indians get together in a space of meadow or in an open wood and whoop and beat the cover to flush the quarry. Terrified by the noise the animal runs wild, springs in the air, and leaps square off from a straight run even when nothing moves or makes a noise near it, and so beats itself completely out, or slips into a burrow. This is sport for the Indians, who whoop, laugh, swing their arms, fling clubs, and make a deal of noise. Mr. Powers says an Indian boy can run a rabbit to cover in ten minutes, split a stick fine at one end, thrust it down the hole, twist it into his scut and pull him out alive.

The Humboldt Bay Indians catch deer or elk in a trap constructed as follows: Two long lines of brushwood fence, or of strips of bark tied from tree to tree, converge until they compel the elk to pass through a narrow chute. At this point the Indians place a pole in such manner that the animal is obliged to let down his horns to pass underneath and thus he inserts his head into the noose. This trap is made of grass or fibrous roots twisted in a rope as large as a man's arm and attached to a pole in such fashion that the elk drags it down, whereupon he speedily becomes entangled in the contiguous bushes and anchored fast.

The eel-trap of Eel River is made of splints, funnel-shape, with a funnel-shaped entrance at the large end through which the creature could wriggle, but which closed on him and detained him inside. Traps of this kind they weight down so that they float mostly below the surface of the water; they then bind them to stakes planted in the river bottom. Thus they turn about with the swish of the tide, keeping the large end always against the current, that the eels might slip in readily. The stakes are driven into hard pack shingle by patiently driving and working them until they are firmly settled. (Powers, 103.)

They construct the toggle-heads of their salmon harpoons (Fig. 80) as follows: A point of antler, bone, or metal from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in length, more or less flattened, and sharp at the tips, is armed at its lower extremity with two barbs laid alongside, lashed down, and covered with pitch. (Fig. —.) In the same lashing is included one end of the leader, a short strap of deer raw-hide. Into a slit at the other end is spliced the line, a piece of rope from 1 to 3 feet long, attached at its opposite end to the side of the shaft. Some spears have two or more prongs, each armed with one of these toggle-heads.

When the fish is struck its struggles detach the toggle-head and it is retrieved by means of the line and pole. Toggle-heads of similar type are in use among all the salmon-eating Indians or northwest California. The Hupa annually dam the Klamath at intervals by a structure arranged so that no fish can pass through with the flow of water. The McCloud Indian trap consists of stakes or bushes built out into the river at a fall or rapid in the form of the letter V, having the angle down-stream and a basket-trap at the angle. This method proved perfectly worthless, as of course it must be, for catching healthy fish, as this contrivance entraps only the exhausted ones that are going down the river and none that are coming up. They do not use salt in drying their fish, the air of California being dry enough to preserve them without it.

Most of the salmon used for drying are taken in August and September when they are spawning or falling down the river after spawning. They are then easily captured by spearing (Fig. 81.) or by traps. Their spears are very long and carefully made.

The traps are merely baskets of bushes placed at a fall or rapid and winged on each side by a fence of stakes or bushes running at a slight angle up the river, so that the exhausted fish coming down the river finally find their way into the basket and are there trapped.

The McCloud Indians do not try to trap the fish coming up the river, but only those going down, which is just the contrary of the principle of the white man's trap and nets. The Indians very singularly prefer the exhausted and dying salmon for drying.

As soon as a salmon is speared or taken from the trap it is opened (the spawn always being saved as a luxury) and split and hung on a bush or fence made for the purpose in the open air. In the dry air of California the drying process is sufficient to preserve them without salt. The Indians never use salt in preserving their salmon and will not eat salt meat of any description. When the salmon are sufficiently dried they are tied together in bundles and packed away around the sides of the lodges. These, repulsive as they seem, represent the main support of the Indians during the winter and are highly valued by them.

The dip-nets used in taking eels and young salmon are made triangular in shape, 10 feet by 14 feet, open along the long side of the triangle and closed on the other side and base. They are knit of two-ply twine made from tough fiber. The meshes are three-fourths of an inch square, made with the regular fisherman's knot or becket hitch. (Fig. 82.)

Their seines are also made of this twine, hard twisted, which is itself manufactured from the leaf of a very tough grass or sedge. Each blade of grass produces two strands of fiber. It is stripped when the grass is green by scraping with the thumb nail or a mussel shell fastened on the thumb, similar to the tool employed in scraping down sinew on the bows.

No spindle is used, the fiber being twisted with the palms of the hands on the thigh. The net is knotted like those of civilized people; that is, the thread of each mesh is brought down around the mesh-stick, then through the bight of the stitch above, and fastened by a half hitch quite around both strands of the same mesh.

Specimens of the raw material, fiber, twine, and nets were sent by Lieutenant Ray. The net is in shape of an elongated isosceles triangle, with a long side open, 10½ feet long and 4 feet deep at the base.

The seine needle has a long and slender shaft (Fig. 82), the two ends resembling a duck's head in outline, the thread passing between the two phalanges of the beak into a wide elliptical space. Length 16½ inches.

The Hupa had well-established laws and riparian rights to hunting, fishing, nutting grounds, laws of murder, injury, insulting words, etc.

The sling of the Hupa is a very intricate affair made of buckskin. The thongs of sinew or tough cord are united to the leather by first passing through it and then coiling on themselves. The ordinary loop on one end and knot on the other are also used by them. (Fig. 83.)

BOWS AND ARROWS.

The methods of the northern Californian bowyer and fletcher are now pretty clearly understood. For ordinary flaking of jasper or obsidian (Fig. 85) he uses a common pebble hammer-stone, but for detaching flakes of the best quality he uses between his hammer and his core a "pitching tool" or sort of cold-chisel of the hardest antler. (Fig. 93.)

For shaping his points he has an arrow-sharpener of bone or antler lashed to a handle of wood, almost identical with the one employed by the Eskimo of Port Barrow, etc. (92 and 96).

NOTE.—A very curious metamorphosis of the Eskimo type is the following: Formerly the Alaskan Eskimo chipped their arrow-head and skin-scrapers with a compound flint chipper of bone and rubbed the brash edge down to prevent tearing the skin. When he substituted the steel for the stone blade, he still employed the arrow-chipper to take the wire-edge off the blade. Finally he has invented a somewhat similar tool, with a beaver tooth in place of a bone, and this tool is now labelled knife-sharpener in most collections.

The Hupa tool for chipping arrow-heads is thus used: The work is held in the palm of the hand, which is protected by a buckskin pad, and the chips are flaked off by pressing on the edge of the flint with the tool held in the right hand, the ball of the handle resting in the palm. The Point Barrow Eskimo also press downward in chipping with a similar tool.

"The Viard arrow-maker," says Powers, "takes a piece of jasper, chert obsidian, or common flint, which breaks sharp-cornered and with a conchoidal fracture; this he heats in the fire and then cools slowly, which splits it in flakes. Then taking one of these flakes he gives it an approximately right shape by striking it with a rough hammer, then slips over his left hand a piece of buckskin with a hole to fit over the thumb (this buckskin is to prevent the hand from being wounded), and in his right hand he takes a pair of buck-horn pincers tied together at the point with a thong. Holding the piece of flint in his left hand he breaks off from the edge of it a tiny fragment with the pincers, by a twisting or wrenching motion. The piece is often reversed in the hand so that it may be worked away symmetrically. Arrow-head manufacture is a specialty, just as arrow-making, medicine, and other arts." These pincers are probably only our compound chipper. With the Klamath River Indians a piece of bone is fastened to a wooden shaft 1½ feet in length, the working point of which is crooked and raised to an edge, the force employed being all the time solely pushing. To guide the instrument with a steady hand the handle is held between the arm and the breast, while the point, with but little play room, assisted by the thumb, works on the edge of the flake, which again is held for greater safety in a piece of deer-skin. After the two sides have been worked down to a point then another instrument is required, with which the barbs and projections are broken out. This is a needle or awl of about 3 inches in length, and by a pushing motion the desired pieces are broken out, as with the first-mentioned tool.

These Indians have also what (Plate XXI, Fig. 90) is called an "arrow straightener," which they use to straighten arrow-shafts, and likewise their arrows that have become warped by use. This tool is employed thus: The arrow-shaft (Plate XX, Fig. 84) is passed through a slot, and the workman looks along the shaft and nips it with the tool where it is crooked. They go over the arrows with the straightener several times while working them down with a knife. For lashing the head and feather

(Fig. 88) the finest shredded sinew from the leg of the deer is used (Fig. 86). Glue is made from the sturgeon and paint from the ochers of the hills (Fig. 89). For filling up the interstices of sinew, wood, and stone, pitch (Fig. 87) is administered by means of a pitch-stick (Fig. 91.)

The war arrows of the Hupas are the perfection of grace. They consist of the following parts, which will be described in the following order: *head*, *foreshaft*, *shaft*, *shaftment*, and *nock*, each with its seizing or lashing. (Figs. 99, 102.)

The arrow-heads are of jasper, chalcedony, obsidian, and bottle-glass from $\frac{3}{4}$ of an inch to $2\frac{1}{4}$ inches in length, quite uniformly $\frac{5}{8}$ of an inch in width and $\frac{3}{16}$ of an inch in thickness, forming an isosceles triangle with incurved base. Side notches are made for the sinew thread which forms the lashing of the head. Bird-arrows, designed to stun rather than to wound, lack the stone head.

The foreshaft (Fig. 102*b*) is about $3\frac{1}{2}$ inches outside measure, painted or not, according to fancy, and inserted into a socket in the end of the shaft by a point 3 inches long. The shaft is always a sucker of white wood, and with the shaftment measures about 2 feet in length. There is little similarity between the uniform, straight, and delicate rod and the twig or sucker out of which it has been formed. Much time and pains are expended in removing the bark by means of wooden wrenches or nippers, in steaming and straightening with a wooden wrench (Fig. 90), scraping, standstoning with two pieces of coarse-grained sandstone having semi-cylindrical groves (Fig. 94), and finally in polishing down, not with emory paper, but with the leaf of a coarse marsh-grass full of siliceous particles.

The shaftment or feathered part is in the neighborhood of 6 inches in length. Three feathers (Fig. 88) are seized on at the ends by sinew (Fig. 86), but they are not always glued down along the shaftment. Almost universally around the shaftment, inside the feather, occur streaks of paint in endless variety of color (Fig. 102*c*), width of stripe, and order of succession. In the same quiver will occur variation of width and succession, but not in colors. These decorations have been called clan and owner marks.

Nock is the part of the arrow concerned with the bow-string (Fig. 102*d*). Itself may be flat, like a fish-tail, cylindrical like the shaftment, only wrapped with the feather seizing, bulbous as in the Chinook arrow, or flaring as in the swallow-tailed nock of the Indian tribes of the plains and the great interior basin.

On the Hupa arrows, the nock is cylindrical, slightly bulbous by reason of thick paint on the feather-seizing. The notch in the nock may either be angular or rectangular. All the sinew lashings in this series are painted.

The fishing arrows of the Hupa (Fig. 100) have a foreshaft of bone which have bilateral barbs, one, two, or three pairs, and to the front of this foreshaft are lashed the stone heads.

The Hupa bows (Fig. 103) all belong to one type, sinew-lined as distinguished from the sinew backing of the Eskimo. There are two varieties, called by the collectors war bows and hunting bows, the former 4 feet long, the latter 3 feet 4 inches, about. They are all made of yew, a little over 1 inch wide and $\frac{1}{4}$ inch thick at the handle, expanding to $1\frac{3}{4}$ inches in width in the limbs, and contracting gracefully to about $\frac{3}{4}$ of an inch at the nock, which is about 1 inch long, less than $\frac{1}{2}$ inch wide, and bent at an angle of 45 degrees.

The back of this bow is covered with a lining of sinew so carefully put on as to mimic the bark of wood, its thickness exactly fitted to the exigencies of the work to be done. The sinew of the larger animals is carefully shredded (Fig. 86) and laid on with glue made from the lower jaw of the sturgeon, making a solid mass. The back of the wood bow is gashed so as to afford a good sticking surface for the glue and sinew.

The sinew is doubled over the nocks, whipped down with strips of buckskin, and tufted with a stripe of otter fur (Fig. 103*b*). The grip is also seized with a strip of buckskin and bound by two rings of otter fur. The bow-string is of two-ply sinew twine, $\frac{1}{12}$ inch thick. Lieutenant Ray thus describes bow and arrow making among the Natano and Kenuck Indians:

Manufacture of Bows and Arrows among the Natano (Hupa) and Kenuck (Klamath) Indians.—The bow-makers of both these tribes are specialists, and the trade is now confined to a very few old men. I have here seen no man under forty years of age that could make a bow or an arrow, and only one old man who could make a stone arrow-head.

To make a bow, the wood of a yew sapling $2\frac{1}{2}$ to 3 inches in diameter is selected and rough hewn to shape, the heart side inward and the back carefully smoothed to the form of the back of the bow. The sinew is laid on while the wood is green, and held in place until dry by means of a twine wrapping. In this condition it is hung in the sweat-house until the wood is thoroughly seasoned, when it is finished and strung, and in some cases the back varnished and painted. The most delicate part of the operation is to get the proper tension on the sinew backing. If too tight the wood crimps or splinters when the bow is strung, and a lack of proper tension leaves the bow weak and worthless. When the bow is seasoned it has a reverse curve of about 3 inches.

The sinew for the backing and bow-string is taken from the back and the hind leg of the deer at the time of killing, and dried for future use. When required it is soaked until pliable, stripped into fine shreds and laid on by commencing at each end and terminating at the center of the bow. The sinew is slightly twisted and dried before it is placed on the bow.

The glue used to fix the backing is obtained by boiling the gland of the lower jaw and the nose of the sturgeon. This is dried in balls and preserved for use, and is prepared by simply dipping it in warm water and rubbing it on the wood.

The arrow-shafts are usually made from the wood of the wild currant and are worked to shape with a knife and tried by the eye. After roughing they are allowed to season and are then finished. Any curves are taken out with a straightener, made of a piece of hard wood, spindle-shaped and perforated in the middle. The arrow-heads used for war and for big game are usually made from flint and obsidian, and more recently of iron and steel. The flakes for the stone heads are knocked off by means of a pitching tool of deer antler. The stone heads are made with a chipper composed of a crooked handle to which is lashed a short piece of antler percisely similar to those which I collected at Pt. Barrow. The work is held in the left hand on a pad and flaked off by pressure with the tool in the right hand in exactly the same manner as I found the Innuits doing in Northern Alaska.

The bows made by these people are effective for game up to 50 or 75 yards, and would inflict a serious wound at 100 yards. At 50 yards the arrows will penetrate a deer from five to ten inches. I never heard of one passing entirely through a deer. The elk-skin armor which I send to the Museum, Fig. 105, is proof against any arrow.

The eye is formed in the middle of the bow-string, by a running knot, the bow-string is then twisted, the right length measured off, and the noose formed by making a half hitch so as to bring the string in the middle of the belly side of the nock. The rest of the string is wrapped around the nock and fastened off by gluing and tucking.

The ornamentation of these bows is done in red and blue paint, the forms being chiefly the triangle omnipresent in the Hupa decorator's imagination.

I shall speak more fully of the development of the sinew back in a paper on savage archery now preparing, and will merely draw attention here to the perfect success which has been achieved in converting the breaking strain upon a brittle wood into the tensile strain upon the toughest fiber in the world.

Another point noticed by Mr. John Murdoch is the similarity of these bows to those of some Tinnéh tribes in the elliptical shape of the limbs. The Eskimo have in some localities this form in the sinew-backed bow.

For a quiver (Fig. 104) the Yurok takes the skin of a raccoon or martin, turns it wrong side out, sews it up, and suspends it behind him by a string passed over one shoulder and under the other, while the striped tail flutters gaily in the air at his shoulder.

In the animal's head he stuffs a quantity of moss, as a cushion for the arrow-heads to rest in, to prevent breakage.

The Hupas employ the skin of the coon, martin, deer, fox, and otter for making their quivers.

The Hupas and Klamath Indians no longer use the stone club of the meri or patoo pattern. The specimen described by Lieutenant Ray was found in a grave; it is made of chloritic schist, and measures 12 inches long. The old men informed Lieutenant Ray that they were in common use before the advent of the white man. The meri form occurs here and there in the new world, but never so graceful in outline, so beautifully polished, nor in such hard material as the typical weapon which reached its perfection in New Zealand.

The function of weapons belonging to this class in our day is the killing of large fish, like the halibut of the Pacific coast. The National Museum contains several fish-killing clubs, somewhat resembling this weapon. It is also proper to say that forms as rude as ours occur in New Zealand. The elk skin armor (Fig. 105) worn by warriors in battle as protection from arrows is now nearly obsolete. These suits have been worn by several generations, and in some of the modern battles with the whites. The cusps and triangular figures are intended to denote the number of enemies slain and captives taken. It is worn so as to cover the left side, with the left arm through the slit, the head through the opening, and the tie on the right shoulder, and it is also tied below the right arm. The arrow cuts and bullet marks were received in battle.

There is another kind of armor made of wattles and twine, woven and bound with buckskin. (Fig. 106.) This is worn in battle to protect the body; it is tied across the breast from left to right. The red lines denote the number of enemies slain or captives taken, also the rank of the wearer.

This class of armor was in common use among the Natano and Kenuck Indians before the introduction of fire-arms, but it is now nearly obsolete. This is the only complete suit which Lieutenant Ray was able to obtain.

BOAT BUILDING.

As the redwood grows only along the Lower Klamath the Yurok have a monopoly of making canoes; and they sell many to the Karok. A canoe on the Klamath is not pointed like the Chippewa canoe, but the width at either end is equal to the tree's diameter. (Figs. 107, 108.) On the great bar across the mouth of the river, and all along the coast for 80 miles, there are tens of thousands of mighty redwoods cast up on the strand, having been either floated down by the rivers or grubbed down by the surf; hence the Indians are not obliged to fell any trees, and have only to burn them into suitable lengths. In making the canoe they spread pitch on whatever place they wish to reduce, and when it has burned deep enough they clap on a piece of raw bark and extinguish the fire. By this means they round them out with wonderful symmetry and elegance, leaving the sides and ends very thin and as smooth as if they had been sand-papered. At the stern they burn and polish out a neat little bracket, which serves as a seat for the boatman. They spend an infinity of puddering on these canoes, two Indians sometimes working on one five or six months, burning, scraping, and polishing with stones (nowadays they use iron tools and dispatch the work in a few days). When completed they are sold for various sums, ranging from $10 to $30, or even more. They are not as handsome as the Smith River or the T'-sin-ŭk canoes, but quite as serviceable.

A large canoe will carry 5 tons of merchandise, and in early days they used to take many cargoes of fish from the Klamath, shooting the dangerous rapids and surf at the mouth with consummate skill, going boldly to sea in heavy weather, and reaching Crescent City, 22 miles distant, whence they returned with merchandise. When they are not using these canoes they turn them bottom side up on the sandy beach and bream them, or haul them into damp and shady coves, or cover them thickly with leaves and brushwood to prevent the thin ends from sun-cracking. When they do become thus cracked, they bore holes through with bucks-horn and bind the ends together with withes, twisting the same tight with sticks—a kind of rude tourniquet, which closes up the cracks better than calking would do. (*Cf.* Powers, Contr. N. A. Ethnol. III.)

MONEY AND ITS USES.

The money-box is made from a section of antler (Fig. 109), probably elk. The rough outer portion has been removed and the white substance cut to resemble a flat column with banded ends. There are in this case rings at either end. Between these bands, on the concave portion, a slit $2\frac{1}{8}$ inches long and about $\frac{1}{4}$ of an inch wide is cut down to the core; the latter is carefully scraped out to form a box or pocket. Into this dentalium shells or Indian currency are put (Fig. 110), a little plate of antler laid over the mouth, and a long strip of buckskin wrapped many times around the whole and tucked in. (Fig. 109*a*.) In this particular specimen the tail of some fur-bearing animal did service, in addition to the mouth cover, in keeping the money from rattling around in the box.

A more elaborate money-box is made of a large section of elk horn; $6\frac{3}{8}$ inches long and $2\frac{1}{4}$ inches thick. The central column is 4 inches; the remaining space forms two bands at the ends, each ornamented with three deeply cut lines and the etched triangles which constitute the chief element of a carver's ornament among the Hupas. The mouth of the box is $3\frac{1}{2}$ by $\frac{5}{16}$ inches. On either side of the mouth a rectangular space is etched in triangles, leaving plain rhombs, no two of which are of the same proportions. The covering of the mouth in this case was the ivory scale of a centigrade thermometer—ominous comment upon the fate of some former prospector. Around the cover was wrapped more than a yard and a half of buckskin, about three-fourths of an inch in width. The contents of this box were most interesting. Six dentalium shells, which we shall number from 1 to 6, were thus characterized:

1. $2\frac{1}{8}$ inches, wrapped with red fish skin.
2. Same length, wrapped with red fish skin.
3. 2 inches, wrapped around the top with woody fibers.
4. 2 inches, wrapped only in upper portion with snake skin.
5. $1\frac{15}{16}$ inches, wrapped with maiden's-hair-fern stalk.
6. $1\frac{3}{4}$ inches, wrapped with woody fiber, dyed red.

Other shells are wrapped with skin and fern and tipped with woodpecker feathers.

The Karok, says Mr. Powers, use the red scalp of the woodpecker for money, which rates at \$2.50 to \$5 apiece, and the dentalium shell, of which they grind off the tip and string it on strings. The shortest pieces are worth 25 cents; the largest about \$2; the value increasing rapidly with the length. The strings are made about as long as a man's arm. It is called allikochik (Yurok "Indian money"). Formerly it was valued at $40 to $50 a string, but now the value has fallen. Shell and feather money are demanded as fines from those who in any way transgress the boundaries of religious rule, fines of $20, $30, $40, being required of one who profanely looks upon the smoke of the propitiatory fire.

Spies were often employed to visit the enemy's camp, and were paid for this dangerous service as high as ten strings of allikochik, or $100, contributed by the leading men.

Hupa allikochik is rated a little differently from the Karok. The standard of measurement is a string of five shells. Nearly every man has ten lines tattooed across the inside of his left arm about half way between the wrist and elbow, and in measuring shell money he takes the string in his right hand, draws one end over his left thumb-nail, and if the other end reaches to the uppermost of the tattoo lines the five shells are worth $25 in gold, or $5 a shell. Of course it is only one in ten thousand that is long enough to reach this high value. The longest ones usually seen are worth about $2—that is, $10 to the string. Single shells are also measured on the creases on the inside of the left middle finger, a $5 shell being one which will reach between the two extreme creases. No shell is treated as money at all, unless it is long enough to rate at 25 cents. Below that it degenerates into "squaw money," and goes to form a part of a woman's necklace. Real money is ornamented with little scratchings or carvings, and with very narrow strips of thin, fine fish-skin wrapped spirally around the shells, and sometimes a tiny tuft of scarlet woodpecker's down is pasted on the base of the shell.*

The shell money of the Round Valley Indians is made of a shell found on this coast, something like that of an oyster, only it has a smooth surface. (Fig. 111.) Similar disk money is from the shell of the olivella, the disks being cut from the lip or the shells being strung after grinding away the apex. This is broken into pieces about the size of a dime; the Indians then drill a small hole through the center of each with a sharp-pointed flint (Fig. 112), by means of the pump-drill with fly-wheel attachment. Thirty or forty of these are strung on a tough piece of wood about the size of a knitting-needle. They are then rubbed carefully on a smooth-surfaced stone until they become perfectly round. Eighty of these pieces are equal to a dollar. This description of the manufacture of flat-shell money is extremely valuable, since strings of this same character are collected as far south as Panama, and in some of the Polynesian groups. Another form of money described by Mr. Purcell has long been noted in California collections, especially that of Captain Wilkes, but its significance has not been appreciated. They

* The money of New Britain, called *Dawarra*, is made of small, rare shells perforated and strung on fiber. It is counted by measuring.

have another money much more valuable. It is a very pretty stone and looks like a fine piece of meerschaum. It is found in the mountains and is very scarce. They do not cut it into small pieces as they do the shells, but work it into cylinders from 1 to 3 inches long, which are made round and polished by the same processes applied to the shell money.

A piece of this stone 2 inches long and three-quarters of an inch thick is worth $10. They wear this money around their necks, and when one dies they often put $500 or $600 worth in the grave.

One sees among the Wailakki very pretty strings of shell money called *to-kal-li*, consisting of thin circular disks about a quarter of an inch in diameter, and resembling somewhat the Catholic rosaries, in having one larger button or "Gloria Patri" to every ten "Ave Marias." Mr. Powers speaks of a Wailakki squaw with ear-drops or pendants carved from the ear-shell (Haliotis) in the shape of fish and exhibiting the glinting tints of that beautiful shell to great advantage, and he says it is the only instance of fancy shell or bone carving aside from the common shell money that he has ever noticed.

Their mode of settling difficulties is to kill their enemies at the first favorable opportunity, and then if they wish to avoid a similar fate, a settlement is made with the relatives of the deceased, and the dead Indian is paid for according to rank and station. This payment is made in Indian money, or perhaps in white deer-skins or woodpeckers' heads. Then all are supposed to be friendly and they have their appropriate dance over it.

The murder of a man's dearest relative may be compounded for by the payment of money, the price of an ordinary Indian's life being one string. If the money is paid without higgling the slayer and the avenger become at once boon companions. If not, the avenger must have the murderer's blood, and a system of retaliation is initiated, which, however, may at any moment be arrested by the payment of money.

Among the Patawat of Humboldt Bay the fine for the murder of a man is ten strings of allikochik, each string consisting of ten pieces; for the murder of a woman it is five strings, or one hundred dollars, and fifty dollars, respectively. A man's life with this tribe is valued at six canoes, each one occupying in its manufacture three months' time of two Indians, or the labor of one man for three years.

A wife is purchased at prices varying from two to fifteen strings.

Judge Roseborough states that with the Hupas these payments are not demanded until the first full moon after the murder. Then the demand is presented by a third party. If the money is paid at once, the affair is amicably settled and is never alluded to again.

If they have a quarrel and it is not settled on the spot, they refuse to speak to each other; but if after awhile one desires to open friendly relations, he offers to pay the other man a certain amount of shell money. If this offer is accepted they exchange moneys (not necessarily in equal amounts) and harmony is at once restored.

Courtship is also conducted by means of money among the Klamath and Trinity River tribes. A wife seldom brings less than half a string, and when she belongs to an aristocratic family, is pretty and skillful in making acorn bread and weaving baskets, she sometimes costs as high as two strings, say $80 or $100.

No marriage is legal or binding unless preceded by the payment of money, and that family is most aristocratic which pays the highest price for the wife. So far is this shell aristocracy carried that the children of a woman for whom no money was paid are accounted no better than bastards, and the whole family is contemned.

In Placer County, Cal., the Nishinam Indians dun their debtors with a device called *sanchest*, which is thrown into the wigwam of the tardy individual. (Fig. 113.) A number of sticks 4 inches long and about ¼ of an inch thick are arranged on a string like a rope ladder. These sticks are painted with streaks of black and red, and represent the amount and character of the debt.

GAMBLING AND MEDICINE.

For gambling they have a bunch of small wands, one of which has a black band around the center. The game is played by any number that wish to engage in betting. Two dealers sit opposite each other on a blanket, each backed by two or more singers and a drummer, and the game commences by one of the dealers taking the sticks in both hands, about equally divided, and holding them behind his back, shuffling them from hand to hand, after which he brings them in front of his body with both hands extended and the sticks grasped so the players can not see the centers. The opposite dealer clasps his hands together two or three times and points towards the hand which he thinks holds the stick with the black center. Should he guess correctly he takes the deal, and holds it until his opponent wins it back in like manner. For each failure a forfeit is paid, and one is also demanded when the dealer loses the deal.

Friends of each party make outside bets on the dealers, and each dealer's band plays and sings as long as he holds the deal.

There is another game, essentially the same as the one above described, except that they use a smaller number of sticks, and the joker is blackened only in the center and the others at both ends and centers. Both games are called *kiu*.

Rattles employed by medicine men and in gambling are composed of many hoofs and hooflets of the black-tail deer. Each piece is pierced through the apex and suspended on a short thread upon which four white beads are also strung. These pendants are then fastened to a long belt of cloth or leather and worn around the waist or held in the hand. The hoofs striking together produce a sharp rattling sound. A small graceful lens-shaped rattle mounted on a stick is held in the hand of the dancer. (Fig. 115.)

The Hupa drum is a rectangular box covered with leather and has little merit as a musical instrument. (Fig. 119.)

The Hupa make tolerably agreeable music on a small bone whistle made either single or double. (Figs. 115–118.) Dr. Abbott describes and figures a collection of prehistoric whistles of bone from southwestern California so similar to those of the Hupa that the continuity of music in prehistoric and recent times is made out. (Wheeler, Vol. VII, 23.)

It is an important principle which archæologists sometimes overlook that arts may survive and obey the laws of technic evolution even though the men through whose instrumentality they live and have their being have had no immediate blood relationship.

Among the Karoks of California there are two kinds of Shamans—the root doctors and the barking doctors. The latter (women mostly) squat like a dog before the patient and bark for hours. The root doctor with potions, poultices, etc., medicate the parts where the ailment is discovered. They believe that witches cause a snake, frog, lizard, or other reptile to fasten to the body and to grow through the skin into the viscera. The barking doctor first discovers the seat of the disease and then sucks until the blood flows. She then takes an emetic and vomits up a frog, which she pretends came from the patient.

ABORIGINAL BOTANY.

The following-named plants enter in some manner into the daily life and experience of the northern California Indians. The list is far from exhaustive, but an effort in the right direction, which it is hoped may be followed up and corrected with reference to all aboriginal peoples. Most of the information is drawn from Mr. Powers, Dr. Watson, and the Wheeler Report, Vol. VI:

AESCULUS CALIFORNICA, Nutt. Buckeye. The shoots used for arrow-shafts and the pounded nuts used in stupefying fish, also eaten in times of scarcity.

ALLIUM CEPA, *Lunkup*, in Yokuts. Eaten as food.

ALLIUM SATIVUM. Eaten raw or roasted.

ALLIT. A kind of salt used for seasoning greens. The Indians pull up the grass in low alkaline grounds when the dew is on, and soak off the salt, or they sweep a stick through the grass and wash it to procure the salt, which is strongly impregnated with alum.

ALNUS. Alder.

AMENOPSIS CALIFORNICA, Hooker. *Yerba Mansa*, *Lipits*, in Yokuts. A piperaceous plant whose root is soaked in water and the infusion drank for a bad stomach.

ANGELICA. *Chehinkinku*, in Huchnom, *Muhachakolen*, in Hupa. The root is used as medicine and also as a charm by many tribes. The tender shoots are eaten as greens in spring.

ANTICLEA NUTTALLII, or ZYGADENUS VENENOSUS. Black-bulb grass, or by some tribes, death camass. The nut is considered poisonous by Indians of California.

ARCEUTHOBIUM DIVARICATUM, Engelm. Mistletoe which grows on the *pinus edulis monophylla.* This as well as the pitch of the same trees good for coughs, colds, and rheumatism. Making a fire with it the Indians fumigate themselves therein.

ARCTOSTAPHYLOS GLAUCA, Lindl. Great berried manzanita. Leaves smoked with native tobacco. The dried berries worn in necklaces.

A. TOMENTOSA, Dougl. and A. PUNGENS. Fruit eaten largely by all California Indians, raw or pounded into flour and made into mush or stored for winter. An agreeable cider is made by soaking the flour and drawing off the liquor.

ASCLEPIAS. Lowland milk-weed. Potter Valley and South Eel River Indians make strings, cords, and nets of the inner bark of this plant. They crush the dry stalk with their teeth or between two stones. They then strip off the outer bark and twist the bast into threads.

ATROPIS TENUIFOLIA, Watson. One of the "bunch grasses;" an excellent forage; the seeds eaten by the natives.

BIGELOVIA. Used as medicine by the Indians of Walker Lake, Nevada.

BLEMOSPERMA CALIFORNICUM, Torrey and Gray. Seeds gathered with the fanning tray and seed basket and made into mush or bread.

BRODIÆA CONGESTA, Smith. Purple flowered grass. A liliaceous plant; the nut eaten raw or roasted.

B. VOLUBILIS, Baker; STROPHOLIRION CALIFORNICUM, Torr. Climbing grass. A liliaceous plant; the nut eaten raw or roasted. Used for ornament by whites.

BROMUS VIRENS, Buckl; CERATOCHLOA GRANDIFLORA, Hook. Wild grass. Fiber used in making cord and netting by Hupa.

CALLIPROA LUTEA, Lindl.; BRODIÆA IXIOIDES, Smith. Yellow blossom grass. A liliaceous plant; the nut eaten raw or roasted.

CASTILLEIA. *Potal'-lu-kai-u-in*, in Yokuts painted cup. Use not given.

CERCIS OCCIDENTALIS, Torrey. *Sakattu*, in Yokuts. Wood split fine and used as sewing material in the coiled basketry, the basis of the coil being willow twig.

CHLOROGALUM POMERIDIANUM, Kunth. *Trokot*, in Yokuts. Soap plant. Root eaten in times of scarcity. Soaked in hot water it is used in removing tar worn by widows in mourning. The pounded root mixed in water is employed in stupefying fish. Heated and laid on old sores it cleanses and heals them. The fiber is also made into brooms and household brushes.

CLAYTONIA PERFOLIATA, Don. Wild lettuce. Used for food. Mr. Powers says that Indians near Auburn lay quantities of the lettuce near red-ant nests for the insects to circulate through it; afterwards the ants are shaken out and the Indians eat the plant with relish, averring that a sour taste has been imparted to it.

COMPOSITÆ, *Lâ'chun*, in Yokuts. The seeds of many species used for pinole and highly esteemed.

CRUCIFERÆ, *Kéyetsah*, in Yokuts. Seeds of several species used in making panada or mush.

CYCLOBOTHRA, Benth.; CALOCHORTUS. Beaver-tail grass. Genus of liliaceous plants with many species. Nut eaten raw or roasted.

DATURA METELOIDES, D. C. *Tannaikh*, in Yokuts. Jimson weed. Pounded roots good for cuts and bruises. Decoction drank as opiate, especially by shamans, who are sometimes killed by it.

ECHIVERIA LANCEOLATA, Nutt.; COTYLEDON LANCEOLATA, Benth. and Hook. Rock lettuce. One of the crassulaceæ. Eaten raw.

EREMOCARPUS SETIGERUS, Benth. Little mullein. Euphorbiaceous plant; decoction used as cure for ague.

ERODIUM CICUTARIUM. *Poh'keuts*, in Yokuts. Pin clover, pin grass. One of the geraniaceæ; eaten raw when tender or boiled for greens. An excellent forage plant, reputed to impart an excellent flavor to milk and butter.

ERIODYCTION GLUTINOSUM, Benth. *Kitnüsil*, in Yokuts. Yerba Santa. Decoction drank for fever and bad blood.

ESCHOLTZIA CALIFORNICA, Cham. *Wa-trá-ko*, in Yokuts. California poppy. Either boiled or roasted with hot stones and then laid in water.

FRANGULA CALIFORNICA, Gray; RHAMNUS CALIFORNICUS, Eschholtz. Buckthorn. Root heated hot and placed on aching tooth.

GALIUM. Used by the Nishinam as an ague medicine. The leaves and stems are heated and placed on affected parts for rheumatism.

GRASS NUTS. Large number of species of bulbous plants under this general name are pried out of the ground with the primitive digging stick and eaten raw or roasted.

GRASS SEEDS. Almost every edible seed in California has been discovered by the Indians, who apply to them the general term of grass seeds. These are parched and ground and eaten uncooked, or made into mush or cakes.

GREENS. The list of plants eaten in the spring as salad is very extensive.

HESPEROSCORDIUM LACTEUM, LINDL. = BRODIÆA LACTA, Watson. White-flowered grass. A liliaceous plant, the nut eaten raw or roasted.

JUNCUS. Mr. Powers tells us that the small bulrush is hatcheled with flints or finger-nails, bleached, and woven into breech cloths, etc.

LABIATÆ. Several species of mints are drunk in a tea or decoction for coughs and colds.

MADARIA DISSITIFLORA, Gray. One of the compositæ; seeds said to be as rich as butter.

MELICA. Eaten raw or boiled for greens.

MIMULUS LUTEUS. Mask flower. One of the Scrophulariaciæ. Used for greens in the spring.

MUSHROOM. Eaten raw or roasted.

NICOTIANA QUADRIVALVIS, Gray, N. PLUMBAGINIFOLIA, Bolander. *Lógon*, in Yokuts. Wild tobacco. Smoked alone or mixed with manzanita leaves. Has a pungent, peppery taste. Said to have been rudely cultivated or protected by the Indians by keeping down inimical weeds. This primitive agriculture is probable, since the Pimos of Southern California have a planting festival in the spring, when they climb the mountains and insert gourd seeds into congenial crevices of the rocks, leaving them to grow. In autumn they return to gather the harvest of gourds, which enter largely into their domestic economy. The Yokuts dry their tobacco, beat it very fine, then wet and compress it into large, solid lumps. It is used frequently as a poultice on cuts. Professor Watson thinks the *Nicotiana bigelovii* is the original of the *quadrivalvis.*

PARMELIA SAXICOLA. A greenish-gray lichen, from which a tea is made as a remedy for colic.

PELLEA BREWERI, Eaton. A kind of fern used as tea.

PHACELIA. There are thirty-five species of this Hydrophyllaceous plant. Mr. Powers mentions Phacelia in the Indian botany, but does not give the use.

PHORADENDRON VILLOSUM, Engelm. Oak mistletoe. Smoked by Chimariko as a substitute for tobacco.

PHOTINIA ARBUTIFOLIA, Lindl., HETEROMELES ARBUTIFOLIA, Roemer. California Holly. Berries eaten with relish.

PINUS EDULIS, Engelm. Nut or silver pine. The piñon pine, the most useful tree to northern California Indians. Nuts for food, poultice, dress, and jewelry. Inner bark, buds, and cone cores used for food when tender in the spring. Pitch placed on sores, arrow wounds, etc. Cone core and bunch-grass boiled together for hair-dye.

PINUS LAMBERTIANA, Dougl., P. FLEXILIS, James, P. SABINIANA, Dougl. All furnish nuts for food and the shells are worked into necklaces and other ornaments.

QUERCUS AGRIFOLIUS, Née. Nishinam eat the acorns.

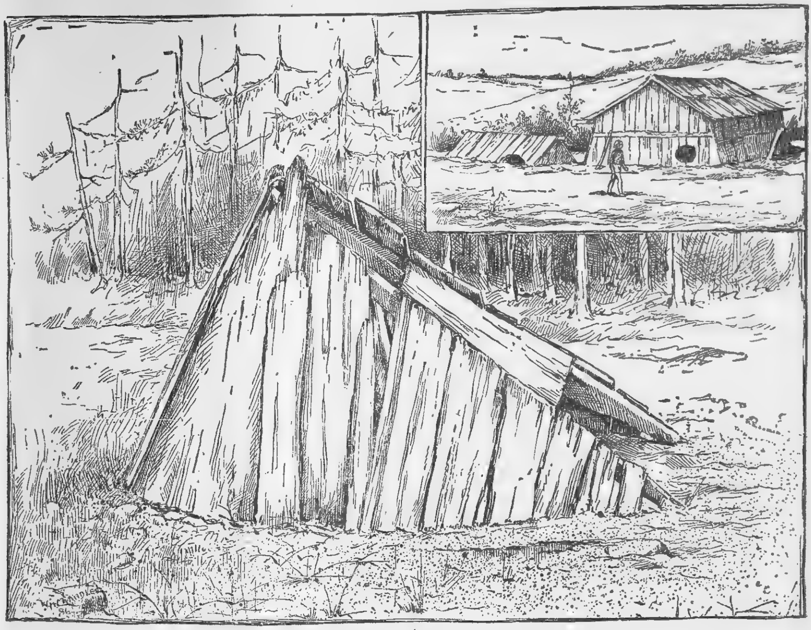
QUERCUS GAMBELII. *Esin*, in Yokuts. White oak. Acorns used most commonly for food.

Q. LOBATA, Née. Q. BREWERI, Engelm. *Kin'min*, in Yokuts. Burr oak. Staple food, but inferior to *Q. Gambellii.*

Q. DENSIFLORA. Chestnut oak. For food.

Q. SONOMENSIS, Benth. Q. KELLOGII, Newberry. The black oak. Acorns eaten when no others are procurable.

Q. WISLIZENIA, A. H. The live-oak. The Nishinam eat the acorns when they can procure no other.



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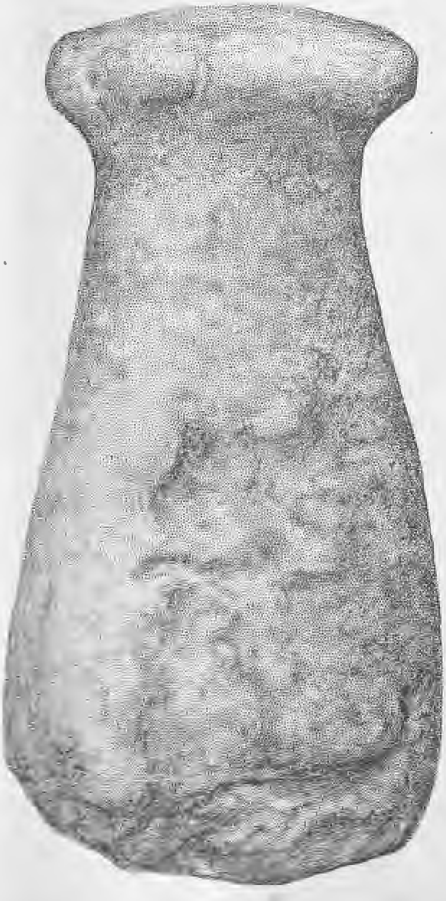

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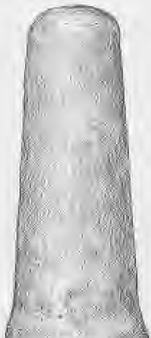

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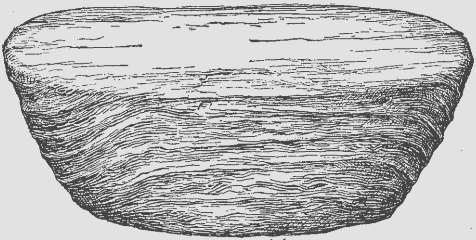

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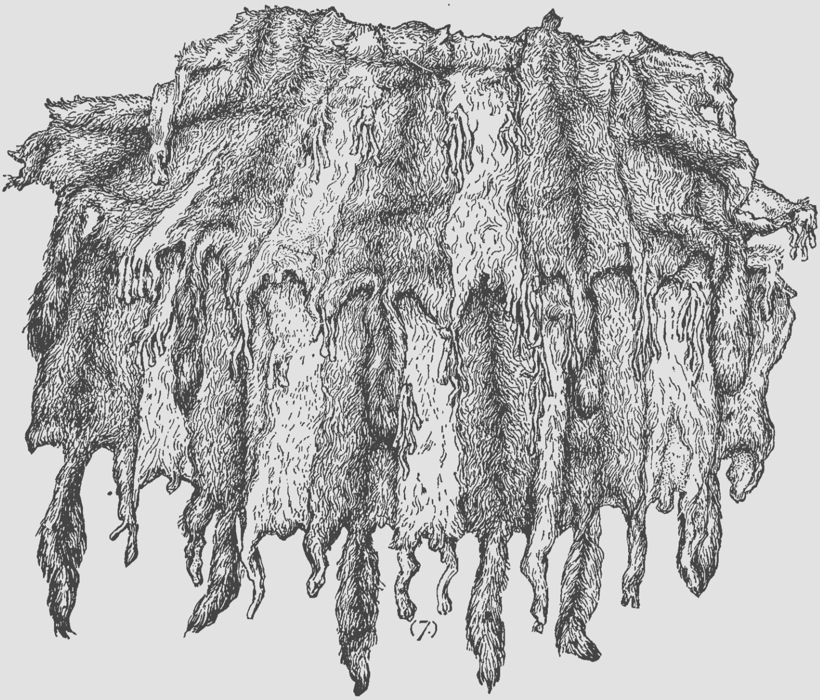

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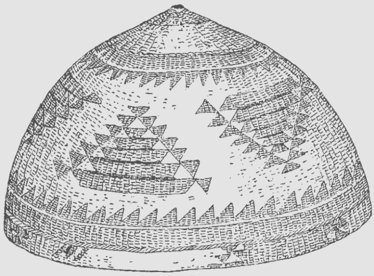

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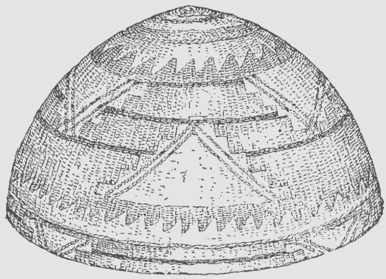

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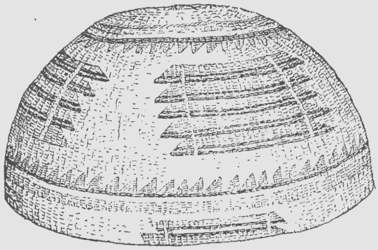

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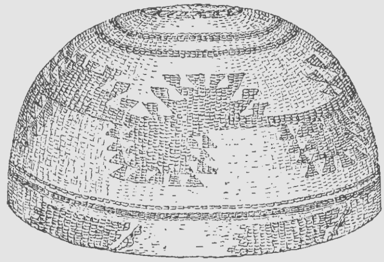

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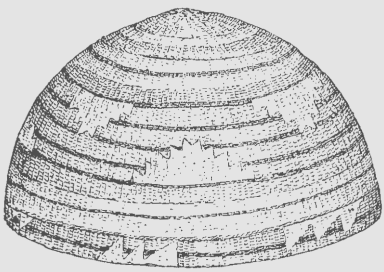

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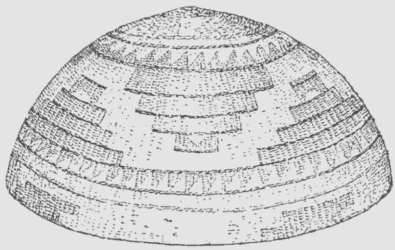

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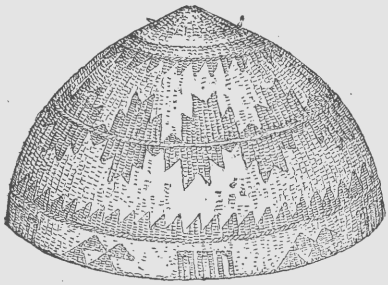

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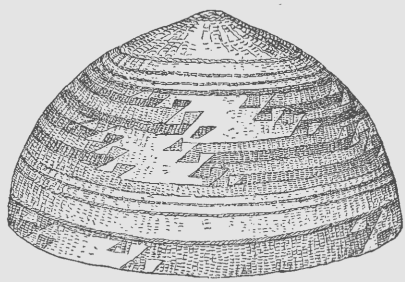

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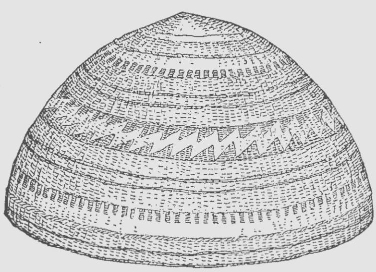

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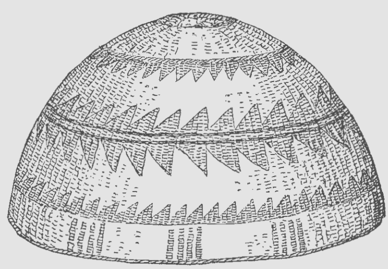

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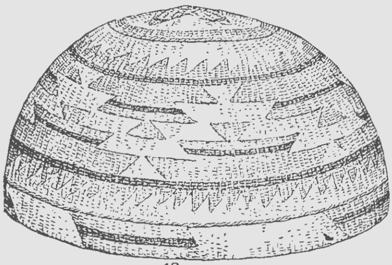

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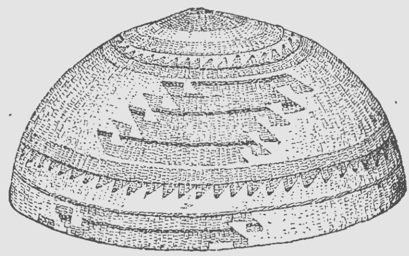

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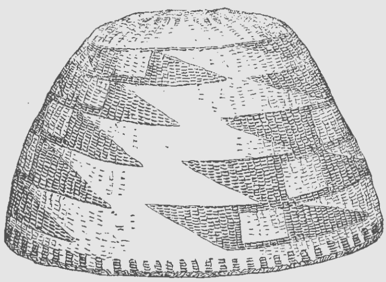

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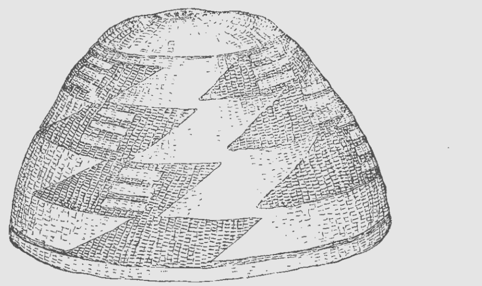

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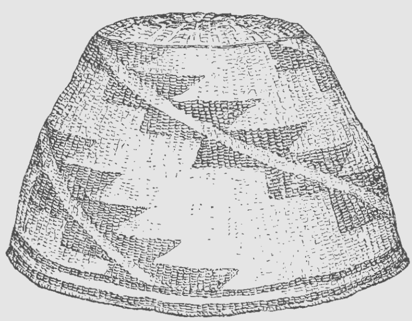

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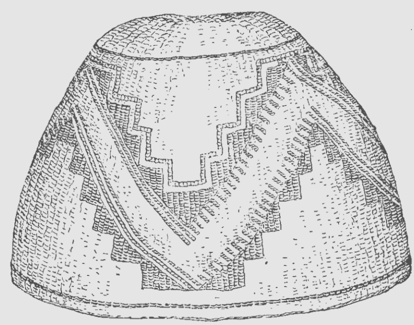

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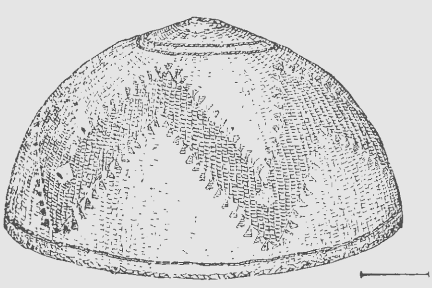

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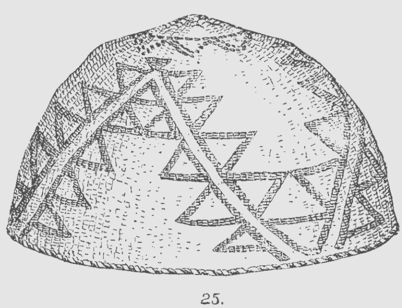

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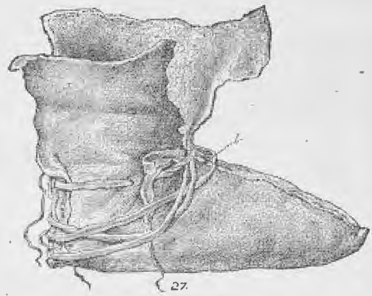

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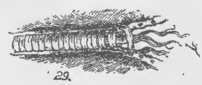

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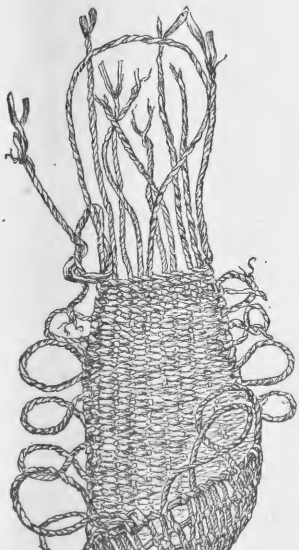

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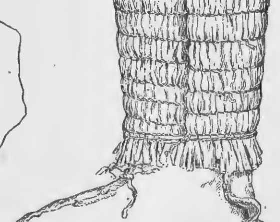

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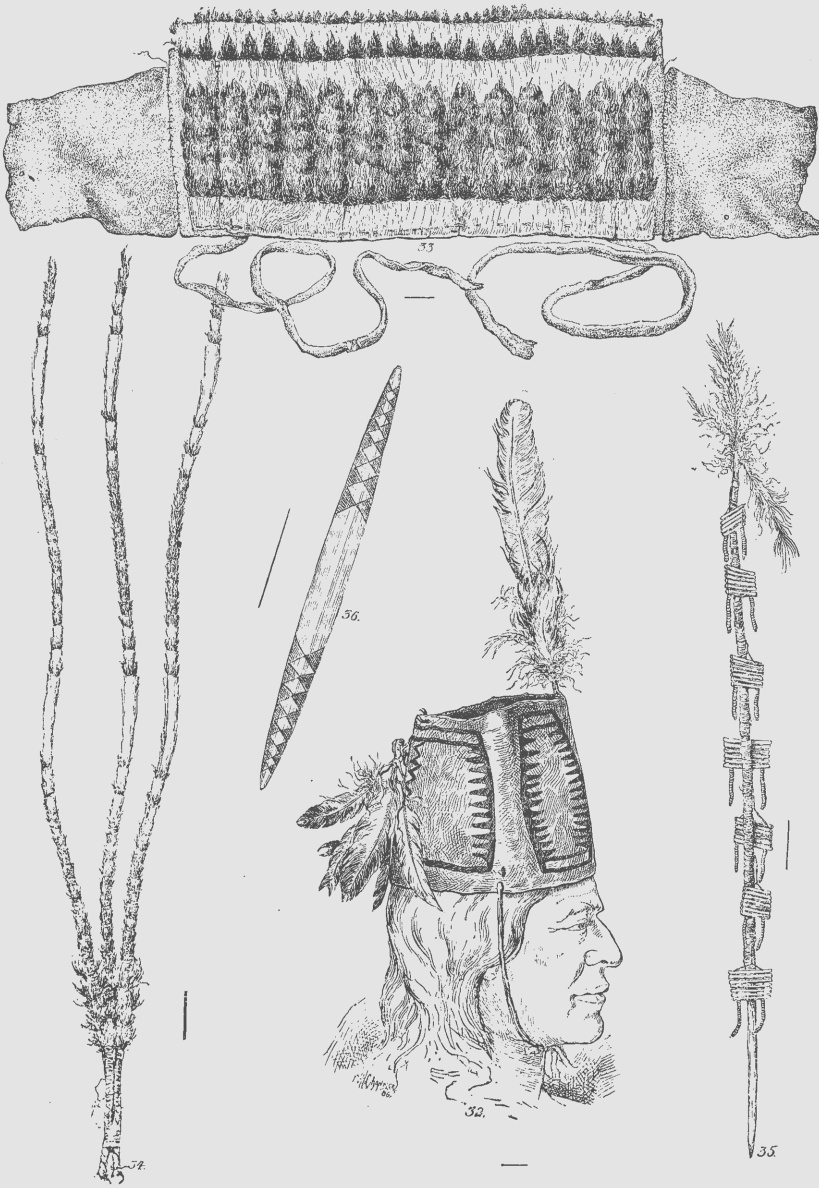
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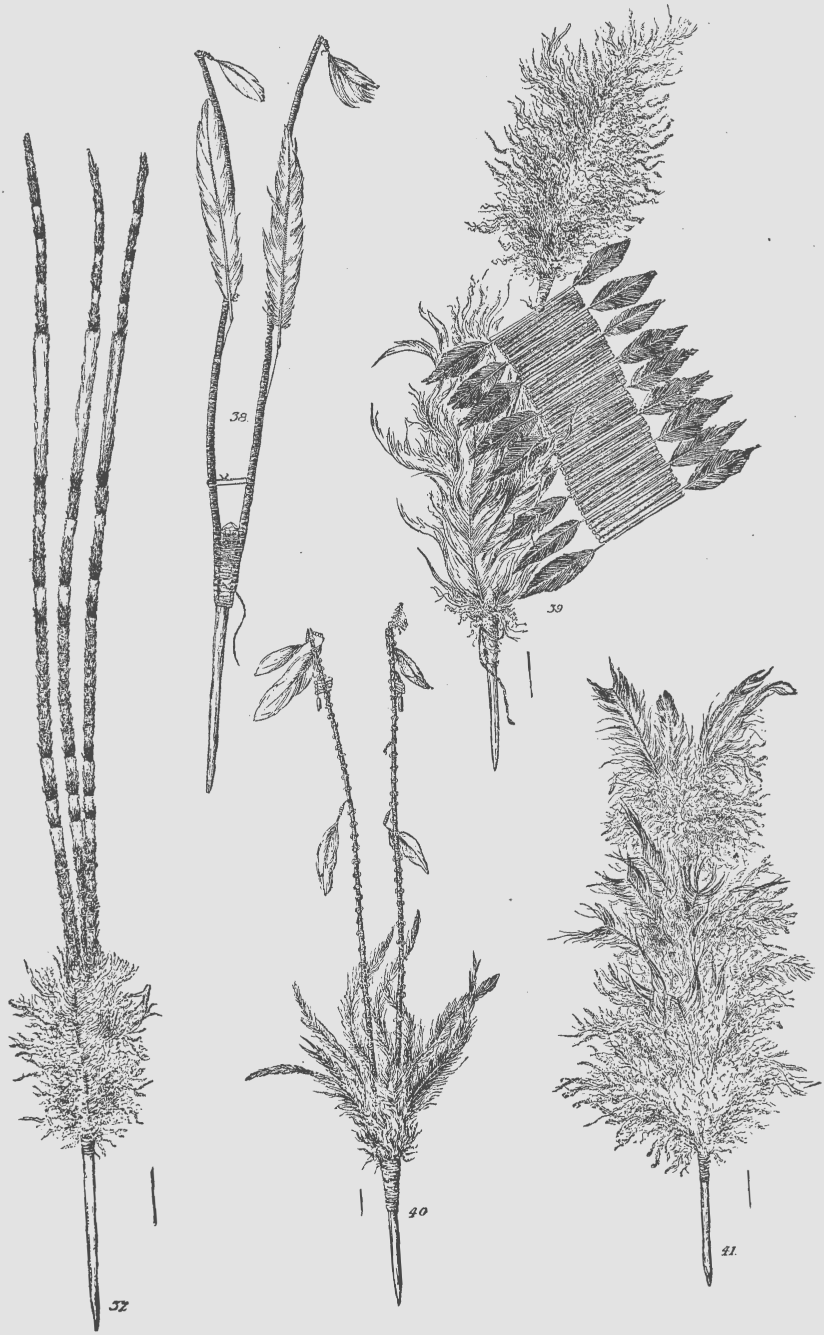

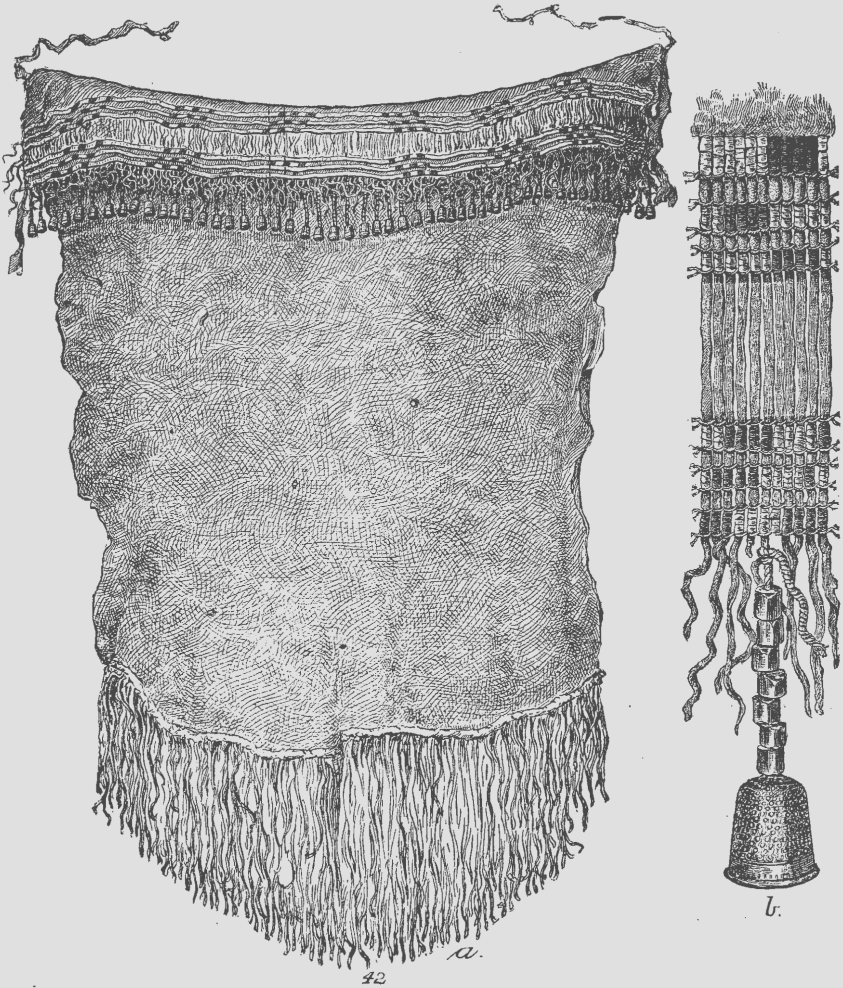

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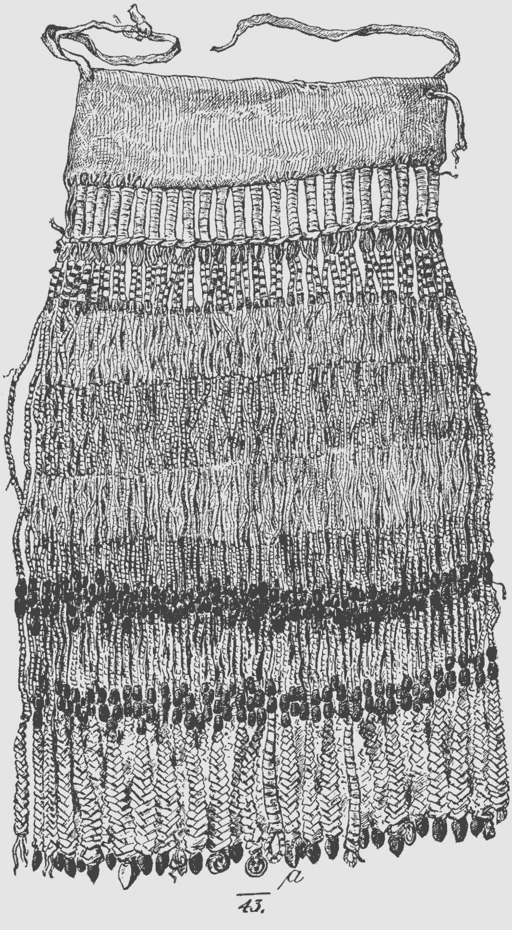

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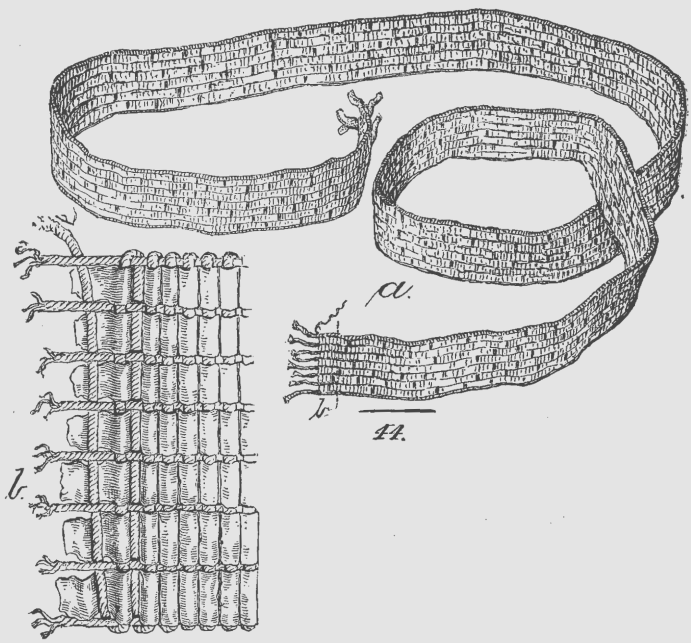

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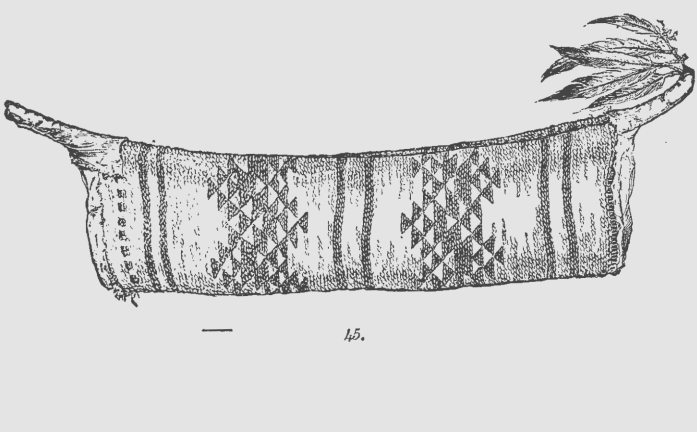

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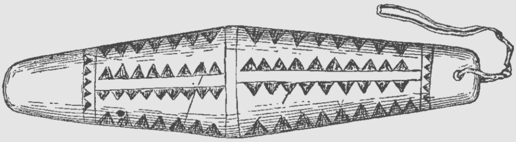

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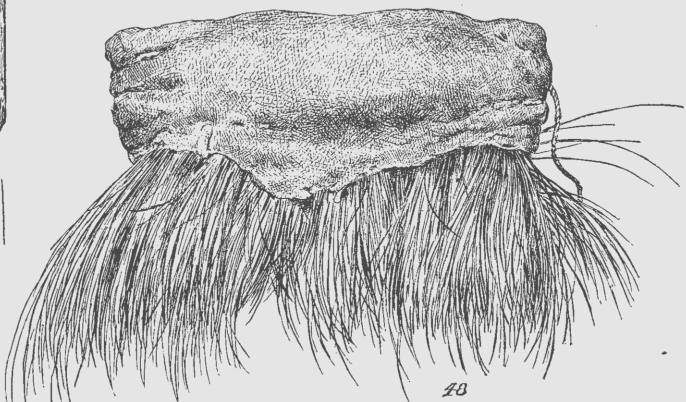

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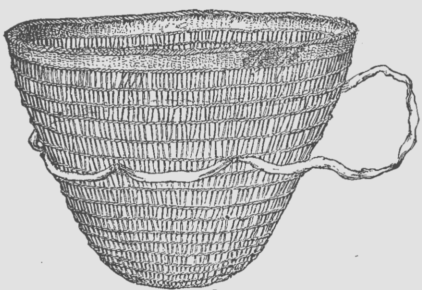
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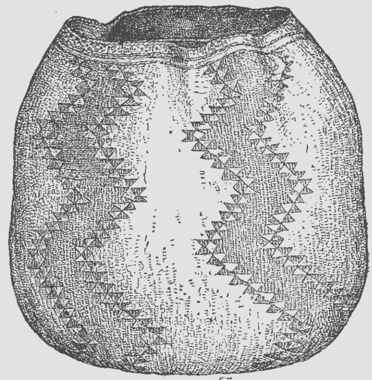
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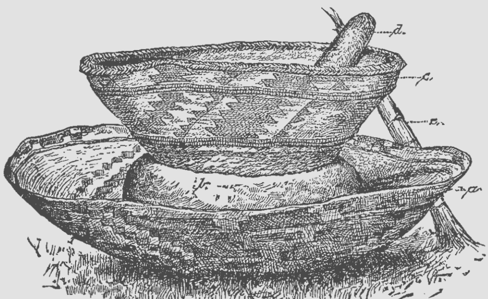
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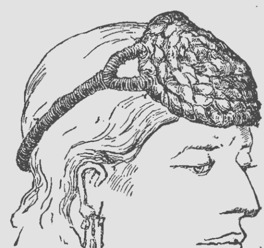
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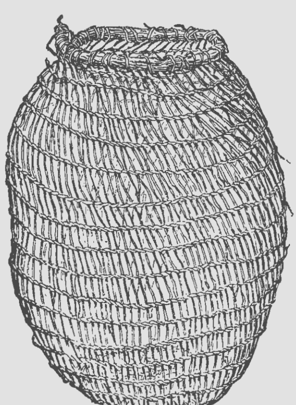
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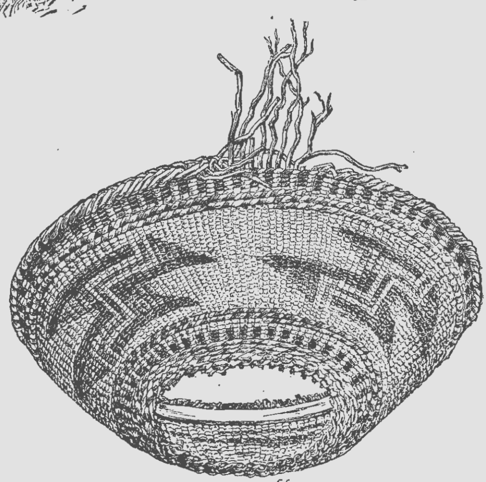
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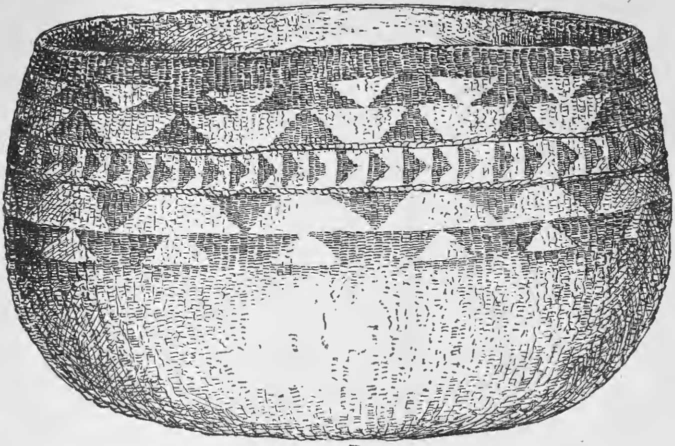

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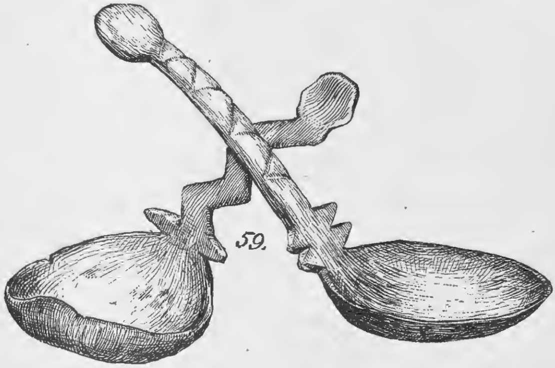

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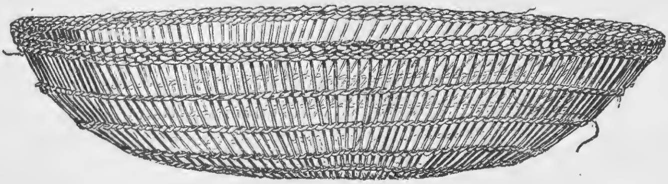

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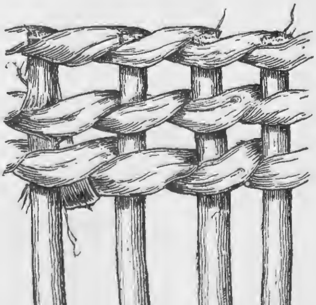

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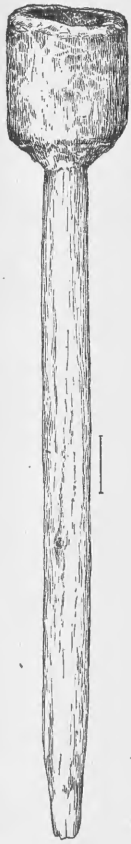

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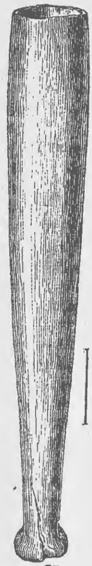

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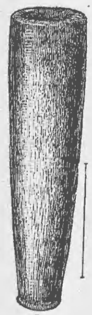

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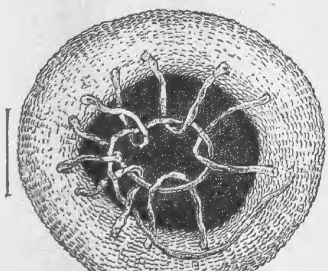

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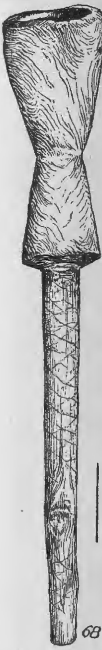

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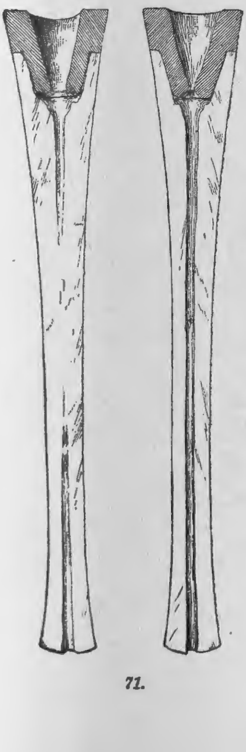

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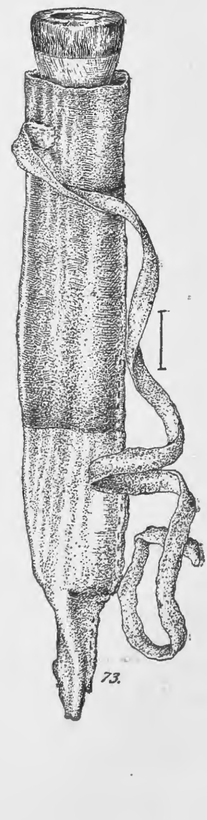

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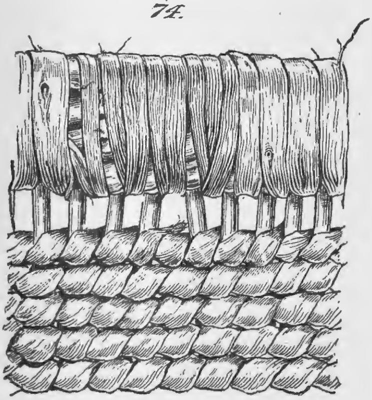

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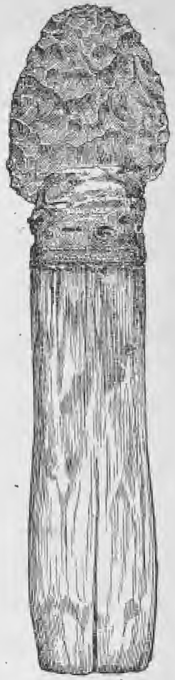

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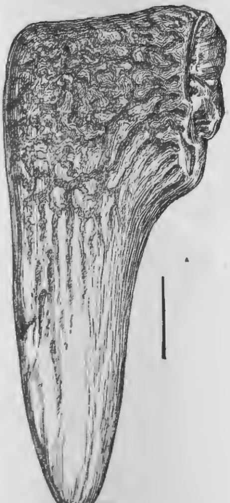

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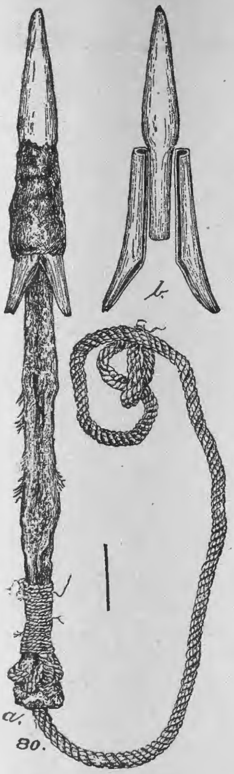

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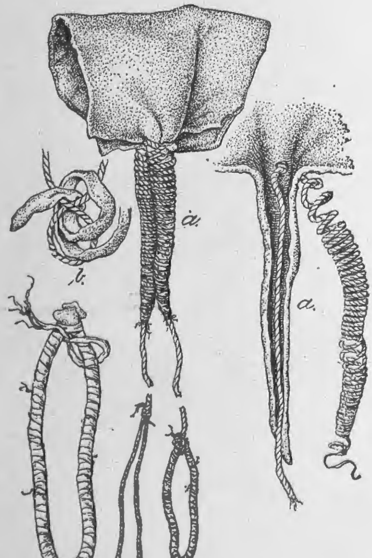

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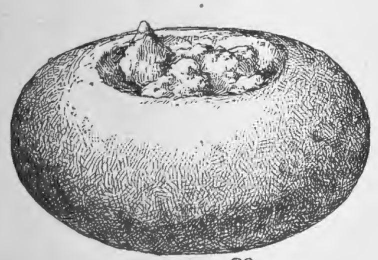

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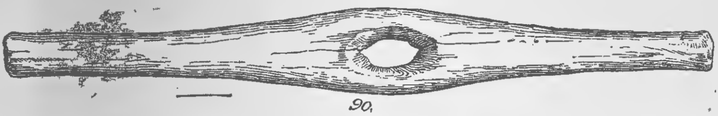

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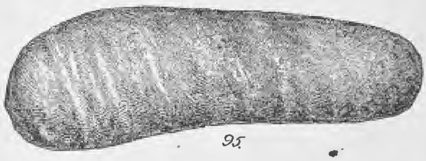

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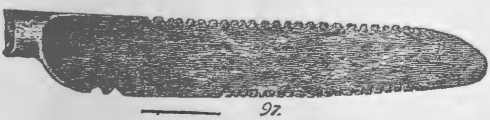

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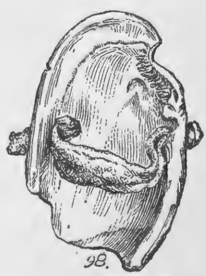

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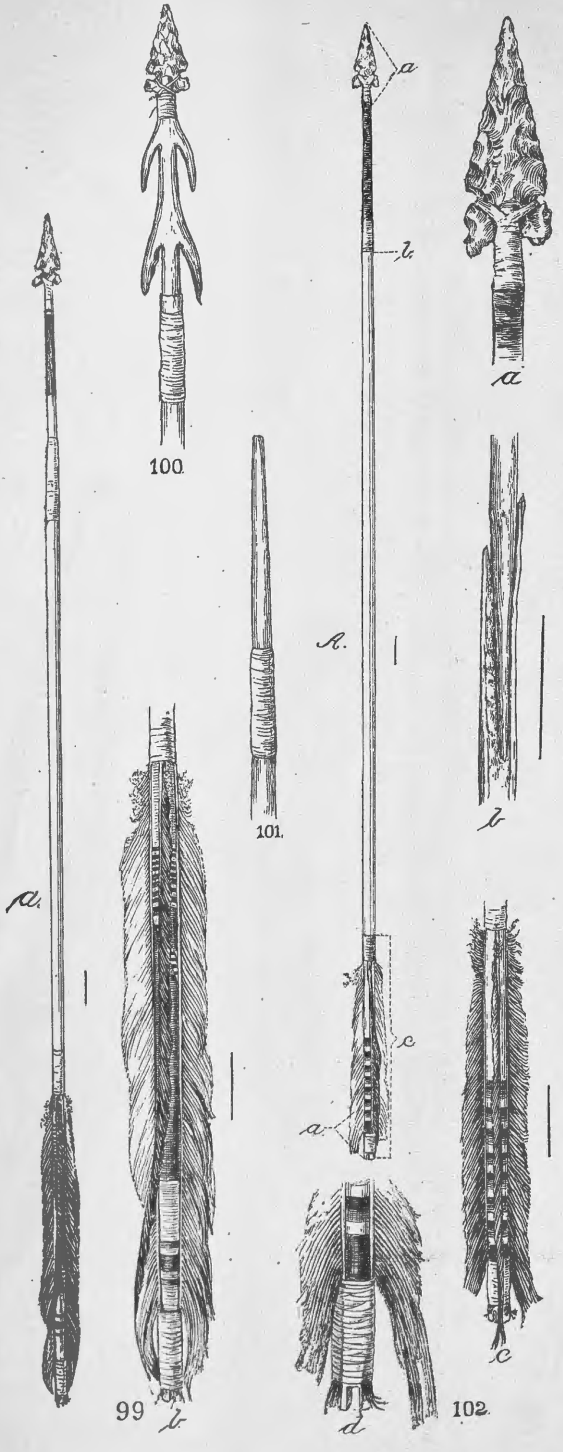
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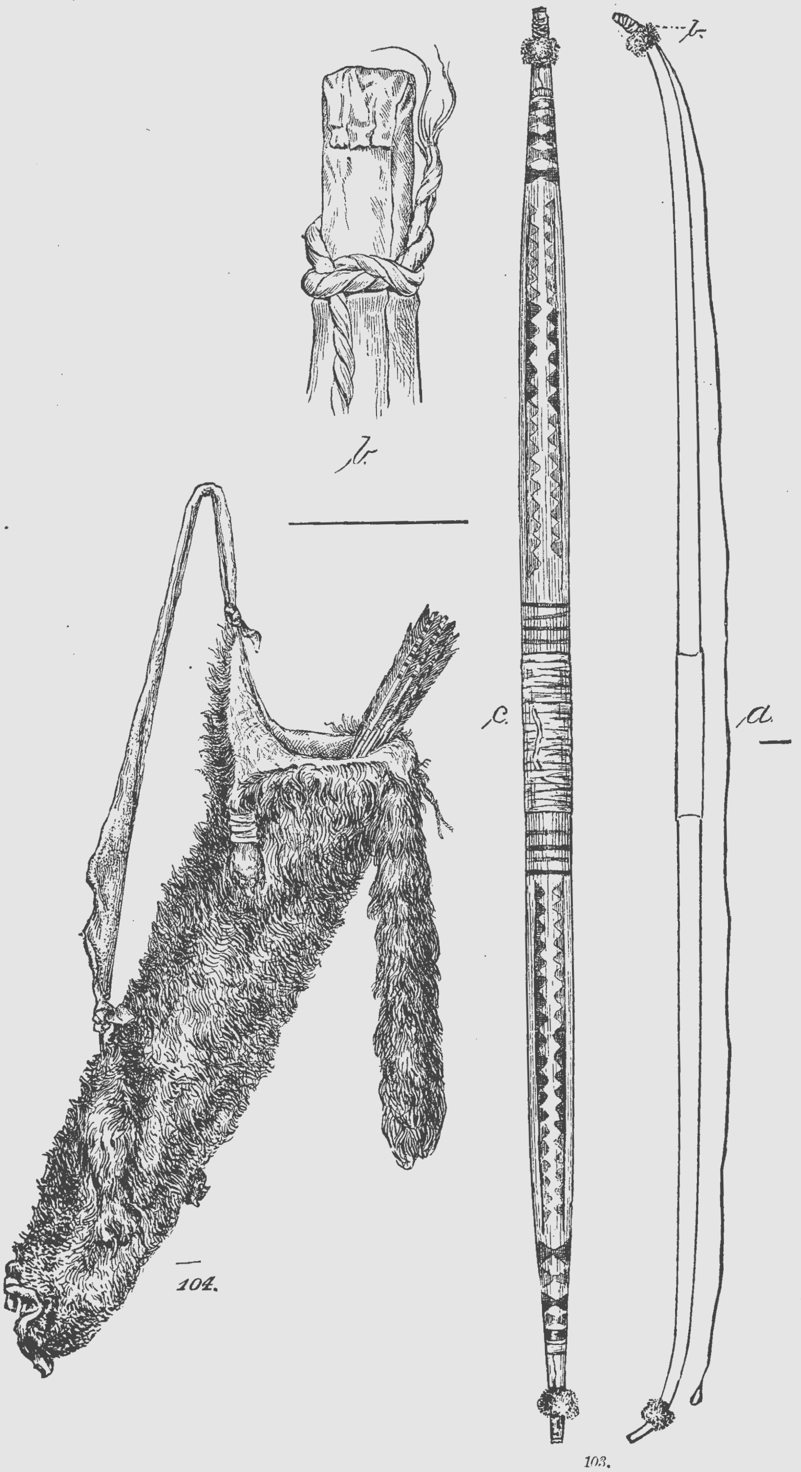
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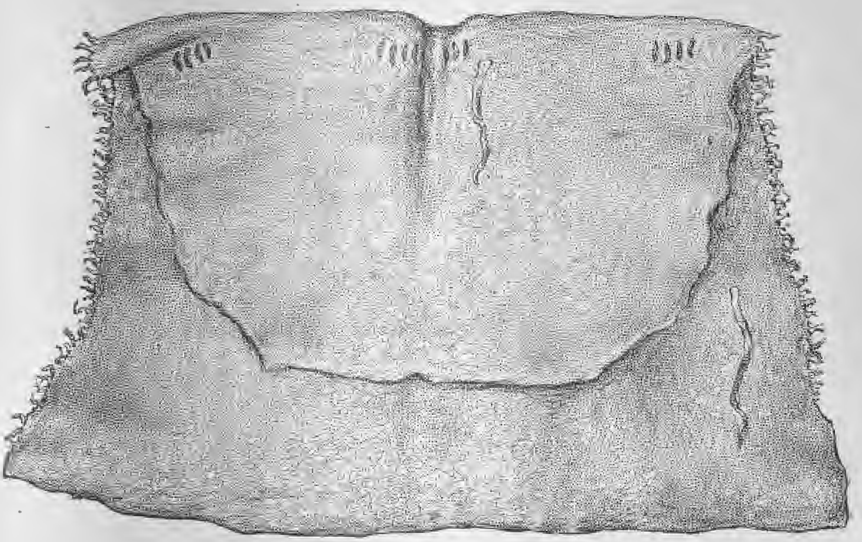

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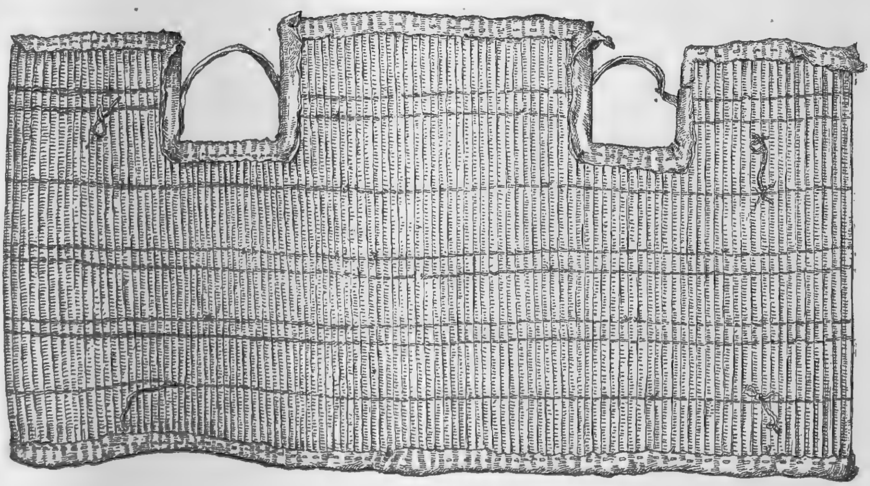

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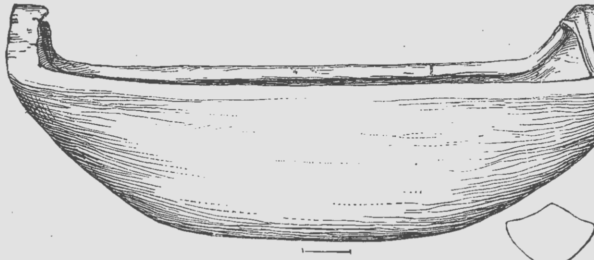

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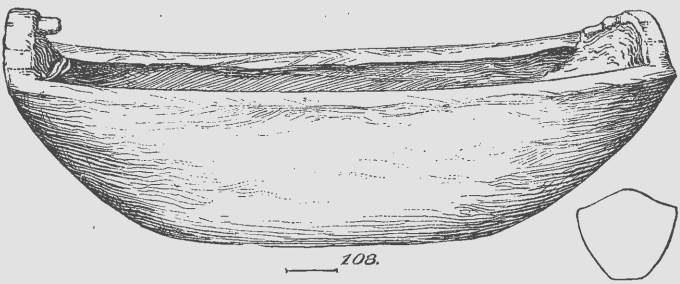

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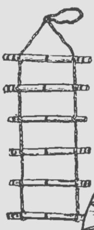

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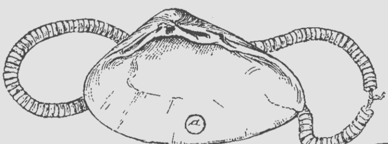

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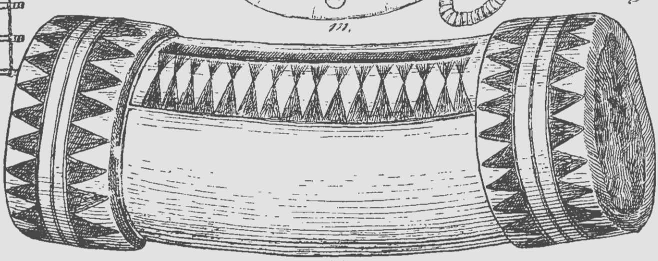

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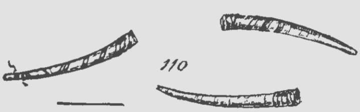

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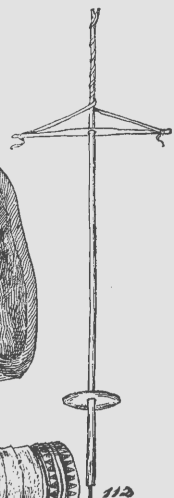

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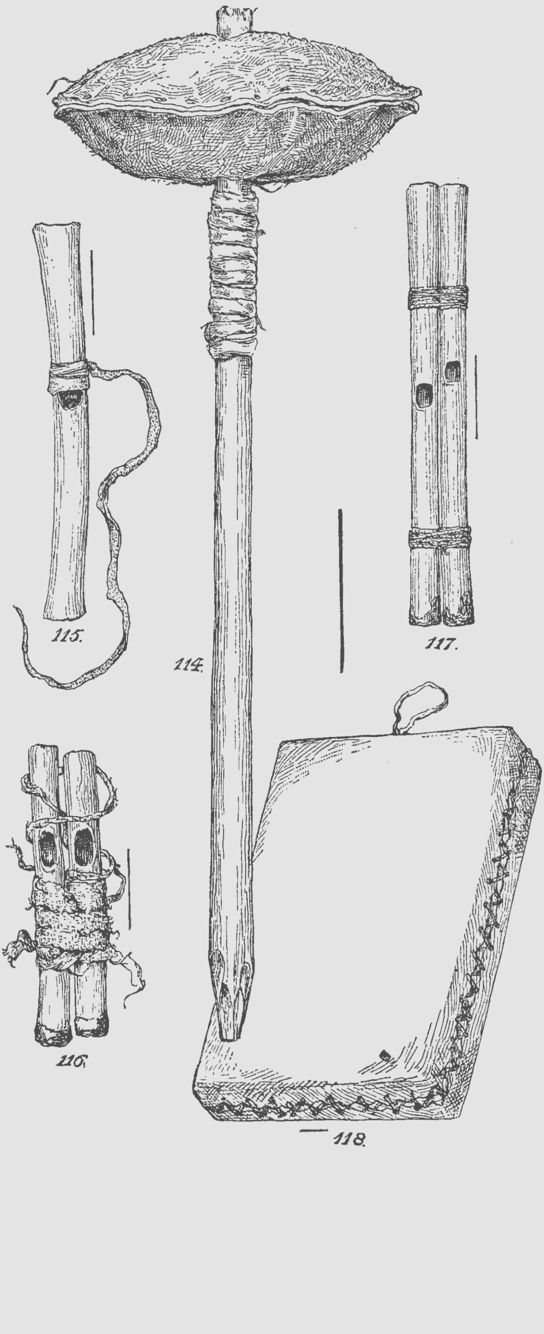
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RANUNCULUS CALIFORNICUS, Benth. Yellow blossom or crow-foot. The seeds are gathered by sweeping through the plants a long-handled basket or a gourd. The dry, parched flour has the taste of parched corn.

RHUS AROMATICA, var. TRILOBA, Gray. The fruit is said to be pleasantly acid and the slender twigs make beautiful coiled basketry.

R. DIVERSILOBA, Torr. and Gray. Poison oak. Indians less poisoned by it. Leaves eaten as antidote to poison. Women use the leaves freely in cooking. They lay them on a pile of roots or a batch of corn bread over which are placed hot stones and earth.

RUMEX. Yellow dock. Leaves eaten in spring. Root heated and applied as a poultice for acute pain.

SALIX. Willow. Twigs made into arrow-shafts and form the body of the coiled basketry.

SALVIA COLUMBINA. Seeds roasted and ground by Southern Californians and Mexicans. Seed-like nutlets infused in water form a pleasant, mucilaginous drink, which is largely consumed.

SAMBUCUS. Elder. Berries eaten.

SANICULA TUBEROSA. Torrey. The turkey pea. An umbelliferous food plant.

SCIRPUS LACUSTRIS, Linn. Tule plant. Pollen used for food. It is beaten off in a cloth and made into pinole or mush. The bulbous roots are eaten and the stalks are exceedingly useful in matting and basketry.

SPOROBOLUS ASPERIFOLIUS. *Tsuk-kus*, in Yokuts. A coarse grass, whose leaves are extensively used in basketry.

TRIFOLIUM. Clover. *Takornes*, in Yokuts. Boiled with dock and other herbs for greens. Also eaten raw.

VITIS CALIFORNICA, Benth. Wild grape. The fruit universally eaten.

XEROPHYLLUM TENAX, Nutt. Used by Hupa in making ornamental basketry.

A NAVAJO ARTIST AND HIS NOTIONS OF MECHANICAL DRAWING.

BY R. W. SHUFELDT.

One of the best known sub-chiefs of the Navajo Indians in northwestern New Mexico is Mariano. This man controls a camp of his people some 20 miles from the military station of Fort Wingate, which latter place he frequently visits. His father was a notable chief before him, and Mariano is highly respected for his sagacity and wise ruling among the remnant of the tribe now under his sway.

An elder sister of his, known among the Navajos by the name of Esta-yeshi, lives in one of the crudely constructed habitations built by these people on the hill-sides close to the Government buildings of Fort Wingate. Esta-yeshi, of whom we present an admirable portrait, is exceedingly masculine in her tastes and instincts, even for a Navajo woman, and when she came to have her picture taken she insisted upon holding her revolver in one hand and steadying her favorite Winchester beside her with the other. The Navajos say that this woman is one of the best, if not the best, blanket weaver in the tribe, and many a time have I watched her skillful weaving, with interest. Nor does she lack intelligence in other respects, for she is often consulted in matters of no little import in the tribe.

Esta-yeshi has a grown son of about twenty-two or twenty-three years of age, whom the Navajos call "Choh," which means some kind of a bird, I believe.

Choh had an unfortunate accident happen to him as an infant. He was strapped up, in the manner of all Navajo papooses, to his little board in a thoroughly confined manner, and had been placed near a smoldering camp-fire by his mother. Something or other tipped him over, face downwards in the hot ashes, and before any one could reach him his face all about his mouth had become frightfully burned. The scar from this has never left him, and his nose is nearly as flat as his face to day.

This Indian is one of the ever-to-be-seen characters about the garrison of Wingate. Usually he is extremely untidy in his appearance and awkward in his carriage. Indeed, with his eccentric movements and great moppish head of hair and highly revolting features, many of the children stand in great awe of the poor, disfigured fellow.

He is by no means the stupid clown we would take him to be, however, upon first sight, as we will very soon see.

Long before I knew Choh had any claims to being one of the artists of the tribe I had been struck on several occasions, when closely studying the peculiar expressions of his face, unknown to him, by certain lights of intelligence that would come into it in spite of its pitiful deformity; these were much enhanced by his overflowing good humor, for he is a warm-hearted, happy type of an Indian, in spite of his repulsive exterior.

It is wonderful to see the affection that Esta-yeshi has for this scarred and half-crippled son of hers. She is never so happy as when he is about; has taught him all that lies within her power to teach; does everything for him, and is pleased to the last degree when he will allow her to decorate his person with all those trappings so impressive in the eyes of the Indian and in which we see him decked out in the accompanying engraving. The two eagle feathers at the side of his head denote his claim to royal blood.

Fort Wingate, in common with all United States military stations on the frontier, has its building known as the trader's store, though the post-office and other minor establishments are included under the same roof. This building is a great resort for the idle ones among the Navajos, who, during most of the time on week days, lounge about on its veranda, incessantly smoking their cigarettes, or if it be cold they practice the same around the stove in the center of the main room within.

Choh forms no exception to this almost general failing, but is, indeed, reckoned among the most inveterate of the regular habitués. When he comes, however, his time is rarely spent in idleness, for, after rapidly puffing through one or two cigarettes, he will saunter over to the distant end of one of the long counters of the salesroom, where he is soon at work on some of the sheets of wrapping-paper there to be found with his bit of illy sharpened pencil. It is a curious sight to see this Indian at his drawing. He is obliged to bring his face almost down in contact with the paper on account of his eyes, which were permanently injured by the burn I have already alluded to above. In this position the great mat of coarse hair which covers his head tumbles all over, so as almost to hide the subject which engages him, from the observer at his side.

The first time I overlooked Choh to see what he was about he was laboring away at a gaudily dressed chief riding at full tilt upon his Indian steed. His work was rather above that of the average Indian artist, but as I had seen many of their productions before and watched many of them while they executed them, I paid no special attention to this additional example of an old story.

Choh has been presented at various times with one of those red and blue pencils, when the results of his handiwork exhibit a striking appearance indeed. Flaming red frogs with blue stripes adown their backs and sides, with still more pretentious birds, will be found on every piece of paper that comes beneath the hand of this untutored artist.

His figures of Indian men and women are particularly worthy of notice, and one in watching him carefully can gain some idea of the relative importance that he attaches to the various parts of their war and ordinary trappings through the emphasis with which he depicts some of them.

But Choh is not much of a naturalist, as his woful delineations of birds and animals will testify, and it was not until a week or more ago that I accidentally discovered the true channel in which his talents lay. I was passing through the salesroom with my budget of mail when I noticed this Indian as usual bent over his paper and more than ordinarily absorbed in the design he was engaged upon, beneath the great disheveled mat of a winter's growth of the blackest of hair that hung down from every part of his head.

The glance I was enabled to get at his paper satisfied me in an instant as to the cause of his increased interest. He was at work upon a locomotive, with its tender and a couple of baggage cars, and was just then giving the finishing touches to his design. The effort attracted my attention at once, because an Indian's idea of a locomotive, drawn by himself without the object before him, was to me something certainly worthy of examination. The drawing of birds, and frogs, and lizards, in their crude way is a thing we somehow naturally look for, and as it has been a fact for so long a time before us, perhaps we take it, too, as a matter of course that such people would make endeavor to depict objects which were constantly before their eyes in their common environment. A moment's consideration would also convince us that among these very Indians, as it is with more highly civilized races, there would be different degrees of merit exhibited even among those who laid claim to being proficient in the same branch. I saw this well exemplified nearly a year ago, among the Zuñi women, as they fashioned and painted their pottery at the Pueblo, and no doubt it holds good everywhere and in all paths of human activity. It was very prettily brought before my mind in the case of the Zuñi women, for one of the group that I was watching on the occasion referred to was painting a jar for me, when I got her to understand that it was my wish that she should incorporate an animal and a few birds in her design. At this she despondingly shook her head and pointed, with rather an envious gesture, I thought, to one of her companions who sat opposite as the one who was skilled in that part of the work.

Another thing I have noticed is that the majority of these Indian artists are great mimics, and there is much to lead us to believe that many of their designs, both in pottery and in art, have become quite stereotyped. Not long ago I pointed out this fact in an article which I contributed to Science, wherein I showed how the Zuñis had clung, perhaps for ages, to a common model for the owl.

But to draw a locomotive at all well is a vastly different thing, and particularly so when it is done from memory alone. This is a great, complicated thing, crowded with detail, and an object which the majority of the Navajos have only had the opportunity of seeing for a few years. The question possesses no little interest from an educational point of view; for if one full-blooded Navajo Indian can, of his own volition, thus step out of the archaic aboriginal rut and make a passable picture of a steam-engine, are there not hidden sparks and abilities in other directions, and how would this one thrive if it were properly guided and nourished?

Choh presented me with his drawing, and during the course of the day made me two others upon some rather common drawing paper, which I gave him for the purpose. The last two efforts were even better than the one he had made for his own amusement, and each possesses points of interest that they do not have in common.

I selected the one I considered the best of all, and present it here as one of the illustrations of this paper, it having been reduced rather more than one-third for the purpose.

In one of the others he drew the telegraph poles and wires alongside the track, and placed a bird on top of each pole—a very common sight in this prairie country; but the birds are entirely out of proportion with the rest of the picture, being fully ten times too large.

In the third he has attempted to represent the rays of light as they issue from the headlight, and the steam in this one is blowing off. His powers of observation have served him well here, for he has drawn the white steam simply in outline, and has tried to show how it cuts through the smoke, which is drawn black, as it comes from the stack.

One of the most interesting things to me was to observe the great care he took to show the "bright line" on the smokestack. Not only that, but he was familiar with the fact that it did not show on the under side of the upper enlarged portion of this part of the engine. He has likewise represented it upon the brass steam-chest and elsewhere, and there is an evident attempt to properly shade the body of the engine itself, or boiler. Now, surely this is good work for an untaught Indian, and I can attest it is far above anything that I have ever seen one of them attempt before, much less accomplish.

Again, the detail about the engine is by no means bad, and, moreover, each of these locomotives is upon a somewhat different model, as in one he has the bell in a frame in front of the sand-box, in another it is belted to it, while finally, in the third, it is in the middle, between sand-box and steam-chest. The driving-gear is not as well shown in the figure as he is wont to make it sometimes, and one has to but watch him draw these parts to become satisfied that the man is ignorant of the principle involved.

He invariably places two men within the cab, and takes evident pains to always draw the top of this part perfectly flat.

For the tender he usually adopts one model, from which he rarely departs, though sometimes he fills it heaping full of coal, while at others, as in the illustration, he neglects to put any in at all. He has examined the method of coupling, for it is carefully shown in one of the figures, though in another a thickened line indicates this arrangement.

It is an extraordinary thing to watch him put the letters on the tender and baggage cars. He must make these entirely from memory, yet he never strikes it as they should be, for it is quite evident that his combinations do not agree with the actual abbreviations used by the railway companies; yet Choh writes these on precisely as if he were positive as to their correctness, and we must own that the form of the majority of his capitals is not bad. He invariably, however, makes his great J's after this fashion, Ɩ, and nearly always turns his capital W's upside down. Often he places the oblique bar across the door of the baggage car, with a window above it, and I see in one of the drawings, he has adopted the elevated plan of brakes seen in this class of cars. Here, again, however, it is quite clear that he has not mastered the use of this contrivance, perhaps one of the simplest in use of all the gearing employed upon a train of cars. The perspective for the wheels, and the proper way of drawing them upon the opposite rails, is another weak point, which he endeavors to conceal by filling it in with the shadow.

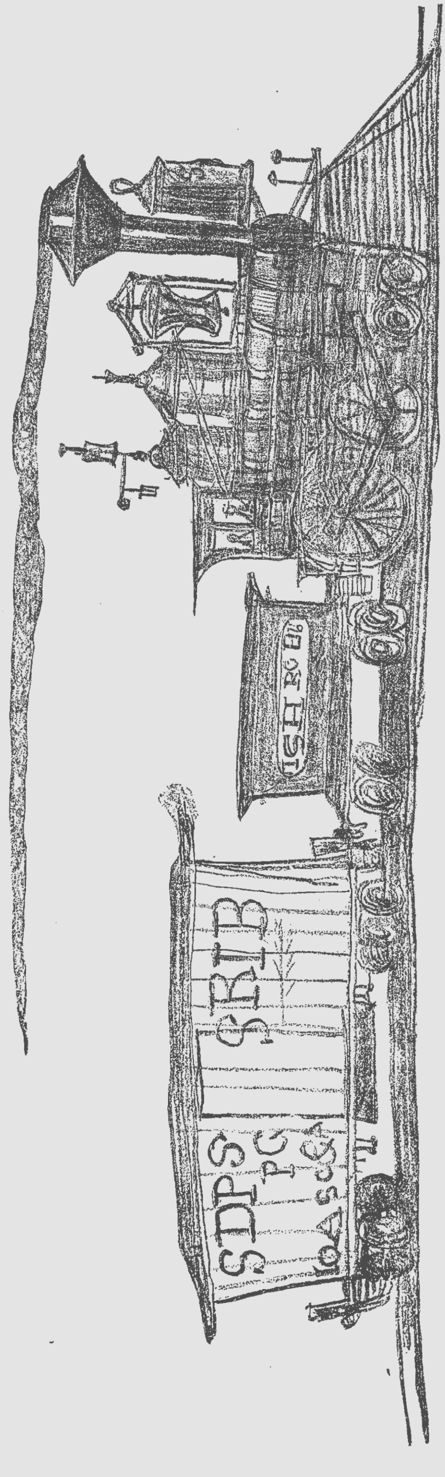
These are the leading points which occur to me for criticism in this drawing, that, taken as a whole, is truly a wonderful piece of work for one of these people. When we come to consider really how low they are in the scale of civilization, it is an astounding production. About Wingate, here, the majority of these savages live more like bears than men, sheltered as they are, summer and winter, in the low, rude "shacks," which they build of limbs and twigs of trees on the hill-sides.

Moreover, it is not as if this man had the opportunity of studying a locomotive every day of his life, for the railway station is fully three miles from his Indian home, and there is nothing else to induce him to go there.


CHANDLEE DEL.
WITTICK PHOTO.


CHANDLEE
APRES PHOTO

PLATE III.



NOTES ON CUSTOMS OF THE DAKOTAHS.

By Paul Beckwith.

The Dakotahs or Sioux now scattered over the great Northwest are divided into seven bands and many sub-bands, as follows:

(1) Sis si-ton-wans, or Village of the Marsh. The major portion of this band are now at Devil's Lake Agency, Dak. The I-san-ties, a sub-band who take their name from a former residence at I-san-tine-di, or Knife Lake.

(2) Wah-pe-ku-tes, or Leaf Shooters, a wandering band scattered over the prairies of the Northwest.

(3) Wah-pe-ton-wans, or Village of the Leaves, from their homes in the woods.

(4) I-hank-ton-wans, End Village of the Lake.

(5) I-hank-ton-wan-na. This band and the preceding, having united, are now known by the name of Yank-tons, and are found on the prairies and agencies of the Northwest. The sub-bands of this confederation are Pa-bak-sa, or Cut Heads; Wa-zi-ku-tes, or Pine Shooters; Ki-guk-sa, or Breakers of Law; and the Hunk-pa-di-dan. From the Wazikutes branch of this band the As-sin-na-boines are said to have sprung.

(6) Te-ton-wans, or Prairie Village, number over one-half of the entire Sioux nation, and comprise those bands most opposed to cultivating the soil. General Custer was defeated and annihilated by this band. The sub-bands are as follows: Si cau-gu, or Burnt Thighs; I-ta-zi-pa, or Bow Pith; Si-ha-sa-pa, or Black Feet; Min-ni-kau-ye-wo-zu-pi, or They who plant by the water; O-o-he-non-pa, or Two Boilings; O-gla-la, and Hunk-pa-pa.

(7) Mdi-wa-kan-ton-wans, or Village of the Spirit Lake, from a former residence at Mille Lacs.

Da-ko-tah is to say the leagued or the allied, and they speak of themselves as the O-ce-ti Sa-ko-wi, or Seven Council Fires.

DANCES OF THE DAKOTAHS.

Wi-cas-ta-wa-kan, holy or medicine man, the high-priest in the religious ceremonies of the Dakotahs, invariably a chief, who through these dances or religious ceremonies retains his influence in the tribe, understands thoroughly the medicinal properties of the various herbs used by them, and often performs cures acknowledged by Army surgeons as remarkable. An Indian staggering into camp many hours after being bit by a venomous snake, his leg swollen horribly, was cured in a short time; the late Dr. De Wolf (U. S. Army surgeon killed in the Custer massacre) and the writer saw the man. The doctor said there was no cure for him, yet he was cured by a medicine man. Another cure, a cataract of the eye, was effected by the insertion within the lids of brass filings. To impress upon the mind of the patient the divine nature of his medicine the medicine man adds to the efficacy of his remedies, mysterious incantations, contortions of feature and body, accompanied always by the drum, often placing upon the ground a paper or bark figure, and while the friends are holding the patient over it, shoots it with his gun. As the patient is held over the figure the sickness falls to the ground, enters the figure, and as he kills it with his incantations and his gun, it will not re-enter the patient. All this power is received, they say, through the Great Spirit, who confers upon them a spiritual medicine so powerful that they can kill at will, resuscitate the dead, and cure the sick. The spiritual medicine is represented by a bunch of feathers, a claw, a bird or animal head, a pebble; anything, in fact, that strikes their fancy. To keep their medicine from the gaze of the profane a medicine-bag is prepared from the skin of birds or small animals, decorated with beads and porcupine quills, and in this bag the medicine is placed, and is carried with them always, as long as they are followers of the Wa̍u-kan Wa-ci-pi, holy or medicine dance, and as its name implies, the religion or worship of the medicine of the Dakotahs, their manner of worshiping the multiplicity of gods through their medicine. A council is held by the head-men of the order, who appoint to act as soldiers ten members of the order, who, selecting a suitable spot, erect a 3-foot barricade, in form an ellipse, at each end a tent, one for the high-priests to hold their councils, and in which to keep their Pa-zu-hi-ta-wau-kan, the other for the soldiers, who preserve order, wait upon the dancers, prevent spectators from leaning upon the barricade, and attend to a large cauldron of meat and wild turnips cooking over a fire immediately in front of their tent, often replenished during the ceremonies.

The high-priests entering the circle from their tent, and the soldiers taking their places, the members are admitted by families or groups, who, standing in line, face the east, or medicine tent, in unison throw up their hands and shout, "Brothers, have mercy upon me." The head of the family or spokesman relates where and when each one was initiated into the order, chanting a refrain to the high-priest and holding the medicine-bags in the left hand, tightly pressed against the heart, the right arm raised as if in the act of affirming, trots around the circle crying, "Friend and brother, have mercy upon me;" when reaching the starting place he chants again, this time in praise of the Wau-kan Tan-ta, or Great Spirit, and takes a seat upon the ground, leaning against the barricade. All the members as they enter go through with the same programme.

The high-priest, taking his seat in the medicine tent, appoints four assistants; to one is given a small drum, to the next a pillow and stick, to the third a rattle, and the last assists in grunting. The big drum in the center of the circle, has several drummers, who add without cessation, to the din. The high-priest now speaks to them of this, the holy dance, founded centuries ago, relating how powerful was the medicine of their ancestors, and advising unbelievers not to scoff at them or their medicine, as they have the power to thrust a claw or a stone through the body of any one at will, causing instant death. To show them how strong his medicine is, he calls up one of his assistants, and pointing his medicine-bag at him, gives a puff with his lips, whereupon the assistant falls apparently senseless upon the ground. The high-priest prays the Great Spirit to aid him, bowing to the north, south, east, and west, asks the assistance of the members in bringing their dead brother to life. All the instruments are pounded, accompanied by frantic gesticulations and sonorous grunts, the lifeless man gradually returning to consciousness, and spitting into his hand a mass of froth and blood, in which is a claw or a stone. The high-priest now dances around the circle, showing his medicine-bag, and imitating the animal from which it is taken. Advancing rapidly towards one of the members, he holds his medicine-bag to his mouth and blows over it towards the one selected, who, giving a yell, falls to the ground. The chief continues, and the "dead men" reviving, assist in shooting others, until the ring is full of howling savages, dancing, yelling, and shooting each other. A signal is given, all congregate around the big drum, raising one foot, then the other, alternately, keeping time with a lateral swing of the body, the men chanting in a sepulchral tone, seeming to die out in the pit of their stomachs, and the women on the outside of the group, raising themselves on the ball of their feet, imitate the peculiar call of the female swan. The hoarse guttural sounds of the men, and the clear swan-like notes of the women, the two blending together, were very musical. During the ceremonies the assistants of the high-priest, in performing their office and upon their instruments, trot around the ring faster and faster, grunting at each step, form into line in front of those selected, advance and retreat several times, then rushing forward, thrust their instruments into the hands of their successors, take the seats just vacated, and now represent the gods of the north, south, east, and the west, the high-priest representing the Wau-kan Tan-ka or Great Spirit. When a candidate is initiated he is first taken into the council-tent for instructions, which are secret, stripped of his clothing, excepting an apron or cloth and moccasins, painted black from head to foot, a red spot about the size of a nickel painted between his shoulders. The candidate is exhorted to remain good, and his medicine will be strong, and that he must give a feast once a year; if not, he will be unfortunate, and meet with sickness and death; if good, the Great Spirit will make his heart strong. The candidate now receives the holy claw or stone; the high-priest approaching from the east with his medicine-bag describes the course of the sun, bowing to the four quarters, says to the candidate, "Now prepare yourself, I am going to transfer to you what I have in my medicine-bag," and thrusting his bag torward the candidate, says, "There goes the spirit." At these words the candidate, kneeling on a blanket, falls upon the ground. All those that wish now come forward and, as offerings, throw over the prostrate figure robes, blankets, skins, and ornaments. By the power of the high-priest the candidate recovers, as described before, is presented with a medicine-bag, and is a recognized member of the order. He must attend the three following meetings in the same costume, painted black, after which he appears as he may wish. Women are members of this order. Dead Indians, men and women, are initiated into this order, through the same performance over a lock of hair of the deceased, wrapped in skin or cloth, laid upon the ground, with robes, blankets, etc., piled as an offering upon it, and afterwards distributed among the members. They say the spirit by this initiation is set on the right road, straight to his or her destination. After the ceremonies the soldiers distribute the food, and the feast commences, constituting the principal attraction to the multitude. The dance, commencing at daylight, lasts until daylight the following morning, and as these dances are given, even in mid-winter, many degrees below zero, one can readily imagine the agony the candidates must undergo, clothed only in a coat of paint. It is generally supposed that the members of the order have secrets and signs, but the penalty is so sure and swift that no exposures have ever been made. Well-known instances have occurred, where indiscretion of members have been punished by their mysterious disappearance, attributed to the medicine men.

Pa-gi-mi-hi-na-ka- Wa-ci-pi.—The circling crow dance, also called the straw or grass dance, is controlled by three men, the most influential of the tribe, who wear a peculiar insignia, a tunic of crow and eagle feathers attached to a belt ornamented with beads and quills; over the small of the back project two sticks several inches long; at the ends are jingling bells, every motion of the wearer causing the sticks to vibrate and the bells to jingle. These tunics are held sacred, and no profane hand allowed to touch them. The next officers of the order are the four drummers, each provided with a baton of office, a stick wrapped with porcupine quills and strings of beads, the four sticks being used to suspend the drum, and a large wash-tub or cheese-box, covered with skin, the sides draped with fine cloth, ornamented with feathers, beads, and quills. The duties of the drummers are to strike the drum with full force and to keep up an incessant singing. Stewards are appointed to collect provisions, which are rarely refused. When sufficient is collected to last several days the three leading men are notified, who, calling the lodge, make arrangements for the dance. The crier then goes through the camp announcing when and where the dance will be held.

The three chiefs appear in their feathered tunics and the members in their most brilliant paint. Seating themselves upon the ground, wrapped in their blankets up to the eyes, the drummers open the ball, the dancers throw their blankets aside, and springing to their feet brandish their tomahawks or knives with violent gestures and an occasional whoop, chant and dance for a few moments, resume their blankets and their seats, leaving one in the ring, who, fiercely gesturing, and wildly waving tomahawk or knife, will brag unmercifully over some exploit in war or chase; again all jump up, dance, and yell. A repetition of the same performances is gone through with again and again for several days or until the provisions are consumed. They will imitate animals, taking raw meat or a fish, snarl, growl, and snap over it, tearing it with their teeth like the wild beast they are so well imitating. All questions are first discussed by the head-men in council, pro and con, and are then put to vote, the votes in the affirmative represented by a stone, those in the negative by a piece of wood. No decision is arrived at until after many pow-wows; even then another lodge will be called in to participate. A question of importance once decided, the head chief of the band will be called in, whether a member of the lodge or not, and he must perform the mission they have intrusted him with, and as their influence is largely kept up through these orders the chiefs are glad of these commissions. There are no signs or pass-words, and with the exception of the skunk-skin garter, elaborately ornamented with beads, there is nothing to designate the members from the outside world. Though this order is of late date it is the most powerful among the Indians. During this dance, if a member wishes a divorce from one or more of his wives (they generally add one or two just before the dance for this purpose), he proclaims that he (naming himself) throws away (naming her), and she is no longer his wife. An outsider, by payment, can deputize a member to act for him. No member will act as spokesman for any one not a member unless paid a retainer's fee, generally a gun or a horse; the more influential gain fifty to one hundred horses during the year, but have to give away as many to retain their influence.

There are no ceremonies of initiation; they generally give a horse, starting him off with a cut of the whip, for any one who chooses to catch him. The order is a charitable one. An old woman called on the order, stated her poverty; immediately the crier was sent around the camp, and in a few hours the members were all present, as they will drop any work or pleasure when called. The leader stated the cause of the meeting; the result was flour and pork, thirteen blankets, calico, fine cloth, and skins. Another instance: An Indian, wishing to build a house, invited the order to a feast; as he was not a member, one stated his wants. After the feast the building was soon completed. Though a charitable and social society, it is one very much feared; and there exist lodges among all the different tribes and bands throughout the great Northwest.

Hi-wau-gag Wa-ci-pi.—The sun dance.—The Sioux are superstitious, and firm believers in dreams, signs, and omens. This dance is given to avoid sickness or any misfortune that may have been foretold by a dream, sign, or omen, it is a self-inflicted punishment the Indian undergoes to propitiate the Great Spirit.

A circle is formed of green branches stuck into the ground; in the center, forming a triangle, are planted three poles or saplings, one much longer than the other two, the trunks cleared of branches excepting a tuft at the tops, a piece of white calico is fastened on one and a piece of red cloth on the other, both burnt after the dance, as they are then considered sacred. To each of the poles is fastened a stout thong, as high as a man's head from the ground. The dancer takes his place in the center of the triangle, and making incisions through the flesh on shoulders and breast, ties the ends of thongs through the incisions, and places between his lips a small quill whistle through which he breathes, at each respiration giving a shrill whistle. He is clothed only in a shawl tied around his waist falling to his knees, his body painted black, hair loose and hanging upon his shoulders, and with rings of white rabbit-skins tied in his flesh on shoulders and legs. As the sun sinks below the horizon this dance of torture is commenced by a slow sidewise motion of the body, as each foot is raised and lowered, their eyes following the course of the sun as it revolves around the earth, and as it rises above the horizon their eyes are kept fastened upon it. This is kept up until sunset, if the dancer has not succumbed through weakness before this; he tugs and strains in his efforts to pull the thongs through the flesh, and finally falling with his whole weight tears the thongs through, generally rendering himself insensible.

The dance, as its name indicates, is in honor of the sun (typical of the Great Spirit), and the great object is to keep their gaze upon it, the object of their adoration, or cease to follow its course, whether beneath or above them, in whose honor they are suffering these tortures. The drummers and a regular band of singers keep up a chant of "The Great Spirit keep us." In dancing, the arms to the elbows are held pressed to their sides and from elbows straight out to the front, hands clinched, the feet raised alternately from the ground, the body moving from side to side and backward and forward, stretching the gashes to their fullest extent. To see one undergoing this fearful torture called dancing, naked, painted black, hair streaming, blood trickling from their gashes, the shrill whistle at each breath, the hoarse gutteral singing, the dull thud of the drum, is a dreadful sight indeed.

I-wa-hi-ci-pi.—The scalp dance.—This dance follows the bringing home of scalps. A circle is formed, on one side stand the warriors, their bodies painted red, the feathers in their head-dress denoting the number of scalps taken, tomahawks, knives, and guns, in their hands; on the other side stand the young women in their best attire, carrying the scalps stretched on hoops and dangling at the ends of long poles. The musicians, drummers, and singers, squat upon the ground near by. The men commence the war song, sometimes forming a circle, dance around the women holding the scalps, who join in the refrain, as it were, then again forming in two lines facing each other, all dance forwards and backwards. If the scalps have been captured during the winter the dance is kept up at intervals until the leaves grow in the spring. If taken in the summer, they dance and rejoice over them until the leaves fall off. Painted red four times, then they are buried. Each time the scalps are painted the warriors are expected to give away their blankets and their clothes, as their hearts are strong.

Ce-ki-ti-pi.—The virgins' lodge.—This feast or ceremony is only participated in by those who are virgins. If reports are circulated in the camp derogatory the girl immediately gets up a "Virgins' Lodge." An old man is selected, who arranges the tipi or lodge, in which the feast is to take place, by smoothing the ground two or three yards in diameter in the center of the lodge. In the middle of the cleared space is placed a round stone, near it a knife is planted, blade up. The crier goes through the camp, specifying where and when the feast will be held. When all are assembled the girl enters, places her hand on the point of the knife blade, typical of the god of war, that he may pierce her through with this sharp blade if she is not pure; then on the stone, typical of the god of the mountains, that he may crush her; then placing her head against the earth, typical of the god of the earth, that he may open the earth and ingulf her if she is not truthful; she then takes her seat, her accuser is brought forward and goes through the same ceremony, and then openly accuses her; if his accusation is not substantiated, he is led from the lodge amid the jeers and laughter of the spectators. After the trial the feast commences, and the girl goes forth with unblemished character. This feast excites a beneficial effect morally upon the Indian women, and serves to make an extremely immoral nation very circumspect in their actions.

The Dakotas have several ceremonies of adulation or praise.

A-do-wan, to sing in praise of the Great Spirit, as the Dakotas do before going into battle, or upon a raid into the enemy's country, that he may render the hearts of the enemy weak, so they may be killed and their scalps captured without danger to themselves.

Wi-cas-ta a-do-wan.—(To sing the praises of a man.)—The singer, taking the heads of several woodpeckers, goes to the lodge or tipi of some particular individual, will sing over these heads in his praise, reciting his deeds in war and at the council fire, or exploits of the chase, receiving in return a valuable present.

A-do-wan.—The pipe or praise dance.—Two persons, the singer and dancer, go to a mourning lodge, and taking the bundle of cloth in which the hair or the medicine of the deceased is kept, hang it on four sticks driven into the ground. The singer then takes the pipe, the stem elaborately decorated with feathers, beads, and quills, invites the spectators to join with him in his song of praise to the spirit of the departed, slowly waving the pipe over the bundle extols the virtues of the deceased. As the mourners are generally very liberal in their presents, the singers make a profitable business at these a-do-wans. The pipe-stem is a peculiar one; a flat stem worked with porcupine quills and beads, in the middle an eagle tail spread so each feather stands out by itself, and attached to the center of each feather are small bundles of horse-hair, wrapped with ribbons and quills. Those who have seen the dance describe it as being very graceful and beautiful.

Yum-ni-wa-ci-pi—The circle dance.—A social gathering where those of both sexes meet and dance around a pole planted in the ground.

Han-wa-ci-pi—Night dance.—Many gather together, men and women, with drums and singers, by moonlight, to dance and sing. Forming two lines quite a distance apart, the men take up the refrain for a few words; then the women answer. As a rule the Indians are too superstitious to leave their tipis after dark, so this dance is but rarely indulged in. The Dakotah can hardly be said to know anything about poetry, as the ho-ho-ho, ugh-ugh-ugh, or hi-hi-hi of their songs is only now and then interrupted by the enunciation of words. Their language is so figurative that the meaning is generally the opposite to what the expressions used would naturally convey.

ORNAMENTS.

There are but few now in use with any meaning. The number of eagle feathers worn denote the number of enemies killed, the wing feathers of the bald-headed eagle denoting male, and the black-eagle feathers denoting women. If they scalped the enemy, a broad red streak is painted across the feather; if shot, a round red spot is painted upon it; if the person killed was of prominence or reputation, the feathers are dyed red. The above is also applied to the killing of a grizzly bear. Small sticks arrayed with porcupine quills are sometimes attached to the quill of the feather, and small pieces of white fur glued to the ends. No one will wear an eagle feather unless entitled to it, as they believe it will fly away from their heads if worn unlawfully.

Many of the so-called civilized Indians still retain the custom of arranging the scalp-lock. The scalp-lock proper is a perfectly round circle on the center of the head where the hair grows to a point. Around this lock they tie very firmly a bead band an inch wide; the hair is then braided, an otter skin twisted around it spirally, forming a braid 2 and even 4 feet long; this is kept oiled and nice for the enemy to capture if they get a chance; the part is dyed vermilion. If an Indian has the time and the person killed is of importance, they will take the entire scalp, including the eyebrows and ears. The scalps are stretched on hoops and dried; sometimes a picture will be painted upon the skin representing the history of its capture. The Indians have many ornaments; none, however, are of any particular significance. It is not to be believed that the grizzly-bear claws worn as a necklace are marks of distinction; but as they are costly it is merely a matter of wealth and not a symbol of chieftainship. In former days it may have been so used, but not within the recollection of those now living.

RELIGION.

The Dakotahs have many gods; their visible and invisible world is peopled with spiritual beings, inhabiting everything in nature; consequently almost everything is an object of worship. He renders homage to the sun and moon, sacrificing as often to the bad as to the great or good spirit. His gods are of air, water, and of the prairies; their religious ceremonies consist of dances. The god of the waters, Un-kte-hi, a fabled monster of the deep, probably a whale, the tradition handed down from their ancestors who may have lived near the great waters. Wa-zi-ya, the ice god, or god of winter, he who approaches the haunts of men in winter and returns to the land of ice in summer. Can-o te-dan, or forest god, as it is said to resemble a man; it may have been a monkey. He-yo ka, god of the prairies, whose home is supposed to be in the little hills upon the prairies. He wraps his ermine robes around him in summer and goes naked in winter. Wa-kin-yan, the god of thunder, a fabled giant who rides upon the clouds, whose thundering voice they hear. He causes the lightning flashes by rubbing two sticks together.

MORTUARY CUSTOMS.

Upon the decease of a member of a family the survivors allow their friends, relatives, and the medicine men to take away the best they have of everything. Their hair is allowed to grow unkempt; they besmear their faces and bodies with earth, and wear old and ragged clothes; the women gash themselves with knives. The body is draped in the best of everything—robes, blankets, and fine cloth—and placed upon a scaffold, until, in the course of time, the bones fall to the ground; they are then taken and buried. The mourning is kept up one year, amidst dirt and ragged garments; then they wash themselves, put on clean clothes, and never mention the name or allude to the dead person, and it is considered a deadly insult that the name of the departed should be mentioned in their presence. Immediately after a death they leave their homes and can not be induced to return to them. They have been known to leave the corpse in the house for months, erecting a tent near by. In either case when the corpse is removed a new opening is made, through which it is carried. Gray Thunder, a noted Dakotah chief, died in 1874—a man said to have been over 7 feet in height. The army surgeon then stationed at Fort Totten, Dak., offered the widow quite a large sum of money for the corpse, in order to articulate the skeleton. The offer was refused. The widow had a stout box made at the agency, and every year up to 1877, in her migratory visits to the Mission River

Agency, loaded the remains upon a sung-wa-kin-i-hu-pa and carried it there and back twice a year, a distance of over 100 miles, for fear the skeleton should fall into the hands of the white doctor.

SUNG-WA-KIN-I-HU-PA.

The apparatus for packing on a horse or dog. It is made by placing the ends of two long tent poles together at an angle of about 40 degrees, the ends fastened together and placed on the back of horse or dog, the other dragging upon the ground; behind the horse's tail cross-pieces are tied, on which loads are packed. The Sissitonwans and the Ihanktonwans of the prairies train large dogs for the purpose.

I-GUS-KA (UNTYING THE BUNDLE).

This is a Dakotah custom. A bundle of tobacco is sent to seal the bond of friendship between bands or villages; if it is untied, blankets, guns, kettles, and articles of finery are sent in return. If they have nothing to give or refuse to accept the overtures of peace the bundle is returned untied.

I-ZU-YA-PI.

Carried by the Dakotahs when going to war, as the palladium of the Romans. Sometimes it is a pipe, sometimes the skin of an animal.

DAKOTAH MENU.

Pemmican, the flesh of ox, buffalo, deer, or other wild meat, cut in long thin strips, and dried in the sun, "jerked;" as soon as cured it is beaten by the squaws with stones until in shreds, collected and placed in skin bags; then bones are pounded and the marrow extracted, melted, and poured into the bags with the shredded meat, to which has been added quantities of hau-tas-ka, a small red berry, very aromatic and indigenous to the praries. Pemmican is used on long marches or journeys, as it is compact, and a small quantity serves for many meals. There are many wealthy white people of Minnesota who are regularly supplied with pemmican for home consumption, as when properly made it is not unlike *pâte defoie gras.* Accompanied by a dish of wild rice from the rice lakes of Minnesota, it is a repast so toothsome that even those without an appetite can enjoy. Throughout Minnesota are many shallow lakes, from which quantities of wild rice are gathered by the Indians, until it has become a business with many of them; it is in fact superior to cultivated rice. *Tip-sin-na*, wild turnip, is nature's most precious gift to the Indians, who in the fall of the year desert their villages and roam the prairies turnip hunting; it is no unusual sight to see the hill-sides of the rolling prairies dotted with men, women, and children, each with a long heavy pole, sharpened at one end, digging turnips. They are agreeable in taste, raw or dried; the Dakotahs dry them for winter's use. It is a bulbous root, growing deep in the ground, and very nutritious; raw and dried it forms the principal item in the Dakotah menu. Some years ago experiments were made by French savants, and it was found that a nutritious substitute for wheat flour could be made from the dried turnips. The following bulbous esculent roots are also eaten: *a-sin-na*, growing in the marshes, about the size of a walnut; pun-cin-na, about the size of hens' eggs, grows on the margins of lakes and rivers; ni-do, in taste resembles a sweet potato; hu-ba, a large water grass, the stalks of which are eaten; ou-mui-ca, beans growing wild in the valleys and low lands, having a vine-like top the pod growing at the roots being dug up in spring and fall of the year; wild hop-vine, as it sprouts from the ground, the fac-simile of the asparagus, but superior in delicacy and flavor, and it is no uncommon sight on the frontier to see officers of the Army (who are generally epicurean in their tastes) digging wild hop sprouts for their own table; ta-to (Anglice evidently), a root with a long branching stalk, dried for winter use; ce-he-ca, a small root the size of a hazel-nut, collected by the ground-squirrels and prairie-mice, and deposited in large quantities in their subterranean homes. In the fall the Dakotahs collect from these supplies for their winter's use. The taste is rather agreeable, resembling somewhat that of a green pea. Shun-ka, or dog, last but not least of the edibles that please the savage palate, can not be called a domestic dish; it is not eaten, except in cases of dire necessity, as it is considered too delicate for ordinary consumption; but is usually eaten at a special feast in honor of warriors of renown, to whom, as the highest mark of courtesy, the head is given. All the birds of the air, excepting the eagle and the turkey, are eaten by the Dakotahs, and all the beasts of the earth, and all the denizens of the water. Capable of containing quantities that would surfeit several white men, the Dakotah will in days of scarcity tighten his belt in order to prevent a vacuum, and go on his way uncomplaining.

MARRIAGE CEREMONIES.

As soon as the young couple have concluded to cast their lot in common and are engaged, the young man calls his brothers, sisters, uncles, aunts, and cousins together, and tells them that it is his desire to take such and such a one for his wife. After eating the repast spread before them they separate for their respective lodges. The following day as many as wish return, each bringing some object as a present—a gun, horse, blanket, anything they may have, and of the best (a bridle represents a horse, and is redeemed on demand). All these things they make into a bundle, carried by the mother of the young man upon her back, who lays it in front of the lodge of the expectant bride and returns home. Now, the girl's mother or other member of her family brings the bundle into the lodge and prepares a feast, inviting all the relatives of the young girl, who, after participating in the good things spread out before them, and learning the particulars of the case, discuss the character of the young brave, after coming to a conclusion in favor of or against the approaching nuptials. If favorable they return next day with their bundle of presents. Then the bundle of the bridegroom elect is opened and the articles are distributed among the bride's family. They, in their turn, take the bundle brought by them, give it to the girl's mother, who takes it upon her back and the girl by the hand and deposits both at the door of the expectant husband. The groom's mother comes out, takes the girl and bundle into the lodge, where all the family are congregated, seated around the fire, leaving the place of honor (opposite the entrance) vacant. In the center of this space is a dish with two spoons in it. The young man and girl sit one on each side, eat a few spoonfuls from the dish, and then pass the dish around. The bride's bundle is then opened and distributed among those present. This constitutes one form of marriage among the Dakotahs. As will be seen, the parents have no voice in the matter, leaving it entirely to the brothers, etc. In making up the bundles those wishing to give a horse throw in a bridle, marked with their totem. This represents a horse, and is always redeemed. Often an old squaw will be seen trudging along, bent double, with a sack on her back containing guns, swords, pistols, knives, blankets, beads, and articles too numerous to mention, bent on a matrimonial pilgrimage such as described above.

In different sections, even among the same tribe, they have other ceremonies: when they purchase their wives, by tying a horse at her parents' door; if, on returning the following day, they find the horse still there, they will add another, keeping this up until their limit is reached; if the horses are taken away he will then enter the lodge and take his bride home; if it requires more horses than he is willing to give he takes his horses away and tries elsewhere. Often when the relatives of the young girl refuse all overtures of the young man he will, through a friend, entice the young girl into the woods, where, joining them, he runs off with her. This is also recognized as a marriage. The Dakotah is a polygamist, having as many as five wives. The marital tie is not very binding, and divorces are not sought after in the courts; but in the straw dance they will "throw away" those wives they no longer wish to retain; in many instances they will take "unto themselves" several wives in order to throw them away at this dance, believing it will add to their importance to have so strong a heart. When a young man throws away his wife he becomes a "young man" again and seeks other wives. The woman is soon married again. The courting is always done in the evening and in the lodge. If the attentions of the young man are disagreeable to the young woman, she will get up and blow up the fire. The young man takes the hint and retires. If, on the contrary, she should be willing, she lets the fire alone.

A husband will never speak to his wife's mother or father, and if it should be an absolute necessity it is done through a third person · the same with the bride, and though all may be living in the same lodge they never speak except in cases of absolute necessity, and then only through a third party. When the husband meets his wives' parents in the woods he turns his head aside and passes by without noticing them.

When a child is sick the father will take the child's name, believing it will cause others of the family to die if the name should die. The grandparents as a rule take care of the children and are called father and mother. Uncles and aunts are always addressed as father and mother.

ATNATANAS; NATIVES OF COPPER RIVER, ALASKA.

By Lieut. HENRY T. ALLEN, U. S. Army.

Upon examination of the natives of Copper River it is found that they are as a rule between 5 feet 6 and 5 feet 8 inches high, though occasionally a man fully 6 feet is seen, and weigh about 140 pounds; that the color of their skin is a brown, tinged with copper, and much darker than that of their nearest coast neighbors; that their hair is generally straight, exceptionally wavy, and that their eyes are invariably black, or nearly so. A great difference in mobility of countenance was noticed, the faces of some being nearly as capable of indicating emotions as those of civilized people, whilst those of others are almost entirely devoid of expression under any circumstances.

Their muscular strength is not so remarkable as their ability to travel great distances in a short time on scanty rations. Ample opportunity was given for measuring their strength and endurance with those of our party. The result of the first day's work was favorable to them, but ever afterwards to us. It is true, however, that our party was selected with special view to physical strength.

It is an unusual occurrence to see a father and mother with more than three children. Whether this small size of family be due to the hardships incident to the gaining of a livelihood or to malpractice in some of its forms, I am unable to say. It is a fact that with them, too, poverty may be blessed with children. I will instance, that one of the most destitute families I met consisted of father, mother, and four children, some of whom were sadly emaciated by hunger. The nature of their food causes so much wearing of the teeth that children are found with the first set worn almost to the gums. Sometimes in the case of adults the teeth are worn to the gums while the body is yet in its prime.

The faces show the result of subjection to hardships long before the hair begins to turn gray. Owing to their ignorance of methods of computing time, the ages could not be determined with any degree of definiteness. Messala, however, who lives on left bank of Copper, one day's march from Tarál, and, presumably, led the party of Massaon against the Russians in 1848, must then have been a man of mature years.

The only sickness noticed among them other than result of hunger was due to costiveness, which doubtless disappears during the run of salmon. But one natural deformity—a shriveled leg—was seen, though the toes of nearly all are abnormally crooked from snow-shoe travel.

Their sagacity in following trails and hunting game is probably not greater than that of others of the Tinneh family, but would astonish one not accustomed to the skill of natives in this respect.

All the people of Copper River region were called by the Russians Meduráskies (more properly Mednévtsi) and all, excepting those at the mouth, belong to the great Tinneh family which peoples the interior of Alaska. Those below the Tezliná River, from their association with Russians, have adopted some abbreviated form of the same, such as Minisky, Muoósky, etc., whilst those above style themselves Tatlatans. I think the name Atnatána, the Indian name for an inhabitant of Atna (Copper) River region, would be a fitting term for the people of both tribes, which differ very little from each other. To particularize, however, I have used the term Midnoosky for the people south of the Tezliná, including those living on the Chittyná, and Tatlatan for those living north of the Tezliná and south of the Alaskan Mountains.

The entire number of natives on the river and its tributaries is about 366, divided as follows: Men, 128; women, 98; children, 140.

Between Alagánik and Woods Cañon, a distance of 110 miles, there are no settlements, yet an occasional party goes down to Bremner River to hunt moose. On the Chittyná and its tributaries are about thirty souls; on the headwaters of Tezliná and Lake Plaveznie, probably twenty. The Tatlatans, including the settlement at Lake Susláta, number 117. On the Copper, between Tarál and the Tezliná, are 209, the total number of Midnooskies.

Nicotai is autocrat of the Chittyná and the fishing rendezvous Tarál, whilst between the latter place and the Tezliná this privilege is held by Lisbigstag and Coneguanta, the former controlling the lower part, the latter, with the largest following of any Atnátana, the upper. The chief native among the Tatlatáns is Babzulnéta, who is a shaman.

As far as I am able to judge from the scanty records of the Russians and my own observations, I should say that the change in number of these people has been very slight for many years. Their history, so far as their records are concerned, will always be a sealed book. On both banks of the river between Chittyná and the Klawahsina River, more especially on the left bank, are frequent excavations 2 to 4 feet deep, indicating the sites of houses. The more recent of these show signs of the attached bath-houses. In some older excavations spruces of largest size are growing.

The territory of the Atnatánas is included between the one hundred and forty-second and one hundred and forty-seventh meridians and between the sixty and half and sixty-third parallels, representing an approximate area of 25,000 square miles, all of which is drained by the Copper and its tributaries. Practically excluded from the rest of the world, it is but natural that they should be a conservative people. With mountains on all sides, their routes of travel are chiefly confined to the water courses winter and summer. Were it practicable to pass from Tarál to the upper waters of the Copper by going nearly due north, one-half the distance over the river route, which is and must be followed, would be avoided. Between these localities are some of the highest mountains of the northern continent, and certainly the highest volcano (Wrangell); below are huge glaciers (*Mileó* and *Child's*), which hem in the river, rendering navigation extremely dangerous. Besides these geographical considerations, the climate, which is practically seven months severe, affects in a large measure the customs of the people.

Their vegetable products are limited in variety and scanty in quantity. Besides the berries, including cranberries, blue-berries, a small red berry (called by them *giness*), a small blackberry (called by them *gizneh*), quite similar to the red one, is a fruit called *tõmbá*, that grows on a bush several feet high. It hangs on the bushes all the winter, and may be eaten in the spring, even to summer, when it is very dry and nearly tasteless. The shape and nature of the fruit is very similar to the black haw, though it is of a yellowish-white color. The natives fry it in moose or other fat, at the same time mashing it well with a stick or spoon, thus making of it a palatable dish. Their chief vegetable food, however, is a peculiar parsnip-shaped root, but longer, which they call *chass*. The portion of it above ground is not more than 6 to 12 inches high and not unlike a bunch of small willows, while the root is frequently several feet long. It is never cured, but is eaten raw, boiled, or roasted, and especially during the spring.

Fish, rabbit, moose, sheep, caribou, bear, goat, porcupine, beaver, lynx, muskrat, goose, duck, and grouse constitute the mass of their food. Of these fish is decidedly the most important, with rabbits next in order. They have no process of curing save that by drying in the sun. The fat of the moose is melted and run into the guts, while the blood is saved in the paunch. It is of little importance to them whether or not their meat be cooked, and in boiling it is seldom allowed to become done through. The entire entrails of rabbits are boiled sometimes with the bodies from which they were taken, and again with other meat; and form one of the most potent antiscorbutics used by them. Good or special food is always cooked by the men and the refuse of all is given to the women. A boy five or six years old has precedence at meals over his mother. There seems to be almost no limit to the amount of food a hungry native can consume. A single kind of food must be abundant to furnish in sufficient quantities the necessary elements required by the system. A much less quantity of mixed food satisfies. Like most other Indians, they seem to eat when hungry, without regard to fixed intervals.

The only drink that I saw used by them, excepting tea, of which they are passionately fond, and the liquors in which the food is boiled, was from the plant lamkill, used by nearly all the Tinneh of Alaska and by the inhabitants of the Hudson Bay country and Labrador. No special preparation of this is required, not even drying being necessary before using.

If they possess any medicinal preparations or medicines of any description they are in the hands of the shamans, who keep them carefully concealed. Their contact with the Russians and Americans, though very slight, has taught them the benefits of more civilized medicine, and they will take any dose given them by a white man.

The houses of the Atnatánas are of two kinds, viz, permanent and temporary. The former are intended for winter use and are annually occupied during that season, while the latter are extemporized at any place where game may be found. In plan it is about 18 feet square, is built of spruce poles and slabs in a loose style, and is covered in with spruce bark. In some places moss is used to help to make it close. The walls under the eaves are nearly 4 feet high, and about 3 feet from the ground around the inside is built a shelf 4 or 5 feet wide, which serves the double purpose of a seat during the day, and a bed at night, the space under this being boxed in with vertical slabs and used as a store-room and sleeping apartments for women, children, and pups. The roof is provided with a large hole in the middle, to permit the escape of smoke from the open fire on the floor. The entrance is through a small "storm-shed," about 2 by 3 feet, protected at the outer end by an undressed sheep or goat skin. Opposite this, at the other end, near the floor, is a round hole about 15 inches in diameter, which is the entrance to the sleeping-room and bath-house. This is 10 or 12 feet square, 4 or 5 feet in height, nearly all of which is underground, and is lighted by a small aperture, over which the intestines of the bear are stretched. The sweat-bath is so highly prized that every permanent house of the Midnooskies and most of those of the Tatlatáns are supplied with the necessary room, the heating of which is quite simple. A large pile of stones placed on a close frame of logs in the main room, after the manner of an old-fashioned limekiln, are heated, then transferred to the sweat-room by means of two sticks used as tongs. The circular aperture is closed with a kind of tompion, and water is then poured on until the necessary amount of heated vapor is obtained. The idea of building this adjunct to the houses came through contact with the Russians, with whom it is a religious as well as a hygienic measure, and is practiced as far north as the Alaskan range. Beyond this it is not seen until the Lower Yukon is reached. The temporary or hunting house, always built of poles and boughs of spruce, cottonwood, etc., is rectangular in plan, with a passage-way through the center. Two sides only are used, and in consequence the ends and upper part are scantily covered. A log placed on the fire extends sometimes several feet beyond each end. A moose or caribou skin, in lieu of cotton cloth used by their more civilized brethren, is occasionally used to help make it water-proof directly over the sleeping places. Tents are not as yet part of their possessions, nor is metal of any kind employed in assembling the different parts of the houses, willow withes and rawhide thongs answering their present requirements for this purpose. In general the winter house, being on the river, may be said to be occupied during the salmon season, and until February, when the occupants depart for the headwaters of streams, where they hunt and trap, occupying the summer houses.

Never have I seen Indians more devoid of luxuries than are the Atnatánas. The wealthiest count only the following vessels and utensils in their subsistence department: One to three large kettles, one tea-kettle, one frying-pan, several wooden trays (native), several knives (generally home manufacture), horn spoons, and two or three cups. In but one place did I see any pretense of furniture, and that was a peculiar-made box to put the tea-cups on. The average head of a family dispenses with all the above save one kettle, one or two wooden trays, a knife or two, and possibly a small cup, which he invariably carries whilst traveling. I found no vessels for boiling or holding water that had been used prior to the introduction of modern ones.

Their clothing consists ordinarily of two garments, trousers and boots forming one, coat or parkee the other. In the winter this is sometimes supplemented by a shirt made of rabbit skin. The coat is usually without a hood attachment, differing in this respect from that of the Eskimos, the head-dress being made from marmot or squirrel skins. The principal decoration of the wearing apparel is of beads, of which those one-eighth to one-quarter of an inch in diameter are especially chosen. Very seldom are porcupine quills utilized for ornamentation.

The men have both ears and nose pierced, the women the former only. In the nose, rings made of shell or metal are worn, some of which are one and one-half inches in diameter. Sinew suspends the ear ornaments, which are made of elongated beads. To be thoroughly *en regle* a little red paint must be applied to the face. This applies more particularly to the women and children than to the men. The beaded knife scabbard attached to the neck is considered indispensable to the well-equipped Atnatána, who does not take it off day or night. In addition to this, the tyones and wealthy men wear a beaded ammunition pouch. Bracelets and finger-rings, likewise tattooing, are almost unknown to them. Combs made of the hoofs of the moose are owned by some, while many keep the hair in condition by dexterous use of the hands. They are very fastidious with respect to the hair, which, be it said to their credit, nearly always appears neat, a shaman's excepted. That of the women and shamans is worn long, while many of the men in early summer cut it straight around at the height of the middle of the neck.

The unit of measurement with them is the distance between the tips of the fingers, the arms horizontally outstretched. I have frequently seen them measuring timber for a baidárra or the length of rope or thongs with this unit.

Beads and ammunition are the mediums of exchange used by the intermediate men in obtaining the furs that are carried to the trading station. Nicolai leaves at his house on the Chittystone River, during his absence at Taràl, beads, caps, and powder for the Calcharnies,* who arrive and deposit an equivalent in furs,—a fact tending to show how definite is the relation between articles of commodity and prices paid for them, and also the mutual confidence amongst themselves.

Their bows and arrows are quite similar to those formerly much used by the Yukon natives, though perhaps they are a little better finished. The material for both is birch, which is subjected to a peculiar process of seasoning which might be called tempering. A rough slab about 5 feet long is blocked out of green birch with the small ax in possession of nearly all; then the knife is used to bring it down to dimensions not exceeding an inch or an inch and one-half in cross section. This rod is alternately put in the fire for a few seconds, and then worked awhile with the knife until it has nearly attained its final dimensions, when it is placed where the smoke can envelop it. It may remain at this stage of the process several weeks, being again subjected to the fire and the knife. When finally tempered a bow one inch by one-half inch in cross-section requires a strong arm to string it. I have seen splendid ramrods made of very crooked timber in the same manner.

Bows and arrows are yet largely used by them, though they are rapidly superseded by the small-bore double-barrel muzzle-loading shot-guns, of which there are two grades, one very inferior, the other good, with laminated steel barrels. Neither of them exceed five or six pounds in weight. They fire out of these guns pebbles and bullets of lead or copper. The copper bullets are claimed by them to be superior to the lead ones for large game, such as moose and bear, for the reason, they say, that the copper ones will always break the bones while the lead ones will not. The copper bullets in use on the Chittyna River are formed by hammering.

Judging from the weapons owned by these natives and from their docile and mirthful characteristics, I should not consider them a specially warlike people.†

In building their houses the only implements used, besides the ax and knife, is an adze, made by securing to an elbowed stick, with rawhide strings, a flat piece of iron, tempered by themselves.

They are by no means of an inventive turn, many of them obtaining their snow-shoes from the Calcharnies; nevertheless they make their toboggans and sleds, which possess the valuable qualities of lightness and durability.

As before stated, their routes of travel are chiefly on or near water-courses. When a long journey down the river is contemplated or a trip to Nuchek is decided upon, a skin boat is built, but if the distance be short a raft, made of four logs fastened with willow withes, is constructed.

* The term *Calcharny*, or Kolshina, is of Russian origin, and is applied by the Midnooskies to all people not belonging to their tribe.

† Since writing this the only white man nearer than Kodiak, Mr. Holt, the trader at Nuchek Island, has been murdered by them.

In ascending the river with a boat only one method can be used, that of "cordelling." A party of Tatlatáns were passed above the Chitsletchia, en route to Tarál, in a baidárra for the fishing season. The skins of their boat were to be dressed at the destination and made into clothing, and the return trip was not contemplated until the ice had formed on the river, thus enabling them to sledge back. There is a trail along the river from Tarál to the mouth of Stana River, though not always on the same bank of it, and in some cases 2 or 3 miles from the river.

To every member of a family belongs on an average three dogs, which are used for hunting moose and bear and other game, and for carrying packs. They are a source of great annoyance in the vicinity of rabbit snares, unless kept at the house—usually by shoving one or both front feet through a string tied around the neck. As pack animals they are exceedingly valuable to people situated as their masters are. They do not average more than 18 to 20 inches in height, yet they can carry for short distances 20 to 33 pounds, and day after day 25 pounds. I can heartily recommend a pack train of these animals for journeys where the greatest transporting power consuming the least quantity of food is desirable. These dogs are never harnessed to the sleds, which the natives haul and push, but transport their burdens directly on the back. The men very seldom carry packs other than their arms and bedding, the work of transportation being assigned to the women, who pack themselves and manage the pack train of dogs. Canoe transportation in none of its forms is attempted on the Copper or any of its tributaries, nor is it probable that it ever will be, owing to the remarkably rapid current produced by the unusual fall in the river of 3,160 feet in 330 miles.

The chief amusement of these people other than eating, and the one they always resort to when hunger is satisfied, is singing. Unassisted by any musical instrument, not even any form of the tumtum, nearly all join in the songs, usually led by the young men and boys.

These are numerous and varied in character, those intended for courtship being much less exciting than the more epic ones. Singing is frequently indulged in whilst enjoying a meal, and all the bodies may be seen keeping perfect time to it The children are taught to sing almost as soon as to talk. When dancing accompanies its violence is in direct proportion to the stress of voice.

The spoken language is markedly accented and seldom are more than three consecutive words uttered with the same intonation. Most dissyllabic nouns and many adjectives are accented on the last syllable. The practice of delivering orations is as frequent amongst them as among the Sioux and Cheyennes. The following limited vocabulary may serve to give a faint idea of the nature of the language. The annexed numerals of the White Mountain Apaches, as obtained from Lieut. Y. B. Dugan, U. S. Army, who was ten months on the San Carlos Reservation, shows an astonishing similarity to the same of the Atnatánas, which, I trust, may lead to a more thorough investigation of the matter.* On further comparison of our respective limited vocabularies a few nouns almost identical in sound and meaning were found to exist.

Man	Keek.	House	Hoonák.
Woman	Sekái.	Sweat house	Sayzill.
Child	Shumkái.	Grease	Dalkak.
Dog	Sklekáy.	To-day	Titagin.
Silver salmon (small)	Slukkáy.	To-morrow	Minta.
King salmon (large)	Sukacháy.	I	Se.
Moose	Tenáyga.	You	Nin.
Caribou	Honnái.	None, nothing, few	T'kwully.
Sheep	Tebáy.	Far, a long distance	Kooteshit.
Goat	S'lai.	A long time	Siyu.
Wolf	Tekant.	A short distance	Cuttlestée.
Fox	Nukleksy.	Good	Wallay.
Lynx	Noótéay.	Bad	Katákwat.
Martin	Choóga.	Large	Traycha.
Black bear	Nolláy.	Small	Tuchóne.
Brown bear	Cháhny.	Plenty	Kuláin.
Rabbit	Gak.	Hot	Hetáy.
Marmot	Chiléss.	Cold	
Smooth ground	Nent.	Tired	Tazée.
Mountains	Trollái.	Hungry	Descháne.
Wood	Chitz.	To go	Hóona.
Ice	Tin.	To come	Ahny.
Lake	Bin.	To sleep	Nastatá.
Water	To.	How many	Dónnakeelan.
River	Na.	Give me some water	To unto.
Sun	Niái.	Mount Wrangell	Keunchilly.
Food	Kuchin.		

	Midnoosky.	Apache.
One	Suskái	Duschlái.
Two	Naytáyky	Nakée.
Three	Tágy	Tágy.
Four	Dinky	Dingy.
Five	Ahtzuuny	Schlái.
Six	Kistáu	Goostáu.
Seven	Konsárry	Gooséltу.
Eight	Klahinky	Saybeé.
Nine	Zutlakwálo	Goostái.
Ten	Lahzún	Gooneznún.

Notwithstanding the fact that women are decidedly in the minority among the Atnatána, polygamy is practiced to a limited extent. How far they observe the laws of consanguinity in their marriages I do not know, but that an occasional Midnoosky marries a Tatlatán is a fact brought about, possibly, by that desire to avoid marriages of relations. The wives are treated with very little consideration and are valued in proportion to their ability to pack and do general work. They and their children are always left in destitute circumstances at the death of the husband, however wealthy he may have been. This arises from the custom of distributing among the tribe at his death the property, the accumulation of which seems to be a great pride, because the demon-

* Since writing this I have learned from Dr. O. T. Mason, director of the ethnological department of the Smithsonian, that the relationship of the Tinneh family to the Southern Indians was discovered by Prof. Turner many years since.

stration at the obsequies will be in proportion to the wealth of the deceased. The oldest son, however young, becomes the head of the family at the death of the father. The treatment of adopted children is not different from that of the natural heirs. Very small children are carried in a kind of birch chair or cradle, the legs hanging over, while older ones sit on the pack with a leg passing on each side of the mother.

The social organization seems to be divided into the following classes: Tyones, skillies (near relations of a tyone), shamans, or medicine men, and vassals of varying degrees of servitude. In all assemblies seats are rigidly assigned according to rank, which is well established among them. The tyones would rarely condescend to consider any of us their equals, nor did they fail to express disgust at seeing the head of our party carrying a pack or pulling on its rope.

Among the Midnooskies the influence of the shamans is much less than with the Tatlatáns, a fact due, I suppose, to contact with the Russians. Nicolai, an influential chief, would not tolerate them, though he himself claimed to be able to perform wonderful cures; certainly many natives far and near believed him. His power is supposed to come from the church (Greek), of which he was an apostle. He wears on his hat a Greek cross as talisman, and has a small quantity of paper and pencil, with which he pretends to keep a record of all matters of importance to his people. It is not strange that with his unusually keen perceptive faculties he deceives his neighbors, as shown by the following at Khilvats, about 350 miles from Tarál: As we traveled was seen a native carrying a highly valued brass cross and some hieroglyphics, both made by Nicolai, who doubtless had received a liberal allowance in furs for them. Some have such confidence in his healing power as to send the garment of a sick child many miles to him in order that he may sleep on it. Liebigstag, a tyone, who has several shamans in his following, caused all to absent themselves from his camp on hearing of our near approach. Farther up the river, however, they are comparatively numerous, and are detected by the uncovered, uncut condition of their hair. They are non-producers, whose missions are those of priest and prophet of the most primitive style.

The skillies are necessarily many, and not a few of them have vassals at their beck and call. I have seen one of fourteen or fifteen years of age, sitting within a few feet of the river, order a man 6 feet high, a vassal, to bring him water. These menials are used for all kinds of work, and are as completely under control of their masters as they possibly could be, yet I never heard of corporal punishment being administered to them. It is but natural to suppose that a threat of depriving them of food or shelter in their poverty-stricken condition would be sufficient incentive to urge them to any length of obedience.

The dead are put under the ground and the site marked by a square frame, about 2 by 5 in plan, placed above. There seems to be no special ceremony attending marriage; a man possessing a few kettles, etc., is always eligible, and when he meets his fate takes her.

INDIANS OF THE QUINAIELT AGENCY, WASHINGTON TERRITORY.

By C. Willoughby.

The Indians now on the Quinaielt Agency are of the Salishan stock, and consist of the following bands: Ayhut, 36; Chehalis, 5; Hohs, 61: Humptulip, 16; Hoquiano, 16; Montesano, 16; Georgetown, 69; mixed bloods, 3; Quilts, 85; Quinaielts, 107; Satsop, 12. In all there are males, 213; females, 210.

In point of intelligence they do not compare favorably with other tribes of Washington Territory. They are indolent, uncleanly, wanting in ambition, and for the most part unable to understand any enterprise that would benefit them financially. They are not satisfied to look forward to a crop in the fall as a result of sowing in the spring-time. An abandoned cannery at this place was never operated, because of the exorbitant price demanded for their fish by the Indians. Their dwellings vary from those patterned after the white man's house, where stoves, chairs, bedsteads, etc., may be found, to the old smoke-blackened lodges of a former day. The latter are built of boards hewn out by hand from slabs split from the spruce tree by means of yew wedges and stone mauls, and dressed with an adz. In former times when iron was unknown the adz was made from the ribs of the whale. The modern adz, with iron blades and elk-horn handles, are very effective implements. The boards are from 12 to 14 inches in width, some times 24 inches wide. These squarely built lodges have a pitched roof, while those of the Mahaks are flat. A latch-string opens the rude door, the lower part of which is about a foot below the level of the ground outside. An earth floor in the middle of the lodge is bordered on each side by a platform of boards a foot high and about $3\frac{1}{2}$ feet wide. On these platforms the women sit to weave their mats and baskets, and behind the platforms next the wall and on both sides of the lodge are ranged their beds of matting and blankets, raised 3 feet from the ground, and extending the whole length of the building. The sleeping mats are from 7 to 8 feet in length, 3 and 4 feet wide, and are made of rushes found in the neighborhood. They are used for bedding, and also as a lining to the walls of their lodges. A bed consists of five or six of these rugs piled up to form a mattress. The rug rolled at the end forms the pillow. These rugs are made by sewing through the rushes, just as if stringing them together on a hempen twine. The needle is made from the ulna of the albatross's wing. A wooden creaser is used to rub down the seams of the mat. The beds are protected from the weather by rush or flag matting fastened upon the wall. Each family living in a lodge has its own separate fire, built upon the ground. Dishes were formerly kept in baskets or boxes, but may now be seen in rude cupboards near the fire.

The winter supply of fish is smoked and dried in the lodge, which is used at the same time as a dwelling, and the atmosphere is always redolent of smoke, old fish, and "ripe" fish eggs. Drift-wood, of which their beach furnishes an unusually large supply, is brought to the lodge by the women. Before the introduction of matches fire was procured by friction from very dry dead cotton-wood. A stick of this was pointed and placed in a small cavity made in another piece of wood, the hands rapidly moving the upright stick as if drilling.*

The sticks with three cavities were placed upon the ground, the Indian kneeling and placing a knee upon each end. He placed one end of the smaller stick in one of the cavities, and, holding the other end between the palms of his hands, kept up a rapid half-rotary motion, causing an amount of friction sufficient to produce fire. With this he lighted the end of the braided slow-match of cedar bark. This was often carried for weeks thus ignited and held carefully beneath the blanket to protect it from wind and rain.

FIG. 1. Quinaielt woman in dress of cedar bark.

In former times clothing was made from seal, elk, bear, and rabbit skins; also of rushes and cedar bark, the plumage of ducks and other fowl being sometimes woven into the latter. In the olden time the skin of the woodchuck was much prized, blankets made therefrom being used only by chiefs. Large basket-work hats were formerly worn. At present grass hats resembling those of white people in shape. The fur garments once worn by the Quinaielts are no longer in existence. On great occasions, when Indians belonging to other tribes are visiting the Quinaielt, the dress of the latter varies from civilized garb by the wearing of their newest and most gaily colored blankets. A new patchwork calico quilt has been seen distinguishing the tall form of the chief, and bright head-feathers are in demand for caps and hats. Then the women wear their most gaudy calico dresses, don their ear and nose rings, sprinkle their hair with down, and paint the face a flaming red, a combination of black and red seeming to be pre-

* The fire-sticks collected by Mr. Willoughby are just as rude as this device could well be, and may stand for the lowest type of the fire-making tools.—O. T. M.

ferred by the men. I have seen an old woman, the lobe of whose ear was cut into five or six deep scallops, where her ear-rings had been torn out during quarrels with others of her sex. When she drew down the cartilage of her nose to insert its ring she was a grotesque-looking object. The skirt of cedar bark was formerly the only garment reaching from the waist that was worn by Indian women. The strips of bark were laid over a rude frame set in the ground, consisting of a thin, flat piece of wood about 2 feet long set edgewise into a support at each end made of two sticks tied together. The bark was then bent over the frame and creased and bruised by the instrument made from the skull of the whale. The bark was then made still softer and more pliable by rubbing with the hands.

FIG. 2. Cedar bark cincture, and apparatus for making.

Many varieties of salmon taken from the Quinaielt River form the principal food of this tribe. When fresh it is eaten boiled, or roasted by fastening to a stick set firmly in the ground and slanting towards the fire. The Indians also dry and salt their salmon. Salmon eggs, from the large "steel-head" are taken from the fish and packed without salt or cleansing in boxes or barrels until the latter are filled. They are then left to ferment and swell, in many cases bursting the packages. The eggs become indescribably putrid and at last solidify, so that they may be cut like cheese. They are thus considered deliciously "ripe" and fit for food.

Their ancient dishes were made of yew and their spoons of horn. Buffalo-skull dishes, with large handles, came originally from the headwaters of the Columbia River. The Atona or Chinook Indians, wishing to procure slaves, invaded a village of the Columbia River Indians and destroyed about half their houses. Those of the Columbia River Indians who were not killed ran away and hid in the forests, except a woman and child, who were captured and carried away. The Skokomish Indians took away with them also many articles of household furniture, including dishes made of the skulls of buffaloes. These were bought from the Chinooks by the Quinaielt Indians, who paid for them with canoes and blankets. The dishes are said to be very old, and only to be found among the descendants of the chiefs. These heirlooms were unexpectedly discovered by the curious white man among heaps of old rags, basket grass, strips of dried fish, and lumps of fermented cheese-like fish eggs that had accumulated in dark and grimy corners of the lodges. Still they are much prized and no poor family can afford to own them. The Quinaielts are not inclined to take an interest in agriculture, on account of the abundance of fish to be obtained. They also use the tender shoots of rushes, young salmon-berry sprouts, and other succulent growths of the spring-time. The salmon-berry sprouts are very freely eaten in the early spring, and their use is always followed by an eruption of the skin and by inflamed eyes, rendering many of the Indians sightless for a time. I have seen the same effect produced among the Makahs when I was in charge of that agency, but to a far less extent.

A plentiful supply of bulbous roots, as those of the la-kamas and fern roots, are made available for food by this people. Strawberries, the wild currant, and gooseberry, thimble berrries, blackberries, crab-apples, sal-lal, and cranberries, huckleberries, and other small fruits are found in large quantities. Sal-lal berries are mashed, dried, and smoked in large cakes for winter use. Bear, whale, and seal oil are largely drank at their feasts. Berries are also served upon such occasions, floating in these oils. Sometimes, but rarely, a deer, bear, or elk is secured, and the flesh of seal and otter is eaten. Any putrid flesh that floats ashore is eagerly devoured. The beaching of a whale creates the greatest excitement, and the largest amount possible of the decaying blubber is secured to be eaten or dried for future use. Sea-gulls, ducks, geese, and other fowl, eggs of sea-birds, sea-weeds, crabs, clams, and other shell-fish complete their bill of fare.

The drag-net is used for fishing in narrow streams of water; for using it two canoes are necessary, with strut from 6 to 8 feet apart and bows diverging. An Indian sits in the stern of each canoe, each Indian holding one pole of the net in one hand, while the other hand holds tight the string that keeps the mouth of the net open. The string always remains fastened to the pole, but when the Indian relaxes his hold on the string, as he does in hauling up the net, the mouth of the net closes, preventing the fish from escaping. The two canoes go up the river until 200 or 300 yards from the mouth; the net is then placed, as in illustration, and one Indian in each canoe paddles, while another throws stones to frighten the fish. Then they paddle down the river with the current into the narrow passage near the bar. Thus while catching salmon in the drag-net, as they proceeded down stream, they are at the same time driving the fish towards the Indians, who are standing in the shallow water on the bar, ready to spear them. Then from fifteen to twenty Indians stand on the bar, from 8 to 10 feet apart, and throwing stones, drive the salmon towards the bar, where, at low tide, the water is from 8 to 12 inches deep. The shaft of the salmon spear is made of cedar, the fork, of the wood of the salmon berry; the barbs, of wood or metal. The loop of cord, which is 16 feet long, is for the left hand, as shown in sketch. The length of the spear is nearly 16 fete. This spear is used on the bar of the river at low water.

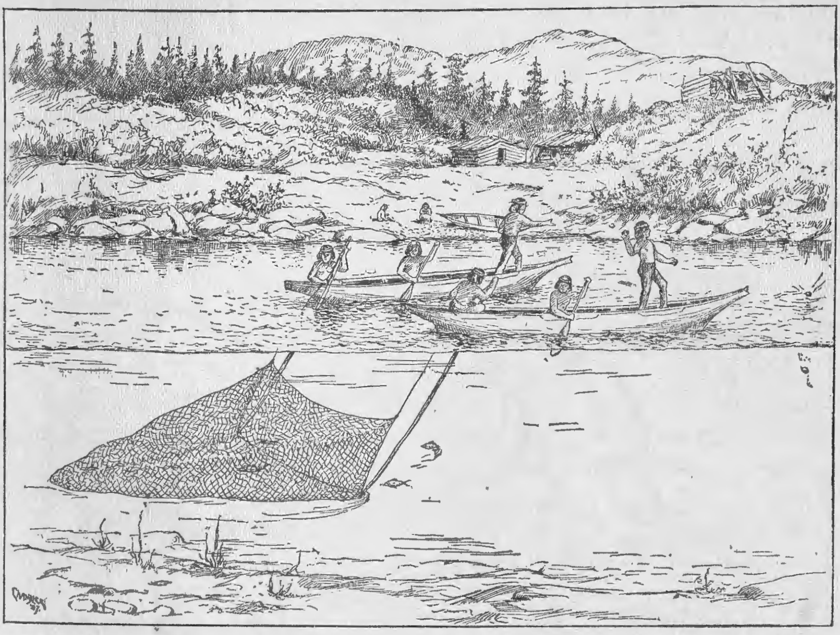


FIG. 3.—Fishing with a drag-net in Washington Territory.

The handle of the surf net is commonly made of yew wood. Formerly the twine of the net was made by the Indians from the fiber of the common nettle, which in some localities here has a very luxuriant growth

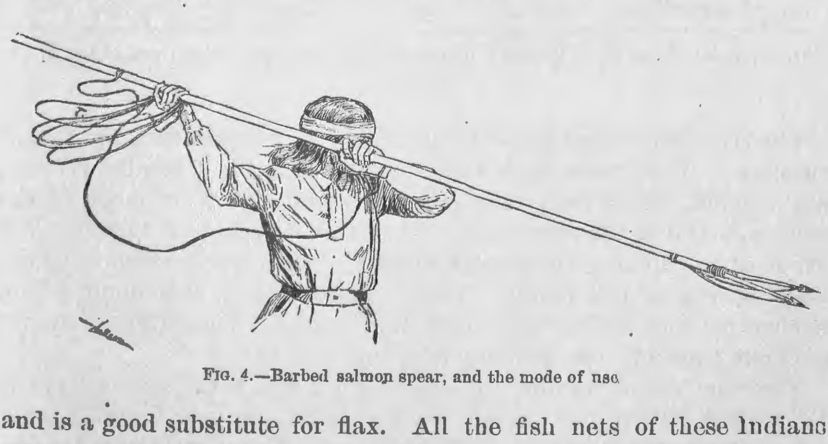


FIG. 4.—Barbed salmon spear, and the mode of use.

and is a good substitute for flax. All the fish nets of these Indians were once made of this material; at present seine twine is used.

The surf net is used in catching the eulachon, or candle fish, and smelt. As the surf rolls in, the Indian runs rapidly forward, and bending down, passes the net under the comb of the breaker, often capturing at once as many as an ordinary water bucket will hold. The handle of the surf net is 6 feet long, mouth of the net 4 feet by 18 inches; depth of the net about 3 feet. The Indians hold the bottom of the net drawn back underneath the handle until they thrust.the net in the water when they let the point fall.

FIG. 5.—Poles of net 10 or 12 feet; mouth of net 6 or 8 feet wide; net about 12 feet long.

The river net is used as in the accompanying illustration, the Indian running a little faster than the current. Length of handle, 14 feet; net's mouth, 1 by 5 feet; depth of net, 4 feet. They are made of the same material as the other nets. They are all rudely put together, and are used in catching the small Quinaielt salmon, pronounced to be the finest species of this family. Their superior quality is no doubt owing to their peculiar feeding grounds in this locality. Their average weight is about 4 pounds, uncommonly deep and rich in color.

Their method of forming the knot in their nets is the same as that of the whites. Their nets are now made of twine, but were formerly made from nettles, rotted as previously described. The strands were twisted singly across the naked thigh until the required length was obtained; then two strands were twisted together on the thigh, the ends being held by the left hand while the two strands were rolled together by a slow forward and quick backward motion of the right hand.

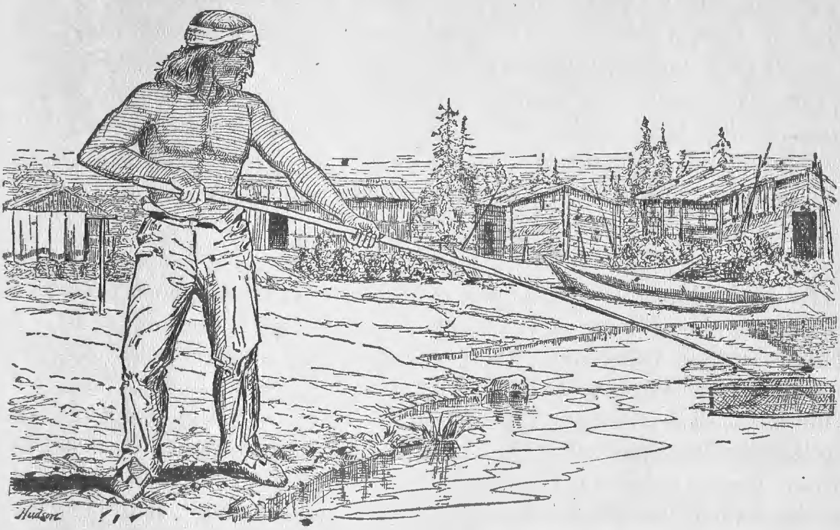


FIG. 6.—Small net used for catching small river salmon.

These Indians have several unwritten laws regarding the beach. If a seal or otter is found by an Indian the profits must be divided by any companions who are with him. Formerly different parts of the beach belonged to different factions. An Indian of one faction could not claim property found on the beach of another faction. This rule is not as firmly adhered to as formerly. Drift-wood, when chopped and left piled against a log on the beach, is never disturbed by others in search of fuel; but any lost article is considered as belonging to the finder, though the owner be known to him. It is difficult to change their ideas in the latter respect. If they give up the article to the owner they expect to be paid its full value.

Basketry.—The Quinaielts excel in textile industry as distinguished from the tanning of furs. They have the cedar bark for the foundation of basketry and strips of the pine root for rigid work, hemp rushes and grass for the weft and ornamentation. The grass used in strengthening the borders of mats, rain cloaks, etc., grows on flat places. It is prepared like flax, by soaking in water until the outer portion decays, when it is beaten with sticks until only the fiber remains. The yellow fiber or grass used by Indians for the outside of baskets is a great source of traffic among these Indians, as it is only found in this locality. The basket grass is gathered very carefully, one blade at a time, to secure that part of the stalk that reaches about 6 inches under the ground before it meets the root. To prepare the grass for drying it is woven together at the ends with fibers of cedar bark. It is then spread upon the ground or upon roofs in the sun. When to be used it is moistened with water and split with two small knife-blades, set in a stick in such a manner as to make the strips of the same width, the smaller portion being thrown away. The grass is kept moist with water while being made into baskets. The colored grasses are prepared by using aniline dyes. They were formerly colored by steeping the roots of plants that yielded a yellow coloring. A red dye was made from the bark of alder, and a paint was made of blue clay.

DOMESTIC RELATIONS.

In their domestic relations chastity seems to be almost unknown. These people are among the most, if not the most, degraded and diseased tribes of this coast. The parents usually manifest great affection for their children, although the animal instinct seems to predominate in this trait. The manner of the Indian boy toward his mother is almost uniformly disrespectful. The condition of the wife is one of degradation. She is expected to bring all the wood used for household purposes, as it is considered a disgrace for a man to be seen doing such work. The woman is expected to dig all the clams and roots and to pick all the berries used by the family, the husband supplying fish and game.

The foreheads of the children are compressed (with few exceptions) soon after birth by laying a small bag containing feathers or the fine beaten fiber of cedar bark on the forehead. Infants are kept constantly in small wooden trays, so tightly wrapped as to permit no use of the limbs, until they are six months old.

When a girl is married after the Indian style, the father of the girl receives compensation in the shape of horses, blankets, and money. Even when the marriage ceremony is performed by the agent this part of the old customs is often retained.

Still "women's rights" are sometimes asserted, as in the case of the woman with scalloped ears, who fought a desperate fight with another squaw to decide which should marry a medicine man, who appeared to have no voice in the matter. Another instance is that of a school girl, who throws large sticks of wood at her husband when he displeases her. He respects, though, her superior education, and when asked why he does not retaliate, replied: "Because I do not like to strike a lady!"

The aged people were formerly neglected, and their death hastened by starvation and abuse; but fear of punishment now restrains the Indians from this cruelty.

The native idea of a Supreme Being finds an embodiment, as with the Makahs, in the Soc-ca-li, Tyee Bird, who is not as awe-inspiring, however, as the Makah Thunder Bird, for, according to a Quinaielt legend, he finds two panthers, brought to him at his request "to play with," more than he can manage, and he entreats "the man," his servant and companion, to take them away. Looking down upon the earth from his house on a high mountain, and seeing a great many Indians playing ball, he covets the ball and sends the man to steal it for him! Such is the childishness of their religious ideas!

The me-satch-ies, or evil spirits, who take possession of sick people, and whom the doctors are employed to drive out, seem to occupy their thoughts to the exclusion of the great bird. With loud beating of the Indian drum and of sticks, accompanied by their own voices and the contortions and guttural howls and wails of their doctors, they seek to drive out the unwelcome guest. The lips of the medicine man are often applied to the body to draw out the evil spirit. An Indian school girl was lately dangerously sick; her friends wished to have her removed to "the ranch" for treatment by Indian doctors. As she expressed no wish in the matter, she was kept in the school and received treatment from the reservation doctor. She recovered, but the credit of her recovery was not given to the white physician. One of her shoes and some of her clothing had been taken to the ranch and had been doctored by the medicine men; hence her recovery!

The Quinaielts have no large figures of idols. The little tamanautas sticks, with faces rudely carved upon them, are the only objects at all resembling idols. The doctors place these sticks in an upright position around the patient, to assist in conquering the disease. The Indians stand in great fear of the medicine man. They believe if they disobey him that he has the power of casting an evil spell upon them; that he will cause them to sicken and die. It seems to be impossible to eradicate this feeling from their minds. Little can be expected from the older and middle-aged people with regard to laying aside their ancient superstitions. Some of the latter, who profess to do so, practically retain their old faith in the medicine man.

While in school and listening to the advice and explanations of white people, the Indian children, as a rule, are not unwilling to take medicine as prescribed; but if their friends visit and talk to them their old prejudices seem to be revived. In one case an Indian girl resisted all efforts to give her suitable remedies, declaring she would rather die than take the white doctor's medicine. She died in a day or two after. Although sick with an incurable disease, her life might have been greatly prolonged if she had consented to receive the medicine required.

Many of the adult Indians seem not only willing but anxious to use the medicines of the white man, but prefer to use them in combination with the efforts of their own doctors, any good resulting from taking the medicines being always attributed to the power of the medicine man.

Recent circumstances have developed the fact that poison is used by these Indian doctors to hasten the death of patients considered incurable. I have been told that a poison made from toadstools was formerly used. At present strong poisons are obtained from unprincipled white men, who sell a small bottle of poison to the Indians for a very high price. Parents of Indian children have been known to ask the agency physician for poison with which to end the sufferings of the sick son or daughter. They say they do not like to see their friends linger when they can not recover. The sudden death of those who have been long sick, but are in no immediate danger, is no doubt owing to the use of poison by the medicine men.

A common river or marsh moss is used for heart disease, and is eaten fresh from the water. Fern is used for the same purpose, eaten raw. The water of boiled crab-apple leaves is used as a drink for spitting blood. Leaves of a tree bearing yellow flowers and black berries (*Lonicera involucrata*) are chewed for sore mouth, or they are chewed and rubbed on sores.

Wood moss is applied to sores. A common weed (*Geum macrophyllum*) is a universal remedy, "good for everything." The leaves are eaten raw. Fungus is chewed and rubbed on sore neck. The roots of *Maianthemum bifolium* are chewed and applied to sore eyes. Having given these uses of the few specimens brought, the squaw suddenly crushed them all up together in her hand and carried them off. She said there were many more herbs used here, but that they grew far away. She promised to bring me some, but thus far has failed to do so.

Among the forest trees on the bank of the river their graves are made conspicuous by the quantity of white cloth or colored fabrics inclosing or floating above them. At present, as formerly, all the personal property of the Indian is buried with him or decorates his grave. With the last Indian woman who died here a large quantity of good clothing and a nice sewing-machine were buried. In old times the animals belonging to an Indian, his horses, cattle, etc., were killed upon the grave, but through the influence of the agents this practice is discontinued. A recent exception to the usual custom is the case of a sick Indian who believes he will soon die, and who has made his will, leaving his personal effects, as well as his house, to his brother. These Indians have not the same fear of handling a dead body as is shown by the Makahs, who hurry it away while still warm, although the Quinaielt bury the body in the earth or lay it in a sheltered canoe very soon after death. In putting the body of a dead Indian into its coffin or box, the body is suffered to lie just as it is first placed. If in the haste consequent upon the dislike of these Indians to handling a dead person it is put face down it is suffered to remain so, and in carrying the dreaded burden the box or coffin is tipped and handled with a roughness and disrespect distressing to civilized men.

Mention has been made of the houses inclosing the dead.

The coffin of an Indian who died last spring was placed in a box, with rounded end, raised high on posts. The box was covered with red cloth, and cloth was stretched around and covered the posts. Over it waves a large American flag, the property of the deceased, in place of the usual gaily colored or white streamers of calico or other cloth.

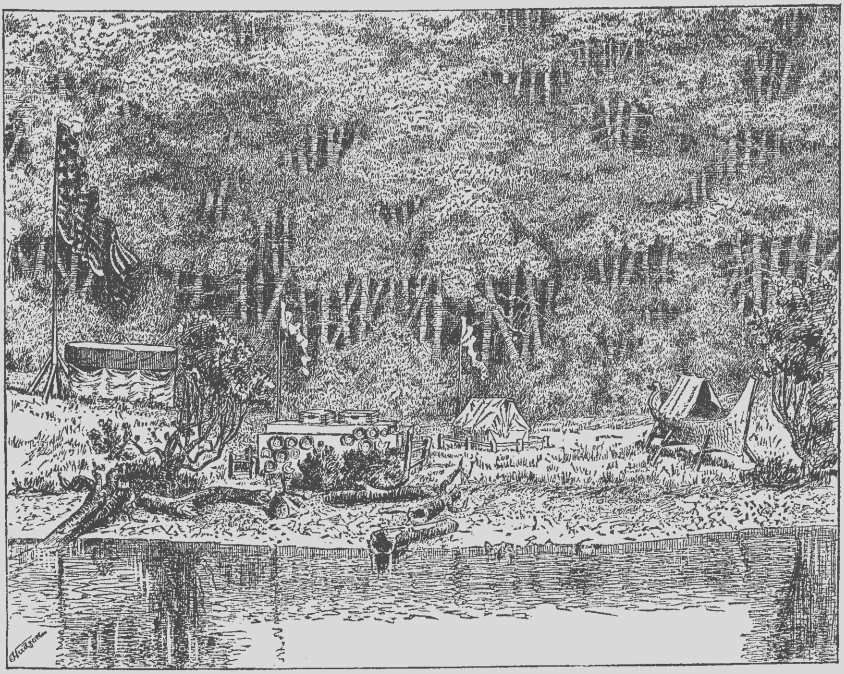


FIG. 7. Example of Quinaelt burial.

The body of an Indian girl who died about a month ago rests in a large ocean canoe, raised on posts, to which it is tied, a white roof covering the coffin.

Between these two is a grave, to which are nailed rusty pans and crockery, and near by a small one resembling a house, covered with white cloth. These graves with others are on the river bank just across from the village and very near the river's mouth. Others are scattered along at short intervals on the way up the river. When articles such as shawls are placed in the coffin, a narrow strip 2 or 3 inches wide is torn off by some friend probably to render the shawl useless and to prevent its being stolen. The house in which an Indian dies is sometimes torn down; recent orders forbid this practice now. Instead, a tamanawas is often kept up in the house for three days after death to drive away the spirit supposed to be still haunting the place.

They are superstitious concerning owls, believing them to be dead Indians. The idea of eating a robin is regarded with horror, not from any humane feeling, as I have yet to see an Indian child of this tribe who does not take pleasure in torturing birds and small animals. To eat while passing an Indian grave is to cause the mouth to grow awry and so remain; to use any clothing that belonged to a dead person would be speedy death. Their dances seem to have no special meaning, except, perhaps, the elk dance, which they perform dressed in the skins of the elk, just before going on a hunting expedition.

Se-guan, meaning a mole, is the name of the wooden image used by one of the medicine men, "Sammy," and is called by him, in English, "my doctor." The medicine man professes to believe that this image is animated by a spirit that tells the medicine man if any one is sick or dying at a distance. If, as the medicine man says, any one dies, the *se-guan* disappears from the house and goes down into the ground. It travels underground from one place to another.

The image has small eyes and mouth, and, resembling a mole, can not see much, but has great will-power.

In doctoring, the *se-guan* always sings; but no one can hear it except its medicine man. If the patient is going to die, the image warns the doctor. In the night, the *se-guan* stands in the middle of Sammy's floor and sings, and is the guardian angel of the household. As the mole is Sammy's protector, Sammy never kills a mole. The *se-guan* goes to the grave-yard and looks after the dead; but none of the dead speak to him when he goes there.

In traveling, if the *se-guan* sees a fire, he never goes near it. If the image should get burned, his medicine man, Sammy, would immediately die; and if Sammy's "doctor" should meet that of another medicine man, both medicine men would soon expire. If Sammy travels, the *se-guan* follows him, even if unsummoned, and is to be seen by Sammy wherever he goes.

About six years ago Sammy had the vision that made him a doctor. Then he heard all kinds of noises proceeding from the earth, and saw spirits and tamanaws (images) "and their little bones were rattling." Sammy had power given him by the Soccali Tyee Bird (the ruling bird spirit) to make and to have in his possession fire images, or "doctors," at once. In order to give or sell one of these images to a white man, the Indian doctor must make a new image like the one to be disposed of, and must place it for a while beside the old one to absorb its spirit. If a new one should not be made, the Soccali Tyee Bird would be angry.

The image tells the doctor when contagious diseases will prevail, and whether they will make the medicine man sick or not; also, how many Indians will be sick, and how many will die. He tells the doctor what to do "to take the sickness out." If any one is about to have sore eyes, the medicine man sees the mole coming from the direction of the water. Its "rattling bones" are deer's toe-nails.

A second image in Sammy's possession is a brother of the mole and exactly resembles the se-guan in appearance. When Sammy's brother, Henry, died, the mole's brother conducted Henry to his new abode in the land of spirits, remained there two months and returned to Sammy with a favorable account of the condition and happiness of Henry. Sammy says that the other world is just the same as this, except that everything is better. There are to be found all kinds of fish, elk, and deer. Of late years, horses also. There are no white men there. This is the most definite account of their superstitions obtainable from the present medicine men of this tribe, as they are usually unwilling to speak on this subject to white people.

A third image belonging to Sammy is made of cedar bark and seal blubber, painted. This one tells Sammy to wash his face and bathe with oil before he begins to doctor. The cedar-bark image regulates the wind currents, is the "doctor of the setting sun," and makes the ocean smooth. He tells Sammy what to do when fishing or whaling, and whether he will be successful or not. This image has been lately manufactured. Sammy says he will try it, and if it proves to be a deceitful adviser he will burn it up.

The Soć-cā-li Tyee Bird.—The Soccali Tyee Bird lives in a mountain. A man wanted to marry the Soccali Tyee Bird's daughter, and the Soccali Tyee said, "No;" he did not want to marry that girl to that man. And that girl wanted to marry very bad with that man, and her father would not let her go and marry with that man. And the Soccali Tyee Bird told the man to get him some bears to play with. And the man told the Soccali Tyee that he would fetch the bear to play with. And that man fetch two bears with a string to take it in the house and give it to that Soccali Tyee. And the Soccali Tyee Bird went to that two bears to play with, and the bears tried to fight the Soccali Tyee Bird. And the Soccali Tyee Bird told that man to take it out; that he was too much afraid for him. And the Soccali Tyee Bird told that man to bring two panthers in that house to play with. And he brought it in the house with a string. And that Soccali Tyee Bird went in to play with the panthers, and that Soccali Tyee Bird afraid for the panthers. And the panthers take the stick to him like everything. And the Soccali Tyee Bird tried to go to the two panthers and tried to fight him, and the Soccali Tyee Bird tried to go away from him and go in his bed; and the two panthers tried to go on the Soccali Tyee and torn his shirt like everything. And the Soccali Tyee Bird told the man that wanted to marry that girl to take the panthers away from the house. And the Soccali Tyee Bird told that man to go and fetch him snow—great lots of snow on the mountain. And that man brought just little bit of snow like a ball. And that Soccali Tyee got mad about it, because he did not brought lots of snow for him. And that Soccali Tyee Bird tried to eat that snow; and that snow did not all go in his mouth. And that Soccali Tyee sat down on his bed and he get cold, and he tried and go and sit down at the fire to make himself warm, and that Soccali Tyee almost dead, because he eat lots of snow. And he throwed it away on the house, and the house full of snow. And the Soccali Tyee told that man that wanted to marry to take that snow away from the house.

And the Soccali Tyee told that man to go and fetch some wood.

And that man that wanted to marry brought him great lots of wood. And that Soccali Tyee tried to cut that wood in two pieces. And the Soccali Tyee told that man to get right in the wood (like a hollow log). The Soccali Tyee took an ax away from that stick, and that man was in the stick, and that Soccali Tyee tried to go away from that stick, and that man was in that stick. Because that Soccali Tyee think that man was dead. And that Soccali Tyee stay in the house as long as he can. And that man get in the house with the wood. And that Soccali man get mad about that man because he thought he was dead, and he is alive now.

And that Soccali Tyee tried to go out from the house. And that Soccali Tyee saw lots of people on the end of the land. And the Soccali Tyee saw lots of people to play in the Indian land. And the lots of people play with a ball and they throw it. They throw it and it get burnt. And that Soccali Tyee tried to go in the house. And the Soccali Tyee told that man to go in the people to steal that ball for him.

And that man tried to go and take that ball away from the people. And that man that wanted to marry tried to stand between the people and watch the ball. And the people throw the ball away, and he take it. Tried to run as fast as he could. And the people cried like everything. And they took the pitchwood and tried to burn it, because the land was too dark like everything to see the man. And the people tried to take the ball away from that man, and the land is raining like everything, and the light is gone out. And the people go back again. They did not take the ball from that man. He run like everything. And that man that wanted to marry gave that ball to the Soccali Tyee Bird. And the Soccali Tyee Bird was glad, and that man married the daughter of the Soccali Tyee Bird.

A story of men and animals.—A lady was married to a man a few days, and she went into the woods to pick some berries; and she was there in the woods as long as she can to pick some berries, and then she came back in the house. Next morning, then again, she will go to the woods and pick some berries; and the lady was stay in the woods as long as she can; and her husband tried to sell her dress and clothes and everything away from her. And the lady came back to the house and tried to find her dress and everything to change her things. And she get mad, because she never find her things in the house; and she didn't want her husband any more. And the man was mad, and told his wife to go to the woods to pick some berries as fast as she could. And the man tried to put his wife on his back, and tried to put her in a high tree, and the man told his wife to sit down in the tree; and he leave his wife in the tree and go home again.

And the woman cried as loud as she could, because her three brothers was fishing in the river. The woman she get three brothers. One of the woman's brother's back was broken, and he heard the crying, and he said that it just looked like his sister crying; that he hear it. And the three boys went back again. And those three boys told his father and mother that it just looked like his sister was crying in the woods; and this man and woman came down the river to see the woman; and that father tried to ask that man where his wife go to. And that man said that woman had gone to the woods to pick some berries; that she was on the tree. And the man and woman tried to go back up the river again; and those three boys tried to go fishing up the river again, and they saw his sister in the high tree, and they heard that woman say: "Oh, that is my brother that was fishing in the river!" And those three boys went back and tried to tell his father and mother that it was his sister in the high tree.

And the man and woman went in the woods and tell all the animals—bear, wolf, fox, whale, blue-jay—every animal. And those animals go with that man and woman to take that woman that was in that tree away from that tree.

And the whale tried to stand up and to take that woman that was in that tree, and he stand just a few minutes and fall down.

And the sea-lion tried to go and fetch that woman that was in the tree. He stand up and he fall down.

And the blue jay scolded the whale because he couldn't fetch the woman. And the whale tried to scold the blue-jay, and the whale told the blue-jay to go on the high tree and take the woman away from the tree himself. And the blue-jay tried to go and take the woman away from the tree. And the jay tried, and then he will fall down. And the blue-jay fall down. Hurts him—dead! And the bear tried to doctor him, and he get well now. And as soon as he get well, he tried to scold again at the whale. And the whale scolded the bear, because he doctored the blue-jay. He didn't want him to get well, because he scold too much to everybody. And the whale told the bear, "Why didn't he let him to dead?" because nobody like him.

And this woman—one of her brothers had his back broken—everybody scold him, because he never think he was going to fetch his sister. And that boy tried to go up in the high tree and fetch his sister, and the boy was singing, and the people was singing, and the animals was singing, and everybody was singing. The blue-jay scolded the whale, because he never helped the animals to sing!

And the boy brought his sister away from the tree and put her on his back and all the animals felt joyful now. And the blue-jay scolded, scolded. He never get joyful with the other animals. And the blue-jay was getting mad to the whale. And all of them were going home now. And that husband want his wife again. And the animals didn't want him to take his wife again. And the blue-jay scolded that husband man, because he don't want that woman to have that man now. And the woman went home with her father and mother.

Capture of wives.—The Indians living at the mouth of the Quinaielt River were formerly hostile to those tribes living further up the stream, towards its source, a lake. Two S'Kokomish Indians came over the mountains to the lake hunting elk. Two Quinaielt Indians were hunting near by and found the fire of the S'Kokomish Indians; also a squaw left in camp, whom the Quinaielts captured and carried home with them. As they journeyed, the woman tore her blanket and scattered pieces along the way. These were found by her two friends, who returned to their tribe and brought a large number of S'Kokomish Indians back with them to the lake. The S'Kokomish were on one side of the lake, the Quinaielts on the other. S'Kokomish Indians sent one of their number for canoes. A lake Indian, who was fishing, discovered the S'Kokomish crossing in a canoe and informed others of the Quinaielts, who captured the S'Kokomish. Two of the lake Indians then crossed to see where the rest of their enemies were concealed. They were found in the woods, gambling by a fire, while awaiting the return of their messenger. Consequently, the S'Kokomish Indians were surprised at night when asleep, and were killed by the Quinaielts with flint knives and hammers.

The Quinaielts took with them to their village the S'Kokomish who was captured while crossing the lake. He was bound to a stake in the middle of the village. A council was held to decide his fate, and he was pierced by a great number of arrows and left to die. The woman first captured became one of the numerous wives of the Quinaielt chief.

THE STONE AGE OF OREGON.

By Rev. M. Eells.

The stone age of Oregon, like that of Washington, is mainly recent. It was evidently fully alive a hundred years ago, and a little of the outcropping may still be seen, though it is probably more nearly buried than that of Washington.

A comparison of the articles which I have seen, with those on Puget Sound, shows a considerable difference. This is partly accounted for because the Puget Sound Indians gained the largest share of their living from the waters of the sound, while the natives of Oregòn, although gaining considerable of their living from the Columbia, Willamette, and other rivers, yet lived more from the products of the land. The Puget Sounder traveled, too, mainly by water, while the Oregonian used horses largely for locomotion. Another reason for the difference between the article used by the inhabitants of the two regions was probably because of the slight intercourse and trade between them.

The distance by water was too great out of the sound by the Straits of Fuca to the mouth of the Columbia, and the sailing on the ocean too dangerous for canoe traveling, while the heavy forests for the 90 miles which lay between the headwaters of Puget Sound and the Columbia River was a great obstacle to both foot and horseback travel, so that the people of each region had mainly to manufacture their own implements during the stone age. There was a little travel and trade from the Columbia up the Cowlitz River, and then through the forests to Puget Sound, and a little from Puget Sound across to the head of the Chehalis, and down it to Gray's Harbor, thence to Astoria; but this was limited. That great forest was a dividing line between the people of the two sections.

The Indians of British Columbia often came in canoes to the Indians of Puget Sound, who thus obtained articles from that far off region, and the people of the Willamette Valley went to the Columbia and up the Columbia for fish, where numerous Indians congregated, and these in turn traded with the people of eastern Oregon, who by horseback went over the vast plains, the buffalo country east of the Rocky Mountains, and occasionally to California, Nevada, and Utah.

Authorities.—For private collections of Oregon implements: Dr. D. Rafferty, East Portland; H. C. Stevens, Oregon City; Mrs. Helen A. Kunzie, Umatilla.

G. M. Powers, of Shedd's station, has examined mounds in that region (American Antiquarian, May, 1886). See also J. L. Hill, in Lang's History of the Willamette Valley, page 487; Capt. C. Bendire, annual report of Bureau of Ethnology 1881–'82; Paul Schumacher, in Hayden's Bulletin, 1877.

Scattering references also are to be found in Lewis and Clarke; Irving's Astoria; Ross Cox's Adventures; Alexander Ross's Adventures; Franchere's Narrative; Parker's Exploring Expedition; Townsend's Narrative; Lee and Frost's Ten Years in Oregon; Mission Sketches.

Mounds, Earthworks, and Skeletons.—On the farm of Mr. Ira E. Purdin, in Washington County, in the northwestern part of the State, are some old works which look like a fort, and Indian tradition gives them that name. It is part way up a hill in front of which is the West Tualatin plain, and back of which is timber. There is a spring at the bottom of the hill; the hill faces the east. On the north side the line and ditch are plain, about 63 feet long; on the east side they are also plain, 75 feet long; on the west side towards the timber is no line. A curious fact is that inside the fort, and parallel with the line on the north side, are other lines, and ditches and mounds, first a ridge as large as the northern one, then a smaller one, then two rows of mounds, another row, mainly a ridge, another small ridge, and then irregular mounds which bound the fort on the south side; but there is no line on that side. The internal lines run back to the west further than the north line, some of them 60 feet further, and they extend south further than the end of the eastern line 50 or 60 feet. The ridges and mounds are generally from 2 to 3 feet high, and the largest are about 12 feet in diameter. Mr. Purdin's son and I dug into two of the largest for three or four feet until we reached the native clay (which is quite hard), but found nothing. It is about 470 feet around it.

In Linn County are some mounds already referred to, which the history of the Willamette Valley says (p. 487) are 7 miles southwest of Albany, and were discovered by Dr. J. L. Hill, of Albany. There are quite a number of them and they are probably of Indian origin.

Mr. G. M. Powers, of Shedd's station, Linn County, states that he discovered them in 1883, nine months before Dr. Hill claims to have discovered; and also states that he opened several at that time, and has opened twelve in all. He says they are from 50 to 150 feet in diameter, and from 3 to 8 feet high. Within them have been found several skeletons, some, at least, of which were buried with care, and various implements, as flints, rudimentary arrow-heads, beaver tusks, bone awls, a pipe, a spoon, a necklace of copper rolls, white beads of bone and shell, matting, solid copper rings for arms, green glass beads, stone beads, flat-headed square brass nails, with sharp points, a curious bone implement for weaving, a spatula-like bone similar to a paper-knife, minute glass-bells for ornaments, stone mortars and pestles, knives, drills, arrow and spear-heads, bone charms, and implements whose use is unknown. No other mounds similar to these are known in the State. The skeletons are said to be in a good state of preservation and to be somewhat unlike the ordinary frame-works of the Indians of to-day, being without the frontal ridge and having a peculiarly receding forehead, so that the explorer thought that they belonged to a tribe anterior to the Calapooias, who lived there when the first whites came to the region.

Mr. H. A. Chase, in the American Journal of Science and Arts, describes some mounds on the coast of southern Oregon. Their position and ruins show them to have been forts; their ruins likewise show them to have been houses, and the skeletons which they yield show them to be graves. They are often 25 or 30 feet high. With the skeletons are found numerous articles as knives or swords of blueish or black obsidian. Pipes of slate and sandstone with straight tubes. Whistles of thigh-bones of birds, pestles and mortars of dark green stone, arrow and heads of Jasper, flint and obsidian and ivory (whale's teeth), stone adze-handles, and one brass hatchet or adze which must have been more than thirty years old.

In Patton's Valley, Washington County, are a number of interesting carvings on rocks. They are in sandstones, and face the south. The most noticeable figures are of four persons. The distance across the largest face is 9 inches, and it is about 12 inches long. The smallest is about two-thirds that size. The mouth, eyes, nose, and hair, of three are very plainly seen, the hair standing out straight all around; the hands of two are plain, and also the ribs of one. A line from the head downward in each of three terminates at the heart, which is also plainly visible. One figure is almost obliterated by time. A number of other lines are on the rock, which look as if they might have been numbers. The outlines of two fishes, with the ribs, can also be seen on the same rock. On other rocks near by are other marks, two of which also seem to be fishes; one a bow and arrow, another a lodge, and some are unknown. There are also many straight irregular marks.

Some eight years ago, while summering at a sea-side house, we noticed skulls amongst the débris used to macadamize the roads in that locality, and visiting the spot whence this material was obtained, we found the side of a wall left by the workmen, which was at least 8 or 10 feet above, showing the great depth of deposit. Bones of fish and fowl, deer, and animals we could not identify, were also found. What we wish most particularly to notice was the frequent présence of human bones of children, as well as adults. These bones were often broken, suggestive of cannibalism.

Graves and cemeteries.—As far as I know these have been the most prolific places where stone and bone implements have been found. Coffin Rock, on the Columbia, received its name because it was an Indian cemetery. From it, and from another cemetery on Sauvie's Island north of Portland, Dr. Rafferty obtained a large number of his specimens. The mounds in Linn County and in southern Oregon described by Messrs. Chase and Schumacher were also places of interment, while near the Umatilla landing is another from which Mrs. Kunzie has obtained many valuable articles.

Implements.—We come next to the articles found in various places. They are of various descriptions.

Stone hammers.—These are very different from those on Puget Sound, the latter being in the form of a pestle, while the former have a groove, and occasionally two or three grooves, or even four, around them, where a wooden handle of some length was fastened. They look somewhat like a Puget Sound sinker for fishing, but are very much larger, while the testimony of the old Indians and the battered ends testify that most of them were hammers. They vary in weight from 9 ounces to 8¾ pounds, in length from 4 to 6 inches, in width from 2¼ to 5¼ inches, and in thickness from 1¾ to 4 inches. Occasionally they are found without battered ends, either having been unused or used as sinkers in fishing. They are rough like beach stones, and were probably originally such stones. Some are of sandstone, others of volcanic origin, with some other kinds such as might be picked up anywhere. Only one of this kind have I ever seen on Puget Sound, and that was longer in proportion to its size than those of Oregon. The Oregon ones are very abundant, being seen in almost every cabinet of implements, and being found in Washington, Clackamas, Multnomah, and Linn Counties, and probably in others. Some of the heavier of these fastened to the end of a stick would strike a heavy blow either as an implement of common use or as a war club. A solitary one is peculiar in that, while it has a single groove running around it crosswise, it has also a large number running lengthwise of it on three sides, about a half an inch wide, and from one-fourth to three-fourths of an inch apart.

Pestles and mortars.—These are not found on the sound, for here are no acorns to pound up. In Oregon they are abundant. Our hammers are much like some of their pestles, but some of the latter are quite different. A very smooth one, well polished, is of jasper, 8¾ inches long and 4 inches thick at the base, with a good handle, and quite symmetrical. The end of the handle of one has a place for two fingers; the handle of another is in the shape of a seal head, with an eye raised, while that of the third looks like a bear, which is large in the middle, and said by the Indians to be with young. Another is flat on two sides, though the ends are round and the handle end is crooked a little like a bow. Another is flat only on one side. Still another seems to have been a pestle at the handle end, and a blunt edge at the other. Two or three very small ones were probably used to grind their paint, the smallest of which is 3½ inches long, and seven-eighths of an inch thick. Generally the others vary in length from 5½ to 11¼ inches, in thickness from 2 to 4 inches, and in weight from 1 pound and 6 ounces to 6¼ pounds. They are generally cylindrical, though a few are a little flattened. Some are almost straight from one end to the other, with no special place for a handle, tapering a little towards the upper end. I saw some forty-five or fifty in all, some of which are of granite, some of basalt, and others of volcanic rocks. The smooth and the rough ones are about evenly divided, a few being polished. Most of them are from the three counties above named. One from California looks almost exactly like those of Oregon; a few as if they were common stones from the beach of about the right shape, but generally they are worked into good shape, some with great labor.

Those collected by Captain Bendire from John Day's River were cylindrical and mostly of compact eruptive rock. Those from the mounds of Linn County are described as being from 5 to 13 inches long, some being nicely polished. They are of a blue, hard gravel. The mortars were evidently used both for grinding food and paint, the smaller ones for the latter; but they grow in size so gradually as to make it impossible to determine accurately the dividing line between the two. There were many of them of tufa, basalt, and trachyte. The upper surface of the bowl is generally round and regular, but sometimes oblong. Among the round ones the distance across the bowl varies from 1½ to 7 inches, and the depth from a quarter of an inch to 7 inches. The upper surface of the bowl of an oblong one is 7 by 13 inches. The whole distance across the upper surface of the stone among the round ones varies from 1⅝ to 10½ inches, though an irregular one is 9 by 17½ inches. The whole height of the stone varies from seven-eighths to 7 inches, though I once saw one in Patton's Valley, Washington County, which was 12½ inches deep. Its bowl had only a depth of 6 inches. Their weight varies from 3½ ounces to 60 pounds. Generally the outside is plain, but a few have some unmeaning lines on them, and one oblong one has the head of a turtle at one end, with an arm and ten ribs on its side. Sometimes the bottoms are quite flat, and sometimes rounding. If any stone mortars are found on the sound they are scarce. Those from the mounds of Linn County are of various sizes and shapes, one being large enough to hold a half gallon. They are the same kind of stone as the pestles—a hard, blue gravel. Those from southern Oregon, found by Mr. Chase, were of a dark green stone.

Stone ladles.—Mr. Stevens has one of light-red porous tufa, which was never used much. The handle is 3 inches long and 1¼ inches thick, and the bowl of it is 4 inches long.

Another beautiful ladle of stone was found by Mr. Schumaker in the southwestern part of the State. He also found a boat-shaped vessel about 9 inches long, of magnesian mica, which showed strong marks of having been exposed to the fire, seemingly for the purpose of cooking food in it. A metate, owned by Mrs. Kunzie, is 19 inches long, 13 inches wide, weight 53 pounds, and has three legs.

Knives.—Those on the sound are of slate, with one edge and small, only 2 or 3 inches long; but some have been found in a cache at Oregon City of black and striped obsidian, the largest of which was 10½ inches long and 2¼ wide, and a half inch thick, with double serrated edges, sharp at both ends, and very irregular. As this kind of stone is not found in the region, they must have imported it, probably from a long distance. They had, from appearances, never been used.

Similar ones were described by Mr. Chase as being found in southern Oregon, too brittle to have been of much practical use, some being nearly in the shape of a Greek sword, the largest being 14¾ inches long, 2 inches broad near one end and 1¾ inches near the other, tapering to a point at each end, and a quarter of an inch thick.

Those from the mounds of Linn County are of flint or jasper, and only from 1 to 2½ inches long. Those obtained by Captain Bendire are from graves on John Day's River, and are of obsidian.

Axes, adzes, and celts.—These are generally small compared with those on the sound, or about the same as our smaller sizes. They vary in weight from half an ounce to 4 ounces (the largest one on the sound which I have seen weighs 12 ounces, and is 7⅝ inches long); in length from five-eighths to 2½ inches, and in width from one-half to 2⅛ inches. There were eleven of these, most of which were believed to have come from near Oregon City. They are all smooth and of metamorphic rock, the same material as those on the sound. In Oregon they are quite scarce; Captain Bendire has, however, found a few on the John Day River, in eastern Oregon. Handles from whale's teeth for these adzes were found by Mr. Chase in the mounds of southwestern Oregon.

Chisels and wedges.—I have only seen one on the sound of stone, and am doubtful of that one, though an old Indian says they were once used here. But Dr. Rafferty has nine whole ones, or parts, about which there is no doubt. They mostly come from Sauvie's Island, and are generally of hard volcanic rock. They vary in weight from 2 pounds 14 ounces to 5 pounds 11 ounces; in length from 6½ to 13¾ inches, in width from 2¾ to 3½, and in thickness from 2⅛ to 2¾ inches. The edges are sharp, but the stone is thick a short distance from the edge. I know of none from other parts of Oregon.

War clubs and swords.—There are three of these, two of which are owned by Dr. Rafferty, and one by Mrs. Kunzie. One of Dr. Rafferty's was found at Fosters, in Clackamas County; is of serpentine; 21½ inches long, 4 inches wide from the club end, tapering towards the handle, and rounding towards the other end; half an inch thick. It weighs 2 pounds and 9 ounces. It is supposed by some to have been a badge of honor. The other came from Vancouver, Wash., is 17 inches long, 2¾ inches wide, 1⅛ thick, and weighs 6 pounds and 14 ounces. The handle is shaped into the head of some animal. The other end looks as if it might have been used for a pestle.

Mrs. Kunzie's was found at the Umatilla Landing, and is 22 inches long and 1¾ inches wide at the handle, tapering gradually to a point at the other end. Like the first one mentioned, it has a hole through the handle, through which a string was passed to assist in holding it. I have but little doubt that these were used in war, as Lewis and Clarke speak of seeing such of wood and iron, while Ross, Cox, and Franchere speak of similar articles, but do not describe the material. I have a similar one of stone, and another of copper, obtained on Puget Sound, which Indians now living remember as having been used in war. Those of stone, however, are now very scarce.

Stone spear and arrow heads.—These are very scarce on the sound; I only saw nine in eight years. The Indians say they did not make them. They generally used those of bone. At Oregon City, about half a mile below the falls, is a perfect mine of them, which the high water, as it washed away the bank, unearthed.

Mr. Stephens has about thirty-two hundred in his cabinet, and many hundred on hand for exchange, besides having sent off very many, and other persons have obtained many. The lance and arrow heads run into each other, so that it is very difficult to draw the dividing line. Some are very small, a half inch long and a quarter wide. In one drawer, 22½ by 16½ inches, he has eighteen hundred and thirty-five of the smaller ones well arranged so that all can be seen. The longest which he has is 6½ and the widest 2¼ inches. They are of obsidian, chalcedony, jasper, and some other varieties of stone, and many are very regular and very beautiful. They are all patterns, some being double serrated.

Another manufactory was at the Umatilla Landing, where Mrs. Kunzie has obtained many, some of them being as beautiful, seemingly, as can be made. The chips are now seen all around, though the stone of which they were made—much the same as that used at Oregon City—must have been brought to both places from a long distance. Others have been found in the mounds of Linn County, very fine, from a quarter to three-quarters of an inch long, mainly of obsidian, but some are of carnelian, chalcedony, and jasper.

In the graves on John Day's River similar ones have also been found by Captain Bendire and by Messrs. Chase and Schumaker in southwestern Oregon.

Stone sinkers.—Those for fishing are generally very different from ours on the sound. Ours being oval, about 2 by 3 inches, around them is fastened bark, to which the lines are tied, but the Oregon sinkers are generally flat, more the shape of a small grind stone, with the edge rounding, as a beach stone. All are evidently water-worn, some being smooth as water will make them and some being rough. There are three kinds of the first style; some are quite circular and some oblong, and each has a hole through it, either in the middle or towards one side, from five-sixteenths to five-eighths of an inch in diameter, through which the string passed that fastened them to the fishing apparatus. Usually this is all the work put upon them, but one has four grooves at the edges and another groove from the hole to the edge where strings were also tied. These sinkers vary in length from 2¼ to 8 inches, in width from 1¾ to 6 inches, in thickness from three-quarters to 1¾ inches, and in weight from 6 ounces to 5 pounds. Some of the smaller ones with very perfect holes are said by an old Indian to have been used for drawing the shaft of an arrow through so as to make it a uniform size, but all could not have been used for this purpose, as the holes are too large and irregular. These generally belong to northwestern Oregon, in the country of the Willamette and Lower Columbia Rivers, and are quite common.

Of the second kind I have seen only two in Mr. Stevens's cabinet, the smallest of which was 1⅝ inches by 1⅜ inches, has no hole in it, but is made more after the style of those on the sound, having two grooves around it, one lengthwise and the other crosswise, in which the bark string was placed to which the line was fastened.

The third style belongs to eastern Oregon, and have been mainly found about the Dalles and Umatilla Landing. They are water-worm stones, flat, from 2½ to 4 inches long, from 2 to 3 inches wide, and from a half to three-fourths of an inch thick, weighing from 4 to 8 ounces. A groove about three-fourths of an inch thick and a quarter of an inch deep is made in each end, and by means of this the string wound around the sinker was kept in its place, to which this line was fastened.

Arrow targets.—Of a somewhat similar shape to the first kind of sinkers, but far more regular, are two targets in Dr. Rafferty's cabinet. They are made round as a grindstone, with a hole in the center nearly an inch in diameter. They are from 1⅝ to 2⅛ inches thick, and weigh from 1½ to 2 pounds 1 ounce. There are none of these on the sound as far as I know.

Arrow polisher.—Another new article is a stone, now broken at the base, 3¼ inches long, 2 inches in diameter at the base, cylindrical but not rounding at the top, and weighing 7 ounces. It is of tufa, and came from the Cascades. Around it run six grooves lengthwise, through which the old Indians say arrows were drawn so as to polish them. Dr. Rafferty likewise owns this. Mr. Stevens also has a stone which perhaps may have been used for a similar purpose. It is oblong, 3 inches long by 1½ wide, and three-fourths of an inch thick. One side is round, the other flat, with a groove one-eighth of an inch deep on the flat side, running lengthwise of the stone.

Hide dressers.—Most of these came from Dalles and eastern Oregon, and are very small and much more worked than those of the sound. A Puget-sounder picks up almost any stone of 2 or 3 pounds weight, splits a stick for a handle, puts the stone in it, and ties it there. But none of those from Dalles weigh over 4 ounces, and the largest is 3¾ inches long. Two found were three-eighths of an inch wide and three-fourths thick, and the smallest is more than an inch shorter and a half inch narrower. They are smooth, and the edge all around is ground somewhat sharp.

Stone scrapers have also been found in the mounds of Linn County.

Mr. Stevens has also a hide dresser, made from a walrus tusk, about 15 inches long. It came from the Malheur country, in eastern Oregon, but evidently made a western tour before it reached that region.

Pipes.—Dr. Rafferty has two of these, and both are of patterns similar to those on the sound. One is like the common American pipe of claystone, 2½ inches long, weighing 1¾ ounces, and came from Sauvie's Island, or Oregen City. The other is of the same weight, from The Dalles, of light basaltic rock, and of the grindstone shape, with the bowl and place for the pipe-stem at right angles to each other. It is 2 inches in diameter, with lines and dots on the side.

Mrs. Kunzie, however, has obtained the most valuable collection of these, some being straight, with carvings on them. They are from 3 to 6 inches long, and the heaviest were about 8 ounces. Some of the most valuable of these were found near her residence.

Captain Bendire also found one of these straight ones, which was obtained from an Indian grave on John Day's River. It is of gray sandstone, shaped much like an ordinary straight cigar-holder, 3 inches long and 1 inch in diameter at the larger end. I have not seen a straight pipe in the Willamette Valley or on Puget Sound.

Dr. Hill found a single pipe in one of the mounds in Linn County, but I do not know its shape. It is 3½ inches long, 1½ wide at the top, and 1 inch at the bottom. Mr. Chase also found some pipes of slate and sandstone in the mounds of southwestern Oregon with straight tubes.

Plates.—Dr. Rafferty has two of these and Mr. Stevens one, but I have seen none on Puget Sound. One of the former came from Sauvie's Island. It was used for baking bread upon, is 12½ inches long, 10 inches wide, and varies in thickness from 1⅛ to 2 inches. It is of light sandstone, and weighs 5 pounds 7 ounces. The depth of depression between the ends is three-fourths of an inch, but there is no depression between the sides.

His other is irregular, but somewhat diamond-shaped, 5½ by 7½ inches, with a depression of about one-half an inch.

The one belonging to Mr. Stevens is circular, about 5¼ inches in diameter, the dish being one-fourth of an inch deep. I do not feel certain, however, that this is a plate, as it is hollowed out on both sides and is quite thick, 1⅝ inches. It came from Dalles.

Awls and drills.—These are of two kinds, bone and stone. Bone ones were common on Puget Sound, but I have not seen any stone one from that region. Those of bone are about the same size as those on the Sound, 2 or 3 inches long. Those of stone have been found at Oregon City, Umatilla Landing, and in the mounds of Linn County. They are flint, jasper, or some very hard rock, and are usually from 1 to 2½ inches long. Some of them have a handle, not far from an inch long, at right angles with the drill; some have none.

Needles.—Like the drills and awls, these are of both stone and bone. Those of bone were the most common. Mr. Stevens has two, 3 and 5 inches long, with eyes one-fourth and three-eighths of an inch in diameter. Those found by Mr. Powers in the mounds of Linn County are about the same size, some of which are highly polished. A stone needle for making nets does not belong to the Sound. A single one was found at Sauvie's Island about 7½ inches long, 1 inch thick, cylindrical, smooth, of volcanic rock, weighing 5¾ ounces, blunt at both ends, with a hole nearly the fourth of an inch in diameter, about an inch from one end to receive the twine. It belongs to Dr. Rafferty.

Game stones.—These also do not belong to the Sound. There are seven in all in Dr. Rafferty's collection, two of which are almost perfect spheres, one of which is 3½ inches in diameter and weighs 2 pounds 6½ ounces, and the other is 13 inches in diameter, weighs about 70 pounds, and came from Cascades. Both of these have dots or holes in them, which are said to be the owner's cue. The others are smaller and less perfect, with no marks on them, the smallest weighing only 10½ ounces. They were thrown and rolled into certain holes, but it is difficult now to determine certainly all the rules of the game.

Calendar stone.—Mrs. Kunzie has a calendar stone, which is 3 feet long and weighs 30 pounds. On one side of it are marks which show the number of months in the year, and on the other those which show the number of days in the month.

Whistlers, of the thigh bones of birds, were found by Mr. Chase in the mounds of southwestern Oregon.

A bone spatula was found by Dr. Hill in a mound in Linn County.

A weaving implement of bone was also found by the same person at the same place.

Money or wampum of various kinds has been found in considerable quantities. Mrs. Kunzie has several strings of these, most of which were found near her home. They are composed of shells of various kinds, some of them being the dentalia and antelope teeth.

Beads.—Mrs. Kunzie has several necklaces of stone beads, which are well polished and of various symmetrical shapes—round, oblong, cylindrical, and square—some of them weighing 2 ounces each and 2¼ inches long. A few have also been found by Mr. Powers in the mounds of Linn County, but they are scarce. They are made of a kind of bluestone which much resembles glass. There is a ledge of this kind of stone near Mount Jefferson, from which it is supposed the Indians obtained that from which they manufactured these articles. Bone beads were also found at the same place, which were made of the leg and wing bones of birds. They were only found on the skeletons, around the neck and hips, and sometimes in the hands.

Beads of Venetian glass have also been found by Mrs. Kunzie, but they were probably introduced by the early traders, as were also the glass beads, brass bells, necklace of copper rolls, and coppers rings for the arms, found in the mounds in Linn County by Dr. Hill.

Animals, etc.—Stones in the shape of animals seem to be peculiar likewise to Oregon—some for use and others apparently with no function. One from Vancouver in the shape of a bear and another from Sauvie's Island with a seal head have been referred to among the pestles.

A turtle from East Portland has been mentioned among the mortars, and the heads of some animals undetermined among the war clubs.

There is also a squirrel head broken off from the body, or whatever implement it was attached to, from Vancouver, now 2½ inches long, 2 inches thick, and weighing half a pound. Dr. Rafferty owns this, and Mr. Stevens has another, which came from Eagle Creek. Like the last, it is broken off from whatever it was attached to, but a good share of the body still remains. The body is about 3 inches thick one way by 2¼ inches the other, the neck being 2 by 1¾ inches.

Birds.—Dr. Rafferty has a bird from the Cascades, of basaltic rock, 6¾ inches long, 3¼ wide from tip of one wing to tip of the other, about 2 inches thick, and weighing 1 pound 10 ounces. Mr. Stevens has a bird head which came from near the Dalles. It was broken off from something, perhaps a hammer, and is quite perfect. It is now about 3½ inches long and 2 inches thick.

Mrs. Kunzie has a stone eagle which came from the Dalles. It is 8½ inches high when standing on its feet.

Feet.—Dr. Rafferty has two human feet, or moccasins, in stone, one from Oregon City, 9¼ inches long, 3¼ high, and 2¼ thick, weighing 5¾ pounds; the other, an inch less in length, 1¾ inches high, 2¾ wide, weighing 2¼ pounds.

Baboons.—He also has a baboon with the eyes, forehead, and nostrils plainly marked; it is 6½ inches long, 4 inches high, weighs 6 pounds 10 ounces, and is of volcanic rock. Mr. Steel, of Portland, has another well-made baboon, which is 7¾ inches long, 17½ inches around the body, and weighs 13½ pounds. The eyes are an inch in diameter; it is 2⅝ inches between the center of the two eyes, 4 inches from the eyes to the end of the nose, and 2 inches across the nose. He obtained it from the Dalles and has traced it some distance further east of the Cascade Mountains. Mrs. Kunzie has another of these stone baboons which likewise came from eastern Oregon, and Mr. Stevens has a fourth, very nearly the same size as that of Dr. Rafferty's, and all of them seem to be of similar stone. Where the Indians of this region obtained the idea of such perfect baboons is a mystery; or were the stones, in their present shape, imported?

Horse head.—Mr. Stevens has the head and neck of a horse, the head being not far from 15 inches long and the neck of proportionate length, but both are slim. He has also a small one. The metate already mentioned as belonging to Mrs. Kunzie is thus described by Mr. S. A. Clarke in the Oregon and Washington Farmer. "Upon first examination it strikes one as an Assyrian or Egyptian carving, the feature and style of ornament being much nearer those wonderful Oriental relics of antiquity than our Northwestern Indians would be thought capable of. The use of this interesting relic was probably for a grinding bowl, though its grand sphinx-like form suggests a nobler use. This great curiosity is cut from reddish-gray granite, and would require a block a foot square for its dimensions. Its front is a human face, distinct, dignified, and in some respects even grand in outline. It is carved with a skill which could have copied nature, yet there is no point of resemblance between the face and that of any modern Indians. Its brow is broad and low, and the wide-curving eyebrows suggest the resemblance to rams' horns, which Assyrian images have also. The nose is almost Grecian, except that the nostrils are wider and the chin and lower jaw are the reverse of Indian physiognomy. Only the mouth bears any resemblance to our Indian carving. In this respect there is a slight leaning towards the style of some of the Alaska totem faces. On each side, above and behind the ear, is a protuberance like the fold over the old Egyptian statues, and a claw, like an arm, extends from the edge of the bowl to the side of the throat, its claws being nearly under the chin of the figure. The hair is not cut in detail. It seems to be in a straight mass without braiding or ornament. The whole head is well proportioned, and is about life size." This was found in the Indian cemetery at the Umatilla landing.

Idols.—Images in stone and shell have also been found which were probably made for religious purposes and not as a mere work of art, as I have seen the Indians on Puget Sound within twelve years actually worshiping an idol made from wood in the shape of the upper part of a man. Mrs. Kunzie has one splendid one which came from near the Dalles. It represents the head, neck, and most of the body of a man, is 17½ inches high, 27 inches in circumference, and weighs 64 pounds.

She has another which is also in the image of the upper part of a person, and came from the same region, which is 6 inches high and 3 inches in diameter, and she has found near her residence most of the pieces of an idol of shell, which is well carved, and a totem post of black stone, 21 inches long, and which weighs 11 pounds.

Dr. Rafferty has another which was unburied at Sauvie's Island. It is 16 inches long, 8 inches wide, while the eyes are about 2 inches in diameter, and it has a mouth and other lines on it.

Mr. Stevens has the head of a small one, which seems to be the face of a person, but broken off from whatever it was attached to; the neck shows that it was some four-legged animal. The face is very regular. He has also some small circular stones from 1 to 2 inches in diameter with various markings on them—lines, diamonds, angles, and parts of circles; one has a human face on it—which I presume were intended for religious purposes.

Unknown implements.—Dr. Rafferty has three of these; one, an egg-shaped stone of quartz, but rather sharp at the ends, very regular and well worked, 7 inches long, 3¼ inches wide, and 2⅞ thick, weighing 3½ pounds.

Mr. Stevens has one similar to it, which is 8½ inches long and 3⅛ in diameter. Dr. Rafferty has another 2½ inches long and five-eighths inch thick, weighing half an ounce, with three small holes through it, and another which looks a little like a great arrow-head, only cylindrical, one end looking as if it had been fastened into a stick, the other being somewhat sharp. It is 8½ inches long, and 2¼ inches thick near its base.

Mr. Stevens has another which is some what egg-shaped, about 2¾ inches long, and 2½ inches in diameter at the largest place. It is quite regular in its form, and there are two small grooves around it. It came from the Columbia River near the Dalles.

CHARM STONES.

NOTES ON THE SO-CALLED "PLUMMETS" OR SINKERS.

By Dr. L. G. Yates.

Several years ago an article appeared in the American Naturalist (November, 1872), by J. G. Henderson, on the subject of "plummets," in which, after describing and figuring several specimens found at various places, he offered some conjectures as to their uses, six of which uses he enumerates as probable.

(1) As slung-shots.
(2) As sinkers for fishing-tackle.
(3) In playing some game.
(4) As sacred implements in performing some religious ceremonies.
(5) As personal ornaments.
(6) As plummets and levels.

After giving his reasons at some length in each of these supposed uses he dismisses all except the last, which he decides were the uses to which they were put. In a note appended to the article, Prof. F. W. Putnam states that "he has considered the implements generally classed under the names plummets and sinkers to represent to a greater or less extent, according to size, material, shape, and finish, first, pestles; second, sinkers; third, spinning weights; fourth, ornaments."

Mr. Henderson gives a number of localities where these implements have been found. My attention was particularly attracted by the statement that "about ten years ago one of these implements was found under remarkable circumstances in Woodbridge County, Cal.;" there being no such county in California.

I commenced an article on this subject at that time, but press of other matters and a desire to obtain as much reliable information as possible have prevented its completion.

During the years that have elapsed since the inception of this article I have noted the various theories advanced by different writers as to the uses of these singular implements.

A great many have written on the subject, and all have accepted some one or more of the various theories projected.

Foster, in his Prehistoric Races of the United States, classes the plummet-shaped stones under the head of "weights which may have been used in the process of weaving," and figures three varieties of them (see Figs. 31, *a*, *b*, *c*, p. 230), Prehistoric Races, as "weights to keep the threads taut."

Thomas Ewbank, in his Life in Brazil, published in 1856, figures two implements which might be classed with those under consideration. I have copied from his illustration on page 451 of his appendix (see Fig. A). He says: "It resembles an egg in shape, is of black, hard, smoothly polished stone, used for working metal."

On page 464 of the same appendix is figured an implement exactly like some of our so-called plummets (see Fig. B), of which he says: "Which, from the notch cut round its pointed end, may have been used as a plumb-line or as a spindle." In the Third Annual Report of the Bureau of Ethnology, by J. W. Powell, director, published in 1884, on pages 509 and 510, are descriptions of implements in a collection from Peru, "neatly made sinkers wrapped in corn husks and sinkers of gray slate, shaped somewhat like a cigar, with one or more grooves partially encircling the end. These were wrapped in corn husks."

The figure given on page 510 represents the ordinary so-called plummets, except that there are two grooves on the smaller end and one on the larger. These grooves only partially encircle the implement and are all on the same side.

Abbott, in his Primitive Industry, very properly separates the plummets and sinkers, devoting one chapter to each.

In the chapter on plummets he gives illustrations of several implements found in Illinois, Ohio, New Jersey, Massachusetts, and Maine. These are nearly identical in general form and outline with those found on the Pacific coast. He says: "While the general name given to the group is convenient, and in a measure descriptive of their appearance, it has but little reference to their uses. It has been remarked that their principal use as plummets may be questioned, as there are far too many of them found and of too great variation in size to lead us to infer that they were used mainly for that purpose."

He remarks of Fig. 216, which he states "is a characteristic specimen of the New England plummet of about the maximum size: Whether it should be classed as a pestle or not can not be readily determined, but from the fact that unquestionable pestles are by no means infrequent in the same localities, and also for the reason that the larger plummet-shaped implements are of too soft a material and seldom exhibit signs of use at their rounded end."

In his chapter on sinkers, he seems to be very uncertain as to whether the Indians were acquainted with the methods of catching fish with nets, and the probabilities are that the Europeans first taught the use of nets to the aborigines. If such is the case, then the "plummets" were certainly not net sinkers.

As for the great size of the larger ones being no objection to their use as sinkers, it may be doubted if they (the Indians) knew how or cared to fish with nets.

They had their certain seasons for fishing, when they knew where to find them and how to catch them. At other times they would be in other localities, hunting other food materials in their season.

A few of the grooved stones and notched pebbles classed as undoubted net sinkers have been found in California. Fig. 22 represents one from Bodega, Cal. Might not some of them have been used as war-clubs or hammers? And were not the grooves made for the purpose of attaching handles of withes? Their shape would indicate their use in some of their manufactures, whereas a "net sinker" would not require to be made after any particular pattern; anything possessing the requisite weight, and of any form that could be attached to the net, would have answered the purpose.

If the Indians did not fish with nets, these "undoubted net sinkers" were *not* "net sinkers," and if used in fishing at all they were line sinkers. The Indian Rafael, who will be referred to hereafter, when shown the implement represented by Fig. 22, said that it was used as a line sinker for fishing.

In Explorations of the Aboriginal Remains of Tennessee, by Joseph Jones, M.D., published by the Smithsonian Institution under the head of "Stones employed for mechanical purposes," is a figure and description of a plummet of black magnetic iron, highly polished, with a hole through the upper end; and he supposes that this, together with a number of similar implements which have been found in Middle Tennessee in the cultivated soil, and also in the stone graves, were used in spinning threads and in weaving. He says: "It has been suggested that they may also have been employed as weights in fishing."

Had they been used in spinning and weaving, as Dr. Jones suggests, they would probably have been made of uniform size and shape.

Dr. Charles Rau, in The Archæological Collection of the United States National Museum, published by the Smithsonian Institution, illustrates a variety of stone implements under the name of "pendants and sinkers," which name, he says, have been given to a class of symmetrically-shaped and well-finished objects, which were evidently designed for suspension, though it is not quite certain for what special purpose they were used. On account of their shape and the pains bestowed upon their production they have been classed among aboriginal ornaments. Yet the former inhabitants of this country devoted much time and labor to the manufacture of objects of a useful character, and hence it appears not improbable that the articles in question were, in part at least, weights for fishing lines.

After a short description of a number of the implements figured, ascribing to them several uses, such as net sinkers or weights, ornaments or amulets and perforated net sinkers, he says, in reference to net weights (page 27): "Some are roundish stones of various sizes, either worked or left in their natural state, and grooved around the middle for fastening the strings or thongs by which they were connected with the nets. - - - It is not always easy to distinguish specimens of this description from grooved hammer-heads." C. C. Abbott, in Vol. VII, Reports of U. S. Geological Survey west of the one hundredth Meridian, suggests the possibility of some of the so-called "plummets" having been encased in skin and fastened to a flexible handle, thereby making a war club that, properly wielded, would have been a formidable weapon.

In the absence of all information that might throw light on its use, we consider it best to class this specimen (referring to his Fig. 66), although wanting the all-important groove, with the preceding plummet-shaped stones. On page 195, of the same report, a photograph of a series of "weights" collected by Mr. Schumacher in various localities of California is mentioned. The specimens are all labelled "spindle-whorls" or "weights for distention of thread." On the same page is figured a specimen of a roughly ground implement made from a fragment of coral rock, apparently pecked or hammered into shape. This is also called a "weight."

In a note by F. W. Putnam, on pages 196 and 197 of same report, mention is made of numerous articles of stone, which there seems to be little doubt were used as sinkers, and by their shape are allied to the implements Dr. Abbott has described on the preceding pages.

Two of these are of great interest, as they still show the method by which they were fastened to fishing-nets or lines - - - by means of asphaltum. This asphaltum has preserved a portion of the twine which was around each end of the stone, and it is evident that in this way the string was held in place on the sinker, which was thus easily attached to the line or net.

The most recent article on this subject, and which probably comes the nearest to giving the explanation of the uses of these implements, is by H. W. Henshaw, published in the American Journal of Archæology, in which article, besides giving a synopsis of the various theories advanced by different writers, he gives as he claims "a direct and circumstantial account of their use," which he obtained from the Santa Barbara Indians.

Mr. Henshaw, in commenting upon Mr. Henderson's article in the American Naturalist, says: "In reference to the fourth possible use given in said article, (viz, sacred implements), that it is only a possibility, there being no evidence whatever from which to draw such an inference." Though admitted to be but a guess, it is remarkable how accurate it proves to be, for in this paragraph we have exactly the use of these plummet-like stones as explained by the Santa Barbara Indians.

The moment these stones were shown to these Indians I was told that they were medicine or sorcery stones.

"The sorcerer arranged twenty of these stones, the proper number, in a circle, pushed them violently together, sprinkled water over them and smoke issued from them. - - - At San Buenaventura substantially the same account was received. Here it was said twelve was the number required by the medicine men, exclusive of a center stone of different character. The center stone shown to me, called Tu-cait, is a flattish-round, beach-worn pebble of quartzite, unworked, and stained black with iron. It was, as I was told, a peculiar power in rain making, and as an evidence of its power, the Indian held it for a few moments tightly grasped in his hands, when moisture was visible on it, caused by contact with the moist hand."

The moisture was pointed to as visible evidence of its rain-making power.

The use of the medicine stones among the San Buenaventura Indians was as follows:

The twelve sorcery stones were arranged in a circle close together; in the center was arranged the *Tu-cait; Chia*, the generic name for seed-meal, together with down from the breast of the white goose, was then spread over the stones, and then red ochre spread over the whole. Around this a dance was held, while three old men sang, keeping time with rattles.

This or similar ceremonies were observed for curing the sick, bringing rain, putting out fires in the mountains, calling fish up the streams, and when war was to be made.

Several other stones of various shapes were shown to me, some in their natural condition; one a piece of iron-pyrites, another resembling a natural concretion.

Those of the third class were fashioned with care and were about 4 inches long, somewhat tapering in shape and encircled with several rings; to all of these mysterious properties were assigned, and it is probable that many other kinds were formerly in use. As nearly as could be gathered, the pear-shaped "sinker" variety was considered the most efficient in sorcery.

Why the sorcery stones were given their peculiar shape it is not easy to understand, and the solution of this problem must be left to the final consideration of those more ingenious in such speculations than the writer.

J. P. McLean, in the Mound Builders on page 163, figures an implement of hematite which he classes under the head "pendants," and remarks: "It may have been used as a plummet or net sinker."

In the year 1885 Mrs. Packard, a visitor to Santa Barbara, discovered an interesting relic in the old Indian burial-ground at Dos Pueblos, about 18 miles west from Santa Barbara, near the coast. This relic, one of the so-called "plummets," is made of specular iron ore. (See Fig. 29.) This, so far as my observation goes, is the first of the kind found on this coast; it resembles a specimen of the same material found near Quincy, Ill., figured on page 232 of Abbott's Primitive Industry.

I know of no ore of this character having been found in this part of the country, and it is my opinion that the greater portion of the *charm stones* found on or near the coast were manufactured by tribes living in the interior, and were articles of barter obtained from tribes who excelled in making the finest and most potent charms.

Fig. 8 represents an implement found in Napa County, Cal., and is made of auriferous slate containing a streak of free gold; it had probably been brought from the Sierra Nevada Mountains, and I had noticed that the greater portion of the charm-stones found appear to be made of rocks *not* found in the localities where the implements were used; and the fact that many of them are of fine workmanship and rare material would go to show that they were not used for ordinary purposes.

During the past twenty years the writer has at various times endeavored to ascertain from the aborigines the uses to which the so-called plummets or sinkers were originally put.

Most of the investigations in this line have been made in the central and northern portions of California, and the conclusions arrived at are that in *those* localities they were not used as sinkers or plummets.

Mr. Henshaw says: "On calling the attention of an Indian to the ring pecked near the extremity of one of the medicine stones, he said he did not know its purpose, but that the stones so encircled were considered to be more potent than the others. In reply to my question, 'Why such a stone could not be used as a sinker to a fishing-line?' a Santa Barbara Indian replied that he never saw one used in this way, and added, of his own accord, 'Why should we make stones like that, when the beach supplies sinkers in abundance? Our sinkers were beach stones, and when we lost one we picked up another.'"

In Ilios, City and Country of the Trojans, by Dr. Henry Schliemann in 1880, which I have just been reading, page 436, is figured a "perforated object of green gabbro rock, probably a weight, which closely resembles some of our perforated charm-stones," and on page 437 several "sling-bullets of hematite or loadstone," which the author remarks, "are all well polished, and, with the rude implements which the Trojans had at their disposal, it must have been tremendous work to cut and smooth hard stone into the cylindroid shape of the pellets before us."

In fact, labor must have had very little or no value at that time, for otherwise it is impossible to imagine that whole months should have been wasted on the manufacture of one bullet which was lost as soon as it was slung. It will be seen that Dr. Schliemann uses the same argument in relation to the uses of these implements that the writer used in the first writing of this article, several years ago, relative to the use of charm-stones as "sling-shots or weights for fishing nets or lines."

He also refers to several such bullets in the British Museum from Assyria and Camirus, made of hematite, loadstone, and granite.

Having given the various theories which have been advanced by different writers on this subject, we will proceed to take up and consider the six different uses which might have been made of these implements.

(1) *As sling-shots.*—It is not probable that the Indians would have spent so much time and labor in the manufacture of these implements for such purposes when the beds and streams and other places would furnish abundance of water-worn pebbles.

The Indians of Lake County, Cal., now manufacture balls of clay, sun-dried, which as sling-stones furnish very effective missiles for killing ducks and other small game.

Stones intended for use as sling-stones would probably have been made of more uniform size and shape, whereas the so-called plummets are remarkably variable in these particulars, for in this state the artists seem to have taxed their ingenuity in making each and every one different in form from all the others, as scarcely any two are exactly alike, as may be seen in Fig. 13, which shows the spheroid shape of one extreme and Fig. 6 the spindle shape of the other extreme, between which all imaginable forms and variations occur.

Figs. 1 or 6 would not be convenient or, in any case, practical implements for such purposes.

(2) *As sinkers for fishing tackle.*—The arguments used against the probable use of these implements as sling-stones will apply with the same force against their use as sinkers. Stones which would answer the purpose equally well can be picked up when wanted for use, and it is not probable that they would have burdened themselves with extra weight while traveling from place to place.

(3) *For playing some game.*—The varied forms of these implements preclude the probability of their having been used for such purpose, as all games requires pieces of more or less similarity of form and size, while, as before stated, it is rare to find two of the same size or shape, and the localities in which they are usually found are not places where games would have been played.

(4) *As sacred implements in the performance of some religious ceremony.*—This theory is the nearest approach to the true use of these implements.

(5) *As personal ornaments.*—This theory is unreasonable and requires no further refutation than that their weight and size would preclude such uses. They were sometimes suspended about the person for purposes to be shown hereafter.

(6) *As plummets and levels.*—This theory is still more far-fetched and untenable than the last, so far as California Indians are concerned. Tribes that build no dwellings other than temporary huts, and hastily constructed at that, would certainly have no more occasion to use plummets and levels than a wild Hottentot. These so-called plummets are nearly always found in low, marshy places near creeks, along the sea shore, and among the wild, rocky recesses of the mountains.

These localities would hardly be selected as places to erect permanent buildings, even if they had ever had the knowledge of such. Again, these so-called plummets would not have been used for the purpose some have claimed, that is, suspended by a string and used to determine perpendicular lines. They are not the form most convenient for this purpose, and if suspended by a string would not hang perpendicularly.

Implements like Figs. 1, 8, and 10 might have been used for such a purpose, providing the lower ends had been pointed, which they are not. One like Fig. 9 would have answered the purpose had it been perforated at the top.

In reference to Prof. F. W. Putnam's note to Mr. Henderson's article, I am sorry to differ with so learned an antiquarian writer as my esteemed friend, but certainly none of his theories will fit our California Indian habits and customs.

He accepts some theories which we have already discussed, with the additional one that they were used as spinning weights. This we can easily dispose of, as the Indians of this locality used no textile fabrics that required spinning or weaving, their toilet being less elaborate than that of the Georgia militia colonel, which consisted of epaulets and a paper collar.

When not nude, the Indians used skins of wild animals for clothing, or tules tied in rows on strings of sinew or bark, worn as aprons or skirts.

As to these implements being used as pestles, there are very few of the so-called plummets that could have been used for such a purpose. It is generally an easy matter to distinguish between the two, and reference to Figs, 5, 6, 7, etc., will show that they could not be mistaken for pestles, as the lower end is generally pointed.

Fig. 1 is perhaps the oldest known specimen of this class of implements. It was found with several other curious and unique implements under Table Mountain, in this State, and under some 200 feet of basalt. It was made of a translucent carbonate of lime finely finished.

In a catalogue of A Collection of Minerals of A. Dohrmann, published by S. H. & H. Chapman, of Philadelphia, 1886, we find No. 1134, slung shot or sinker, described as an oval stone, with deep groove around the edge; limestone, found 30 feet below the surface in a gravel bed, Camptonville, Yuba County, Cal. No. 1135, plumb-bob; shape same as those used by masons, pierced and grooved at end; serpentine; perfect and very rare; found in Alameda County, 40 feet below the surface.

Having endeavored to show what these implements were *not* used for, we will try to show what their real use was.

The majority of surviving Indians do not seem to know anything about this. One reason for this is that they had superstitious notions that these stones were dangerous and the sight of them would cause death. Another weighty reason was, that the missionaries used their utmost endeavors to eradicate the use and knowledge of all their traditions and religious ceremonies.

Several years ago the writer had an opportunity to interview a very old Indian chief of the Napa tribe, and one of the two sole survivors, making most of the opportunity by laying in a supply of eatables, tobacco, and sweet cider. He stated to me that the plummet-shaped implements were used as charm stones; that they were used by being suspended by a cord from the end of a pole, one end of which was stuck into the bank of a creek in such a manner as to leave the stone suspended over the water where the Indians intended to fish. At other places they were suspended at points in the mountains favorable for hunting.

This will account for the asphaltum and string on the implements, which, Professor Putnam says, "show the method by which they were fastened to fishing nets or lines."

The Napa Indians also stated that they were sometimes laid upon ledges of rocks on high peaks, with the belief that, owing to their peculiar form and some occult power which they possessed, they traveled in the night through the water to drive the fish up the creeks to favorite fishing places, or through the air to drive the land game up towards certain peaks and favorite hunting grounds.

The peculiar pear-shaped form was given them to enable them to cleave through the air and water. He also stated they were used in time of war, as they were supposed to travel about at night for the purpose of worrying the enemies of their tribe.

In a recent interview with one Rafael Solaris, the last male representative of the Tsa-ma-la tribe, who occupied a village called Tsok-to-no Ha-moo, near the Santa Ynez Mission, Santa Barbara County, I obtained direct information which substantiates my views as to the uses of these implements. Rafael at first disclaimed any knowledge of the use of the so-called plummets; but when shown a perforated one he recognized it and said it was worn suspended from the neck for defense, and to make the wearer impervious to arrows, and that in time of war any one biting this implement was rendered invisible to his enemies, and enabled to travel with safety.

The medicine men, after fasting one month and abstaining from the use of fatty substances, after drinking several cups of the decoction of a herb which they called Tol-wàch-ie, were in proper condition to make use of the charm stones. This herb is common in our mountains, and has a profusion of white flowers and spiny seed-pods. The whole plant—root, leaf, and flower—is poisonous, producing an abnormal condition in the person using it.

In a still more recent interview with the host of the Tchú-mah Indians I obtained the words and translation of a song which refers to this subject.

The meter and music are Schú-may (or Chuma); the words are in the Mish-khon-a-ká, or language of the Ventura Indians. It is called *Su-to-wen-cush.*

SONG.

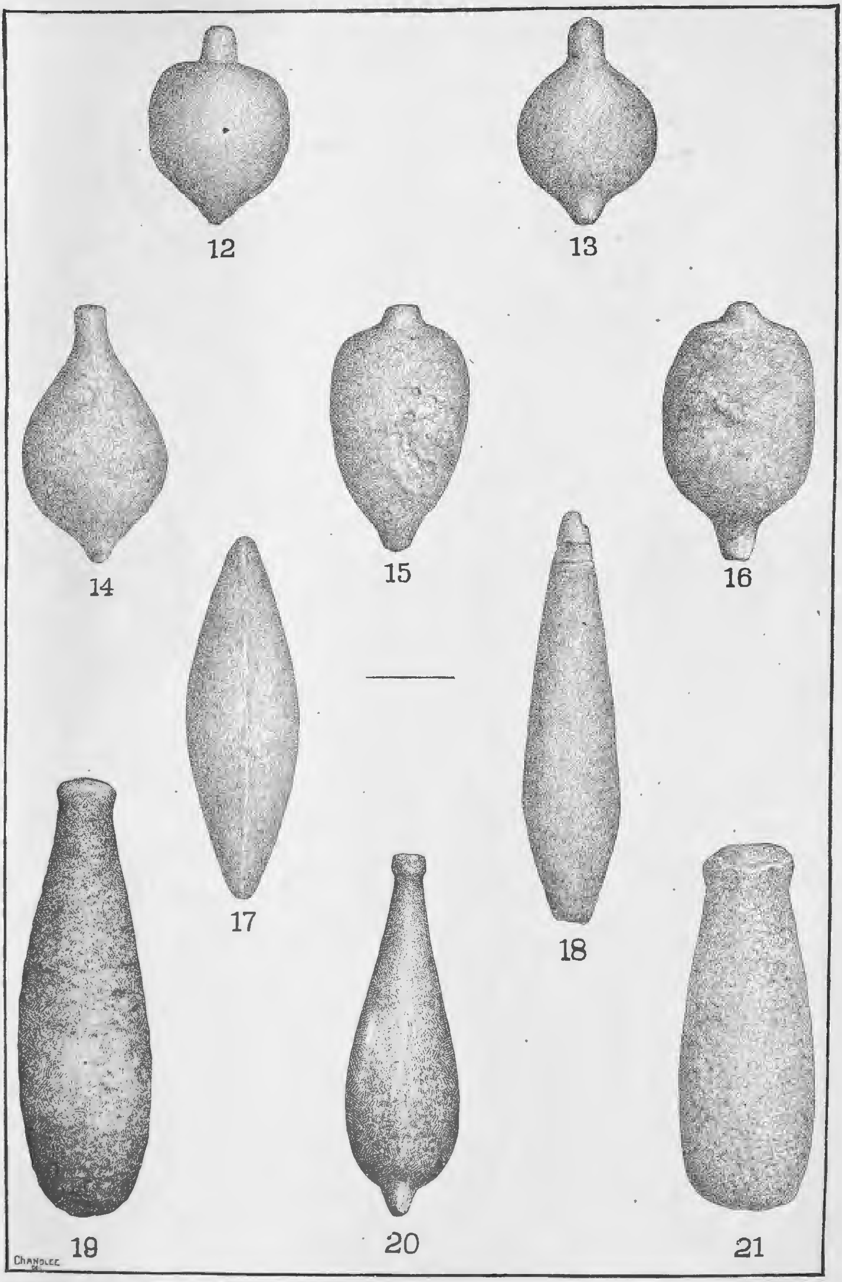
Ká-yu-wa-will-le
I am going to tell
Le-le-ni-mu-stu me sip-posh
Uneasy my heart
Su-mus-il. Ka-teush-wen
Charm stone I have not.
Lá-li-o-li-o Iwen-new
I am sad.

In relation to Figs. 32 and 33, Juan de Jesus, a Ventura Indian, stated that the implements which these figures represent were *idols*. Feathers were tied on each end, the idol placed in a basket or similar receptacle in the house of the medicine man, when the people who were desirous of obtaining favors from the spirit or power attributed to the idol threw in seeds and other offerings to the receptacle until the idol was covered up. It is needless to say the offerings were appropriated by the medicine man.

Justo, a Santa Barbara Indian, stated that the charm stones were sometimes arranged or scattered in various places; those without perforations were covered up, while the perforated stones were placed on the surface of the ground, and during the dance, upon the approach of the individuals who had been made holy by the ceremonies before mentioned, the perforated charm stones would elevate themselves on one end, to be grasped by the fortunate individuals, who thereby obtained their desire in relation to having a good year. These stones were suspended upon the person of the medicine man only during the sacred dances, except in the case of a warrior, who would hang them upon his person to render him arrow-proof. In this connection I learned that the peculiar stone implement figured in Vol. VII, Wheeler's Report, on page 215, the uses of which have been heretofore unknown, was used in the following manner:

Twenty of them were arranged in a square, five on each side; in the center was a bowl of water, beside which stood the medicine-man, with a long stone pipe shaped like a cigar, in which an a herb, called *pispivate* by the Mexicans, resembling southern wood, was smoked. The smoke was first directed toward the bowl of water, then toward the stones. The people came and moistened their faces with the water in the bowl, which had been made holy by the previous ceremonies. This ceremony brought rain, caused death to enemies, and various other things.

In conclusion, the evidence which I have obtained directly from the aborigines, the localities in which the implements have been found, the materials of which they are composed, the care and labor necessary in their manufacture, the evident superstitious ideas connected with them, and the ignorance of their uses (pretended or real), favor the conclusion that these implements were objects highly prized and religiously venerated. Had they been intended to be used for any ordinary purpose or purposes as assigned to them, the Indians would not have been in ignorance of it, nor would they have hesitated to give information concerning them.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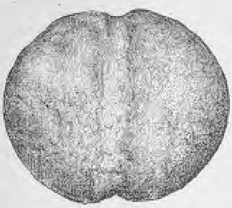
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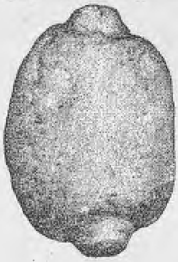
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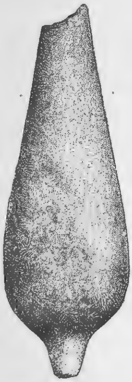
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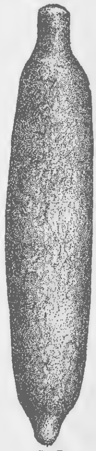
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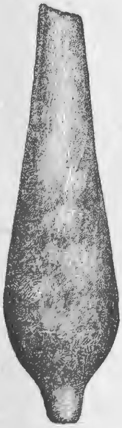
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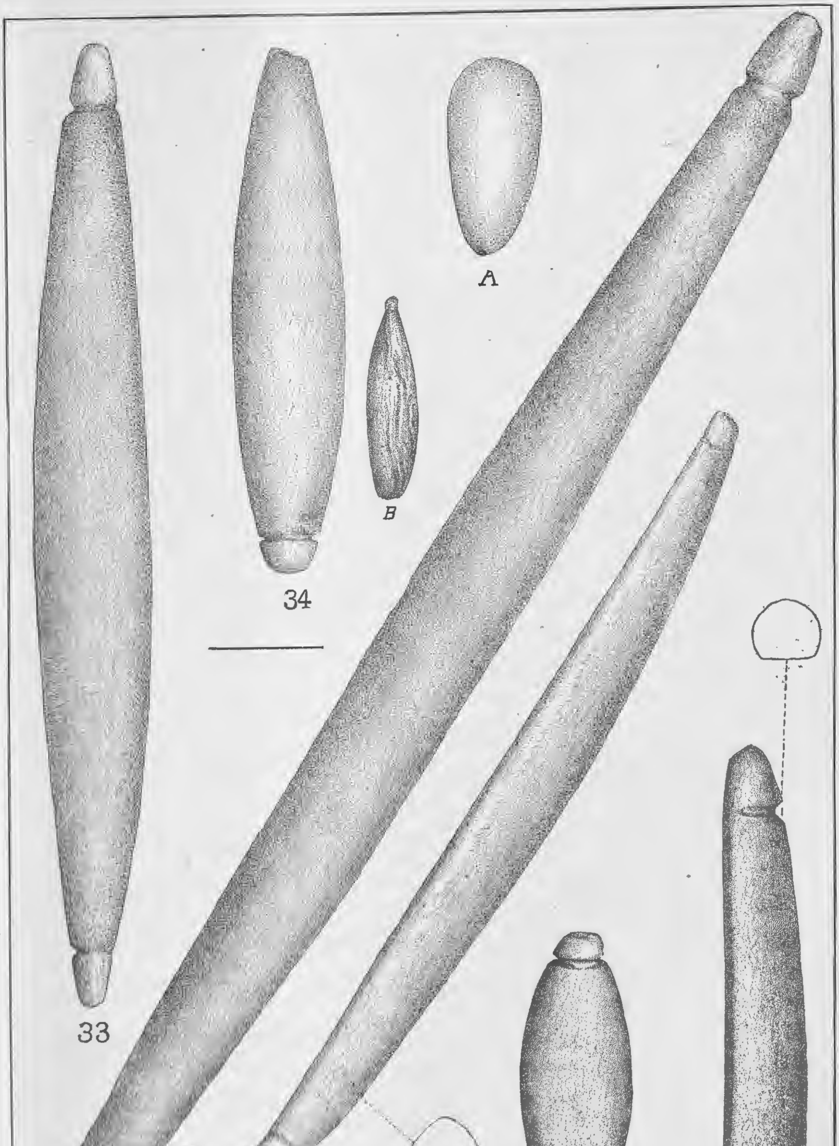
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STUDIES ON THE ARCHÆOLOGY OF MICHOACAN (MEXICO).

By Dr. Nicholas Leon.

THE "LIENZO" (DRAWING ON LINEN) OF TUCUTACATO.

In the district of Uruapan (Michoacan) and distant one league south of this city, is situated the ancient Tarascan Indian village called Tucutacato (Xucutacato). In this village our industrious friend and companion, Dr. Don Crescencio Garcia de Cotija, found some years ago the precious original of the painting which forms the subject of these lines. This gentleman succeeded with great difficulty in obtaining it from the natives, and exhibited it at the first exposition of Michoacan, held in the year 1877. From that time it strongly attracted our attention, and we endeavor to make a study of it. The colors in which it is drawn are undoubtedly of vegetable origin, for they have not lost their intensity in the least; on seeing them one would say that they were recent and not from remote times. The fiber of the cloth is brilliant and very smooth, much resembling that of cotton (*Gossypium herbaceum*), and identical with that of *Eriodendron anfractuosum.* As it is not possible to subject the latter to permanent spinning, we must suppose either that it is not of this material, or that the "Tarascos" understood some peculiar method, now lost, of preparing it so as to use it to advantage. Two colors appear in the drawing, black and red. The latter is used only for the line which indicates on the pictures the road followed, and for the species of shirt or jacket worn by the individuals who appear to be chiefs or priests. The original measures 2 meters 63 centimeters in length by 2 meters 3 centimeters in breadth. The annexed photograph is an exact copy of it.

Let us see now its explanation. In the very rare "Chronicle of the Order of our Angelic Father St. Francis, Province of San Pedro and San Pablo de Mechoacan, in New Spain, by the professor of theology, Fray Alonso de la Rea, etc., 1639, in Mexico by the widow of Bernardo Calderon, 1643, I Vol.," in Book I, Chapter V (On the people who inhabited this province, whence they came, and the cause of their coming), we read the following: "And according to the paintings and traditions preserved in the archives of the times, these Indians, in order to come to these regions, passed a small arm of the sea, viz: the Strait of Anian, which bounds this land on the north. Although this is not certainly known, we must accept it as true, for all the region inhabited by the divisions which remain in their first condition is an island. I persuade myself of its truth, because in depicting their first migrations on an ancient linen preserved in the village of Cucutacato, a league distant from Uruapan, the 'Tarascos' represented these nine nations as setting out from the seven caves of the west, and as passing the narrow arm of the sea or large river, which passes from north to south, on wooden rafts or hurdles made of large canes fastened together. We see from this that these Tarascos are of those nine families who came with the Mexicans conducted by that fabulous bird; and although it may be a fable, it is certain that they came moved by some hidden impulse which urged them on. They marched in a troop from this place Aztlan (for thus it was called) to another place where there was a very large tree. The devil, as oracle of this people, made them stop in the shade of this tree, in the trunk of which they erected an alter to the idol Huitzilolvehtli, whence the idolatry of these people took its origin. They sat down to eat with the mistrust excited by a novelty experienced for the first time, and when they were more at ease the tree began creaking and split in the middle. The heads of families and chiefs of bands took this event as a bad omen, and, leaving off eating, they consulted their god. He then called the Mexicans aside and said to them: 'Dismiss those eight families and tell them to go, to follow whatever road and to stop wherever they please; you remain.' This was done, some remaining, the others setting out and following the road towards the east. Some peopled one place, the others another." There is no doubt that this is the linen or painting to which the chronicler refers, but it may be easily inferred that he knew it only by report, for he changes some things and omits others. He does not say, for example, that the hurdles or rafts have the form of turtles (Testudo), and he does not explain the rest. Let us now try to do it.

Let us take as a starting point the upper right-hand corner of the photograph, and for the sake of more clearness let us number the pictures progressively.

No. 1. Here is seen the cave from which go forth the chiefs of the nine tribes. One of them wears the red jacket and carries in his right hand a circle or disk with a handle, and appears to be conferring with another, dressed in like manner, who carries a large walking-stick, apparently with the "fabulous bird" spoken of by La Rea resting on its upper extremity. Between the two is seen a censer, identical in form with one in our possession taken from a "yacata" in Zamora. At the feet of both persons are playing some cornet or clarion players, over one of whom is a kind of flourish, the signification of which we do not know. The remaining chiefs are in a reverential attitude; the others are already embarked on their turtle-shaped rafts, indicating perhaps that the navigation or march has begun. Others look as if they wished to throw themselves in to swim. We do not know what is meant by the two stooping figures and the eight heads, nor by the one riding an animal resembling a dog. The vessel placed above him reminds us of nothing.

In those persons with the trumpets we think we recognize the priests, who, according to the "Narration of Mechoacan," page 2:, "play trumpets and cornets;" and from numerous graves we have dug up in the neighborhood of our native village Quiroga (Cucupa), near Tzintzuntzan, and various other reasons, we are certain that the one with the disk is the chief priest. Further on we see the priest seated, with the disk in his right hand crossed by various lines like diameters. The trumpeters, the man with the staff, the bird, the dog, and the eight heads are all present, and we see besides a species of herbaceous plant which might be the flame of a bon fire or a column of air. Here only is the chief priest represented with a red jacket. This part of the square has an undulating line, which crosses its whole extent and denotes the road followed. The inscription, which, as well as the others, was evidently added to the linen at the time of the conquest, appears to be in the Tarascan idiom. Aided by intelligent Indians, we have read, as we believe, the following: *cualcniuihtlahpazco*, place where one sets out; *cualc*, place; *niuiht*, where; *lahpazco*, one sets out.

No. 2. The chief priest resting, chatting apparently with another who is on foot; his disk without diametrical lines; the staff thrust into the ground before him; the bird, censer, water vessel, the two trumpeters playing, and only seven heads; two groups of individuals separated by a little eminence, pyramid, or "yacata," apparently in conference. Near the water vessel we meet with an object resembling a porringer. The "yacata" is perhaps a sepulcher or temple, or the two combined, as we are led to believe by the things found in those still existing. The inscription reads *nuimualco*, which is not Tarascan, but appears rather to be Mexican. We do not understand it. The line indicating the road passes over the picture. The figure resembling a flourish which we see in No. 1 is wanting.

No. 3. The chief priest in the same attitude, but not addressing anybody; in front of him the censer; further on the figure like a flourish, with the bird to all appearance perched on it; at his feet the water vessel and the porringer; at his sides the two trumpeters and the seven heads. A short distance from the individual is an elevated beam driven in the ground, and on top of it is seen a puppet. Further on is seen the pyramid or "yacata," and an individual in the attitude of haranguing a group of six persons seated on the ground in an attitude which indicates both weariness and grief. The line indicating the road is not wanting. The inscription reads *teyeuahcan*, and is to all appearance of Mexican origin.

No. 4. The chief in the attitude of No. 2; the censer nearer to him, and then the staff; the disk with diametrical lines; four heads; the bird; the vessel; and the porringer. The trumpeters are wanting. The flourish at the feet of the chief priest; the pyramid, and eight individuals in the same posture as in No. 2. No inscription.

No. 5. The priest, on foot, always with the disk in his right hand, appears to be addressing those about him; the censer is within reach of his hand; the staff is not to be seen; at his feet are the water jug, porringer, and flourish; at his sides the two trumpeters; there are only two heads; four individuals are advancing toward the pyramid, and the bird is seen perched on a nopal (cactus) a short distance away; it has no inscription.

No. 6. The attitude of the priest, the incensory, vessels, porringers, flourishes, and trumpeters are as in the preceding; the staff is driven in the ground, the bird resting likewise on the ground; there are four individuals in a squatting posture and four on foot; the pyramid is present and five heads are seen; the inscription reads *xiquipilco*, a word of Mexican origin.

No. 7. Priest, trumpeters, incensory, staff, flourish, vessels, and bird as in preceding; near the pyramid are four individuals standing and one seated; there are only two heads; we have also a new personage, with a disk in the right hand, and clothed exactly like the first priest, but smaller of stature and apparently younger, standing behind the first. Perhaps it is the son of some one of the heads of families or of the priest, who is initiating him in his ministry, seeking, perhaps, a successor. The inscription, which is a Mexican word, reads, *ayutzinco*.

No. 8. The old priest seated and the new one standing in his presence. The trumpeters, incensory, vessels, and bird as before. Seven figures are scattered about in the picture and the pyramid in the background. The staff and flourish are wanting. The latter is not again seen in any of the remaining pictures. We notice, also, two foot-prints which look as if they were made by a person wearing the now popular *huarache*. The inscription, the first genuine Tarascan we have met with, reads *tzacapo*, and signifies "stony place," from *tzacapu*, stone in general, and *o*, which indicates "place of." This village exists now. We forgot to observe that the priest holds in his left hand, supported on his knees and shoulder, the staff, which is perhaps a mark of temporal power as the disk is of spiritual. It appears that in this place he assumed alone the authority which before he divided with the chiefs of the tribes or families. The heads, separated from their bodies, are wanting.

No. 9. The chief is seated, with the staff in his presence but not the disk. We see the bird, the incensory, two porringers, and the prints of two feet. Three persons are advancing towards the pyramids. Everything else which appeared in the other pictures is wanting. The inscription, in Tarascan, reads *phatsingo*. We do not know what it signifies.

No. 10. We see here only the priest seated with the disk in his right hand, the staff in his left. In his presence is the incensory and three heads. We see, also, one of the trumpeters, apparently on foot, and an object like a torch, of which we know not the signification. The inscription reads *cupaquaro*, place of meeting; from *cupani* or *cumtani*, to meet; *aro*, place of.

No. 11. Here appears to be the place where, according to the chronicler, they rested at the foot of a tree, which appears in the center, with a "fabulous bird" at its foot. Towards the bottom the priest is seated, with the censer in front of him and a trumpeter at his feet. On the same side, but higher up, is seen the same figure of a priest in an identical position. At his feet two individuals are seated as if in conference. A trumpeter standing at his side is playing his instrument, while two persons in front of him are reverently talking to him. One head also is seen near him. In the middle two figures, with blow-pipes, are stirring up the fire of a brazier, and at their sides are six objects probably representing molds, into which they pour the melted metal, which is undoubtedly copper. In the form of these moulds we recognize various cutting instruments used by the present Indians; and in our archæological collection we have two of them, taken from a tomb, both of copper. Again we see the priest, who appears to be directing this operation, and behind him three persons who appear to be making the molds. Various figures of men are seen in the background, some standing, some sitting; two of them hold in their hands the cutting instruments already determined. The semi-circular one is the one called *coa* (Mexican *Coatl.*) and the other is called by the Tarascos *thiamu.** The color of these objects is red. The pyramid is present, and we see also a foot-print and a porringer. The line indicating the road, which has reached this point undivided, here divides into two; the most focal soon terminates, the other extends farther. For the first time we see two houses, of construction similar to the present ones, and from which issue the lines mentioned. These constructions appear to us to be by the same person who wrote the inscriptions, and were intended to show that in this place the Tarascos first fixed their residence. We are confirmed in this opinion by the two figures seen on the roof of the smaller; for, taking away the house, they appear to be occupied in extracting some heavy object from the ground. On the house, they indicate nothing to us. The inscription reads: *Vnacico. nicanymuhtenenaxinhqui lan. ynix || quich nauatlacatl mucemtemacomican.* In this inscription we have Tarascan and Mexican words, and others unknown to us. This is what we make of it: *Vnacico*, *a* or *the* palm; *ni*, goes or walks; *ca*, there; *nymuhtene*, the others; *naxinhqui* (properly written it should be *naxaqui*), sit down, or rest, or remain here; *lan. ynix* (properly *canihuex*), they set out or march; *quich*, we do not know the meaning or whether it is Tarascan or Mexican; *nauatlacatl*, a Mexican word of which we know not the meaning; *mucemte*, we know neither the origin nor signification: *macomican*, jointly, at the same time.

No. 12. The central line takes us to this picture. Here we see a house,

* This instrument serves them as an ax, chisel, adz, paring chisel, and hammer. When used as an ax, it is placed in a special handle; also when used as an adz. The word *thiamu* is equivalent to our metal. Here the name "iron" is vulgarly given to every metallic instrument; for example, a carpenter, in complaining of the want of tools useful in his profession will say, "I do not work for want of 'irons.'"

a head, the chief priest seated, and in his presence the small priest (seen in Nos. 7 and 8), holding in his hand the disk, which is wanting to the chief priest. Near the small priest is seen standing a single figure. The inscription reads *mataguaran*, place where they danced a second time, from *matero*, for the second time; *varhani*, to dance; and *an*, place in which or place of.

No. 13. The two priests are seen in the same position as in the preceding. The one sitting down has a head at his feet, and the one standing has an individual at his left. In the background of the square is seen a small house. No inscription.

No. 14. In the background of this square we see some edifices of a more complicated construction than the preceding, since we observe a tower on one of them. We may therefore affirm that this group was added to the picture after the time of Columbus. There are two figures on foot, one seated, and one head. The line indicating the road turns to the right, forming a right angle. The inscription reads *uruuapan*. Various etymologies have been proposed to explain this name. Lejarza says it is derived from *urani*, and signifies gourd tree (Xicara). Ruiz says it is from *urúpani*, a verb which expresses the germinating of shoots of plants. In Gilberti we meet with this verb, *vrahpeni*, to command to do something, but where does it come from? Some have told us (and this is the most probable derivation) that it is from *uruu*, cherimolia (Anona Hum boldti?), *pa*, imperative of the verb *pani*, to carry, and *an*, a particle, signifying place from or in which; and thus it is *vruuapan*, place from which they brought cherimolias.

No. 15. In this large square we have three villages, Tezcatlan, Michoacan, and Patzcuaro. The first shows five individuals who look as if they were about to throw themselves into the water, the presence of which is indicated by the interruption of the line indicating the road and by the presence of a canoe occupied by five figures—perhaps the same five. At the opposite end of the lake, which we suppose is Lake Patzcuaro, the road continues and ends at a house, at the side of which is seen a "yacata." On the shore of the lake stands an individual with a porringer in his right hand and in an attitude which shows that he is speaking to those coming in the canoe. Further on is seen an individual advancing towards the house. On the border of the lake is seen a stranded canoe with only its oar. Our attention is attracted by a group of eleven individuals and three heads on the shores of the same lake and occupying the middle of the picture. Two of them, undoubtedly chiefs, are seated on little stools like those of the individuals in the preceding squares whom we called chief and priest. The dress of one of them, apparently the principal, is very similar to that of the present mountebanks. He wears a hat similar in form to those worn by the Chinese mandarins, as we see them drawn on fans and porcelains. His left hand grasps a staff. Face to face with this one is the other priest, with the dress in which we have seen him in the former pictures. At the sides of both are seen large cups or receivers, which three of the figures, in reverential attitude, are presenting to them. Near these are five copper instruments similar in shape to those which we see them casting in picture No. 11. Of the other figures, some are standing, others sitting on the ground. There is no doubt that this represents the payment of some tribute to the "Yrecha," and that the tributaries, after having passed the lake in their canoes, are paying their respects to the chief and the priest. The inscription corresponding to this part is *michuacan*, a name which, like *tezcatlan*, is of Mexican origin and signifies place of fishermen; from *michua*, fisherman, and the possessive *can*, place of. For many years after the conquest the *city of Tzintzuntzan* was called by this name, and this fact shows that this place is Tzintzuntzan, the capital of the Tarascos.

In the right-hand angle are four figures standing as if in conversation, and near them is an edifice which appears to be a foreign temple. The inscription reads *pazquaro*. Various etymologies have been proposed to explain this word. Some say that it signifies place of rejoicing; others, place where something is kept (Gilberti), from *patzani*, to keep. Lagunas says that it signifies place where they dye blackish, from *phatzani*, to dye blackish. To us none of this appears certain. In our humble opinion the key is to be found in the "Relacion de Mechuacan:" "How they found the place for their houses, and how they fought with the inhabitants of Curingüaro."

"As they found their place of abode in the district of *Pazquaro* called *Tarimichundira*, so also they found the site of their dwellings called *Petezequaque*. There were some lofty rocks, on the summit of which they built their houses, etc. They said one to another, 'Come hither, here is the place which your gods say is called *Zacapuhamucatin pazquaro*,' etc. They admired the waters in this place, and when they saw them all they said, 'This is without doubt *pazquaro*. Let us go and see the sites we have found for our houses.' And they went to that place where the cathedral is to be built, and found there the said rocks called *petazequa*, which means building site," etc., pages 150 and 151.

No. 16. Following the other fork of the road in picture No. 11, we come to No. 16, whose inscription reads *tamaqua*, and signifies orchard, according to Gilberty. Lagunas says: "The lands through which he passed are muddy or slimy. He passed by them, consequently, as worthless on this account. This was not regretted by those who wished to sow in them melons and other such things." We give it the meaning fertile land, which is justified by the large leaves we see pictured and which appear to be those of "uinfáceas" or some plants like "ciperáceas" (cyperus or sedge ?), essentially aquatic or flourishing in damp places. In the background is the pyramid, and three human figures are seen advancing hastily toward it.

No. 17. The pyramid in the background, and the same three figures round about it in an attitude as if holding a conversation with reference to it. The inscription is *xucupan* and signifies place of hump or humped, from *xucupa* or *cutupa*, the hump, and *n*, place of. This place is now called the town of Luinga (?).

No. 18. In this square is seen only a withered tree, an indication, perhaps, of sterile land, with two individuals at its side speaking about it. No inscription.

No. 19. A house in the background with one person seated near it, and two others standing in his presence speaking with him. The inscription, which is Tarascan, reads *Vacanan*. We have not been able to decipher its meaning. The village still exists.

No. 20. We have here two large hills and at the side of one of them a house, towards which two individuals, descending from the hill, are advancing loaded with bundles. Behind them is seen a bundle with a head under it, which may, perhaps, denote that its bearer perished with fatigue under its weight. The priest on his little stool appears to be watching over them, as well as over another individual who is advancing towards those descending the hill. In the same picture, but at its lower part, is seen the same priest in an identical position. Behind him is a head. Before him stands an individual with the staff raised in his two hands, as if representing the authority of him who is seated, or looking at two individuals, who, each provided with large bags, are squatting down, apparently waiting orders. In the corner, opposite to and facing the priest, is seen another head. The inscription is *tepulan*, and although of Tarascan origin, we have not been able to decipher it.

No. 21. The topography of this place is identical with that of the preceding. Two individuals, one of them with a burden on his back, are descending the mountain. At the foot of these heights is the house, and near it the priest or chief seated on his bench of peculiar shape, with an individual standing before and behind him. The Tarascan inscription is *churumncuo*. We do not know its meaning. This village still exists.

No. 22. The house appears to be high up; near it an individual on foot. Towards the bottom two individuals are seen advancing towards a third. The lines forming the square are interrupted in the lower right-hand corner, which we suppose indicates that the Lake Patzcuaro reaches this place. The inscription reads *metztlan*. We do not know its meaning.

No. 23. We see only an elevated hill, with two individuals descending one of its sides. At its foot are three heads, and the lower line which completes the square is wanting, It has the inscription *xantfiquiyo*, place of few flowers; from *xan*, few; *tsitsiqui*, flower; and *yo*, a particle joined to the noun to indicate place of.

No. 24. Here is a house, and near it an individual on foot. Three others are seen a short distance from the house, apparently conversing. The left hand angle of the square is interrupted, and there is seen a head. The line which we have followed from picture No. 11 terminates in this place, which is inscribed with the word *tecumatla*, of doubtful Tarascan origin and unknown meaning.

No. 25. Returning to square No. 11, we will see to the right two other lines, which leave it for other squares. No. 25 shows a hill, and two human figures who are apparently descending from its summit. On the plain are two shrubs with large leaves, which, perhaps, indicate the fertility of the place, and it has the name *purunato* written, which signifies place of calabashes (*Cucumis*), from *puruna*, calabash (*Cucumis pepo*), and the particle *tio*, small place of.

No. 26. Again we have a hill with three individuals about its foot. In the plain is seen a vegetable identical with that of the preceding picture, and a human figure at its foot. Two heads are also seen, and the inscription reads *tsichahpeto*, a Tarascan word which we have not been able to make out.

No. 27. Here also we meet with a hill. On its left side are two large trees in foliage, and on its right two human figures on foot, apparently advancing towards it. In the field are two individuals, who are evidently conversing with great animation. It has the inscription *chunenco*, which we do not understand, although it is Tarascan.

No. 28. Here are two hills, one small and the other large. Two men loaded with great burdens are descending the latter, and another is going up towards them or pointing out the right road. On the small hill are seen two figures on foot, and at one side two dead trees. A road goes from the base of the small hill to that of the large one, and in the valley between the two we read the inscription *xicalvatica*. We do not know its etymology. This village has disappeared completely; only its site is known. Remains of houses and some mounds or pyramids (yácatas) are the only things which recall it to mind. In some excavations made here vessels of singular construction and design have been found. We have inspected them and compared them with those described by George Ebers in his great work on Egypt. They appeared to us similar. Axes of copper and darts of obsidian, and the skeleton of the buried person complete and in the horizontal position—an attitude which corresponds to the third class and to the more modern mode of burial, which we have discovered and classified in our archæological investigations in Michoacan. A short distance from this place exists the new Jicalan. Above the larger hill we read the inscription *Minas*, so that those descending it are miners, bearing the products of their industry. That the Tarascans were skillful miners is proved by the great number of shafts, galleries, and caves met with in Michuacan, and all bear evidence of having been worked in primitive times. Frequently large mallets, anvils, and caves, with the remains of minerals, are found there, and the walls of these excavations show undoubted evidence of having been worked with these rude instruments. Their knowledge of minerals was extensive, and their idiom itself proves it to us. The word *tiyamu*, or *tiamu*, corresponds to the generic word metal. Thus they call iron *phácapeti tiamu;* silver, *tayacata;* copper, *tiamu charapeti*, or red metal; tin, *hoy tayacata*, watered silver or water of silver; lead, *pahca peti ytsi tayacata;* and gold, *tiripi*. It may be seen from from this that the Tarascans almost equalled the Europeans of their epoch in metallurgic knowledge. The other peoples of the greater part of America supplied themselves with metals from Michoacan, and if we are to heed the light afforded us by some objects found in the capital of the Tarascan kingdom, the Michoacans carried their commerce as far as Nicaragua. In the second session of the international congress of special students of America, held at Luxemburg in the year 1877, Dr. Sanchez, with bold reasoning, refuted some theories put forth by M. de Hellwald regarding native copper. A short time ago a plate of native copper, weighing 6 arrobas (150 pounds), was extracted from a mine, and frequently pieces of different sizes are found in almost all the numerous mines of this metal in Michoacan. In addition to the objects of wrought copper in our possession extracted from ancient tombs, we preserve a fragment of native copper, found in a tomb, carefully wrapped in cotton and covered with small fragments of carbon. From what we have investigated regarding the mineral wealth of Michoacan, we dare to affirm that it is in this branch the richest State of the whole Republic. Finally, we will state that in an ancient sepulcher we find a small vessel full of native cinnabar.

No. 29. As in the preceding ones, the hill is seen in its middle part. Two men are advancing towards it and ascending. On the opposite side is another human figure stooping over, as if examining the ground and searching for something, perhaps some metal. At the base of the hill are three heads, and the inscription reads *Apahtsingan*, the name of a village which still exists and of unknown etymology.

No. 30. In this square without an inscription we see only two human figures walking at a distance and in different directions, and some withered trees—a sign of vegetable sterility and perhaps of mineral wealth.

No. 31. *Cuindo*, place of the bird; from *cuin*, bird, and *do*, place of. In this square is depicted a hill divided by a large ravine, made by the water which descends from its brow. Towards this ravine are advancing two men, who appear to be examining it attentively. It was the custom among the ancient Tarascans to examine these ravines, either to search the sand brought down by the water and to separate the gold dust from it or to see if the flood had uncovered any mine. At the foot of the hill are three heads, and another figure is seen on the side opposite to the two above mentioned.

No. 32. On some hills are two human figures, one of whom is introducing his hand into the ground hunting for something; the other has the right hand raised and is attentively examining something contained in it. In the background are two heads. The inscription is *temexio*.

No. 33. We see here a hill, and two figures in exactly the position as in square No. 31; the third is found seated, and the three heads are likewise in the same position. It has no inscription.

No. 34. Here also is a hill, and at its left is seen an individual advancing on foot towards two others walking in an opposite direction. The inscription reads *xucutla*, a word of Tarascan origin, but of inscrutable signification.

No. 35 This last square appears very interesting to us, for it clearly shows the occupation of the Tarascans as miners. The two hills seen here evidently contain the beginning or entrance of two mines. On the opposite side a human figure is digging with an instrument after the manner of a crow-bar, and another party is already loaded from the same point with a bundle, which perhaps contains metals. In front of him is seen a person on foot, and in a very strange attitude. Another individual is walking rapidly towards him or the mine. This square has no inscription.

The above must not be considered strictly as an explanation, but simply a statement of the ideas which our Michuacan studies have suggested to us on examining the painting. Against the prehistoric antiquity of the painting has been urged, First, the presence of the inscriptions; second, the construction of the houses and churches which are painted in some of the squares. With regard to the first we have replied, and shall add here, that the same thing is seen in genuine Aztec hieroglyphics, and of the second we said that the houses were sometimes drawn by the same person who wrote the inscriptions. There is no doubt that these are both posterior to the Conquest, for, according to a manuscript in possession of our learned and distinguished friend Señor Don Joaquin Garcia Icazbalceta, entitled "Description of Tiripitio by its corregidor, Pedro de Monterdeoca, September 15, 1580," (original 21 pp., text illustrated by two small figures), we know that the dwellings of the Tarascans had a very different form from those drawn in the map or linen ot Jucutacato.

The third observation is touching the relative correctness of the figures and touching certain shades seen in some of them quite superior to those of native origin. We know little of native Mexican painting, for, at a distance from the capital, we have scarcely learned the names of the "Eodice Vaticano," of Kinsboroug, of Aubin, etc. We have seen something of the Mendocino, of the "Tira del Musęo," of the "Peregrinacion del Valle," and the atlas of Padre Duran, and we note the superiority of execution in the linen of Jucutacato.

This prejudiced us for some time, but we remember what Acosta La Rea and Beaumont say about the great ability of the Tarascans for manufacturing mosaics of feather; and, according to those who saw them, there is a choice of colors and consequently middle tints, shades, etc. If they made these in a masterly manner, why can we not believe that in their paintings they tried to imitate in some degree what nature taught them and obliged them to perform?

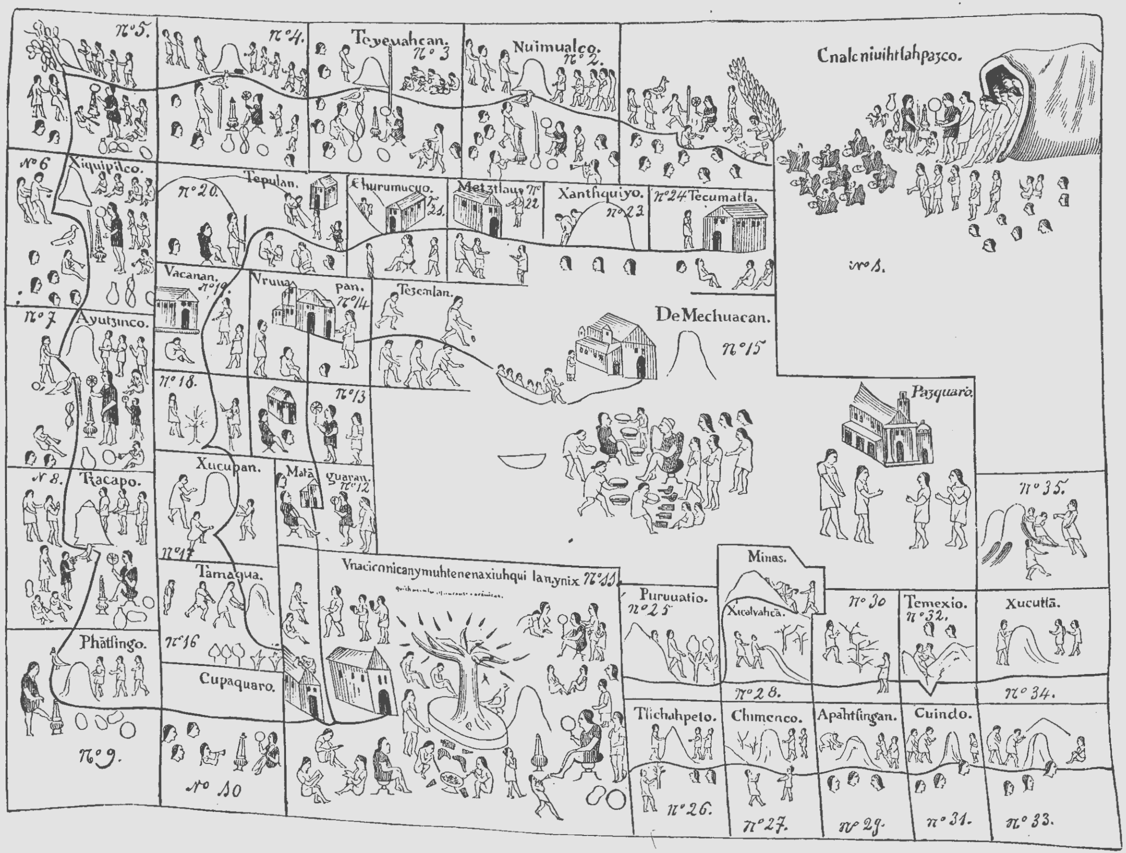
We notice that Beaumont, a diligent investigator of the Michoacan antiquities, notwithstanding that he was well acquainted with the chronicle of Padre La Rea, makes no reference to this painting.

Having the second part of the original manuscript of the chronicle of Michoacan in our possession, we have compared what he calls maps with the original of the Jucutacato drawing, and have always found the latter superior in execution. To give any value to such comparison it would have been necessary to have the originals from which Beaumont copied, for he confesses that those in his original manuscript are transcribed, and perhaps not very faithfully, according to our view.

Our friend the learned Señor Chavero, referring to this painting in the appendix to the work of Padre Duran (vol. II, p. 101), and before he knew of our photograph of it, says: "Larrea, in his Chronicle of Michoacan, an extremely rare book, says that the Tarascans preserved in the town of Cucutacato a hieroglyphic drawing of their journey." Señor Arozco y Berra, judging Beaumont's geographical drawings, assures us that "they are material representations of the deeds, drawings and not writing, probably the exclusive work of painters after the conquest. (Vol. II, page 596, of his Ancient History and History of the Conquest of Mexico.) Señor Riva Palacio, in the second volume of "Mexico across the Centuries," (p. 31, note), concludes that "these pictures were made some years, though very few, after the arrival of Cristobal de Olid," etc. We wished to anticipate the earlier opinions, in order to judge if this is properly a hieroglyphic. Señor Orozco y Berra and Riva Palacio neither know nor refer to this linen. Señor Chavero was actually acquainted with it, and already calls it hieroglyphic in anticipation. Does it then merit this name? We believe that it does. Supposing that it does, how shall we distinguish it from the others? With the name *Kiriologic* or *figurative*.* With regard to the opinions of Señors Riva Palacio and Orozco y Berra, leaving out the houses and inscriptions, we consider them inapplicable to this linen drawing.

* According to Bescherelle *Kiriologic* is a painting of ideas solely by the images of visible objects.

PLATE I.


nº 5.
nº 4.
Tepeuahcan. nº 3
Nuimualco. nº 2.
Cnalcniuihtlahpazco.
nº 6 Xiquipilco.
Tepulan. nº 20.
Churumucuo. 21.
Metztlau nº 22
Xanthquiyo. nº 23
nº 24 Tecumatla.
nº 1.
Vacanan. nº 19
Vruua pan. nº 14
Tezemlan.
De Mechuacan.
nº 15
nº 7 Ayutzinco.
nº 18.
nº 13
Pazquaro.
nº 8. Tiacapo.
Xucupan.
Matā guaran. nº 12
nº 17
Tamagua.
Vnaciconicanymuhtenenaxiuhqui lan,ynix nº 11.
Minas.
Puruuatio. nº 25
Xicalvahca.
nº 30
Temexio. nº 32.
nº 35.
Xucuttā.
Phātlingo.
nº 16
Cupaquaro.
nº 28.
nº 34.
Tlichahpeto.
Chimenco.
Apahtlingan.
Cuincło.
nº 9.
nº 10
nº 26.
nº 27.
nº 29.
nº 31.
nº 33.

ON SOME SPURIOUS MEXICAN ANTIQUITIES AND THEIR RELATION TO ANCIENT ART.

By William H. Holmes.

In order to place archæology in America upon an entirely safe basis, there should be a most searching scrutiny of the art materials upon which the work is based. It has been rather too customary in the past to lump archæologic materials together without much attempt at discrimination. Pure indigenous art has not been carefully distinguished from mixed art, ancient from modern art, and real from fraudulent art. To be sure, distinctions are not always easily drawn, and it is not at all surprising that on some pages of our pioneer work we find many incongruous elements intermingled and employed to illustrate indigenous culture. In many parts of Spanish America the conditions are exceedingly mixed, as three hundred years of miscegenation have passed by almost unobserved by science, and in the districts settled by the French and the English, the confusion, if not so great, is hardly less perplexing.

In undertaking a discussion of this subject we need to distinguish at least four classes of archæologic materials: First, native art, the outgrowth of aboriginal effort and adapted to aboriginal ends; it may be either pre-Columbian or post-Columbian. Second, mixed art, in which native and foreign elements are combined in the legitimate practice of art; such art results from the close association or actual intermixture of distinct races, and being perfectly normal, and illustrating an oft-repeated phase of the development of culture, it repays careful study. Third, exotic art, examples of which become associated with the native art through trade or other accidents of contact, and which, owing to our lack of knowledge, are liable to be taken for native work, thus leading to error. Fourth, a most pernicious group of products executed purely for commercial purposes, which are imitations more or less perfect of interesting or valued classes of art products. They are made by Europeans for trade with the natives, by the natives for trade with the whites, or either by Europeans or natives for the purpose of deceiving collectors. They are absolutely without value to science, and if not carefully distinguished from genuine work are capable of doing great injury. Passing by for the present the abundant materials of the three first-mentioned classes, I shall in this paper present some remarkable examples of the fourth class encountered in my studies of ancient Mexican art.

Spurious objects are executed in wood, stone, and metal, and experts of no mean order of talent ply their trade within the valley of Mexico. One reproduces ancient instruments of music, the curious teponaztli, for example, in worm-eaten wood and with surprising cleverness; another forges articles of bronze and copper in divers well-known, as well perhaps as heretofore unknown, forms; whilst many carve in stone, rivaling the ancient lapidaries in shaping even the harder forms of quartz. Names of a number of makers could be given and illustrations of their work could be obtained from scores of collections. Three-fourths of the objects of copper and perhaps one-third of those of stone now found n American collections are frauds.

Of all the materials, however, clay is the most extensively used, and on account of the ease with which it is manipulated some very curious and remarkable developments have taken place. The enterprising potters have not confined themselves to the copying of actual antiquities, but, following the natural bent of their genius, new forms have been invented and repeated until a family of frauds exhibiting a separate life and development has come into existence.

In Science, of February 19, 1886, I called attention to some examples of this class of work, but not wishing to hurt the feelings of those who had given it a place in their collections, or who had published specimens under the belief that they were important relics of ancient art, I did not trim closely; but the hint did not make the impression I had intended, and I propose now to push the matter a little further, and to extend the range of illustrations of dangerous specimens. This work is not undertaken in the spirit of a mere critic. On the contrary, facts have been suppressed and statements and forms of expression have been modified in order that, in the correction of rapidly growing errors, all personal friction should be avoided.

In classifying the ceramic products of Mexico in the U. S. National Museum, I found it necessary at the outset to eliminate this class of excrescences, but not caring to make innovations about which there remained a doubt, I concluded to wait until I could pay a visit to Mexico, and in 1883 I had the good fortune to spend a short time in that country. I found the class of works here referred to given an important place in the National Museum there, and I was much perplexed thereby. It is not surprising that the archæologists in the United States or in Europe should make mistakes in interpreting this work, as they have to take the word of unscientific collectors who rely upon the statements of native dealers; but it is strange that Mexican scholars should so long have passed the work by without remark. Professor Mendoza is said to have expressed the opinion that it should be classed as ordinary domestic Aztec ware,* thus implying that it probably constituted a normal feature of Mexican art originating in the distant past, and extending down to the present. This was a rather easy way of dealing with

* Brocklehurst, Mexico To-day. London, 1883, page 178.

the matter, but it was not all that science demanded, and I undertook to examine into the subject more closely.

In the first place, let me call attention to one of the fundamental principles of art growth—a principle which must be understood by the archæologist who would test the authenticity of unidentified relics of primitive art, and draw the line between the normal and the abnormal. Every proper product of the shaping arts is intended for some normal use. In indigenous work, vessels made for use in the domestic arts are suitable to that end; those made for ceremonial purposes are adapted to that end, and are embellished with symbols suitable to their office. They are in all cases exactly what a natural indigenous growth makes them. Forms are not interchangeable and embellishments, especially those of an ideographic character, are not used indiscriminately as long as the art is in a normal condition. The Aztec race, and each native race as well, had distinct groups of ware devoted to the peculiar ceremonies in which they were employed. As soon as the religious observances were interfered with by the conquerors, the particular function of each class was lost, and in a short time forgotten. The art of vessel-making went on, but under very changed conditions. All symbolic forms and embellishments fell into disuse. Indigenes, who still secretly held to their old beliefs, understood symbolic forms, and perhaps understandingly repeated them, but with the great mass, vessels ceased to be more than meaningless utensils. Now many of the modern vases which I class as spurious products are remarkable in shape, and are profusely bedecked with strange figures or devices, such as are, in a normal primitive state of art, universally and exclusively symbolic; but the modern Aztec of the valley of Mexico does not understand the ancient mythology. It is not to be supposed that he attaches any significance whatever to the forms of vases or to the symbolic figures and ornaments of ancient times, and if he reproduces them they can not be more than mere copies. But why should he copy them? Not for use, for neither vases nor symbols are adapted to any use. The simple truth is, that the manufacture is exclusively for trade, and the objects have a market because they are thought by foreigners to be old, or to be copies of the ancient, and for no other reason.

Antique objects began many years ago to have a value in money and the Aztec potter was equal to the occasion.* He has filled the museums of two continents with works which are not legitimate products of Aztec art. The pottery utilized by his people—the modern Mexicans—is a very different affair indeed, as a glance at the water-bottles,

* Désiré Charnay, who learned, through rather unpleasant experience, the true nature of this ware, writes as follows in his recent work, *Les Anciennes Villes du noveau monde*, page 36: "The fabrication of these pieces goes back as far as 1820 or 1826. This grand hoax was conceived in Tlateloco street, and the fortunate inventor must have made his fortune thereby, to judge from the immense number of vases dispersed by him. Most of the museums are infested by them, to say nothing of private collections."

the chocolate sets, and the multitude of homely but useful forms will amply show.

But the remarkable fact is that the vessels of which I speak are generally not copies of antique forms. It is possible that the manufacture began by the copying of actual specimens, but few originals can now be identified. The resemblances to the antique are slight and vanish under closer scrutiny. A careful study of the array of examples at hand shows that the makers are fancy free and that little attention is paid to antiquity save in the semblance of age so skillfully given. In consequence there is a lack of any fixed style of ware or range of forms; each generation and each maker produces distinct classes of results based in a measure upon what has gone before.

It is stated by persons who have had occasion to try the experiment that all kinds of ware are imitated with equal ease, that one has but to go to these obliging artisans and say what he wants and how much, and it is done. I observe, however, that there are decided limitations, that brilliantly polished and colored work is rarely attempted and that decoration in the refined colors and enamel-like slips of the ancients is quite beyond the reach of the moderns. The great body of the spurious ware is unpainted and is either finished in black or dark brownish hues or is of the natural tints of the baked clay. The walls of vases are heavy and the whole effect is rather clumsy. The entire surface is usually covered with ornamentation consisting of figures and devices in relief, or in the round, or of intaglio patterns. The latter are made by incising the soft clay, or by the application of stamps. The attached figures are usually formed separately in molds and afterwards set into their places and neatly joined to the body of the vase. The molds, an assortment of which forms an essential part of the potter's outfit, are in many cases made from antique specimens. After finishing, the vases are prepared for market by burial for a short time in the moist earth, or more frequently perhaps, by simply washing them with a thin solution of clay. The clay is afterwards partially wiped off, leaving the incised lines and depressions filled with the light-colored deposit.

I am speaking mainly of vases, but it should be observed that all classes of objects are produced and reproduced, vases, statuettes, pipes, whistles, spindle-whorls, calendar-disks, stamps, etc. Large statuettes are treated as are the vases, and examples are given farther on. Works of the latter class rarely appear in ancient art independently of vases. They are usually executed in stone. Less important objects, small and simple pieces, are very generally formed by pressing the clay into shallow molds, because apparently this is the easier method of fabrication. The molds are made from original pieces recovered from ancient sites and the copies are often excellent and very difficult to distinguish from originals. It is those classes of objects produced chiefly by free-hand modeling that call for attention here as they alone display the tendencies of modern genius as applied to this novel branch of art.

Vases of a variety much affected at the period of my visit by leading makers at San Juan Teotihuacan consist of an upright cylindrical body mounted upon three legs and surmounted by a conical lid. They are modeled without a wheel, in dark clay, and bristle with a superabundance of figures in high relief which give a castellated effect. Plain or flat portions of the surface are rudely polished and are generally well covered with incised or indented ornaments. This ware may be purchased at any of the relic shops in the City of Mexico, but can be had at much lower rates at San Juan. In passing back and forth by rail, I found that each train was met at San Juan by one or more of the venders, who were careful to expose but a limited number of pieces. Wishing to secure an example, I waited until the train was moving off, when I held out a silver dollar and the vase shown in Fig. 1 was quickly in my possession. The price asked at San Juan was $5, and in the City of Mexico

FIG. 1.—Dark vase with lid, made at San Juan Teotihuacan; height, 11 inches.

it would have been three times that amount. The dealers do not hesitate to assign definite localities to the "relics" and to give circumstantial accounts of their discovery, notwithstanding the fact that no such ware is ever found in the locality. One of the National Museum pieces is said to have been discovered by workmen in digging a well, 52 feet beneath the surface of the ground, and another, a lithograph of which appears in the Zeitschrift für Ethnologie for 1882, is reported to have been found in an ancient cavern near or beneath one of the great pyramids. Two of the most clever workmen, as I am credibly informed, have their shops just outside of the ancient city. Examples of other varieties are

Fig. 3.

Fig. 2.

Fig. 4.

FIGS. 2, 3, and 4.—Vases in dark clay, made at San Juan Teotihuacan.

presented in Figs. 2, 3, and 4. The form shown in Fig. 2 is a favorite, and with slight modifications is produced in numbers. Figs. 3 and 4 are more rare. In the latter a serpent with flattish body forms the head-

FIG. 5.—Vase in brown clay, made at San Juan Teotihuacan.

dress of a personage whose strongly modeled visage appears upon the front of the vase. The lid of this piece which is hidden by the head-dress is surmounted by a coiled serpent. These coiled-serpent lids are found in many collections, and being separated from the vases to which they belonged are esteemed as valuable relics.

A characteristic specimen, decorated with interlocked serpents and with heads of men and birds, is shown in Fig. 5. It is rudely made of brownish clay and is rather recent work of the San Juan makers.

I must not omit mention of the manufacture of calendar disks in clay, although I cannot say positively that they are made at San Juan. These objects are often used as lids of vases, as in the example presented in Fig. 6. They are generally made to resemble more or less closely

FIG. 6.—Small cylindrical vase in black clay with calendar lid.

the well known stone calendars and are executed in dark clay. The conventional figure seen upon this vase is the impression of one of the well-known stamps found plentifully in Mexico, and supposed by the modern potters to have been used by the ancients in a similar way. But a careful examination of the ancient ware indicates that there is little warrant for this assumption. A curious piece—a clay calendar about 15 inches in diameter and evidently quite new—was recently brought by Dr. E. Palmer from Guadalajara, Mexico. It is of a species wholly distinct from specimens found in the valley of Mexico. This discovery indicates that the business is extending. Whether or not the State of Jalisco, in which Guadalajara is situated, has furnished any example of ancient calendar peculiar to the region I can not say.

A great variety of statuettes are made at San Juan, and copies of the peculiar little antique heads, for which the locality is noted, are reproduced in great numbers.

Vases and other articles of somewhat different and often remarkable styles are more frequently met with in or near the City of Mexico. They also may be made at San Juan and elsewhere, but since the potter is, to some extent, migratory, the exact locality is of little consequence. They are of a brownish uncolored clay, or are finished in strong glistening black. In form and detail they are often novel, and notwithstanding the fact that no such models have come down to us from antiquity, hawkers and dealers find a ready sale for them. The vases are generally large and upright, and are covered with embellishments pretty much as those known to have been made at San Juan, but the intaglio figures are more frequently indented or stamped than incised. One variety is distinguished by a series of whistles which encircle the rim or are attached to the neck or body. The mouths of the whistles are sometimes obscure and are ranged about the rim, often in places difficult to reach with the lips. The whistles are modeled roughly after ancient forms, and usually the bulbous body, which contains the air chamber, is modeled to resemble a human face with distended cheeks. I present a typical but rude example in Fig. 7.

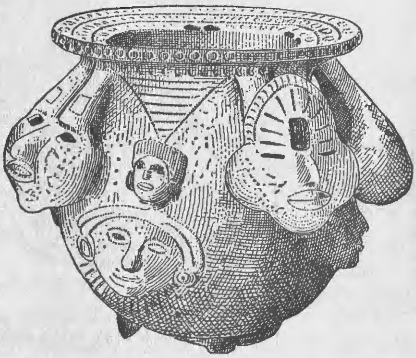


FIG. 7.—Rude vase in brown clay, with whistles attached.

Some pieces are very much superior to this, and belong to a better period of the manufacture or are the work of superior artists. It is possible that such vases may not all have been made with the idea of deceiving, and that their intrinsic beauty was sufficient to secure them a market. No satisfactory estimate of their age can be formed, yet I believe that very few persons having any knowledge of such matters will venture to call any of them antique.

The piece shown in Fig. 8 is preserved in the Mexican Museum, and is not only very pretentious, but has many points worthy of admiration. It is unusually elaborate, and is unique in having both a lid and a pedestal or stand. The lid is bell-shaped and the neck is encircled by a series of whistles; the mouth-pieces of these appear as narrow slits on the upper surface of the rim of the vessel and the sound holes are in the eyes or mouths of the faces which form the body of the whistles. Detailed description is unnecessary, as the cut conveys a very complete idea of the work. The color is that of ordinary burnt clay and the surface is hardly tarnished by age. An illustration of this piece was published by Charnay in the North American Review. He expresses the opinion that it is not ancient. In some of its characters it recalls the art of the period of degeneracy in Aztec art that followed the conquest, and which is shown to good advantage in some of the codexes published by Kingsborough.

FIG. 8.—A large elaborately embellished whistle-vase in brownish clay. Whole height about 3 feet.

FIG. 9.—A pitcher-shaped vase in light-brownish clay.

Many of the more recent examples are very poorly constructed and fall to pieces in handling. As a result it is readily discovered that partially hidden portions of the surface are quite new, being wholly unaffected by time or by the artificial aging given to the exposed parts. This group furnishes many pieces copied from, or rudely imitating, modern European products, such as pitchers, soup-tureens, etc.—forms not known to the pre-Spanish aborigines. An example owned by the Mexican Museum is illustrated in Fig. 9.

A similar piece representing another variety of ware is given farther on.

Statuettes are numerous, but are generally rude. So coarse are the more recent ones, and so unlike Aztec art in every essential character, that no one having a wide knowledge of antiquities could be deceived. They are the work of children or of extremely ignorant persons. Notwithstanding this fact, hundreds of pieces are found in our museums. They are not worth reproducing here. In past years some better work was done so far as execution is concerned, and it would appear that considerable attention was paid to the imitation of antique forms. A few examples sent from Mexico several years ago are now in the Museum at Washington. Characteristic forms are given in Figs. 10 and 11. These are types of forms most frequently imitated.

FIGS. 10 and 11.—Statuettes in brown clay.

An unusually pretentious piece having close affinities with the specimens considered above is found in the Mexican Museum. It is a heavy-set human figure, about half the size of life, and was in 1884 catalogued as the God of War, Huitzilopoxtli. It may seem that I venture too much in associating such a piece with fraudulent antiquities. I am convinced, however, that it is not ancient, and that it was not made to satisfy the normal demands of aboriginal art. It is shown in Fig. 12.

Another noteworthy piece, Fig. 13, also in the Mexican Museum, should be placed in the category of modern fabrications, if not of frauds. The personage represented appears to be an American edition of the dying gladiator. He has received a fatal wound; his macana or toothed club, has fallen from his hand and his head falls backward in death.

The work, although for a rude people pretty well done, is extremely meretricious, and in conception and execution has but a very distant relation to pre-Columbian Aztec art.

FIG. 12.—Large figure in dark brownish clay. Height, 39 inches.

One variety of this suspected ware, as already mentioned, is finished in a jet black, highly polished surface, and furnishes some quite pleasing

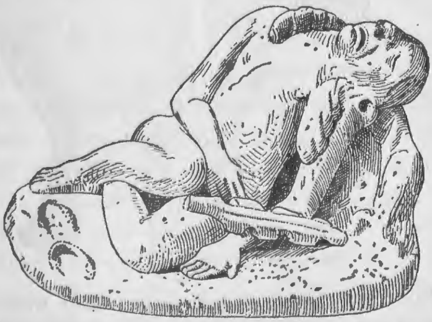


FIG. 13.—Figure of a dying warrior, in brown clay.

pieces. The best example in the Mexican Museum is shown in Fig. 14. The same hands have modeled the heavy pitcher-shaped vase illustrated in Fig. 15.

These pieces, although certainly comparatively modern, are less meretricious than the palpable frauds.

FIG. 14.—Black, well-finished vase, with lid.

FIG.—15. Pitcher-shaped vase of black ware.

That this ware does not all belong to the immediate present is clear. Much of that now in the Mexican Museum has been there for many years, and an American officer engaged in the Mexican war brought back a number of showy pieces, now in the U. S. National Museum, but so far as I can learn we are left in uncertainty as to whether this officer actually saw them exhumed or whether he took the word of some native collector. Dr. Charles Rau, relying upon the statements furnished by the collector, published cuts of some of them in his "Collections of the National Museum."

By reference to Fig. 16 it will be seen that these pieces are highly ornate and that although they are somewhat clumsy, they show considerable skill in construction and finish. The plastic ornamentation consists of a heterogeneous collection of figures and ornamental elements thrown together apparently without reference to origin or signif-

FIG. 16.—Large ornate vase in black clay.

icance, and by artists wholly ignorant of the true nature of ancient art. The maker has had in his outfit an assortment of molds made from little figures, picked up here and there throughout Mexico. By pressing bits of clay into these, casts are made which were afterwards attached to the body of the vase in such positions as fancy happened to dictate. A serpent was added here and a bird or a lizard there and the work was finished by polishing with pebbles and indenting with little stamps. These vases have been attributed to the Zopotecs, but they bear but slight resemblance to the well-authenticated work of that people. In Zopotec art, a vase is embellished with the figure of a single personage and the symbols proper to him, but in this bastard art, images and symbols of the whole Mexican pantheon are crowded upon a single piece.

A multitude of figureens of greatly varying sizes are made in this variety of ware and are sold at from a penny apiece up. The head is often made into a whistle, the mouth-piece being in the top of the head and the sound hole in the mouth. Fig. 17 represents one of the very worst examples of this class. It is quite recent.

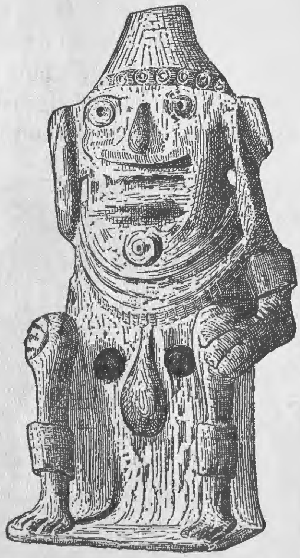


FIG. 17.—Figurine in black clay with a whistle in the head.

Some very pretentious pieces in black, well-polished ware come down from past years, but in all cases they lack authentication. A rather remarkable example, reproduced in Fig. 18, is figured in "Collections of the National Museum." It is a sitting figure, purporting to represent some great personage or deity. It is fifteen inches in height, and is preserved in the U. S. National Museum.

Ancient carvings of the serpent, especially of the rattlesnake, are very common in Mexico, and the subject is a popular one with modern imitators. It is true that antique examples in clay are preserved to us, but they are quite rare, whereas the spurious ones are to be found everywhere. I could point out several other classes of frauds, but I confine my efforts for the present to the illustration of the one great family.

Fraudulent work in wood, stone, and metal, although assuming considerable importance, is limited for the most part to the copying of actual originals. In neither of these materials does a group of new forms appear to have risen with sufficient individuality and consistency to perpetuate itself independently of legitimate art.

I have not even attempted to identify the thousands of copies in clay of genuine relics now spread broadcast over the world, but my illustrations are, I believe, sufficient in number and variety to enable archæologists to identify many of the most dangerous classes of objects, and my declarations are, I hope, sufficiently strong to put all collectors upon their guard.

FIG. 18.—Large image in black clay.

And now let me recapitulate briefly some of the arguments brought against the genuineness of the great body of the wares described as antiquities and as products of legitimate art. As a class they are post-Spanish and comparatively recent. That they are extensively made to-day is easily proved. A critical examination of the internal evidence of many specimens reputed to be antique demonstrates their newness beyond a doubt. A few pieces only can stand the ordeal of a thorough examination. In regard to these there is an absence of sufficient positive information to condemn them as frauds, but an inquiry into the nature of the negative evidence is instructive. In the first place, no single piece has a pedigree, no one has a well-authenticated locality or is known to have been found, so far as I can learn, in a position to lead us to suspect it of any considerable antiquity. Again, no ware of its class, whole or in fragments, is, to my knowledge, found upon any ancient site in Mexico or elsewhere. It has therefore absolutely no place among antiquities, and has but slight affinities with any known class of antiquities. It is not Zapotec pottery, as the land of the Zapotecs yields none such. It is not Toltec, as the sites of Toltec cities furnish only their own fine wares. It is not ancient Aztec, for I have shown* that on the site of the Aztec capital, the ancient Tenochtitlan, a series of deposits filled with relics of all ages contains no such ware. It is not modern Aztec, as it is not used by the Atzec people; and finally I may say, without fear of controversion, that no matter where or by whom made, it was as a rule not intended to be used at all, excepting as abait for the gullible collector.

The decoration is in the main un-American in character and in execution, it is incongruous and wholly meaningless. The greater part of these products have absolutely no place in legitimate art and should be nameless in the discussion of archæology, save in so far as naming is necessary in branding them as spurious.

Arguments which seem sufficient to me may not be strong enough to convince others of the correctness of my position, but there is such pressing need of clearing away much useless and harmful débris that I make these strong assertions hoping, if I am wrong, that some ambitious student may be spurred on to a closer definition of the true line between the normal and the abnormal phases of Mexican art.

* Transactions of the Anthropological Society, Vol. III, p. 68.

EARTHWORKS AT FORT ANCIENT, OHIO.

By W. M. Thompson, F. R. A. S.

These earthworks are supposed to have been constructed long before the red man obtained possession of the country. They are situated on the east bank of the Little Miami River on the top of the hill and about one-fourth of a mile east of the little railroad station, by the name of Fort Ancient. It is the strongest, largest, and most important of the defensive works of the extinct races of the continent, and is probably better known than any other in southern Ohio.

To all appearances the long mounds were used during some ancient war for breastworks, while the conical-shaped ones *m*, *m*, *m*, were probably the ones used for picket or signal stations.

In the vicinity of these earthworks, known as the Old Fort, there are several groups, all of which are well worth a visit.

A few of these mounds have been dug into, and bones, various stone implements, some pottery, and bronze or copper axes, etc., found.

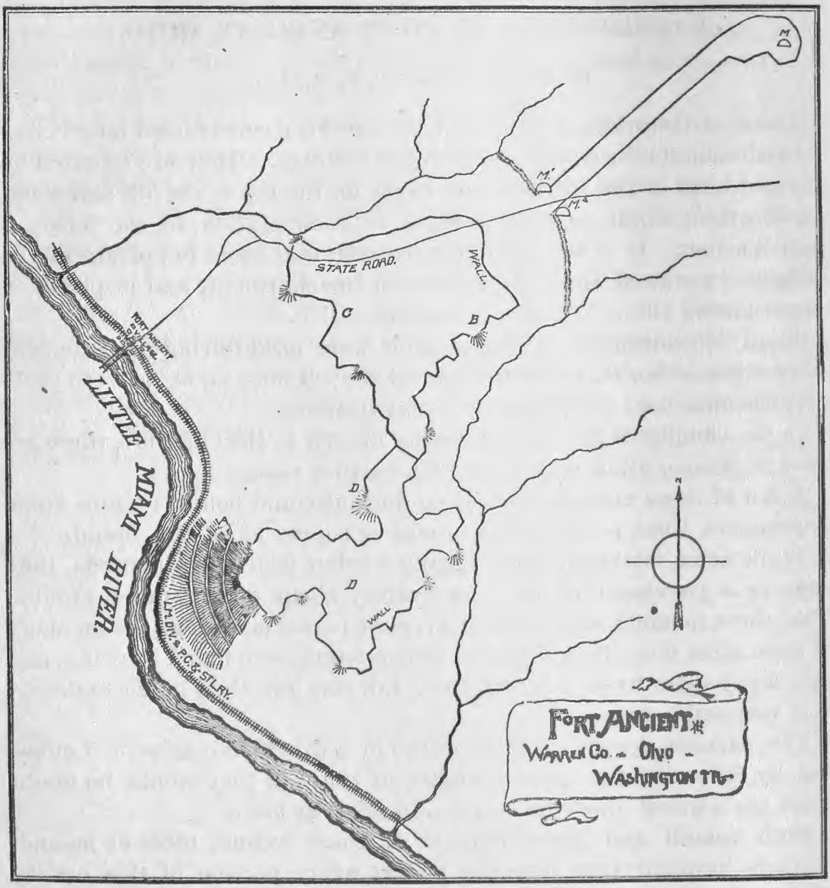
While some workmen were digging a cellar near these mounds, they came to a pavement of brick or pottery about 8 feet under ground. That these mounds were built at a remote period is evident, for on many of them trees more than 7 feet in circumference are found growing, and how many more have attained their full size and then fallen to decay, it is impossible to say.

The extreme length of these works in a direct line is quite 3 miles, but by following the various angles of the wall they would no doubt reach (in a direct line) the length of 6 miles or more.

Both tumuli and mural remains of these extinct races of mound-builders (probably) are found in almost every portion of this county (Warren). Several skeletons have been unearthed from various mounds in this (Warren) county. Five were unearthed two years ago from one mound.

The following description of this remarkable work is from *Archæologiæ Americanæ:* "The fortification stands on a plain nearly horizontal, about 236 feet above the level of the river, between two branches with very steep and very deep banks. The openings in the walls are gate-ways, *B*, *C*, *D*, *etc.*, the plain extends eastward along the State road, nearly level, about a half mile. The fortification on all sides, except the east and west where the road runs, is surrounded with precipices nearly in the shape of the wall. The wall on the inside varies in its height according to the shape of the ground. The outside being generally from 8 to 10 feet, but on the plain it is nearly 19½ feet high."

In a few places *B*, *D*, the openings appear to be washed away in gutters. At about 20 poles east from the gate through which the State road runs are two mounds, *M′ M″*, about 10 feet 8 inches in height, the road running through them nearly equidistant from each other.



From these mounds are gutters running nearly north and south, that appear to be artificial, and made to communicate with the branches on each side. Northeast from the mound, on the plain, are two roads, about 1 pole wide, elevated about 3 feet, and which run nearly parallel about one-fourth of a mile, and then form an irregular semicircle round a small mound, *M*. Near the southwest end of the fortification are three circular roads, between 30 and 40 poles in length, cut out of the precipice between the wall and the river; the wall is made of earth.

Several of these openings have evidently been occasioned by the water which had collected on the inside until it overflowed the walls and wore itself a passage.

In several other places the walls might never have been completed, as at b. The three parallel roads *A*, near the southwest end of the fortification appear to have been designed for persons to stand on and annoy those who were passing up and down the river. The Indians, as I have been informed, made this use of these roads in their war with each other and with the whites.

Whether these works all belong to the same era and the same people I can not say, though the general opinion is that they do. The two parallel roads outside the fortifications running from two mounds northwest are very similar to modern turnpikes, and are made to suit the nature of the soil and make of the ground.

If the roads were for foot-races, the goals from which the pedestrians started or around which they ran and the area which these parallel walls inclose, smoothed by art, might have been the place where games were celebrated.

As another proof of the great antiquity of these formations, we would call attention to the fact that the depth of the soil is the same on the mounds as it is 20 rods distant. This is one of the strongest evidences of the age of the remains. These works are located in a populous district and are very accessible, being almost within a stone's-throw of the station on the Little Miami Railroad. They have been less obscured by cultivation and occupancy than most works of this class.

A thorough and systematic exploration of these works is, however, a desideratum. Recent examinations go to show that such explorations would be rewarded by discoveries which would give to theories of origin and use a much better foundation than they have hitherto had.

NOTE.—On earth-works at Fort Ancient. The enduring parapet still tracing the brink of the precipice presents only a broken outline of ruined strength. The location of this work in its details proves it to have been one of the most perfect in the world. An immense tree which grew upon the parapet fell where it grew; the rings which indicated its growth were counted some years ago, and showed it to be five hundred years old. It is about 230 feet above the level of the river (Little Miami).

ON CERTAIN PARASITES, COMMENSALS, AND DOMICILIARS IN THE PEARL OYSTERS *MELEAGRINÆ*.

By ROBERT E. C. STEARNS.

The presence of nodules or tubercles on the interior surface of the shells or valves of lamellibranch (bivalve) mollusks is of frequent occurrence. These excrescences are nacreous or otherwise, according to the character, in this respect, of the shell in which or upon which they occur. They are found alike in fresh-water and marine species. In the pond and river mussels (*Unionidæ*), they are chiefly due to *interior* causes; in marine forms, like the cockles (*Cardium*), mussels (*Mytilus*), the scallops (*Pecten*), etc., these formations are generally traceable to *exterior* causes. It is often the case that specimens of the large scallop of the New England coast (*P. tenuicostatus*), are so burrowed into by a species of sponge (*Cliona sulphurea*) that nearly the entire inside surface of the valves will be roughened with sharp, thickly-set pustulæ.

So, too, with the beautiful pecten of the west coast, *P. hastatus*, common in certain localities in Puget Sound. Fully one-half of the specimens obtained by the dredge are so defaced by the ravages of a similar species of sponge as to be of no value.

We sometimes meet with these nodulæ in the shells of marine gastropods, notably the *Haliotidæ*, popularly known as Abalones, or ear-shells. In all of the marine species in which these nodules occur it will usually be found that the substance of the shell has been bored into from the outside by either a species of pholad or lithodomus.

Neither of these forms are, properly speaking, either parasites or commensals.

They are, more definitely, *domiciliares*, and excavate their burrows, not for the purpose of getting at the softer parts of the mollusk upon whose shell they have "squatted" in order to use said softer parts as food, after the manner of the predaceous *Naticas* and *Purpuras*, but solely for the purpose of a residence or domicile.

The lithodomi, especially, burrow into many species of shells, and the pholad, so often found in the heavy shells of old individuals of the *Haliotidæ*, I am inclined to believe as a differentiated and dwarfed variety of a widely distributed *rock-borer*. A related form (*Martesia cuneiformis* Gray) is common on the Atlantic coast of North America, and may often be seen *in situ* in the shells of the common oyster (*O. virginica*).

The burrows of these shell-boring pholads and lithodomi are at first quite small, increasing in size in the same ratio as the burrower increases in age or in growth. After a while the depth of the boring is equal to the thickness of the shell in which it has been made, and the occupant of the latter, in order to keep his own shell intact and maintain the integrity of his own domicile, commences depositing layer upon layer of nacreous or porcellaneous matter, as the case may be. In keeping pace with the continued encroachments of the domiciliary squatter upon the outside, this deposit finally becomes a more or less conspicuous protuberance.

In one of the mother-of-pearl shells which illustrate this paper (Plate I, which exhibits, as do all the figures, the *inner* side of the shell), the exterior has been perforated in both directions; that is to say, *transversely*, or at right angles *to the growth-layers* of the shell *also between the growth-layers*, the first class of perforations leading to the separate rounded nodules and the latter to the elongated form. If the reader had the shell in his hand, so that he could turn it over and examine the exterior perforations, he would at once perceive that the site of each of the nodules or tubercles exactly corresponds with the site of an exterior perforation or burrow.

In the *Haliotis* shell, the domiciliares are a species of pholad (*Penitella parva* Tryon), and the site of each may be seen on the outside of the shell and the corresponding nodosity on the inside.

Plate I represents an adult abalone or ear-shell, *Haliotis rufescens* Swainson (Mus. No. 74877), a Californian species. The figures 1, 2, and 3 indicate the rounded elevations of nodules caused by *Penitella*, and figures 4, 5, and 6 show the ends or edges of the pholad shells, the surface of the ear-shell having been bored through or otherwise removed.

Sometimes these nodules or tubercles are due to some foreign inorganic matter, a particle getting in between the mantle of the mollusk and the inner surface of its shell. In such cases it is, we may say, at once plastered over, and thus fixed upon the surface of the valve.

Free concretions, *i. e.*, unattached or non-adherent nodules, are, as is well understood, caused by some particle, organic or inorganic, becoming in some way lodged *exclusively in the soft parts* of the body of the mollusk, and so far away from the surface of the shell as not to admit of its being cemented to it.

No doubt many of the mollusca, both gastropod and lamellibranch, contain or are inhabited by true parasites. In certain species of fresh-water mussels (*Anodonta cygnea* of Europe, and *Anodonta fluviatilis* of America) a species of water mite (*Atax*) has been detected, and sometimes *Filaria* (thread worms) and other forms occur.

CRUSTACEAN PARASITES.

A small species of crab (*Pinnotheres*), an epicurean no doubt, finds a salubrious habitation in the common oyster, but parasites of *any considerable size* appear to be rather rare.

Besides *Pinnotheres ostreum* Say, the name of the species above referred to, another small crab (*Pinnotheres maculatus* Say) is sometimes found in the common mussel (*Mytilus edulis*), and the large scallop (*Pecten tenuicostatus*) before mentioned. It is doubtful, however, whether these crabs are really parasites or only commensals, though probably the former.

Before the Zoological Society (London, April 6, 1866), Dr. H. Woodward exhibited specimens of animals, commensal or parasitic, in the pearl mussels of Australia. Among these was "a specimen of Pinnotheres which has been entombed in a cyst of pearl by a living pearl-mussel," etc.

He further remarked: "It seems extraordinary and beyond belief that the *Meleagrina* should of all the Conchifera be the one to resent the commensalism of the pea-crab, which has been known since the days of Cicero, Pliny, Oppian, and Aristotle, to inhabit the shell of the *Pinna* and the oyster, and has been recorded from *Astarte*, *Pectunculus*, and at least some half-dozen other bivalves, with whom it appears to live on the most friendly terms.

"It is the females, however, which constantly reside within the shells of the Conchifera, whilst the males are said to avail themselves of favorable opportunities to visit the females in their retirement.

"Whether or not in this case the unlucky male intruded himself upon *Meleagrina* at an unfavorable period, and, finding no female *Pinnotheres*, penetrated so far beneath the mantle of the pearl-mussel as to be unable to retreat, one thing is quite clear, namely, that the *Meleagrina* entombed the intruder in a cyst of pearl from which the clever pearl-button maker alone liberated him."

FISH PARASITES.

We have, however, evidence of the occurrence of fishes of two species as parasites in the true pearl oyster, or mother of pearl shell *Meleagrina*, not by the presence of the living fish, or even by dead specimens of "fish in the flesh," if we may use so convenient a paradox, but by their entombed remains in the form of nacreous nodulæ or tubercles on the shells or valves of the said mollusk.

At a subsequent meeting of the Zoological Society (June 1, 1886), Dr. Günther exhibited a specimen of a small fish of the genus *Fierasfer* embedded in a pearl oyster, and said:

"The specimen which is represented in the accompanying wood-cut of the natural size has been in my possession for many years. It is an old shell of *Margarita margaritifera*,* in which there is imbedded, behind the impression of the attractor muscle, a perfect individual of a fish belonging to the genus *Fierasfer*. The fish is covered by a thin layer of pearl substance, through which not only the general outlines of the body but even the eye and the mouth can be seen. The parasitic habits

eleagrina margaritifera L.

of *Fierasfer* are well known, and Putnam describes, in the 'Proceedings of the Boston Society of Natural History,' Vol. XVI, 1874, p. 344, a species, *Fierasfer dubius*, which is found on both coasts of Central America, but inhabits holothurians on the Atlantic and pearl oysters on the Pacific side; and he further mentions, in a foot-note, an example belonging to the Museum of Comparative Zoology at Cambridge, in which also a *Fierasfer* has been imbedded in the substance of the shell. In this case, as well as in ours, the fish, instead of introducing itself into the cavity between the two halves of the mantle, penetrated between the mantle and the shell, causing irritation to the mollusk, which the latter resented by immediately secreting the substance with which the intruder is now covered. It is remarkable to note that the secretion must have taken place in a very short time, at any rate before the fish could be destroyed by decomposition."

Soon after the close of the New Orleans Exposition Prof. F. Ferrari Perez and Señor J. G. Aguilera, of the Mexican Geographical Commission, visited Washington and remained here for several weeks for the purpose of comparing and identifying various natural history material with the assistance of the curators in different departments of the National Museum.

The collections in charge of these gentlemen, so far as molluscan forms are considered, were rather meager, though many interesting points pertaining to geographical distribution were derived from the examination.

The collection included a hundred or more valves of the common pearl oyster of the Pacific coast of Mexico, *Meleagrina fimbriata* Dkr., of which two or three species have been made by as many authors. Upon examining these last winter I found a single valve (see Plate II, Fig. C), the right half of a rather young individual in which was imbedded, in very nearly the same region as in the specimen mentioned by Dr. Günther, a small fish of rather a long and slender form, probably of the same genus and perhaps the same species as that inclosed in his (Günther's) pearl-oyster valve, and previously described by Putnam, as quoted by. Günther. The Mexican collection contained but a single specimen of this special character.

ANOTHER SPECIES OF FISH DETECTED.

Among the lot, however, were two or three valves, in each of which, inclosed in nacreous splendor, was a specimen of a small fish, apparently a species of *Oligocottus*.* In each instance the fish had worked its way between the interior face or surface of the valve and the mantle towards and near to the adductor muscle, as can be seen by examining the shell close by the muscular scar.

The squarish, chunky head of the little intruder, also the somewhat

* Submitted to Dr. Bean, curator of ichthyology, who, though not p fiedly refers it to this group.

prominent spines of the head, are easily discerned, though covered and partially obscured by the coating of nacre. (See Plate III, Fig. D.)

The single specimen containing the inclosed *Fierasfer* was retained by the commission, but one of the others (Plate III, Fig. E) was kindly presented to the National Museum. (No. 73934*a*.)

I am not aware that the occurrence of *Oligocottus* in this way has heretofore been observed or made known.

This determination is not positive. The specimen (73934*a*) represented in Plate III, Fig. E, is not as favorably presented for this purpose as in the others in the possession of the commission.

The genus *Oligocottus* Girard includes certain small fishes inhabiting rock pools between tide marks on the Pacific coast of North America. The species described, and their distribution as given in Jordan and Gilbert's Synopsis of the Fishes of North America (Bulletin of the U. S. National Museum, No. 16), is as follows:

O. analis Grd., coast of California; abundant in rock pools, from Monterey southward to Lower California.

O. maculosus, Grd., San Luis Obispo to Alaska, exceedingly abundant northward.

O, globiceps, Grd., Pacific coast northward to Kodiak, in rock pools; rather rare.

Assuming that Dr. Bean is correct in placing the above in this group, it will be observed that whether it belongs to the more southern species of the three (*O. analis*) or otherwise, the geographical disribution is evidently considerably extended, as the pearl-oysters in which our specimens are inclosed came from the Gulf of California, where the fishery of these shells is carried on.

After entering the shell, which of course must be at such time as the valves are partially open or gaping, these fishes find no obstruction to their course as they push their way towards the interior between the mantle and the smooth inner surface of the valves until they approach the adductor muscle, and here they find a barrier which most likely causes them to expend somewhat greater activity or energy and consequently in a correspondingly increased degree disturb the serenity if not the structural economy of the oyster.

Having reached thus far, the invader is in the immediate vicinity of—if not the seat of intellect, then—the center of sensitiveness. The deposit of nacre in such instances must be very rapid, and it is quite possible that the unwelcome explorer is not only enshrouded and entombed in pearl, but previously drowned in a pearlaceous flood, for it may be reasonably presumed that the annoyance caused by its presence must be exceedingly great, and likely to induce a copious flow of nacreous lymph at the point and in the region of greatest irritation.

It is evident that the deposition and induration are sufficiently rapid to inclose the parasite before decomposition has taken place.

DECEMBER 15, 1886.

PLATE I.

(Fig. A.)

Haliotis rufescens Swainson (Museum No. 74877), the red-backed ear-shell or abalone of California and elsewhere, on the west coast of America (somewhat reduced).

The figures 1, 2, and 3 indicate nodules caused by the burrowing of a *pholad, Penitella parva*, and 4, 5, and 6 show other nodules, the nacreous coating removed by accident or otherwise, exposing the edges of the pholad shells, etc.

From nature, by W. H. Chandlee.

(PLATE II.)

Fig. B.

Right valve of the pearl-oyster, mother-of-pearl shell *Meleagrina fimbriata* Dunker, two-thirds natural size (a West Mexican species) showing rounded and elongated tubercles or nodulæ caused by perpendicular and inter lamellar perforations of *lithodomi*.

From nature, by W. H. Chandlee.

Specimen belongs to U. S. Nat. Museum, No. 73934*b*.

(Fig. C.)

Right valve (two-thirds natural size) of *Meleagrina fimbriata* Dkr., mother-of-pearl shell from west coast of Mexico with parasitic fish *Fierasfer* inclosed in same.

From nature, by A. Z. Shindler.

Specimen belongs to the Mexican Geographical Commission.

PLATE III.

(Fig. D.)

Right valve (two-thirds natural size) of *Meleagrina fimbriata* Dkr., mother-of-pearl shell from west coast of Mexico with parasitic fish *Oligocottus* sp. inclosed in same.

From nature, by A. Z. Shindler.

Specimen belongs to the Mexican Geographical Commissior

(Fig. E.)

Left valve (two-thirds natural size) of *Meleagrina fimbriata* Dkr., from west coast of Mexico, with parasitic fish *Oligocottus* sp. inclosed in same.

From nature, by W. H. Chandlee.

Specimen belongs to the U. S. Nat. Museum, No. 73934*a*.

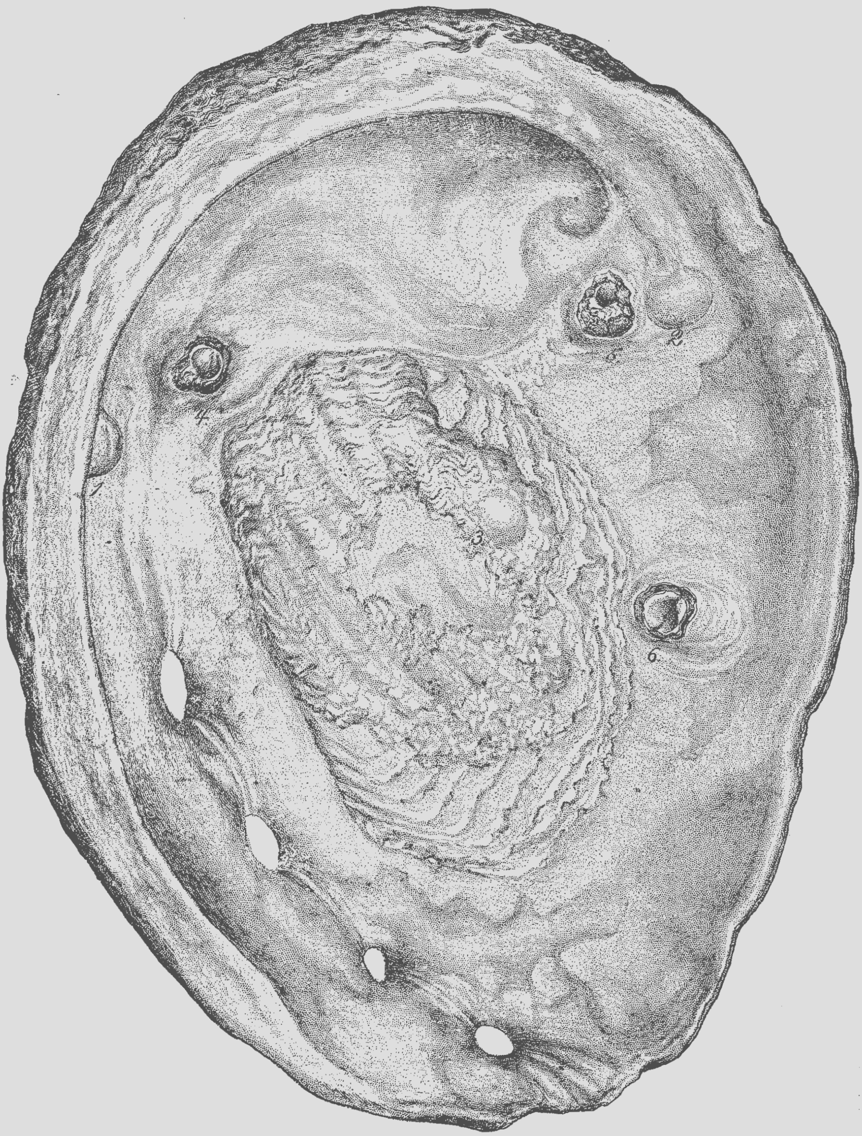


FIG. A.—*Haliotis rufescens.* (Nearly natural size.)

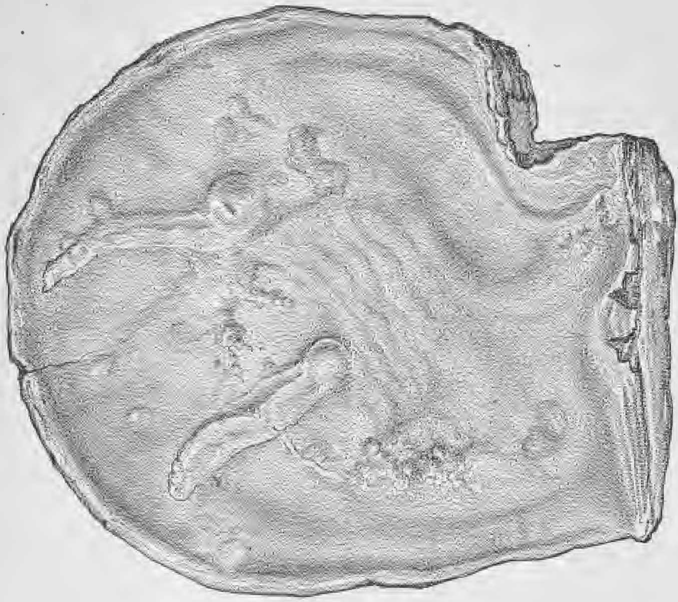


FIG. B.—Right valve of *Meleagrina fimbriata*. ($\frac{2}{3}$ natural size.)

FIG. C.—Right valve of *Meleagrina fimbriata*. ($\frac{2}{3}$ natural size.)

FIG. D.—Right valve of *Meleagrina fimbriata*. (⅔ natural size.)

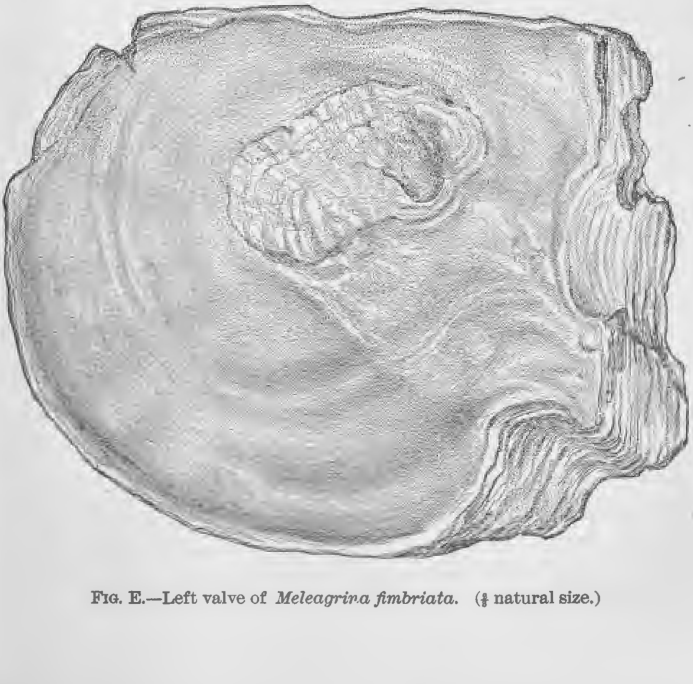


FIG. E.—Left valve of *Meleagrina fimbriata*. (⅔ natural size.)

TIME-RECKONING FOR THE TWENTIETH CENTURY.

By Sanford Fleming, C. M. G., LL. D., C. E., etc.

During the early historical ages much chronological confusion prevailed, and it is largely owing to this cause that the annals of the centuries which preceded the Christian era are involved in obscurity. The attempt to end this general disorder was made by Julius Cæsar, who established regulations with respect to the divisions of time and the mode of reckoning to be followed. The Julian Calendar was introduced forty-six years before Christ. It continued unchanged until the sixteenth century. In 1582 recognition was obtained of the errors and defects which the circumstances of the period had made manifest and which demanded correction. Pope Gregory XIII accordingly directed the reformation of the calendar and established new rules of intercalation. These two epochs are certainly the most important in the history of our chronology.

Three centuries have passed since the reform of Pope Gregory. New continents have been opened to civilization and immense regions then wholly unknown to Europe have been peopled by races busied in commerce and skilled in the arts, and characterized by unwearied energy and determination. In these three hundred years a marvellous succession of inventions bearing upon human activity and progress has been introduced, and the character of nearly every requirement of life has undergone change. The discoveries and inventions which have marked this period have produced new conditions of society; and our minds have received an impulse which leads to investigation wherever need of improvement appears to be demanded. It is within the last half century more especially that the bounds of human knowledge have been so wonderfully extended; perhaps in the whole world's annals no fifty years have witnessed such a marvellous revolution. The triumphs of applied science in facilitating intercourse between men and nations have given an extraordinary impulse to general progress, but in so doing they have developed imperfections in our system of time-notation which previously were unknown, and it is no longer possible to escape the conviction that we have reached a stage when further reform is demanded as a requirement of our condition. The necessity for a reform in time-reckoning is recognized by the highest authority, and has obtained a hold of public opinion. The President of the United States, General Arthur, at the request of Congress, authoritatively took proceedings to bring the subject prominently to the attention of the world. After prolonged diplomatic correspondence with the Governments of foreign powers, he invited delegates from all nations to a scientific conference at Washington in which the subject should be fully considered.

The conference met in the autumn of 1884. Twenty-five nationalities were represented. The proceedings extended over the month of October, and they resulted in the almost unanimous adoption of seven resolutions bearing upon time-reckoning.

As no records can be in accord unless a common starting point be agreed upon from which computations are to be made, the first resolutions had reference to the determination of an initial meridian. The meridian passing through Greenwich was selected.

In the fourth and fifth resolutions the conference laid down the following important principles:

IV. "That the conference proposes the adoption of a universal day for all purposes for which it may be found convenient and which shall not interfere with the use of local or other standard time where desirable."

V. "That the universal day is to be a mean solar day; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the civil day and date of that meridian, and is to be counted from zero to twenty-four hours."

The opening of the national Congress at Washington shortly followed the international conference. The President regarded the importance of the proceedings to be such as to call for special mention of them in his annual message. General Arthur thus expressed himself on the subject: "The conference concluded its labors on the 1st of November, having with substantial unanimity agreed upon the meridian of Greenwich as the starting point whence longitude is to be computed through one hundred and eighty degrees eastward and westward, and upon the adoption, for all purposes for which it may be found convenient, of a universal day, which shall begin at midnight on the initial meridian and whose hours shall be counted from zero up to twenty-four."

There was no exaggerated importance in these allusions, for the conclusions of the conference are productive of most important results. They make provision for terminating all ambiguity in hours and dates and for establishing throughout the world, free from national susceptibility and caprice, perfect uniformity in reckoning time. Some years may elapse before the new notation becomes the one recognized mode of reckoning; but when it shall have been generally accepted in the practice of daily life, it is calculated to sweep away the difficulties now experienced, and it will add greatly to the general convenience of civilized man.

One of the first practical efforts to direct public attention to the rapidly growing necessity for a comprehensive reform in time-reckoning can be found in a paper published in the Transactions of the Canadian Institute, Toronto, for the session of 1878–'79.* This paper adduces in

* Time-reckoning and the selection of a prime meridian to be common to all nations. By Sandford Fleming.

support of its argument many pertinent facts, and points out that the gigantic systems of railways and telegraphs which in modern times have been established in both continents have developed social and commercial conditions which never previously existed. These conditions have so affected the relations of time and distance as to establish the fact that our inherited system of notation is defective; that it is inconvenient to men of business; that it produces confusion and frequently results in loss of life, and leads to other difficulties; that under the circumstances which have followed the substitution of steam for animals as a motive power, the ancient usages as retained in our notation of hours and dates are generally inappropriate. Moreover, the use of the telegraph in our daily lives practically subjects the whole surface of the globe to the observation of civilized communities in each individual locality. It leaves no interval of time between widely separated places proportionate to their distances apart. It practically brings into close contact the opposite sides of the earth where daylight and darkness prevail at the same period. By this agency noon, midnight, sunrise, sunset, and the whole range of intermediate gradations of the day, are all observed and recognized at the same moment. Thus in matters out of the domain of local importance confusion is developed and all count of time is thrown into multiplied disorder.

Again, under the usages now observed, a day is assumed to begin twelve hours before—and end twelve hours after—the sun passes the meridian of any place. As the globe is constantly revolving on its axis, a fresh meridian is every moment coming under the sun; as a consequence a day is always beginning somewhere and always ending somewhere. Each meridian around the circumference of the sphere has its own day, and therefore it results that there are, during every diurnal revolution of the earth, an infinite number of local days all beginning within a space of twenty-four hours and each continuing twenty-four hours. These days overlap each other, but they are as perfectly distinct as they are infinite in number. While a day is nominally twenty-four hours in length, as a matter of fact forty-eight hours elapse between the first beginning and the last ending of every week day. Taking the whole globe into our view, Sunday actually commences in the middle of Saturday and lasts until the middle of Monday. Again, Saturday runs into the middle of Sunday, while Monday begins twenty-four hours before Sunday comes to an end and continues twenty-four hours after Tuesday commences. Similarly for all the days of the week, as time is now reckoned. Except those on the same meridian, there are no simultaneous days on the earth's surface, and as the different days are always in the various stages of advancement, discrepancies and errors must necessarily result in assigning the precise period when an event takes place. The telegraph may give the exact local time of an occurrence, but the time so given must be in disagreement with local time on every other meridian around the globe. An event occurring on any one day may on the instant be announced in a locality where the time is that of the previous day, and in another locality where the time is that of the following day. About the period when the month or year passes into another month or year an occurrence may actually take place, according to our present system of reckoning, in two different months or in two different years; indeed, there can be no certainty whatever with regard to time, unless the precise geographical position be specified as an essential fact in connection with the event described. Under these circumstances it must be conceded that our present system of notation is most defective, certainly it is unscientific, and possesses every element of confusion; it produces a degree of ambiguity which, as railways and telegraphs become greatly multiplied, will lead to complications in social and commercial affairs, to errors in chronology, to litigation in connection with succession to property, insurance, contracts, and other matters; and, in view of individual and general relationships, it will undoubtedly act as a clog to the business of life and prove an increasing hindrance to human intercourse.

The problem to be mastered is to put an end to this confusion. In order to do so, it is important that we should endeavor to form correct ideas of time and its attributes.

According to the ordinary usages which we follow, the time of any particular locality depends upon its position on the earth's surface; in other words, upon its longitude. The principle followed is that there is a separate time on every meridian around the circumference of the globe. Let us carry this theory to its logical conclusion. Take, by way of example, a hundred or a thousand meridians, each with a distinct and separate time. It will be conceded that what is true of one point on a meridian must be true of every point. A meridian line runs due north and south on the earth's surface from pole to pole; hence it follows that at the point where every meridian must converge we have the time of every meridian. That is to say, at the earth's pole, a point common to every meridian, there are a hundred or a thousand different notations of time, each distinct and separate. The extreme absurdity of this hypothesis establishes beyond question that the premises are false; and it is in no way surprising that confusion and difficulty result from a system such as we possess, based on principles so erroneous.

We may here ask the question: "Why should time vary with every mile of longitude?" The answer comes, It is not possible to conceive more than a single unity of time in the whole universe. Time, which is "an infinite continuity in infinite space," resembles a mighty river, whose unvarying stream passes before us. Such a river is unchangeable, yet continually changing; volumes of water always advancing are replaced by new volumes in perpetual succession, and yet the river continues one and the same ever flowing unity. The passing stream of time is much the same, and the problem presented to us is to keep a proper record of its flow. It is perfectly obvious that the principles which should govern should be such as to secure complete accord in the detail of its admeasurement independently of locality. All peoples are concerned in the attainment of harmonious results, and therefore it is important that they should acquiesce in the employment of the same unit of computation and in counting the measurements from one common zero.

We have not to look in vain for a convenient unit and the most perfect instrument for measuring the passage of time. The rotation of the earth on its axis is marked by complete uniformity of movement, and nothing is more certain than the recurrence of this diurnal phenomenon. Accordingly the earth itself supplies all our wants as a timekeeper; in it we have at our command a perpetual standard for the use and guidance of the entire family of man.

Before, however, we can attain this end it is essential that mankind should come to an agreement on the following points:

1. With respect to a zero from which the revolutions are to be counted.

2. The acceptance of a common subdivision and a common notation by which parts of revolutions will be known by all and receive universal recognition.

The importance of a definite understanding on these points is self-evident, for if each individual or group of individuals adheres to the practice of observing time from different zeros and each maintains separate reckonings of it, the outcome must be general confusion, such as we now experience.

If in imagination we place ourselves at one extremity of the earth's axis, we shall find ourselves in a peculiarly favorable position, free from all local influences, for observing the revolutions of the globe. At no other point in the northern hemisphere are the conditions the same. A spectator standing at the north pole would have neither east nor west; in whatever direction he might cast his eyes he would look towards the south; he would no longer see the daily return of sunrise and sunset; the sun when visible would move, or seem to move, in a horizontal line, and its path would encircle the earth parallel to and not far distant from the horizon. Under such circumstances it would not be possible to note the diurnal revolutions of the earth by the rising or setting of the sun, or by the sun's greatest altitude at mid-day, or by his southern position in the heavens. As the passage of time can only be marked by events, what course could be followed? Obviously it would be necessary to take special means to observe the earth's diurnal rotation, and the method most readily to suggest itself would be to select a conspicuous object near the horizon and according to this object observe the sun's passage over it. The object so selected would become the zero of time, and the interval between two successive solar passages would be the period occupied by a revolution of the earth. If from zero the horizon be divided into a series of arcs of 15° each the whole circle around will consist of twenty-four divisions. If each of the division points be numbered from zero in the direction contrary to the motion of the earth or towards the right, and in imagination the numbers be placed in a conspicuous manner against the sky, the spectator will have within his range of vision a great dial-plate on which as it revolves the vertical sun will continually point to the passing hours. With the twenty-four division points so numbered around the circle of the horizon, it is obvious that every hour in the day, and equally the smaller divisions of time, will invariably be manifested by the solar passage.

As the imaginary point of observation, the north pole, is common to every meridian, the hours and minutes indicated by the great polar chronometer will be equally common to every locality on the surface of the globe. Whatever the longitude, the solar passage will be the index of time. Two successive passages at zero will complete an interval of twenty-four hours; but it will not be a day in the ordinary sense, as an ordinary day is a local phenomenon in no two longitudes identical.* To distinguish this new interval of time common to the whole world from the infinite number of local days at present recognized it has been suggested to term it the "Cosmic Day," or some distinctive appellation by which it may be known.

Necessarily the zero point must be arbitrarily selected according to convenience, and any zero whatever, other things being equal, would serve the purpose which we have in view. We have only to assume the zero so selected to coincide with the Antiprime Meridian determined by the Washington Conference, and the Cosmic Day will be identical with the Universal Day, established under the same authority. A Universal or Cosmic Day may therefore be defined as the interval of time between two succeeding solar passages at the Antiprime Meridian common to all nations.

In his recent discourse on the subject at the Royal Institution, London, the astronomer royal for Great Britain, Mr. Christie, expressed a preference for the term "World Time" to designate this new measure of duration. It has been termed "Cosmic Time" by various societies and individuals; but the name is of secondary importance, if it be understood that the new measure of time is equally related to every locality. By its very nature, Cosmic Time, or by whatever name it may be known, must coincide with some one of the multiplicity of existing times. The decision of the Washington Conference caused it to correspond with Greenwich Civil Time. Greenwich time is the local time of Greenwich. Cosmic Time is a new and an entirely different conception; it is the time of the world common to every nation. "Cosmic" and "Greenwich" time are identical fortuitously, but the expressions imply two totally different ideas, and a proper deference to national sensitiveness suggests the good taste and expediency of distinguishing the two ideas by different terms. Some distinctive name is undoubtedly called for, until the

* The Nautical Almanac defines an ordinary solar day to be the interval of time between the departure of *any meridian* from the sun and its succeeding return to it.

period arrives when the unification of time will be complete. In the not far distant future it may become equally as unnecessary to speak of "Solar," "Lunar," "Astronomical," "Civil," "Nautical," "Local," "Cosmic," or "World" time, as at present it is unnecessary to attach these or other distinctive appellations to "Space." The simple expression "Time" may then become sufficient for all purposes.

1 Longitude east and west from Greenwich.	2 Longitude west from time zero.	3 Longitude by hour meridians.	4 Cosmic Time at mean solar passage.
°	°	*Number.*	*Hour.*
180 antiprime meridian..	*	0	Change of the day.
165 east..................	15	1	1
150 east..................	30	2	2
135 east..................	45	3	3
120 east..................	60	4	4
105 east..................	75	5	5
90 east..................	90	6	6
75 east..................	105	7	7
60 east..................	120	8	8
45 east..................	135	9	9
30 east..................	150	10	10
15 east..................	165	11	11
0 the prime meridian ..	180	12	12
15 west..................	195	13	13
30 west..................	210	14	14
45 west..................	225	15	15
60 west..................	240	16	16
75 west..................	255	17	17
90 west..................	270	18	18
105 west..................	285	19	19
120 west..................	300	20	20
135 west..................	315	21	21
150 west..................	330	22	22
165 west..................	345	23	23
180 antiprime meridian ..	360 and 0	0 and 24	24 and change.

* Zero of Cosmic Time and of Longitude.

The relation between time and longitude is important. If longitude be reckoned by hour meridians, as in the second and third columns of the table, that is to say, numbered continually westward from the Antiprime Meridian, which is the true time zero, the inhabitants of every individual locality in whatever longitude will daily have an opportunity of regulating time by the great natural standard of measurement. The longitude of the locality being known, at mean solar passage the time will invariably and precisely agree with the longitude. Conversely, the time being known, the longitude of the place will be in strict agreement with time at the moment of mean solar passage.

A reference to the following plate will make it clear that the solar passage will be the invariable index of Cosmic Time.

Fig. 1 shows the relative position of sun and earth at the initial instant of the Cosmic Day, that is, at the moment of mean solar passage on the Antiprime Meridian adopted by the Washington Conference.

Fig. 2 gives the position when the earth has made a sixth of a revolution and four hours have elapsed. The solar passage at this stage is on the four-hour meridian.

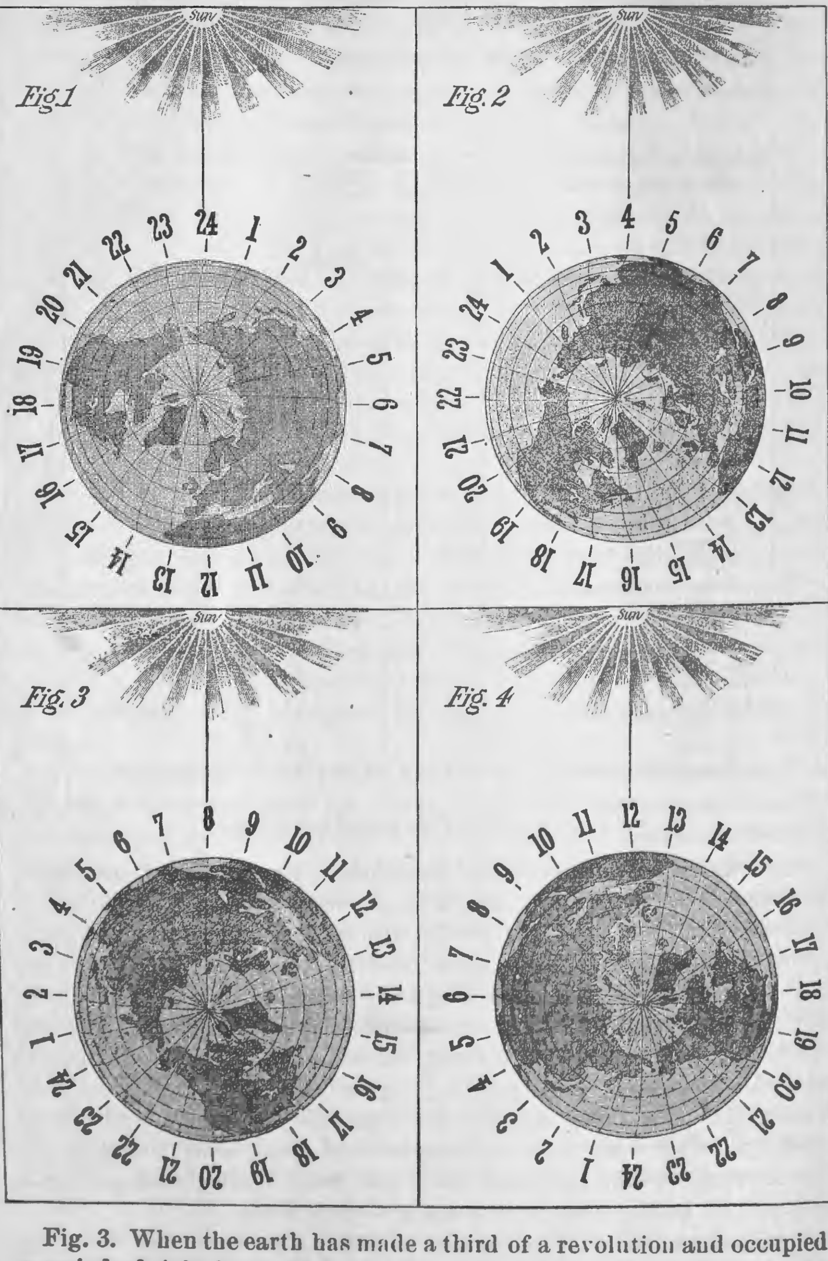


Fig. 3. When the earth has made a third of a revolution and occupied a period of eight hours, the solar passage occurs on the eight-hour meridian.

Fig. 4. When the earth has made half a revolution and twelve hours have elapsed, the solar passage is at this stage on twelve-hour or Prime Meridian.

Similarly for every other meridian, and thus the precise relation between Cosmic Time and longitude is definitely established.

It may be said that Cosmic or Universal Time is accepted in science, but its adoption in ordinary life can only be gradually and perhaps with difficulty effected. It is not to be looked for that a change so marked, involving a revolution of thought in some of our social customs, can be speedily introduced, however desirable it may be in the public interest. There is a class of men who habitually express their contempt for what they designate as "new-fangled notions," and who refuse to go out of sight of old land-marks. The usages which we desire to supersede are certainly old, for they took their origin when our civilization was young. In those days it was a dogma that the earth had a flat surface, but as the belief that the earth is a plane is no longer invested with the authority of a truth, we may venture to call in question the theory that each locality on its surface possesses an independent stream of time and is called upon to defend and maintain it. The human race is no longer confined within a narrow area. It has overspread the surface of the earth; in the Old and New Worlds it has grown, in some portions of their extent it is still growing, from an infantile condition to a state of manhood. Are we not yet able to look beyond one individual horizon and enlarge our range of vision so as to include a system which will satisfy the requirements, not of a locality, but of the whole globe?

We are living in an age of intellectual and social progress, when men are less fettered than our fathers were by the restraints of custom. On the continent of North America extraordinary progress has already been made by an essentially practical people towards the adoption of a complete reform in time-reckoning. What is known as the Standard-hour system, in itself in complete harmony with the principles of Cosmic Time, has been in common use for nearly three years, and it is generally recognized as an incalculable benefit to the whole community.

Throughout the United States and Canada we have outgrown the notion of isolating each locality by compelling it to observe a separate time notation. The Continent is divided into zones, each zone having the same time throughout its extent, based on a meridian which is a multiple of fifteen degrees from the Prime Meridian. Consequently the time of each zone varies exactly one hour from that of the adjoining zones. Thus all the variations of time which formerly were limited only by the number of towns and cities and localities which observed their own local time are reduced to the five zones. Only at points where the zones come in contact is there any exception to the common satisfaction which has resulted from the change. These are the only localities where we find the old-time difficulties, now so happily removed from every other section of the Continent. At such localities the difficulties must continue to be felt until Cosmic Time comes into general use, for it is the only one remedy which can satisfy every requirement.

The Standard-hour system is an effective preliminary means for the introduction of universal time, and it is not confined to North America. In Sweden, as well as Great Britain, the principle is in common use. The Standard Time of Sweden is based on the meridian fifteen degrees east of the prime meridian; consequently an hour in advance of the Prime Meridian time. The time of Great Britain is that of the prime meridian itself.

The scheme of hour meridians can only be regarded as a provisional arrangement. It greatly lessens the difficulties experienced, but it does not wholly remove them. It is, however, an important practical step towards the general unification of time, as it brings the minutes and seconds into complete agreement with the world's time wherever the system is adopted. The Astronomer Royal of Great Britain calls particular attention to the breadth of view evidenced by the managers of the American railways who were so largely instrumental in having this important step taken. "By adopting a national meridian as the basis of their time-system they might have rendered impracticable the idea of a universal time to be used by Europe as well as America. But they rose above national jealousies and decided to have their time-reckoning based on the meridian which was likely to suit the convenience of the greatest number, thus doing their utmost to promote uniformity of time throughout the world by setting an example of the sacrifice of human susceptibilities to general expediency."

There is one feature of time-reform alluded to by President Arthur in his message to Congress which promises before long to be accepted by the community. I refer to the proposal to count the hours from zero to twenty-four. The recent report of the special committee on Standard Time of the American Society of Civil Engineers (January, 1886) thus alludes to this branch of the subject:

"This feature has the authority of the International Conference for its introduction. In intelligent circles in Europe, particularly in England and in Russia, also at the antipodes in Australia, the proposal is reported to have been greeted with enthusiasm. The Astronomer Royal of England, Mr. Christie, has established at Greenwich Observatory a division of the great dial into twenty-four hours. In London and in other cities, public clocks have been also changed to accustom the English public to this division of the day. Some newspapers in all their announcements adopt the change, and scientific societies give notce of their meetings in the same manner as this Society, according to the twenty-four-hour system.

"On this Continent there has been no uncertain sound. In the last annual report of the Committee it was stated that one hundred and seventy-one managers of railways in the United States and Canada had declared their readiness to abandon the division of the day into half-days, known as *ante* and *post* meridian, and to accept the numeration of the hours in one series, from midnight to midnight, these managers having under their control some 60,000 miles of railway.

"During the past year the seed sown has been fructifying, and many who held back have been won over and have given their adhesion to the movement. Among the many important railways ready to co-operate, some appear to see no necessity for further delay, and desire to secure at once the advantages which will result from the change. At this date it is publicly announced that the Canadian Pacific Railway Company have determined to adopt the 24-hour system, and are actually preparing to make the change at an early day.* Such proceedings can be accepted as indicating a proper appreciation of the reform which the American Society of Civil Engineers has advocated, and equally shows the discernment of those who direct the management of the youngest of the transcontinental railways. This practical commencement will, without a doubt, be speedily followed by other railway companies, and before long we may look for the 24-hour system coming into general use.†

There is undoubtedly a growing feeling in many quarters in favor of the 24-hour system. It is reported to be used with great advantage on the whole of the cables and other lines of the Eastern Telegraph Company, and its connections extending from England through Europe and the Mediterranean to Egypt, and from Egypt to South Africa, India, China, and Japan, Australia, and New Zealand.

It is a pertinent question to ask, what influence these various changes will have in preparing the public mind for another, and it may be said a final, change—the adoption of one uniform time in every longitude? For it must be evident to the thoughtful observer that the movement

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* At midsummer, 1886, the Canadian Pacific Railway was opened from the Atlantic to the Pacific and the 24-hour system went into force in running "through" trains. The example set by the railway company has been followed in the towns and villages along the line, and the inhabitants generally having experienced the advantages of the change, no desire is expressed in any quarter to return to the old usage.

†The following foot-note is added: "It is proposed to adapt clocks and watches now in use to the change, by having inscribed on the existing dials the new numbers of the afternoon hours—thirteen to twenty-four (13 to 24) inclusive. The only practical difficulty to be overcome is met by the simple expedient of placing on the face of the watch or clock a supplementary dial, showing the new afternoon hours in Arabic numerals within the present Roman figures. The supplementary dial must be of thin material, and it has been found that, by being made simply of paper and secured to its position by any gum which will adhere to an enammeled surface, the object is attained without any further alteration of the watch or clock. The committee is aware that these seem trifling matters to bring under the notice of the convention, but questions of great moment not seldom hinge on small details. It is evident, from what has been set forth, that every person in the community may, at the cost of a few cents in each case, adapt his watch to the 24-hour system. The committee accordingly repeat their conviction that, with the disappearance of the only practical difficulty at an insignificant cost, there is nothing to prevent the railway authorities and the community at large adopting the change as soon as they become alive to its advantages."—Report of the Buffalo Convention of the American Society of Civil Engineers.

for reforming our time-system will not have attained its object until this end be accomplished.

Those persons who have been in the habit of finishing their daily work at 6 p. m. under the 24-hour system will end it at 18. Those who retired to rest at 10 or 11 p. m. will seek their beds at 22 or 23. The idea that solar noon and 12 o'clock are one and inseparable has already been set aside throughout the United States and Canada; only on five meridians—the 60th, 75th, 90th, 105th, and 120th—is it held to be 12 o'clock at the mean solar passage. In all other longitudes throughout North America the identity between solar noon and 12 o'clock has practically been swept away.

These modifications in the time reckoning must tend to remove the idea that there is some necessary connection between the numbers of the hours and the position of the sun in each local firmament. The force of habit has heretofore associated noon with 12 o'clock, but in due time it will become obvious to every one that the hour of the sun's passage at any one locality may with as much propriety be distinguished by any one of the twenty-four numbers as by the now generally received number 12. So soon as this new idea comes generally to be accepted, so soon as it is understood that the numbers of the hours are arbitrary and conventional, it will not be difficult to take the final step in time reform and entirely supersede the present system by a notation which will give to mankind throughout the world simultaneous dates and hours and minutes.

The final step may appear to involve serious changes in much which concerns every individual, but it is not to be supposed that it will in any way interfere with the periods for labor, sleep, meals, or any ordinary usage. The one change will be in the numbers of the hours. In social affairs the regulating influence of daylight and darkness will always, as now, be paramount. The terms "noon" and "midnight" will continue to preserve their present meaning, although the numbers of the hours at which these periods occur will vary in each case according to longitude. Each separate meridian will have its own midnight hour distinguished from the midnight hours of other meridians by a distinctive number. So also with the noon hour, which, as already stated, will invariably agree with the longitude of the place. It is the midnight hour in each locality which will constitute the initial time-point to regulate the legal hours for opening and closing banks, registry, and other public offices. The midnight hour may be arbitrarily chosen and be established by statute as circumstances may demand. It will be held to be the local zero to govern the hours of business, working hours, the hours for attendance at church, at school, and at places of amusement, and generally to regulate all the social affairs of life. While the seven week days will practically remain unchanged in every longitude, the simple expedient of numbering the hours so that everywhere they will correspond with Cosmic Time will result in securing the general uniformity to be desired. Thus it will be obvious that in all matters relating to time, whether local or non-local, the same hours, minutes, and seconds will universally be observed at the same instant. In cases when business men separated by long distances make contracts by telegraph, the engagements will be free from all ambiguity as to time. Both parties will be bound absolutely by the same notation.

The Cosmic Day is a new measure of time entirely non-local. It will be held to be the date of the world, and the change of date will occur at the same instant in all longitudes. On the prime meridian the change of date will be at midnight; to the east it will occur after midnight; and to the west of the prime meridian it will come before midnight. It will be one hour before or after midnight for every fifteen degrees of west or east longitude. Fortunately, in nearly all the important countries on the surface of the globe, the change of date will occur out of ordinary business hours.

It will thus be seen that while the contemplated reform will interfere as little as possible with existing customs, it will result in giving to the human family around the globe concurrent dates and in making every division of time uniform the world over.

In the adoption of the new system, temporary inconvenience may arise, but it will be trifling in extent and not of long duration; and any momentary disadvantage should not be allowed to weigh against the benefits to be secured to mankind for all future ages.

On the night of November 18, 1883, a noiseless revolution was effected throughout the United States and Canada. The hands of the clocks of some fifty millions of people were for the most part moved forward or backward in order to indicate the time of one of the five hour zones. The time now observed from the Atlantic coast to the Pacific varies with Cosmic Time, according to situation, from four to eight whole hours. In North America, therefore, the portion of the problem yet to be adjusted is easy of solution. As the minutes and seconds are already everywhere in agreement, the transition to universal uniformity of reckoning can be effected simply and with ease. It will only be necessary to move forward the dial hands of the clocks an even number of hours, varying from four to eight, as each case may require, to bring the Continent into complete accord with the time of the world.

When eventually it may become necessary to bring the time throughout all parts of North America to the world's standard, the transition may be effected by adjusting the clocks as follows:

I. *Clocks in the hour zones of the west meridians.*

Meridian west.		Hours.
60°	will have to be moved *forward*	4
75°		5
90°		6
105°		7
120°		8

Similarly wherever the scheme of hour meridians be adopted the common reckoning may with equal ease be secured. To the west of the prime meridian the clocks will require to be moved forward, to the east backward. In Europe, Asia, and Africa the change would thus be effected:

II. *Clocks in the hour zones of the east meridians.*

Meridian east.		Hours.
15°	will have to be moved *backward*	1
30°		2
45°		3
60°		4
75°		5
90°		6

Thus, for example, New Orleans, in the hour zone of the 90th meridian west, would have its clocks advanced six hours, while Calcutta, in the 90th meridian east, would have its clocks retarded six hours. By the same simple process of transition, every city and district on the surface of the globe may be brought to the one common time-reckoning.

It is a significant fact that at the Washington Conference the principle of Universal Time obtained unanimous recognition from the delegates of so many nationalities. It is a presage that the peoples whom they represent will before long be fully impressed with the belief that a system of reckoning time uniformly throughout the globe is really the one rational system by which it can be noted, and the only system which will meet the demands of the human family in coming years. It is only step by step that a reform so great can be carried out. Moreover, although the difficulties to be overcome are undoubtedly serious, this much may be said with confidence, that they are less formidable than those which have already been conquered. A few years back the very question of a universal time for all nations was a theory not only new in itself but it was held by many to be wild and Utopian, and so impracticable as to be unworthy of consideration. In 1878 the subject could not command a hearing at the British Association! Since 1878 the arguments advanced to point out the necessity of change have, however, obtained attention, and a general movement for reform has been inaugurated. Scientific and practical men and learned societies in both hemispheres have taken part in the consideration of the question. It has formed the subject of discussion at International Congresses at Venice and Rome. The President and Congress of the United States have been induced to take decisive action in connection with it. The governments of twenty-five civilized nations have aided in its development. The International Washington Conference itself has greatly promoted the solution of the problem by coming to an unanimous determination on the essential principles to be observed. In several countries the recommendations of the conference have already in part been acted on, and changes have been effected which a few years back were not even dreamed of.

If so much has been accomplished within the eight years since the scheme of reform was first promulgated, is it too much to expect that the public mind will be prepared in the more advanced communities to accept the final step in a like period?

In about a dozen years we pass into another century. Is it taking too sanguine a view to suggest that by that time all nations will be willing to accept the change, and that the first day of January in the Twentieth Century may appropriately be inaugurated by the adoption of one uniform system of reckoning time throughout the world?

I learn from the recent lecture of the Astronomer Royal that the Board of Visitors of Greenwich Observatory have unanimously recommended that, in accordance with the resolutions of the Washington Conference, the Astronomical day should in the English Nautical Almanac be arranged from the year 1891 (the earliest practicable date) to begin at Greenwich midnight, so as to agree with the civil reckoning, and further that steps have been taken to give effect to this recommendation; thus in a few years this source of confusion to sailors navigating ships using the Nautical Almanac—embracing at least 70 per cent. of the tonnage of the world—will be removed. The distinguished Russian Astronomer, Struve, has suggested that all astronomers throughout the world should simultaneously abandon Astronomical Time and bring their notation into harmony with the civil reckoning. He further suggests that this reform should be introduced into the publications of observatories at the initial day of the century. In reference to this the Astronomer Royal, Greenwich, says (October, 1885) "it would be intolerable to have a fundamental question of time-reckoning left open for fifteen years," and urges that the step be taken ten years earlier. Be that as it may with regard to the assimilation of the astronomical and civil notations no one can question that the change of the century is an appropriate period for effecting the complete unification of time, and doing away with all the errors of our present mode of reckoning. Every auxiliary circumstance points to the possibility of that result being attained. The proceedings of the Washington Conference have given the movement an immense impulse. Its members have authoritatively recognized the principles on which the new notation may be established. So unimpeachable and simple are these principles as to be within the grasp of the most limited comprehension. In their application we may have to contend against the prejudices engendered by habit and custom, but the principles of reckoning time adopted by the conference are based on truth and they commend themselves to every one of intelligence, as the proper means to meet the admitted emergency. The unanimity with which the standard hour system was brought into common use in North America is an evidence that the age is sufficiently intelligent to adopt a reform when its advantages are understood. It will doubtless require the lapse of some years to win over those who feel it to be a bounden duty to cling to old institutions and existing customs. Gradually, however, the minds of the great mass of men will become familiarized with the new ideas and in the end the new system of notation can not fail to prevail. The main obstacles to be overcome are the restraints which tradition imposes and the usages which our ancestors have transmitted to us. But prejudices of this character can be gradually and certainly surmounted, if the true principles of time-reckoning be taught in schools and colleges. In a few years the youth of to-day will be moving actors in life, to influence public opinion and so effect an easy escape from the thraldom of custom. We have therefore good grounds for the belief that, by the dawn of the coming century, the civilized nations may enjoy a system of notation limited to no locality; when the record of the events of history will be unmarked by doubt; when ambiguity in hours and dates will be at an end; when every division of time will be concurrent in all longitudes.

These expectations realized, the Washington Conference will have rendered a great service to mankind. If the reforms of B. C. 46 and A. D. 1582 owed their origin to the dominant necessity of removing confusion in connection with the notations which existed in the then conditions of the human race, in no less degree is another reform demanded by the new conditions which are presented in this age. Obviously the needed change could not be consummated at a more suitable period than at the beginning of the new century, but whether effected at that or an earlier date, a provision is made for the change in the conclusions and recommendations of the Washington Conference—a conference which, representing all civilized nations and having established the fundamental principles of the new notation, must be held by future generations to mark an epoch in the annals of the world not less important than those of the reforms of Julius Cæsar and Pope Gregory XIII.

SUPPLEMENTARY NOTE.

TIME RECKONING FROM THE PROCEEDINGS OF THE CANADIAN INSTITUTE 1878-'79.

(*Extract.*)

Persons who inhabit different sections of the earth differ from each other in their reckoning of the day. At one place it is noon, at another it is midnight; at a third it is sunrise, at a fourth it is sunset. In consequence we have the elements of confusion, which involve in some cases the mistake of a whole day.

People even living in the same meridian may differ a day in their usual reckoning of time, according as the countries they inhabit have been colonized from the one side or the other of the globe. There are instances in the Pacific Ocean where islands almost adjacent reckon by different days of the month and week; a circumstance calculated to produce much confusion when intercourse becomes frequent.

In Alaska the days of the week and month were one day in advance of those in the adjacent colony of British Columbia, indeed of the whole of America. On the advent of citizens of the United States a few years ago, when that territory was transferred by Russia, the Saturday was found to be the Sunday of the old residents. For ordinary business purposes a change became necessary, and a dispensation was granted in 1871 by the dignitaries of the Greek Church in Russia, authorizing their missionaries and adherents in Alaska to celebrate Sunday a day later, or on Monday, according to the old reckoning.

The reverse has been met in another quarter of the globe. The Philippine Islands, lying between Australia and Asia, and about 100 degrees of longitude to the west of Alaska, were discovered in 1521 by the illustrious Magellan in his memorable first circumnavigation of the globe. That navigator followed the sun in his path around the world. Legáspi succeeded him and took possession of these important islands in the name of Philip II, King of Spain. The Philippine Islands extend for a thousand miles from north to south, they embrace Manilla, one of the oldest cities of the Indies, and they contain a population of 5,000,000. They were colonized, as well as discovered, by Spaniards coming from the East, and as a consequence the reckoning of the inhabitants has for more than three centuries remained a day behind the day in British India and the neighboring countries in Asia.

Travelers who arrive at New Zealand or the Australian colonies by the San Francisco route meet the same difference, owing to the fact that the countries in the South Pacific were colonized from the West. The day of the week and of the month carried from San Francisco never agrees with the day and date reckoned by the inhabitants at the destination of the steamer.

All travelers who have made the voyage between America and Asia have experienced the difficulty in reckoning referred to. Those who have proceeded westward have lost, while those who have traveled eastward have gained a day. In Mrs. Brassey's Around the World in the Yacht *Sunbeam*, this experience is recorded. The journal of that lady passes from Wednesday, January 10, directly to Friday, January 12—Thursday, January 11, having no existence with the travelers.

In sailing across the Pacific from west to east, one day has to be repeated before landing on the American coast. If, for example, the correction be made on Wednesday, 1st July, there will be two Wednesdays in the one week, and two days of the month dated July 1.

A journey round the world is now an everyday undertaking, and is accomplished with comparative ease. Suppose two travelers set out from a given place, one going eastwardly, the other westwardly. A singular circumstance will result when they both return to the common starting point, and the reason is obvious. One man will arrive, according to his reckoning, say on Tuesday, December 31, when in fact at that locality it is Wednesday, January 1. The other traveler, assuming that he has kept accurately a daily journal, will enter in his diary on precisely the same day, Thursday, January 2. This consequence has been brought out by Edgar Allen Poe, in his amusing story of "Three Sundays in one Week," but it no longer can be held to be an imaginary contingency, since steam communication by land and water is now affording extraordinary facilities for making the tour of the globe.

To illustrate the difficulty more particularly. First, let us select points in four quarters of the globe, each about 90 degrees apart, say in Japan, Arabia, Newfounda nd, and Alaska. If we assume it to be Sunday midnight at the first-mentioned place, it must be noon at the opposite point, Newfoundland, but on what day is it noon? Arabia being to the west of Japan, the local time there will be 6 p. m., on Sunday, and Alaska, lying to the east of Japan, the time there will be 6 a. m. on Monday. Again, when the clock indicates 6 p. m. on Sunday in Arabia, it must be Sunday noon at a point 90 degrees farther west, or at Newfoundland; when it is 6 a. m. on Monday in Alaska, it must be noon on Monday 90 degrees farther east, also at Newfoundland. Thus, by tracing local time east and west from a given point to its antipodes, the clock on the one hand becomes twelve hours slower, on the other hand twelve hours faster. In the case in point, while it is midnight on Sunday in Japan, at precisely the same moment it is noon at Newfoundland on two distinct days, viz, on Sunday and on Monday.

Secondly, let us trace local time only in one direction around the earth. The day does not begin everywhere at the same moment. Its commencement travels from east to west with the sun, as the earth revolves in the opposite direction, and it takes an entire revolution of the globe on its axis for the day everywhere to be entered on. Immediately on the completion of one revolution the inception of any one day ends, and at this moment the end of the day begins; and the globe must make another complete revolution before the end of the day entirely finishes. The globe must in fact make two entire revolutions before any one week day runs out, consequently each and every day of the week runs over forty-eight hours; and, taking the whole globe into account, two civil days always co-exist. The first twenty-four hours of one day co-exist with the last twenty-four hours of its predecessor, while the remaining twenty-four hours co-exist with the first twenty-four hours of the day which follows.

It is difficult to accept the fact that any one day lasts more than twenty-four hours; but it can be demonstrated that it is the case. Let us place together several maps of the world on Mercator's "Projection," so as to represent, in consecutive order, each part of the earth's surface as it passes the sun during several diurnal revolutions. (See plate).

AA^1, A^1A^2, are intended to represent each a complete map of the world. Within each of these limits every place on the earth's surface is brought under the sun during a daily revolution.

The vertical lines $E\ I\ N\ R\ V$ represent meridians, for the sake of simplicity selected 60 degrees apart, and the stars or dots at their intersection denote the beginning and end of a day on each of the six meridians. As the earth revolves, the sun passes successively the meridians of those localities, with an interval of four hours elapsing between each.

Let us assume it to be 12 o'clock midnight on Thursday at meridian A. At that moment and at that place Friday begins and runs for twenty-four hours, or on the diagram from A to A^1.

Four hours later Friday begins on meridian E, and runs four hours on the second map, or into the second revolution of the earth. Four hours still later Friday begins on meridian I and runs eight on the second map or into the second revolution. This goes on from spot to spot, until at last the commencement of Friday reaches the last meridian, and at that point Friday runs entirely across the second map to A^2. Thus Friday begins at A, runs during two complete revolutions of the earth, as shown on the map from A to A^2.

The diagram will thus illustrate the duration of every day in the week, and it becomes obvious, when we take a general view of the whole globe on any given day, say Saturday, that day begins in the middle of Friday and does not end until the middle of Sunday. Friday, on the other hand, beginning in the middle of Thursday, runs into the middle of Saturday, while Sunday commences at the moment Friday ends. To state the case differently: the same moment of absolute time which is part of Saturday in one place, is equally part of Friday and of Sunday in some other places east and west.

It is a preconceived idea with many that there is a simultaneons Sunday over the earth, and that Christians in every meridian keep the Lord's day at one and the same time. Facts, however, establish that this is a mistake. From its first commencement to its final ending, the Sunday extends over forty-eight hours. Indeed, if we take into account the remarkable circumstance mentioned with regard to Alaska and the Philippine Islands, Sunday has been discovered to run over some fifty-five hours. The same may be said of any day in the week; and as a consequence we have, taking the whole globe into view, Saturday and Monday running over the intervening Sunday to overlap each other about seven hours. We have, in fact as a constant occurrence, portions of three consecutive days co-existent.

From the fact that not only are the hours of the day different in every meridian, but that different days are constantly in progress on the face of the globe, it is a difficult matter under our present system of reckoning to assign relatively the hour and

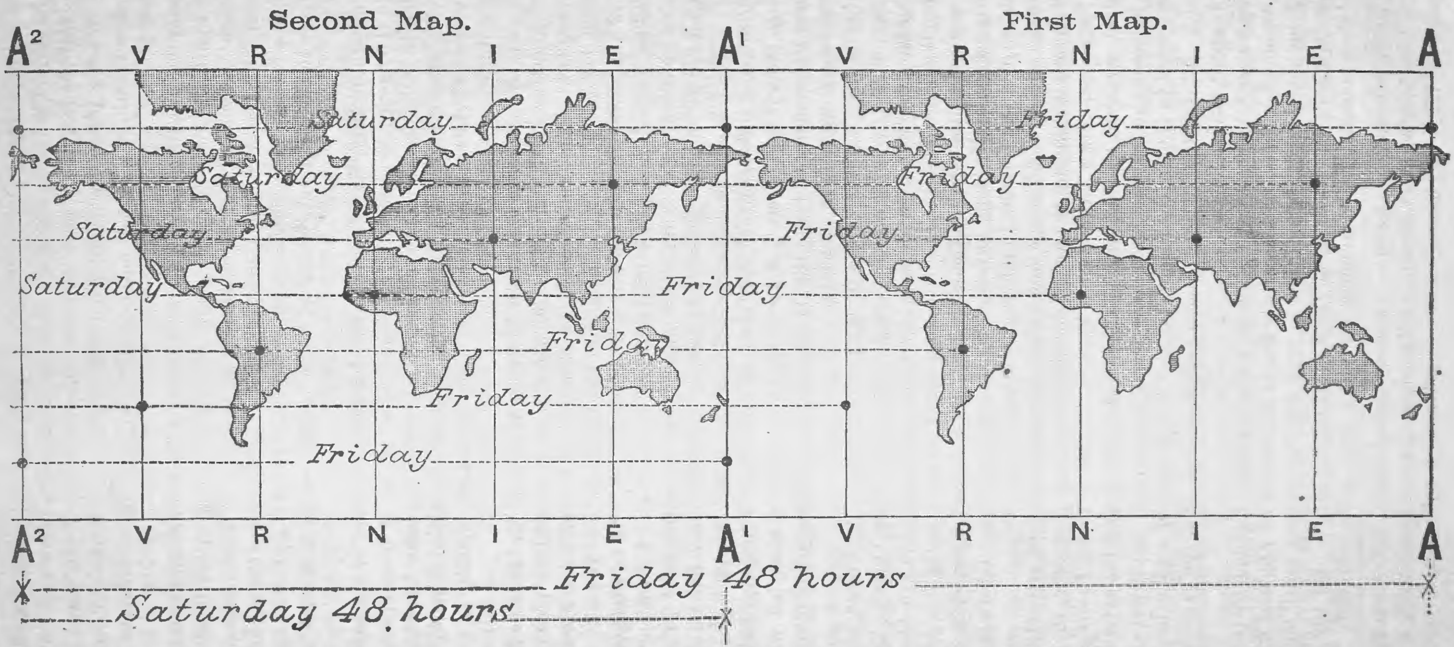

Diagram to illustrate the progress and duration of the days of the week around the globe.

day when events take place. We may learn of an occurrence, and the time assigned will be correct in the meridian of the locality. Everywhere else it will be inaccurate. Indeed, if the fact of the occurrence be transmitted over the world by telegraph, it may, in some places, be recorded on different days.* If the incident occurs at the close of a month, or a year, it may actually take place in two different months, or two distinct years.

Under our present system it is quite possible for two events to take place several hours apart, the first and older occurring in the new year in one locality; the second, although the more recent in absolute time, falling, in another locality, within the old year. The same may be said of events that occur during the period which elapses when one century merges into another. In one part of the globe the same event may transpire in the nineteenth century, while in another it falls within the twentieth century.

Another difficulty, forced on the attention by the science of the century, is mainly due to the agency of electricity, employed as a means of telegraphy, and to steam applied to locomotives. These extraordinary sister agencies having revolutionized the relation of distance and time, having bridged space, and drawn into closer affinity portions of the earth's surface previously separated by long and, in some cases, inaccessible distances.

Let us take the case of a traveler in North America. He lands at Halifax in Nova Scotia, and starts by a railway to Chicago through the eastern portions of Canada. His route is over the Intercolonial, the Grand Trunk, and other lines. He stops at St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, and Detroit. At the beginning of the journey he sets his watch by Halifax time. As he reaches each place in succession, he finds a considerable variation in the clocks by which the trains are run, and he discovers that at no two places is the same time used. Between Halifax and Chicago he finds the railways observing no less than seven different standards of time. If the traveller remains at any one of the cities referred to, he must alter his watch to avoid inconvenience, and perhaps not a few disappointments and annoyances to himself and others. If, however, he should not alter his watch, he would discover on reaching Chicago that it was an hour and thirty-five minutes faster than the clocks and watches in that city.

If his journey be made by one of the routes through the United States, the variation in time and its inconveniences will not be less. If he extends his journey west of Chicago, traveling from place to place until he reaches San Francisco, he will meet continual change, and finally discovers a loss in time of nearly four hours (3h. 56m.). Between the extreme points there are many standards of time, each city or place of importance generally being governed by its own meridian. Hence the discrepancies which perplex the traveler in moving from place to place.

On the continent of Europe, and indeed wherever lines of communication extend between points differing to any considerable extent in longitude, the same difficulty is experienced. On a journey from Paris to Vienna or to St. Petersburg, the standard time employed by the railways changes frequently, and the extreme difference in time between the first and last city is nearly two hours. As railways and telegraphs are extended in Russia, the inconveniences will become of serious importance in that country. Within the limits of Russia in Europe and Asia, the extreme variations of time is about twelve hours.

Suppose we take the case of a person traveling from London to India. He starts with Greenwich time, but he scarcely leaves the shores of England when he finds his watch no longer right. Paris time is used for the journey until that of Rome becomes the standard. At Brindisi there is another change. Up the Mediterranean ships' time is used. At Alexandria Egyptian time is the standard. At Suez, ships'

* TIME AND THE TELEGRAPH.—A message dated Simla, 1.55 a. m. Wednesday, was received in London at 11.47 p. m. on Tuesday. As the clerk said, with pardonable confusion, "Why, this message was sent off to-morrow."—*Times.*

time is resumed, and continues, with daily changes, until India is reached. Arriving at Bombay, the traveler will find two standards employed, local time and railway time, the latter being that of Madras. If he has not altered his watch since he left England, he will find it some five hours slow. Should he continue his journey to China, it will have fallen eight hours behind.

In the United Kingdom the difficulties due to longitude are only felt in a modified form. The greater island, embracing England and Scotland, is comparatively limited in width; one standard of time is therefore used. It is only in respect to the sister island, Ireland, that the difference in longitude calls for a difference in time. In the whole United Kingdom, consequently, there are practically only two standards, viz, Greenwich time and Irish time, the difference being twenty-five minutes. No one, therefore, whose experience has been confined to the United Kingdom, can form an adequate idea of the extent of the inconvenience arising from the causes alluded to, where geographical circumstances render necessary the use of a multiplicity of standards.

The railway system is the principal agent in the developing of the difficulties referred to, and the still further extension of steam communications in great continental lines is forcing the subject on public attention. Canada supplies a good illustration of what is occurring. The railways built and projected will extend from the eastern coast of Newfoundland on the Atlantic to the western coast of British Columbia on the Pacific, embracing about 75° of longitude. Every Canadian city has its own time. Innumerable settlements are now being formed throughout the country ultimately to be traversed by railways; and in a few years scores of populous towns and cities will spring up in the now uninhabited territories between the two oceans. Each of these places will have its own local time, and the difference between the clocks at the two extremes of Canada will be fully five hours. The difficulties which will ultimately arise from this state of things are apparent. They are already in some degree felt, they are year by year increasing, and will at no distant day become seriously inconvenient. This is the case not in Canada alone, but all the world over.

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The division of the day into two halves, each containing twelve hours, and each numbered from 1 to 12, is also a fertile source of error and inconvenience.

Travelers who have had occasion to consult railway guides and steam-boat time-tables will be familiar with the inconvenience resulting from this cause; none know better by experience how much the divisions *ante meridian* and *post meridian* have baffled their inquiries, and how often these arbitrary divisions have led to mistakes. Were it necessary, innumerable instances could be given. The evil, however, is one so familiar that it has come to be looked upon as unavoidable, and is, as a matter of course, silently endured.

The halving of the day has doubtless long been in use, but beyond its claim to antiquity, is a custom that confers not a single benefit, and is marked by nothing to recommend it.

SCHEME OF COSMIC OR UNIVERSAL TIME.

1. That a system of universal time be established, with the view of facilitating synchronous scientific observations, for chronological reckonings, for the purpose of trade and commerce by sea and land, and for all such uses to which it is applicable.

2. That the system be established for the common observance of all peoples, and of such a character that it may be adopted by each separate community, as may be found expedient.

3. That the system be based on the principle that for all terrestrial time-reckonings there be one recognized unit of measurement only, and that all measured intervals of time be directly related to the one-unit measure.

4. That the unit measure be the period occupied by the diurnal revolution of the earth, defined by the mean solar passage at the meridian twelve hours from the prime meridian established through Greenwich.

5. That the unit measure defined as above be held to be a day absolute, and designated a cosmic day.

6. That such cosmic day be held as the chronological date of the earth, changing with the mean solar passage at the anti-meridian of Greenwich.

7. That all divisions and multiples of the cosmic day be known as cosmic time.

8. That the cosmic day be divided into hours, numbered in a single series, one to twenty-four (1 to 24), and that the hours be subdivided, as ordinary hours, into minutes and seconds.

NOTE.—As an alternative means of distinguishing the cosmic hours from the hours in local reckonings, they may be denoted by the letters of the alphabet, which, omitting I and V, are twenty-four in number.

9. That until cosmic time be accepted as the recognized means of reckoning in the ordinary affairs of life, it is advisable to assimilate the system to present usages, and to provide for the easy translation of local reckonings into cosmic time, and *vice versa;* that, therefore, in theory, and as closely as possible in practice, local reckonings be based on a known interval in advance or behind cosmic time.

10. That the surface of the globe be divided by twenty-four equi-distant hour-meridians, corresponding with the hours of the cosmic day.

11. That, as far as practicable, the several hour-meridians be taken according to the longitude of the locality, to regulate local reckonings, in a manner similar to the system in use throughout North America.

12. That in all cases where an hour-meridian is adopted as the standard for regulating local reckonings in a particular section or district, the civil day shall be held to commence twelve hours before, and end twelve hours after, the mean solar passage of such hour meridian.

13. That the civil day, based on the prime meridian of Greenwich, shall coincide and be one with the cosmic day. That civil days on meridians east of Greenwich shall be (according to the longitude) a known number of hours, or hours and minutes, in advance of cosmic time, and to the west of Greenwich the contrary.

14. That the surface of the globe being divided by twenty-four equi-distant meridians (fifteen degrees apart) corresponding with the hours of the cosmic day, it is advisable that longitude be reckoned according to these hour-meridians.

15. That divisions of longitude less than an hour (fifteen degrees) be reckoned in minutes and seconds and parts of seconds.

16. That longitude be reckoned continuously towards the west, beginning with zero at the anti-prime meridian, twelve hours from Greenwich.

17. That longitude generally be denoted by the same terms as those applied to cosmic time.

REPORT ON ASTRONOMICAL OBSERVATORIES.

By George H. Boehmer.

INTRODUCTORY NOTE.

In the Annual Report of the Smithsonian Institution for 1879 Prof. E. S. Holden, then connected with the U. S. Naval Observatory at Washington, published a preliminary account of astronomical observatories, principally American, although reports of a few foreign observatories, translated from the "Vierteljahrsschrift der Astronomischen Gesellschaft," were incorporated.

In the beginning of 1880 a circular* was sent to the directors of observatories, requesting their co-operation in the continuation of the work. Professor Holden, however, having accepted a call to Madison, Wis., as director of the Washburn Observatory, the editing of the notes received was entrusted to the writer, and the result was published in the Smithsonian Annual Report for 1880 (pp. 623–739).

Since then, by correspondence, a large amount of material has been collected, and this is now presented, classified under the two heads: I. American observatories, and II. Foreign observatories. Notwithstanding, however, the care given by comparison with other works on the subject, such as "A. Lancaster, Liste Générale des Observatoires et des Astronomes," "U. S. Nautical Almanac," "Connaissance des Temps," "Astronomische Nachrichten," etc., the report is not regarded as complete; and the directors of the observatories and astronomers generally into whose hands the paper may come are earnestly requested to freely criticise it and to furnish the corrections and additions necessary to secure, for another year, a more correct and complete account of their respective observatories.

*Smithsonian Annual Report, 1880, p. 623.

I. AMERICAN OBSERVATORIES

Akron, Ohio.

Buchtel College Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director, ——.

Albany, New York.

Dudley Observatory.

Longitude from Washington, $13^m\ 12.87^s$ E.
Latitude, 42° 39′ 49.5″ N.
Directors: B. A. Gould, 1854.
O. M. Mitchel, 1859.
G. H. Hough, 1862.
L. Boss, 1875.

Founded in 1851, by subscription, the principal subscriber being Mrs. Blandina Dudley. Built in the form of a cross, with wings east and west for the meridian instruments. Finished in 1854, and inaugurated in 1856.

Alfred Center, New York.

Observatory of Alfred University.

Longitude from Washington, $2^m\ 55^s$ W.
Latitude, 42° 15′ 19.8″ N.
Instructors: Prof. A. B. Kenyon,
Prof. H. C. Coon.

The observatory has not been used for original research, but only for class instruction.

Allegheny City, Pennsylvania.

Allegheny Observatory.

Longitude from Washington, $11^m\ 50.84^s$ W.
Latitude, 40° 27′ 41.6″ N.
Director: S. P. Langley.

Founded in 1860, enlarged in 1873, and further enlarged in 1881. Equipped in 1867, principally through the liberality of W. Thaw, of Pittsburgh, to whom its subsequent accessions are also largely due. The dome, 22 feet in diameter, contains the equatorial.

The observatory in 1870, under its present director, inaugurated and carried into active operation the system of time service on a scale then, and probably still, as regards the systematic distribution of time to railroads, the most extensive in the country. The observatory is the standard of time for a large portion of the railroads connecting the Atlantic and the Mississippi. It is better known by its investigations in solar physics, to which the director has given his principal attention for the last ten years.

INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, TROUGHTON & SIMMS; aperture, 4 inches; magnifying power, 150 diameters.

(*c*) *Equatorial instruments:* Makers, FITZ, reworked by CLARK; aperture of objective, 13 inches; magnifying powers of eye-pieces, 50 to 1,200; equatorial carries a 12-inch flat mirror by CLARK at south end of its polar axis; also, position filar micrometer, polarizing solar eye-piece; apparatus for projecting solar image; eight other subsidiary pieces.

(*d*) *Spectroscopes:* One employing large RUTHERFURD grating; one with small grating; one 2-prism spectroscope; apparatus for using large equatorial as collimator, etc.

(*e*) *Photometers and other subsidiary apparatus:* A variety of thermopiles, used in connection with a THOMPSON reflecting galvanometer; large BUNSEN photometer; small portable heliostat, etc.

(*f*) *Chronographs:* One of BOND's pattern, built by HAMBLET.

(*g*) *Clocks:* Mean time; two by HOWARD, both break-circuit: sidereal; one by FRODSHAM, break-circuit.

(*h*) *Chronometers:* Mean time; one by FRODSHAM: sidereal; one FRODSHAM, break-circuit.

(*i*) *Miscellaneous:* One reflecting telescope of 6½-inch aperture, specially used for obtaining an image projected any size without the employment of any enlarging lenses; one Foucault siderostat and a large number of special pieces of apparatus for the study of radiant heat.

The observatory has never issued any regular series of annals; for abstracts of the results of its work reference must be made to the Comptes Rendus de l'Institut de France, to the Memoirs of the U. S. National Academy, to the pages of the American Journal of Science, of the Annales de Chimie et Physique, Wiedemann's Annalen, and to various foreign and domestic scientific journals.

Electric appliances for the distribution of exact time, automatically and continuously to points outside the observatory.

AMHERST, MASSACHUSETTS.

The Lawrence Observatory of Amherst College.

Longitude from Washington, $18^m\ 4.8^s$ E.
Latitude, $42°\ 22'\ 15.6''$ N.
Director: DAVID P. TODD.

ANN ARBOR, MICHIGAN.

Detroit Observatory.

Longitude from Washington, 26^m 43.1^s W.
Latitude, 42° 16′ 48″ N.
Directors : F. BRÜNNOW, 1854.
J. C. WATSON, 1858.
M. W. HARRINGTON, 1879.

Annex of the University of Michigan. Projected in 1852, commenced in 1853, completed in 1854. The principal structure is surmounted by a dome and has two wings. About thirty planetoids have been discovered here.

ANNAPOLIS, MARYLAND.

U. S. Naval Academy Observatory.

Longitude from Washington, 2^m 15.61^s E.
Latitude, 38° 58′ 53.48″ N.

Authority for longitude, U. S. Coast Survey; for latitude, Professor CHAUVENET.

Director: Lieut. Commander P. F. HARRINGTON, head of department of astronomy, navigation, and surveying.

The officers attached to the observatory are occupied in duties of instruction in the department of astronomy, navigation, and surveying. The instruments are used in the course of instruction, but regular ob servations are not made for purposes of astronomical investigation.

INSTRUMENTS:

(*a*) *Meridian circle:* One; maker, REPSOLD, Germany; diameter of circles, 30 inches; divided to 2′; read by 4 microscopes to 2″. Aperture of objective, 4 inches; for observations of the sun, aperture employed, — inches; magnifying power ordinarily employed, 80 diameters.

(*b*) *Meridian transit instrument:* Maker, WÜRDEMANN; aperture, 2 inches; magnifying power, 40 diameters.

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 7¾ inches; magnifying power of eye-pieces, 40, 106, 553, and 966; micrometer eye-pieces, 89, 226, 673.

(*f*) *Chronographs:* One MORSE fillet; one Transit of Venus Commission.

(*g*) *Clock:* One sidereal; makers, ARNOLD, CHAS. FRODSHAM, London.

(*h*) *Chronometers:* Five mean time; makers, NEGUS, Nos. 1030, 1088, 1260; DENT, 2,099; HATTON, 262: two sidereal; maker, NEGUS, Nos. 1520, 1527.

(*i*) *Miscellaneous:* One Talcott's zenith telescope (WÜRDEMANN); one Transit of Venus telescope (STACKPOLE); portable transit (WÜRDEMANN).

BALTIMORE, MARYLAND.

Denmore Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director: ——.

BARNESVILLE, OHIO.

Olney Observatory.

Longitude from Washington (about), 16^m W.
Latitude (about), 40° N.

Authority for longitude and latitude, A. von Steinwehr's map of Ohio.
Director: CHARLES E. GAUSE, Jr.

No systematic observations. Instruments used only for purpose of class instruction.

BATTLE CREEK, MICHIGAN.

High School Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director: ARTHUR K. BARTLETT.

INSTRUMENTS:

(*a*) *Meridian circle:* One; aperture of objective, 4 inches; for observations of the sun, aperture employed, 2 to 4 inches; magnifying power ordinarily employed, 75 diameters.

(*i*) *Miscellaneous:* The only instrument at present used in the observatory is a 4-inch achromatic telescope, which was purchased by the board of education about nine years ago, for the use of students and teachers in the high school. It was manufactured by PIKE, the New York optician, and is mounted upon a portable tripod stand, provided with all the necessary adjustments. For the general observations of astronomy it is regarded as one of the best telescopes in this State.

BELOIT, WISCONSIN.

Smith Observatory of Beloit College.

Longitude from Washington, ——.
Latitude, ——.
Director: ——.

BROOKLYN, NEW YORK.

I. *Private Observatory of Mr. W. T. Gregg.*

Longitude from Washington, ——.
Latitude, ——.
Director: W. T. GREGG.

(*c*) *Equatorial instrument:* Maker, WILLIAM T. GREGG; aperture of objective, 6¼ inches; magnifying powers of eye-pieces, 50 to 600.

II. *Private Observatory.*

Longitude from Washington, ——
Latitude, ——
Director: G. P. SERVISS.

INSTRUMENTS:

(*c*) *Equatorial instruments:* One telescope; maker, JOHN BYRNE, of New York; aperture of objective, $3\frac{3}{8}$ inches; magnifying powers of eye-pieces, 50, 106, 160, 250, and 320.

(*i*) *Miscellaneous:* The director remarks: "My telescope is mounted equatorially on a tripod stand. The objective is of excellent quality. I can see the companion of α Lyræ and both the debilissima in *epsilon* Lyræ with ease. It also easily separates double stars only 1.5″ apart. Under favorable circumstances I have seen five of Saturn's moons. I have no observatory, and my observations are made from lofty windows having a southerly and westerly exposure, and occasionally from the roof of my residence on Brooklyn Heights. In observing Jupiter and Saturn I ordinarily employ powers of 160 and 250, and occasionally 320. For special purposes I have used a power of 480 with good effect."

BUFFALO, NEW YORK.

I. *Private Observatory.*

Longitude from Washington, ——.
Latitude, ——.
Director: JAMES W. WARD.

INSTRUMENTS:

(*b*) *Meridian transit instrument.*

(*c*) *Equatorial instrument:* Maker, JOHN BYRNE, New York City; aperture of objective, 4 inches; magnifying powers of eye-pieces, 60, 80, 130, 200, 330, 400; useful with Barlow lens to 550.

(*h*) *Chronometer:* One mean time; maker, SAMUELS, Liverpool.

(*i*) *Miscellaneous:* DOLLOND, $1\frac{3}{4}$ inches, used roughly on alt azimuth swivel for southern transits, etc.

II. *Private Observatory.*

Longitude from Washington, $7^m\ 21.65^s$ W.
Latitude, 42° 54′ 9.5″ N.
Authority for longitude and latitude: Report for 1862 of the regents of University of State of New York.
Director: HENRY MILLS.

INSTRUMENTS:

(*c*) Telescope not equatorial; maker, BARDON; aperture of objective, 3 inches; magnifying powers of eye-pieces, 50 to 250.

CAMBRIDGE, MASSACHUSETTS.

I. *Private Observatory.*

Longitude from Washington, $23^m\ 41.26^s$ E.
Latitude, 42° 22′ 58.8″ N.
Director : E. L. TROUVELOT.

II. *The Astronomical Observatory of Harvard College.*

Longitude from Washington, $23^m\ 41.11^s$ E.
Latitude, 42° 22′ 48.3″ N.
Directors : W. C. BOND, 1839.
G. P. BOND, 1859.
J. WINLOCK, 1866.
EDWARD C. PICKERING, 1876.

Annexed to Harvard College; projected in 1815; ground acquired in 1842; instruments set up in 1844–'48; a central tower and dome, two wings, with a small dome on the western wing. Here it was that G. P. BOND discovered in 1848 the seventh satellite of Saturn (Hyperion), and in 1850 the dusky interior ring inside the bright rings of that planet. Among the chronographs, this observatory possesses the original instrument of W. C. BOND, mounted in 1850.

INSTRUMENTS:

(*a*) *Meridian circle:* Makers, TROUGHTON & SIMMS (glasses by ALVAN CLARK & SONS); diameter of circles, 36 inches; divided to 5′; each circle read by 4 microscopes to 0.1″; aperture of objective, 8¼ inches; for observations of the sun, aperture employed, 8¼ inches; magnifying power ordinarily employed, 300 to 350 diameters. (*a′*) East transit circle, by TROUGHTON & SIMMS; diameter of circles, 48 inches; divided to 5′; each circle read by 4 microscopes to 0.2″; aperture of objective, 4¼ inches.

(*b*) *Meridian transit instruments :* One made by HERBST, of Pulkowa; aperture, 2¾ inches; magnifying power, up to 200 diameters. (*b′*) Large photometer, mounted in the meridian, for comparing images of stars during transit.

(*c*) *Equatorial instruments :* One made by MERZ; aperture of objective, 15 inches; magnifying powers of eye-pieces, 100 to 2,000. (*c′*) West equatorial, by ALVAN CLARK & SONS; aperture, 5¼ inches.

(*d*) *Spectroscopes :* Three, described in vol. viii of the Annals of the Observatory.

(*e*) *Photometers and other subsidiary apparatus :* One ZÖLLNER photometer, and several photometers of other kinds.

(*f*) *Chronographs :* Two spring governors, by W. BOND & SON; one small barrel chronograph.

(*g*) *Clocks :* One mean time; maker, BOND, 394; one sidereal; makers, FRODSHAM, 1327; BOND, 312.

(*h*) *Chronometers:* Two sidereal; makers, FRODSHAM, 3451; BOND, 236; one thermometric chronometer, FRODSHAM, 3424.

(*i*) *Miscellaneous:* Comet-seeker and other small telescopes and apparatus.

CAMBRIDGEPORT, MASSACHUSETTS.

Private Observatory.

Longitude from Washington, $23^m\ 49^s$ E. (approximately).
Latitude, 42° 21′ 56″ N. (approximately).
Director: E. F. SAWYER.

CHICAGO, ILLINOIS.

Dearborn Observatory.

Longitude from Washington, $42^m\ 14.69^s$ W.
Latitude, 41° 50′ 1″ N.
Directors: T. H. SAFFORD, 1865.
ELIAS COLBERT, 1874.
G. W. HOUGH, 1879.

Annexed to the university. Founded by subscription in 1822.

INSTRUMENTS:

(*a*) *Meridian circle:* Makers, REPSOLD & SON; diameter of circle, 40 inches; divided to 2′; read by 4 microscopes to 0.1″; aperture of objective, 6 inches; for observations of the sun, aperture employed, 3 inches.

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 18½ inches; magnifying powers of eye-pieces, positive, 120, 190, 287, 385, 900; negative, 135, 225, 450, 900.

(*f*) *Chronograph:* G. W. HOUGH; cylinder recording.

(*g*) *Clocks:* One mean time; makers, HOWARD & CO.; GRAHAM escapement, mercury pendulum; one sidereal; makers, CHARLES GORTNER & CO., London; GRAHAM escapement, mercury pendulum.

(*h*) *Chronometer:* Sidereal; makers, BOND & SON.

(*i*) *Miscellaneous:* Signal mean time clock for transmitting time signals.

CINCINNATI, OHIO.

Cincinnati Observatory. (See *Mount Lookout.*)

CLINTON, NEW YORK.

Litchfield Observatory of Hamilton College.

Longitude from Washington, $6^m\ 34.65^s$ E.
Latitude, 43° 3′ 17″ N.

Authority for longitude and latitude: Longitude telegraphically determined from Cambridge, Mass. Latitude by stars in prime vertical.

Director: C. W. F. PETERS.

Founded in 1852 by subscription; completed in 1855; central edifice with wings east and west. Forty-two planetoids have been discovered here.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, W. WÜRDEMANN, Washington, D. C.; aperture $2\frac{1}{2}$ inches; magnifying power, — diameters.

(*c*) *Equatorial instrument:* One made by SPENCER & EATON; aperture of objective, $13\frac{1}{2}$ inches; magnifying powers of eye-pieces, 80 to 1600. (*c′*) One by STEINHEIL SONS; aperture, 4 inches. (*c″*) One by HUGO SCHRÖDER; aperture, 5 inches.

(*d*) *Spectroscope:* One direct vision 5 prisms; attached to the 4-inch STEINHEIL refractor.

(*f*) *Chronograph:* By WM. BOND & SON, Boston, Mass.

(*g*) *Clocks:* Mean time; makers, WM. BOND & SON.

(*h*) *Chronometer:* Sidereal; makers, WM. BOND & SON.

COLUMBIA, MISSOURI.

The Laws Observatory, University of the State of Missouri.

Longitude from Washington, $1^h\ 1^m\ 6^s$ W.
Latitude, 38° 56′ 51.5″ N.
Authority for longitude and latitude: JOSEPH FICKLIN and THOMAS J. LOWRY.
Director: JOSEPH FICKLIN.

During February and March, 1880, the old observatory building, which stood a few feet west of the main university edifice, was moved and enlarged. It now stands on the beautiful eminence in the campus near the chalybeate spring. The meridian line of each pier now passes between the university building and the president's mansion. In this position a good horizon is secured. In the old position the horizon was obstructed on the north by the scientific building, and on the east by the university building.

The old dome was found to be too small for the equatorial recently purchased, and a brick addition was made at the east end for the accommodation of this instrument. The whole building is 63 feet long from east to west, and fronts east.

The present greatly improved condition of the observatory is due to the liberality of the president, Dr. S. S. LAWS, who, for the advancement of astronomical science, has given to the university more than $2,000, in order to procure the telescope and put it in complete working order, and to move and enlarge the observatory building.

INSTRUMENTS:

(*a*) *Meridian circle*: One; maker, BRUNNER, of Paris; diameter of circle, $10\frac{1}{2}$ inches; divided to 5′; read by two microscopes to 3″; aperture of objective, $2\frac{1}{16}$ inches; for observations of the sun, aperture employed, $2\frac{1}{16}$ inches; magnifying power ordinarily employed, 50 diameters.

(*c*) *Equatorial instruments*: One made by HENRY FITZ, of New York; aperture of objective, $4\frac{1}{16}$ inches; magnifying powers of eye-pieces, 30 to 240; one made by MERZ & SON, of Munich; aperture of objective, $7\frac{1}{2}$ inches; magnifying powers of eye-pieces, 80 to 1018. This instrument is furnished with a micrometer, reflecting prisms and sun-shades. It is driven by clock-work. The hour circle is 10 inches in diameter. It is graduated on silver to single minutes, and read by two verniers to 4 seconds of time. The declination circle is 15 inches in diameter. It is graduated on silver to 10 minutes, and read by two verniers to 10 seconds of arc. The finder was made by ALVAN CLARK & SONS, of Cambridgeport, Mass. It has an aperture of $1\frac{7}{8}$ inches and a focal length of $17\frac{1}{2}$ inches.

(*g*) *Clocks*: One mean time; maker, RIGGS, of Philadelphia: one sidereal; makers, GREGG & RUPP, of New York.

(*i*) *Miscellaneous:* The instrumental equipment includes also a sextant made by E. & G. W. BLUNT, of New York; the arc is graduated on silver, and reads by a vernier and miscroscope to 10 seconds. An alt-azimuth instrument, made by E. & G. W. BLUNT; it has an aperture of $2\frac{1}{8}$ inches; the circles are 12 inches in diameter and graduated to 10 minutes; the horizontal circle has four verniers with microscopes and the vertical circle two, and each reads to 10 seconds. A Transit theodolite, made by GREGG & RUPP, of New York.

COLUMBUS, OHIO.

Private Observatory.

Longitude from Washington, $23^{m}\ 54^{s}$ W.
Latitude, 40° 0′ 1.5″ N.
Authority for longitude and latitude: U. S. Coast Survey for State-House dome, 2 miles distant.
Director: R. W. MCFARLAND.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 5 inches.

(*g*) *Clock:* Mean time; makers, PARKINSON & FRODSHAM.

CRETE, NEBRASKA.

Boswell Observatory of Doane College.

Longitude from Washington, ——.
Latitude, ——.
Director: ——.

DUBUQUE, IOWA.

Dubuque Observatory.

Longitude from Washington, $54^m\ 27.61^s$ W.
Latitude, 42° 29′ 38″ N.
Authority for longitude and latitude: Boundary line between the States of Illinois and Wisconsin, projected through the city of Dubuque; and telegraphic record of star transits at Ann Arbor and Dubuque.
Director: ASA HORR, M. D. Under the supervision of Prof. J. C. WATSON, in 1865.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, WM. WÜRDEMANN, Washington, D. C. Aperture, 1½ inches; magnifying power sufficient to note time by stars of the 10th magnitude. Finding circle, 4½ inches diameter, reading by verniers and lenses to half a minute of arc. The pier extends 17 feet into the ground, through clay to gravel; it is 7 feet 6 inches diameter at base, 3 feet at top, which is 4 feet above the surface; is surrounded by a brick wall, 8 inches from the stone shaft, the space between (at the surface of the ground) being stuffed with oakum. The Y's rest on thin brass supports on the top of *stone pillars*, instead of the iron frame which acme with the instrument.

(*g*) *Clock:* Mean time; makers, HOWARD & Co., Boston. Tower clock, reliable to less than a second a day through all extremes of temperature.

(*h*) *Chronometer:* Mean time; maker, K. ZIMMERMAN, Liverpool, England.

DUE WEST, SOUTH CAROLINA.

Astronomical Observatory of Erskine College.

Longitude from Washington, ——.
Latitude, ——.
Director: Rev. W. M. GRIER, D. D.

EASTON, PENNSYLVANIA.

La Fayette College Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

ELIZABETH, NEW JERSEY.

Observatory.

Longitude from Washington, $11^m\ 22.2^s$ E.
Latitude, 40° 40′ 19″ N.
Authority for latitude and longitude: United States Coast Survey.
Director: CHARLES W. PLYER.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Makers, JOHN BLISS & SONS, New York; aperture, 1 inch; magnifying power, 10 diameters.

(*c*) *Equatorial instrument:* Maker, HENRY G. FITZ; aperture of objective, 6¼ inches. Nine eye-pieces, from 50 to 630.

FORDHAM, NEW YORK.

Private Observatory.

Longitude from Washington, $12^m\ 40.47^s$ E.
Latitude, 40° 52′ 31.3″ N.
Authority for longitude and latitude: Coast Survey map of 1863 and American Ephemeris, 1879, assuming the longitude and latitude of New York, given in the Ephemeris, to be that of the city hall.
Director: WILLIAM MEIKLEHAM.

Observatory removed to *Riverdale, New York.*

FORT DODGE, IOWA.

Private Observatory.

Longitude from Washington, $1^h\ 8^m\ 5^s$ W.
Latitude, 42° 30′ N.
Authority for longitude and latitude: F. HESS.
Director: F. HESS.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Makers, J. BROWN & SON, New York; aperture, 1 inch; magnifying power, 10½ diameters, with horizontal and vertical circle, each reading to 1.

(*c*) *Equatorial instrument:* Aperture of objective, 2⅝ inches; for observations of the sun, aperture employed, 2⅝ inches; magnifying power ordinarily employed, 50 diameters.

(*g*) *Clock:* Mean time; maker, G. M. WHEELER, Elgin, Ill.

(*i*) *Miscellaneous:* One TROUGHTON sextant and artificial horizon.

GEORGETOWN, DISTRICT OF COLUMBIA.

Observatory of Georgetown College.

Longitude from Washington, 6.2^s W.
Latitude, 38° 54′ 26.07″ N.
Directors: JAMES CURLEY, S. J.
JOHN G. HAGEN, S. J.

The observatory was ready for use on January 1, 1846, and was built by means of a donation of the Rev. MEREDITH JENKINS, of Baltimore.

Miscellaneous observations were made first to determine the latitude and longitude with great accuracy. It is now used principally for instruction.

The plan of this observatory was made and the first instrument ordered in the year 1841. The excavations for the building were commenced in 1843, and three years later observations began. The building is situated on a hill, northwest of the college, commanding a free horizon. It is 60 feet long by 30 feet wide, comprising two wings on the east and west sides, and two rooms in the middle, viz: The clock-room and library, besides cellar and dome.

The west wing has a transit instrument by ERTEL & SON, 7 feet long and 4½ inches aperture; the east wing a meridian circle by TROUGHTON & SIMMS, reading to fractions of a second by four microscopes, with an object-glass of 4 inches clear aperture. The equatorial was also made by TROUGHTON & SIMMS, has 4.8 inches aperture with powers from 25 to 400, clockwork and micrometer, strong mounting and large circles. The dome measures 20 feet in diameter, and was intended for an 8-inch equatorial, which had been ordered in Paris, but had to be replaced by the present one. Two sidereal clocks, originally mounted in the east and west wings, and a meantime chronometer by MOLYNEAUX, of London, a universal instrument by ERTEL & SON, a reflecting circle by TROUGHTON & SIMMS, and two 3-inch telescopes completed the original outfit of the observatory, which, together with the building, cost about $13,000, a small sum compared to the prices of the present day. The expenses were defrayed for the most part by a donation of the Rev. THOMAS MEREDITH JENKINS, S. J., of Baltimore.

The building of the observatory and the mounting of the instruments was superintended by the first director, JAMES CURLEY, S. J. The geographical position was determined by him in 1846, the longitude by corresponding observations of moon-culminations at Georgetown and Greenwich, the latitude by upper and lower culminations of circumpolar stars.

The revolution of 1847 brought several Italian professors to Georgetown, among whom were DE VICO, SECCHI, and SESTINI. The former had to leave a few weeks later for London on some important business, where he died of typhoid-fever on November 15, 1848, only forty-three years of age; but the gold medal is still preserved here, which he received from the King of Denmark for his discovery of six comets (I, 1844; II, 1847; I, V, VI, IX, 1846) while director of the observatory at the Roman College. He was a member of the Royal Astronomical Society of London.

F. SECCHI, then thirty years of age, taught physics for one year and then returned to Rome to enter upon his career in physical astronomy, but his first interest in this study dates from the observations he made with F. CURLEY at Georgetown.

F. SESTINI began observations of star-colors in 1849, the manuscript of which is preserved in the library of the observatory. The list of his stars was taken from Baily's Catalogue, and is the same which he had observed at Rome. The result was that in general there is no difference in color observed in Italy and in our sky. In 1850 he made drawings of sun-spots from September 20 till November 6, missing only six days out of forty-eight. The drawings were lithographed and, together with a journal and preface, published in the appendix of the Washington Astronomical Observations for 1847. A duplicate set of copies is still in the library of the observatory.

In 1852 a quarto volume of 215 pages, containing a description of the observatory, with eight plates and reduction tables for time observations, was published and distributed by the director. That nothing more has appeared from his pen finds sufficient explanation in the facts that he considered the observatory mainly as a means of education, and that he is now in the venerable age of ninety-three years.

As the centennial celebration of the foundation of the college drew near, the regents of the university placed the observatory in charge of a younger director and put a liberal allowance at his disposal. Almost a thousand dollars were expended for repairs of the building, drying and warming the cellar, roofing, painting, and so on. The problem of revolving the heavy dome was successfully solved by Mr. GARDNER, of the Naval Observatory. A spring which allows the vertical shaft of the gearing a horizontal play of 1 inch, so as to keep the pinion always in contact with the rack, and a large (vertical) steering wheel, with handles, enable a strong man to turn the dome half round in two minutes.

Nearly another thousand dollars were spent on old and new instruments. The equatorial received a helioscope, one of the 3-inch glasses was changed into a portable equatorial, with circles, the other into a comet-seeker; the clocks were cleaned and mounted in double glass cases on the large equatorial pier, one running on sidereal the other on mean time, both provided with the Gardner spring contact, and a new chronograph by FAUTH & Co., of Washington, placed between them. A triple electric-wire system is now being run to the switch-board in the clock-room, one making connection with the U. S. Naval Observatory, another connecting clocks and observing keys with the chronograph, and a third giving incandescent illumination to the field and reading microscopes of the equatorial and transit instruments. The arrangement of the switch-board has been made by Mr. WILLIAM C. WINLOCK, assistant observer at the U. S. Naval Observatory, and is the same as in the observatories of Harvard College and Mount Hamilton, Cal.

The transit instrument and meridian circle are still awaiting a thorough examination, and piers will have to be built for the smaller instruments and for collimators.

The equatorial is the only instrument now ready for use, and will be mainly employed for variable star work. All the known variables, from the equator down to the horizon, have been put on the observing list, while the northern sky is left to the care of more northern observatories. Star occultations and comets will be taken in occasionally. If the staff of the observatory be raised, as is hoped, to three regular observers and one servant, the establishment will be able to produce useful results.

GLASGOW, MISSOURI.

Morrison Observatory.

Longitude from Washington, $1^h\ 3^m\ 5.93^s$ W.
Latitude, 39° 16′ 16.75″ N.
Authority for longitude: Exchange of clock-signals with the Naval Observatory in June and July, 1879, five nights; latitude, from circumpolar stars observed on meridian circle.
Director: C. W. PRITCHETT.

The observatory was founded, 1875–'76, by the liberality of Miss BERENICE MORRISON, of Saint Louis.

INSTRUMENTS:

(*a*) *Meridian circle:* One; makers, TROUGHTON & SIMMS; diameter of circles, 24 inches; divided to 5′; read by 4 microscopes to 1″; aperture of objective, 6 inches; for observations of the sun, aperture employed, 4 inches; magnifying power ordinarily employed, 200 diameters.

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 12¼ inches; magnifying powers of eye-pieces, 50 to 1,200.

(*f*) *Chronograph:* One.

(*g*) *Clock:* Sidereal; maker, CHARLES FRODSHAM, London.

(*h*) *Chronometer:* Sidereal; maker, T. S. & J. D. NEGUS, New York.

(*i*) *Miscellaneous:* Alt-azimuth, by L. P. CASELLA, London; comet-seeker, by ALVAN CLARK & SONS.

GREENCASTLE, INDIANA.

McKim Observatory of De Pauw University.

Longitude from Washington, $14^m\ 17.91^s$ W.
Latitude. 39° 37′ N.
Director: J. P. D. JOHN.

HANOVER, NEW HAMPSHIRE.

Shattuck Observatory of Dartmouth College.

Longitude from Washington, $19^m\ 3.56^s$ E.
Latitude, 43° 42′ 15.2″ N.
Authority for longitude and latitude, Prof. C. A. YOUNG.
Directors: C. A. YOUNG, 1853.
CHARLES F. EMERSON, 1878.

Founded in 1853 through the liberality of Dr. G. S. SHATTUCK. Consists of a west rotunda and three additions. It has double brick walls and an air chamber with a space of 6 inches (0.15^m) between the walls

INSTRUMENTS:

(*a*) *Meridian circle:* Makers, TROUGHTON & SIMMS; diameter of circle, 30 inches; divided to 5′; read by reading microscopes to 1′, and micrometers to single seconds; aperture of objective, 4 inches; magnifying power ordinarily employed, 120 diameters.

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 9.25 inches; magnifying powers of eye-pieces, 100 to 1,200, 20 in number.

(*d*) *Spectroscopes:* Large 9-prism CLARK spectroscope; seven prism, double acting (equivalent to 13 prisms), fitting equatorial mentioned above.

(*f*) *Chronograph:* BOND'S spring governor.

(*g*) *Clocks:* One mean time: makers, UTZSCHNEIDER & FRAUENHOFER; connected with chronograph; one sidereal; makers, UTZSCHNEIDER & MAHLER, of Munich; connected with chronograph.

(*i*) *Miscellaneous:* Comet-seeker, aperture 3.6 inches, mounted on large tripod; small portable telescope, aperture 3 inches; zenith sector, loaned by Coast Survey, aperture 4 inches; full set of common meteorological apparatus, including a recording barometer; sextant by HARDY, of London.

HASTINGS, NEW YORK.

Private Observatory.

Longitude from Washington, $12^m\ 42.7^s$ E.
Latitude, 40° 59′ 25″ N.
Authority for longitude and latitude, U. S. Coast Survey.
Director: HENRY DRAPER.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Makers, STACKPOLE & BROTHER; aperture, 2 inches; magnifying power, 45 diameters.

(*c*) *Equatorial instruments:* One reflector, 28 inches aperture, made by HENRY DRAPER; (*c′*) one refractor, 11 inches aperture, by ALVAN CLARK & SONS, with photographic corrector.

(*d*) *Spectroscopes:* One diffraction, 1 stellar photographic, 1 automatic, etc.

(*f*) *Chronograph:* One made by HENRY DRAPER.

(*g*) *Clock:* One mean time; maker, HOWARD.

(*h*) *Chronometers:* One mean time; maker, NEGUS: one sidereal; maker, NEGUS.

(*i*) *Miscellaneous:* Altitude and azimuth reflector of 15½ inches aperture.

Haverford College, Pennsylvania.

Haverford College Observatory.

Longitude from Washington, $6^m\ 59.33^s$ E.
Latitude, 40° 0′ 36.5″ N.
Authority for longitude and latitude: Observations on moon, culminating stars, and with transit in the prime vertical in the years 1854–'55. [The triangulations from U. S. Coast Survey stations give:

Longitude, $7^m\ 0.47^s$ E.
Latitude, 40° 0′ 49.73″ N.

Director: Isaac Sharpless.

Instruments:

(*a*) *Meridian circle:* One; diameter of circles, 26 inches; divided to 15′; read by 4 microscopes to 2″; aperture of objective, 4 inches.

(*c*) *Equatorial instrument:* Makers, Henry Fitz, re-worked by Clark; aperture of objective, 8¼ inches; magnifying powers of eye-pieces, 60 to 800.

(*f*) *Chronograph:* Bond's magnetic.

(*g*) *Clocks:* One sidereal; maker, Lukens: one sidereal; maker, Harper; mercurial compensation.

(*i*) *Zenith instrument:* Aperture, 2¼ inches; rejuvenated by Fauth & Co., and to be set up as soon as addition is built to observatory, to determine our latitude.

Hudson, Ohio.

Hudson Observatory.

Longitude from Washington, $17^m\ 32.06^s$ W.
Latitude, 41° 14′ 42.6″ N.
Authority for longitude and latitude: Prof. Elias Loomis, LL. D.
Director: Charles J. Smith.

Instruments:

(*a*) *Meridian circle:* One; maker, Simms, of London; diameter of circles, 18 inches; divided to 5′; read by 3 microscopes to 1″; aperture of objective, 3 inches.

Equatorial instrument: One; maker, Simms; aperture of objective, 4 inches; magnifying powers of eye-pieces, 50, 100, 150, 250, 350.

Clock: Sidereal; maker, Molineux; mercurial pendulum.

Iowa City, Iowa.

Private Observatory.

Longitude from Washington, $57^m\ 52.5^s$ W.
Latitude, 41° 39′ 8″ N.
Director: C. W. Irish.

INSTRUMENTS:

(b) *Meridian transit instrument:* A small one made by the director himself; aperture, one inch; magnifying power, 11 diameters.

(c) *Equatorial instrument:* Maker, CHEVALIER, Paris; aperture of objective, 4 inches; magnifying powers of eye-pieces, 25 to 300.

(f) *Chronograph:* A Morse register.

(g) *Clock:* One mean time; beating three-quarter seconds; of German make.

JERSEY CITY, NEW JERSEY.

Private Observatory.

Longitude from Washington, $11^{m}\ 48.49^{s}$ E.
Latitude, 40° 42′ 50.30″ N.
Director: HENRY HARRISON.

INSTRUMENTS:

Equatorial: Refractor, new, by JOHN BYRNE; aperture, 4¼ inches; focal length, 39 inches; power of eye-pieces (with insertion of BARLOW lens) from 20 to 400; TROUGHTON position filar micrometer; apparatus for projecting solar image.

Spectroscope: With view telescope and collimator cabinet; length, 7 inches; RUTHERFURD diffraction grating ¾ by 1 inch.

Clock: sidereal, THOMAS.

LANSING, MICHIGAN.

State Agricultural College Observatory.

Longitude from Washington, $29^{m}\ 44^{s}$ W.
Latitude, 42° 43′ 54″ N.
Director: R. C. CARPENTER.

The observatory is rather for instruction than investigation.

LAWRENCE, KANSAS.

Observatory of the Kansas State University.

Longitude from Washington, $1^{h}\ 12^{m}\ 47.9^{s}$ W.
Latitude, 38° 57′ 15″ N.
Authority for longitude and latitude: FRED W. BRADWELL, late professor of astronomy, Kansas State University.
Director: H. J. S. SMITH.

INSTRUMENTS:

(b) *Meridian transit instrument:* Makers, STACKPOLE BROS.; aperture, 2¼ inches.

(g) *Clocks:* One mean time; makers, E. HOWARD & CO., Boston (medium): one sidereal; maker, BROCKBANKS, London (old).

(*h*) *Chronometer:* Sidereal; makers, T. S. & J. D. NEGUS, New York (good).

(*i*) *Miscellaneous:* Sextant, by GAMBEY; comet-seeker, 6-inch object glass.

LINWOOD, OHIO.

Private Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director: R. H. MCCLURE.

Situated about one mile E. by S. from Cincinnati observatory.

INSTRUMENTS:

(*c*) One equatorial silvered glass Newtonian reflector. Diameter of the concave reflecting objective, $5\frac{1}{2}$ inches; magnifying powers of the eye-pieces, 60, 100, and 200 diameters. The mirror, tube, and mounting all constructed by Mr. MCCLURE himself.

MADISON, WISCONSIN.

The Washburn Observatory.

Longitude from Washington, $49^m\ 25.8^s$ W.
Latitude, $43° 4' 36.7''$ N.
Authority for longitude and latitude: a pier of the United States Coast and Geodetic Survey, about 500 feet from the observatory, has been connected by a triangulation with the transit room, and the position given refers to the center of the transit circle.
Directors: EDWARD S. HOLDEN, 1880.
GEORGE C. COMSTOCK, 1885.

INSTRUMENTS:

(*a*) *A meridian circle:* Maker, REPSOLD & BROTHER, Hamburg; diameter of circles, about 30 inches; divided to $2'$; read by 4 microscopes to $1''$. Aperture of objective, 4.8 inches; for observations of the sun, aperture employed, —inches; magnifying power ordinarily employed, — diameters.

(*b*) *Meridian transit instrument:* Makers, FAUTH & Co., Washington; aperture, 3 inches; magnifying power, 60 and 120 diameters; two 12-inch circles divided on the edges: one circle to $10''$, the other for setting only. The fine circle has a level for latitude.

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 15.5 inches; magnifying powers of eye-pieces, 145 to 1200.

(*f*) *Chronograph:* A chronograph by FAUTH & Co., with a conical pendulum.

(*g*) *Clocks:* One mean time; makers, SETH THOMAS CLOCK COMPANY: one sidereal; maker, HOHWU, of Amsterdam.

(*h*) *Chronometers:* One sidereal; maker, BLISS, No. 2786; one sidereal break-circuit, BLISS, No. 2791.

MOUNT HAMILTON, CALIFORNIA.

Lick Observatory of the University of California.

Longitude from Washington, 2^h 58^m 14.6^s W.
Latitude, 37° 21′ 3″ N.
Director: EDWARD S. HOLDEN, 1885.

The Lick Observatory of the University of California owes its origin to the bequest of the late JAMES LICK, of California, who bequeathed to the University of California "a telescope of greater power than any yet made." As the site of his observatory he selected Mount Hamilton, in the Santa Clara Valley.

The following description of the establishment of the observatory is taken from the Scientific American (New York), March 17, 1888:

In administering their trust the custodians met with legal obstacles and suits brought by his relatives. These delayed the carrying out of his plans, but eventually a settlement was reached. On June 30, 1883, the corner-stone of the observatory to which this article is devoted was laid, and to-day the work is practically complete. When Mount Hamilton was selected as the site for the Lick Observatory, in order to test its atmospheric conditions Prof. S. W. BURNHAM, the discoverer of many double stars, was invited to observe there in 1879. Owing to the dryness of the air and its excellent quality for astronomical work, his 6-inch telescope described many stars, catalogued by Prof. OTTO STRUVE as double, into triple stars. Mr. LICK died in 1876, and the original plans for the observatory were determined by Capt. RICHARD S. FLOYD, president of the trustees, and Mr. T. E. FRASER, superintendent of construction, acting under the advice of Prof. EDWARD S. HOLDEN, and Prof. SIMON NEWCOMB, of the Naval Observatory, in Washington. Many noted astronomers have been interested in the work, and this will probably be the most famous observatory in the world. It owns about 1,550 acres of land, a portion of which will eventually be made into a public park, and the graded road of 26 miles leading to the summit of Mount Hamilton from San José may, perhaps, become a direct route to the Yosemite Valley. Since 1880, when the work was first begun, 7,000 tons of rock and earth have been removed to level a plateau upon which the buildings stand. They are constructed of solid masonry, and are of simple but effective architecture, and include the main building, 287 feet long, containing the directors' and secretary's offices, the library, clock-rooms, etc., with the large dome at its southern end for the large telescope, and a smaller dome for the 12-inch equatorial at the northwest corner, the meridian-circle house, the transit house, the photographic laboratory, and several temporary wooden workshops. The dwelling house of the astronomers, 63 by 60 feet, stands below the summit and is connected with the plateau by a bridge. The surrounding peaks have been named from several famous astronomers.

The large dome, built by the Union Iron Works, of San Francisco, is 75 feet in diameter and its moving parts weigh 100 tons. It revolves upon wheels which run on hardened steel balls. A man merely pushing against it can move the entire dome. The usual motive power is obtained from a water engine which can rotate the dome 360 degrees in less than nine minutes. Its diameter changes one-half inch in the extreme change of temperatur., and its track is given a smooth and oiled surface to slide upon. The observing slit is 9½ feet wide, and the pintle of the shutter is placed eccentrically. A practical device for carrying the observer to the eye-piece of the telescope, which at times is far above the base of the dome, was planned by Sir HOWARD GRUBB, of Dublin. This is an elevating floor 61½ feet in diameter, weighing 50,000 pounds, and is moved up and down through a space of 16 feet. It is highly probable that the present system will not be sufficiently powerful to raise the flooring rapidly enough, but in this event the hydraulic system can be altered, or steam or electricity substituted. The actual speed required can only be determined after a series of experiments have been made.

The dome for the 12-inch equatorial is 25 feet wide, weighs 8 tons, and its observing slit, which extends beyond the zenith, is 3 feet wide. The meridian-circle house is 43 by 38 feet. Its walls are double, the outer frame of galvanized iron, the inner one of California redwood. Between these is an air space 24 inches wide, which encircles the buildings. There is also an air space above the ceiling, which communicates with the room and with the air spaces of the walls, and on the west there is a ventilating tower two stories in height, which connects with the room of the meridian-transit instrument. By these means the temperature of the building is kept the same as that of the external air. The transit house, adjoining the meridian-circle house, is built of iron, with a wooden lining, and is arched by a curved shutter, which is controlled by levers, planned by Sir HOWARD GRUBB. The photographic observatory, north of the transit house, is a small wooden building, with brick foundation. The tube of the photoheliograph telescope enters this house, and a brick pier supports the photoheliograph. A room in the second floor of the main building is also fitted for photography.

The large telescope, which embodies the expressed object of the $700,000 donation, was mounted by WARNER & SWASEY, of Cleveland. The tube is nearly cylindrical, and is 60 feet in length. There are three finders, 6, 4, and 3 inches in aperture, and in addition to these the 12-inch equatorial can be quickly attached, as a pointer, for photographic work if the controlled driving clock does not work satisfactorily. The lens is 36 inches clear aperture, being the largest object glass in the world, and has a 678-inch focus. The flint disk was obtained from FEIL, in April, 1882, and after nineteen failures the crown-glass disk was cast successfully in September, 1885. The third photographic crown lens was purchased from FEIL in 1886, and broke while in the hands of the CLARKS. The trustees of Yale University then offered their 27-inch flint glass to the Lick Observatory, but this was too yellow, and in 1887 Mr. ALVAN G. CLARK bought in Paris, from FEIL, the crown glass which is worked into a third lens. In addition to its magnifying power and its perfect definition, *i. e.*, neatness, accuracy, etc., this telescope has great light-gathering power, and stars may be seen through it which are thirty thousand times fainter than the faintest seen by the naked eye, and the moon will appear under the same conditions as if it were seen by the naked eye at about 200 miles from the earth.

The 12-inch refractor, which was originally made for Dr. HENRY

DRAPER'S private observatory at Hastings, N. Y., by ALVAN CLARK & SONS, is of the finest construction. The object-glass of the 6½-inch equatorial was also made by the CLARKS, and is provided with a portable mounting made by WARNER & SWASEY. The 4-inch comet-seeker, made by ALVAN CLARK & SONS, has a focal length of 33 inches. The rays fall on a reflecting prism, and are bent into a horizontal plane. The eye of the observer, moving in azimuth while the telescope is in altitude, can cover the whole sky. The motion is effected by turning a crank. This was bought on Professor NEWCOMB'S recommendation.

The photoheliograph is mounted south of the transit house. The transit instrument determines the axis of the photoheliograph, and this is also used as a collimator for the transit. The 6-inch REPSOLD meridian circle was delivered in 1884, after having been inspected by Professors AUWERS and KRUEGER, of Berlin. The declinograph was made under the supervision of Dr. JOHANN PALISA, of Vienna, to fit either a 12-inch or a 6-inch equatorial. The universal instrument made by REPSOLD consists of a telescope containing a prism, into which the rays of light are reflected. Its aperture is 2.15 inch. The horizontal circle reads by two microscopes to two seconds, and the circles are 10 inches in diameter. This is a perfect geodetic instrument, and together with a 6-inch equatorial and a chronometer can be easily packed for astronomical expeditions. There are several chronometers made by NEGUS, and a thermometric chronometer by C. FRODSHAM. The most important of the minor instruments are the filar micrometer for the 36-inch telescope by FAUTH & Co., the duplex micrometer by GRUBB, and a star spectroscope made by BRASHEAR from designs of Mr. KEELER. Plans for a large solar spectroscope are being worked out by Professors HOLDEN and LANGLEY. The other instruments are a delicate sphereometer by FAUTH & Co.; resistance coils; galvanometers; a disk photometer; spectroscopes; a lever trier of refined construction; and an engine for measuring photographs, scales, etc., made by STACKPOLE & BROS., from designs of Professor HARKNESS.

The meteorological instruments are: Self-registering rain-gauges, wind-gauges, barometers, and a number of thermometers. There is a complete set of apparatus for registering earthquakes, provided by the Cambridge Scientific Instrument Company, consisting of a horizontal seismograph with clock and driving plate, the clock being started by an electric contact at the beginning of a shock, and the two rectangular components of the horizontal motion then registering on a moving plate; a vertical seismograph to register vertical motions on a dial plate; a duplex pendulum seismograph to give independent records on a dial plate, the pencil being free to move in any azimuth; and a chronograph, which is set in motion at the beginning of an earthquake and records its duration upon a clock. The staff of the observatory consists of Prof. EDWARD S. HOLDEN, director and chief astronomer; SAMUEL W. BURNHAM, JAMES E. KEELER, JOHN M. SCHAEBERLE, and EDWARD E. BARNARD, assistant astronomers; and C. B. HILL, secretary, librarian, and occasional observer.

Early in 1886, Professor HOLDEN made contracts with the Southern Pacific and other railroad companies for supplying time from the observatory by automatic electric signals. This regular time service, of which Mr. KEELER has charge, has been in operation since January, 1887. A great part of the apparatus used in this service forms an integral part of the observatory's equipment. The system which has thus been introduced has been of great service to that particular section of the country, as well as to the railroad companies.

Instruments for recording earthquake shocks have been constructed by a company in San Francisco, and are sold at a very low figure. It is designed in this way that records of any seismic movements shall be procured by private individuals in different parts of the State, and plates upon which the movement has been recorded may be sent to the observatory, where a record will be kept of all such data, and blue prints will be made of the diagrams and copies of this sent to the person from whom the plate has been obtained. Although this is quite independent of the regular work of the observatory, it will doubtless lead to the accumulation of data which will be most important in formulating statistics for future use.

The great telescope has been mounted for several weeks, and several satisfactory tests of its capacity have been made. It was first directed to the sky on the evening of January 3, 1888, and a few observations were then made for the partial adjustment of the object-glass, but the observation was abbreviated by the skies becoming cloudy. The next observations made were on the evening of the 7th. On this occasion Saturn was observed, and Mr. KEELER, who conducted the observation, says with rapture that it was "the most glorious telescopic spectacle ever beheld." He exclaims: "Not only was he shining with the brilliancy due to the great size of the objective, but the minutest details of his surface were visible with wonderful distinctness."

MOUNT LOOKOUT, OHIO.

Cincinnati Observatory.

Longitude from Washington, $29^{m}\ 29.33^{s}$ W.

Latitude, 39° 8′ 20″ N.

Authority for longitude: Washington Observations for 1877. Appendix IV; for latitude: Preliminary reduction of unpublished Observations.

Directors: O. M. MITCHEL, 1842.
H. TWITCHEL, 1853.
W. DAVIS, 1854.
C. ABBE, 1869.
ORMOND STONE, 1875.
H. C. WILSON, 1882.

Founded in 1842 through the efforts of Professor MITCHEL.

The ground was donated by NICHOLAS LONGWORTH. Removed in 1873 to new building erected at Mount Lookout. The new grounds were donated by JOHN KILGOUR.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Makers, BUFF and BERGER; aperture, 3 inches; magnifying power, 100 diameters.

(*c*) *Equatorial instruments:* One made by UTZSCHNEIDER and FRAUENHOFER; finished by MERZ & MAHLER; object-glass refigured by ALVAN CLARK & SONS; aperture of objective, 11¼ inches; magnifying powers of eye-pieces, 90 to 1400. (*c′*) One by ALVAN CLARK & SONS; aperture, 4 inches; magnifying powers, 15 to 250.

(*f*) *Chronograph:* BOND

(*g*) *Clocks:* Two mean time; makers, ROBERT MOLYNEUX, JAMES RITCHIE & SON.

(*h*) *Chronometer:* Sidereal; makers, WILLIAM BOND & SON.

(*i*) *Miscellaneous:* Magnetic theodolite; maker, GAMBEY. Sextant; makers, STACKPOLE & BROTHER. Inclinometer time-ball, telegraphic apparatus, etc.

MIDDLETOWN, CONNECTICUT.

Observatory of Wesleyan University.

Longitude from Washington, ——.
Latitude, ——.
Director: Prof. J. M. VAN VLECK.

NEW BRUNSWICK, NEW JERSEY.

Observatory of Rutgers College.

Longitude from Washington, ——.
Latitude, ——.
Director: ——.

NASHVILLE, TENNESSEE.

Observatory of Vanderbilt University.

Longitude from Washington, 38^m 56^s W.
Latitude, 36° 10′ 01″ N.
Authority for longitude and latitude: U. S. Coast Survey.
Director: E. E. BARNARD.

INSTRUMENTS:

(*c*) *Equatorial instrument:* A simple equatorial; aperture of objective, 5 inches; magnifying powers of eye-pieces, 52 to 520. (*c′*) A small 2½ inches alt-azimuth telescope with good rack-work; all the eye-pieces of large telescope fit it.

(*i*) *Miscellaneous:* In use also a small instrument. The base of this instrument is divided to degrees and read by vernier to 3′ of arc. An upright pillar carries a semi-circle of altitude; this is divided to degrees and read to 3′ of arc by a vernier. Attached to the semi-circle of altitude is an hour-circle divided to 4^m of time and read to single minutes by vernier. Upon the hour-circle rests a semi-circle of declination divided to degrees and read to 3′ of arc by vernier. On the base are two levels, the instrument being leveled by three adjusting screws, which also serve as feet. The declination semi-circle carries a very small telescope about .4 inch diameter of objective. The telescope has a diagonal eye-piece with metal reflector and single lenses and vertical and horizontal hairs. The instrument was made by W. & S. Jones, London. It is used for identifying stars in comet observations by setting the altitude semi circle for the latitude, thereby converting the instrument into an equatorial.

NEW HAVEN, CONNECTICUT.

Winchester Observatory of Yale College.

Longitude from Washington, $0^h\ 16^m\ 30.1^s$ E.
Latitude, 41° 18′ 36.5″ N.
Authority for longitude: U. S. Coast Survey. For latitude: Zenith telescope observations in 1857–'58. (See Am. Jour. of Sci., vol. 30, p. 52, second series.) Coast Survey latitude, 41° 18′ 10″ 67 N.
Directors: E. LOOMIS, 1831.
D. OLMSTEAD, 1836.
C. S. LYMAN, 1847.
H. A. NEWTON.

The *horological bureau* is a department of the Winchester Observatory organized in January, 1880, with a special equipment of instruments for a regular and extended public time service. The standard time by law of the State is that of the meridian of the city hall, New York, which is $4^m\ 19.6^s$ slow of New Haven and $12^m\ 10.5^s$ fast of Washington. Another important work of the bureau is the testing of watches and chronometers in the interest of the watch manufacture, for which hot and cold closets and other special facilities are provided.

There is also connected with the observatory a *thermometrical bureau*, in charge of DR. WALDO, for the verification of clinical and other thermometers.

INSTRUMENTS:

(*a*) *Meridian circle:* Makers, ERTEL & SONS, 1845. Formerly the property of the U. S. Naval Observatory. Altered by WILLIAM J. YOUNG, 1855, and regraduated 1876. Diameter of circles, 40 inches; divided to 2′; read by six microscopes to 1″; aperture of objective, 3.8 inches; for observations of the sun, aperture employed, 1.7 inches; magnifying power ordinarily employed, 190 diameters; focal length, 58.2 inches.

(*b*) *Meridian transit instruments:* One made by C. S. LYMAN, of 36-inch focal length; aperture, 2.6 inches; magnifying power, 185 diameters. Circle, 12 inches, reading to 10″ by verniers; it has declination micrometer and fine level, for use as zenith telescope, made in 1852–'53. One by TROUGHTON & SIMMS, London; aperture, 3.99 inches; magnifying power, 150–200 diameters; focal length, 5.108 feet. (*b′*) Combined transit and zenith telescope, 36-inch focal length; aperture, 2.6 inches; power, 185 diameters; 12-inch circle, reading to 10″ by verniers; declination micrometer and sensitive level for latitude work; made in 1852–'56: object-glass by FITZ, design and mounting by C. S. LYMAN.

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 9 inches; magnifying powers of eye-pieces, 40, 80, 140, 200, 280, 450, 620. (*c′*) Portable 4⅜-inch refractor by Messrs. CLARK & SONS.

(*d*) *Spectroscope:* By A. CLARK & SONS, of 7 prisms twice traversed.

(*f*) *Chronographs:* One by A. CLARK & SONS, with conical pendulum governor; another by WILLIAM BOND & SONS, Boston, with BOND'S spring governor.

(*g*) *Clocks:* One mean time, made by E. HOWARD & CO., Boston; one by WILLIAM HILLHOUSE, New Haven; one sidereal, by WILLIAM BOND & SON, Boston; one by APPLETON, London; one by E. HOWARD & CO.

(*h*) *Chronometers:* One pocket chronometer, mean time, by JOHNSON, London; one sidereal, by POOL, London, improved by NEGUS, New York.

(*i*) *Miscellaneous:* Two bifilar position-micrometers, one by DOLLOND, the other by FAUTH & CO., Washington, D. C.; a patent sextant and a patent reflecting circle, by PISTOR & MARTINS, Berlin; repeating relays, sounders, etc., for time service. Yale College has also in use a 5-inch 10-foot refractor by DOLLOND, a sidereal clock, and a 20-inch transit instrument, in charge of Professor LOOMIS.

NEW ORLEANS, LOUISIANA.

Observatory.

Longitude from Washington,

Latitude, 29° 57′ 26″ N.

Authority for longitude and latitude: U. S. Coast Survey, 1859, p. 265; Connaissance des Temps, Paris, 1884, p. lx.

Director: ———.

NEW WINDSOR, ILLINOIS.

Private Observatory.

Longitude from Washington, 53^m 53^s W.

Latitude, 41° 13′ N., approximately.

Authority for longitude: telegraphic time signals direct from U. S. Naval Observatory at Washington on December 4, 5, 6, 7, 1882; for latitude, own determination.

Director: EDGARD L. LARKIN.

Permanent observatory; brick pier and revolving dome.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS; aperture of objective, 6 inches; magnifying powers of eye-pieces, 27, 60, 130, 250, 300, 600, with prism and solar eye-piece. Two of the eye-pieces are GUNDLACH'S periscopic.

(*g*) *Clock:* Sidereal; ordinary clock.

(*i*) *Miscellaneous:* Planisphere, charts, maps, and catalogues.

NEWINGTON, CONNECTICUT.

Private Observatory.

Longitude from Washington, $21^m\ 25^s$ E.
Latitude, 41° 44′ N.
Authority for longitude and latitude: difference from Hartford state-house, Coast Survey.
Director: D. W. EDGECOMB.

This observatory consists of a small frame building, with dome 12 feet 6 inches diameter, upon the grounds of the owner, covering an equatorial telescope.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Makers, A. CLARK & SONS; aperture of objective, 9.4 inches; magnifying powers of eye-pieces, various up to 2,000.

(*g*) *Clock:* Mean time; Swiss regulator; seconds.

NEW YORK, NEW YORK.

I. *Columbia College Observatory.*

Longitude from Washington, $12^m\ 18.4^s$ E.
Latitude, 40° 45′ 23.1″ N.
Authority for longitude and latitude: these constants were calculated from data furnished by city surveyors and based on the position of Mr. Rutherfurd's observatory. The longitude and latitude of the latter were determined by the Coast Survey.
Director: J. K. REES.

The old observatory has been torn down and a new observatory has been erected within a few feet of the old site.

II. *Private Observatory.*

Longitude from Washington, $12^m\ 15.47^s$ E.
Latitude, 40° 43′ 48.53″ N.
Authority for longitude and latitude: U. S. Coast Survey party (1859), with zenith telescope upon 24 pairs of stars, and telegraphic communication with Washington and Cambridge.
Director: L. M. RUTHERFURD.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, STACKPOLE; aperture 3 inches. Only used for time.

(*c*) *Equatorial instrumemt:* Makers, Messrs. RUTHERFURD & FITZ; aperture of objective, 13 inches. The telescope has been employed mostly in photographing the sun, moon, and groups of stars.

(*f*) *Chronograph:* MORSE.

(*g*) *Clock:* Sidereal; maker, DENT.

NORTHFIELD, MINNESOTA.

Carleton College Astronomical Observatory.

Longitude from Washington, $1^h\ 4^m\ 23.85^s$ W.
Latitude, 44° 27′ 40.77″ N.
Authority for longitude: longitude depends on exchange of telegraphic signals between Coast Survey office at Saint Paul and director at Northfield. Authority for latitude: zenith telescope observations of 40 pairs of stars reduced to apparent places from Safford's catalogue.
Director: WILLIAM W. PAYNE.

Completed in 1878. Attached to Carleton College, central building, 6 meters long, surmounted by a dome, with two wings, one used for meridian instruments, the other for the library.

INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, FAUTH & Co.; aperture, 3 inches; magnifying powers, 60, 70, and 80 diameters.

(*c*) *Equatorial instruments:* Makers, A. CLARK & SONS; aperture of objective, 8¼ inches; magnifying powers of eye-pieces, 50, 100, 200, 400, 800. (*c*′) Portable equatorial: maker, JOHN BYRNE, of New York; aperture of objective, 4.3 inches.

(*f*) *Chronograph:* One, made by A. CLARK & SONS.

(*g*) *Clocks:* One mean time; makers, E. HOWARD & Co., No. 196; one sidereal; makers, E. HOWARD & Co., No. 195.

(*h*) *Chronometer:* Sidereal; makers, BOND & SONS, No. 374.

(*i*) *Miscellaneous:* The observatory has been favored by the loan of a good zenith telescope for several months from Lieut. EDWARD MAGUIRE, chief engineer in the department, with headquarters at Saint Paul. The large equatorial is provided with micrometer, with a full battery of eye-pieces.

OMAHA, NEBRASKA.

Creighton College Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director: ——.

(NEAR) OXFORD, MISSISSIPPI.

Observatory of the University of Mississippi.

Longitude from Washington, $49^m\ 55.03^s$ W.
Latitude, 34° 22′ 12.64″ N.
Authority for longitude and latitude, R. B. FULTON.
Director: R. B. FULTON.

The observatory was erected in 1876.

INSTRUMENTS:

(*a*) *Altitude-azimuth:* Makers, LEREBOURS & SECRETAN; diameter of circles, 10 inches; divided to 10′; read by 4 microscopes to 10″; aperture of objective, 1½ inches.

(*b*) *Meridian transit instrument:* Makers, B. PIKE & SONS; aperture, 2¼ inches.

(*c*) *Equatorial instrument:* Maker, MERZ, of Munich; aperture of objective, 4½ inches; magnifying powers of eye-pieces, 96 to 312 diameters.

(*d*) *Spectroscope:* KIRCHOFF'S 4-prism table spectroscope.

(*g*) *Clock:* Mean time; makers, RITCHIE & SONS, Boston.

(*h*) *Chronometer:* Sidereal; makers, WILLIAM BOND & SON, Boston.

PHELPS, NEW YORK.

Red House Observatory.

Longitude from Washington, 12ˢ W.
Latitude, 42° 58′ N.
Director: WILLIAM R. BROOKS.

INSTRUMENTS:

(*c*) A silver-glass reflecting telescope of 5 inches aperture and 50 inches focal length, mounted as a Newtonian on alt-azimuth stand. A 2-inch reflector, 36 inches focus. Both made by the director.

(*g*) *Clock:* Mean time; makers unknown; marine.

PHILADELPHIA, PENNSYLVANIA.

Central High School Observatory.

Longitude from Washington, 7ᵐ 33ˢ.64 E.
Latitude, 39° 57′ 7.5″ N.
Director: M. B. SNYDER.

POUGHKEEPSIE, NEW YORK.

Vassar College Observatory.

Longitude from Washington, 12ᵐ 38.5ˢ E.
Latitude, 41° 41′ 18″ N.
Director: MARIA MITCHELL.

Observatory was built in 1865..

INSTRUMENTS:

(*a*) *Meridian circle:* Maker, YOUNG, of Philadelphia; aperture of objective, 3¾ inches.

(*c*) *Equatorial instrument:* Object-glass by CLARK; aperture of objective, 12⅓ inches; magnifying power of eye-pieces, 200 to 600+.

(*f*) *Chronograph:* One.
(*g*) *Clock:* One sidereal; makers, BOND & SON.
(*h*) *One chronometer:* Mean time; makers, BLISS & CREIGHTON.
(*i*) *Miscellaneous:* Small telescopes; one by CLARK & SONS; aperture, 3 inches.

PRINCETON, NEW JERSEY.

Observatories of the College of New Jersey.

I. *Halstead Observatory.*

Longitude from Washington, 9^m 32.60^s E.
Latitude, 40° 20′ 55.8″ N.
Director: Prof. C. A. YOUNG.

Situated at the western extremity of the college campus, and about half a mile west of the School of Science observatory.

The large telescope has been placed in position. The required funds have been subscribed by the friends of the college, ROBERT BONNER, of New York, R. L. STUART, and the trustees of the JOHN C. GREEN estate being the largest contributors.

The iron dome under which it is mounted is 39 feet inside diameter, and very heavy. A 4-horse gas-engine in the basement furnishes the power for moving it and managing the shutter. It is possible to raise the shutter, turn the dome to any part of the sky, and have the telescope pointed upon any designated object within five minutes after entering the building. The same engine drives a small Edison dynamic machine, which supplies electric light to all parts of the observatory and furnishes electric currents for spectroscopic work.

II. *Observatory of the John C. Green School of Science.*

Longitude from Washington, 9^m 34.54^s E.
Latitude, 40° 20′ 57.8″ N.
Director: Prof. C A. YOUNG.

The establishment is designed for purposes of instruction, and devoted almost entirely to that object.

PROVIDENCE, RHODE ISLAND.

Seagrave Observatory.

Longitude from Washington, 22^m 34.51^s E.
Latitude, 41° 49′ 46,40″ N.
Authority for longitude and latitude: United States Coast Survey, and ourselves, F. E. SEAGRAVE and LEONARD WALDO.
Director: F. E. SEAGRAVE.

INSTRUMENTS:

(*c*) *Equatorial instrument:* One equatorial; makers, ALVAN CLARK & SONS; aperture of objective, 8¼ inches; magnifying powers of eye-pieces, 93, 121, 184, 311, 571; negatives, 518, 116, 230, 335, 375; positive eye-pieces achromatic, 248.

(*d*) *Spectroscope:* One by BROWNING, which consists of 4 whole and 2 half prisms of 60° ; flint glass ; gives a dispersive power of ten prisms by reflection.

Chronometer: Sidereal; maker, VICTOR KULLBERG, London.

RIVERDALE, NEW YORK.

Private Observatory.

Longitude from Washington, ——.
Latitude, ——.
Director: WILLIAM MEIKLEHAM.

Observatory was removed from Fordham, N. Y.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Maker, JOHN BYRNE, of New York; aperture of objective, $4\frac{3}{10}$ inches; focal distance, 65 inches; magnifying powers of eye-pieces, 20, 30, 45, 60, 80, 150, 250, 300, 350, and 450; also an amplifier, which doubles each of these powers when used. Attached to the telescope is a finder of 1½ inches aperture, magnifying 20 diameters. Right ascension circle divided to read to 4 seconds of time; declination circle divided to read to 1′ of arc. Both circles divided on silver and read by microscopes attached thereto. Driving clock.

(*d*) *Spectroscope:* One.

(*g*) *Clock:* Mean time; maker, SETH THOMAS, SONS & CO.

(*i*) *Miscellaneous:* Filar micrometer; divided on silver to measure 0″.3 of arc in distance and 6′ in position, with suitable eye-pieces and illuminating apparatus.

ROCHESTER, NEW YORK.

Warner Observatory.

Longitude from Washington, $3^m\ 8^s$ W.
Latitude, 43° 8′ 15″ W.
Authority for longitude and latitude: Signal Service Officer.
Director: LEWIS SWIFT.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Makers, ALVAN CLARK & SONS (constructing); aperture of objective, 16 inches; magnifying powers of eye-pieces, from 45 to 2000. (*c′*) Altitude-azimuth, 4½ inches, by FITZ; powers from 25 to 432. Telescope 4½-inch refractor, originally by FITZ, but since last report the flint lens of the objective was unfortunately broken; it has been replaced by ALVAN CLARK & SONS. Its performance, which was always good, appears to be rather better than before the accident.

SAINT LOUIS, MISSOURI.

Observatory of Washington University.

Longitude from Washington, $52^m\ 37.02^s$ W.
Latitude, 38° 38′ 3.64″ W.
Authority for longitude and latitude: A pier about 150 feet away from the observatory pier was located by EIRNBECK in 1870. The longitude has again been determined by a Coast Survey party.
Directors: J. K. REES, 1877.
H. S. PRITCHETT, 1881.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, WÜRDEMANN; aperture, 2.65 inches; magnifying power, 90 diameters, with micrometer attachment.

(*c*) *Equatorial instrument:* Maker, H. FITZ, of New York City; aperture of objective, $6\frac{1}{4}$ inches; magnifying powers of eye-pieces, 76, 125, 190, 305, and 456 diameters. (*c*′) *Finder:* $2\frac{3}{100}$ inches aperture; magnifying power, 23 diameters.

(*d*) *Spectroscope:* One single prism BROWNING spectroscope.

(*e*) *Photometer and other subsidiary apparatus:* Filar position, micrometer attached; clock-work for moving telescope.

(*g*) *Clock:* Mean time; common tower clock.

(*h*) *Chronometer:* Mean time; makers, (1) DENT No. 2749, (2) BLACKIE No. 789.

(*i*) *Miscellaneous:* Sextant, by BLUNT, of New York City.

SOUTH BETHLEHEM, PENNSYLVANIA.

Sayre Observatory of Lehigh University.

Longitude from Washington, $6^m\ 40.19^s$ E.
Latitude, 40° 36′ 23.89″ N.
Director: C. L. DOOLITTLE.

Founded in 1877, in connection with Lehigh University.

INSTRUMENTS:

(*c*) *Equatorial instrument:* Makers, CLARK & SONS; aperture of objective, 6 inches; magnifying powers of eye-pieces, 12 to 225.

(*g*) *Clock:* Sideral; makers, BOND & SON.

(*i*) *Miscellaneous:* A portable transit instrument by STACKPOLE, a zenith telescope by BLUNT, and a prismatic sextant by PISTOR & MARTIN.

SOUTH HADLEY, MASSACHUSETTS.

Observatory of Mount Holyoke Seminary.

Longitude from Washington, $17^m\ 51.75^s$ E.
Latitude, 42° 15′ 18.2″ N.
Authority for longitude: R. H. WEST, by telegraphic communication with Cambridge at the time of the transit of Venus. For latitude: C. A. YOUNG, by zenith telescope method.
Director: Miss E. M. BARDWELL.

Through the liberality of Mr. A. L. WILLISTON, of Northampton, the seminary has recently been enabled to erect a small but very complete astronomical observatory, supplied with all the necessary instruments. It is designed to furnish the means for instruction to any who may wish to make the subject a specialty, and to give opportunity to any of the teachers or post-graduates who may take an interest in astronomy to make observations of real value.

The building, of wood, consists of a tower with a dome 18 feet in diameter, flanked by two wings, one extending to the east and one to the north. The dome is very light, and rotates so easily that even the feeblest of the young ladies can manage it without difficulty. The arrangements for opening and closing the shutters which cover the slit in the dome, and the openings for the transit and prime vertical instrument, are worked with equal facility. In the dome is mounted a fine 8-inch equatorial by CLARK, completely fitted out with clock-work, finding-clock, micrometers, spectroscope, solar eye-piece, etc., and so arranged that the circles can be read and the clamps and tangent screws worked from the eye-piece of the instrument.

The object-glass is almost entirely the work of the senior ALVAN CLARK, and is one of the most perfect specimens of his art.

In the transit-room is mounted a meridian circle by FAUTH & CO., of Washington. The instrument has a telescope of 3 inches aperture, and circles of 16 inches diameter, reading to seconds by two microscopes. It has a reversing apparatus, and is fitted with a "latitude level" and micrometer, so that it can, if desired, be used as a zenith telescope. A large collimator is mounted upon a pier south of it, and in a corner of the room is a clock with DENISON escapement, also by FAUTH & CO., as is the chronograph, which is mounted in an adjoining closet. The Observatory possesses also a sextant and artificial horizon and a set of meteorological apparatus.

There is no instrument in the prime vertical room (which is used mainly as a waiting-room or for recitations), but it is provided with a pier and shutter, so that the meridian circle can be set up there if it is ever thought desirable to make observations in that plane.

SPICELAND, INDIANA.

Private Observatory.

Longitude from Washington, 33^m 30^s. W. (approximately).
Latitude, 39° 50′ N. (approximately).
Director : WILLIAM DAWSON.

TARRYTOWN, NEW YORK.

Private Observatory.

Longitude from Washington, 12^m 47.16^s E.
Latitude, 41° 04′ 21″ N.
Authority for longitude and latitude: United States Coast Survey.
Director : CHARLES H. ROCKWELL.

INSTRUMENTS:

(*c*) *Equatorial intrument :* makers,—glass, Dr. C. S. HASTINGS;—mounting, JOHN BYRNE; aperture of objective, 6⅛ inches; magnifying powers of eye-pieces, 60, 112, 170, 243, 327, 409, 751.

TROY, NEW YORK.

Williams Proudfit Observatory.

Longitude from Washington, 13^m 27.5^s E.
Latitude, 42° 43′ 52″. 89 N.
Authority for longitude and latitude: Longitude by electro-magnetic signals from United States Naval Observatory. Latitude determined by observations with the zenith telescope.
Director : Prof. DASCOM GREENE.

INSTRUMENTS:

(*b*) *Meridian transit instruments :* Makers,—one by E. KÜBEL, Washington; aperture, 2.5 inches; magnifying power, 60 diameters.

(*b′*) Makers, PHELPS & GURLEY, Troy; aperture, 2 inches; magnifying powers, 30 diameters.

(*c*) *Equatorial instruments :* Maker, HENRY FITZ, New York; aperture of objective, 3.5 inches; magnifying powers of eye-pieces, 45 to 200 diameters.

(*g*) *Clocks :* Mean time; makers, STOKELL, New York; and HOWARD, Boston.

(*h*) *Chronometers :* Sidereal; maker, J. FLETCHER, London.

(*i*) *Miscellaneous :* Sextant; TROUGHTON & SIMMS, London.

VEVAY, INDIANA.

Private Observatory.

Longitude from Washington, ———.
Latitude, ———.
Director : CHAS. G. BOERNER.

UNIVERSITY OF VIRGINIA.

Leander McCormick Observatory.

Longitude from Washington, 5^m 53.13^s W.
Latitude, 38° 2′ 1.2″ N.
Director: ORMOND STONE.

WASHINGTON, DISTRICT OF COLUMBIA.

United States Naval Observatory

Longitude from Greenwich, 5^h 8^m 12.09^s W.
Latitude, 38° 53′ 38.8″ N.
Directors: M. F. MAURY, 1841.
JAMES M. GILLISS, 1861.
CHARLES H. DAVIS, 1865.
BENJAMIN F. SANDS, 1867.
JOHN RODGERS, 1874.
STEPHEN C. ROWAN, 1882.
ROBERT W. SHUFELDT, 1883.
SAMUEL R. FRANKLIN, 1884.
GEORGE E. BELKNAP, 1885.
ALLAN D. BROWN, 1886.
ROBERT L. PHYTHIAN, 1886.

Created by the Navy Department in 1833.

INSTRUMENTS:

(*a*) *Meridian circles:* 1; makers, PISTOR & MARTINS; diameter of circles, 43.40 inches; divided to 2′; read by 4 microscopes to 0″.1; aperture of objective, 8.52 inches; for observations of the sun, aperture employed, 3 inches; magnifying power ordinarily employed, 186 diameters.

(*b*) *Meridian transit instruments:* Makers, ERTEL & SON, aperture 5.33 inches; magnifying powers 85, 86, 106, 118, 162.

(*b′*) Eight portable transits and zenith telescopes combined, used on Transit of Venus Expeditions.

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 26 inches; magnifying powers of eye-pieces, 176 to 1800.

(*c′*) Made by MERZ: 9.62 inches aperture; powers, 90–900.

(*c″*) Eight 5-inch equatorials by ALVAN CLARK & SONS, used on Transit of Venus Expeditions.

(*e*) *Photometers:* One nebula-photometer (Hastings' pattern) for use with the 26-inch equatorial.

(*f*) *Chronographs:* Some 10 or 12 in all, of various kinds.

(*g*) *Clocks:* Mean time, 2; sidereal, 6.

(*h*) *Chronometers:* Mean time, all the chronometers of the United States Navy are kept here. Sidereal, eight, by NEGUS.

WEST POINT, NEW YORK.

West Point Observatory.

Longitude from Washington, 12^m 22.71^s E.
Latitude, 41° 23′ 31″ N.
Director: Col. P. S. MICHIE, Ph. Dr.

No regular work is done at this observatory beyond the practical instruction of the cadets in the use of the various instruments and the solution of the usual problems connected with the determination of latitude, longitude, time, etc., and work for local time, and local co-ordinates.

In 1882 a fine and permanent observatory was erected, designed to combine the latest and most improved observatory plans and to be equipped well, and intended to be a regular working observatory.

WILLETS POINT, NEW YORK.

Field Observatory—Engineer School of Application.

Longitude from Washington, 13^m $04.39^s \pm 0.14^s$.
Latitude, 40° 47′ 21.59″ N. ± 0.08″.
Authority for longitude and latitude: Longitude determined by telegraphic time-signals from United States Naval Observatory, Washington; latitude determined by observations with zenith telescope.
Director: General HENRY L. ABBOT.

INSTRUMENTS:

(*b*) *Meridian transit instruments* (*four*): One; makers, LINGKE & Co., Silesia; aperture, 2½ inches; magnifying power, — diameters; focal length, 30 inches. One, Russian transit, aperture, 2.6 inches; STACKPOLE & BRO., New York; focal length, 30 inches. One, TROUGHTON, aperture, 2 inches; TROUGHTON, London; focal length, 30 inches. One, STACKPOLE; aperture, 2 inches; STACKPOLE & BRO., New York; focal length, 24 inches.

(*c*) *Equatorial instrument:* Makers, FAUTH & Co., Washington; aperture of objective, 5½ inches; magnifying powers of eye-pieces, assorted.

(*f*) *Chronographs:* HIPP'S; NEGUS-MORSE register.

(*h*) *Chronometers:* One mean time; makers, ARNOLD & DENT. One sidereal; makers, LUKENS, BOND & SON. Both break-circuit.

(*i*) *Miscellaneous:* One portable telescope, equatorially mounted; one zenith telescope—WILLIAM WÜRDEMANN; two sextants, STACKPOLE & BRO.; one personal equation machine; one barometer, GREEN'S cistern.

WILLIAMSTOWN, MASSACHUSETTS.

Field Memorial Observatory.

Longitude from Washington, $15^m\ 18.6^s$ E.
Latitude, 42° 42′ 49″ N.
Director: TRUMAN HENRY SAFFORD, Ph. D.

YPSILANTI, MICHIGAN.

State Normal School Observatory

Longitude from Washington, $26^m\ 10^s$ W.
Latitude, 42° 13′ N.
Authority for longitude and latitude, J. C. WATSON.
Director: LEWIS McLOUTH, M. A.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, GURLEY, Albany; aperture, 1½ inches; magnifying power, 30 diameters.

(*c*) *Equatorial instrument:* Maker, A. CLARK, Cambridgeport, Mass.; aperture of objective, 4 inches: magnifying powers of eye-pieces, 45, 90, 144, 210.

(*d*) *Spectroscope:* BROWNING, London, 2 prism.

(*h*) *Chronometer:* Sidereal; maker, NEGUS.

II. FOREIGN OBSERVATORIES.

ABERDEEN, SCOTLAND. (See DUN ECHT.)

ADELAIDE, SOUTH AUSTRALIA.

Observatory Branch of Post and Telegraph Department.

Longitude from Greenwich, $9^h\ 14^m\ 20.4^s$ E.
Latitude, 34° 55′ 33.8″ S.
Director: C. TODD, 1860.

ALGIERS, ALGERIA.

Observatoire National.

Longitude from Greenwich, $12^m\ 17^s$ E.
Latitude, 36° 44′ N.
Authority for longitude and latitude, A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: C. TRÉPIED.

ALTONA, PRUSSIA.

Sternwarte.

Longitude from Greenwich, $39^m\ 46.35^s$ E.
Latitude, 53° 32′ 45.3″ N.
Authority for longitude and latitude, Connaissance des Temps, 1884, p. xx.
Directors: H. C. SCHUMACHER, 1816.
A. C. PETERSEN (transient), 1851.
P. A. HANSEN, 1852.
C. A. F. PETERS, 1855.

Built in 1815; transferred to KIEL in 1873. (See Kiel.)

ANTWERP, BELGIUM.

Observatoire.

Longitude from Greenwich, $17^m\ 38.6^s$ E.
Latitude, 51° 12′ 28″ N.
Authority for longitude and latitude, A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: A. DE BOË.

ARMAGH, IRELAND.

Observatory.

Longitude from Greenwich, 26^m 35.5^s W.
Latitude, 54° 21′ 12.7″ N.
Authority for longitude and latitude, Connaissance des Temps, 1884, p. xiii.
Directors: J. A. HAMILTON, 1792.
T. R. ROBINSON, 1825.

ASHURT, ENGLAND.

Observatory.

Longitude from Greenwich, 1^m 16^s W.
Latitude, 51° 15′ 58″ N.
Authority for longitude and latitude, Connaissance des Temps, 1884, p. xiii.

ATHENS, GREECE.

Observatory.

Longitude from Greenwich, 1^h 34^m 55.7^s E.
Latitude, 37° 58′ 20″ N.
Directors: G. C. BOURIS, 1844,
J. F. J. SCHMIDT, 1858.

The observatory is an establishment of BARON GEORG VON SINA at Vienna. At the wish of the first Athenian astronomer, Professor BOURIS, Baron PROKERCH von OSTEN, the Austrian embassador at the Grecian court, by his influence, had favored the project, and on the 8th of July, 1842, during the great eclipse of the sun, KING OTTO laid the first brick on the Hill of the Nymphs, the northern extremity of the Hills of Onyx, northwesterly of the Akropolis, in an isolated situation, 105 meters above the level of the sea.

The founder of this establishment, GEORG VON SINA, died in May, 1856. His son, SIMON, Baron VON SINA, became the protector, and on May 15, 1858, appointed J. F. JULIUS SCHMIDT as astronomer, and on the 16th of December, 1858, as director:

BAMBERG, BAVARIA.

Sternwarte, C. Remeis.

Longitude from Greenwich, 43^m 32^s E.
Latitude, 49° 53′ 28″ N.
Director: E. HARTWIG.

BARNET, ENGLAND.

Arkley House Observatory (Private.)

Longitude from Greenwich, ——.
Latitude, ——.
Proprietor: J. CAMPBELL.

BASEL, SWITZERLAND.

Physikalisches Institut, Bernoullianum.

Longitude from Greenwich, 30^{m} 20^{s} E.
Latitude, 47° 33′ 40″ N.
Director: ED. HAGENBACH-BISCHOFF, 1874.

The institute was founded in 1874, and the astronomical instruments were mounted in 1878.

INSTRUMENTS:

(*a*) The *Meridian circle*, constructed by the Société Genevoise, with 2½-inch objective, by C. A. STEINHEIL.

(*c*) The *Equatorial* made by the "Société Genevoise pour la construction d'instruments de physique" mounted on an isolated pillar, under a movable dome of 16½ feet (5 meters) diameter. The instrument is provided with a centrifugal regulator, constructed according to Prof. M. THURY'S directions, with position micrometer, spectroscope, and camera obscura.

(*d*) *Spectroscope.*

(*g*) The *astronomical clock* was constructed by THEODOR KNOBLICH, in Hamburg.

The mean time is given by means of an electric pendulum, by M. HIPP, in Neuenburg.

Both clocks connect with a number of dials in various rooms, and also with the chronograph.

BASSES-PYRÉNNÉES, FRANCE.

M. D'Abbadie's Observatoire.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

BEDFORD, ENGLAND.

Observatory.

Longitude from Greenwich, 11^{m} 13^{s} W.
Latitude, 52° 8′ 28″ N.
Authority for latitude and longitude, Connaissance des Temps, 1884, page xiii.
Director: ——.

BENARES, INDIA.

Observatory.

Longitude from Greenwich, $5^h\ 22^m\ 31^s$ E.
Latitude, 25° 18′ 33″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, page xxxviii.
Director: ——.

BERGEN, NORWAY.

Naval Observatory.

Longitude from Greenwich, $21^m\ 13^s$ E.
Latitude, 60° 23′ 54″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Directors: C. F. G. BOHR, 1818.
J. J. ÅSTRAND, 1833.

Founded in 1788. Has only been used to furnish standard time.

BERLIN, PRUSSIA.

Königliche Universitäts Sternwarte.

Longitude from Greenwich, $53^h\ 34^m\ 91^s$ E.
Latitude, 52° 30′ 16.7″ N.
Authority for longitude and latitude: [LOEWY and LE CLERK] Connaissance des Temps., 1884, p. xxvi.
Directors: G. KIRCH, 1706.
J. H. HOFFMANN, 1710.
C. KIRCH, 1717.
J. W. WAGNER, 1740.
H. N. GRISCHOW, 1745.
J. KIES, 1754.
F. U. S. ALPINUS, 1755.
J. J. HUBER, 1756.
JEAN BERNOULLI, 1767.
J. E. BODE, 1786.
J. F. ENCKE, 1825.
W. J. FOERSTER, 1865.

Founded at the request of LEIBNITZ in 1705; completed in 1711. Originally situated in the suburb Dorotheenstadt, in the northern part of the city. A great square tower of five stories, 46 feet in length and 88½ feet in height. This observatory was re modelled in 1787 and again in 1800. In 1833 a new observatory was built at the southern extremity of the Charlotten strasse. It was here that GALLE discovered Neptune in 1846. The Astronomische Jahrbuch has been published annually since 1776.

BERN, SWITZERLAND.

Sternwarte.

Longitude from Greenwich, 29^m 45.66^s E.
Latitude, 46° 57′ 8.7″ N.
Directors: F. TRECHSEL, 1821.
R. WOLF, 1847.
J. KOCH, 1856.
H. WILD, 1859.
A. J. T. FORSTER, 1871.

Constructed upon a bastion in 1821. In plan a regular octagon, the circle described about which has a diameter of 65½ feet (20 meters).

BESANÇON, FRANCE.

Observatoire.

Longitude from Greenwich, 23^m 57.5^s E.
Latitude, 47° 14′ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: L. J. GRUEY.

BILK, PRUSSIA. (See DÜSSELDORF.)

BIRR CASTLE, IRELAND.

Parsonstown Observatory.

Longitude from Greenwich, 31^m 40.9^s W.
Latitude, 53° 5′ 47″ N.
Director: The EARL OF ROSSE.

INSTRUMENTS:
The celebrated 60-foot reflecting telescope, with a 6-foot speculum.

BLENHEIM PARK, OXFORD COUNTY, ENGLAND.

Observatory.

Longitude from Greenwich, 5^m 26^s W.
Latitude, 51° 50′ 28″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xiii.
Director: ——.

BOGOTÁ, UNITED STATES OF COLOMBIA.

I. *Observatorio Astronómico Nacional.*

Longitude from Greenwich, 4^h 56^m 59^s W.
Latitude, 4° 35′ 48″ N.
Directors: FRANCISCO JOSÉ DE CALDOS, 1805–1810.
BENEDICTO DOMINGUEZ, 1837.
INDALECIO LIEVANO, 1862.
JOSÉ M. GONZALES BENITO, 1867.

The observatory was built in 1803 under the auspices of the Viceroy Don PEDRO MENDIMETA and the botanist MUTIZ, according to the plans of DOMINGO PETRES. From 1810 to 1837 it was abandoned. It was finally reorganized in 1881, by order of the President of the Republic, RAFAEL NUÑEZ, by JOSÉ M. GONZALES BENITO, its present director.

II. *Observatoire Flammarion.*

Founded in 1881 by JOSÉ M. GONZALES BENITO, director of the National Observatory of Bogotá, in honor of CAMILLE FLAMMARION. It is built in the private dwelling of M. Gonzales.

BOLOGNE, ITALY.

Observatorio Astronomico.

Longitude from Greenwich, 45^m 24.9^s E.
Latitude, 44° 29′ 47″ N.
Director: A. SAPORETTI.

BOMBAY, INDIA.

Government Observatory at Colaba.

Longitude from Greenwich, 4^h 51^m 12.09^s E.
Latitude, 18° 53′ 45″ N.
Director: CHARLES CHAMBERS.

The principal work of the Colaba observatory is in the fields of terrestrial magnetism and meteorology, and astronomical observations are made only for the practical purpose of time-keeping, partly for the public service and partly for the use of the observatory.

BONN, PRUSSIA.

I. *Universitäts Sternwarte.*

Longitude from Greenwich, 28^m 23.29^s E.
Latitude, 50° 43′ 45″ N.
Authority for longitude and latitude: [LE CLERK and BENARDIÈRES] Connaissance des Temps, 1884, p. xxvi.
Directors: K. D. VON MÜNCHOW, 1818.
F. W. A. ARGELANDER, 1837.
E. SCHÖNFELD, 1875.

Founded in 1818, near the university. The erection of a more complete observatory was decided upon in 1837, and the new establishment was finished in 1840. It includes two halls for meridian instruments and five turrets. Here it was that the review of the heavens, known under the name of *Durchmusterung*, was undertaken and accomplished under the direction of ARGELANDER, including all stars up to the ninth magnitude.

II. *Photometrisches Observatorium.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: J. T. WOLF.

BOTHKAMP (NEAR KIEL), PRUSSIA.

Sternwarte des Kammerherrn von Bülow.

Longitude from Greenwich, $40^m\ 30.8^s$ E.
Latitude, 54° 12′ 9″ 6 N.
Owner: Kammerherr VON BÜLOW.
Astronomers: Dr. VOGEL, 1870.
Dr. LOHSE, 1870.
Dr. DE BALL, 1881, 1882.
F. C. LAMP, 1883.

The observatory was established in 1870. Most of the work done between the years 1870 and 1874 was spectral analysis by Drs. VOGEL and LOHSE. These gentlemen receiving a call to the Astro-physical Observatory at Potsdam, the observatory remained in idleness until 1881, when Dr. DE BALL took charge. On September 3, 1882, he discovered here a planetoid (230).

BORDEAUX, FRANCE.

Observatoire.

Longitude from Greenwich, $2^m\ 5.54^s$ E.
Latitude, 44° 50′ 17″ N.
Authority for longitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: G. RAYET, 1879.

The observatory, created by a decree of the President of the French Republic under date of March 11, 1878, was erected at the joint expense of the city and the Republic on the summit of a hill, about 4 kilometers (2½ miles) E.S.E. of the center of the city. Each instrument is placed in a separate building.

BREMEN, GERMANY.

I. *Observatorium der Navigations-Schule.*

Longitude from Greenwich, $35^m\ 15^s$ E.
Latitude, 55° 4′ 48″ N.
Director : ——.

II. *Observatorium des Herrn Olbers.*

Longitude from Greenwich, $35^m\ 15^s$ E.
Latitude, 53° 4′ 36″ N.
Authority for longitude and latitude: (Astr. Nach., IV, 392) Connaissance des Temps, 1884, p. XXVI.
Director : ——.

BRESLAU, PRUSSIA.

Universitäts Sternwarte.

Longitude from Greenwich, $1^h\ 8^m\ 8.90^s$ E.
Latitude, 51° 6′ 56.5″ N.
Directors : L. A. JUNGNITZ, 1780.
E. J. SCHOLTZ, 1831.
P. H. L. von BOGUSLAWSKI, 1841.
Prof. DR. J. G. GALLE, 1851.

Established by L. A. JUNGNITZ.

Observations here were begun about 1760 at the gymnasium, (high-school) where J. E. Scheibel, the professor of mathematics, had collected a few instruments. They were continued at the university, and the observatory properly so called was gradually developed.

BREST, FRANCE.

Observatoire de la Marine.

Longitude from Greenwich, $17^m\ 58^s$ W.
Latitude, 48° 23′ 32″ N.
Authority for longitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887; for latitude, Connaissance des Temps, 1884, p. iv.
Director : DE KERMAREC.

BRUSSELS, BELGIUM.

I. *Observatoire Royal.*

Longitude from Greenwich, $17^m\ 28.9^s$ E.
Latitude, 50° 51′ 10.7″ N.
Directors : L. A. J. QUETELET, 1829.
J. C. HOUZEAU, 1876.
F. FOLIE, ——.

Projected in 1826, begun in 1829, completed in 1831. A large hall for meridian observations is located between two wings, each surmounted by a turret.

II. *Observatoire de C. Montigny* (*Private*).

Longitude from Greenwich, ——.
Latitude, ——.
Director: C. MONTIGNY.

BUDA-PESTH, HUNGARY.

I. *Sternwarte.*

Longitude from Greenwich, 1^h 16^m 13^s E.
Latitude, 47° 29′ 12″ N.
Authority for longitude and latitude: (LINDENAU, 1846, c. 1866), Connaissance des Temps, 1884, p. xxix.
Directors: J. PASQUICH, 1804.
P. TITTEL, 1824.
L. MAYER, 1831.

Founded upon the "Blocksberg" or "Gerhardsberg" in 1803, and was destroyed in 1849.

II. *Geodetisches Observatorium des Polytechnikums.*

Longitude from Greenwich, 1^h 16^m 15.4^s E.
Latitude, 47° 29′ 34.7^s N.
Authority for longitude and latitude, A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: STEPHEN KRUSPER.

III. *K. Ung. Central-Anstalt für Meteorologie und Erdmagnetismus.*

Longitude from Greenwich,
Latitude,
Director: Dr. GUIDO SCHENZL.

BUKAREST, ROUMANIA.

Universitäts Sternwarte.

Longitude from Greenwich, 1^h 44^m 26^s E.
Latitude, 44° 25′ 39″ N.
Director: ——.

BUSHEY HEATH, ENGLAND.

Observatory.

Longitude from Greenwich, 1^m 20^s W.
Latitude, 51° 37′ 44″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xiii.
Director: ——.

CADIZ, SPAIN.

Naval Observatory. (See *San Fernando.*)

CAIRO, EGYPT.

Observatoire Khédivial.

Longitude from Greenwich, $2^h\ 5^m\ 8.91^s$ E.
Latitude, 30° 4′ 38.2″ N.
Authority for longitude and latitude: Liste Générale des Observatoires et Astronomes, 1887.
Director: MAHMOUD.
Founded about 1850.

CAMBRIDGE, ENGLAND.

Cambridge Observatory.

Longitude from Greenwich, 22.75^s E.
Latitude, 52° 12′ 51″.6 N.
Directors: W. LUDLAM, 1767.
A. SHEPHERD, 1769.
S. VINCE, 1797.
R. WOODHOUSE, 1820.
G. B. AIRY, 1827.
J. CHALLIS, 1836.
J. C. ADAMS, 1860.

Commenced at Christ College; removed to St. John's College in 1767. In 1764 a special location was assigned to it above the entrance gate of Trinity College. The senate of the university caused a better observatory to be erected in 1820, which was completed in 1824. The structure consists of four halls, forming a cluster of buildings.

CAPETOWN, AFRICA.

Royal Observatory, Cape of Good Hope.

Longitude from Greenwich, $1^h\ 13^m\ 55^s$ E.
Latitude, 33° 56′ 3.4″ S.
Authority for longitude, HENDERSON; for latitude, E. J. STONE.
Directors:
F. FALLOWS, 1820.
T. HENDERSON, 1831.
T. MACLEAR, 1834.
E. J. STONE, 1870.
DAVID GILL, 1879.

Founded in 1820. Owned no instruments of importance until 1829. It was not at this observatory that JOHN HERSCHEL made his observations, but some distance from here on a private estate called *Feldhausen.*

INSTRUMENTS:

(*a*) *Meridian circle*, by RANSOME & SIMMS for the engineering part; TROUGHTON & SIMMS for micrometric and optical part; a sister instrument to the Greenwich circle; diameter of circles, 66 inches, divided to 5′; read by 6 microscopes to 0′.01 estimating easily to 0′.001 as at Greenwich. Aperture of objective, 8 inches; magnifying power always employed, 200 diameters.

(*c*) *Equatorial instruments:* Makers, object-glass by MERZ, mounting (German form) by TROUGHTON & SIMMS; aperture of objective, 6.9 inches; magnifying power of eye-pieces, 40 to 400. (*c*′) Small equatorial, 3.6-inch aperture (DOLLARD), 46 inches focal length, mounting on long polar axis (English form), maker unknown; without clock-work, at present dismounted.

(*d*) *Spectroscope:* Spectroscope by TROUGHTON & SIMMS.

(*f*) *Chronograph*, one by BOND, not at present in use.

(*g*) *Clocks:* One mean time; maker, MOLYNEUX: one sidereal, maker, BARRAUD.

(*h*) *Chronometers:* Mean time and sidereal. A supply of these instruments kept for use of Her Majesty's ships; consequently frequently changed.

(*i*) *Miscellaneous:* A heliometer of 5 feet focal length, 4 inches (French) aperture. Tube and cradle by REPSOLD, mounting by GRUBB. (This instrument is the private property of Mr. GILL.)

CARLSBURG, HUNGARY.

Sternwarte.

Longitude from Greenwich, $1^h\ 34^m\ 17^s$ E.
Latitude, 46° 4′ 17″ N.
Auchority for longitude and latitude: Connaissance des Temps, 1884, p. xxix.
Director: Domherr FRANZ BARES.

CATANIA, ITALY.

Observatory on Mount Etna.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

CHAPULTEPEC, MEXICO. (See TACUBAYA.)

Observatorio Astronómico Nacional.

Longitude from Greenwich, $6^h\ 36^m\ 38.24^s$ W.
Latitude, 19° 25′ 17.5″ N.

Projected in 1876; established in 1878; transferred to TACUBAYA on March 8, 1883.

CHRISTIANIA, NORWAY.

Universitäts-Sternwarte.

Longitude from Greenwich, 42^m 53.65^s E.
Latitude, 59° 54′ 43.7″ N.
Authority for longitude and latitude: Beschreibung und Lage der Universitäts-Sternwarte in Christiania; Verhandlungen der fünften allgemeinen Conferenz der europäischen Gradmessung, p. 300; Expéd. chronom. exécutée en 1844 entre Alton et Greenwich.
Directors: C. HANSTEEN, 1815.
C. FEARNLEY, 1873.

Projected in 1815; constructed in 1818; rebuilt at some distance from the first structure in 1830.

INSTRUMENTS:

(*a*) *Meridian circles:* One; makers, ERTEL, with objective by FRAUENHOFER and UTZSCHNEIDER: diameter, 38 inches; divided to 3′, read by 4 microscopes to 2″; aperture of objective, 4 inches; magnifying power, 180 diameters.

(*b*) *Portable transit instrument:* PISTOR & MARTINS, makers; aperture of objective, 2 inches; magnifying power, 80 diameters.

(*c*) *Equatorial* by A. & G. REPSOLD. Diameter of circles, 30 inches, divided to 3′; read by 2 microscopes to 1″; aperture of objective, 4½ inches; magnifying power, 50–290. Wire micrometer and ring micrometer. (*c′*) Refractor: Makers, G. MERZ & SÖHNE; objective, 7 inches; magnifying power, 80–600; diameters of circles 10 and 14 inches; read by 2 Noniers each to 4^s and 10″. Wire micrometer.

(*d*) Small universal star-spectroscope by MERZ, à vision directe.

(*g*) *Clocks:* One sidereal: pendulum, by KESSELS, 1365; one mean time, by URB. JURGENSEN OG SÖNNER (for the bifilar): one by L. LAMTVORK (for the unifilar); F in the magnetic building.

(*h*) *Chronometers:* Mean time; (Box) KESSELS, 1259; (Pocket) KESSELS, 1280: one sidereal; DENT, 2103.

(*i*) Unifilar magnetometer, by MEYERSTEIN; bifilar magnetometer, by MEYERSTEIN inclinatometers, by GAMBEY, BARLOW, Dover; siphon barometer, by PISTOR; cistern barometer, by FORTIN; thermometers, pluviameters, etc.

CHURTS, ENGLAND.

Private Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: R. CARRINGTON.

Discontinued upon the death of Mr. CARRINGTON in 1875.

Coimbra, Portugal.

Observatorio Magnetico-Meteorologico de la Universidade de Coimbra.

Longitude from Greenwich, $33^m\ 34.1^s$ W.
Latitude, 40° 12′ 25.8″ N.
Directors: J. Monteiro de Rocha, 1796.
De Pinheiro, 1820.
De Souza Pinto, 1855.

Established about 1796. From 1779 to the present time the Astronomical Ephemeris has been published here, which for ten years previous (1789) had been issued at Lisbon.

Collooney, Ireland (See Markree).

Cologne, Prussia (See Klön).

Colombo, Ceylon, Asia.

Private Observatory.

Longitude from Greenwich, $5^h\ 19^m\ 23^s$ E.
Latitude, 6° 55′ 33″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xxxix.
Director: Mr. Green.

Constantinople, Turkey.

Observatoire Impérial.

Longitude from Greenwich. $1^h\ 55^m\ 56^s$ E.
Latitude, 40° 1′ 40″ N.
Authority for longitude and latitude: A. Lancaster, Liste Générale des Observatoires et Astronomes, 1887.
Director: A. Coumbary.

Copenhagen, Denmark.

Universitets Astronomiske Observatorium.

Longitude from Greenwich, $50^m\ 19.2^s$ E.
Latitude, 50° 41′ 13.6″ N.
Directors: C. Lumborg, 1637.
T. Bartholin, 1647.
O. Roemer, 1681.
Peter I. Horrebow, 1714.
C. Horrebow, 1753.
T. Bugge, 1777.
H. C. Schumacher, 1815.
Von Caroc, 1822.
C. F. R. Olufsen, 1832.
H. D'Arrest, 1856.
T. N. Thiele, 1875.

Founded in 1637, but only completed in 1656. The first edifice was destroyed by fire the 20th of October, 1728. The observatory was re-established in the round tower belonging to the University. In 1820 a wooden addition was made to it on the Holken bastion. In 1857 it was removed to the glacis of the fortress between the citadel and the Osterthor (eastern gate). In 1859-'60, a new building was erected upon the Rosenborg bastion of the old fortress. At present this new observatory is surrounded by the Botanical Garden.

CORDOBA, ARGENTINE REPUBLIC.

Observatorio Nacional Argentino.

Longitude from Greenwich, $4^h\ 16^m\ 45.1^s$ W.
Latitude, 31° 25′ 15.4^s S.

Director: B. A. GOULD, 1870.

Proposed in 1869; built in 1871 on an eminence southeast of the town; a cruciform structure, with four towers at the extremities of the limbs of the cross.

CORK, IRELAND.

Observatory of Queen's College.

Longitude from Greenwich, $33^m\ 51^s$. W.
Latitude, 51° 54′ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xiii.
Director: ——.

Founded in 1878. Hill for meridian observations. Dome, 14¾ feet ($4^m.5$) in diameter.

CRACOW, AUSTRIA. (See KRAKAU.)

K. K. Universitäts Sternwarte.

CRONSTADT, RUSSIA. (See KRONSHTADT.)

Naval Astronomical Observatory.

CROWBOROUGH, SUSSEX, ENGLAND.

Private Observatory.

Longitude from Greenwich: 9.30^s E.
Latitude: 51° 3′ 14″ N.
Director: CHAS. LEESON PRINCE.

Founded at Uckfield, Sussex, in 1854. Removed to the summit of Crowborough Hill in 1872.

CUCKFIELD, ENGLAND.

Observatory of G. Knott (Private).

Longitude from Greenwich, 0^m 34^s W.
Latitude, 51° 0′ 35″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: G. KNOTT.

CZERNOWITZ, AUSTRIA.

Physikalisches Institut der k. k. Franz Josephs Universität.

Longitude from Greenwich, ———.
Latitude, ———.
Director: Prof. ALOIS HANDL.

DANZIG, PRUSSIA.

Observatorium der Naturforschenden Gesellschaft.

Longitude from Greenwich: 1^h 14^m $37^s.9$ E.
Latitude: 54° 25′ 58″ N.
Directors: VON WOLF, 1780.
Dr. BERENDT, 1784.
Dr. JUL. AUG. KOCH, 1792–1817.
Dr. WESTPHAL, 1820–1821.
Dr. THEODOR ANGER, 1831.
——— FLEMMING, 1840.
——— KAYSER, 1860.

The observatory was planned by WOLF, and in 1780 the corner stone for the building was laid by him on the summit of the Bishofsberg, an elevated position. In 1781 the building was completed and used by WOLF; on the 17th of December, 1781, for the observation of the solar eclipse.

In 1806 the invasion of the French army necessitated the removal, to a safe location in the city, of the instruments, and the building on the Bishofsberg was occupied by the French army and partly torn down, but through the exertions of Dr. KLEEFELD, of the society, the French provincial governor, General RAPP, had it restored. In 1812, however, its complete devastation became a necessity of war.

In 1818 the society reclaimed the old site, intending to rebuild the observatory; the failure of obtaining the requisite funds, however, caused the project temporarily to be abandoned.

Meteorological observations alone were continued in Schönberg, near Carthaus. The collecting of astronomical instruments was continued, and in 1831 a small observatory was erected upon the "Apotheke," in the "Neugarten."

In 1866 the society authorized the erection of the present observatory, which was completed and inaugurated on the 2d of January, 1868, the one hundred and twenty-fifth anniversary of the Naturforschende Gesellschaft.

DERPT (DORPAT), RUSSIA.

Imperatorskaia Astronomicheskaia Observatoria.

Longitude from Greenwich, 1^h 46^m 53.5^s E.
Latitude, 58° 22′ 47.4″ N.
Directors: J. W. A. PFAFF, 1808.
F. G. W. STRUVE, 1813.
J. H. MADLER, 1840.
T. CLAUSEN, 1874.
L. SCHWARZ, 1878.

Founded in 1808 as a dependency of the university. In 1825 FRAUNHOFER'S equatorial, with an aperture of 9 inches and a focal length of 13½ feet, moved by clock-work, the largest and most powerful refractor in the world at that time, was mounted there. With the help of this instrument the elder STRUVE accomplished his famous *Mensuræ Micrometricæ*, published in 1837, and continued by his successor.

DENTZ, GERMANY.

Sternwarte des Herrn E. Mengering (Private).

Longitude from Greenwich, 27^m $49^s.9$ E.
Latitude, 50° 56′ 33″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: E. MENGERING.

DRESDEN, SAXONY.

I. *Königliches Mathematisch-Physikalisches Institut.*

Longitude from Greenwich, 54^m 56^s E.
Latitude, 51° 3′ 45″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Directors: J. OTTO, 1560–1580.
M. JOSTELIN, 1580–1609.
L. BRUNNER, 1609–1637.
TH. HÄSELL, 1637–1661.
TOB. BEUTEL, 1661–1720.
B. MICHAELIS, 1720–1740.
H. EULENBURG, 1740–1743.
F. WALZ, 1743–1747.
J. MAYEN, 1747–1768.
E. ZEITER, 1768–1783.
G. KÖHLER, 1783–1801.
S. SEIFFERT, 1801–1818.
A. SCHMIDT, 1818–1828.
G. LOHRMANN, 1828–1840.
R. BLOCHMANN, 1840–1869.
A. DRECHSLER, 1869.

The Royal Mathematical-Physical Institute, an astronomical and meteorological observatory, together with a considerable collection of astronomical, physical, and mathematical instruments, dating principally from the XVI, XVII, and XVIII centuries, had its origin in the cabinet of art which was founded in 1560 by August I, Elector of Saxony.

II. *Private Observatorium des Herrn B. von Engelhardt.*

Longitude from Greenwich, 54^m 54.80^s E.
Latitude, 51° 2′ 16.80″ N.
Director: B. VON ENGELHARDT.

III. *Private Observatorium des Herrn Dr. Hugo Guericke.*

Longitude from Greenwich, ———.
Latitude, ———.
Director: Dr. HUGO GUERICKE.

DRONTHEIM, NORWAY.

Observatory.

Longitude from Greenwich, 41^m 49^s E.
Latitude, 63° 25′ 48″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. XX.

DUBLIN, IRELAND.

Dunsink Observatory.

Longitude from Greenwich, 25^m 21^s W.
Latitude, 53° 23′ 13″ N.
Authority for longitude and latitude: Dr. BRÜNNOW.

Directors: H. USSHER, 1774.
J. BRINKLEY, 1792.
W. R. HAMILTON, 1827.
F. BRÜNNOW, 1865.
ROBERT S. BALL, Astronomer Royal of Ireland, 1875.

Dunsink Observatory belongs to Trinity College, Dublin. It was founded in 1774, by means of a legacy left for the purpose by F. ANDREWS. It is built in the midst of a vast park at Dunsink, 3¾ miles (6 kilometers) northwest of Dublin, and was not finished until 1792. It is a structure of three stories, surmounted by a revolving dome. An annual visitation of the Observatory is held every summer by the board of Trinity College.

INSTRUMENTS:

(*a*) *Meridian circle:* Makers, PISTOR & MARTINS; diameter of circles, 36 inches; divided to 2′; read by 8 microscopes to 1″; aperture of objective, 6.4 inches; magnifying power ordinarily employed, 180 diameters.

(*b*) *Meridian transit instruments:* One, made by RAMSDEN; aperture, 4 inches; not in use. (*b*′) One with reversible circle by RAMSDEN & BERGE; object-glass, 3 inches; diameter of circle, 8 feet; 3 micrometers; not in use.

(*c*) *Equatorial instruments:* One; makers, CAUCHOIX object-glass, GRUBB mounting; aperture of objective, 11¾ inches; magnifying powers of eye-pieces, 300; is generally used. (*c*′) One of 4 inches aperture; English equatorial by TULLEY. (?) Hardly ever used.

(*d*) *Spectroscopes:* One of BROWNING'S 2-prism spectroscopes; and one of VOGEL'S small-star spectroscopes.

(*f*) *Chronograph:* Maker, GRUBB; two barrels and controlled clock.

(*g*) *Clocks:* One mean time; maker, BOOTH, of Dublin; one sidereal; maker, DENT, London.

(*h*) *Chronometer:* Sidereal; maker, M'MASTER.

(*i*) *Miscellaneous:* The mean-time clock controls by electricity the clocks in the port and docks board and Trinity College, the distance being about 5 miles from Dunsink.

DUN ECHT (ABERDEEN), SCOTLAND.

Longitude from Greenwich, $9^m\ 40^s$ W.
Latitude, 57° 9′ 36″ N.
Authority for longitude: Ordnance Survey; for latitude, observations with a SIMMS'S alt-azimuth. The transit circle confirms the result within a fraction of a second.
Astronomer: RALPH COPELAND.

Dun Echt Observatory, the property of the EARL OF CRAWFORD AND BALCARRES (late Lord Lindsay), is on the estate of Dun Echt, about 13 miles west of Aberdeen.

INSTRUMENTS:

(*a*) *Meridian circles:* 1. Transit circle by TROUGHTON & SIMMS; one movable and one fixed circle; diameter 36 inches, divided to 5″; 16 microscopes (carried by 2 Alidade circles, 1 movable and 1 fixed), reading to 1″-tenth by estimation; aperture of object-glass 8.59 inches; $6\frac{1}{6}$-inch collimators; $2\frac{1}{2}$-inch axle telescope. 2. Reversing transit with V's for meridian and prime vertical, by T. COOKE & SONS; 4-inch object-glass. 3. Transit instrument by TROUGHTON & SIMMS; $2\frac{3}{4}$-inch object-glass.

(*b*) *Meridian transit instruments:* 1. Alt-azimuth, by TROUGHTON & SIMMS; 12-inch circles, divided to 5′; 4 microscopes, vertical and horizontal circles reading seconds and tenths by estimation. Horizontal circle movable. 2. Theodolite by T. COOKE & SONS. 3. Theodolite by APPS.

(*c*) *Equatorial instruments:* One 15.06-inch refractor by GRUBB. Several sets of eye-pieces. Bifilar micrometer. MERZ helioscope. DAWES solar eye-piece, 2, 3, 74-inch finders. This telescope is controlled absolutely by the sidereal clock. Driving-clock by T. COOKE & SONS, made to special design. 2. One 12.9-inch reflector 122.5 focus; mirror by Rev. H. COOPER KEY, English mounting. 3. One $12\frac{1}{4}$-inch reflector by BROWNING. Solar spectroscope. 4. One 6.06-inch refractor by SIMMS; bifilar and double image micrometers, used generally for comet seeking. 5. One 6.04-inch refractor by T. COOKE & SONS; complete. 6. One 4-inch refractor by T. COOKE & SONS; bifilar micrometer. Clock by EICHENS; complete. 7. One 3-inch refractor by T. COOKE & SONS. Bifilar micrometer; complete.

(*d*) *Spectroscopes:* Large solar spectroscope with 1 whole and 2 half RUTHERFURD prisms, with reversion and heliometer viewing telescope. Stellar spectroscope modified at Dun Echt (the one most used). BROWNING 5-prism automatic solar spectroscope and 2 stellar ones; also VOGEL spectroscope by HEUSTRELL, and a variety of direct vision, quartz, and other prisms. Besides the above-mentioned spectroscope there is a 6-prism automatic reversing-table instrument by BROWNING, and a hand direct-vision spectroscope used for auroræ.

(*e*) *Photometer:* ZÖLLNER astro-photometer by AUSFELD of Gotha.

(*f*) *Chronographs:* 1. Four-fold barrel-chronograph, each barrel to run six hours, driven by the same clock as the 15.06-inch equatorial. 2. Portable fillet chronograph by SIEMENS.

(*g*) *Clocks:* 1. Sidereal clock, quicksilver compensation by FRODSHAM. 2. Mean-time clock, quicksilver compensation by MOLYNEUX. 3. Electric clock, outside dial and time gun.

(*h*) *Chronometers:* 1. KULLBERG; mean time. 2. FARQUHAR; mean time. 3. J. WALKER; mean time. 4. FRODSHAM; mean time 8-day. 5. WALKER; sidereal (electric contact). 6. WALKER; sidereal. 7. MCLENNAN; $\frac{4}{10}$ seconds; pocket M. T.

(*i*) *Miscellaneous:* 1. Metre: A copy of the Mêtre du Conservatoire.

FROMENT. 2. Linear dividing engine by FROMENT. 3. Linear dividing engine by ELLIOTT BROTHERS. 4. Photograph measuring machine by GRUBB. 5. Balance by OERTLING. 6. Five 2-meter and one 1¼-meter bars; GRUBB. 7. Two comparator microscopes and long stone table. 8. Ten-inch wheel cutting engine, Swiss; JENSSEN & HENSEN.

(*j*) 1. Sprengel pump six end on and many GEISSLER tubes. 2. Air-pump and apparatus.

(*k*) Various photographic apparatus.

(*l*) A large assortment of electrical and electro-magnetical apparatus. One standard and one marine barometer, NEGRETTI & ZUMBRA. Various thermometers. Seven-inch spherometer, 1 part=$\frac{1}{10000}$ inch, $\frac{1}{100000}$th by estimation; 4-inch spherometer; both by HILGER. Arithmometer by THOMAS DE COLMAR; six places. Arithmometer by THOMAS DE COLMAR; ten places. Foucault siderostat by EICHENS; 16-inch mirror (and a spare one), silver in glass, by A. MARTIN. Silbermann heliostat by DUBOSCQ. Heliostat by BROWNING. King's barograph and anemograph by CASELLA. Binocular microscopes by SMITH & BECK and ROSS. Polariscope by LADD; 10-inch, 6-inch, and 4-inch induction coils by APPS. A large collection of cut crystals; also diffraction apparatus by SCHWERD.

DURBAN (NATAL), AFRICA.

Observatory.

Longitude from Greenwich, $2^h\ 2^m\ 1.18^s$ E.
Latitude, 29° 50′ 47.4″ S.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: E. NEISSON, Government Astronomer.

DURHAM, ENGLAND.

University Observatory.

Longitude from Greenwich, $6^m\ 19^s.75$ W.
Latitude, 54° 46′ 6.2″ N.
Directors: TEMPLE CHEVALLIER, 1840.
SAMUEL WAYMOUTH, 1872.
ROBERT JOHN PEARCE, 1873.

Founded by subscription, 1840. First observations made in 1842. The observatory is under the general superintendence of the professor of mathematics in the University of Durham.

DÜSSELDORF, PRUSSIA.

Sternwarte (formerly at Bilk near Düsseldorf).

Longitude from Greenwich, $27^m\ 5^s$ E.
Latitude, 51° 12′ 25″ N.
Authority for longitude and latitude, "Astronomische Nachrichten," 643, und "Berliner Jahrbuch."

Directors: J. F. BENZENBERG, 1809–1846.
F. BRÜNNOW, 1847–1851.
ROBERT LUTHER, 1851.

Established in 1809, by J. F. BENZENBERG, the savant, who in 1844 erected a more complete building at BILK, 1¼ miles (2 kilometers) south of the town. This establishment, liberally endowed by its founder, became the property of the town in 1847, and was enlarged by it in 1852.

INSTRUMENTS:

(*a*) An old repetition circle of 1 foot, by the late BAUMANN, at Stuttgart, giving 10″ of centesimal division.

(*b*) Meridian transit instrument made by the late EMIL SCHROEDTER, at Düsseldorf, objective from Munich, focal distance 2 feet, aperture 2 inches, little circle divided in half degrees, with nonius, 1 minute.

(*c*) New equatorial instrument, by CHARLES BAMBERG, at Berlin, in use since September, 1877, objective by Dr. SIGMUND MERZ, at Munich, focal distance 7 feet, aperture 7 inches, magnifying powers of eye-pieces 49 to 188. Stars of the 11.5 magnitude can be seen with it. Old reserve tube, with horizontal and vertical motion, made by MERZ & SONS, at Munich, 1847, focal distance 6 feet, aperture 4⅓ inches. Stars of the 11.0 magnitude can be seen with it.

(*n*) Two old sidereal-time clocks made by UTZSCHNEIDER & FRAUENHOFER, at Munich.

(*h*) One mean-time chronometer by KESSELS, at Altona, and a Swiss watch.

Some small instruments of minor importance.

EDINBURGH, SCOTLAND.

I. *Royal Observatory.*

Longitude from Greenwich, $12^m\ 43.05^s$ W.
Latitude, 55° 57′ 23.2″ N.
Authority for longitude: C. PIAZZI SMYTH; for latitude, THOMAS HENDERSON.
Directors: THOMAS HENDERSON, 1833–1844.
C. PIAZZI SMYTH, 1845.

A preceding so-called observatory tower existed on the site, which is a grassy and rocky hill-top in the midst of the city, from 1776, but no observations of scientific character were ever made there. It was founded by subscription, and was not completed until 1792. The present observatory was projected in 1812 and erected on shares in 1812. The municipality donated the ground. In 1833 the founders ceded its administration to the state, and in 1846 made over the ownership.

It is by no means a model building for an observatory, being small, isolated, smoke-exposed, without dwelling-houses attached, often difficult of access at night, hide-bound by its too ornamental white-stone Greek architecture; and looking, as well as acting, rather like a classical temple of the winds than a modern working observatory.

II. *Ben Nevis Observatory.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

ELSFLETH (OLDENBURG), GERMANY.

Sternwarte der Navigations Schule.

Longitude from Greenwich, $33^{m}\ 52^{s}$ E.
Latitude, 53° 14′ 46″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884.
Director: C. BEHRMANN, 1876.

ERLAU, HUNGARY.

Sternwarte.

Longitude from Greenwich, $1^{h}\ 30^{m}\ 32^{s}$ E.
Latitude, 47° 54′ 4″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884.
Director: DR. ALBERT FRANZ VON MONTEDEGO.

EKATHERINEBOURG, RUSSIA.

Magnetic and Meteorological Observatory.

Longitude from Greenwich, $4^{h}\ 2^{m}\ 48^{s}$ E.
Latitude, 56° 49′ N.
Authority for longitude and latitude: KUPFFER, 1841; FRITSCHE, 1873 and 1876; SCHARNHORST und KUHLBERG, 1875.
Director: G. O. CLERK.

The observatory was built in 1835; regular observations began on January 1, 1836. It took part in the work of the first "Magnetischer Verein," and has lately been required to act as a "polar observatory," from August 1, 1882, until September 1, 1883, according to the programme of the International Polar Commission, St. Petersburg, August, 1881.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Makers, ERTEL & SOHN (small passage instrument), aperture, 1.5 inches. (*b'*) Another by BRAUER in St. Petersburg (universal instrument).

(*g*) *Clocks:* One mean time; maker, F. FLAUTH, in St. Petersburg (without No.); another regulator, without name.

(*h*) *Chronometers:* Mean time; makers, F. FLAUTH, No. 37; WIREN, No. 86.

(*i*) *Miscellaneous:* Magnetic theodolite, BRAUER, No. 37; BRAUER'S compass for magnetical declination and intensity; GAMBEY'S inclinatorium; variation magnetometers (syst. GAUSS); several series of meteorological instruments of different construction; thermometers for observation of the temperature from superficy to 3 meters depth.

FLORENCE, ITALY.

I. *Reale Osservatorio Astronomico di Firenze ad Arcetri.*

Longitude from Greenwich, $45^m\ 3.13^s$ E.
Latitude, 43° 45′ 14.3″ N.
Authority for longitude and latitude: Royal Staff of Engineers.
Director: GUGLIELMO TEMPEL.

II. *Observatory of the Royal Museum.*

Longitude from Greenwich, $45^m\ 1.5^s$ E.
Latitude, 43° 46′ 4.1″ N.
Directors: PROF. F. FONTANA, 1784.
ALESSANDRO GALILEI.
—— FABBRONI, 1805.
COUNT GIROLAMO BARDI, 1807.
DOMENICO DE VECCHI, 1808.
GAETAMO DEL RICCO, 1814.
FATHER INGHIRAMI, 1815.
LUIGI PONS, 1825.
GIOVANNI BATTISTA AMICI, 1837.
G. B. DONATI, 1859.
DOMENICO CIPOLETTI, 1873.
PROF. PITTEI, 1874.
GUGLIELMO TEMPEL, 1875.

III. *Meteorological Observatory of the Royal Museum.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: DR. PITTEI, 1875.

IV. *Observatory of San Giovannino* (*Ximeniano*).

Longitude from Greenwich, ——.
Latitude, ——.
Director : Prof. F. CECCHI.

Founded by FATHER LEONARDO XIMENES, a Jesuit.

In the annals of the Imperial Museum of Florence, Vol. II, for the year 1810, we read that about the year 1784, the Grand Duke LEOPOLD I gave directions to his architect, GASPERO PAOLETTI, to make the designs for an observatory to be erected within the precincts of the Imperial and Royal Museum of Physical Science and Natural History of Florence, of which the ABBÉ FÉLIX FONTANA was director.

Prof. DOMENICO DE VECCHI, in an astronomical report inserted in the above-mentioned annals, declares that after diligent search he was unable to discover any historical document relative to the erection of this observatory, and that the date of 1774 was given him by the Engineer DEL ROSSO. The same professor De Vecchi, in the introduction to the description of the Imperial Observatory (above annals, Vol. II), declares it to have been already constructed and furnished with some instruments as far back as the year 1775.

In the year 1784, there had been collected in the observatory a clock, a transit instrument, and zenith sector, for the work of Professor SLOP, of the University of Pisa, who also constructed a meridian, passing under the pavement of a hall, which owes its name to this circumstance and bears the following inscription: "Linea meridiana ducta in observatrio Regii Musæi Scientiorum Florentini, Petro Leopoldo, Imperante anno, MDCCLXXXIV."

In the year 1784, Professor FONTANA began the meteorological observations, using eight large instruments of his own invention and constructed under his attention, care, and direction. Arrested in his career by calumny, and in consequence withdrawn from the Museum. Fontana was succeeded as director *pro tempore* by ALESSANDRO GALILEI; he was succeeded by FABBRONI, nominated by the ecclesiastical party in 1789 vice-director under Fontana.

On the 1st of January, 1805, we find the entry of the death of this distinguished scientist, at a distance from that Museum, to which he had rendered such service as instructor and director.

Shortly after, FABBRONI having been appointed director of the mint, Count GIROLAMO BARDI was named director of the museum in his place. He immediately founded several chairs of instruction, among them one of astronomy, which was assigned to DOMENICO DE VECCHI, professor of physical sciences at the University at Sienna, and to him was also entrusted the directorship of the observatory (1807).

DE VECCHI remained in this position in the Florentine Observatory until July, 1814, when he was removed by an order of the Commissario Plenipotenziario, Prince RASPIGLIOLI, under date of June 22, 1814. (This order is found in a letter addressed to the director of the museum, number 92, in the file of papers relating to the transactions of the I. and R. Museum for the year 1814.) Professor DE VECCHI himself refers to this suppression in the memorial before mentioned, in speaking of the methods of observing with reflecting instruments. Professor DE VECCHI never returned to his office as instructor in the observatory.

In the letter of Prince RASPIGLIOLI to the director of the museum it was also stated: "I think it well to inform you that Father GAETANO DEL RICCO has been invited to take charge of the preservation of the astronomical instruments," which, in consequence, were received from the professor himself, and held from June, 1814, to May 17, 1818, on which day, having passed from this life, Father GAETANO DEL RICCO was succeeded by Father INGHIRAMI, professor of astronomy in the Ximeniano Observatory.

At this point it is necessary to observe that the observatory of the Royal Museum was always an entirely distinct institution from that of San Giovannino, some time designated degli Scolopi, the latter having been founded by Father LEONARDO XIMENES, Jesuit, from whom it derived the name of Ximeniano, which it retains and by which it is at this time especially distinguished.

Father INGHIRAMI held the position until the 7th of October of the same year, when, by desire of the Count, he had added to his other duties those of Director of the Museum.

From 1814 to 1825 we find no document which proves the presence of an astronomer; it remained wholly inactive for a period of about eleven years.

In July, 1825, Prof. LUIGI PONS, of Marseille, was appointed, and succeeded in 1837 by Prof. GIOVANI BATTESTA AMICI, of Modena, who held the directorship of the observatory until 1859, when he was retired on account of extreme old age. Although all the duties of the office since 1852 had been performed by Prof. G. B. DONATI, he did not succeed to the official title of director until 1864, a year after the death of Professor AMICI.

At that time DONATI conceived the idea of erecting a new observatory in the vicinity of Florence; the old institution, in a central part of the town, no longer meeting the requirements of astronomical study, and not being large enough to hold the large and excellent equatorial constructed by his predecessor. Aided in this bold enterprise by the influence and support of the municipal, provincial, and state authority, and by securing the interest of King VICTOR EMANUEL, Professor DONATI, in October, 1872, was able to inaugurate the new observatory on the Calle d'Arcetri, a little removed from the house, where, two hundred and thirty years before, GALILEO had ended the labors of his life.

To the new institution was transferred all the scientific material belonging to the Department of Astronomy, and the place occupied by it in the observatory was devoted exclusively to meteorological observations, both branches remaining under the direction of Professor DONATI, the meteorological division being represented in Florence by his assistant, Prof. COSTANTINUS PITTEI.

DONATI having died on February 20, 1872, the charge of the new observatory was given to Prof. DOMENICO CIPOLETTI, formerly DONATI'S assistant in the astronomical course, who held it until the following May, when he began to fail. The observatory at Arcetri was provisionally confided to Professor PITTEI, until June 1, 1875, when Signor GUGLIELMO TEMPEL was called as astronomer, which position he still retains, and Professor PITTEI thereupon assumed the definite direction of the observatory of the Museum, re-organized under special direction, and entirely separated from the observatory at Arcetri.

FRANKFURT, A. M., PRUSSIA.

Private Observatory.

Longitude from Greenwich, $34^m\ 47.1^s$ E.
Latitude, 50° 7′ 3″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. EPSTEIN.

FUNCHAL, MADEIRA.

Observatory.

Longitude from Greenwich, $1^h\ 7^m\ 35.5^s$ W.
Latitude, 32° 37′ 46″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. lv.
Director:

GALATZ, ROUMANIA.

Private Observatory.

Longitude from Greenwich, $1^h\ 52^m\ 14^s$ E.
Latitude, 45° 26′ 12″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xxix.
Director:

GENEVA, SWITZERLAND.

Observatoire de Genève.

Longitude from Greenwich, $24^m\ 36.77^s$ E.
Latitude, 46° 11′ 58.8″ N.

Directors: J. A. MELLET FAVRE, 1772.
M. A. PICTET TURRETIN 1790.
J. F. T. MAURICE, 1794.
P. PICTET, 1802.
A. GAUTIER, 1819.
L. F. WARTMANN, 1832.
E. PLANTAMOUR, 1840.
E. GAUTIER.

Founded in 1771, completed in 1773. Octagonal structure built in great part at the expense of J. A. MELLET, upon a casemate of the Bastion Saint Antrine. In 1829 the representative council of the canton passed a resolution for the construction of a new observatory to be built upon the same bastion, not far from the old edifice. It is composed of a main building of one story, and of two lateral turrets with hemispherical domes. In 1879 the original building had an annex built to it; at the same time a tower was erected to the west of the old building, in which the 10-inch refractor, presented to the cantons of Geneva by E. PLANTAMOUR, has been placed.

GENOA, ITALY.

I. *Observatorio delle R. Università.*

Longitude from Greenwich,
Latitude, 44° 24′ 59″ N.
Directors: GIUSEPPE GARIBALDI, 1830.
MICHELE ALBERTO BANCALARI, 1849.
PIETRO MARIA GARIBALDI, 1865.

This observatory was entirely refitted in 1874, and is particularly intended for meteorological observations.

II. *Observatory of the Hydrographic Office.*

Longitude from Greenwich, 35^m 41.4^s E.
Latitude, 44° 25′ 9.3″ N.
Director: G. B. MAGNAGHI.

GEORGETOWN, BRITISH GUIANA.

Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

GLASGOW, SCOTLAND.

Observatory.

Longitude from Greenwich, 17^m 10.6^s W.
Latitude, 55° 52′ 42.8″ N.
Directors: J. P. NICHOL, 1840.
R. GRANT, 1860.

Commenced in 1818 at the expense of a society. Permanently organized with the help of a public subscription, of one subsidy from the University and another from the State. In 1862 a special hall was added for an equatorial, which has an aperture of 9 inches: (0.23^m).

GOHLIS (NEAR LEIPZIG), SAXONY.

I. *Private Sternwarte.*

Longitude from Greenwich, 49^m 28.6^s E.
Latitude, 51° 21′ 42.3″ N.
Authority for longitude and latitude: Prof. C. C. BRUHNS.
Proprietor: AUGUST AUERBACH.
Observatory was built in 1861–'62.

II. *Private Sternwarte.*

Longitude from Greenwich, 49^m 29.65^s E.
Latitude, 51° 21′ 35″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: W. WINKLER.

GOTHA, GERMANY.

Sternwarte.

Longitude from Greenwich, 42^m 50.56^s E.
Latitude, 50° 56′ 37.5″ N.
Directors: E. X. VON ZACH, 1787.
B. A. VON LINDENAU, 1808.
J. F. ENCKE, 1817.
P. A. HANSEN, 1825.
A. KRÜGER, 1876.
L. DE BALL (ad interim).
H. SEELIGER, 1881.
Dr. E. BECKER.

The first observatory was erected in 1784, on the "SEEBERG," 1¼ miles (two kilometers) from the town. In 1853 a new observatory was built in the "Jägerstrasse," not far from the ducal palace.

GÖTTINGEN, PRUSSIA.

Königliche Sternwarte.

Longitude from Greenwich, 39^m 46.4^s E.
Latitude, 51° 31′ 7.9″ N.
Authority for longitude and latitude: Berliner Jahrbuch.

Directors: J. A. VON SEGNER, 1735.
J. TOBIAS MAYER, 1754.
G. M. LORNITZ, 1762.
A. G. KÄSTNER, 1764.
K. F. VON SEYFFER, 1800.
C. F. GAUSS, 1807.
Dr. E. F. W. KLINKERFUES, 1866.
Dr. W. SCHUR.

Founded in 1734, at the same time with the university, and located in one of the round towers of the ancient fortification, around which was built an exterior gallery. In 1811 the observatory was transferred to a more suitable spot outside the southern gate-way of the town. This new building is on the plan of a rectangle, with the longer sides facing east and west. An addition is made by wings to the north; a cupola surmounts the central vestibule, and a terrace encircles the whole structure. In 1818 the first meridian circle ever made and mounted in Europe was placed there.

INSTRUMENTS:

(*a*) *Meridian circles:* One made by REPSOLD, sr., of Hamburg; diameter of circle 3½ feet, divided to 5′; read by two microscopes to 1″; aperture of objective 4½ inches (114^{mm}); magnifying power ordinarily employed, 96 diameters: one made by REICHENBACH, of Munich; diameter of circle 3 feet; divided to 3′; read by four microscopes to 0.24″; aperture of objective 4¼ inches (109^{mm}); magnifying power ordinarily employed, 50 diameters.

(*b*) *Meridian transit instrument:* Maker, REICHENBACH, of Munich; aperture, 4½ inches (116^{mm}); magnifying power, 75 diameters; (*b′*) one portable, maker, ERTEL, of Munich.

(*c*) *Equatorial instrument:* Maker, FRAUENHOFER, of Munich; aperture of objective, 2.9 inches (74^{mm}); magnifying power of eye-piece, 75. (*c′*) Five telescopes: makers, 1st, MERZ, of Munich; 6 feet long, aperture 5 inches; 2d, STEINHEIL, of Munich; 5 feet long, aperture 4 inches; 3d, DOLLOND, of Munich; 4 feet long, aperture, 3½ inches; 4th, DOLLOND, of Munich; 3 feet long, aperture 3 inches; 5th, PLÖSSL, of Vienna; 28 inches long, aperture 2¼ inches. Three comet-seekers: makers, 1st, MERZ, of Munich; 6 inches aperture; 2d, MERZ, of Munich; 3 inches aperture; 3d, VOIGTLANDER, of Brunswick; 2½ inches aperture.

(*d*) *Spectroscope:* By MERZ, of Munich.

(*f*) *Chronograph:* By AUSFELD, of Gotha.

(*g*) *Clocks:* One mean time; maker, CASTENS; two sidereal: makers, 1st, HARDY, of London; 2d, SHELTON.

(*h*) *Chronometers:* Four mean time; makers, 1st, BERTHOUD; 2d, SACKMANN; 3d and 4th, KNOBLICH; 5th, HARDY; sixtieth part of a second.

(*i*) *Miscellaneous:* Heliometer by FRAUENHOFER, of Munich; theodolites, one by REICHENBACH, two by MEYERSTEIN; sextants by CARY, TROUGHTON, PISTOR, STEINHEIL, and BREITHAUPT; two heliotropes by MEYERSTEIN.

GRAZ, AUSTRIA.

I. *Physikalisches Institut der K. K. Carl Franzens Universität.*

Longitude from Greenwich, ———.
Latitude, ———.
Director: Prof. Dr. LUDWIG BOLTZMANN.

II. *Universitäts Sternwarte.*

Longitude from Greenwich, $1^h\ 1^m\ 47.9^s$ E.
Latitude, 47° 4′ 37.2″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. C. FRIESACH.

III. *Private Sternwarte.*

Longitude from Greenwich, ———.
Latitude, ———.
Director: E. MATHEY GUENET.

GREENWICH, ENGLAND.

Royal Observatory.

Longitude from Washington, $5^h\ 8^m\ 12.09^s$ E.
Latitude, 51° 28′ 38.4″ N.
Authority for longitude and latitude: Nautical Almanac, Greenwich Observations, 1878.
Directors: J. FLAMSTEED, 1675.
E. HALLEY, 1720.
J. BRADLEY, 1742.
N. BLISS, 1762.
N. MASKELYNE, 1765.
J. POND, 1811.
G. B. AIRY (Astronomer Royal), 1835.
W. H. M. CHRISTIE (Astronomer Royal), 1881.

Founded by royal statute on the 4th March, 1675. Built in the park at Greenwich by CHRISTOPHER WREN, architect. At first it consisted merely of an octagonal tower. In 1660 FLAMSTEED put up an additional wing to accommodate the mural sector, with the help of which he made his catalogue of stars. The board of visitors was created in 1710. In 1749 and the years immediately following great improvements and additions were made.

A statute of 1765 confirmed the right of supervision vested in the royal society and exercised by the board of visitors. In 1770 two revolving domes were constructed upon the turrets, and these have served as models for all revolving turrets since constructed. In 1772 the first achromatic object glass ever used at Greenwich was attached to the south quadrant. In 1779 the expediency of enlarging the meridian openings was acknowledged; hitherto the aperture had only been 6 inches (0.15^m).

At the beginning of the present century it became necessary to rebuild the observatory, and the work, continuing until 1811, consisted in the construction of two rectangular buildings, the eastern one being the observatory proper, and containing halls for the meridian instruments, the library, and office, while the western structure was intended for the dwelling house of the superintendent.

The present organization of Greenwich Observatory dates from a royal statute of 1830. According to the terms of this statute the board of visitors consists of the members of the Royal Society, the members of the Astronomical Society, and the Oxford and Cambridge professors of astronomy.

As a finishing touch the immense dome to the southeast was built in 1859.

INSTRUMENTS:

(*a*) *Meridian circle:* One; makers, RANSOMES & MAY (engineers), TROUGHTON & SIMMS (opticians); diameter of circle, 72 inches; divided to 5′; read by six microscopes to 0.06″; four supplementary microscopes for determination of division errors and occasional use: aperture of objective, 8.1 inches; for observations of the sun, aperture employed, 8.1; magnifying power ordinarily employed, 195 diameters.

(*b′*) *Alt-azimuth:* Makers, RANSOMES & MAY and W. SIMMS; aperture, 4 inches. Magnifying power, 100; diameter of circles, 3 feet, divided to 5′.

(*c*) *Equatorial instruments:* Makers, RANSOMES & SIMMS (engineers), TROUGHTON & SIMMS (opticians), MERZ (objective); aperture of objective, 12.8 inches; magnifying power of eye-pieces, 60 to 1500. (*c′*) *Sheapshank's equatorial:* makers, T. GRUBB, CAUCHOIX (objective); aperture of objective, 6¾ inches. *Naylor equatorial:* maker, T. COOKE, of York; aperture, 6 inches. *Shuckburgh equatorial:* maker, RAMSDEN; aperture, 4.1 inches.

(*d*) *Spectroscopes:* Half-prism spectroscope; maker, HILGER. Direct vision: one, two, or three compound "half-prisms" with dispersions (A to H) of about 18½°, 83°, and 335°. *Single prism stereoscope:* Makers, TROUGHTON & SIMMS; one flint prism.

(*e*) *Photometer:* AIRY'S double-image micrometer; makers, TROUGHTON & SIMMS.

(*f*) *Chronograph:* Makers, E. DENT & Co.

(*g*) *Clocks:* One mean time; Makers, SHEPHERD & SON: one sidereal; makers, E. DENT & CO., HARDY, ARNOLD, GRAHAM.

(*h*) *Chronometers:* Mean time; makers, various. There are always on hand a large number rated for the navy; some of these are used when necessary for the Observatory. Sidereal; none of accurate character.

(*i*) *Miscellaneous:* Photoheliograph; maker, DALLMEYER; aperture of objective, 4 inches. Several portable telescopes; aperture, 4 inches to $2\frac{3}{4}$ inches. Five other 6-inch equatorials (packed in cases) returned from Transit of Venus Expedition, 1874. Five 3-inch portable transits by SIMMS; one 14-inch alt-azimuth by SIMMS; three 14-inch altitude instruments by SIMMS; four photoheliographs by DALLMEYER (all returned from the Transit of Venus Expeditions, 1874).

GRIGNON (CÔTE D'OR), FRANCE.

Observatoire du prieuré de St. Jean.

Longitude from Greenwich, 17^m 38^s E.
Latitude, $47°$ $33'$ $42''$ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: F. MAYEUL LAMEY.

GUILDOWN (SURREY) ENGLAND.

Private Observatory.

Longitude from Greenwich, 1^m 55.1^s W.
Latitude, $51°$ $13'$ $39.2''$ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprictor: J. RAND CAPRON.

HABANA, CUBA.

Observatorio del R. Colegio de Belen.

Longitude from Greenwich, 5^h 29^m 30^s W.
Latitude, $23°$ $9'$ $24''$ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. lxiii.
Director: ——.

HALIFAX, ENGLAND.

Bermerside Observatory, Skircoat.

Longitude from Greenwich, 7^m 28^s W.
Latitude, $53°$ $42'$ $9''$ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: E. CROSSLEY.
Observer: J. GLEDHILL.

HAMBURG, GERMANY.

Sternwarte.

Longitude from Greenwich, 39^m 53.8^s E.
Latitude, 53° 33′ 7″ N.
Directors: —— MOSER, 1823.
K. L. C. RÜMKER, 1830.
GEORG F. W. RÜMKER, 1863.

Built by J. G. REPSOLD, in 1810, upon a location near the Altona gate; destroyed by the French in 1813; rebuilt in 1825, through a legacy left by GRELL, upon the site of the old ramparts, and still in the neighborhood of the Altona gate. It has a central hall for meridian instruments and two wings surmounted by turrets. The east wing is used for a school of navigation.

HARROW, ENGLAND.

Private Observatory.

Longitude from Greenwich, 1^m 20^s W.
Latitude, 51° 35′ 15″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: LIEUT. COL. G. L. TUPMAN.

HEIDELBERG, GERMANY.

Sternwarte des Herrn Dr. T. Wolf.

Longitude from Greenwich, ———.
Latitude, ———.
Authority for longitude and latitude A.: LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. T. Wolf.

HELSINGFORS, FINLAND.

Astronomiska Observatoriet.

Longitude from Greenwich, 1^h 39^m 49.14^s E.
Latitude, 60° 9′ 2.6″ N.
Directors: F. W. A. ARGELANDER, 1829.
G. LUNDAHL, 1841.
F. WOLDSTEDT, 1852.
A. KRÜGER, 1852.
DR. A. S. DONNER.

Founded in 1829, near the university, after the fire at Åbo had destroyed the scientific instruments of that Finnish town. This observatory is the most northerly in the world.

HERÉNY, HUNGARY.

Astro-Physikalisches Observatorium.

Longitude from Greenwich, 1^h 6^m 24.7^s E.
Latitude, 47° 15′ 47″ N.

Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Proprietor: E. DE GOTHARD.

Established in 1881.

HONG-KONG, CHINA.

Observatory.

Longitude from Greenwich, 7^h 36^m 41.86^s E.

Latitude, 22° 18′ 12.2″ N.

Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Director: W. DOBERCK, Astronomer Royal.

INNSBRUCK, AUSTRIA.

Physikalisches Institut der K. K. Leopold Franzens Universität.

Longitude from Greenwich, 45^m 36^s E. (approximately).

Latitude, 47° 16′ 10″ N. (approximately).

Director: Prof. LEOPOLD PFAUNDLER.

IPSWICH, ENGLAND.

Orwell Park Observatory.

Longitude from Greenwich, 4^m 55.8^s E.

Latitude, 52° 0′ 33″ N.

Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Proprietor: Colonel TOMLINE.

Astronomer: J. I. PLUMMER.

JENA, SAXE-WEIMAR.

Sternwarte.

Longitude from Greenwich, 46^m 17^s E.

Latitude, 50° 56′ 29″ N.

Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Directors: J. F. POSSELT, 1820.
L. SCHRÖN, 1852.
E. ABBE, 1878.

Built in 1820, in the same garden where Schiller wrote Wallenstein.

JUVISY, FRANCE.

Private Observatory.

Longitude from Greenwich, 9^m 29^s E.

Latitude, 48° 41′ 36″ N.

Authority for longitude and latitude, A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.

Proprietor: C. FLAMMARION.

KALOCSA, HUNGARY.

Erzbischof Haynald's Observatorium.

Longitude from Greenwich, $1^h\ 15^m\ 54.28^s$ E.
Latitude, 46° 31′ 41.25″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Directors: Dr. CHARLES BRAUN, S. J.
A. HÜNINGER.

The observatory was founded by Cardinal HAYNALD, Archbishop of Kalocsa, in 1878–'79.

KARLSRUHE, BADEN.

Grossherzogliche Sternwarte.

Longitude from Greenwich, $33^m\ 22^s$ E.
Latitude, 48° 59′ 44″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xxvi.
Director: W. VALENTINER.

Transferred from MANNHEIM in 1879.

KASAN, RUSSIA.

Observatoria.

Longitude from Greenwich, $3^h\ 16^m\ 29.1^s$ E.
Latitude, 55° 47′ 24″ N.
Directors: J. J. LITROW, 1814.
J. SIMONOFF, 1816.
M. LIAPOUNOFF, 1846.
M. KOWALSKI, 1854.
D. DOUBJAGO.

Founded in 1814 by the university. Constructed upon a very solid ancient structure; square tower, 23 feet (7 meters) in height. The southern gallery adjoins a wooden shed at its west angle, which has a movable roof. The building, with a portion of the instruments, was burned on the occasion of a fire which destroyed part of the town on the 5th September, 1842. Immediately restored.

KEMPSHOT, JAMAICA.

Observatory of Max. w. Hall.

Longitude from Greenwich, $5^h\ 11^m$ W.
Latitude, 18° 29′ N.
Authority, A. LANCASTER, Liste Générale, etc., 1887.
Director: ———.

KENSINGTON, ENGLAND.

Observatory.

Longitude from Greenwich, 46^{s} W.
Latitude, 51° 30′ 12″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884 p. xv.

KHARKOFF, RUSSIA.

Observatoria.

Longitude from Greenwich, $2^{h}\ 24^{m}\ 54.7^{s}$ E.
Latitude, 50° 0′ 10.2″ N.
Directors: J. FEDORENKO.
G. LEVITZKY.

Recently established.

KIEL, PRUSSIA.

I. *Königliche Sternwarte.*

Longitude from Greenwich, $40^{m}\ 35.74^{s}$ E.
Latitude, 54° 20′ 28.6″ N.
Directors: C. A. F. PETERS, 1873.
A. KRUEGER, 1881.

Founded in 1873, by the transfer of the observatory from ALTONA.

II. *Chronometer Observatorium der K. Marine.*

Longitude from Greenwich, $40^{m}\ 37.2^{s}$ E.
Latitude, 54° 20′ 3.3″ N.
Authority for longitude and latitude: A. LANCASTER Liste Générale des Observatoires et Astronomes, 1887
Director: C. F. W. PETERS.

KIEFF, RUSSIA.

Observatoria.

Longitude from Greenwich, $2^{h}\ 2^{m}\ 0.7^{s}$ E.
Latitude, 50° 27′ 11.12″ N.
Directors: —— FEADOROW, 1838.
A. SCHIDLOFFSKY, 1855.
M. K. KHANDRIKOFF, 1872.

Established in 1838 as an annex to the university.

KINGSTON, CANADA.

Observatory.

Longitude from Greenwich. $5^{h}\ 5^{m}\ 56.4^{s}$ W.
Latitude, 44° 13′ 25.2″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: J. WILLIAMSON.

Kis-Kartal, Hungary.

Sternwarte der Baronesse von Podmaniczky.

Longitude from Greenwich, $1^h\ 18^m\ 13^s$ E.
Latitude, 47° 42′ N.
Authority for longitude and latitude: A. Lancaster, Liste Générale des Observatoires et Astronomes, 1887.
Director: R. von. Kövesligethy.

Kilmarnock, Scotland.

Observatory.

Longitude from Greenwich, $18^m\ 10.5^s$ W.
Latitude, 55° 36′ 40″ N.
Directors: Thomas Morton, 1818.
Thomas Lee, 1862.

Erected in 1818 by the late Mr. Morton, H. M. R. S. S. A., at an expense of about £1,500, and is now the property of Thomas Lee, F. R. A. S. Its height is 70 feet, and being at an elevated situation, it commands an extensive and delightful view.

Klausenburg, Hungary.

Sternwarte.

Longitude from Greenwich, ——.
Latitude, ——.
Director: Carl Juszta.

Kjöbenhavn (Copenhagen), Denmark.

Universitets Astronomiske Observatorium.

Longitude from Greenwich, $50^m\ 19.2^s$ E.
Latitude, 55° 41′ 13.6″ N.
Directors: C. Lumborg, 1637.
T. Bartholin, 1647
O. Roemer, 1681.
Peter I. Horrebow, 1714.
C. Horrebow, 1753.
T. Bugge, 1777.
H. C. Schumacher, 1815.
Von Caroe, 1822.
C. F. R. Olufsen, 1832.
H. d'Arrest, 1856.
T. N. Thiele, 1876.

Founded in 1637, but only completed in 1656. The first edifice was destroyed by fire on the 20th of October, 1728. The observatory was re-established in the round tower belonging to the university. In 1820 a wooden addition was made to it on the Holken bastei. Finally, in 1857, it was reorganized and removed to the glacis of the fortress between the citadel and the Osterthor (eastern gate).

KÖLN, PRUSSIA.

Sternwarte.

Longitude from Greenwich, $27^m 51^s$ E.
Latitude, 50° 55′ 31″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. HERMANN KLEIN.

KÖNIGSBERG, PRUSSIA.

Universitäts Sternwarte.

Longitude from Greenwich, $1^h 21^m 58.91^s$ E.
Latitude, 54° 42′ 50.6″ N.
Directors: Z. W. BESSELS, 1811.
A. L. BUSCH, 1849.
M. L. G. WICHMANN 1866.
E. LUTHER, 1880.

Constructed in 1811 on one of the most elevated points of the ramparts to the northwest of the town. A main building divided into two great halls—a northern and a southern. Two wings—one the meridian hall, the other an addition. With the use of a meridian circle BESSELS and his assistants accomplished the work known as the "Königsberger Zonen." This great undertaking was begun August 19, 1821, and finished January 21, 1833.

KRAKAU, AUSTRIA.

K. K. Universitäts Sternwarte.

Longitude from Greenwich, $1^h 19^m 50.5^s$ E.
Latitude, 50° 3′ 50″ N.
Directors: Dr. J. B. SNIADECKI, 1791–1803.
Dr. J. I. LITTROW, 1807–1809.
Dr. J. LESKI, 1811–1825.
Dr. MAX WEISSE, 1826–1861.
Dr. F. M. KARLINSKI, 1862.

The observatory, established in 1791 and partially reconstructed in 1858, lies in the botanical garden at the eastern extremity of the city. The building, two and one-half stories high, with two domes, was originally not intended for an observatory, and it is impossible to mount in them any larger modern instrument.

KREMSMÜNSTER, AUSTRIA.

Sternwarte der Benediktiner Abtei.

Longitude from Greenwich, 56^m 31.6^s E.
Latitude, 48° 3′ 23.8″ N.
Directors: A. DESING, 1748.
P. FIXLMILLNER, 1761.
T. DERFFLINGER, 1791.
B. SCHWARZENBRUNNER, 1824.
M. KOLLER, 1830.
A. RESLHUBER, 1847.
G. STRASSER, 1875.
C. WAGNER.

Founded in the convent of the Benedictines in 1748; built in the convent garden at the northern extremity of the buildings. The observatory consists of a massive tower eight stories high, with two wings of five stories.

KRONSTADT, RUSSIA.

Morskaia Astronomicheskaia Observatoria.

Longitude from Greenwich, 1^h 59^m 3.60′ E.
Latitude, 59° 59′ 24.2″.
Authority for longitude and latitude: V. FUSS.
Directors: L. HÜBNER, 1857.
V. FUSS, 1871.

Observatory of the school of pilots.

LA PLATA, ARGENTINE REPUBLIC.

Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: F. C. BEUF.

LEIPZIG, SAXONY.

I. *Universitäts Sternwarte.*

Longitude from Greenwich, 49^m 34.02^s E.
Latitude, 51° 20′ 6.3″ N.
Directors: C. F. RÜDIGER, 1794.
K. B. MOLLWEIDE, 1811.
A. F. MOEBIUS, 1816.
C. A. JAHN, 1845.
C. C. BRUHNS, 1860.
H. BRUNS, 1883.

Constructed from 1787 to 1794, upon the great tower of the castle of Pleissenburg. A new observatory, situated at the extreme end of one of the suburbs, took the place of the old one in 1861.

II. *Private Sternwarte des Herrn Rudolph Engelmann.*

Longitude from Greenwich, $49^m\ 38^s$ E.
Latitude, 51° 20′ 7″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. RUDOLF ENGELMANN.

LEMBERG, AUSTRIA.

Sternwarte der Technischen Hochschule.

Longitude from Greenwich, ———.
Latitude, ———.
Director: ———.

The observatory is used for geodetic purposes.

LEYDEN, HOLLAND.

Rijks Observatorium.

Longitude from Greenwich, $17^m\ 56.35^s$ E.
Latitude, 52° 9′ 20.2″ N.
Directors: J. GOLIUS, 1632.
S. C. KECHEL, 1667.
C. MELDER, 1668.
B. DE VOLDER, 1682.
L. ZUMBACH DE KOESFELD, 1705.
W. J. S'GRAVESANDE, 1717.
J. LULOFS, 1742.
D. VAN DE WIJNPRESSE, 1768.
P. NIEUWLAND, 1794.
J. A. FAS, 1797.
J. F. VAN BEEK-CALKOEN, 1799.
C. E. KAMA, 1812.
F. KAISER, 1837.
H. G. VAN DE SANDE BAKHUIJZEN, 1872.

Founded in 1632. The most ancient of existing observatories in Europe. Originally built as a great tower for the town clock; enlarged in 1689; repaired in 1817. In 1858 a new observatory was commenced, and completed in 1860.

LEYTON, ENGLAND.

Barclay Observatory. (Private.)

Longitude, 0.87^s W.
Latitude, 51° 34′ 34″ N.
Authority for longitude and latitude: Ordnance survey.
Proprietor: J. GURNEY BARCLAY.
Observer: CHARLES GEORGE TALMAGE, F. R. A. S.

INSTRUMENTS:

(*a*) *Meridian circles:* Makers, HOUGHTON and SIMMS; diameter of circles, 36 inches, divided to 5′; read by 4 microscopes to 0.1″; aperture of objective, 4 inches; for observations of the sun aperture employed, 4 inches; magnifying power ordinarily employed, 80 diameters.

(*c*) *Equatorial instrument:* Maker, COOKE, York; aperture of objective, 10 inches; magnifying power of eye-pieces, 70 to 1200.

(*g*) *Clock:* Sidereal; maker, SIMMONDS, London.

LIEGE, BELGIUM.

Institut Astronomique de l'Université.

Longitude from Greenwich, $22^m\ 12^s$ E.
Latitude, 50° 37′ 0.6″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: F. FOLIE.

LISBON, PORTUGAL.

I. *Real Observatorio Astronomico de Lisbon (Ajuda).*

Longitude from Greenwich, $36^m\ 44.68^s$ W.
Latitude, 38° 42′ 31.3″ N.
Director: F. A. OOM, 1878.

The Royal Observatory is situated in the Ajuda Park (Tapada da Ajuda), about 1,300 meters west of Lisbon. It had its origin in 1857, when the late King, D. PEDRO V, made a first donation of 30,000 milreis for the establishment of an astronomical observatory.

The building was commenced in 1861. It consists of a central two-story octagonal structure, surmounted by a revolving tower 11 meters in diameter, containing the great equatorial, with four one-story wings, corresponding to the cardinal points of the compass. In the southern wing is the principal entrance, with a peristyle and vestibule which communicates with the lower and upper stories of the central structure.

The whole length of the building is 67.1 meters E—W. Its breadth is 42 meters.

A three-story dwelling-house for the personnel is built 36.5 meters east of the observatory. A part of its ground floor is occupied by a mechanical workshop for repairs and modifications in the instruments

The organization of the observatory dates from May, 1878. According to its statute the observatory is chiefly destined to the progress of sidereal astronomy.

II. *Observatorio da Marinha.*

Longitude from Greenwich, 36^{m} 33.5^{s} W.
Latitude, 38° 42′ 17.6″ N.
Directors; M. E. S. LIMPE.
A. CONTO VALENTE.
J. CORDEIRO FEIJO.
F. FOLQUE.
F. DE PAULA FERREIRA DE MESQUITA, 1874.

Established in 1798. Renewed in 1859 and 1874.

III. *Observatorio Astronomico na Escola Polytecnica.*

Longitude, ———.
Latitude, ———.
Director: ———.

For the instruction of students only.

LIVERPOOL, ENGLAND.

Observatory.

Longitude from Greenwich, 12^{m} 17.2^{s} W.
Latitude, 53° 24′ 3.8″ N.
Director: J. HARTNUP, 1845.

Founded in 1838 by the municipal council; completed in 1848. Transferred to Birkenhead, on the opposite bank of the Mersey, in 1867. It is provided with an apparatus for the examination of chronometers where the temperature can be raised by means of a gas heater. The equatorial is moved by clock-work, set in motion by hydraulic power. The time-signal is given to the shipping by the firing of a cannon.

LONDON, ENGLAND.

Tulse Hill Observatory (Upper Tulse Hill, London, S. W.).

Longitude from Greenwich, 27.7^{s} W.
Latitude, 31° 26′ 47″ N.
Director: WILLIAM HUGGINS.

Founded in 1856.

INSTRUMENTS:

An equatorial instrument by GRUBB, of Dublin, so constructed that either a refractor, of 15 inches aperture and 15 feet focal length, or a CASSEGRAIN reflector with metallic speculum of 18 inches aperture may be placed at pleasure on the same equatorial mounting, so that with either instrument the circles read sufficiently for the finding of objects. The driving-clock has, in addition to the usual governor balls, a secondary control of a pendulum in electrical connection with a standard clock.

Up to 1870, when the present equatorial was erected, a transit circle of $3\frac{1}{4}$ inches aperture was mounted in the observatory. At that time the principal instrument the observatory contained was an 8-inch refractor by ALVAN CLARK, mounted equatorially by COOKE, of York.

There is a fine sidereal clock by ARNOLD, and various spectroscopes for use, with the telescopes, on the sun and stars; and there has been recently added a spectroscope, with Iceland spar prism and quartz lenses, for photography of spectra of stars.

Underneath the observatory are two rooms, one devoted to chemistry and photography, the other to physical experiments in connection with spectrum analysis.

LOUVAIN, BELGIUM.

I. *Observatoire des Collège de la Compagnie de Jésus.*

Longitude from Greenwich, $18^m\ 48^s$ E.
Latitude, 50° 53′ 27″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: J. THIRION, S. J.

II. *Private Observatory of Dr. Terby.*

Longitude from Greenwich, $18^m\ 51^s$ E.
Latitude, 50° 52′ 40″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: Dr. TERBY.

LÜBECK, GERMANY.

Sternwarte.

Longitude from Greenwich, $42^m\ 45.7^s$ E.
Latitude, 53° 51′ 31.2″ N.
Director: ED. THIEL.

Founded in 1860 as an annex to the navigation school. The tower, with a revolving turret of 20 feet diameter, stands upon the ramparts to the south of the town 63 feet above the level of the Baltic.

LUCKNOW, INDIA.

Observatory.

Longitude from Greenwich, $5^h\ 23^m\ 24.02^s$ E.
Latitude, 26° 51′ 10″ N.
Authority for longitude and latitude: Annuaire des Bureau des Longitudes, 1884, p. 412.

LUND, SWEDEN.

Lund Observatory.

Longitude from Greenwich, $52^m\ 45.02^s$ E.
Latitude, 55° 41′ 52.05″ N.
Authority for longitude and latitude: Undersökning af Meridiancirkeln pŭ Lunds Observatorium jemte beståmming af den sammas polhöjd af AND. LINDSTEDT. Bestimmung der Längen-Differenz Zwischen Berlin und Lund, auf telegraphischem Wege ausgeführt im Jahre 1868. Herausgegeben von C. BRUHNS.
Directors: ———.
A. LINDGREEN, 1786.
——— ———, 1815.
J. M. AGARDH, 1847.
AXEL MÖLLER, professor of astronomy.

Founded as a dependency of the University about 1760. Reorganized in 1866.

INSTRUMENTS:

(*a*) *Meridian circle:* One; makers, A. & G. REPSOLD, in Hamburg; diameter of circles, 39 inches (1 meter); divided to 2′; read by 4 microscopes to 0.1″; aperture of objective, 6½ inches (163^{mm}); magnifying power ordinarily employed, 173 diameters.

(*c*) *Equatorial instruments:* Makers, G. & S. MERZ, in Munich, and E. JÜNGER, in Copenhagen; aperture of objective, 9½ inches (245^{mm}); magnifying powers of eye-pieces, 80 to 1,300 diameters. (*c′*) Makers, A. STEINHEIL, in Munich, and E. JÜNGER, in Copenhagen; aperture of objective, 4¼ inches (108^{mm}); magnifying powers of eye-pieces, 16 to 200 diameters.

(*d*) *Universal spectroscope* by G. & S. MERZ, in Munich, with 3 sets of prisms *à vision directe.* (*d*) *Simple spectroscope* by HEUSTREU, in Kiel, constructed after the indication of Professor VOGEL, in Potsdam.

(*f*) *Chronograph:* One by MAYER & WOLF, in Vienna.

(*g*) *Clocks:* Sidereal time; one, maker, KESSELS, in Altona: one, maker, TIEDE, in Berlin.

(*h*) *Chronometer:* Mean time; maker, KESSELS, in Altona.

(*i*) One universal instrument by REPSOLD, in Hamburg; 3 telescopes by DOLLOND, MERZ, and PLÖSSL.

LYME REGIS (DORSET), ENGLAND.

Observatory of C. E. Peek.

Longitude from Greenwich, $44^m\ 56.02^s$ W.
Latitude, 50° 42′ 12″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887, p. 35.
Director: C. E. PEEK.

LYONS, FRANCE.

Astronomical and Meteorological Observatory.

Longitude from Greenwich, 19^m 18^s E.
Latitude, 47° 41′ 14″ N.
Director: C. ANDRÉ, 1877.

There was an observatory in existence in the eighteenth century at the Jesuit College, where Fathers BONNET, BÉRAULD, LEFÈVRE, and LAPON made observations. The new observatory was founded in 1877.

INSTRUMENTS:

(*a*) *Meridian circle:* Maker, EICHENS; diameter of circles, 23½ inches (0^m.60), divided to 5′; read by 4 microscopes to 0.1″; aperture of objective, 6 inches; for observations of the sun, aperture employed, 6 inches; magnifying power ordinarily employed, 300 diameters.

(*b*) *Meridian transit instrument:* Maker, RIGAUT; aperture, 2 inches; magnifying power, 150 diameters.

(*g*) *Clocks:* Two sidereal; makérs, BRÉGUET & RÉDIER, Paris.

(*h*) *Chronometers:* Mean time; makers BRÉGUET, Paris: sidereal; maker, BRÉGUET, Paris.

MADRAS, INDIA.

Madras Observatory.

Longitude from Greenwich, 5^h 20^m 59.33^s E.
Latitude, 13° 4′ 8.1″ N.
Directors: J. GOLDINGHAM, 1787.
—— —— WARREN (intermediate), 1805.
J. GOLDINGHAM, 1811.
S. G. TAYLOR, 1830.
W. S. JACOB, 1848.
—— WORSTER (intermediate), 1854.
W. S. JACOB, 1855.
J. F. TENNANT, 1860.
N. R. POGSON (Astronomer Royal), 1860.

Founded in 1787 by the East India Company.

MADRID, SPAIN.

Observatorio de Madrid.

Longitude from Greenwich, 14^m 45.5^s W.
Latitude, 40° 24′ 29.7″ N.
Directors: J. CARONADO, 1790.
J. RODRIGUEZ, 1817.
—— BAVIA, 1821.
D. FONTAN, 1835.
PALO MARUZ, 1850.
A. AGUILAR, 1860.
M. MERINO.

Established at Buen Retiro in 1790. When the French occupied Madrid in 1808, they set up a battery at that place, and the instruments were destroyed by fire. The observatory then abandoned was not restored until 1846. In 1852 the grounds were enlarged, and a pavillion with a revolving turret was erected.

MANILA, PHILIPPINE ISLANDS.

Observatorio del Ateneo Municipal.

Longitude from Greenwich, $8^h\ 3^m\ 48.6^s$ E.
Latitude, 14° 35′ 25″ N.
Directors: P. FRANCISCO COLINA, 1865–1866.
P. FEDERICO FANRA, 1866–1871.
P. JOSÉ CANUDAS, 1871–1873.
P. JOSE MINORES, 1873–1877.
P. FRANCISCO SANCHEZ, 1877–1878.
P. FEDERICO FANRA, 1878.

The observatory was founded in 1865. In the year 1859 T. VERNACAI projected an observatory in which he should be intrusted with the hydrographic commission for this archipelago. With this object in view instruments were purchased, but never mounted by the hydrographic commission, and remained in the observatory of the municipal Athenæum from 1865 to 1873.

MANNHEIM, BADEN.

Grossherzogliche Sternwarte.

Longitude from Greenwich, $35^m\ 50.52^s$ E.
Latitude, 45° 29′ 11″ N.
Directors: C. MARGER, 1764.
K. J. KÖNIG, 1783.
J. N. FISCHER, 1786.
P. UNGESCHICK, 1788.
R. BARRY, 1788.
H. C. SCHUMACHER, 1813.
F. B. G. NICOLAI, ——.
A. M. NELLE, 1852.
E. SCHÖNFELD, 1859.
W. VALENTINER, 1875.

First established in the electoral castle of SCHWETZINGEN, 6¼ miles (10 kilometers) from Mannheim, and in 1772 removed to the west of the town where it was located in a tower 105 feet (32 meters) in diameter, with remarkably thick walls.

Transferred to KARLSRUHE in 1879. (See KARLSRUHE.)

MARBURG, GERMANY.

Sternwarte.

Longitude from Greenwich, $35^m\ 5^s$ E.
Latitude, 50° 48′ 46.9″ N.
Director : DR. MELDE.

MARKREE, COUNTY SLIGO, IRELAND.

Markree Observatory.

Longitude from Greenwich, $33^m\ 48.4^s$ W.
Latitude, 54° 10′ 31.8″ N.
Directors : E. J. COOPER, 1832–1863.
W. DOBERCK, 1875.

Founded by E. H. COOPER, M. P., and built in the park of Markree.

MARSEILLES, FRANCE.

Observatoire.

Longitude from Greenwich, $21^m\ 34.64^s$ E.
Latitude, 43° 18′ 19.1″ N.
Directors : A. F. LAVAL, 1702.
E. PERENAS, 1728.
G. SAINT JACQUES DE SILVABELLE, 1764.
J. J. C. SHULIS, 1793.
—— BLANPAINT, 1811.
J. F. A. GAMBART, 1822.
B. VALZ, 1835.
E. STEPHAN, 1868.

The Society of Jesus had an observatory at their College of Sainte Croix, founded 1702. In 1849 this scientific institution was taken in hand by the ministery of marine. It is a three-story building, longest from east to west, erected on the summit of the Butte des Moulins. In 1797 this observatory was repaired. A new establishment was erected in 1869 on the hill of Longchamps, to supplement the work at the Paris observatory. The instruments are distributed in separate apartments.

MELBOURNE, VICTORIA.

Melbourne Observatory.

Longitude from Greenwich, $9^h\ 39^m\ 54.8^s$ E.
Latitude, 37° 49′ 53.4″ S.
Director : R. L. J. ELLERY, F. R. S., F. R. A. S.

Proposed first in 1853, and established, to begin with, at Williams town. Transferred to Melbourne in 1861. Building completed in 1863.

MERAN (TYROL), AUSTRIA.

Astro-Physikalisches Observatorium.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

MEUDON (PARIS), FRANCE.

Observatoire d'Astronomie—Physique.

Longitude from Greenwich, $8^m\ 55.6^s$ E
Latitude, 48° 48′ 18″ N.
Director: J. JANSSEN, 1875.

INSTRUMENTS:

A parallactic apparatus bearing two twin telescopes to be used conjointly; 1, a photographic telescope of 81 centimeters aperture and 16 or 17 meters focal length, for astronomy and spectroscopy; 2, a photographic telescope of the same focus and 62 centimeters aperture.

A 5-inch photographic telescope (images 30 centimeters).

A reflector, 1 meter in diameter and 3 meters focal length.

A series of various instruments for the study of absorption of gases and vapors, scales, etc.

MEXICO, MEXICO.

Observatorio.

Longitude from Greenwich, $6^h\ 36^m\ 26.67^s$ W.
Latitude, 19° 26′ 1.3″ N.
Director: F. JIMENEZ.
M. BARCENA.
Founded in 1877.

MILAN, ITALY.

R. Osservatorio Astronomico di Brera.

Longitude from Greenwich, $36^m\ 45.97^s$ E.
Latitude, 45° 27′ 59.4″ N.
Directors: L. LAGRANGE, 1763.
F. REGGIO, 1777.
B. ORIANI, 1804.
F. CARLINI, 1833.
G. V. SCHIAPARELLI, 1862.

The observatory was founded in 1763. In the beginning it consisted of an octagonal structure to which, in 1775, two side towers were added.

In 1760 a telescope of 33 feet (10 meters) focal distance was mounted in the College of the Brera by P. BOVIO and D. GERRA.

MODENA, ITALY.

Osservatorio.

Longitude from Greenwich, $43^m 42.9^s$ E.
Latitude, 44° 38′ 52.8″ N.
Director: D. RAGONA.

MONCALIERI, ITALY.

Osservatorio del R. Collegio Carlo Alberto.

Longitude from Greenwich, $0^h 30^m 44.0^s$ E.
Latitude, 44° 59′ 58.6″ N.
Authority for longitude and latitude: R. Institue—military topographer.
Director: P. FRANCESCO DENZA, 1859.

MONTREAL, CANADA.

McGill College Observatory.

Longitude from Greenwich, $4^h 54^m 18.54^s$ W.
Latitude, 45° 31′ N.
Director: C. McLEOD.

MONTSOURIS (PARIS), FRANCE.

Observatoire du Bureau des Longitudes.

Longitude from Greenwich, $9^m 20.68^s$ E.
Latitude, 48° 49′ 18″ N.
Directors: E. MOUCHEZ, 1875.
DR. MARIE DAVY.

Founded in 1875 by the department of marine, in the southwest corner of the park of Montsouris at the southern extremity of Paris.

MOSCOW, RUSSIA.

Observatory of the Imperial University.

Longitude from Greenwich, $2^h 30^m 16.9^s$ E.
Latitude, 55° 45′ 19.8″ N.
Authority for longitude and latitude, Nautical Almanac.
Directors: M. PANKEVICH, 17—.
C. F. GOLDBACH, 1804.
M. PANKEVICH, 1811.
M. TSCHOUMAKOFF, 1814.
D. PEREVOSTSCHIKOFF, 1823.
A. DRASCHOUSSOFF, 1847.
K. G. SCHWEITZER, 1856.
Prof. Dr. THEODORE BREDICHIN, 1876.

INSTRUMENTS:

(*a*) *Meridian circle:* One; maker, REPSOLD, in Hamburg; diameter of circle, 36 inches; divided to 2′; read by 4 microscopes to 0.1″; aperture of objective, 5.3 inches; magnifying power ordinarily employed, 100 diameters.

(*c*) *Equatorial instrument:* Maker, MERZ, in Munich; aperture of objective, 10.7 inches; magnifying power of eye-pieces, 100 to 1,200. (*c*′) Photoheliograph of DALMAYER, in London.

(*d*) Universal spectroscope of MERZ, in Munich; direct vision with 10 prisms and micrometer.

(*e*) One photometer of ZÖLLNER.

(*f*) *Chronograph:* of SIEMENS and HALSKE.

(*g*) *Clocks:* Mean time, two; makers, TIEDE, UTZSCHNEIDER; sidereal, two; makes, KESSELS, TOLSTOI.

(*h*) *Chronometers:* Mean time, two; maker, DENT; sidereal, two; makers, DENT, KESSELS.

(*i*) *Miscellaneous:* Transportable transit instruments, theodolites, universal instruments, etc.

MÜNCHEN, BAVARIA.

Königliche Sternwarte, Bogenhausen.

Longitude from Greenwich, 46^m 26.13^s E.
Latitude, 48° 8′ 45.5″ N.
Directors: K. F. VON SEYFFER, 1809.
J. VON SOLDNER, 1819–1833.
Prof. Dr. J. VON LAMONT, 1833–1879.
Dr. SEIDEL (provisory).
Prof. Dr. H. SEELIGER, October, 1882.

Founded in 1809, on the hill of Bogenhausen, near Munich; a main building of one story, facing east and west; two wings extend toward the north. An edifice designed for the purpose was put up in the garden for a great refractor, by the aid of which LAMONT made his observations of the satellites of Saturn and of the nebulæ.

MUNICH, BAVARIA. (See MÜNCHEN.)

MÜNSTER, PRUSSIA.

Sternwarte.

Longitude from Greenwich, 30^m 31^s E.
Latitude, 51° 58′ 10″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xxvii.
Directors: E. HEIS, 1852–1877.
Professor STURM.

Founded in 1852, in the neighborhood of the academy (high school).

NAPLES, ITALY. (See NAPOLI.)

NATAL, SOUTH AFRICA.

Natal Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

NAPOLI, ITALY.

R. Osservatorio, Capo di Monte.

Longitude from Greenwich, 57^m 0.9^s E.
Latitude, 40° 51′ 45.4″ N.
Directors: G. CASELLA, 1791.
F. M. DA PRADO, 1808.
F. ZUCCARI, 1812.
C. BRIOSCHI, 1818.
E. CAPOCCI, 1833.
LEOPOLDO DEL RE, 1849.
—— CAPOCCI, 1860.
A. DE GASPARIS, 1864.

Proposed in 1788. The buildings begun at the northeast corner of the Palace of the Library (Palazzo della Biblioteca) and Royal Museum (Museo Reale) were left incomplete in 1790. In 1809 one of the towers of the old convent of San Gaudioso was appropriated to this object. In 1812 was laid the first stone of a new observatory on the hill of Miradois, at the point called Capo di Monte. The instruments were mounted in 1819. Nine asteroids have been discovered at this observatory.

NEUCHATEL, SWITZERLAND.

Observatoire Cantonal.

Longitude from Greenwich, 27^m 50.2^s N.
Latitude, 46° 59′ 51″ N.
Director: A. HIRSCH, 1858.

Founded in 1857. A rectangular structure of 88½ feet by 26¼ feet (27 by 8 meters) and 19½ feet (6 meters) in height; a tower with a revolving turret.

NICE, FRANCE.

Observatoire.

Longitude from Greenwich, 29^m 12.3^s. E.
Latitude, 43° 43′ 16.9″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: J. PERROTIN.

This observatory was erected at the expense of BISCHOFSHEIM.

NICOLAEV, RUSSIA.

Nicolaevskaia Observatoria.

Longitude from Greenwich, $2^h\ 7^m\ 54.1^s$ E.
Latitude, 46° 58′ 20.6″ N.
Authority for longitude: Telegraphic determination of 1877; for latitude, K. KNORRE, Astron. Nach. VII, p. 261.
Directors: K. F. KNORRE, 1821.
J. KORTAZZI, 18—.

Founded in 1821; completed in 1826.

INSTRUMENTS:

(*a*) *Meridian circle:* Maker, ERTEL, in Munich; diameter of circle, 38 inches; divided to 3′; read by four microscopes to 1″; aperture of objective, 4.2 inches; magnifying power ordinarily employed, 100 diameters.

(*c*) *Equatorial instrument:* Makers, REPSOLD & SONS, in Hamburg; aperture of objective, 9½ inches; magnifying powers of eye-pieces, 100, 150, 330, 476, 666.

(*f*) *Chronograph:* One of HERBST, in Pulkowa.

(*g*) *Clocks:* One mean time; maker, KESSELS, No. 1282; one sidereal; makers, BARRAUD, No. 769, and HOHVIN, No. 24.

(*h*) *Chronometers:* Mean time, 89, of different makers; sidereal, 3, of different makers.

(*i*) *Miscellaneous:* One transportable transit instrument of HERBST, in Pulkowa, for the determination of time in the vertical of Polaris; aperture 2.7 inches; magnifying power, 100.

(*k*) One transportable vertical circle, 11 inches; aperture, 1.9 inches; circle divided to 4′; read by two microscopes to 2″.

NOTTINGHAM, ENGLAND.

Private Observatory.

Longitude from Greenwich, $6^m\ 0^s$ W.
Latitude, 52° 58′ 24″.
Director: THOMAS W. BUSH, F. R. A. S.

The observatory is a provisional structure of wood, built in 1876, and comprising equatorial room of 12 feet diameter and small transit annex.

ODESSA, RUSSIA.

I. *Sternwarte.*

Longitude from Greenwich, $2^h\ 3^m\ 2.5^s$ E.
Latitude, 46° 28′ 36″ N.
Authority for longitude: E. BECKER and E. BLOCK, telegraphic determination of the longitude between Berlin and Odessa in 1876; for latitude: observations with the meridian circle.
Directors: L. BERKEWITSCH, 1871; 1881.
E. BLOCK, 1873.

II. *Sternwarte des Herrn L. Hildesheimer.*

Longitude from Greenwich, ———.
Latitude, ———.
Director: L. HILDESHEIMER.

OFEN, AUSTRIA-HUNGARY. (*See* BUDAPEST.)

O-GYALLA, HUNGARY.

Astro-physikalisches Observatorium.

Longitude from Greenwich, $1^h\ 12^m\ 45.59^s$ E.
Latitude, 47° 52′ 43.4″ N.
Director: Dr. N. DE KONKOLY.

OLMÜTZ, AUSTRIA.

Sternwarte.

The observatory at Olmütz was owned by the RITTER VON UNKRECHTSBERG, with Dr. J. SCHMIDT (later at Athens) as director. With the owner's death, in 1869, the observatory was discontinued.

OXFORD, ENGLAND.

I. *Radcliffe Observatory.*

Longitude from Greenwich, $5^m\ 2.6^s$ W.
Latitude, 51° 45′ 35″ N.
Directors: T. HORNSBY, 1771.
A. ROBERTSON, 1810.
S. P. RIGAUD, 1827.
M. J. JOHNSON, 1839.
R. MAIN, 1860.
E. J. STONE, 1878.

Founded in 1772 by the trustees of Dr. JOHN RADCLIFFE, on ground donated by the DUKE OF MARLBOROUGH. A large tower containing library, etc., and two wings, east and west, for meridian instruments, computing-rooms, etc. Detached buildings for equatorial instruments. Dwelling-house for the director.

II. *Oxford University Observatory (Savilian Observatory).*

Longitude from Greenwich, $5^m\ 0.4^s$ W.
Latitude, 51° 45′ 34.2″ N.
Director: C. PRITCHARD.
Founded in 1873.

PADOVA, ITALY.

Osservatorio Astronomico dell' Università.

Longitude from Greenwich, 47^m 29.13^s E.
Latitude, 45° 24′ 2.5″ N.
Directors: G. TOALDO, 1761.
V. CHIMINELLO, 1797.
G. SANTINI, 1813.
G. LORENZONI, 1877.

Founded in 1761 by the Venetian senate, and accommodated in a massive tower built in the thirteenth century by the tyrant Ezzelino for a state prison.

PADUA, ITALY. (*See* PADOVA.)

PAISLEY, SCOTLAND.

Observatory of T. Coats.

Longitude from Greenwich, 17^m 43.3^s W.
Latitude, 55° 50′ 43.8″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Observer, D. MACLEAN.

PALERMO, ITALY.

R. Osservatorio.

Longitude from Greenwich, 53^m 25^s E.
Latitude, 38° 6′ 44″ N.
Authority for longitude and latitude: PIAZZI DAUSSY, 1835, p. 21. In Connaissance des Temps, 1884, p. xxxiv.
Directors: G. PIAZZI, 1787.
N. CACCIATORE, 1817.
G. CACCIATORE, 1842.
D. RAGONA, 1858.
G. CACCIATORE, 1860.

Proposed in 1786. Established in the Saint Ninfa tower of the Royal Palace, the ancient residence of the Emirs during the Arabian dominion. The first complete vertical circle made by RAMSDEN, and finished in 1789, was mounted in this observatory. PIAZZI used it from 1792 to 1813 for the observations which served him as a basis for his famous catalogue. Ceres was discovered at Palermo on the first day of the nineteeth century.

PARAMATTA, NEW SOUTH WALES, AUSTRALIA.

Private Observatory.

Longitude from Greenwich, 10^h 4^m 6.2^s E.
Latitude, 33° 48′ 49.8″ W.

Established by BRISBANE. Its instruments went to the Government Observatory at Sydney, New South Wales.

PARIS, FRANCE.

I. *Observatoire Nationale.*

Longitude from Greenwich, $9^m\ 21.02^s$ E.
Latitude, 48° 50′ 11.8″ N.

Directors: J. D. CASSINI, 1671.
J. CASSINI, 1712.
C. F. CASSINI (de Thury), 1756.
J. D. CASSINI (de Thury), 1784.
J. J. L. DE LA LANDE, 1795.
P. MÉCHAIN, 1801.
A. BRUNARD, 1804.
D. F. J. ARAGO, 1811.
U. J. J. LE VERRIER, 1853.
C. E. DELAUNAY, 1871.
U. J. J. LE VERRIER, 1872.
E. MOUCHEZ, 1878.

National Observatory (formerly royal, since imperial), built in 1667, under the auspices of the Academy of Sciences, according to plans of C. PERRAULT. A vast central hall; two towers, east and west. In 1732 a small room to accommodate a mural quadrant was added beyond the eastern tower, and in 1742 this was extended by a second inclosure for a movable quadrant. In 1760 a turret, with a revolving roof, was built to the south of this addition. The main building, having become dilapidated, was restored in 1786, completed 1793; since when it has been detached and the south terrace built. In 1832 the small rooms where observations are taken were repaired, and the amphitheater and a rotunda with a revolving roof built upon the principal terrace. The dome intended for the shelter of the great equatorial was placed on the summit of the building in 1850. The great telescope, with a mirror of silvered glass, 4 feet (1.2^m) in diameter, was mounted in 1876, in a building on the ground-floor level. JOHN DOMINIC CASSINI discovered four of the satellites of Saturn at the Paris observatory, and also first investigated the subject of the zodiacal light, and here, too, the great grandson of this astronomer was the first to follow the variations of the magnetic needle with minute and persevering industry; and it was here that ARAGO and MATHIEU demonstrated the extremely small parallax of the stars.

A large number of astronomical manuscripts, containing matter of great interest, are preserved at the Paris observatory.

II. *Observatoire du Bureau des Longitudes.*

(See MONTSOURIS.)

PARMA, ITALY.

R. Osservatorio Astronomico.

Longitude from Greenwich, $41^m\ 20^s$ E.
Latitude, 44° 48′ 15″ N.
Director: ——.

PARSONSTOWN, IRELAND. (See BIRR CASTLE.)

PEKIN, CHINA.

Observatory.

Longitude from Greenwich, $7^h\ 45^m\ 37.02^s$ E.
Latitude, 39° 54′ 13″ N.
Authority for longitude and latitude: Annuaire Bureau des Longitudes, Paris, 1884, p. 414.

PESARO, ITALY.

Observatory.

Longitude from Greenwich, $51^m\ 38^s$ E.
Latitude, 43° 55′ 27″ N
Directors: LUIGI GUIDI.
PIO CALVORI, 1883.

Prof. LUIGI GUIDI, who was the founder of this observatory, who for many years very ably filled the place of its director, and to a great extent maintained it at his own expense, died on the 6th March, 1883.

The municipality of PESARO, which already owned the property and a considerable portion of the scientific apparatus, by an agreement with Mr. GEROLAMO GUIDI, the son of the deceased Professor GUIDI, took possession of the observatory and temporarily appointed Sr. CALVORI as director.

INSTRUMENTS.

(*a*) *Astronomical division:*

(1) A small equatorial by MERZ, with an opening of 12 centimeters, very simply mounted, for cosmographic observations, with a *Merz* helioscope with three reflectors and a HOFMANN spectroscope.

(2) A perfectly good transit instrument in an adjoining room, with a meridian opening, firmly imbedded in Istrian rock.

(3) Two chronometers, one a marine chronometer (English), and the other with a pendulum (HIPP).

(*b*) *Meteorological division:*

(1) Barometers for direct observations.

(2) A meteorological case with termographs, psychrometer, hygrometer, evaporometer for direct observation.

(3) Registering apparatus for various meteorological data, barometric pressure, temperature, hygrometric state of the air, velocity and direc-

tion of the wind and rain. These apparatus, some mechanical and a few electric, are in duplicate, so that there may be no interruption of the observations if one of them should be out of order. The SECCHI meteorograph is complete.

(4) Heliophotometer (CRAVERI), nefoscope (BRAUN), termoheliometer (MARY DEVY), pyroheliometer (PUILLET), photometer, cyanometer ARAGO polarimeter, for direct atmospheric observations.

(c) *Magnetic division:*

(1) Declinometer, inclinometer, inclination balance for observing the variations in the intensity and direction of terrestrial magnetism. These apparatus are constructed according to the method of GAUSS.

(2) Inclination compass and magnetic theodolite (BRUNNER) for making exact observations of terrestrial magnetism.

(d) *Division of geodynamics and atmospheric electricity:*

(1) An instrument for microseismic observations.

(2) A ROSSI seismograph for observing the motions of earthquakes.

(3) A SECCHI seismograph for analyzing the motions of earthquakes.

(4) Galvanometer for the daily observations of the telluric current.

(5) PALMIERI electrometer with movable conductors; a BOENGHARTEN electroscope for making observations of the atmospheric electricity.

PEKIN, CHINA.

Observatory of the Imperial Russian Embassy.

Longitude from Greenwich, $7^h\ 45^m\ 56^s$ E.
Latitude, 39° 54′ 13″ N.
Authority for longitude and latitude: WURM, 1845. In Connaissance des Temps, 1884, p. xli.
Director: ———.

PISA, ITALY.

Observatorio.

Longitude from Greenwich, $41^m\ 36^s$ E.
Latitude, 43° 43′ 5″ N.
Authority for longitude and latitude: MARIENI, 1861. In Connaissance des Temps, 1884, p. xxxiv.
Director: ———.

PLONSK, RUSSIA.

Private Observatory of Dr. J. Jedrzejewicz.

Longitude from Greenwich, $1^h\ 21^m\ 32^s$ E.
Latitude, 52° 37′ 40″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale Observatoires et Astronomes, 1887.
Director: Dr. JEDRZEJEWICZ.

POLA, AUSTRIA.

Nantisches Observatorium.

Longitude from Greenwich, $55^m\ 23.18^s$ E.
Latitude, 44° 51′ 49″ N.
Directors: J. PALISA, 1872.
R. MÜLLER, 1880.
F. LASCHOBER.

Founded in 1872.

The observatory at Pola has grown out of the old marine observatory at Venice, which, after the campaign of 1848, was at first removed to Trieste, and from there to Pola in the year 1866. The observatory was naturally used chiefly as a "chronometer depot." That meteorological, and later magnetic observations were taken there was owing to the exertions of the director and to the sagacity of the leading marine central stations.

The regular meteorological records at Pola began in August, 1864, and were continued in the marine barracks by officers and cadets at an altitude of 20.5 meters till February 7, 1866, after which they were taken in charge by the marine observatory, which had just been moved here from Trieste.

The observatory has paid particular attention to astronomy only under Mr. J. PALISA'S direction. Mr. J. PALISA has discovered at this observatory twenty-three small planets, and his brother, Mr. A. PALISA, one comet. Since his call to Vienna nothing has been done in addition to the regular time determinations but to fix the position of occasional comets and small planets. We have at our disposal the following astronomical instruments:

One meridian, by TROUGHTON & SIMMS, with 6-inch object glass, of 6-foot focal distance, and two circles of 0.9 meter diameter.

One refractor, with 6-inch object glass, of 7-foot focal distance, objective by STEINHEIL.

One brachytelescope, by FRITSCH, Vienna, with 12-inch glass.

Two transportable comet-seekers.

Four fixed telescopes, by Messrs. FRAUNHOFER and PLÖSSEL.

Four pendulum clocks, among them a stationary pendulum, by KNOBLICH in Hamburg, as a normal clock.

One chronograph, by HIPP.

Several portable universal instruments and theodoliths.

It is intended to sell the brachytelescope, which was procured only to observe the last transit of Venus, and which has too little space in its cupola, and to install in its place the great comet-seeker in the way invented by VILLARCEAU. Beginning with the year 1885, the astronomical observations are to be taken up in a regular manner, and observations will be made particularly on the planets; later also the sun and the stars of 1° to 2° on the meridian circle; then on the refractor occasional observations of comets and planets; finally, with the small stationary telescope, the occultations of the stars and the eclipses of the satellites of Jupiter.

The building stands upon the highest hill within the town limits. The towers of the two parallactic mounted instruments are at the top of a second story. The meridian room is in a northern lateral wing. The executive offices and the chronometer depot occupy the northern half of the first floor. One messenger has lodgings in the building.

The observatory's endowment amounts to 3,200 Austrian florins annually, together with heating and lighting of all the rooms, incidentals, and the salaries of the officers and employés. This sum may be considered sufficient, although intended also for the completion and repair of the stock of chronometers.

PORT LOUIS, MAURITIUS.

Royal Alfred Observatory.

Longitude from Greenwich, $3^h\ 50^m\ 12.5^s$ E.
Latitude, 20° 5′ 39″ S.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: C. MELDRUM.

The foundation was laid by H. R. H. the Duke of Edinburgh, in May, 1870. Work commenced in 1874.

PORTSMOUTH, ENGLAND.

Observatory of the Royal Naval College.

Longitude from Greenwich, $4^m\ 24.8^s$ W.
Latitude, 50° 48′ 3″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xiv.
Director: H. G. SWAINSON.

This establishment is no longer an astronomical observatory; its work being now confined to the testing of chronometers. The director is now "Superintendent of chronometers."

POTSDAM, PRUSSIA.

Astro-Physikalisches Observatorium.

Longitude from Greenwich, $52^m\ 15.9^s$ E.
Latitude, 52° 22′ 56″ N.
Director: Prof. Dr. H. C. VOGEL.

Built upon a hill adjoining the park at Potsdam. Opened in 1879 under the auspices of the Astronomische Gesellschaft.

The new observatory erected by the Royal Government in the neighborhood of Potsdam, and whose buildings and equipments are now nearly completed, has for its fundamental purpose the investigation of the composition and movements of planetary bodies by means of spectral analyses and continued records of the events on their surfaces.

The observatory occupies the so-called Telegraphenberg, formerly a station of the optic telegraph line "Berlin–Cologne," situated south of the city of Potsdam, upon the east bank of the river Havel, and about 1½ kilometers (0.8013 mile) from the railroad depot. On the summit, $1^m\ 18^s$ W. of Berlin, in north latitude 52° 21′ 56″, 94 meters (318 feet) above the level of the sea and 64 meters (209 feet) above the level of the river Havel, is located the principal building, supplied with three movable cupolas, one of 10 and two of 7 meters (33 and 23 feet) diameter, respectively. Around this are physical, chemical, and photographic laboratories, workshops provided with a dynamo-electrical machine, office, janitor's dwelling, and some other rooms for observations and collections. Along the gentle northeast slope are three dwelling-houses for the scientific staff and the messenger; farther down, close to the entrance of the lot and 20 meters (65.6 feet) below the main building, lies the well, accessible for observations down to the level of the river Havel, the building of the water-works, a shop for the preparation of oil gas, and a dwelling-house for the machinists.

The observatory is surrounded by a tract of woods which forms a desirable protection against terrestrial radiation and at the same time serves as a condenser of atmospheric humidity.

This and the adjacent tract of land are the property of the Crown, and thus unobstructed possession for all times is secured for the observatory reservations, now amounting to nearly 17 hectares (42 acres).

The principal instrument of the observatory is a refractor of 0.298^m (11.7 inches) aperture and 5.4^m (17.7 feet) focus, made, together with auxiliary apparatus of spectroscopes and helioscopes, by H. SCHRÖDER, of Hamburg; parallactical mounting and micrometers by A. REPSOLD & SOHNE. It is used in plain astro-physical work, but principally for the observation of fixed stars, spectra of nebulæ, and for the study of planetary surfaces. Exclusively for solar observations it is proposed to use the second refractor, made by H. GRUBB, of Dublin, with a parallactic telescope of 0.207^m (8.1 inches) aperture and 3.4^m (11.1 feet) focus, and also a STEINHEIL telescope of 0.135^m (5.3 inches) aperture and 2.16^m (7 feet) focus, with parallactic mounting by PISTOR & MARTINS. This was formerly used by Professor SPORER, of Anclam, in his solar observations.

Furthermore, for regular photographic work of the sun a special heliograph is to be employed, of which now only exist the optical parts, made by H. SCHRÖDER, an achromatic objective of 0.16^m (6.3 inches) aperture and 4^m (13 feet) focus, together with ocular magnifying glasses, and of 0.25^m (9,8 inches) diameter.

The observatory furthermore owns some smaller telescopes, a 12-inch universal instrument by REPSOLD, a pendulum clock by KESSELS, and one by KNOBLICH, box chronometers, one each, by KESSELS, KNOBLICH, and IREDE, and a considerable equipment of spectroscopic and other physical, chemical, and photographic apparatus, meteorological instruments, and a set of registering magnetic instruments after the KEW pattern.

Two observers were secured for its observatory on the 1st of July, 1874, namely: Prof. G. SPORER, formerly teacher of mathematics and physics, and pro-rector of the gymnasium in Anclam, and Prof. H. C. VOGEL, formerly astronomer in the observatory of Kammerherr von Bülow, in Bothkamp; Dr. OSCAR LOHSE, of the same observatory, was engaged as first assistant. Professor SPORER continued in an intermistic building in Potsdam, the solar observations made in Anclam from 1861–1874, and Professor VOGEL and Dr. LOHSE observed at the Berlin Observatory until spring 1877, when temporary arrangements were made to enable them to observe in the new institute. Dr. GUSTAV MÜLLER is employed as assistant since July 1, 1877, and Dr. PAUL KEMPF since July 1, 1878.

(Translated from, Publicationen des Astrophysikalischen Observatorium zu Potsdam. Erster Band. Mit sechszehn Tafeln. Potsdam, 1879.)

PUEBLA, MEXICO.

Observatory of the College of Jesus.

Longitude from Greenwich, $6^h\ 32^m\ 41^s$ W.
Latitude, 19° 2′ 30″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887, p. 49.
Director: P. SPINA.

PULKOVA, RUSSIA.

Nicolaevskaia Glavnaia Observatoria.

Longitude from Greenwich, $2^h\ 1^m\ 18.67^s$ E.
Latitude, 59° 46′ 18.7″ N.
Directors: F. W. G. VON STRUVE, 1834.
OTTO VON STRUVE, 1864.

Founded in 1834. Three principal halls on the ground floor, the eastern one being used for meridian circle; the western one for the meridian telescope, and the southern one occupied by the prime vertical. Three revolving domes, the central and largest containing MERZ and MAHLER'S refractor, which has a focus of 23¼ feet (7.1^m), and an aperture of 15¼ inches (0.40^m). A very rich astronomical library. The most elaborate and minute researches on the minor corrections of spherical astronomy, notably the corrections of aberration of nutations and precession, have been made chiefly at this observatory.

PRAGUE, AUSTRIA.

I. *K. K. Universitäts Sternwarte.*

Longitude from Greenwich, 57^m 41.4^s E.
Latitude, 50° 5′ 18.8″ N.
Authority for latitude and longitude, AL. DAVID and J. BÖHM.
Directors: J. STEPLING, 1751.
A. STRANDT, 1781.
A. DAVID, 1799.
A. BITTNER, 1836.
K. KREIL, 1845.
C. JELINEK, 1851.
J. G. BÖHM, 1855.
Dr. C. HORNSTEIN, 1868.
Prof. LADISLANS WEINEK, ——.

TYCHO DE BRAHE had some astronomical instruments temporarily mounted at Prague (1600–1601). The observatory, properly so called, was not erected until 1751, in the Altstadt quarter, at the Collegium Clementinum, under the direction of the Jesuits.

INSTRUMENTS:

(*a*) *Meridian circle:* One; maker, CHR. STARKE (mechanical workshop of the I. R. Polytechnic Institute in Vienna); diameter of circle, 36 inches; divided to 3′; read by 4 nonius to 2″; aperture of objective, 4 inches.

(*b*) *Meridian transit instruments:* Maker, CHR. STARKE; aperture, 4 inches; (*b*′) maker, SCHRÖTTER; aperature of objective, 3 inches.

(*c*) *Equatorial instruments:* Makers, C. A. STEINHEIL'S SONS, in Munich; aperture of objective, 6 inches; magnifying powers of eye-pieces, 56, 84, 252, 420, 672. (*c*′) Makers, UTZSCHNEIDER & FRAUNHOFER, Munich; aperture of objective, 3 inches.

(*d*) *Spectroscopes:* One; G. & S. MERZ, Munich; one small star spectroscope; makers, G. & S. MERZ, Munich.

(*f*) *Chronograph:* One; Dr. M. HIPPS, Neuchatel, maker.

(*g*) *Clocks:* Mean time; makers, LEPAUTE, Paris; sidereal; makers, J. BOZEK, Prague.

(*h*) *Chronometer:* Mean time; maker, BARRAUD.

(*i*) *Miscellaneous:* One sextant; maker, TYCHO BRAHE; one octant; maker, TYCHO BRAHE; one large (Hohen Kreis), by TROUGHTON, in London.

II. *Sternewarte des Herrn A. Safarik.*

Longitude from Greenwich, 57^m 47^s E.
Latitude, 50° 4′ 25″ N..
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: A. SAFARIK.

PUY-LE-DOME, FRANCE.

Observatoire.

Longitude from Greenwich, 11ᵐ 33ˢ E.
Latitude, 45° 46′ 28″ N.
Director: ——.

QUEBEC, CANADA.

Observatory.

Longitude from Greenwich, 4ʰ 44ᵐ 49.3ˢ W.
Latitude, 46° 48′ 17.3″ N.
Director: E. D. ASHE, 1863.
C. W. DRURY.

Prior to 1883 the instruments were at the residence of Capt. ASHE; they were then removed to the observatory at the citadel.

QUITO, ECUADOR.

Observatorio del Colegio Nacional.

Longitude from Greenwich, 5ʰ 15ᵐ 20ˢ W.
Latitude, 0° 14′ 0″ S.
Director: J. B. MENTEN, 1874.

RATHOWEN, IRELAND.

Obseratory of W. E. Wilson.

Longitude from Greenwich, ——.
Latitude, ——.
Director: W. E. WILSON.

RICHMOND (SURREY), ENGLAND.

Kew Observatory of the Royal Society.

Longitude from Greenwich, 1ᵐ 15.1ˢ W.
Latitude, 51° 28′ 6″ N.
Directors: Sir FRANCIS RONALDS, 1842.
I. WELSH, 1852.
BALFOUR STEWART, 1859.
S. JEFFERYS, 1871.
G. M. WHIPPLE, 1876.

Erected in 1768 as the private observatory of George III; in 1841 it was dismantled and transferred to the British Association for use as a physical observatory; in 1871, having been endowed by J. P. GASSIOLT, esq., it was placed under the control of a committee of the Royal Society.

Rio de Janeiro, Brazil.

Imperial Nautical Observatory.

Longitude from Greenwich, $2^h\ 52^m\ 41.41^s$ W.
Latitude, 22° 54′ 23.7″ S.
Directors: A. M. de Mells, 1850.
E. Liais, 1871.
L. Cruls.
Founded in 1780; restored in 1871.

Rome, Italy.

I. *Osservatorio astronomico del Colegio Romano.*

Longitude from Greenwich, $49^m\ 55.5^s$ E.
Latitude, 41° 53′ 53.7″ N.
Directors: G. Asclepi, 1764.
G. Calandrelli, 1773.
S. Dumouchel, 1824.
F. de Vico, 1838.
A. Secchi, 1849.
G. S. Ferrar, 1878.
P. Tacchini, 1879.

Before the establishment of a regular observatory a succession of astronomers, more or less famous, made use of temporary accommodations. In the buildings of the old college Clavias made observations with a zenithal sector in 1572, and following years. Scheiner collected the materials for his famous *Rosa Ursina*, the printing of which was completed in 1630 at the new college, west of the Church of St. Ignatius. There, too, Gottignies and Borgondio made occasional observations. Maire observed the comet of 1844 at the English college. Boscovich fixed himself in the principal hall of the Kircher Museum. Finally, Asclepi organized a permanent establishment in 1764; and in 1787 a square tower was built to accommodate the observatory at the eastern angle of the college façade on via del Gesù. A new building was put up in 1853, having for substructure the enormous piles which had been intended to support the dome of the Church of St. Ignatius.

II. *Observatory of the Capitol.*

Longitude from Greenwich, $49^m\ 56.5^s$ E.
Latitude, 41° 53′ 33.5″ N.
Authority for longitude and latitude: A. Lancaster, Liste Générale des Observatoires et Astronomes, 1887.
Directors: G. Callandrelli, 1824.
A. Conti, 1827.
I. Callandrelli, 1841.
L. Respighi, 1876.

Established in 1824 upon the east tower of the capitol, which is built above the ancient forum.

III. Osservatorio astronomico privato.

Longitude from Greenwich, $49^m\ 50.3^s$ E.
Latitude, 41° 54′ 6″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: Father S. FERRARI.

RUGBY, ENGLAND.

Temple Observatory.

Longitude from Greenwich, $5^m\ 1.9^s$ W.
Latitude, 52° 22′ 5″ N.
Curators: J. M. WILSON, 1872.
G. M. SEABROKE, 1878.

The observatory was built in 1871 as a memorial to Dr. TEMPLE, late head-master of Rugby School, now bishop of Exeter. The funds for this purpose were collected chiefly from old Rugbians by the Rev. J. M. WILSON.

RUNGSDORF (NEAR BONN), PRUSSIA.

Sternwarte.

Longitude from Greenwich, ——.
Latitude, ——.
Director: Baron CAMPHAUSEN.

SAINT CROIX, ANTILLES.

Observatoire.

Longitude from Greenwich, $4^h\ 18^m\ 43^s$ W.
Latitude, 17° 44′ 32″ N.
Authority for longitude and latitude: LANG. WURM, 1837. In Connaissance des Temps, 1884, p. lxii.
Director: ——.

ST. JOHN'S, NEW BRUNSWICK.

Observatory.

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

SAIGON, FRENCH COCHIN CHINA.

Observatoire.

Longitude from Greenwich, 7^h 6^m 48^s E.
Latitude, 10° 46′ 40″ N.
Authority for longitude and latitude: HATT, 1875. In Connaissance des Temps, 1884, p. xli.

ST. HELENA.

Observatory.

Longitude from Greenwich, 21^m 9.98^s W.
Latitude, 15° 55′ S.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. lv.
Director: ——.

ST. PETERSBURG, RUSSIA.

I. *Observatoria Akademii Nauk (Observatory of the Imperial Academy of Sciences).*

Longitude from Greenwich, 2^h 1^m 13.5^s E.
Latitude, 59° 56′ 29.7″ N.
Directors: J. N. DE L'ISLE, 1747.
P. INSCHODZOW, 1768.
R. BARRY, 1794.
V. WISNIWSKY, 1811.
A. SAWITSCH, 1856.
Founded in 1747.

II. *Astronomicheskaia Observatoria pri Imp. Universitet.*

Longitude from Greenwich, 2^h 1^m 11.4^s E.
Latitude, 59° 56′ 32″ N.
Director: S. VON GLASENAPP.

III. *Zentralnaia Fisicheskaia Observatoria.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: H. WILD.

SAN FERNANDO, SPAIN.

Instituto y Observatorio de Marina de San Fernando.

Longitude from Greenwich, 24^m 49.6^s W.
Latitude, 36° 27′ 41.5″ N.

Directors: R. ARMESTO, 1797.
J. O. CANELAS, 1798.
J. T. CERGUERO, 1825.
S. MONTOJO, 1851.
F. DE P. MARQUEZ, 1855.
C. PUJAZON, 1866.

An observatory had first been established at Cadiz in 1753, upon an ancient Roman tower, but was soon abandoned, observations being made there only from 1773 to 1776 by TOFIÑO and VARELA. The new observatory was built at San Fernando in 1797. This is the most southerly astronomical establishment in Europe.

SAN LUIS POTOSI, MEXICO.

Observatorio del Instituto Cientifica y Literaria.

Longitude from Greenwich, ———.
Latitude, ———.
Director: Dr. G. BARROETA.

SANTIAGO, CHILE.

Observatorio Nacional.

Longitude from Greenwich, $4^h\ 42^m\ 46.3^s$ W.
Latitude, 33° 26′ 42″ S.
Directors: E. G. MOESTA, 1852.
J. I. VERGARA, 1861.

Proposed in 1852. The instruments and buildings which had been used for the temporary Naval Observatory of the United States at Santa Lucia, under Lieutenant GILLISS, were purchased as a beginning, and in 1856 the construction of a permanent observatory was undertaken, consisting simply of a one-story building and central dome. The equipment has been added to gradually since 1859.

SCARBOROUGH, ENGLAND.

Observatory Wigglesworth.

Longitude from Greenwich, ———.
Latitude, ———.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Assistant: J. G. LOHSE.

SCHWERIN, MECKLENBURG.

Geodetisches Observatorium.

Longitude from Greenwich, $45^m\ 40.7^s$ E.
Latitude, 53° 37′ 38.2″ N.
Authority for longitude and latitude: Astron. Nachr., LVII, 6, 1868.
In Connaissance des Temps, 1884, p. xxviii.

SENFTENBERG, BOHEMIA.

Sternwarte des Baron Perish.

Longitude from Greenwich, $1^h\ 5^m\ 50.6^s$ E.
Latitude, 50° 5′ 10.4″ N.
Director: Dr. BOORSEN.
Ceased to exist.

SLOUGH, ENGLAND.

Observatory.

Longitude from Greenwich, $2^m\ 23^s$ W.
Latitude, 51° 30′ 20″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xvi.
Director: ——.

SOUTH KILWORTH, ENGLAND.

Observatory.

Longitude from Greenwich, $4^m\ 26^s$ W.
Latitude, 52° 25′ 51″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xvi.

SPEYER, BAVARIA.

Sternwarte des Königlichen Lyceums.

Longitude from Greenwich, $33^m\ 45.6^s$ E.
Latitude, 49° 18′ 55.4″ N.
No longer in existence.

STARFIELD, ENGLAND.

Observatory.

Longitude from Greenwich, $11^m\ 47^s$ W.
Latitude, 53° 25′ 3″ N.
Authority for longitude and latitude: Connaissance des Temps., 1884, p. xvi.

STOCKHOLM, SWEDEN.

Observatory.

Longitude from Greenwich, $1^h\ 12^m\ 14^s$ E.
Latitude, 59° 20′ 34″ N.
Directors: P. V. WARGENTIN, 1750.
H. NICANDER, 1776.
J. SVANBERG, 1803.
S. A. CRONSTRAND, 1828.
N. H. SELANDER, 1858.
J. A. HUGO GYLDEN, 1871.

Founded in 1750. Here WARGENTIN made that long series of observation on Jupiter's satellites which resulted in the first reliable tables of eclipses of these satellites.

INSTRUMENTS:

(a) *Meridian circle:* Makers, ERTEL & SON; diameter of circles, 18 inches; divided to 3′; read by 4 microscopes to 1″; aperture of objective, 4⅕ inches (0.107 meters); magnifying power ordinarily employed, 124 diameters.

(b) *Meridian transit instrument:* Maker, A. REPSOLD; aperture, 2½ inches.

(c) *Equatorial instrument:* Maker, A. REPSOLD; aperture of objective, 7 inches; magnifying powers of eye-pieces, 114, 150, 190, 302, 600.

(f) *Chronographs:* Two.

(g) *Clocks:* Mean time; makers, MOLYNEUX & COPE; sidereal; makers, KESSELS, SWEDER.

(h) *Chronometer:* Mean time; makers, DENT, LINDEROTH.

STONYHURST COLLEGE (NEAR WHALLEY), ENGLAND.

Stonyhurst College Observatory.

Longitude from Greenwich, $9^m\ 52.68^s$ W.
Latitude, 53° 56′ 40″ N.
Authority for longitude and latitude: Nautical Almanac.
Directors: Rev. A. WELD, S. J., F. R. A. S., 1838.
Rev. S. J. PERRY, S. J., F. R. A. S., 1860.

Location: Four miles W. of Whalley, Lancashire, England.

Height above sea, 381 feet. Built in 1838 in the park of the Jesuit College.

INSTRUMENTS:

(a) *Meridian circle:* By Jones; 2 feet 6 inches; divided to 5′; microscopes reading to 1″; aperture of object glass, 3 inches; power generally used, 56.

(b) *Transit instrument:* Aperture of object glass, 2⅝ inches; power generally used, 42; by CARY.

(c) *Equatorial instruments:* One by NAPIER, CURRY, TROUGHTON and SIMMS; aperture, 8 inches; powers from 30 to 600 or 700; one by JONES; aperture, 4 inches. (c′) A CASSEGRAIN reflector; aperture, 9½ inches; two, NEWTONIAN; aperture, 7 inches.

(d) *Spectroscopes:* An automatic instrument by BROWNING, 6 prisms of 60°, each used twice, with a half prism, making largest dispersion=36 prisms of 60°. A large star spectroscope by SIMMS, 4 compound prisms by HOFFMAN. A large direct-vision spectroscope by BROWNING. Two smaller instruments by BROWNING.

(f) *Chronograph:* Small one by BREGUET.

(g) *Clocks:* Two sidereal, mercurial pendulums.

(*h*) *Chronometer:* FRODSHAM, No. 3148.

(*i*) *Miscellaneous:* A couple of self-recording meteorological and magnetical instruments are in constant use.

STRASBURG, GERMANY.

Sternwarte.

Longitude from Greenwich, 31^m 2.49^s E. Latitude, 48° 34′ 53.8″ N.	Of the old observatory.
Longitude from Greenwich, 31^m 4.65^s E. Latitude, 48° 34′ 59.7″ N.	Of the new observatory.

Director: A. WINNECKE.

About 1770 some astronomical instruments were placed above the gate of the hospital. In 1804 J. HENRY established a small observatory in the Münster (Cathedral) and observations were made there in 1824. A regular observatory was not established by the city until 1836, and then it was placed under the charge of LEQUIANTE, but almost immediately abandoned. In 1873 a new observatory was erected without the town, in connection with the University. Its general plan is a quadrilateral.

SYDNEY, NEW SOUTH WALES, AUSTRALIA.

Government Observatory.

Longitude from Greenwich, 10^h 4^m 50.6^s E.
Latitude, 33° 51′ 41.1″ S.
Directors: W. SCOTT, 1856.
G. R. SMALLEY, 1862.
H. C. RUSSELL, 1870.

Proposed in 1855; completed in 1858. Its first instruments, supplied from the private observatory which BRISBANE had established at Paramatta, were those by means of which DUNLAP had made his catalogues of double stars and of southern nebulæ.

TACUBAYA, MEXICO.

Observatorio Astronomico Nacional Mexicano.

Longitude from Greenwich, 6^h 36^m 41.63^s W.
Latitude, 19° 24′ 17.5″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: ANGEL ANGUIANO.

Projected in 1876, and established at Chapultepec in 1878. Transferred from Chapultepec March 8, 1883.

TACHKENT, RUSSIA.

Observatoire Astronomique et Physique de Tachkent.

Longitude from Greenwich, $4^h\ 37^m\ 10.8^s$ E.
Latitude, 41° 19′ 32.2″ N.
Authority for longitude, telegraphic; for latitude, vertical circle observations.
Director: H. POMERANZEFF, 1880.

TIFLIS, RUSSIA.

Observatoria.

Longitude from Greenwich, $2^h\ 59^m\ 17^s$ E.
Latitude, 41° 41′ 46″ N.
Authority for longitude and latitude: Triangulation, Novo Tcherkask, 1862. In Connaissance des Temps, 1884, p. xlii.

TOKIO, JAPAN.

Observatory of the Daigaku.

Longitude from Greenwich, ——.
Latitude, ——.
Director; Prof. H. M. PAUL.

TOULON, FRANCE.

Observatoire de la Marine.

Longitude from Greenwich, $23^m\ 42^s$ E.
Latitude, 43° 7′ 22″ N.
Authority for latitude and longitude: Connaissance des Temps, 1884, p. xii.
Director: —— PAGEL.

TOULOUSE, FRANCE.

Observatoire de Toulouse.

Longitude from Greenwich, $5^m\ 51.1^s$ E.
Latitude, 43° 36′ 45.3″ N.
Directors: F. P. A. DE GARIPNY, 1735.
A. DARQUIER DE PELLEPOIX, 1748.
J. VIDAL, 1774.
DUBUISSON, 1807.
VICTOR DE MARQUÉ, 1822.
DE DESPLATS ET VAUTHIER, 1832.
E. PETIT, 1867.
—— DESPEYROUS, 1867.
SAGUIN, 1867.
F. DE TISSERAND, 1873.
B. BAILLAUD, 1878.

TREVANDRUM, INDIA.

His Highness the Maha Rajah's Observatory.

Longitude from Greenwich, $5^h\ 7^m\ 59^s$ E.
Latitude, 80° 30′ 32″ N.
Directors: JOHN CALDECOTT, F. R. A. S., 1837.
JOHN ALLAN BRONN, F. R. S., 1852.

TRIESTE, AUSTRIA.

Astronomisches und Meteorologisches Observatorium der K. K. Nautischen und Handels Akademie.

Longitude from Greenwich, $55^m\ 2.1^s$ E.
Latitude, 45° 38′ 34″ N.
Directors: F. SCHAUB, 1857.
A. KUNES, 1870.
A. PALISA.

TUNBRIDGE WELLS, ENGLAND. (See CROWBOROUGH.)

TURIN, ITALY.

Regio Osservatorio dell' Universita.

Longitude from Greenwich, $30^m\ 48.4^s$ E.
Latitude, 45° 4′ 6″ N.
Directors: G. B. BECCARIA, 1759.
T. VALPERGADI CALUSO, 1782.
A. M. VASSALI EANDI, 1806.
J. PLANA, 1811.
A. DORNA, 1865.

Established in 1759 in the top of a tower at the corner of Piazza Castello. The Academy of Sciences undertook its direction in 1790, and had a new observatory built in the palace of the academy. In 1820 the establishment was transferred to a terrace of the Palazzo Madama. In 1865 the observatory became an appendage of the university.

TWICKENHAM, ENGLAND.

Longitude from Greenwich, $1^m\ 13.1^s$ W.
Latitude, 51° 27′ 4.2″ N.
Director: Mr. HIND.

UCKFIELD, ENGLAND.

Observatory of Captain W. Noble.

Longitude from Greenwich, 17.8^s E.
Latitude, 51° 0′ 56.3″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Proprietor: W. Noble.

UPSALA, SWEDEN.

Observatory of the University.

Longitude from Greenwich, $1^h\ 10^m\ 30^s$ E. } Of the old observatory.
Latitude, 59° 51′ 37″ N.
Longitude from Greenwich, $1^h\ 10^m\ 30^s$ E. } Of the new observatory.
Latitude, 59° 51′ 29.4″.
Authority for longitude and latitude: New determination in 1880–'81, by C. BOHLIN.

Directors: A. CELSIUS, 1730.
M. STRÖMER, 1745.
D. MELANDERHJELM, 1761.
E. PROSPERIN, 1797.
L. REGNÈR, 1799.
J. BREDMAN, 1811.
G. SVANBERG, 1842.
HERMAN SCHULTZ, 1864.

This observatory was founded in 1742, and ceased to exist in 1853. The new observatory was founded in 1844 by G. SVANBERG, finished and in use since 1853.

URBINO, ITALY.

Osservatorio del Colegio Rafaël.

Longitude from Greenwich, $50^m\ 33.1^s$ E.
Latitude, 43° 43′ 29.59″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: G. MARTINOTTI.

UTRECHT, HOLLAND.

Observatorium.

Longitude from Greenwich, $20^m\ 31.7^s$ E.
Latitude, 52° 5′ 9.5″ N.
Directors: J. F. HEUNERT, 1767.
G. MALL, 1812.
R. VAN REES, 1836.
M. HOCK, 1860.
J. A. C. OUDEMANS, 1874.

Founded in 1767. Remodelled in 1864.

VALENTIA, IRELAND.

Observatory of the London Meteorological Office.

Longitude from Greenwich, $41^m\ 16^s$ W.
Latitude, 51° 54′ 36″ N.

Directors: Rev. T. KERR, 1868.
J. E. CULLUM, 1875.

Established by the London Meteorological Office in 1868 as an observatory of the first order.

VENICE, ITALY.

Observatory of the Naval Institute.

Longitude from Greenwich, $49^m\ 22.12^s$ E.
Latitude, 45° 26′ 8.5″ N.
Directors: B. VON WÜLLERSDORF-URBAIR, 1840.
E. MILLOSEVICH, 1874.

Established about 1840.

VERONA, ITALY.

Osservatorio.

Longitude from Greenwich, $43^m\ 56^s$ E.
Latitude, 45° 26′ 8″ N.
Authority for longitude and latitude: Ingén. géogr. 1837. In Connaissance des Temps, 1884, p. xxxv.
Director: ——.

VIENNA, AUSTRIA. (See WIEN.)

VILNA, RUSSIA.

Astronomicheskaia Observatoria.

Longitude from Greenwich, $1^h\ 41^m\ 11.9^s$ E.
Latitude, 54° 41′ N.
Authority for longitude and latitude: SLAVINSKI: "Astronomische Nachrichhen," Vols. V and VIII.
Directors: M. O. POCZOBUT, 1764.
J. B. VON SNIADECKI, 1808.
P. SLAVINSKI, 1824.
M. KLOUSCHNEVITCH, 1841.
G. A. VON FUSS, 1848.
G. SABLER, 1854.
Col. PETER SMYSLOFF, 1867.

It appears that this observatory had already existed for some time when in 1764 POCZOBUT restored it and replaced its instruments. Its labors, suspended during the revolution, were not resumed until 1802.

INSTRUMENTS:

(*b*) *Meridian transit instrument:* Maker, RAMSDEN, in 1777; aperture, 4 inches; magnifying power 40 diameters.

(*c*) *Equatorial instrument:* Maker, RAMSDEN, in 1777; aperture of objective, 4 inches; magnifying powers of eye-pieces, 40 and 60.

(*d*) *Spectroscope:* Direct vision, maker, S. MERZ, at Munich.

(*e*) *Photometer:* Made by the late Prof. L. SCHWERD, at Speyer. Of the three made by him, one is in Bonn, and the other in Pulkowa.

(*f*) *Chronograph:* Maker, ANSFELD, at Gotha.

(*g*) *Clocks:* One, mean time, maker, SHELTON (London); one sidereal, maker, HARDY (London 1819).

(*h*) *Chronometer:* One, mean time, maker, DENT, No. 2,796; one sidereal, maker, DENT, No. 2,000.

(*i*) A heliostat, by S. MERZ. Various ancient astronomical instruments and modern meteorological instruments. The library of the observatory contains 1,966 works, in 4,181 volumes.

VIVIERS, FRANCE.

Observatoire.

Longitude from Greenwich, $18^m\ 44^s$ E.
Latitude, 44° 29′ 14″ N.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. xii.
Director: ——.

WARSAW, RUSSIA.

Astronomicheskaia Observatoria.

Longitude from Greenwich, $1^h\ 24^m\ 7.4^s$ E.
Latitude, 52° 13′ 5.7″ N.
Directors: —— ARININSKI, 1820.
J. D. BARANOWSKI, 1848.
J. WOSTOKOFF, 1877.

In 1764 Rostan made observations at the castle. From 1765 to 1768 N. WOLF made observations at the Blue Palace on the Mniszech. The observatory was not established permanently until 1820, and the expenses of construction were met by STRASZYZ, president of the university. It contains a hall for meridian instruments, and two towers with cupolas.

WELLINGTON, NEW ZEALAND.

Government Observatory.

Longitude from Greenwich, $11^h\ 39^m\ 11^s$ E.
Latitude, 41° 17′ 15″ S.
Authority for longitude and latitude: Connaissance des Temps, 1884, p. lii.
Director: ——.

WHALLEY, ENGLAND. (See STONYHURST.)

WIEN, AUSTRIA.

I. *K. K. Universitäts Sternwarte in Währing.*

Longitude from Greenwich, $1^h\ 5^m\ 21.49^s$ E.
Latitude, 48° 13′ 55.4″ N.
Directors: M. HELL, 1756.
F. VON FRIESNECKER, 1792.
J. S. BÜRG, 1817.
J. J. VON LITTROW, 1819.
K. L. VON LITTROW, 1841.
D. EDMUND WEISS.

The first observations made in Vienna were undertaken in 1745 by the Jesuits J. FRANÇOIS and J. LIESGANG. A permanent observatory was founded in 1756. It was rebuilt from 1820 to 1826, and located among the university buildings. In 1874 a new establishment on a greatly enlarged scale was erected at Währing, outside the town, and completed in 1879.

INSTRUMENTS:

(*a*) *Meridian circle:* Made by CHRISTIAN STARKE, at Vienna (after the example of the meridian circles of REICHENBACH); diameter of circles, 36 inches; divided to 3′; read by four microscopes to single seconds; aperture of objective, 48 inches; magnifying power ordinarily employed 120 diameters.

(*b′*) *Prime vertical:* Maker, CHRISTIAN STARKE; aperture, 50 inches; magnifying power, 120 diameters.

(*c*) *Equatorial instruments:* One, made by ALVAN CLARK & SONS; aperture of objective, 11¾ inches; magnifying powers of eye-pieces, up to 1,200. (*c′*) One, made by FRAUENHOFER; aperture of objective, 6 inches; magnifying powers, up to 600.

(*d*) *Spectroscopes:* One small star spectroscope; one ZOELLNER'S solar spectroscope.

(*g*) *Clocks:* Two mean time; makers, UTZSCHNEIDER, at Munich; VORAUER, at Vienna; several sidereal; makers, MOLYNEUX (London); AUCH (Gotha); GRAHAM (London); and a few, more or less accurate.

(*h*) *Chronometers:* Mean time; maker, ARNOLD; sidereal, makers, KESSELS, MOLYNEUX.

(*i*) *Miscellaneous:* An equatorial with adaptation for various latitudes, the 6-inch objective by STEINHEIL, the mounting by SCHÄFFLER. Two refractors of 4-inch aperture; one of them not equatorially mounted. One equatorial of 3-inch aperture, adapted for various latitudes, objectives by FRAUENHOFER. One equatorial of 3-inch aperture, by DOLLOND. One dialitic equatorial of PLÖSSEL, of 5 inches. One comet-seeker, of 6-inch aperture and 4 feet focal length, by MERZ; mounted equatorially on the principle of VILLAREAU, by SCHNEIDER. One comet-seeker of 3-inch aperture by PLÖSSEL; one of $2\frac{1}{2}$ inches, by STEINHEIL. Besides these, various smaller portable transit instruments, theodolites, sextants, etc.

II. *Observatory of the High School of Technology.*

Longitude from Greenwich, $1^h\ 5^m\ 25.3^s$ E.
Latitude, 48° 12′ 53.8″ N.
Directors: J. HERR, 1865.
W. SINTER, 1870.

Founded in 1865 at the southwestern extremity of the city; completed in 1867.

III. *Private Observatory.*

Longitude from Greenwich, $1^h\ 5^m\ 25.3^s$ E.
Latitude, 48° 12′ 54.9″ N.
Director: DR. TH. VON OPPOLZER.

IV. *Hohe Warte (bei Döbeln).*

Longitude from Greenwich, ——.
Latitude, ——.
Director: DR. JULIUS HAUN.

V. *Sternwarte Kuffner.*

Longitude from Greenwich, $1^h\ 5^m\ 11^s$ E.
Latitude, 48° 12′ 47.8″ N.
Authority, A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: DR. N. HERZ.

VI. *Sternwarte des Herrn K. Fritsch.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: K. FRITSCH.

VII. *Sternwarte des Herrn Baron A. von Rothschild.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: ——.

VIII. *Sternwarte des Herrn W. Biela.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: W. BIELA.

IX. *Sternwarte des Herrn L. Kurzmayer.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: L. KURZMAYER.

WILLIAMSTOWN, VICTORIA.

Observatory.

Longitude from Greenwich, $9^h\ 39^m\ 38.8^s$ E.
Latitude, 37° 52′ 7.2″ S.
Removed to Melbourne, Victoria, in 1861.

WILHELMSHAVEN, GERMANY.

Kaiserliches Marine Observatorium.

Longitude from Greenwich, $32^m\ 35.21^s$ E.
Latitude, 53° 31′ 52.2″ N.
Authority for longitude: Astronomische Arbeiten des Kgl. preuss. Geodätischen Instituts für 1878; for latitude: Director's observations of zenith-stars with meridian circle.
Director: C. BÖRGEN, Dr. Phil., 1876.
Founded in 1875; completed in 1878.

INSTRUMENTS:

(*a*) *Meridian circle:* One; makers, A. REPSOLD SÖHNE, in Hamburg; diameter of circles, 21.6 inches, divided to 2′; read by 4 microscopes, each to 0.1″; aperture of objective, 4½ inches; magnifying power ordinarily employed, 125 diameters.

(*b*) *Meridian transit instruments:* One portable, by C. BAMBERG, Berlin; aperture, 1½ inches.

(*c*) *Equatorial instruments:* One, by STEINHEIL SÖHNE, in Munich; aperture of objective, 4 inches; magnifying powers of eye-pieces, 48 to 360; ring-micrometer. (*c*′) One, STEINHEIL SÖHNE; 2½ inches aperture; magnifying power, 24 to 150.

(*f*) *Chronograph:* One, by FUESS, Berlin.

(*g*) *Clocks:* Mean time; one, by EPPNER, Berlin; sidereal; one, by F. TIEDE, Berlin (standard clock).

(*i*) *Miscellaneous:* A complete set of LAMONT'S instruments for observing the variations of the magnetical declination, horizontal force, and inclination.

LAMONT'S magnetical theodolite; dip-circle by DOVER; self-registering barometer and anemometer (ROBINSON); meteorological instruments; self-registering tide-gauge; time-ball. Since September, 1880, a self-registering tide-gauge, devised by Mr. REITZ, of Hamburg, has been erected in Heligoland and placed under the control of this observatory.

WINDSOR, NEW SOUTH WALES, AUSTRALIA.

Observatory of John Tebbut.

Longitude from Greenwich, $10^h\ 3^m\ 21.8^s$ E.
Latitude, 33° 36′ 28.8″ S.
Director: JOHN TEBBUT.

WOLSINGHAM, ENGLAND.

Observatory of the Liverpool Astronomical Society.

Longitude from Greenwich, ——.
Latitude, ——.
Authority: A. LANCASTER, Liste Générale, etc., 1887, p. 63.
Observer: T. E. ESPIN.

ZACATECAS, MEXICO.

Observatory.

Longitude from Greenwich, $6^h\ 41^m\ 0.67^s$ W.
Latitude, 22° 46′ 34.9″ N.
Authority for longitude and latitude: A. LANCASTER, Liste Générale des Observatoires et Astronomes, 1887.
Director: A. JOSE Y BONILLA.

ZIKAWEI, CHINA.

Longitude from Greenwich, ——.
Latitude, ——.
Director: MARC DECHEVREUS.

ZÜRICH, SWITZERLAND.

I. *Sternwarte des Schweizerischen Polytechnikums.*

Longitude from Greenwich, $34^m\ 12.6^s$ E.
Latitude, 47° 22′ 40″ N.
Authority for longitude and latitude: Astronomische Mittheilungen von Dr. RUDOLF WOLF.
Directors: J. H. WASER, 1773.
J. FEER, 1787.
J. ESCHMANN, 1823.
RUDOLF WOLF, 1860.

Founded in 1773 upon the Carolus Thurm (Charles Tower), through the efforts of the Zürich Society of Naturalists. Abandoned from 1798 to 1805. In 1810 a new observatory was erected east of the Carolus Thurm; this was abandoned in 1852. Finally in 1860 the observatory was rebuilt at the polytechnikum, where it was inaugurated in 1863.

The observatory is mainly used for the practical training of the students. The scientific results are voluntary contributions by the director and assistant.

INSTRUMENTS:

(*a*) *Meridian circles:* Two; makers, KERN, in Aarau, ERTEL, in Munich; diameter of circles, 20 inches; divided to 2′; read by 2 microscopes to 0.1″; aperture of objective, 5.3 inches; magnifying power ordinarily employed, 120.80.

(*c*) *Equatorial instruments:* Makers, KERN, in Aarau; aperture of objective, 6 inches; magnifying power of eye-pieces, 60 to 500. (*c'*) MERZ, in Munich, 3½ inches; 64 to 212.

(*d*) *Spectroscope:* One, by MERZ, in Munich.

(*f*) *Chronographs:* Four, by HIPP, in Neuchatel, and HASSLER, in Aarau.

(*g*) *Clocks:* Mean time; makers, Association ouvrière au Locle; sidereal; maker, SILVAIN MAIRET, Locle. Also several pendulum clocks, among which one by REPSOLD.

(*h*) *Chronometer:* Sidereal; seconds chronometer; maker, BUZENGEIGER.

(*i*) *Miscellaneous:* Several astronomical theodolites, meteoroscopes, panagenprisms, etc.; also historical collection of antique instruments.

II. *Private Observatory.*

Longitude from Greenwich, ——.
Latitude, ——.
Director: Dr. F. SCHINZ.

CATALOGUE OF PUBLICATIONS

OF THE

SMITHSONIAN INSTITUTION.

BY WILLIAM J. RHEES.

INTRODUCTION.

The present catalogue embraces all the articles published by the Smithsonian Institution, from its organization in 1846 to the first of July, 1886, a period of forty years.

At the beginning nothing was issued but pamphlets explanatory of the plan of the Institution, and brief annual reports of the proceedings of the Board of Regents, indicated in the catalogue by the letters A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, Q. An elaborate work (P in the catalogue), by ROBERT DALE OWEN, on public architecture, with special reference to the plans of the Smithsonian Institution, prepared on behalf of the building committee, was printed at the expense of the Institution in 1849, but did not form part of the regular series organized by the Secretary of the Institution, Professor Henry.

1. *Smithsonian Contributions to Knowledge.*

The series entitled "Smithsonian Contributions to Knowledge," in quarto form, was commenced in 1848 by the publication of Squier and Davis's Ancient Monuments of the Mississippi Valley. The following "advertisement" of the first volume, prepared by Professor Henry, indicates the character and design of the series:

"This volume is intended to form the first of a series of volumes, consisting of original memoirs on different branches of knowledge published at the expense and under the direction of the Smithsonian Institution. The publication of this series forms part of a general plan adopted for carrying into effect the benevolent intentions of James Smithson, esq., of England. This gentleman left his property in trust to the United States of America to found at Washington an institution which should bear his own name, and have for its objects 'the *increase* and *diffusion* of knowledge among men.' This trust was accepted by the Government of the United States, and an act of Congress was passed August 10, 1846, constituting the President and other principal executive officers of the General Government, the Chief Justice of the Supreme Court, the Mayor of Washington,* and such other persons as they might elect honorary members, an establishment under the name of the 'Smithsonian Institution, for the increase and diffusion of knowledge among men.' The members and honorary members of this establishment are to hold stated and special meetings for the supervision of the affairs of the Institution and for the advice and instruction of a Board of Regents, to whom the financial and other affairs are intrusted.

"The Board of Regents consists of three members *ex officio* of the establishment, namely, the Vice-President of the United States, the Chief Justice of the Supreme Court, and the Mayor of Washington*, together with twelve other members, three of whom are appointed by the Senate from its own body, three by the House of Representatives from its members, and six citizens appointed by a joint resolution of both houses. To this Board is given the power of electing a Secretary and other officers, for conducting the active operations of the Institution.

"To carry into effect the purposes of the testator, the plan of organization should evidently embrace two objects, one, the increase of knowledge by the addition of new truths to the existing stock; the other, the diffusion of knowledge thus increased, among men. No restriction is made in favor of any kind of knowledge, and hence each branch is entitled to and should receive a share of attention.

"The act of Congress, establishing the Institution, directs, as part of the plan of organization, the formation of a library, a museum, and a gallery of art, together with provisions for physical research and popular lectures, while it leaves to the Regents the power of adopting such other parts of an organization as they may deem best suited to promote the objects of the bequest.

"After much deliberation, the Regents resolved to divide the annual income, thirty thousand nine hundred and fifty dollars, into two equal parts, one part to be devoted to the increase and diffusion of knowledge by means of original research and publications, the other half of the income to be applied in accordance with the requirements of the act of Congress to the gradual formation of a library, a museum, and a gallery of art."

(The Programme of Organization, adopted December 8, 1847, follows.)

"In accordance with the rules adopted in the Programme of Organization, each memoir in this volume has been favorably reported on by a Commission appointed for its examination. It is, however, impossible, in most cases, to verify the statements of an author; and, therefore, neither the Commission nor the Institution can be responsible for more than the general character of a memoir."

The total number of papers published in the 25 volumes of "Contributions" is 125, with an aggregate of 13,287 pages, 2,115 wood-cuts, 536 plates, and 21 maps, each volume averaging 531½ pages.

2. *Miscellaneous Collections.*

In the year 1862, another series was instituted, entitled "Smithsonian Miscellaneous Collections," each volume of which has the following preface:

"The present series, entitled 'Smithsonian Miscellaneous Collections,' is intended to embrace all the publications issued directly by

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*** As there is no Mayor of Washington at present, this is inoperative.**

the Smithsonian Institution in octavo form; those in quarto constituting the 'Smithsonian Contributions to Knowledge.' The quarto series includes memoirs, embracing the records of extended original investigations and researches, resulting in what are believed to be new truths, and constituting positive additions to the sum of human knowledge. The octavo series is designed to contain reports on the present state of our knowledge of particular branches of science; instructions for collecting and digesting facts and materials for research; lists and synopses of species of the organic and inorganic world; museum catalogues; reports of explorations; aids to bibliographical investigations, etc.; generally prepared at the express request of the Institution and at its expense.

"The position of a work in one or the other of the two series will sometimes depend upon whether the required illustrations can be presented more conveniently in the quarto or the octavo form.

"In the Smithsonian Contributions to Knowledge, as well as in the present series, each article is separately paged and indexed, and the actual date of its publication is that given on its special title-page, and not that of the volume in which it is placed. In may cases works have been published and largely distributed years before their combination into volumes.

"While due care is taken on the part of the Smithsonian Institution to insure a proper standard of excellence in its publications, it will be readily understood that it can not hold itself responsible for the facts and conclusions of the authors, as it is impossible in most cases to verify their statements."

The total number of papers published in the 30 volumes of "Miscellaneous Collections" is 140, each volume averaging 884 pages, with an aggregate of 26,516 pages, 3,033 wood-cuts, and 48 plates.

3. *Annual Reports.*

By the act of Congress organizing the Institution it was made the duty of the "Board of Regents to submit at each session a report of the operations, expenditures, and condition of the Institution." These annual reports form a third series of Smithsonian publications. They consist of the reports of the Secretary to the Board of Regents of the operations and condition of the Institution; the reports of committees of the Board; reports of lectures; extracts from correspondence; original or translated articles relating to the history and progress of science, etc.

The first report was submitted by the Board to the second session of the 29th Congress, 1847, and formed an octavo pamphlet of 38 pages. A similar report was presented annually thereafter, varying in size from 64 pages to 326, printed in pamphlet form with paper covers up to 1853, when Congress ordered the report to be bound in cloth. In the volume for that year the essential portion of the contents of the preceding seven reports was reprinted, and this is now considered as the first of a set of Smithsonian reports. The number of pages was limited between 1854 and 1876 to 400. In the latter year this restriction was removed, and since then the average number of pages has been 600.

The number of copies of these reports for general distribution ordered by Congress has been very variable, the largest being 7,500 in 1874 and 1875, and the smallest 150 in 1847. The number of copies granted the Institution each year is shown in the following table:

Number of extra copies furnished the Institution by Congress for distribution.

For the year	Number of copies.	For the year.	Number of copies.	For the year.	Number of copies.
1847	150	1861	2,000	1875	7,500
1848	1,000	1862	2,000	1876	6,500
1849	500	1863	2,000	1877	6,500
1850	1,000	1864	2,000	1878	6,500
1851	2,000	1865	2,000	1879	7,000
1852	2,000	1866	2,000	1880	7,000
1853	3,000	1867	2,000	1881	7,000
1854	2,500	1868	2,000	1882	7,000
1855	2,500	1869	3,000	1883	7,000
1856	2,500	1870	5,000	1884, I }	7,000
1857	5,000	1871	5,000	1884, II }	
1858	5,000	1872	5,000	1885, I }	7,000
1859	2,000	1873	6,000	1885, II }	
1860	2,000	1874	7,500		

The total number of pages in the 41 volumes of annual reports is 21,292, average, 50 pages; total number of wood-cuts, 2,340, and 148 plates.

4. *Bulletins of the U. S. National Museum.*

In the year 1875 a fourth series of publications (octavo) was commenced, entitled "Bulletins of the National Museum," intended to illustrate the collections of natural history and ethnology belonging to the United States, constituting the National Museum, of which the Smithsonian Institution is the custodian.

Thirty-one of these bulletins have been published, with an aggregate of 7,475 pages, 623 wood-cuts, 80 plates, and 7 maps.

5. *Proceedings of the U. S. National Museum.*

In imitation of the practice of those learned societies which publish periodically descriptions of new species, etc., in the form of proceedings of weekly or monthly meetings, and thus present to the world the discoveries connected with the establishment at the earliest practicable moment, it appeared to be very desirable that the National Museum should have some medium of prompt publication for announcing descriptions of specimens received (many of which are new species), as well as other interesting facts relative to natural history furnished by correspondence of the Institution. To meet this want a fifth series of publications (octavo), entitled "Proceedings of the National Museum," was commenced in 1880. They are printed in successive signatures as fast as material sufficient for sixteen pages is prepared, and distributed at once to scientific societies and leading active working naturalists in this country and in Europe,* each signature having printed at the bottom of its first page the date of actual issue, for settling any questions as to priority of publication. Of this series eight volumes have been published, comprising 5,052 pages, with 109 cuts and 72 plates.

6. *Reports of the Bureau of Ethnology.*

The sixth series of publications is the annual report (in imperial octavo) of the Bureau of Ethnology, placed by Congress in charge of the Smithsonian Institution. Of this series four annual volumes have been published—those for 1879–'80, 1880–'81, 1881–'82, and 1882–'83—with an aggregate of 2,369 pages, 1,821 cuts, 259 plates, and 3 maps.

The distribution of these volumes to individuals is wholly by members of Congress and the Director of the Bureau, Maj. J. W. Powell.

7. *Copyright.*

No copyright has ever been secured on the publications of the Institution. They are left free to be used by compilers of books without any restrictions, except that full credit shall be given to the name of Smithson for any extracts which may be made from them.

8. *Use of Illustrations.*

Copies of the wood cuts used by the Institution are granted to authors or publishers on payment of the actual cost of production of electrotypes, and promise to give proper reference to the article in which they originally appeared.

9. *Size of editions.*

In the first experiments of the Smithsonian system of publication the proper magnitude of the editions necessary to meet the immediate and future demand could not be accurately ascertained. The number of copies of the contributions then fixed upon has since been found inadequate, although it was larger than that usually issued by other institutions. The edition has, therefore, been augmented, until at the present time 1,000 copies of each article are set aside to be combined into volumes, and an extra number, varying with the probable demand, struck off for separate distribution, and for sale.

Each article is complete in itself, with separate paging, title, and index, and without any necessary relationship to others combined with it in the same volume.

Of the early volumes of Smithsonian Contributions, the edition, for reasons already explained, was less than that of the succeeding ones, so that complete sets can not now be furnished.

In the year 1862 the plan of stereotyping every article printed by

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* Professor Baird's report for 1880.

the Institution was adopted, the plates being carefully preserved, thus making it practicable at any time to issue new editions except where expensive lithographic plates were used, a limited number only of impressions from these having been taken.

A number of the earlier articles in octavo were out of print before the commencement of the series of "Miscellaneous Collections," and consequently are not included in them.

The printing of the "Bulletins" and "Proceedings" is authorized by the Department of the Interior and paid for out of its fund. An edition of 1,000 copies is published, of which one-half is distributed by the Department of the Interior and one-half by the Institution.

10. *Distribution of publications.*

The distribution of the publications of the Institution is to make known to the world the truths which may result from the expenditure of the Smithson fund. For this purpose the "CONTRIBUTIONS TO KNOWLEDGE" are so distributed as to be accessible to the greatest number of readers; that is, to *large central libraries.*

They are presented on the express condition that, while they are carefully preserved, they shall be accessible at all times to students and others who may desire to consult them, and be returned to the Institution in case the establishments to which they are presented at any time cease to exist.

Full sets of the publications can not be given to all the libraries which apply for them, since this is impossible with the limited income of the Institution, and, indeed, if care be not exercised in the distribution, so large a portion of the income will be annually expended on the production of copies for distribution of what has already been published that nothing further can be done in the way of new publications.

The rules governing the distribution of the Smithsonian publications are appended. To enable institutions not coming within their provisos, as well as individuals, to procure copies of such as may be desired, a small number is set aside and sold by the Institution at a price which is intended merely to cover the actual cost of their publication.

11. *Rules for distribution of the publications of the Smithsonian Institution.*

TO INSTITUTIONS.

The publications of the Smithsonian Institution are furnished—

1st. To learned societies of the first class, which present complete series of their publications to the Institution.

2d. To public libraries containing 25,000 volumes.

3d. Institutions devoted exclusively to the promotion of particular branches of knowledge may receive such Smithsonian publications as relate to their respective objects.

TO INDIVIDUALS.

There is no gratuitous distribution to *individuals* of the publications of the Institution.

They can only be obtained by purchase, exchange of books or specimens, or by services rendered to the Institution.

12. *Form of application for publications.*

To the Smithsonian Institution, Washington, D. C.:

Date, 18

In behalf of the , we respectfully apply for the publications of the Smithsonian Institution, on condition that all volumes received shall be carefully preserved, be accessible to any person who may wish to consult them, and be returned to the Smithsonian Institution in case the establishment at any time ceases to exist.

1. Name of establishment ____________________
2. Location — Town ____________________
   State ____________________
3. When established ____________________
4. Character ____________________
5. Buildings and property ____________________
6. Permanent fund ____________________
7. Annual income ____________________
8. Volumes in library ____________________
9. Number of persons having use of books ____________________
10. Date of last catalogue of library ____________________
11. What publications made ____________________
    (Send printed list if possible.)
12. Name of officers: President ____________________
    Secretary ____________________
    Librarian ____________________
13. Addresses of principal scientific men connected with the establishment and subjects in which specially interested ____________________

I recommend the above application.

____________________ *Member of Congress,*

____________________ *District* ____________________ *State.*

LIST OF PUBLICATIONS OF THE SMITHSONIAN INSTITUTION.

NOTE.—A to Q indicate early publications not embraced in the regular series.

A. Journal of Proceedings of the Regents of the Smithsonian Institution at the city of Washington, beginning on the first Monday of September, 1846. 1846. 8vo., pp. 32.

B. Report of the Organization Committee of the Smithsonian Institution, with the resolutions accompanying the same and adopted by the Board of Regents; also, the Will of the testator, the act accepting the bequest, and the Act organizing the Institution. 1847. 8vo., pp. 32.

C. Digest of the act of Congress establishing the Smithsonian Institution. August 10, 1846. 8vo., pp. 8.

D. Address delivered on occasion of laying the Corner-stone of the Smithsonian Institution, May 1, 1847. By GEORGE M. DALLAS, Chancellor of the Institution. 1847. 8vo., pp. 8.

E. Smithson's Bequest. Professor HENRY'S exposition before the New Jersey Historical Society, at its meeting in Princeton, on Wednesday, September 27, 1847. 8vo., pp. 8.

F. First Report of the Secretary of the Smithsonian Institution to the Board of Regents; giving a Programme of Organization, and an account of the operations during the year. Presented December 8, 1847. 1848. 8vo., pp. 48.

G. [First] Report from the Board of Regents, submitted to Congress, of the operations, expenditures, and condition of the Smithsonian Institution. Senate Doc. 211; Twenty-ninth Congress, second session. 1847. 8vo., pp. 38.

H. Second Report of the Board of Regents of the Smithsonian Institution, to the Senate and House of Representatives, showing the operations, expenditures, and condition of the Institution during the year 1847. Thirtieth Congress, first session. Senate Mis. No. 23. 1848. 8vo., pp. 208.

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JEWETT, C. C. Report on plan of library.

LOOMIS, E. Report on meteorology of the United States.

ESPY, J. P. On meteorology.

I. Third Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1848. Thirtieth Congress, second session. H. R. Mis., No. 48. 1849. 8vo., pp. 64.

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Report of Prof. J. Henry, and Proceedings of the Board.
Jewett, C. C. Report on library.
Stevens, H. Prospectus of a Bibliographia Americana.
Hare, R. Letter relative to gift of apparatus.
Guyot, A. On metric system for scientific observations.

J. Programme of organization of the Smithsonian Institution. Presented in the First Annual Report of the Secretary, and adopted by the Board of Regents, December 13, 1847. 1847. 4to., pp. 4.

K. Correspondence relative to the acceptance for publication of the Ethnological Memoir of Messrs. Squier and Davis. 1847. 8vo., pp. 8.

L. [First] Report of the Organization Committee of the Smithsonian Institution. Reprinted from the National Intelligencer, December 8, 1846. 8vo., pp. 8.

M. Reports, etc., of the Smithsonian Institution, exhibiting its plans, operations, and financial condition up to January 1, 1849. From the Third Annual Report of the Board of Regents. Presented to Congress February 19, 1849. 1849. 8vo., pp. 72.

N. Officers and Regents of the Smithsonian Institution, with the act of Congress accepting the bequest, and the act incorporating said institution. 1846. 8vo., pp. 14.

O. An act to establish the Smithsonian Institution. Approved August 10, 1846; pp. 8.

P. Hints on Public Architecture, containing, among other illustrations, views and plans of the Smithsonian Institution; together with an appendix relative to building materials. Prepared on behalf of the Building Committee of the Smithsonian Institution, by Robert Dale Owen, chairman of the committee. 1849. 4to., pp. 140, 99 wood-cuts, 15 plates.

Q. Check list of periodical publications received in the reading-room of the Smithsonian Institution, for the year 1853. 1853. 4to., pp. 28.

REGULAR SERIES.

1. Ancient Monuments of the Mississippi Valley; comprising the results of extensive original surveys and explorations. By E. G. Squier and E. H. Davis. 1848. 4to., pp. 346, 207 woodcuts, 48 plates. (S. C., I.)

2. Smithsonian Contributions to Knowledge. Vol. I. 1848. 4to., pp. 360, 207 woodcuts, 48 plates.

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SQUIER and DAVIS. Ancient Monuments, Mississippi Valley. No. 1.

3. Researches relative to the Planet Neptune. By SEARS C. WALKER. 1849. 4to., pp. 60. (S. C., II.)

4. Ephemeris of the Planet Neptune for the Opposition of 1848. By SEARS C. WALKER. 1848. 4to., pp. 8. (S. C. II.)

5. Ephemeris of the Planet Neptune from the date of the Lalande Observations of May 8 and 10, 1795, and for the Opposition of 1846, 1847, 1848, and 1849. By SEARS C. WALKER. April, 1849. 4to., pp. 32. (S. C., II.)

6. Ephemeris of the Planet Neptune for the year 1850. By SEARS C. WALKER. April, 1850. 4to., pp. 10. (S. C., II.)

7. Ephemeris of the Planet Neptune for the year 1851. By SEARS C. WALKER. December, 1850. 4to., pp. 10. (S. C., II.)

8. *Occultations visible in the United States during the year 1848. By JOHN DOWNES. 1848. 4to., pp. 12.

9. *Occultations visible in the United States during the year 1849. By JOHN DOWNES. 1848. 4to., pp. 24.

10. *Occultations visible in the United States during the year 1850. By JOHN DOWNES. 1849. 4to., pp. 26.

11. Occultations visible in the United States during the year 1851. By JOHN DOWNES. October, 1850. 4to., pp. 26. (S. C., II.)

12. On the Vocal Sounds of Laura Bridgman, the Blind Deaf-Mute at Boston; compared with the Elements of Phonetic Language. By FRANCIS LIEBER. 1850. 4to., pp. 32, one plate. (S. C., II.)

13. Contributions to the Physical Geography of the United States, Part I. On the physical geography of the Mississippi Valley, with suggestions for the improvement of the navigation of the Ohio, and other rivers. By CHARLES ELLET, Jr. 1850. 4to., pp. 64, 2 woodcuts, 1 plate. (S. C. II.)

14. A Memoir on *Mosasaurus*, and the three Allied New Genera, *Holcodus*, *Conosaurus*, and *Amphorosteus*. By ROBERT W. GIBBES. November, 1850. 4to., pp. 14, 3 plates of 28 figures. (S. C., II.)

15. Aboriginal Monuments of the State of New York. Comprising the results of original surveys and explorations; with an illustrative appendix. By E. G. SQUIER. 1850. 4to., pp. 188, 79 woodcuts, 14 plates of 33 figures. (S. C., II.)

* These three papers by Mr. Downes, Nos. 8, 9, 10, were not published in the series of Contributions.

16. The Classification of Insects from Embryological Data. By LOUIS AGASSIZ. 1850. 4to., pp. 28, 8 woodcuts, one plate of 23 figures. (S. C., II.)

17. Memoir on the Explosiveness of Nitre, with a view to elucidate its agency in the tremendous explosion of July, 1845, in New York. By ROBERT HARE. 1850. 4to., pp. 20. (S. C., II.)

18. Report on the History of the Discovery of Neptune. By BENJAMIN APTHORP GOULD, Jr. 1850. 8vo., pp. 56.

19. Directions for Meteorological Observations, intended for the first class of observers. By ARNOLD GUYOT. 1850. 8vo., pp. 40, 9 woodcuts.

20. Microscopical Examinations of Soundings, made by the United States Coast Survey off the Atlantic coast of the United States. By J. W. BAILEY. January, 1851. 4to., pp. 16, and 1 plate of 68 figures. (S. C., II.)

21. Fourth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1849. Thirty-first Congress, first session. Senate Mis. No. 120, 8vo., pp. 64, with appendix of 207 pp. House of Representatives Mis. No. 50. 1850. 8vo., pp. 272.

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JEWETT, C. C. Report on public libraries of the United States.

22. Plantæ Wrightianæ Texano-Neo-Mexicanæ. By ASA GRAY. Part I. March, 1852. 4to., pp. 146, 10 plates of 127 figures. (S. C., III.)

An account of a collection of plants made by Charles Wright in Western Texas, New Mexico, and Sonora, in the years 1851 and 1852.

23. Microscopical Observations made in South Carolina, Georgia, and Florida. By J. W. BAILEY. 1851. 4to., pp. 48, 3 plates of 83 figures. (S. C., II.)

24. Ephemeris of the Planet Neptune for the year 1852. By SEARS C. WALKER. 1853. 4to., pp. 10. (S. C., III.)

25. Notices of Public Libraries in the United States of America. By CHAS. C. JEWETT. Printed by order of Congress, as an appendix to the Fourth Annual Report of the Board of Regents of the Smithsonian Institution. 1851. 8vo., pp. 210.

26. Smithsonian Contributions to Knowledge. Vol. II. 1851. 4to., pp. 572, 89 wood-cuts, 24 plates.

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27. On recent Improvements in the Chemical Arts. By JAMES C. BOOTH and CAMPBELL MORFIT. 1852. 8vo., pp. 216. (M. C. II.)

28. Fifth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1850. Special session, March, 1851. Senate Mis., No. 1. 1851. 8vo., pp. 145. (Extra edition of 326 pp.)

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29. Occultations visible in the United States during the year 1852. By JOHN DOWNES. 1851. 4to., pp. 34. (S. C., III.)

30. Contributions to the Natural History of the Fresh Water Fishes of North America. By CHARLES GIRARD. Part I. A monograph of the Cottoids. December, 1851. 4to., pp. 80, 3 plates of 48 figures. (S. C., III.)

31. A collection of Meteorological Tables, with other tables useful in Practical Meteorology. By ARNOLD GUYOT. 1852. 8vo., pp. 212.

32. Nereis Boreali-Americana: or Contributions to a History of the Marine Algæ of North America. By WILLIAM HENRY HARVEY. Part I. Melanospermeæ. January, 1852. 4to., pp. 152, 12 colored plates of 29 figures. (S. C., III.)

33. The Law of Deposit of the Flood Tide, its Dynamical Action and Office. By CHARLES HENRY DAVIS. 1852. 4to., pp. 14. (S. C., III.)

34. Directions for Collecting, Preserving, and Transporting Specimens of Natural History. March, 1859. 8vo., pp. 40, 6 wood-cuts. (M. C., II.)

35. Observations on Terrestrial Magnetism. By JOHN LOCKE. April, 1852. 4to., pp. 30. (S. C., III.)

36. Researches on Electrical Rheometry. By A. SECCHI. May, 1852. 4to., pp. 60, 3 plates of 15 figures. (S. C., III.)

37. Descriptions of Ancient Works in Ohio. By CHAS. WHITTLESEY. 1851. 4to., pp. 20, 7 plates of 18 figures. (S. C., III.)

38. Smithsonian Contributions to Knowledge. Vol. III. 1852. 4to., pp. 562, and 35 plates.

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39. Smithsonian Contributions to Knowledge. Vol. IV. 1852. 4to., pp. 426.

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40. Grammar and Dictionary of the Dakota Language. Collected by the members of the Dakota mission. Edited by S. R. RIGGS. 1852. 4to., pp. 414. (S. C., IV.)

41. Memoir on the Extinct Species of the American Ox. By JOSEPH LEIDY. December, 1852. 4to., pp. 20, 4 plates of 15 figures. (S. C., V.)

42. Plantæ Wrightianæ Texano-Neo-Mexicanæ. By ASA GRAY. Part II. February, 1853. 4to., pp. 120, 4 plates of 39 figures. (S. C., V.)

43. Nereis Boreali-Americana; or, Contributions to a History of the Marine Algæ of North America. By W. H. HARVEY. Part II. Rhodospermeæ. March, 1853. 4to., pp. 262, 24 plates, colored, of 64 figures. (S. C., V.)

44. A Flora and Fauna within Living Animals. By JOSEPH LEIDY. April, 1853. 4to., pp. 68, 10 plates of 140 figures. (S. C., v.)

45. Anatomy of the Nervous System of *Rana pipiens.* By JEFFRIES WYMAN. March, 1853. 4to., pp. 52, 4 wood-cuts, 2 plates of 29 figures. (S. C., v.)

46. Plantæ Frémontianæ: or, Descriptions of Plants collected by J. C. Frémont in California. By JOHN TORREY. 1853. 4to., pp. 24, 10 plates of 89 figures. (S. C., VI.)

47. On the Construction of Catalogues of Libraries, and their publication by means of separate stereotyped titles. With rules and examples. By CHARLES C. JEWETT. 1852. 8vo., pp. 78. 1853. 8vo., pp. 108.

48. Bibliographia Americana Historico-Naturalis; or Bibliography of American Natural History for the year 1851. By CHARLES GIRARD. December, 1852. 8vo., pp. 64.

49. Catalogue of North American Reptiles in the Museum of the Smithsonian Institution. By S. F. BAIRD and C. GIRARD. Part I. Serpents. January, 1853. 8vo., pp. 188. (M. C., II.)

50. Synopsis of the Marine Invertebrata of Grand Manan: or the Region about the Mouth of the Bay of Fundy, New Brunswick. By WILLIAM STIMPSON. March, 1853. 4to., pp. 68, 3 plates of 37 figures. (S. C., VI.)

51. Sixth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1851. Thirty-second Congress, first session, Senate Mis., No. 108. 1852. 8vo., pp. 104.

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Report of Committee of American Association for Promotion of Science on a system of combined meteorological observations for North America.

52. Winds of the Northern Hemisphere. By JAMES H. COFFIN. November, 1853. 4to., pp. 200, 6 wood-cuts, 13 plates of 238 figures. (S. C., VI.)

53. Catalogue of Portraits of North American Indians, and Sketches of Scenery, etc., painted by J. M. STANLEY. Deposited with the Smithsonian Institution. December, 1852. 8vo., pp. 76. (M. C., II.)

54. Occultations of Planets and Stars by the Moon, during the year 1853. By JOHN DOWNES. 1853. 4to., pp. 36. (S. C., VI.)

55. Smithsonian Contributions to Knowledge. Vol. V. 1853. 4to., pp. 538, 4 wood-cuts, 45 plates.

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56. Smithsonian Contributions to Knowledge. Vol. VI. 1854. 4to., pp. 484, 9 wood-cuts, 53 plates.

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57. Seventh Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1852. Thirty-second Congress, second session, Senate Mis., No. 53. 1853. 8vo., pp. 96.

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58. The Ancient Fauna of Nebraska: or, a Description of Remains of Extinct Mammalia and Chelonia from the Mauvaises Terres of Nebraska. By JOSEPH LEIDY. June, 1853. 4to., pp. 126, 3 wood-cuts, 25 plates of 126 figures. (S. C., VI.)

59. Account of a Tornado near New Harmony, Ind., April 30, 1852, with a map of the track, etc. By JOHN CHAPPELSMITH. April, 1855. 4to., pp. 12, 2 wood-cuts, 1 map, 1 plate. (S. C., VII.)

60. Observations on the *Batis maritima* of Linnæus. By JOHN TORREY. April, 1853. 4to., pp. 8, 1 plate of 21 figures. (S. C., VI.)

61. On the *Darlingtonia Californica;* a new pitcher-plant from northern California. By JOHN TORREY. April, 1853. 4to., pp. 8, 1 plate of 9 figures. (S. C., VI.)

62. Catalogue of the Described Coleoptera of the United States. By F. E. MELSHEIMER. July, 1853. 8vo., pp. 190.

63. Notes on New Species and Localities of Microscopical Organisms. By J. W. BAILEY. February, 1854. 4to., pp. 16, 7 woodcuts, 1 plate of 39 figures. (S. C., VII.)

64. List of Foreign Institutions in Correspondence with the Smithsonian Institution. 1856. 8vo., pp. 16.

65. Registry of Periodical Phenomena. Folio, pp. 4.

66. The Annular Eclipse of May 26, 1854. 1854. 8vo., pp. 14, 1 map.

67. Eighth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1853. Thirty-third Congress, first session; Senate Doc. No. 73, pp. 269. House of Representatives Mis. Doc. No. 97. 1854. 8vo., pp. 310.*

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68. Vocabulary of the Jargon or Trade Language of Oregon. By B. RUSH MITCHELL, with additions by W. W. TURNER. April, 1853, 8vo., pp. 22.

69. List of Domestic Institutions in correspondence with the Smithsonian Institution. 1853. 8vo., pp. 16.

70. The Antiquities of Wisconsin, as Surveyed and Described by I. A. LAPHAM. May, 1855. 4to., pp. 108, 65 wood-cuts, one map, 54 plates of 112 figures. (S. I., VII.)

71. Archæology of the United States; or Sketches, Historical and Bibliographical, of the progress of information and opinion respecting vestiges of antiquity in the United States. By SAMUEL F. HAVEN. July, 1856. 4to., pp. 172. (S. C., VIII.)

* This is the first of the series of annual reports published by Congress as a bound volume.

72. A Memoir on the extinct Sloth tribe of North America. By JOSEPH LEIDY. June, 1855. 4to., pp. 70, 16 plates of 139 figures. (S. C., VII.)

73. Publications of Learned Societies and Periodicals in the Library of the Smithsonian Institution. December 31, 1854. Part 1. 1855. 4to., pp. 40. (S. C., VII.)

74. Catalogue of Publications of the Smithsonian Institution. Corrected to June, 1862. 8vo., pp. 52. (M. C., V.)

75. Ninth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1854. Senate Mis. Doc. No. 24, Thirty-third Congress, second session. House of Representatives Mis. Doc. No. 37, 1855. 8vo., pp. 464, 4 wood-cuts.

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76. Smithsonian Contribution to Knowledge. Vol. VII. 1855. 4to., pp. 260, 74 wood-cuts, 72 plates, 2 maps.

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77. Tenth Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1855. Thirty-fourth Congress, first session, Senate Mis. Doc. 73. House of Representatives Mis. Doc. 113. 1856. 8vo., pp. 440, 79 wood-cuts.

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78. Smithsonian Contributions to Knowledge. Vol. VIII. 1856. 4to., pp. 564, 52 wood-cuts, 9 plates.

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79. New Tables for determining the Values of the Coefficients in the Perturbative Function of Planetary Motion, which depend upon the ratio of the mean distances. By JOHN D. RUNKLE. November, 1856. 4to., pp. 64. (S. C., IX.)

80. The Tangencies of Circles and Spheres. By BENJAMIN ALVORD. January, 1856. 4to., pp. 16, 25 wood-cuts, 9 plates of 20 figures. (S. C., VIII.)

81. On the recent Secular Period of the Aurora Borealis. By DENISON OLMSTED. May, 1856. 4to., pp. 52. (S. C., VIII.)

82. Investigations, Chemical and Physiological, relative to certain Americanta Vertebrata. By JOSEPH JONES. July, 1856. 4 to., pp. 150, 27 wood-cuts. (S. C., VIII.)

83. On the Relative Intensity of the Heat and Light of the Sun upon Different Latitudes of the Earth. By L. W. MEECH. November, 1856. 4to., pp. 58, 5 wood-cuts, 6 plates of 9 figures. (S. C., IX.)

84. Record of Auroral Phenomena observed in the higher Northern Latitudes. By PETER FORCE. July, 1856. 4to., pp. 122. (S. C., VIII.)

85. Publications of Learned Societies and Periodicals in the Library of the Smithonian Institution. Part II. May, 1856. 4to., pp. 38. (S. C., VIII.)

86. Observations on Mexican History and Archæology, with a special notice of Zapotec Remains, as delineated in Mr. J. G. Sawkins's drawings of Mitla, etc. By BRANTZ MAYER. November, 1856. 4to., pp. 36, 17 wood-cuts, 4 plates of 6 figures. (S. C., IX.)

87. Psychrometrical Table for Determining the Elastic Force of Aqueous Vapor, and the Relative Humidity of the Atmosphere from indications of the Wet and the Dry Bulb Thermometer, Fahrenheit. By JAMES H. COFFIN. 1856. 8vo., pp. 20. (M. C., I.)

88. Researches on the Ammonia-cobalt Bases. By WOLCOTT GIBBS and FREDERICK AUG. GENTH. December, 1856. 4to., pp. 72, 21 wood-cuts. (S. C., IX.)

89. North American Oölogy. By THOMAS M. BREWER. Part I. Raptores and Fissirostres. 1857. 4to., pp. 140, 5 plates of 193 figures. (S. C., XI.)

90. Illustrations of Surface Geology. By EDWARD HITCHCOCK. April, 1857. 4to., pp. 164, 2 wood-cuts, 12 plates of 89 figures. (S. C., IX.)

91. Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1856. Thirty-fourth Congress, third session, Senate, No. 54, House of Representatives, Mis. Doc. No. 55. 1857. 8vo, pp. 468, 69 wood-cuts.

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* Part II. Report of National Museum.

PROCEEDINGS OF SOCIETIES.

REPORTS ON RECENT PROGRESS IN SCIENCE.

TONER LECTURES.

(For the advance of medical science.)

LIST OF BOOKS FOR COLLECTORS AND EXPLORERS.

No. 34. Directions for collecting, preserving, etc., specimens of natural history.
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261. " " " " " insects.
460. " " " " " plants.
366. " " " " " diatoms.
363. " " " " " land and fresh-water shells.
319. " " " " " crawfish and crustacea.
384. " " shipping fresh fish.
464. " " collecting fish.
205. " " " archæological specimens.
572. " " " aboriginal antiquities.
148. " " meteorological observations.
517. Check list, reptiles and batrachians.
164. Museum miscellanea, series of numbers, etc.
589. Directions for removing and preserving skins of mammals.
590. Instructions for taking paper molds of inscriptions in stone, wood, etc.
600. Directions for collecting tortricids and small moths.
601. Directions for mound explorations.
603. Instructions for collecting eggs.
626. Notes on the preparation of skeletons.

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3	Bulletin No. 3. Kidder and others. Natural History Kerguelen Island. Part 2	294	XIII
4	Bulletin No. 4. Lawrence and Sumichrast. Birds of Mexico	295	XIII
5	Bulletin No. 5. Goode. Catalogue of Fishes of Bermuda	296	XIII
6	Bulletin No. 6. Goode. Classification of Animal Resources of the United States	297	XIII
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8	Bulletin No. 8. Dall. Index of Brachiopoda	304	XIII
9	Bulletin No. 9. Jordan. N. A. Ichthyology. I. Rafinesque, North American Fishes	305	XIII
10	Bulletin No. 10. Jordan. N. A. Ichthyology. II. Cottidæ	306	XIII
11	Bulletin No. 11. Gill. Bibliography of Fishes of Pacific coast	463	XXIII
12	Bulletin No. 12. Jordan and Brayton. N. A. Ichthyology. III. Fishes, Alleghany Region	308	XXIII
13	Bulletin No. 13. Eggers. Flora of St. Croix and Virgin Islands	313	XXIII
14	Bulletin No. 14. Goode. Catalogue of Collection Philadelphia Exhibition	326	XXIII
15	Bulletin No. 15. Kumlien. Natural History of Arctic America	342	XXIII
16	Bulletin No. 16. Jordan and Gilbert. Synopsis of Fishes of North America	492	XXIV
17	Proceedings National Museum for 1878. Vol. I	332	XIX
18	Bulletins National Museum. Nos. 1 to 10. Vol. I	312	XIII
19	Proceedings National Museum for 1879. Vol. II	333	XIX
20	Bulletin No. 17. Cope. Zoölogical Position of Texas	412	
21	Bulletin No. 18. Goode. Catalogue of Collection Berlin Fisheries Exhibit	413	
22	Bulletin No. 19. Scudder. Nomenclature Zoologicus. Index of genera	470	
23	Bulletin No. 20. Goode. Bibliography of S. F. Baird	508	
24	Bulletin No. 21. Ridgway. Nomenclature North American Birds	422	
25	Proceedings National Museum for 1880. Vol. III	425	XXII
26	Bulletin No. 22. Ward. Guide to the Flora of Washington, D. C	444	
27	Proceedings National Museum for 1881. Vol. IV	467	XXII
28	Bulletins National Museum. Nos. 11 to 15. Vol. II	475	XXIII
29	Bulletin No. 23. Scudder. Bibliography of Isaac Lea	570	
30	Bulletin No. 24. Yarrow. North American Reptilia and Batrachia	493	

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31	Bulletin No. 25. Jones and others. Natural History of Bermuda	495	
32	Bulletin No. 26. Coues and Prentiss. Avifauna Columbiana. Birds of District Columbia	500	
33	Bulletin No. 27. Goode and others. Catalogue, London Fisheries Exhibition	511	
34	Proceedings National Museum for 1882. Vol. V	518	
35	Bulletins National Museum. No. 16. Vol. III	492	
36	Proceedings National Museum for 1883. Vol. VI	548	
37	Proceedings National Museum for 1884. Vol. VII	607	
38	Bulletin No. 28. Binney. Manual of Land Shells	549	
39	Bulletin No. 29. Stejneger. Ornithological Explorations in the Commander Islands and Kamtschatka	624	
40	Bulletin No. 30. Marcou. Palæontological Bibliographies	625	
41	Bulletin No. 31. Williston. Syrphidæ	653	
42	Bulletin No. 32. Cope. (In press)		
43	Proceedings National Museum for 1885. Vol. VIII	650	
44	Bulletin No. 33. Egleston. (In press)		
45	Bulletin No. 34. Cope. (In press)		
46	Proceedings National Museum for 1886. (In press)		

PUBLICATIONS OF THE U. S. NATIONAL MUSEUM.

Separate list of Bulletins.

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I	1878	524	8	8	1879	XIX	17	332
II	1879	503	2	7	1880	XIX	19	333
III	1880	594	5	2	1881	XXII	25	425
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4	Department of insects. Spencer F. Baird	448
5	Establishment and officers. Spencer F. Baird	449
6	Classification of materia-medica collection. James M. Flint	450
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PUBLICATIONS OF THE BUREAU OF ETHNOLOGY.

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Second Annual Report, for 1880–'81	1883	515	714	77	2	542
Third Annual Report, for 1881–'82	1884	680	200	44	......	631
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PUBLICATIONS HAVING SEPARATE NUMBERS IN THE SMITHSONIAN SERIES, BUT INCLUDED IN THE ANNUAL REPORTS OF THE INSTITUTION.

		Vol. of Report.
A	Journal of Regents	1847
B	Report of Organization Committee	1847
D	Address at laying Corner-stone. DALLAS	1847
E	Exposition of Bequest. HENRY	1847
F	First Report of Secretary. HENRY	1848
J	Programme of Orgauization. HENRY	1848
K	Correspondence, Squier and Davis	1848
L	First Report of Organization Committee	1847
M	Reports of Institution to 1849	1849
N	Officers and Regents	1847
25	Public Libraries. JEWETT	1850
152	Lectures on Mollusca. CARPENTER	1860
251	Memoir of Von Martius. RAU	1869
307	Report on Centennial. BAIRD	1876
343	Annual Reports. HENRY	1865–77
348	Fishes of New Jersey. BAIRD	1854
351	Forests of North America. COOPER	1858
352	Lectures on Linguistics. WHITNEY	1863
354	Essay on Velocity of Light. DELAUNAY	1864
355	Ozone and antozone. WETHERILL	1864
360	Palafittes. DESOR	1865
361	Aborigines of California. BAEGERT	1863–4
362	Artificial Shell Deposits in New Jersey. RAU	1864
364	Classification of Birds. LILLJEBORG	1865
365	Tinneh Indians. ROSS and others	1866
367	Flora of Alaska. ROTHROCK	1867
368	Indian Pottery. RAU	1866
369	Dorpat and Poulkova. ABBE	1867
370	Flint Implements in Illinois. RAU	1868
371	Metric Tables. NEWTON	1865
372	Drilling in Stone without Metal. RAU	1868
373	Meteorological Station and Observers	1868
375	Origin and Nature of Force. TAYLOR	1870
376	Chemistry of the Earth. HUNT	1869
377	Diamond and Precious Stones. BABINET	1870
378	Dakota Language. RŒHRIG	1871
379	Eulogy on A. D. Bache. HENRY	1870
380	Scientific Education of Mechanics. PEABODY	1872
382	North American Stone Implements. RAU	1872
385	Ancient Aboriginal Trade. RAU	1872
386	Crystallography. BREZINA	1872
389	Investigation of Illuminants. HENRY	1880
390	Tides. HILGARD	1874
392	Prehistoric Antiquities of Hungary. ROMER	1876
393	Mound Builders and Ancient Man in Michigan. GILLMAN	1873 and 1875
394	Stone Age in New Jersey. ABBOTT	1875
395	Kinetic Theories of Gravitation. TAYLOR	1876
396	History and climate of New Mexico. MCPARLIN	1877
397	Latimer Antiquities. MASON	1876
398	Meteorological Memoirs. ABBE	1877

		Vol. of report.
399	Color-blindness. HOLMGREN	1877
400	Aboriginal Structures in Georgia. JONES	1877
401	Mexican Axolotl. WEISMANN	1877
402	Stock-in-trade of Aboriginal Lapidary. RAU	1877
403	Gold Ornament from Florida. RAU	1877
404	Polychrome Bead from Florida. HALDEMAN	1877
405	Henry and the Telegraph. TAYLOR	1878
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