ANNUAL REPORT

OF THE

BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION,

SHOWING

THE OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION

FOR

THE YEAR 1879.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1880.

FORTY-SIXTH CONGRESS, SECOND SESSION.

IN THE SENATE OF THE UNITED STATES,
May 22, 1880.

The resolution to print extra copies of the report of the Smithsonian Institution for 1879 has been agreed to by both Houses to read as follows:

Resolved by the Senate (*the House of Representatives concurring*), That fifteen thousand five hundred copies of the Report of the Smithsonian Institution for the year 1879 be printed; two thousand five hundred copies of which shall be for the use of the Senate, six thousand copies for the use of the House of Representatives, and seven thousand copies for the use of the Smithsonian Institution.

Attest:

JOHN C. BURCH,
Secretary.

LETTER

FROM THE

SECRETARY OF THE SMITHSONIAN INSTITUTION,

ACCOMPANYING

The annual report of the Board of Regents of that Institution for the year 1879.

MARCH 10, 1880.—Ordered to be printed.

SMITHSONIAN INSTITUTION,
Washington, March 10, 1880.

GENTLEMEN: In behalf of the Board of Regents, I have the honor to submit to the Congress of the United States the annual report of the operations, expenditures, and condition of the Smithsonian Institution for the year 1879.

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

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

Hon. WM. A. WHEELER,
President of the United States Senate, and

Hon. S. J. RANDALL,
Speaker of the House of Representatives.

THE SMITHSONIAN INSTITUTION.

RUTHERFORD B. HAYES, President of the United States, *ex officio* Presiding Officer.
MORRISON R. WAITE, Chief Justice of the United States, Chancellor of the Institution (President of the Board of Regents).
SPENCER F. BAIRD, Secretary (Director of the Smithsonian Institution and of the National Museum).
WILLIAM J. RHEES, Chief Clerk.

REGENTS OF THE INSTITUTION.

MORRISON R. WAITE, Chief Justice of the United States, *President of the Board.*
WILLIAM A. WHEELER, Vice-President of the United States.
HANNIBAL HAMLIN, member of the Senate of the United States.
NEWTON BOOTH, member of the Senate of the United States.
ROBERT E. WITHERS, member of the Senate of the United States.
HIESTER CLYMER, member of the House of Representatives.
JAMES A. GARFIELD, member of the House of Representatives.
JOSEPH E. JOHNSTON, member of the House of Representatives.
JOHN MACLEAN, citizen of New Jersey.
PETER PARKER, citizen of Washington, D. C.
ASA GRAY, citizen of Massachusetts.
HENRY COPPÉE, citizen of Pennsylvania.
WILLIAM T. SHERMAN, citizen of Washington, D. C.
NOAH PORTER, citizen of Connecticut.

EXECUTIVE COMMITTEE OF THE BOARD OF REGENTS.

PETER PARKER. JOHN MACLEAN. WILLIAM T. SHERMAN.

MEMBERS EX OFFICIO OF THE INSTITUTION.

RUTHERFORD B. HAYES, President of the United States.
WILLIAM A. WHEELER, Vice-President of the United States.
MORRISON R. WAITE, Chief Justice of the United States.
WILLIAM M. EVARTS, Secretary of State.
JOHN SHERMAN, Secretary of the Treasury.
ALEX. RAMSEY, Secretary of War.
RICHARD W. THOMPSON, Secretary of the Navy.
DAVID M. KEY, Postmaster-General.
CARL SCHURZ, Secretary of the Interior.
CHARLES DEVENS, Attorney-General.
EDGAR M. MARBLE, Commissioner of Patents.

OFFICERS AND ASSISTANTS OF THE SMITHSONIAN INSTITUTION AND NATIONAL MUSEUM, JANUARY, 1880.

SMITHSONIAN INSTITUTION.

SPENCER F. BAIRD,
Secretary, Director of the Institution
WILLIAM J. RHEES, *Chief Clerk.*
DANIEL LEECH, *Corresponding Clerk.*

Assistants and Clerks.

CLARENCE B. YOUNG.
H. DIEBITSCH.
J. A. TURNER.
L. STOERZER.
HENRY GASS.
WM. B. TAYLOR.
G. H. BOEHMER.
M. E. GRIFFIN.
H. DE C. DAINGERFIELD.
S. G. BROWN.

NATIONAL MUSEUM.

G. BROWN GOODE, *Curator of the Museum.*
F. M. ENDLICH, *Assistant, Mineralogy.*
ROBT. RIDGWAY, *Assistant, Ornithology.*
TARLETON H. BEAN, *Assistant, Ichthyology.*
CHAS. RAU, *Assistant, Archæology.*
EDWARD FOREMAN, *Assistant, Ethnology.*
F. H. CUSHING, *Assistant, Ethnology.*
CHARLES A. WHITE, *Assistant Paleontology.*

HENRY HORAN, *Superintendent of Building.*
JOSEPH HERRON, *Janitor.*
W. J. GREEN, *Carpenter and Electrician.*
J. H. RICHARD, *Artist.*
A. Z. SHINDLER, *Artist.*
S. C. BROWN, *Clerk, Property and Records.*
E. P. UPHAM, *Clerk, Archæological Collections.*
JOSEPH PALMER, *Taxidermist.*
T. W. SMILLIE, *Photographer.*

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR THE YEAR 1879.

CONTENTS.

CONTENTS.

I. REPORT OF THE SECRETARY.

II. GENERAL APPENDIX.

REPORT OF PROFESSOR BAIRD,

SECRETARY OF THE SMITHSONIAN INSTITUTION, FOR 1879.

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 1879:

THE SMITHSONIAN INSTITUTION.

INTRODUCTORY.

The year just passed has been marked by a number of interesting and important incidents in the history of the Institution, which will be detailed in their proper places; the most noteworthy being the memorial services, held in the United States Capitol, in honor of Professor Henry, and the commencement of work upon the new fire-proof building for the National Museum.

The usual routine of business has been prosecuted by the Institution during the year, the various departments receiving their share of attention and expenditure.

HENRY MEMORIAL SERVICES AND VOLUME.

In conformity with the action of the Board of Regents in reference to the holding of a public commemoration of Prof. Joseph Henry, a joint resolution of Congress was passed appointing January 16, 1879, as the time, and the Hall of the House of Representatives as the place, of such memorial services. These proceedings took place at the time announced, in the presence of a very large and distinguished auditory. Dr. Asa Gray was appointed by the Board of Regents to "prepare a sketch of the life, character, and public services of Professor Henry," which it was ordered should form part of the exercises at the Capitol.

The Vice-President of the United States, supported by the Speaker of the House, presided on the occasion. After prayer by the Rev. Dr. James McCosh, president of Princeton College, addresses were delivered by Hon. Hannibal Hamlin, Senator and Regent (the address being read by Vice-President W. A. Wheeler); Hon. R. E. Withers, Senator and Regent; Prof. Asa Gray, of Harvard University, Regent; after which Hon. Hiester Clymer, Member of the House and Regent, read the telegrams received on the occasion. The remaining addresses were delivered by Prof. William B. Rogers, of Boston; Hon. James A. Garfield, Member and Regent; Hon. S. S. Cox, Member, and formerly a

Regent, and by General William T. Sherman, a Regent. The exercises were concluded with prayer by the chaplain of the Senate, Rev. Dr. Byron Sunderland.

In addition to the Senators and Members of the House assembled, the President of the United States, members of the Cabinet, justices of the Supreme Court, and other dignitaries, were present; and the proceedings were solemn and impressive, as befitted the occasion.

By joint resolution of Congress, these memorial addresses were ordered to be printed in the "Congressional Record," which was accordingly done on the 4th of March following. The same resolution also directed the printing of fifteen thousand copies of the said proceedings in a "Memorial Volume," which volume should include also "such articles as may be furnished by the Board of Regents." A selection has accordingly been made by the special committee of the Regents appointed January 17, 1879 (consisting of Messrs. Gray, Parker, and Baird), embracing a few commemorative discourses delivered elsewhere, to form a concluding portion of the memorial volume. This material is now in the hands of the Public Printer, and it is hoped will soon be published.

Among other gratifying illustrations of the respect in which the memory of Professor Henry is held by the community, we may mention the efforts made to perpetuate it by means of works of art. Reference has been made in previous reports to the life-size portrait, painted, at the request of the Board of Regents, by Mr. Le Clear, of New York; and, also, to a similar portrait as to size and general character, by Mr. Henry Ulke, of Washington. A copy of the latter has been ordered by gentlemen in Philadelphia for the American Philosophical Society. A crayon portrait, also by Mr. Ulke, and considered an excellent likeness, has been furnished by him to Princeton College and other institutions.

Mr. Clark Mills, the well-known sculptor, has modeled a bust of Professor Henry partly from a cast taken after his death. A copy of this in plaster has been placed in the Smithsonian Institution.

Mr. C. V. Burton spent some time during the year at the Institution in modeling a small-sized bust, of which he has disposed a large number of copies.

A medallion likeness was made by Mr. Barber, the engraver of the Philadelphia mint, and a medal has been struck with this as the obverse side.

A likeness has also been engraved on steel at the Treasury Department, to accompany the Memorial Volume, an appropriation of five hundred dollars having been made by Congress for the purpose.

Another steel portrait has been engraved and published by the Messrs. Appleton, of New York, in their Annual Cyclopedia for the year 1878.

The Institution is also in possession of an oil painting of Professor Henry, painted from one or two sittings only, and presented by the artist, Mr. Ingalls. Excellent photographs have been taken of him by Gutekunst, of Philadelphia, and by Messrs. Smillie, Gardner, Brady, and Fassett, of Washington.

A statue of Professor Henry.—A few weeks ago (December 16, 1879) the Hon. Mr. Booth introduced in the Senate the following bill providing for a statue of Professor Henry in the grounds of the Smithsonian Institution:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of twenty thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury of the United States not otherwise appropriated, for the purpose of erecting a statue of Joseph Henry on the grounds of the Smithsonian Institution.

SEC. 2. The money herein appropriated shall be expended under the direction of the Secretary of the Smithsonian Institution.*

APPOINTMENT AND ELECTION OF REGENTS.

By the terms of the act of Congress, the three members of the Board of Regents selected by the Speaker of the House to act in that capacity are appointed for a single Congress, or for two years; their term of service expiring on the fourth Wednesday of December, on which day, according to law, the appointment of new members is to be made.

These appointments were made by the Speaker on the 4th of April, 1879, by renewing the terms of service of Hon. Hiester Clymer, of Pennsylvania, and Hon. J. A. Garfield, of Ohio, and by appointing Hon. Joseph E. Johnston, of Virginia, in the place of Hon. Alexander H. Stephens, of Georgia. It is for the Board of Regents to say whether this apparent informality will in any way vitiate the appointments, and render it desirable that they be renewed at the present session.

The vacancy in the Senatorial Regents, caused by the expiration of the term of Hon. A. A. Sargent, was filled by the appointment, by the President of the Senate, on the 21st of March, of Hon. Newton Booth, of California.

The terms of four of the six citizens at large, namely, of Dr. John Maclean, of Princeton, Hon. Peter Parker, of Washington, Prof. Henry Coppée, of Pennsylvania, and Prof. Asa Gray, of Cambridge, having also expired, a joint resolution reappointing them, introduced in the Senate by Hon. Hannibal Hamlin, was passed, and approved by the President on the 17th of December.

* It is gratifying to be able to state here that since the date of the above, a modification of this bill (introduced into the Senate by the Hon. Justin S. Morrill, of Vermont, and into the House of Representatives by the Hon. Hiester Clymer, of Pennsylvania) passed Congress unanimously and was signed by the President on the 1st of June, 1880. The act is entitled "AN ACT for the erection of a bronze statue of JOSEPH HENRY, late Secretary of the Smithsonian Institution," and is in the following terms: "*Be it enacted, &c.,* That the Regents of the Smithsonian Institution be, and are hereby authorized to contract with W. W. Story, sculptor, for a statue in bronze of JOSEPH HENRY, late Secretary of the Smithsonian Institution, to be erected upon the grounds of the said Institution; and for this purpose, and for the entire expense of the foundation and pedestal of the monument, the sum of $15,000 is hereby appropriated out of any moneys in the Treasury not otherwise appropriated."

In this connection I would also call the attention of the Board of Regents to the fact that the law of Congress, in establishing six years as the term of service of the six Regents elected as citizens at large, provides, at the same time, that two vacancies shall occur at the beginning of each new Congress and be filled by election. I am unable to say in what manner there happened to be four vacancies at a time; but in this, as in the case previously mentioned, it is for the Board of Regents to determine what action, if any, shall be taken in the premises.

MEETING OF THE ESTABLISHMENT.

The act of Congress organizing the Smithsonian Institution provides for an annual meeting of the establishment, although there is no special business to be prosecuted by that body, with the exception of a general inspection of the condition of the Institution. The meetings, although proposed by the Secretary, have, by the direction of the President, mostly been omitted. The following table shows the number of meetings held since the commencement of active operations by the Institution:

August 1, 1849.	June 6, 1853.	July 15, 1854.
May 3, 1853.	May 2, 1854.	June 4, 1873.
May 17, 1853.	June 6, 1854.	May 5, 1877.

The usual notice of a meeting on the 6th of May, 1879, was made to the President; but, in the absence of any special necessity, it was, by his authority, indefinitely postponed.

FINANCES.

In the report of the Executive Committee will be found a detailed statement of the finances of the Institution, which are believed to be in better condition than at any previous time, all arrearages having been paid and a larger balance than usual being on hand.

The following is a statement of the condition of the Smithsonian fund at the beginning of the year 1880:

The amount originally received as the bequest of James Smithson, of England, deposited in the Treasury of the United States, in accordance with the act of Congress of August 10, 1846	$515,169 00
The residuary legacy of Smithson, received in 1865, deposited in the Treasury of the United States, in accordance with the act of Congress of February 8, 1867	26,210 63
Total bequest of Smithson	541,379 63
Amount derived from savings of income and increase in value of investments, and deposited in the Treasury of the United States, as authorized by act of Congress of February 8, 1867	108,620 37
Amount of bequest of James Hamilton, of Carlisle, Pa., February 24, 1874	1,000 00

Total permanent Smithson fund in the Treasury of the United States, bearing interest at 6 per cent., payable semi-annually	$651, 000 00
In addition to the above, there are Virginia bonds and certificates, viz, consolidated bonds, $58,700; deferred certificates, $29,375.07; fractional certificate, $50.13; total, $88,125.20, valued January, 1880, at	32, 000 00
Cash balance deposited in the Treasury of the United States at the beginning of the year 1880, for current expenses	20, 894 06
Total Smithson fund January 2, 1880	$703, 894 06

The receipts in 1879, were $62,004.08, and the expenditures $41,110.02, leaving a balance on hand of $20,894.06.

THE HABEL BEQUEST.

Previous reports of the Institution contain allusions to the explorations and researches of Dr. Simeon Habel. This gentleman was of Austrian birth; graduated in 1846 at the Vienna University, and for several years had been the resident-physician in charge of a public hospital. In consequence of his liberal views, he was obliged to leave Europe and seek a home in America. His love of nature and the desire to advance science led him to undertake an extended tour through Central and South America. Before doing this, however, he spent several months at the Smithsonian Institution, in making himself familiar, under the direction of Professor Egleston, then in charge of the Geological Department, with the most important species of minerals and rocks. Subsequently, during seven years, he made collections in natural history and observations in meteorology, geography, geology, and archæology.

Among the regions of South America to which Dr. Habel devoted special attention were those of the guano deposits of Peru and of the remarkable group known as the Galapagos Islands. Of the peculiar bird fauna of these islands, Dr. Habel made large collections, which were fully described by Messrs. Sclater and Salvin in the proceedings of the Zoological Society of London.

Returning to New York about the year 1877, he devoted himself to the elaboration of his researches and, in time, prepared for the Institution, a memoir entitled "The Sculptures of Santa Lucia Cosumalwhuapa, with an account of travels in Central America and on the North-western coast of South America." This work was published by the Institution in 1878, and contains a brief account of Dr. Habel's ethnological and archæological researches, and a minute description of a group of sculptures discovered by him at Santa Lucia Cosumalwhuapa, a small town in Guatemala. The variety of ornamentation, the skill in execution, and the grade of refinement exhibited in the designs upon these bas-reliefs, as well as the almost total absence of sculptures hitherto reported on the southern side of the Sierras, induced the Institution, on the recommendation of Profs. W. D. Whitney and J. H. Trumbull, to include Dr. Habel's paper among its publications.

The author was invited to visit Washington, where a room was provided for him at the Institution, and the drawings of these sculptures were reproduced by an artist, under his personal supervision. Dr. Habel highly appreciated the aid thus rendered him, and informed Professor Henry of his intention to leave a part of his estate to the Institution, to repay, at least in part, the cost of the publication of his memoir.

The Institution having learned of the death of Dr. Habel on the 1st of January, 1879, steps were taken to secure the legacy which he had promised as indicated in the following letter, deposited by him in the Emigrant Industrial Savings Bank, New York:

"DAVID LEDWITH, Esq.,

"*Comptroller of the Emigrant Industrial Savings Bank:*

"DEAR SIR: I have left with the Emigrant Industrial Savings Bank, for safe-keeping, three account-books in my name, with the order that the money deposited in the bank on each respective book should be paid after my death to the following persons and institution, namely:

"1. One thousand dollars of the account on book No. 122426 to Ernest Haeckel, of Jena, in Germany, and the *remainder of said account to the Smithsonian Institution at Washington.*

"2. All the amount in my favor on book No. 125437 should be paid to Stephen Pearl Andrews.

"3. The money in trust for Lizzie Fleischman on book No. 125436 should be paid to said person.

"Requesting the bank will comply with said order,

"I am, respectfully, yours,

"DR. HABEL."

Mr. Ledwith, the comptroller of the bank, on the 26th of February, 1879, presented a statement to the Institution of the amount to the credit of Dr. Habel on the account-book No. 122426, above referred to, showing a balance of $1,402.59. Of this $1,000 was paid to Professor Haeckel in accordance with the instructions of Dr. Habel, and the remainder, $402.59, paid to the secretary of the Smithsonian Institution.

It is proper to state that every facility was rendered by the officers of the bank in turning over to the Institution the bequest of Dr. Habel.

As it is the policy of the Institution to fund all moneys that may be received other than as income, I would suggest that the amount received from Dr. Habel be increased from the income of the Institution to $500, and that this sum be added to the Smithson fund as the Habel bequest. It will be remembered that, by a law of Congress, the Institution is authorized to increase its principal in the United States Treasury to a million dollars. In a somewhat similar case, that of Mr. James Hamilton, of Carlisle, Pa., the amount of $1,000 was deposited in the Treasury as the Hamilton fund.

RESEARCHES.

In the last report an account was given of an investigation of the ancient solar eclipses by Mr. Todd, of the Nautical Almanac Office. Among a number of eclipses added to the list then given are three observed in China in 709 B. C., 601 B. C., and 549 B. C., being the eclipses which have formed the subject of a paper by Schjellerup, of Copenhagen. During the past year the work of this investigation has consisted mainly in the collection of data and their preparation for discussion. As the research progresses, there seems reason for extending the scope of the research to include a large number of ancient ecliptic dates.

Apparatus for Testing Stone.—Many years ago a series of experiments were conducted at the Smithsonian Institution, under the direction of Professor Henry, in regard to the strength and durability of building materials, primarily for the purpose of determining what varieties of marble and other stones were best adapted for the construction of the extension of the United States Capitol. The apparatus used in these experiments has since been lying idle in the Smithsonian building, and as it occupied valuable space it has been returned to the arsenal, from which it was originally borrowed. It has there been put in order, and is now again in use by the Ordnance Bureau of the Army.

LABORATORY.

As stated in the last report, after a partial suspension of active operations in that direction, the laboratory of the Institution was put in order, and again made available for scientific research. This has always been an important feature in the operations of the Institution, and is one of those especially required by the act of Congress.

A thorough overhauling of the old instruments and equipment was made under the direction of Dr. Endlich, the chemist in charge, and all obsolete apparatus and unserviceable material was eliminated. The chemical and physical departments of the colleges in the District, such as the Columbian, Georgetown, and Howard University, were invited to select from this unserviceable matter what they could use for purposes of instruction, the remainder being suitably disposed of. The apartments were then altered to meet the requirements of the present day, and a sufficient amount of apparatus and equipment obtained to make a fairly efficient working establishment.

The work of the laboratory consists partly in determining the character of various minerals belonging to collections in the National Museum, and partly in carrying on researches asked for by the various departments of the government. No private work of this kind is undertaken by the Institution; but whenever a chemical investigation of any subject is required by the proper authorities it is carried out, if the time of the chemist will permit.

Under the first head, the identification of large numbers of specimens, previously undetermined, has been completed, the series placed in the mineralogical department, and the duplicates made up into sets for distribution to various educational establishments throughout the country, or to be held for exchange for other minerals. Further reference to this subject, however, will be found under the head of the National Museum.

Among the investigations carried on by the Institution for the benefit of the government may be mentioned the following:

An examination of the character and chemical composition of the Appolinaris water, at the request of the Secretary of the Treasury, a controversy having arisen between the custom-house authorities in New York and the importers of Appolinaris water, as to whether the article imported under that name really came unchanged from the springs or was artificially charged with other substances, especially carbonic acid. To solve this problem the services of several chemists were invoked, but these furnished contradictory results, and the Smithsonian Institution was therefore asked by the Treasury Department to give the subject proper attention, specimens of the water being duly supplied. This was among the most laborious researches ever intrusted to the Institution for prosecution, requiring the constant labor of the chemist for several weeks for its accomplishment. A report was finally made and transmitted to the Secretary.

Another investigation was as to the comparative percentages of carbon in different brands of steel, made at the request of Chief Engineer Shock, of the Bureau of Steam Engineering of the Navy Department.

In addition to the chemical work actually performed in its laboratory for the government, the Institution has also acted as adviser to the departments in securing specialists for investigations too extensive for the time and apparatus of its chemist, or which, for other reasons, could not be undertaken by him. Among these may be mentioned an examination of crude opium, for the amount of morphine it contained, made for the Treasury Department by Dr. Theodore G. Wormley, of the University of Pennsylvania, and by Dr. W. M. Mew, U. S. A., of Washington, &c.

The attention of the inspector of marine products for the city of Washington having been attracted by the occurrence of green oysters among those offered for sale, the health department, under Dr. Smith Townshend, requested of the Smithsonian Institution an investigation as to the cause of this color, the popular impression being that it was due to the presence of copper in the water, and denoted a poisonous condition of the oysters. Although this phenomenon is quite well known in Europe, and green oysters are considered in France an especial delicacy, the examination desired was made by Dr. Endlich with very perfect tests and without detecting any copper. In this connection it may be stated that recent investigations in Europe have shown that the green color is due to the presence of minute algæ on which the oyster feeds voraciously. In France the oysters are kept in pits along the seashore, where the highly-prized tinge is very soon acquired.

By a resolution of Congress the Secretary of the Institution was appointed a member of a commission to investigate the merits of signal apparatus to give warning of the accidental occurrence of fire, and during 1879 Mr. Watkins made experiments in the laboratory of the Institution to test his invention for this purpose.

In this connection it may be stated that the Secretary of the Institution has, by resolution of Congress, been appointed a member of the commission on improving the ventilation of the hall of the House of Representatives at the Capitol, and that he has attended the meetings of this commission and rendered it such service as his time and opportunity permitted him.

TELEGRAPHIC ANNOUNCEMENTS OF ASTRONOMICAL DISCOVERIES.

There are many astronomical discoveries, which, for the purpose of co-operative observation, require immediate announcement to observers in distant localities. Among such discoveries are those of planets and comets, or of bodies which are generally so faint as not to be seen except through the telescope, and which being in motion require that their place in the heavens be made known to the distant observer before they so far change their position as not to be readily found. For this purpose the ordinary mail conveyance requiring at least ten days, is too slow, since in that time the body will have so far changed its position as not to be found, except with great difficulty; and this change will become the greater if the body is a very faint one, for in that case it could only be discovered on a night free from moonlight, which of necessity, in ten or twelve days, must be followed by nights on which the sky is illuminated by the moon, and all attempts to discover the object would have to be postponed until the recurrence of a dark night. Indeed, even then the search would often prove in vain; and it would not be, in some cases, until after a set of approximate elements had been calculated and transmitted, that the astronomers on the two sides of the Atlantic would be able fully to co-operate with each other.

These difficulties were discussed by some of the principal astronomers of America and Europe, and an application was made to the Smithsonian Institution, through Dr. C. H. F. Peters, of Clinton, N. Y., to remove them by transmitting intelligence immediately through the Atlantic telegraph cable. For this purpose the Institution, in 1873, applied to the New York, Newfoundland and London Telegraph Company and to the Western Union Telegraph Company to be allowed free transmission of this kind of intelligence, and received through Cyrus W. Field, esq., and William Orton, esq., with that liberality which has always attended applications of a similar character by the Institution, the free use of all the lines of these companies for the object in question.

Similar privileges were granted in Europe for transmitting the intelligence between some of the principal centers of astronomical research in Europe and the eastern ends of the Atlantic cables.

The transmission of intelligence is not restricted to the discovery of planets and comets, but includes that of any remarkable solar phenomenon which may suddenly present itself in Europe, and of which observation in America may be practicable for several hours after the sun has set to the European observer; also the sudden outburst of a star like that in the "Crown" in 1866, together with unexpected showers of shooting stars, &c.

To carry out the proposition the following arrangements have been adopted, which are essentially those published in 1873, but with such additions and modifications as subsequent experience has proved necessary.

I.—*Center of communication in the United States.*

1. THE SMITHSONIAN INSTITUTION. Spencer F. Baird, director.

Centers of communication in Europe.

1. GREENWICH OBSERVATORY. Sir George B. Airy, astronomer-royal.
2. PARIS OBSERVATORY. Admiral Mouchez, director.
3. BERLIN OBSERVATORY. Prof. W. Foerster, director.
4. VIENNA OBSERVATORY, Academy of Sciences. Prof. Edmund Weiss, director.
5. PULKOVA OBSERVATORY. Otto von Struve, director.

II.—Telegrams received at the Smithsonian Institution from observers in the United States will be forwarded immediately by Atlantic cable to Greenwich, Paris, Berlin, Vienna, and Pulkova, and thence by telegraph to other observatories in Europe.

III.—Discoveries made in Europe of new comets, planets, &c., will be announced without delay from Greenwich, Paris, Berlin, Vienna, and Pulkova, by Atlantic cable, to the Smithsonian Institution, and thence by telegraph to American observatories * and the Associated Press.

IV.—The telegraphic dispatch announcing a discovery should be as brief as possible, and, after conference with astronomers, the following form has been agreed upon:

After the single word "planet" (or "comet"), is given—

1. Its right ascension in time, hours, minutes, and seconds (the latter only to the nearest round tenth, *i. e.*, ten, twenty, thirty, forty, or fifty); next, separated by the word—
2. North or south, is given its—
3. Declination, to the nearest minute.
4. Then, in the case of a *planet*, the magnitude expressed by the nearest ordinal number.

* The list of these observatories is at present as follows:

Shattuck Observatory	Hanover, N. H.
Observatory of Harvard College	Cambridge, Mass.
Yale College Observatory	New Haven, Conn.
Dudley Observatory	Albany, N. Y.
Litchfield Observatory	Clinton, N. Y.
Hobart College Observatory	Geneva, N. Y.
Red House Observatory	Phelps, N. Y.
Warner Observatory	Rochester, N. Y.
Allegheny Observatory	Allegheny, Pa.
Observatory of College of New Jersey	Princeton, N. J.
United States Naval Observatory	Washington, D.C.
Cincinnati Observatory	Cincinnati, Ohio.
Dearborn University Observatory	Chicago, Ill.
Ann Arbor Observatory	Ann Arbor, Mich.
University of State of Missouri	Columbia, Mo.
Morrison Observatory	Glasgow, Mo.
Observatory of Carleton College	Northfield, Minn.

In the case of a *comet*, the word *bright* or *faint* should be added.

5. Next, *the daily motion*, as near as the first observations allow it to be estimated.

For a *minor planet in opposition*, the motion in right ascension is approximately evident, and it is therefore sufficient to indicate the motion in declination, in minutes of arc, preceded by the word *north* or *south*.

For a *comet*, the direction of motion should be indicated by south, west, north, east, or by a combination of two of these words, which must be understood always (also below the pole) in reference to the equator, not in reference to the horizon. If the comet has a rapid motion, the number of degrees per day, as estimated, may follow.

6. Finally, the *date* of the position (having regard to Art. V) indicated by the day of the week.

The day of sending (civil reckoning, of course) is always written at the head of the dispatch by the telegraph operator (the United States law requires also the hour), and it may be presumed that the communications only exceptionally fail to reach the center stations (Art. I), even those on the other side of the Atlantic, on the same day. In order, however, to be independent of any delay of the operator, and agreeably to the wishes expressed by high astronomical authority, the date is now embodied in the dispatch by naming the *week* day, whereby at the same time all ambiguity is removed as to whether astronomical or civil date be meant.

7. Should it be deemed desirable to communicate the authority for the discovery, the shortest way would be to insert the name as the second word in the dispatch (after "planet" or "comet"). For example, the following dispatch, "Planet N. N. twenty-three thirty-five forty north twenty-one forty-six eleventh south three Wednesday," would be interpreted thus: A new planet is discovered by N. N. At midnight (see Art. V) between Wednesday and Thursday it will be in right ascension $23^h\ 35^m\ 40^s$, and declination $+21°\ 46'$; it is of the 11th magnitude, and has a daily motion of $3'$ towards the south.

Or a dispatch like the following, "Comet N. N. twenty-two forty-three ten north sixty-five thirty-one bright southeast two Monday," would announce the discovery made by N. N. of a bright comet, that at midnight Monday—Tuesday will be in right ascension $22^h\ 43^m\ 10^s$ and declination $+65°\ 31'$, the declination decreasing, the right ascension increasing, moving daily about two degrees.

The preceding examples contain the greatest number of words (16) required for any dispatch, if composed according to the rules adopted above. Usually the number will be less. Sometimes, however, the dispatch thus composed would become equivocal, and it has, therefore, been established as an additional rule that the number expressing the minutes of right ascension or declination shall always be expressed in words, even when *zero* occurs. Therefore $23^h\ 0^m\ 40^s$ should be written "twenty three nought forty," while "twenty three forty" will be understood to mean $20^h\ 3^m\ 40^s$. Again, "north thirty six" would be +30° 6′, but "north thirty six nought" is +36° 0′. In a similar way 0^h of right ascension, or 0^s of declination are to be distinctly expressed by the word "nought." Only for the seconds of right ascension when they are zero, that word for brevity's sake is omitted as unnecessary.

V.—The right ascension and declination in the dispatch will be understood to give the position (by proper motion approximately reduced) for THE MIDNIGHT FOLLOWING the date of the dispatch: Washington time for American discoveries; Greenwich time for European.

Usually the discoverer himself has more complete data on hand than others for bringing the position up in advance, and for this reason the *following* midnight is given preference to any preceding time, as, for example, that of the discovery.

VI.—Since in conformity with the preceding article, only an approximate estimate of a later position, and not that of the first observation itself, is given, the dispatch is not to be considered as a document for deciding the question of priority of discovery.

On the other hand, it is expected that observers, in communicating their discoveries, will adhere to the form of the programme explained in the foregoing articles, and thus save much time and labor to those that wish to co-operate.

List of minor planets discovered in the year 1879.

No.	Name.	Date.	Discoverer.	Discoverer's No.	Observatory.
192	Nausikaa	February 17	Palisa	15th	Pola.
193	Ambrosia	February 28	Coggia	3d	Marseilles.
194	Procne	March 21	Peters	33d	Clinton.
195	Eurycleia	April 19	Palisa	16th	Pola.
196	Philomela	May 14	Peters	34th	Clinton.
197	Arete	May 21	Palisa	17th	Pola.
198	Ampella	June 13	Borrelly	11th	Marseilles.
199	Byblis	July 9	Peters	35th	Clinton.
200	Dynamene	July 27	Peters	36th	Clinton.
201	Penelope	August 7	Palisa	18th	Pola.
202	Chryseis	September 1	Peters	37th	Clinton.
203	Pompeia	September 25	Peters	38th	Clinton.
204	Callisto	October 8	Palisa	19th	Pola.
205		October 13	Palisa	20th	Pola.
206	Hersilia	October 13	Peters	39th	Clinton.
207		October 17	Palisa	21st	Pola.
208		October 21	Palisa	22d	Pola.
209	Dido	October 22	Peters	40th	Clinton.
210		November 12	Palisa	23d	Pola.
211		December 10	Palisa	24th	Pola.

LIST OF COMETS DISCOVERED IN 1879.

A	Brorson's Comet. Periodic	February 26			Windsor, N. S. W.
B	Comet 1867. II. Periodic	April 24	Tempel		Florence.
C	1879. III	June 15	Lewis Swift		Rochester, N. Y.
E	1879. IV	August 24	Hartwig		
D	1879. V	August 21	Palisa		Pola.

PUBLICATIONS.

The publications of the Institution consist of three classes: The first, the "Smithsonian Contributions to Knowledge"; the second, the "Smithsonian Miscellaneous Collections"; and the third, the "Annual Reports of the Regents" of the Institution. The works of the first class, the Smithsonian Contributions to Knowledge, are published in quarto form, and are intended to embrace original memoirs, either the result of special investigations authorized and directed by the Institution, or prosecuted under other auspices and presented to it. The works of the second class, the Miscellaneous Collections, are similar in plan and construction to the "Contributions," but are in octavo form, and embrace more particularly monographic and descriptive papers in natural history, formal or systematic lists of species of animals or plants, physical tables, reports on the present state of knowledge in some department of physical or biologic science, &c. As with the "Contributions," each volume is composed of several distinct and independent papers, having no necessary connection with each other, the combination being determined chiefly by the aggregate number of pages suitable for a volume of average size. The average number of pages in the quarto volume is about 600; in the octavo volume, about 800. Each paper or memoir in either class is separately paged and indexed, with its own title-page, so as to be complete in itself, and separately distributed according to its subject. Of the quarto "Contributions," twenty-one volumes, and of the octavo "Collections," fifteen volumes have been published.

The Smithsonian annual reports, commenced in 1847, being made to Congress, are published by that authority, and not at the expense of the Smithson fund. The earlier reports of the Secretary were printed in small pamphlet editions, but were collected and reprinted with the report for 1853, and with this the series of bound volumes may be said to have begun. The number, or edition, ordered by Congress has varied from year to year, but the proportion of copies placed at the disposal of the Institution has been distributed to its correspondents as fully and liberally as possible.

Smithsonian Contributions to Knowledge.—The Institution has now enough material ready for two volumes of the quarto series of Contributions, the twenty-second volume of which will be issued early in the year 1880, and will consist of the following memoirs:

1. Antiquities in Tennessee. Joseph Jones.
2. Sculptures of Santa Lucia. S. Habel.
3. Archæological Collections of the National Museum. Charles Rau.
4. The Palenque Tablet. Charles Rau.
5. Remains of Man in the Aleutian Islands. W. H. Dall.

These papers have all been described in previous reports with the exception of the one on the Palenque tablet, by Charles Rau. This publication relates to a stone tablet covered with glyphic designs which was formerly in the possession of the National Institute for the Promotion of Science (established at Washington about forty years ago) and became afterward the property of the Smithsonian Institution. The records state that the fragments constituting this tablet were presented to the National Institute by Mr. Charles Russell, consul of the United States at Laguna, island of Carmen, Mexico. They had been obtained at Palenque in a manner not explained, and arrived in Washington in 1842, and were deposited in the Patent Office with the collections of the National Institute. The transfer of these collections to the Smithsonian Institution took place in 1858.

The archæological importance of this tablet was first pointed out in 1863 by Dr. George A. Matile. While engaged in making a cast of it, at the request of the late Professor Henry, he recognized it as one of the three stone slabs which, placed together, bore on their surface the sculpture of the famous group of the cross, forming the chief ornament of one of the temples at Palenque. The earliest explorers of the ancient city, Del Rio and Dupaix, still saw the Smithsonian tablet in its proper place in the "Temple of the Cross," and figured it, though in a very defective manner, as a part of the group; but it probably was already broken in 1832, when Waldeck explored the ruins of Palenque. Stephens, who was there eight years afterward, noticed its scattered pieces. As a consequence, neither of the last-named explorers has left a representation of this valuable complement of the celebrated sculpture.

Impressed with the importance of the subject, the author undertook to prepare this monograph, which is not merely confined to a description of the tablet but embraces also a number of cognate topics. Of the two accompanying plates, which were specially executed for the work, one represents the Smithsonian tablet in juxtaposition with Catherwood's well-known delineation of the Tablet of the Cross in Volume II of Stephens's "Incidents of Travel in Central America, Chiapas, and Yucatan"; the other is an artotype showing the Smithsonian tablet as it appears after its restoration. Most of the illustrations in the text were kindly lent by Mr. H. H. Bancroft, of San Francisco; the others were expressly engraved for the publication.

The work comprises five chapters, to which an appendix is added.

In the first chapter the author gives the history of the Smithsonian tablet as far as he could trace it by an examination of the existing records. The second chapter treats in chronological order of the expeditions undertaken for the purpose of exploring the ruins of Palenque, and of the works and minor publications resulting from these explorations. It is a curious circumstance that the existence of the ancient city remained unknown until the second half of the eighteenth century, when accident led to the discovery of these remarkable ruins, hidden for centuries in the shadows of a Guatemalan forest. Cortez, on his famous expedition to Honduras (in 1524), doubtless passed at no great distance from the locality now called Palenque, and if it had been an inhabited city at that time the daring conquistador probably would have turned aside from his march for the purpose of conquering and plundering it. Moreover, no mention of the city is made in the Spanish records of that period, and it may be assumed that it was deserted and in a ruinous condition at the time of the conquest.

The principal explorations of Palenque were undertaken by Del Rio, Dupaix, Waldeck, and Stephens, between the years 1787 and 1839, thus extending over a period of more than half a century; but while the reports of the three first named explorers remained unpublished for many years, Mr. Stephens's account appeared in print within a year or two after his visit to the ruins, which thus became known to a large body of readers, both in this country and abroad.

In the third chapter the author describes, according to the accounts of the different explorers, the Temple of the Cross and the celebrated bas-relief from which it derives its name. These accounts, though not absolutely harmonious, coincide in the main points and give a pretty good idea of the edifice and its appurtenances.

The fourth chapter is devoted to a consideration of the Group of the Cross, including the Smithsonian tablet. It will be seen that the earlier representations of this interesting piece of ancient American sculpture are incorrect and fanciful, more particularly with regard to the design and arrangements of the glyphs surrounding the cross, and the human figures standing at its sides. In speaking of the significance of the bas-relief, the author combats the theory that the adoration of the cross among the aborigines of certain parts of America was due to the influence of Christian missionaries, said to have gone to the New World long before its discovery in the fifteenth century. He adduces facts showing that the cross had a symbolic meaning in America in times long antedating the Columbian era.

The fifth chapter treats of aboriginal writing in Mexico, Yucatan, and Central America. The Mexicans, it is well known, had already made some steps toward phonetization, being able, as Humboldt says, "to write names by writing some signs which recalled sounds." The Yucatecs and Central Americans, however, used signs of a different character, denominated *calculiform* by M. Aubin, the distinguished French savant. The question of their significance has been revived of late years by Brasseur de Bourbourg's discovery and publication of Bishop Landa's manuscript of the sixteenth century, which had lain for many years unnoticed in the archives of the Royal Academy of History at Madrid. The celebrity of the bishop's work is chiefly due to the circumstance that it contains delineations of what he calls the alphabetic signs of the Yucatecs. The discovery of this supposed key was hailed with great enthusiasm by scholars interested in the decipherment of the glyphs sculptured on the walls of ancient edifices in Central America and Yucatan, and of the few manuscripts in similar characters which have escaped the destructi fanaticism of Spanish priests, namely, the Dresden Codex, the Cod Peresianus and the Codex Troano, yet the results have thus far n justified the high expectations at first entertained.

The author endeavors to show, by an analytical process, the affini between Bishop Landa's characters and the glyphs on the Palenque tablets, to which he consequently ascribes a Maya origin. He thin it probable that the Yucatecs employed in their writing certain chara ters as equivalents for sounds, perhaps syllabic and at the same tim possibly to a great extent, conventional figures imparting a defini meaning. On the other hand, he strongly doubts whether the May and kindred tribes ever went so far as to express the elementary sig of their speech by corresponding signs; in short, whether they possess a written language in the modern sense. He hardly believes that t meaning of Central American and Yucatec glyphs will ever be reveal through Landa's key, which, if it really was what the bishop claim would apply to the Maya as spoken at the time of the conquest, bu owing to the mutability of languages, not to the earlier kindred verna ular of the builders of Palenque and other now ruined cities of t same regions.

The appendix relates to the ruins of Yucatan and Central Ameri and forms a complement to the chief topics of the publication.

The twenty-third volume of Contributions will probably contain:

1. Lucernariæ. H. J. Clark.
2. Geology of Louisiana. E. W. Hilgard.
3. Internal Structure of the Earth. J. G. Barnard.
4. Monograph of the Trochilidæ. D. G. Elliot.
5. Fever, a Study in Morbid and Normal Physiology. H. C. Wood, j

Miscellaneous Collections.—Several volumes of Miscellaneous Colle tions will be published in a few months, the articles composing the having already been printed and stereotyped.

Volume XVI of this series will contain:

1. Monograph of Strepomatidæ. G. W. Tryon.
2. Catalogue of Diptera. R. Osten-Sacken.
3. Toner lecture: Nature of Reparatory Inflammation in Arteries aft Ligature. E. O. Shakespeare.
4. Circular relative to Smithsonian Literary and Scientific Exchange
5. Circular relative to Business Arrangements of the Smithsonian I stitution.
6. List of Humming Birds. D. G. Elliot.
7. List of the Principal Libraries in the United States.
8. Check-list of Smithsonian Publications to July, 1879.

Volume XVII of the Miscellaneous Collections will consist of—

1. Documents relative to the Origin and History of the Smithsonian Institution. W. J. Rhees.

Volume XVIII of the Miscellaneous Collections will be composed of—

1. The Scientific Writings of James Smithson.
2. An Account of James Smithson and his Bequest. W. J. Rhees.
3. Journals of the Board of Regents, reports of committees, statistics, &c., from 1846 to 1877.

Volume XIX of Miscellaneous Collections will consist of—

1. Proceedings of the National Museum for 1878.
2. Proceedings of the National Museum for 1879.

Writings of James Smithson.—The scientific writings of James Smithson, the distinguished founder of the Smithsonian Institution, have been collected and are published in accordance with the instructions of the Board of Regents. These memoirs were originally contributed to the "Transactions of the Royal Society of London," of which Smithson was a member between the years 1791 and 1817, and to Thomson's "Annals of Philosophy," between 1819 and 1825. They are twenty-seven in number and embrace a wide range of subjects, from the origin of the earth, the nature of the colors of vegetables and insects, the analyses of minerals and chemicals, to an improved method of constructing lamps, and of making coffee. Some of these papers were translated into French by the author and others, and published in the "*Journal de Physique, de Chimie, et d'Histoire Naturelle.*" They prove conclusively the scientific character of Smithson and his title to distinction as a contributor to knowledge.

Among the personal effects of the founder of the Institution were several hundred manuscripts, besides a large collection of scraps and notes on a great diversity of subjects, including history, the arts, language, rural economy, construction of buildings, &c., which, unfortunately, were destroyed by the fire in the Smithsonian building in 1865. It is probable that Smithson also contributed articles to scientific and literary journals other than those mentioned, but none have been found, though the leading English periodicals of the day have been carefully examined.

Appended to the writings of Smithson are reviews of their scientific character, by Prof. Walter R. Johnson, communicated to the National Institute of Washington in 1844, and by J. R. McD. Irby prepared for the Institution in September, 1878. The material for this work has been collected and the volume edited by Wm. J. Rhees, chief clerk of the Institution.

History of the Institution.—The work mentioned in the last report relative to the origin and history of the Institution, as ordered by the Board of Regents, has been completed under the efficient editorship of

Mr. William J. Rhees, chief clerk of the Institution lished. This history forms an octavo volume of tains the will of Smithson, a republication of all the lation of Congress relative to the bequest, the official papers of Mr. Rush, the agent of the United the legacy, the history of the investment of the learned men as to the best disposition of the bequ documents of value in connection with the history The work has a full index.

Journals of the Board of Regents.—Another volum the Institution has been compiled by Mr. Rhees, con of proceedings of the Board of Regents from its first ber 12, 1846, to January 26, 1876, together with the re tive, building, and special committees for the same gies on deceased members of the Board and distingui of the Institution are given, and also a full account of tific fund, the Tyndall trust, Corcoran Gallery of Art Hamilton bequest, the report of the committee of the vention of the electro-magnetic telegraph, the report of of Professor Henry by the English scientific commi tables, and valuable information relative to the histor of the Institution.

Toner lectures.—The seventh Toner lecture has been p Institution, and is a concise and interesting presentatio of reparatory inflammation in arteries after ligature, torsion," by Dr. Edward O. Shakespeare, of Philadelp Washington, June 27, 1878. The bleeding of wounds a a favorite theme of study from time immemorial; its nat efficient means for its arrest have drawn to it the attenti in all ages. Dr. Shakespeare gives an epitome of the made by skilled hands to stay the subsequent bleeding amputations, from the first recorded authority, Jean 1731-'32, to date; this valuable summary is followed by alent opinions in regard to the question, and he then sketc succinct detail, his own personal observations. This conc is illustrated by four carefully prepared plates.

Monograph of Chitonidæ.—Reference has been made ports to a monograph of the *Chitonidæ* prepared by Dr. penter, of Montreal, with a view to publication by the Ins

At Dr. Carpenter's death, this manuscript, in a still unf tion, was discovered to consist largely of notes and memor in a peculiar and antiquated short-hand, with which no one try was familiar. The skeleton of classification was almo but the details in regard to particular species were ofter existed only in the form of these short-hand notes. As the usefulness of the work and especially its completeness depended largely on the comprehension of these notes, search was made, for a long time unsuccessfully, for some one able to decipher them. At last an old classmate and personal friend of Dr. Carpenter, Mr. R. D. Darbishire, of Manchester, England, undertook the task, with the assistance of the Rev. W. H. Herford. To the knowledge of the short-hand possessed by Mr. Darbishire (one of the few living persons who can read it) and to his generous willingness to devote his time to the wearisome duty for the benefit of science and out of regard for Dr. Carpenter's memory we are very greatly indebted and owe the translation of the above-mentioned notes. Mr. Darbishire declined any remuneration for his services, and the labor bestowed by Mr. Herford was quite beyond the value of any honorarium which the Institution was able to make him. The thanks of the Institution and of men of science generally are therefore due to these gentlemen. The illustrations for the monograph, which are quite numerous, are yet to be engraved, though they have already been beautifully drawn by Mr. Emerton, under Dr. Carpenter's direction, at the cost of the Institution. This and a not inconsiderable amount of editing, which has been intrusted to Mr. W. H. Dall, remain to be accomplished before the monograph will be ready for publication, a task which cannot be wholly completed under a year or two.

List of zoological genera.—Among the works offered to the Smithsonian Institution for publication is a list of the zoological genera, giving the time of publication and the class of the animal kingdom referred to. Such works, if properly executed, are of great value to the investigator, since, although imposing an immense labor upon the compiler, they enable the student to at once determine points of synonymy and priority of date; also whether a name proposed for a new genus has already been used, thus sparing an enormous aggregate of individual effort. This work, by Mr. Samuel H. Scudder, of Cambridge, will probably be completed and published in the course of the year 1880.

Bulletins of the National Museum.—In the Secretary's Report for 1875 it was stated that another series of publications, which would form a part of the Miscellaneous Collections, had been commenced under the above title. This series is intended to illustrate the collections of natural history and ethnology belonging to the United States, and constituting the stock of the National Museum, of which the Smithsonian Institution is the custodian. These bulletins, prepared at the request and mainly by the attachés of the Institution, have been printed under the authority of the Secretary of the Interior. They form an independent series, which has proved very acceptable to naturalists, as enabling them to obtain prompt information as to the additions to and the components of the National Museum.

The following is a list of the titles and contents of the bulletins already published:

Bulletin 1.—Check-List of North American Batrachia and Reptilia; with a Systematic List of the higher groups, and an essay on geographical distribution based on the specimens contained in the United States National Museum. By Edward D. Cope. 1875. 8vo., 104 pp.

Bulletin 2.—Contributions to the Natural History of Kerguelen Island, made in connection with the American Transit of Venus Expedition, 1874–'75. By J. H. Kidder, M. D., Passed Assistant Surgeon, United States Navy. I. Ornithology. Edited by Dr. Elliott Coues, United States Army. 1876. 8vo., 51 pp.

Bulletin 3.—Contributions to the Natural History of Kerguelen Island, made in connection with the American Transit of Venus Expedition, 1874–'75. By J. H. Kidder, M. D., Passed Assistant Surgeon, United States Navy. II. 1876. 8vo., 122 pp. The contents are as follows:

OOLOGY.—By J. H. Kidder and Elliott Coues.
BOTANY:
A. Phænogamia, Filices, et Lycopodiaceæ.
Revised by Asa Gray.
B. Musci. By Thomas P. James.
C. Lichenes. By Edward Tuckerman.
Algæ. By W. G. Farlow.
CROZET FLORA:
GEOLOGY. By F. M. Endlich.
MAMMALS. By J. H. Kidder.
FISH. By Theodore N. Gill.
MOLLUSKS. By W. H. Dall.
INSECTS:
Diptera. By C. R. Osten-Sacken.
Pseudo-Neuroptera. By H. A. Hagen.
Crustaceans. By S. I. Smith.
Annelids, Echinoderms, and Anthozoa. By A. E. Verrill.
Surgeon E. Kershner's Collection.
A STUDY OF CHIONIS MINOR. By J. H. Kidder and Elliott Coues.

Bulletin 4.—Birds of Southwestern Mexico. Collected by Francis E. Sumichrast for the United States National Museum. Prepared by George N. Lawrence. 1875. 8vo., 56 pp.

Bulletin 5.—Catalogue of the Fishes of the Bermudas. Based chiefly upon the collections of the United States National Museum. By G. Brown Goode, M. A., Curator United States National Museum. 1876. 8vo., 82 pp.

Bulletin 6.—Classification of the Collection to illustrate the animal resources of the United States. A list of the substances derived from the animal kingdom, with synopsis of the useful and injurious animals, and a Classification of the methods of capture and utilization. By G. Brown Goode. 1876. 8vo., 126 pp.

Bulletin 7.—Contributions to the Natural History of the Hawaiian and Fanning Islands and Lower California, made in connection with the United States North Pacific Surveying Expedition, 1873–'75. By Thomas H. Streets, M. D., Passed Assistant Surgeon, United States Navy. 1877. 8vo., 172 pp. The subjects treated of are:

ORNITHOLOGY.
HERPETOLOGY.
ICHTHYOLOGY:
I. Fishes of Upper and Lower California.
II. Fishes of the Hawaiian Islands.
III. Fishes of the Fanning Islands.
IV. Fishes of the Samoan Islands.
CRUSTACEA.
BOTANY.

Bulletin 8.—Index to the Names which have been applied to the Subdivisions of the Class Brachiopoda, excluding the *Rudistes*, previous to the year 1877. By W. H. Dall, United States Coast Survey. 1877. 8vo., 88 pp.

Bulletin 9.—Contributions to North American Ichthyology, based primarily on the Collections of the United National Museum. I. Review of Rafinesque's Memoirs on North American Fishes. By David S. Jordan. 1877. 8vo., 53 pp.

Bulletin 10.—Contributions to North American Ichthyology, based primarily on the Collections of the United States National Museum. II. A.—Notes on *Cottidæ*, *Etheostomiatidæ*, *Percidæ*, *Centrarchidæ*, *Aphredoderidæ*, *Dorosomatidæ*, and *Cyprinidæ*, with Revisions of the Genera and Descriptions of New or Little Known Species. B.—Synopsis of the *Siluridæ* of the Fresh Waters of North America. By David S. Jordan. 1877. 8vo., 120 pp.

Bulletin 11.—Bibliography of the Fishes of the Pacific United States. By Theodore N. Gill. (In Press.)

Bulletin 12.—Contributions to North American Ichthyology. III. A.—On the Distribution of the Fishes of the Alleghany Region of South Carolina, Georgia, and Tennessee, with Descriptions of new or little known species. By David S. Jordan and Alembert W. Brayton. B.—A Synopsis of the Family *Catostomidæ*. By David S. Jordan. 1878. 8vo., 237 pp.

Bulletin 13.—Flora of St. Croix and the Virgin Islands. By Baron H. F. A. Eggers. 1879. 8vo., 139 pp.

Bulletin 14.—Catalogue of Collection illustrating the animal resources and the Fisheries of the United States. Prepared under the direction of G. Brown Goode. 1879. 8vo., 351 pp.

Bulletin 15.—Contributions to the Natural History of Arctic America, made in connection with the Howgate Polar Expedition, 1877–'78. By Ludwig Kumlien, Naturalist of the Expedition. 1879. 8vo., 179 pp.

ETHNOLOGY, MAMMALS, AND BIRDS. By Ludwig Kumlien.
FISHES. By Tarleton H. Bean.
ANNELIDES, MOLLUSCOIDS, AND RADIATES. By A. E. Verrill.
MOLLUSKS. By W. H. Dall.
INSECTS:
Diurnal Lepidoptera. By W. H. Edwards.
INSECTS:
Hymenoptera, Nocturnal Lepidoptera, Diptera, Coleoptera, Neuroptera, and Arachnida. By S. H. Scudder and others.
PLANTS. By Asa Gray.
LICHENS. By Edward Tuckerman.
ALGÆ. By W. G. Farlow.

Bulletin 16.—Synopsis of the Fishes of the United States. By David S. Jordan. (In Press.)

The fifteenth number of the Bulletin of the National Museum is wholly made up of the interesting and novel notes of Mr. Ludwig Kumlien, who, under the auspices of the Smithsonian Institution, in 1877–'78, accompanied the Howgate polar expedition as naturalist. He passed the long arctic winter of 1877–'78 in the little harbor of Annanactook, Cumberland Gulf, latitude 67° north, longitude 68° 50′ west. This sound, gulf, or inlet of Cumberland extends from about latitude 65° north to latitude

67° + north. It is the "Cumberland Straits" of Baffin, who was its original discoverer at the end of the sixteenth century; again rediscovered by Captain Penny in 1839, who named it Hogarth Sound; and still again it was visited by Captain Wareham in 1841, who, unconscious of his predecessors, named it once more anew as Northumberland Inlet. It has become latterly a frequented place of resort for Scotch and American whalemen, whôse ships frequently winter on the southwest shores of its boundaries.

Here Mr. Kumlien passed seven or eight months in close intercourse with the Eskimo, and neglected no opportunity for study of this people. His detailed account of the curious habits and mental characteristics of the Innuit is one of the most complete and finished descriptions ever given of them; clear, succinct, and comprehensive, it is a valuable ethnological pen picture.

Mr. Kumlien paid attention to the various subdivisions of natural history, and made as full notes as possible, under the circumstances, upon the mammals, birds, and fishes of the region. His limited means for action, his scant accommodations on the little schooner, and the forced, hasty departure from winter quarters gave no opportunity for exhaustive collections of any kind whatever; but the insects, the plants, the mollusks, and the algæ secured have been carefully examined by experts in these branches, and reported on in this bulletin, thus rendering it a most valuable contribution to our knowledge of circumpolar life.

Proceedings of the National Museum.—It had frequently been suggested as 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 presenting other interesting facts relative to natural history, &c., as furnished by the correspondents of the institution. The publication of the "Proceedings of the National Museum" was accordingly commenced, the work comprising short descriptions of the additions to the museum, accounts of new species, faunal, and other lists, &c. It is printed in successive signatures, as fast as copy sufficient for sixteen pages is prepared, each signature having printed at the bottom of its first page the date of actual issue, for deciding questions as to priority of publication. It is at once distributed to scientific societies and leading naturalists in this country and in Europe. The list of important articles of greater or less length already printed, and forming the volume for 1878, is as follows:

By Tarleton H. Bean. Description of a new sparoid fish from Savannah bank; on the occurrence of *Stichæus punctatus*, at Saint Michaels, Alaska; on the identity of *Euchalarodus putnami*, Gill, with *Pleuronectes glaber* (Storer) Gill, with notes on the habits of the species; description of a species of *Lycodes* from Alaska, believed to be undescribed.

By L. Belding. A partial list ot the birds of Central California.

By Caleb Cook. The manufacture of porpoise oil.

By W. H. Dall. Descriptions of new forms of mollusks from Alaska, contained in the collections of the National Museum; Post-pliocene fossils in the coast range of California; fossil mollusks from later Tertiaries of California; note on shells from Costa Rica, Kitchenmidden, collected by Drs. Flint and Bransford; distribution of Californian Tertiary fossils; descriptions of new species of shells from California in the collections of the National Museum; report on the limpets and chitons of the Alaskan and Arctic region, with descriptions of genera and species believed to be new.

By Vinal N. Edwards. On the occurrence of the oceanic bonito in Vineyard Sound, Massachusetts.

By Theodore Gill. Synopsis of the pediculate fishes of the eastern coast of extratropical North America; note on the *Antennariidæ;* on the proper specific name of the common pelagic antennariid *Pterophryne;* note on the *Ceratiidæ;* note on the *Maltheidæ.*

By G. Brown Goode. The *Clupea tyrannus* of Latrobe. The occurrence of *Belone latimanus* in Buzzard's Bay, Massachusetts; the voices of crustaceans; a revision of the American species of the genus *Brevoortia*, with a description of a new species from the Gulf of Mexico; the occurrence of *Hippocampus antiquorum* or an allied form on Saint George's banks; the occurrence of the Canada porcupine in West Virginia; on two fishes from the Bermudas, mistakenly described as new by Dr. Günther.

By G. Brown Goode and Tarleton H. Bean. The Craig flounder of Europe on the coast of North America; the oceanic bonito on the coast of the United States; description of *Caulolatilus microps*, a new species of fish from the gulf coast of Florida; on a new serranoid fish from the Bermudas and Florida; descriptions of two new species of fishes from the coast of Florida; a note upon the black grouper of the southern coast; descriptions of two gadoid fishes from the deep-sea fauna of the Northwestern Atlantic; description of *Argentina syrtensium*, a new deep-sea fish from Sable Island bank; the identity of *Rhinonemus caudacuta*, Gill, with *Gadus cimbrius*, Linn.; note on *Platessa ferruginea*, D. H. Storer, and *Platessa rostrata*, H. R. Storer; on the identity of *Brosmius americanus*, Gill, with *Brosmius brosme*, White.

By J. B. S. Jackson. Arsenic acid for protecting anatomical preparations from insects.

By Lieut. J. P. Jefferson. On the mortality of fishes in the Gulf of Mexico in 1878.

By Lieut. J. P. Jefferson, Dr. Joseph Y. Porter, and Thomas Moore On the destruction of fish in the vicinity of the Tortugas during the months of September and October, 1878.

By David S. Jordan. Notes on a collection of fishes from Clackamas River, Oregon.

By David S. Jordan and Charles H. Gilbert. Notes on the fishes of Beaufort Harbor, North Carolina.

By George N. Lawrence. Catalogue of the birds of Dominica, from collections made for the Smithsonian Institution by Frederick A. Ober, together with his notes and observations; catalogue of the birds of St. Vincent, from collections made by Mr. Fred. A. Ober, under the directions of the Smithsonian Institution, with his notes thereon; catalogue of the birds of Antigua and Barbuda, from collections made for the Smithsonian Institution by Mr. Fred. A. Ober, with his observations; catalogue of the birds of Grenada, from a collection made by Mr. Fred. A. Ober for the Smithsonian Institution, including others seen by him, but not obtained; catalogue of the birds collected in Martinique by Mr. Fred. A. Ober for the Smithsonian Institution; catalogue of a collection of birds obtained in Guadeloupe for the Smithsonian Institution by Mr. Fred. A. Ober; a general catalogue of the birds noted from the islands of the Lesser Antilles, visited by Mr. Fred. A. Ober, with a table showing their distribution and those found in the United States.

By Prof. N. T. Lupton. On the breeding habits of the sea catfish.

By Dr. James C. Merrill. Notes on the ornithology of Southern Texas, being a list of birds observed in the vicinity of Fort Brown, Tex., from February, 1876, to June, 1878.

By Felipe Poey. Notes on the American species of the genus *Cybium*.

By Captain R. H. Pratt. Catalogue of casts taken by Clark Mills, esq., of the heads of sixty-four Indian prisoners, of various Western tribes and held at Fort Marion, Saint Augustine, Fla., in charge of Capt. R. H. Pratt.

By Robert Ridgway. On a new humming-bird (*Atthis ellioti*) from Guatemala; a review of the American species of the genus *Scops* Savigny; descriptions of several new species and geographical races of birds contained in the collection of the United States National Museum; description of two new species of birds from Costa Rica, and notes on other rare species from that country; descriptions of new species and races of American birds, including a synopsis of the genus *Tyrannus*.

By Silas Stearns. A note on the gulf menhaden.

By Dr. Franz Steindachner. Note on *Perca flavescens*.

By Samuel Wilmot. Notes on the Western gizzard shad.

The above collection constitutes Vol. I of the *Proceedings of the United States National Museum*, comprising 524 pages, octavo, and embellished with 8 plates and 10 wood-cuts.

Chief among these interesting papers is the digest of Mr. F. A. Ober's researches in the Lesser Antilles, as given by Mr. Geo. N. Lawrence. The labors of Mr. Ober were principally devoted during two years to ornithological observation and collection on the island of Dominica, which is about midway in the group known as the Lesser Antilles, being in latitude 15° 20′ to 15° 45′, north; longitude 61° 13′ to 61° 30′ west. The island is mountainous, possessing a range of high peaks and hills from two to three thousand feet in height. It is only in these mountainous sections that land birds of any moment are found, for, in fact, along the coast and in the low valleys very few species other than ordinary sparrows, humming-birds, &c., can be obtained. Owing to the bold, precipitous character of the island coast and the absence of small outlying islands or detached rocky islets, Mr. Ober found that only a few sea birds were resident.

As far as known, the most significant result of Mr. Ober's collection and investigation of the avifauna of the Lesser Antilles is embodied in the statement that each one of these several little islands constituting that group has one or more species peculiar to itself alone.

Mr. W. H. Dall has contributed several papers to the *Proceedings*, describing new forms of mollusks, both recent and belonging to the Tertiary formation, nearly all of which are from the western coast of the United States, several being particularly interesting. One of these forms was brought up on a sounding-line by Capt. Geo. E. Belknap, of the U. S. S. *Tuscarora*, on his celebrated sounding expedition from Japan to California via the Aleutian Islands, in 1874. This mollusk, a species of *Chiton*, came from a depth of 6,066 feet below the surface, a much greater depth than that in which any other species of the genus has yet been known to exist. Many of the other shells and fossils described were due to the exertions of Mr. Henry Hemphill, of California, whose ability as a collector stands unrivalled, and who kindly presented those objects, which he believed to be new, to the National Museum.

Small but interesting collections of shells from "Kitchen Middens," on the Pacific coast of Costa Rica, were also identified by Mr. Dall. These species, collected by Drs. Flint and Bransford, are still found living in adjacent waters, and are now used for food by the natives.

Mr. Dall also contributed a paper on the Limpets and Chitons of the Alaskan region, with descriptions of genera and species believed to be new. This was illustrated by five plates, representing chiefly the teeth of these animals, worked out by microscopical investigations of his own. Some forty-two forms were figured, only three or four having previously been known. The paper contains a review of the general classification of the *Chitonidæ*, based on the researches of P. P. Carpenter and the author, together with a summary of the known facts in regard to the anatomy and development of these animals, some of which are here stated for the first time. A number of genera and subgenera, proposed by Dr. Carpenter in his unpublished monograph of the *Chitonidæ*, together with others heretofore only partially characterized, are here fully described for the first time.

Mr. R. Ridgway has contributed the following:

(1) *On a new humming-bird* (*Atthis ellioti*) *from Guatemala* (pp. 8–10).—Certain constant differences, previously overlooked by authors, between specimens of *Atthis heloisæ* (Less. & Delattr.) from Mexico and the birds from Guatemala referred to that species are pointed out and illustrated by outline figures. The Guatemalan bird is characterized as a new species, and named in honor of Mr. Daniel Giraud Elliot, the well known ornithologist, and a special authority on this family of birds.

(2) *A review of the American species of the genus Scops* Savigny (pp. 84–117).—This article is an elaborate monograph of the American Scops owls (species allied to the common screech-owl of the United States), embracing the full synonymy and descriptions of the known species, two of which, *S. brasilianus cassini*, from Eastern Mexico, and *S. cooperi*, from Costa Rica, are new to science. The owls of this genus have been particularly perplexing to ornithologists on account of remarkable variations of plumage, some species being "dichromatic," while all vary to an unusual degree, according to locality, the amount of individual variation also being extraordinary. The present paper is an attempt, based upon ample material contained chiefly in the National Museum, to clear away the confusion which has hitherto existed in regard to the relationships and nomenclature of certain forms.

(3) *Notes on the ornithology of Southern Texas, being a list of birds observed in the vicinity of Fort Brown, Texas, from February*, 1876, *to June*, 1878. *By James C. Merrill, Assistant Surgeon, U. S. Army* (pp. 118–173).—The critical remarks and synonymy relating to the species noticed in this article were prepared by Mr. Ridgway, although in several instances, through an oversight of his own, his initials do not appear in connection with his portion of the work. The species thus treated by Mr. Ridgway, are: *Thryomanes bewicki leucogaster* (p. 121), *Vireosylvia flavo-viridis* (p. 125), *Molothrus æneus* (pp. 130–131), *Sturnella magna neglecta* (p. 134), *Myiarchus erythrocercus cooperi* (pp. 138–141), *Nyctidromus albicollis* (pp. 142–145), *Amazilia fuscicaudata* (pp. 147–148), *A. yucatanensis* (pp. 148–149), *Buteo albicaudatus* (pp. 154–156), *Æchmoptila albifrons* (p. 158), and *Parra gymnostoma* (pp. 166–168). Mr. Ridgway is also responsible for the nomenclature adopted in the catalogue.

(4) *Descriptions of several new species and geographical races of birds contained in the collection of the United States National Museum* (pp. 247–252).—The new forms described in this article are the following: *Rhodinocichla rosea schistacea*, from Mazatlan, Western Mexico; *Embernagra rufivirgata crassirostris*, from Eastern Mexico, and the *E. r. verticalis*, from Yucatan; *Loxigilla violacea bahamensis*, from the Bahamas; and *Anas aberti*, from Mazatlan. A description is appended (p. 253) of the adult female of *Anas wyvilliana*, Sclater, a recently discovered Sandwich Island duck, the female of which was previously unknown.

(5) *Description of two new species of birds from Costa Rica, and notes on other rare species from that country* (pp. 252–255).—The new species here described are *Thryophilus zeledoni* and *Pseudocolaptes lawrencii*. The others noticed are the very rare *Carpodectes nitidus*, the young male of which is here for the first time described, and the "*Zonotrichia*", *vulcani*, of Boucard, which is referred to the genus *Junco*, as the most southern form of that genus, of which the common snowbird (*J. hyemalis*) is the representative in Eastern North America. The Costa Rican bird inhabits the almost alpine summit of the volcano of Irazu.

(6) *A partial list of the birds of Central California. By L. Belding, of*

Stockton. Edited by R. Ridgway (pp. 388–449). Mr. Ridgway is to be credited merely with the editing of this paper and the nomenclature adopted. The list is the most complete catalogue extant of Central Californian birds, being based upon the observations of Mr. Belding, made during a residence of about twenty years in the State, and includes 220 species, which, with very few exceptions, are represented in the collection of the National Museum by specimens (upwards of 600 in number) sent by Mr. Belding.

(7) *Descriptions of new species and races of American birds, including a synopsis of the genus Tyrannus*, Cuvier (pp. 466–486).—The new species here described are *Tyrannus luggeri*, from Demerara and Cayenne; *Lichenops perspicillatus andinus*, from Western South America (Chili to Colombia); *Dacnis pulcherrima aureinucha*, from Ecuador; *Parus rufescens neglectus*, from the coast of California.

Smithsonian Annual Report.—The report of the Institution for the year 1878 was presented to Congress on the 8th of February, 1879, and 10,500 copies were ordered to be printed, 1,000 being for the use of the Senate, 3,000 for that of the House of Representatives, and 6,500 for the Smithsonian Institution.

For almost the first time in the history of the Institution, this report has failed to make its appearance, and to be distributed before the close of the following year. Under ordinary circumstances it should have been printed by the 1st of July, but the year has come to an end, and not more than half the number of pages have been set up. This is due to the fact that the extra session of Congress held in March last found the Public Printer without any special appropriation to meet the cost of printing; and instead of going on with the work ordered at the previous session, he was obliged to postpone it. Work was, however, resumed upon the report late in the autumn, and it will probably be finished in the course of a few months. It is earnestly to be hoped that a similar delay will not occur again. The same cause has prevented the printing of the Henry Memorial volume authorized by Congress last winter, but the work on this will soon be begun.

Reports of the United States Fish Commission.—A series of publications which may be considered as in some respects connected with the work of the Institution, not only in the *personnel*, but in the subjects of natural history discussed and in the resulting contributions to our knowledge, may properly be here noticed. The present Secretary being at the head of the United States Commission of Fish and Fisheries, and the work accomplished by this agency in increasing and diffusing scientific as well as practical information being quite within the objects and province of the Institution, much of the material would legitimately form a portion of the Smithsonian Contributions or Miscellaneous Collections. These reports are, however, published by the government, and are distributed by Congress.

ANTHROPOLOGY.

It is well known to the Board that the natural history of primitive man, especially in North America, has always been a special object of the attention of the Smithsonian Institution. The first volume of its series of publications consisted of a work by Messrs. Squier and Davis, entitled "The ancient monuments of the Mississippi Valley," which, appearing in 1848, gave a stimulus to archæological research in America, and added greatly in exciting that high degree of interest in the subject, which now pervades the whole country. The work, although thirty years old, is still a standard publication, and greatly sought after. It had been in contemplation to reprint this work, to meet the great demand; but the destruction of all the wood-cuts by the disastrous fire of 1865 involved so great a cost in their reproduction that nothing has yet been done in the matter.

For the purpose of a more definite inquiry into the subject of mounds, earth-works, and other remains of early man in America, a large edition has been distributed, within a few years past, of a circular prepared at the request of the Smithsonian Institution by Prof. O. T. Mason, and a great many returns have been received, containing more or less valuable information on the subject in question. Some of these responses will appear in the reports of the Institution. The entire material is in Professor Mason's hands for elaboration and the preparation of part of a new and systematic account of the whole subject, taking the memoir of Squier and Davis as a basis.

In view of the fact that some of the most interesting localities of archæological remains in the United States are now being systematically explored and the "finds" removed by foreign governments, it is very desirable that Congress should make the necessary appropriation to enable this work to be done for the benefit of the National Museum. The remains of prehistoric man, as well as illustrations of the life and manners of living savage races, have of late years been considered the most interesting objects of exhibition in all civilized nations, and especially within the last twenty or thirty years, and the greatest efforts are now made everywhere not only to complete the material for each country itself, but to obtain supplementary matter from elsewhere; indeed, so greatly are these aboriginal objects valued in many countries that positive laws prohibiting their exportation are in vogue, as in Denmark, Mexico, &c. The English, German, and French Governments have of late years been particularly active in archæological research in America, Central and South America being until recently the chief field of investigation. Within a short time, however, the French Government, through its agents, has been diligently occupied in collecting prehistoric remains along the coast of California, and is about extending its work into New Mexico and Arizona, Oregon and Alaska, and many tons of the choicest objects have already been removed to Paris. Whatever the feelings of regret on the part of Americans at seeing the removal of articles of such value from our country, and which can never be replaced, there is no redress in the way of prohibiting their collection and its exportation. We may, however, prevent it in the future by our pre-occupying the ground. It is, therefore, to be hoped that Congress will make suitable appropriations for the purpose in question. Ten or twenty thousand dollars expended annually would enable us in a manner to defy foreign competition.

In the sundry civil appropriation bill of March 3, 1879, the following item was included:

"For completing and preparing for publication the contributions to North American ethnology, under the Smithsonian Institution, twenty thousand dollars: *Provided*, That all the archives, records, and materials relating to the Indians of North America, collected by the geographical and geological survey of the Rocky Mountain region, shall be turned over to the Smithsonian Institution, that the work may be completed and prepared for publication under its direction: *Provided*, That it shall meet the approval of the Secretary of the Interior and of the Secretary of the Smithsonian Institution."

Under the authority of this enactment, Major Powell sent out a party to make a renewed examination of the pueblo villages of New Mexico, for the purpose of obtaining more accurate information for publication in the final report, as authorized. Accordingly, Mr. James Stevenson was placed by Major Powell at the head of an expedition, and was accompanied by Mr. Frank H. Cushing, one of the assistants in charge of the ethnological department of the National Museum. With Santa Fé as a starting-point, they explored several localities in that vicinity and elsewhere, and succeeded in obtaining a large collection of everything illustrating the manners and customs of the pueblo towns. The collections made have all been shipped by the Quartermaster's Department, under the order already referred to, and are expected to arrive in a few weeks. The whole mass occupies nearly one hundred boxes.

The operations of Messrs. Stevenson and Cushing have been much facilitated by means of letters furnished by the Secretary of War and Generals Sherman and Meigs to the officers of the military posts.* General Hatch took a special interest in the subject, and issued a circular calling attention to the mission of the party, and inviting cooperation

*WAR DEPARTMENT,
QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., June 19, 1879.

SIR: You are respectfully informed that your communication of the 12th instant, requesting that a circular be issued authorizing the Quartermaster's Department to receive from parties living at or near military posts and to forward to Washington any articles intended for the National Museum, has been referred by the Secretary of War to this office for report, and this day returned with the following remarks:

"The Quartermaster's Department, under existing orders, transports to the National Museum the collections of United States surveys and exploring expeditions, organized under the War Department.

"The law of March 3, 1879 (Forty-fifth Congress, third session, chap. 182), makes from all quarters. The effect of this was seen in the ready assistance rendered, and in the numerous contributions by both the military and civil residents of the district. The material result of this expedition will perhaps be thrown in the shade by the information obtained by Mr. Cushing in regard to the manners and customs of the Indians. Securing their confidence to a greater degree than any preceding traveller, his presence has been permitted at the performance of their most sacred rites; and the publication of his report by Major Powell may be looked for as promising to be of intense interest.

A very important addition made during the year to the ethnological department of the National Museum is the collection of Indian portraits and scenes painted by Mr. George Catlin, and presented by Mrs. Harrison, widow of Thomas Harrison, of Philadelphia.

There have been two of the so-called Catlin collections. The first is that which was exhibited by Mr. Catlin many years ago, in the United States, and afterwards taken to Europe and shown in the principal capitals. It made Mr. Catlin's reputation as an artist and ethnologist, and furnished the material for his great work on the North American Indians.

Several years ago, Mr. Harrison, being in Belgium, found Mr. Catlin there very much embarrassed financially, and in danger of having his entire gallery sold for a trifle. He advanced the money to relieve Mr. Catlin's embarrassment, and took the collection as security, with the understanding that at any time within a certain period of years it could be redeemed. This was out of Mr. Catlin's power, and the collection was transferred to Philadelphia, where it was stored for many years, and, as stated, has just been presented by Mrs. Harrison.

After parting with his first gallery, Mr. Catlin traveled extensively in Western North America and through South America, and obtained many additional sketches of much interest. This second collection was brought some years ago by him to Washington in the hope of selling it to the government, and was exhibited in the upper hall of the Smith-

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the National Museum the ultimate place of deposit and safe custody of all these collections.

"It, under the laws and orders relating to the Centennial Exhibition, transported to Philadelphia various and extensive collections for that exhibition; many, if not most, of which were finally brought to Washington, for deposit in the National Museum.

"I recommend that the request of the director of the National Museum and Secretary of the Smithsonian Institution be granted."

Very respectfully, your obedient servant,

M. C. MEIGS,
Quartermaster-General, Brevet Major-General, U. S. A.

Prof. SPENCER F. BAIRD,
Secretary Smithsonian Institution, Washington, D. C.

WAR DEPARTMENT,
Washington, D. C., June 21, 1879.

SIR: Replying to your letter of the 12th instant, in which you request that the Quartermaster's Department be authorized to receive from parties living at or near sonian Building (then otherwise unoccupied), under the care of Mr. Catlin himself. He, however, died before anything was accomplished, and the pictures were packed up and stored in the Smithsonian basement until 1876, when the heirs had them transferred, for the purpose of exhibition at the Centennial. They are still displayed in Philadelphia as a part of the collections of the permanent exhibition.

Among particularly noteworthy contributions to the Museum during the year is a series of specimens of North African pottery, furnished by Mr. George Maw, of England, to whom the National Museum is indebted for the donation of his display of ceramic wares made at Philadelphia and which is now in the permanent exhibition building.

The National Museum of Mexico has furnished a cast of the calendar stone of the city of Mexico, and the originals of many rare and remarkable articles.

A collection of Brazilian pottery by Mr. Steere has already been mentioned, as also a fine collection of New Mexican objects by Mr. Metcalfe. An extremely interesting collection of prehistoric articles of France and other localities in Europe was presented by Mr. Gaston L. Feuardent, of New York. The great archæological knowledge of this gentleman renders this collection particularly valuable in the authentic indication of the character of the different pieces.

Under the general head of "Explorations" will be found mentioned a considerable number of researches, having in view the collecting of

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military posts, and to forward to Washington, by the usual military channels, any articles intended for the National Museum, I have the honor to inform you that instructions have been given in accordance with your wishes.

Very respectfully,

G. W. McCRARY,
Secretary of War.

Prof. SPENCER F. BAIRD,
Secretary Smithsonian Institution.

[General Orders No. 65.]

HEADQUARTERS OF THE ARMY,
ADJUTANT GENERAL'S OFFICE,
Washington, July 1, 1879.

By direction of the Secretary of War, the following is published:

The Quartermaster's Department is authorized to receive from parties living at or near military posts any articles intended for the National Museum, and forward them to Washington, under the regulations governing transportation of military property, and on the same forms of bills of lading. The packages to be marked, "National Museum, care Depot Quartermaster, Washington, D. C.," and settlement to be made by the Quartermaster's Department.

By command of GENERAL SHERMAN:

E. D. TOWNSEND,
Adjutant General.

HEADQUARTERS DISTRICT OF NEW MEXICO,
Santa Fé, N. M., September 5, 1879.

To all officers of the Army serving in the district of New Mexico:

The following letter is published for your information:

As Mr. James Stevenson may find it impossible to visit all posts of the district, offiarchæological and anthropological material, and the list of donations gives an account of those of less moment. The most important explorations are those of Major Powell and Mr. E. W. Nelson.

Considering the subject geographically, we may refer, for Alaska, to the labors of Messrs. Nelson and Turner; for New Mexico, to those of Messrs. Metcalfe, Stevenson, and Cushing. From the interior of the United States the archæological collections have been very many, and will be found detailed in the list of donations.

From Mexico the most important material has been furnished by the National Museum of Mexico and by Professor Dugès. From the former have been received a very excellent model of the famous calendar-stone, and numerous articles of obsidian, stone, pottery, &c. Professor Dugès has contributed a diminutive human face carved in iron pyrites, with small opals for eyes. The collections of Professor Steere, from Brazil, have already been referred to. From Europe we have a very interesting collection of prehistoric remains, especially from France, presented by Mr. Gaston L. Feuardent; and pottery from Persia, Morocco, and other countries, by Mr. George Maw, of London.

Casts of Indian heads.—Reference was made in the report for 1877 to a series of casts, made by Mr. Clark Mills, at the joint expense of the Smithsonian Institution and the Peabody Museum at Cambridge, of the faces of sixty-five Indians held as prisoners of war at Saint Augustine, in Florida, these representing quite a number of different tribes and furnishing a very rare opportunity of securing life-like reproductions of the Indian physiognomy. The Indians, as a rule, are averse to such an operation, and but few such casts are extant in any anthropological museum. The few series distributed of duplicates of these representations have been much appreciated.

After the discharge of the Saint Augustine prisoners, or their trans-

cers serving therein are solicited to contribute any Indian relics, specimens of natural history, curiosities, &c., that may be obtainable in their neighborhood, and address them to Mr. Stevenson, care of chief quartermaster, district of New Mexico, sending the same by any government transportation leaving their posts for Santa Fé.

EDWARD HATCH,
Colonel Ninth Cavalry, Commanding.

"SMITHSONIAN INSTITUTION, *Washington, July* 7, 1879.

"Mr. James Stevenson, the bearer of this letter, has been instructed by the Smithsonian Institution to visit New Mexico, Arizona, and other portions of the Southwest for the purpose of prosecuting investigations in ethnology and natural history.

"I therefore commend him to the kind attention of officers of the United States Army, civilian officers of the United States Government, correspondents of the Smithsonian Institution, and the friends of science generally. All aid rendered him in his work or contributions of specimens through him to the National Museum of the United States, will be duly acknowledged by the Smithsonian Institution.

"Mr. Stevenson is authorized to make use of all facilities granted to the Smithsonian Institution by railroad companies and the War Department in the transportation of collections made or otherwise obtained by him.

"SPENCER F. BAIRD,
"*Secretary Smithsonian Institution.*"

fer to other stations, Capt. R. H. Pratt, United States Infantry, who had them in command, and who had become greatly interested in all measures looking towards the education of the Indians, was authorized by the government to bring a number of young Indians of both sexes to the school for colored youth so successfully conducted by General Armstrong at Hampton, Va. This having been accomplished, an opportunity was furnished of extending the series of casts, and Mr. Clark Mills again volunteered his services to do the work, simply for his expenses. Captain Pratt accordingly made the arrangements for its execution. This second series makes the entire number of representations of Indians in the museum about one hundred. These casts are valuable to us, both as anthropologic representations in themselves and as furnishing the means of producing lay figures in great number and variety to display the many sets of Indian clothing and equipment now forming part of the general collection.

In this connection it may be mentioned that Captain Pratt has more recently established a special school for the education of Indian youth, of both sexes, at Carlisle, Pa., using the government barracks for its accommodation. Here he expects to bring together between three and four hundred individuals and has every assurance of a successful experiment.

EXPLORATIONS.

Among the operations of the Smithsonian Institution, especially fostered from the beginning by my predecessor, and looked upon by him as one of its most important functions, is that of exploration in little-known regions of North America. It was his policy not to use the funds of the Institution in purchasing collections already made, but rather, by means of occasional grants of money in small sums, either to fit out small parties starting from Washington, or to assist correspondents of the Institution, wherever they might be resident, in making researches in their own vicinity. These labors generally included more than one branch of science, and in their aggregate have tended very largely to give the National Museum its remarkable number of type specimens. Thus grants of money were made, of various sums, from $5 to $250, very rarely exceeding the latter amount in any one year to any one agent.

The results of the explorations condensed in whole or in part by the Smithsonian Institution, in 1879, have not been inferior in importance to those of any previous year; in fact they have seldom been exceeded; resulting not only in bringing together many new facts in natural history and ethnology, but also in adding large collections to those already in hand. The prospect of having a new building capacious enough to accommodate whatever may be received in this direction was an encouragement to utilize opportunities of obtaining objects, from which we were formerly deterred by want of space.

Among the more important explorations made under the auspices of the Smithsonian Institution in 1879, may be mentioned that of Mr. E. W.

Nelson in Northwestern Alaska. As explained in previous reports, Mr. Nelson was nominated by the Smithsonian Institution to General Myer as a signal observer at Saint Michael's, a station on Norton Sound, south of Behring Strait—a district of very great interest in both an ethnological and natural-history point of view; and although numerous collections had previously been received from that region, as made by Messrs Dall, Kennicott, Pease, Bannister, and Turner, there was still enough unaccomplished to make it important that the work should be continued. The institution was fortunate in being able to secure the aid of Mr. Nelson, as being a most excellent naturalist and particularly well acquainted with the vertebrate animals of North America.

Mr. Nelson proceeded to his station at Saint Michael's, and has remained there ever since, of course devoting the principal portion of his time to his duties as signal observer, and, it is understood, to the satisfaction of his superiors, while his leisure has been employed in making observations and collections of natural history. Previous reports have noted the additions already made by him. The collection of 1879 is especially important in an ethnological point of view; not less than three thousand specimens of Indian and Esquimaux work in the way of carvings, implements, clothing, domestic and household utensils, games, &c., have been received. These filled fourteen large boxes, the remainder of the collection consisting chiefly of birds, eggs, and fishes. The total number of pieces furnished by Mr. Nelson amounts to 2,935.

Mr. Nelson is preparing an elaborate report on the natural history and ethnology of Northwestern Alaska for publication after his return.

The labors of Mr. Lucien M. Turner in the Aleutian Islands have also been prosecuted during the year, and have furnished, as heretofore, a large amount of interesting material for the National Museum.

Mr. Turner, as mentioned in previous reports, like Mr. Nelson, is one of the observers of the United States Signal Service, and has under his charge a number of temporary stations along the entire extent of the Aleutian Islands. The supervision of these stations makes it necessary for him to go from point to point as an opportunity is furnished, thus allowing a chance to study the natural history and ethnology of a widely-extended region. The greater part of the season of 1879 was passed at Sitka, his principal station, however, being Unalaska. Among the collections sent down by him, besides some very finely-prepared specimens of birds (among them species of great rarity), was a series of very elaborate and delicate carvings in bone made by the Aleutian Islanders.

Capt. L. A. Beardslee, of the Navy, who for several years had been detailed by the Navy Department to take charge of the steamers furnished to the United States Fish Commission, especially the "Blue Light" and the "Speedwell," was sent out during the early part of the year in command of the sloop-of-war Jamestown to look after the interest of the citizens of the United States in Alaskan waters. With

Sitka as his headquarters he was enabled to exercise a supervision over the Indians of the adjacent parts of the country.

The experience which Captain Beardslee acquired during his service with the Fish Commission, in making observations on the natural and physical conditions of the water, prepared him more fully for his researches in this new field, and the Institution gladly accepted his offer of service and supplied him with necessary apparatus. No specimens have so far been received from Captain Beardslee, but a consignment is expected in the early part of 1880.

An extensive exploration of the islands and waters of the North Pacific, indeed even through Behring Strait, was made during the last summer by the "Richard Rush," Captain Bailey, commander. Before starting, her surgeon, Dr. White, of the Marine Hospital Service, offered his services to the Institution in making such collections as might be designated; and as a trained naturalist, experienced in research, having prosecuted his studies in Edinburgh under the direction of Sir Wyville Thompson and others, his proposition was gladly accepted. Many collections of much interest were made by Dr. White and duly received by the Smithsonian Institution. They consist for the most part of embryonic or fœtal seals, porpoises, &c., various fishes, and many marine invertebrates. Skins and skeletons of several species of seals were also included.

The "Jeannette."—Much interest was excited during the past year by the announcement that the "Pandora," an English vessel, which had already been engaged in Arctic research in the hands of Capt. Allen Young was to be employed in a similar service, entirely at the expense of Mr. James Gordon Bennett, of New York, as the "Jeannette," under the command of Lieutenant De Long, an officer of the United States Navy, who had already had a Northern experience in the Greenland Seas while in search of the "Polaris." The "Jeannette" was taken by Lieutenant De Long to San Francisco, by way of Cape Horn; her commander returning overland to the East, and spending some time in Washington in obtaining his outfit and instructions. The Smithsonian Institution was requested by Mr. Bennett to nominate a competent naturalist for the expedition, and selected Mr. Raymond L. Newcombe, of Salem, Mass., who joined the steamer in San Francisco, and with her left for the North. Letters received, both from him and Captain De Long, and written at Saint Michael's, Alaska, show that a large amount of work has been accomplished in the way of natural history research; and it is hoped that the results of the expedition will be commensurate with the expectations of all interested. At the last advices from the "Jeannette" she was seen by a whaling captain in the vicinity of Wrangel Land, this being her main objective point.

Professor Jordan, who has been detailed by Mr. Goode to work up the fisheries of the Pacific coast of the United States, reported at the Smithsonian Institution in Washington, in December, 1879, and there received the necessary instructions for his work. At the latest advices he had reached San Diego and commenced his investigations of the fisheries, with the promise of exhaustive results there and at other points on the coast. He is provided by the National Museum with the necessary apparatus for making collections on a liberal scale, to serve as illustrations of the fishery statistics.

The collecting and exhibition of what may be considered vouchers of his labors are very necessary, since the names of our Eastern species are largely applied to Western forms in every respect different from them; and without the means of examination and comparison much confusion would result. Thus, what is called cod in San Francisco has no relation to the cod of the Eastern coast, belonging to an entirely different group.

Among the explorations of the year, and especially rich in ethnological results, is that prosecuted by Mr. S. T. Walker, on the west coast of Florida. With this gentlemen the Institution has been in communication for several years, and has received from him many valuable archæological objects. During the past year he has been engaged in a systematic survey of the mounds in the vicinity of Clear Water, Fla., and has found evidence to show that at the time of their construction white men were in the vicinity, from whom were obtained numerous articles of ornament, &c. Conspicuous among these are gold and silver beads, portions of bronze fittings of gun locks, Venetian beads, fragments of Spanish pottery, &c. From all the indications, it is possible that these were obtained from some of the early Spanish invaders, or other whites, at no distant period from the time of De Soto's conquest.

Many collections of reptiles, living and in alcohol, fishes, mammals, and birds have also been furnished by Mr. Walker.

Mr. James W. Milner, the Assistant Fish Commissioner of the United States, was obliged by ill health to spend the winter of 1878-'79 in Florida, making his home at Homosassa, on the west coast. Here, although greatly enfeebled by disease which in a great measure crippled his efforts, he obtained, with the help of those about him, very valuable collections of prehistoric remains, birds, fishes, and other natural-history objects.

Mexico.—Mr. Silas Stearns, formerly of Pensacola, and for several years a valued correspondent of the Smithsonian Institution, in the early part of last summer was detailed by Mr. Goode to collect the statistics of fish and the fisheries on the Gulf of Mexico in the interest of the fisheries branch of the census. For this purpose he chartered a small sloop for use in prosecuting his work. From time to time, without interfering with his regular duty, he has succeeded in securing numerous objects of natural history for the National Museum, among them quite a number of fish, some of these, probably, new to science.

Mr. Robert Ridgway, curator of ornithology in the National Museum, accompanied by a friend, Mr. H. W. Henshaw, made an expedition to

Cobb's Island, off the Eastern Shore of Virginia, during the past summer, for the purpose of collecting skins of the adult and young water birds abounding in that vicinity. Although rather late in their undertaking (July 29) they were quite successful, obtaining a number of interesting species during their stay of ten days.

For several years past Mr. F. A. Ober has been engaged, under the auspices of the Smithsonian Institution, in making observations and collections in natural history and archæology in the West India Islands; this group, strange as it may appear, furnishing almost a virgin field of research. In the course of his labors, beginning in 1877, Mr. Ober visited a number of the islands and collected many specimens; of these the birds have already been worked up, fully catalogued, and described by Mr. Lawrence in the proceedings of the National Museum. No less than twenty new species of birds have been added to science, and a great deal of information obtained in regard to their geographical distribution. The National Museum is now in possession of what is believed to be the most complete collection of West Indian birds extant; a very important corollary to its North and Central American series. The other collections made by Mr. Ober were mainly of archæological objects and reptiles.

Mr. Ober has lately published an interesting account of his travels, entitled "Camps in the Caribees."

Prof. J. B. Steere, of the University of Michigan, at Ann Arbor, who has an excellent record as an explorer in China, Formosa, and elsewhere, invited the Smithsonian Institution to a co-operation in a proposed exploration of the Amazon River during the past summer. He was accordingly provided with certain apparatus and material for collecting, and made excellent use of his opportunities. Since his return he has contributed to the National Museum a collection of the ancient pottery from the island of Maranon, and other localities in the Amazon River, thus filling a very serious gap in our archæological museum. During Professor Steere's previous explorations in the East, the Smithsonian Institution was the consignee of his collections, and rendered much service in securing their safe and inexpensive transmission to America.

Dr. Charles J. Hering, of Paramaribo, Surinam, still maintains his interest in the Smithsonian Institution, by sending to it collections in natural history and archæology. Several parcels have been forwarded by him during the past year, the contents of which will be mentioned under his name in the list of acquisitions.

Dr. Otto Finsch, the eminent ornithologist and naturalist, and for many years director of the Natural History Museum at Bremen, in Germany, after completing his recent explorations in Siberia, undertook to visit the islands of the Pacific Ocean, partly in the interest of the Berlin Museum, partly at the expense of the Humboldt Exploration Fund, and partly at his own.

Having offered his services to the United States Fish Commission in any way connected with his labors, he was requested to bring over a consignment of German carp, a fish which promises to be of great value in American pisciculture. This was done by him, and he delivered to the United States carp ponds, in Washington, a number of these fishes in a healthy condition, which, it is hoped, will, in a few years, be the progenitors of a large number of that species of fish.

In order to enable Dr. Finsch to carry on his polynesian researches to better advantage and at less expense to himself, free passes and reduced passage tickets for himself and party were obtained from several of the transcontinental railroad companies. The Smithsonian Institution provided Dr. Finsch with a partial outfit for marine exploration, including a supply of alcohol for the preservation of reptiles and fishes. Dr. Finsch proceeded first to the Sandwich Islands, and then to the Fijis, and at the latest advices he had reached one of the groups of the Marshall Islands.

EXCHANGES.

As was explained in the report for 1878, the system of international exchanges organized by the Smithsonian Institution nearly thirty years ago has long been considered one of its most important functions, and no greater obstruction to the intercourse between the scientific institutions of the Old World and New can be imagined than that of an interruption of this work. As already stated, an organization intended primarily to aid in the prompt transmission of the publications of the Institution to its correspondents, at home and abroad, was extended so as to include the corresponding exchanges of other institutions; this has now resulted in furnishing by far the most extensive system of exchanges in existence, the benefits of which are experienced and appreciated all over the world.

The foreign agencies employed in the Smithsonian exchanges are of three classes.

First. Individuals or firms, some of them salaried by the Institution and devoting more or less of their time to its work.

Second. Learned societies or universities, which do on a small scale in their respective countries what the Smithsonian Institution does on a larger scale for the world in general.

Third. Special government bureaus of international exchange, organized for the purpose. It is quite probable that the number of this class, now restricted to four, namely, the Commission Belge des échanges internationaux, the Commission Française des échanges internationaux, the Bureau central scientifique of Haarlem, and the Bundes Canzlei for Switzerland, will be increased until, possibly, in time, the greater part of the service in Europe in connection with the Smithsonian Institution, may be performed by them. This will, of course, constitute a very desirable aid to the Smithsonian Institution and to the second class mentioned, especially as to the expenses of the work.

The operations of the Commission Française des échanges internationaux, inaugurated in 1878, have constantly improved in extent and efficiency through 1879, a large number of boxes having been exchanged between it and the Smithsonian Institution to the entire satisfaction of both parties. Numerous applications have been made by the French bureau to the Smithsonian Institution for special works, public or private, required by the governmental bureaus, especially for the national library, the ministry of public instruction, etc. On receipt of these applications circulars were sent to various parties interested, and a large number of acceptable returns promptly received and duly forwarded by the Institution. On the other hand applications by the Institution in behalf of American bodies have been satisfactorily answered. This feature of the system of international exchanges is one of great importance.

In addition to the official applications for special publications of the United States, made through the system of international exchanges, one was presented by the French minister to the Smithsonian Institution for the reports of the United States Fish Commission, those of the several State fish commissions, and any other documents serving to illustrate the steps taken for the propagation and utilization of fishes in the United States. This request was in behalf of the Senate of France, which recently appointed a commission to investigate the relations between citizens and the State in respect to the rights and conditions of fishing in both fresh and salt waters. A circular was accordingly addressed to the parties indicated, and quite a complete series of documents was obtained and transmitted to Monsieur Outrey, the minister. He has acknowledged with thanks the receipt of the package, and given assurance of his appreciation of the courtesy.

It has already been explained that the Smithsonian Institution not only serves as a medium of exchange to institutions and individuals in the United States, but also to those of Canada, Central America, Mexico, the West Indies, and South America. An extra amount of labor has been imposed upon the Institution, during the past year, owing, in large part, to the interruption of operations in 1878, caused by the death of Professor Henry. The accumulated material of that year has, however, all been disposed of, together with the receipts of 1879; the aggregate being shown in the accompanying schedule. It is quite likely that operations in this line during 1880 will be but little behind those of 1879, as, for years, there has been a steady increase in the bulk of the exchanges; and this is not likely to be interrupted.

In the preceding report reference was made to the adoption of a rule, under authority granted by the Board of Regents, by which packages received from the government bureaus were charged a uniform rate of five cents per pound for packing, boxing, and shipping to destination. This has been carried into effect, but has only secured the return of about a hundred dollars, evidently not a sufficient sum to affect materially the expense of the exchange system—a very onerous burden upon the funds of the Institution, and greatly affecting its operations. Formerly, when the cost of the exchanges amounted to only two or three thousand dollars a year, the publications of the Institution were of much greater extent than they are now; and it is to be hoped that some provision may be made by which the expenses of exchange may be materially lessened, and the former very desirable prominence of the publication department be restored. It is a question whether the assistance of Congress might not be invoked to make an appropriation to bear at least a part of the cost. If a few thousand dollars were furnished by the Government, it would be of very material aid and tend greatly to relieve the Institution of a burden which is fast becoming oppressive. One special argument in favor of such Congressional action is found in the fact that, while this system of exchanges benefits equally all the libraries and societies of the country, the benefit of the returns inuring to the Smithsonian Institution is experienced directly by Congress; the expenditures for both publications and exchanges being actually in the interest of the Congressional Library, in which all the Smithsonian books are now deposited. It may safely be said that if the amount of money used in carrying on the exchanges was expended directly in the purchase of books for the Library of Congress, it would not produce the same yield, in view of the fact that these returns to the Smithsonian Institution consist largely of the publications of societies interested in the prosecution of theoretical and applied science, which, while embracing the earliest announcement of important discoveries, are for the most part not on sale, and only to be obtained by a system of exchange.

As in previous years, the following transportation companies have favored the Institution by a remission of charges upon its packages, and thus enabled it to carry on its system of international exchanges with a fraction of the expense which would otherwise have been required.

Anchor Steamship Company.
Atlas Steamship Company.
Companie Générale Transatlantique.
Cunard Steamship Company.
Hamburg American Packet Company.
Inman Steamship Company.
Merchants' Line of Steamers.
Netherland-American Steam Navigation Company.
New York and Brazil Steamship Company.
New York and Mexico Steamship Company.
North German Lloyd Steamship Company.
Pacific Mail Steamship Company.
Pacific Steam Navigation Company.
Panama Railroad Company.
White Cross Line of Antwerp.

The special thanks of the Institution are again tendered to the above-mentioned companies for their enlightened liberality.

In addition to this, through the mediation of Mr. Isaac Hinckley, president of the Philadelphia, Wilmington and Baltimore Railroad Company, the four roads forming the connection between New York and Washington, namely, the Pennsylvania Railroad, the Philadelphia, Wilmington and Baltimore, the Baltimore and Potomac, and Baltimore and Ohio, have agreed to a reduction to one-half of the usual charges on first-class freight. The saving from this concession, although not quite o that of free freights by the ocean steamers, is a matter of eat importance, and is deserving of special acknowledgment.

rs. Murray, Ferris & Co., of 62 South street, New York, have free freight to the Bahamas.

Statistics of exchanges sent during the last ten years.

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.
boxes..	121	108	179	196	131	208	323	397	309	311
bic feet	1, 189	772	954	1, 476	933	1, 503	2, 261	2, 779	2, 160	2, 177
....	31, 383	28, 950	26, 850	44, 236	27, 990	45, 300	80, 750	99, 250	69, 220	69, 975

'ollowing table exhibits the number of foreign establishments iich the Institution is at present in correspondence, or, in other :o which it sends publications and from which it receives others n:

gn institutions in correspondence with the Smithsonian Institution.

	6	India	34
Republic	17	Italy	198
and Tasmania	44	Japan	5
[ungary	163	Java	5
	112	Liberia	1
	1	Mauritius	4
	11	Mexico	18
merica	20	New Zealand	16
uiana	3	Norway	25
)nies and St. Helena	7	Paraguay	1
.merica	2	Peru	4
	8	Philippine Islands	3
	6	Portugal	35
	3	Russia	163
	29	Sandwich Islands	2
iiana	1	Spain	25
	1	Sweden	22
	8	Switzerland	76
	358	Turkey	13
	541	Uruguay	5
tain and Ireland	401	Venezuela	2
	10	West Indies	12
	74	International societies	7
	4		
		Total	2, 481

ange of Government documents.—It will be remembered that some ;o Congress directed that fifty sets of all government publica- 'hether printed by order of Congress or of the departments, be placed at the command of the Joint Library Committee for)ose of exchange for corresponding publications of other nations.)rk was intrusted to the Smithsonian Institution, by which it ried on for a number of years.

ppropriation of one thousand dollars is made by Congress for s connected with this exchange, of which a portion is paid for and expenses on boxes of books received by the library through ;itution. The returns received are increasing rapidly in value, and in a few years may be expected to nearly or quite equal the tra missions.

In accordance with the law relative to the exchange of the official p lications of the United States Government for those of foreign natic sixty boxes of documents were forwarded during the past year, as sho by the following list of distribution:

International exchange of government publications in 1879.

	Boxes.		Bo
Argentine Republic	1	New Zealand	
Bavaria	1	Norway	
Belgium	1	Portugal	
Brazil	1	Prussia	
Buenos Ayres	1	Queensland	
Canada (Ottawa)	1	Saxony	
Canada (Toronto)	1	South Australia	
Chili	1	Spain	
Denmark	10	Sweden	
France	11	Switzerland	
Germany	1	Tasmania	
Greece	1	Turkey	
Hayti	1	Venezuela	
Holland	1	Victoria	
Japan	1	Würtemberg	
Mexico	1		
New South Wales	1	Total	

LIBRARY.

A steady increase in the number of additions to the library of t Institution has, as usual, characterized the year just past, the agg gate, amounting to 10,203 books, pamphlets, and charts, as compa with 8,729 in the previous year. The greater portion of these wo have already been transferred to the library of Congress, in accorda with the arrangements of previous years, where, however, owing to t very crowded condition of the shelves, they are not very serviceat It is much to be hoped, in the interest of the Institution, that so measures may soon be adopted by Congress for increasing the acc modations of the library, and consequent accessibility to its volumes the part of students.

As heretofore, the great mass of additions to the library consists the transactions of learned societies, which, indeed, constitute its m important feature. Books published in the regular way can be p chased without any difficulty through established agencies. Trans tions of societies, however, are for the most part, only to be had by exchange, and it would be almost impossible to secure the works tained by the Institution through its exchanges, with any reasonal amount of money and to any degree of completeness. Every year n scientific associations are being formed, and these, for the most pa take the initiative in seeking an exchange with this establishment.

Of course the older societies are seldom able to furnish volumes their series which date very far back; but the Smithsonian Institution has succeeded in completing its sets, partly by purchase of such as have drifted into the second hand or antiquarian book trade, and partly by exchange with public libraries possessing duplicates. It is confidently believed that the library of the Institution, and consequently that of Congress, is in possession of a larger and more perfect series of such transactions, as also, of scientific periodicals than any other library extant.

The accompanying memorandum gives an indication of some of the more important additions to the library.

The receipts from the system of Congressional exchanges already referred to, by which fifty sets of the publications of the government are available for exchanges with foreign governments have also been very great; but as these are not catalogued, but transferred directly to the library of Congress, it is, of course, to the report of Mr. Spofford that reference must be had for details.

Statement of the books, maps, and charts received by the Smithsonian Institution during the year ending December 31, 1879.

Volumes:		
Octavo, or smaller	1,509	
Quarto, or larger	440	
		1,949
Parts of volumes:		
Octavo, or smaller	3,240	
Quarto, or larger	2,612	
		5,852
Pamphlets:		
Octavo, or smaller	1,628	
Quarto or larger	591	
		2,219
Maps and charts		183
Total		10,203

List of some of the more valuable works received in 1879.

From the Norwegian Geographical Institute, Christiania: Historisk Beretning om Norges Geografiske op Maaling, 1873–1876, af C. M. de Seue. Kristiania, 1878. 8vo. Aarbog for Handelsmarinen. 1875, ii; 1876, i, ii; 1877, i, ii; 1878, i. Kristiania. 8vo. And 19 maps.

From the Society of Agriculture, Sciences, and Arts, Valenciennes: Mémoires. vols. iii, vi, ix. Valenciennes, 1841–1855. 8vo. Mémoires historiques sur l'arrondissement de Valenciennes. vols. ii, v. Valenciennes, 1868–'78. 8vo. Revue agricole, industrielle, littéraire et artistique. vols. v–xxxi. Valenciennes, 1853–'78. 8vo.

From the Imperial Society of Friends of Natural Sciences, Anthropology, and Ethnology, Moscow: Ezoyistia (Bulletin, 55 parts), 1866–78. Moscow. 4to.

From the Bodleian Library, Oxford: Calendar of the Clarendon st: papers, 1523–1657. vols. i–iii. Oxford, 1872–76. 8vo. Calendar charters and rolls preserved in the Bodleian Library. Oxford, 1878. 8

From the Ministry of Public Instruction and Worship, Paris: Com| général du matériel du dép. de la marine et des colonies, 1874. Pa 1878. folio. Journal des savants, 1877, 1878, 1879. Paris. 4to. (35 par Nouvelles archives du Museum d'histoire naturelle. 2e série, to i. 1878. Paris. 4to. (2 copies.) Exposition universelle de Vien 1873. France. Rapports. vols. 1–5. Paris, 1875. 8vo. Annuaire la marine et des colonies. 1878, 1879. Paris. 8vo. (2 copi Tableaux de population, de culture, de commerce et de navigati 1865–76. Paris. 8vo. (24 vols.) Voyage géologique dans les ré bliques de Guatemala et de Salvador, par MM. A. Dollfus et E. de Mo Serrat. Paris. 1878. 4to. Annuaire statistique de la France. An i, 1878. Paris. 8vo. Notice sur la déportation à la Nouvelle-Calédo 1874, 1876, 1878. Paris. 8vo. (6 vols.) Notice sur la transportation Guyane française et à la Nouvelle-Calédonie, 1868–75. Paris. 8 Statistique des pêches maritimes. 1875. Paris. 8vo. (2 copi Monnaies à légendes arabes frappées en Syrie par les croises Henri Lavoix. Paris, 1877. 8vo. Énumération des arbres et brisseaux cultivés à Legrer, par A. Lavallée. Paris, 1877. 8vo. Gr maire Malgache, par Marre de Marin. Paris, 1876. 8vo. Théorie fonctions de variables imaginaires, par Maximilien Marie. vols. i- Paris, 1874–76. 8vo. Inventaire général et méthodique des ma scrits français de la Bibliothèque nationale. vol. ii. Paris, 1878. 8 Études égyptologiques. 8, 10, 11. Paris, 1877, 1878. 4to. Mélan d'archéologie égyptienne et assyrienne. 9, 10. Paris, 1877, 1878. 4 Catalogue de la Bibliothèque de la ville de Lille, and other works. vols. Lille, 1839–79. 8vo. Œuvres complètes de La Place. v i–iii. Paris, 1878. 4to. Dionysii Byzantii de Bospori navigatione, C. Wescher. Paris, 1874. 4to. De la température du corps hum par P. Lorain. Tomes i, ii. Paris, 1877. 8vo. Dictionnaire de la lan Déné Dindjié, par le R. P. E. Pelitot. Paris, 1876. 4to. Vocabul français-esquimau, par le R. P. E. Pelitot. Paris, 1876. 4to. Dict naire d'archéologie égyptienne, par Paul Pierret. Paris, 1875. 8 Théorie des fonctions de variables imaginaires, par M. Marie. Pa 1874–76. 8vo. Tome i–iii. Six charts and 31 volumes, 36 parts an pamphlets, government documents.

From the Belgian Commission of International Exchanges, Bruss Messager des sciences historiques de Belgique, 1833–75. Gand. 8 (44 vols.) Documents et rapports de la Société paléontologique et arc logique de Charleroi. vols. i–iii. Mons, 1866–70. 8vo. Bulletin d Société royale linnéenne de Bruxelles. vols. i–vi. Bruxelles, 1872- 8vo. Bulletins de l'Académie royale des sciences, des lettres et beaux-arts de Belgique, 1832–75. Bruxelles. 8vo. Annales des vaux publics de Belgique. vols. i–xxxiii. Bruxelles, 1843–75. 8

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From the Société de médecine, Marseille: Bulletin des travaux. Années i–xii. 1857–68. Marseille. 8vo. Marseille médical. 1869–78. Marseille. 8vo. 115 parts.

From the National Institute of France, Paris: Mémoires de l'Académie des sciences. vols. xxxviii, xxxix, xl. Paris, 1873–77. 4to. Comptes-rendus des séances de l'Académie des sciences. vols. lxxi–lxxxvi. Paris. 4to. 1871–78. Annuaire, 1865–79. 8vo. (13 vols.) Mémoires de l'Académie des inscriptions et belles-lettres. 8 parts. Paris. 1871–78 4to. Notices et extraits de manuscrits de la bibliothèque nationale, etc. vols. xv–xxii, i; xxiii; xxiv, ii; xxvi, ii; xxvii, ii; xxviii, ii. Paris, 1870–78. 4to. Recueil des discours, rapports et pièces diverses. 1860–69–70–79. Paris. 4to. Recueil des mémoires, rapports, etc., relatifs à l'observation du passage de Vénus sur le soleil. T. i, ii, i. Paris, 1876–78. 4to. And 40 pamphlets.

From the Academy of Montpellier, Faculty of Medicine: Thèses. 1876–77–78. Montpellier. 4to. (9 vols. and 158 parts.)

From the Royal Danish Academy of Sciences, Copenhagen: Nye Samling af det kongelige Danske videnskabers Selskabs Skrifter. vols. i–v. Copenhagen, 1871–1799. 4to. Det kongelige Danske Videnskabernes Selskabs Skrifter. Naturv. og Malhem. Afd. viii, 3, 4, 5. x, 3–6, xii, 3. 1869–78. Historisk og Philos. Afd. iv, 1–3, 5, 6, 10. 1868–73. Copenhagen. 4to. Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandlinger. 1870, 3; 1873, 1874, 1. Copenhagen. 8vo. Description de la Cathédrale de Ribe en Jutland, par Jacob Helms. Année xvi. Plumes lithographiques. Copenhagen, 1870. Folio. Roskilde Domkirke Beo-Kreven, af J. Kornerup. Med 24 lithographerede, og Chemity Tauler. Copenhagen, 1877. Folio.

From the Turkish Government, Constantinople: "Destour," or collection of the laws and regulations of the empire. 6 vols. 8vo. "Saluame," or official annuary. 8vo. (In Turkish.)

From the Hellenic Philological Society, Constantinople: Publications. 1871–79. Constantinople. 8vo. 9 vols, in Greek.

From the Von Malzan Natural History Museum, Waren, Mecklenburg-Schwerin: Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg. Years i–xxx. Neubrandenburg, 1847–76. 8vo. And 21 natural-history pamphlets.

From Daniel Oehlert, Laval: Traité des maladies chirurgicales, par le Baron Boyer. vols. i–xi. Paris, 1814–22. 8vo. Nosographie chirurgicale, ou nouveaux élémens de pathologie, par M. le Chevalier Richerand. vols. i–iv. Paris, 1815. 8vo. Nouveaux élémens de physiologie, par A. Richerand. vols. i, ii. Paris, 1814. 8vo. Nouveaux élémens de thérapeutique et de matière médicale, par J. L. Alibert. Paris, 1877. 8vo. Concours d'animaux réproducteurs, etc., 1857, 1860, 1862. Paris, 1859–66. 8vo. Enquête agricole. Deuxième série. Enquêtes départementale. 2e circonscription. Paris, 1867. 4to. (2 copies.) Agriculture française, par MM. les inspecteurs de l'agriculture. 6 vols. Paris, 1843–47. 8vo. Thomæ Sydenham. Opera medica. vols. i, ii. Geneva, 1757. small 4to. Rapports au ministre sur la collection des documents inédits de l'histoire de France. Paris, 1874. 4to. Rapport sur l'Exposition universelle de 1855. Paris, 1857. 8vo. Rapport général sur les travaux du conseil d'hygiène publique et de salubrité du département de la Seine, 1849–58. Paris, 1861. 4to. Leçons de médecine légale, par M. Orfila. 3 vols. Paris, 1821–23. 8vo. Travaux du conseil d'hygiène publique et de salubrité du département de la Gironde. Tome xx. Bordeaux, 1879. 8vo. Bulletin de la Société de l'industrie de La Mayenne. vols. i–iv. Laval, 1853–68. 8vo. Rapport sur l'asile de La Roche Gandon, 1869, 1870, 1873, 1874, 1875. Mayenne, 1870–76. 8vo. Traité d'assainissement industriel, par C. de Freycinet. Paris, 1870. 8vo. L'Agriculture allemande, par Royer. Paris, 1847. 8vo. Documents statistiques concernant le choléra en 1854. Paris, 1862. 4to. Théorie nouvelle concernant les maladies concéreuses, etc., par J. M. Gamet. i, ii. Paris, 1772. 8vo. Bulletin de la Société d'agriculture de Mayenne, 1859–68. Mayenne. 8vo. And 22 pamphlets.

From the Magnetical and Meteorological Observatory, Zi-ka-wei, China: Cursus litteraturæ Sinicæ. vols. i, ii. Changhei, 1879. 8vo. L'infanticide et l'œuvre de la saint-enfance en Chine. Changhei, 1878. 4to. And 84 volumes of theological works, written in Chinese, and published by the Catholic mission of Kiangnan.

CORRESPONDENCE.

In the report of 1878, under this head, an explanation was given as to the causes of the large increase in the correspondence during that year. This statement will apply also to the period of 1879, with the exception that, while letters of condolence on account of the death of Professor Henry have necessarily been fewer, the number of communications relative to exchanges has exceeded that of any previous year, the increase in this direction being largely due to renewed activity in that department of the Institution, and especially in the international branch of the system.

CO-OPERATION OF THE GOVERNMENT DEPARTMENTS.

Very important service has been rendered to the Smithsonian Institution, and to the National Museum under its charge, by an order from the Secretary of War authorizing the use of the Quartermaster's Department in the transportation of collections, &c. As many of these come from regions where there is no established mode of transportation, the benefit of this arrangement promises to be very great, and under it quite a number of boxes have been already transferred to Washington.

CO-OPERATION OF THE INSTITUTION IN THE WORK OF OTHERS.

In previous years requests have frequently been received from foreign governments, especially those of Japan and China, and of Central and South America, for the selection of persons to carry on certain operations, particularly those relating to engineering and mining geology, nearly every year bringing at least one call of this character. To this the year 1879 furnished no exception, the Government of Salvador, through the American minister, Mr. George Williamson, having asked to be supplied with an experienced geologist to explore the recently discovered gold fields of the state. Of course in such cases the advice of experts is always solicited, and several of these uniting on the name of Mr. Goodyear, a resident of California, and formerly connected with the geological survey of that State, he was selected for the mission in question, and has already entered upon his duties.

Communication from the Belgian Government in regard to a prize for the improvement of Belgian harbors.—On the 27th of December, 1879, the following communication was received from the chargé d'affaires of Belgium:

[Translation.]

"BELGIAN LEGATION,
"*Washington, December* 27, 1879.

"SIR: Inclosed in a communication dated March 29, 1875, Mr. Delfosse, the Belgian minister at Washington, transmitted to Prof. Joseph Henry a copy of a royal decree of December 14, 1874, instituting an annual prize of 25,000 francs for the purpose of encouraging intellectual labors in Belgium, and to induce foreigners to take part in this movement.

"According to the terms of article 12 of this decree, the prize to be contested for in an international competition will be awarded in 1881 *for the best paper on the means of improving harbors situated on low and sandy coasts like those of Belgium.*

"The government desires again to call the attention of foreigners to this subject, inviting them to compete with Belgian authors. To this end I shall be obliged to you if you will have a translation of the inclosed notice published in the annual report of the Smithsonian Institution, or in any other manner you may see fit, to insure it the greatest possible publicity in the United States.

"Accept, sir, the assurance of my most distinguished considerations,
"GEO. NEYT,
"*Chargé d'Affaires of Belgium.*

"Prof. SPENCER F. BAIRD,
"*Secretary Smithsonian Institution, Washington, D. C.*"

"NOTICE.—By a decree of December 14, 1874, His Majesty the King of the Belgians has instituted an annual prize of 25,000 francs ($5,000) for the purpose of encouraging intellectual labors.

"The prize to be contested for in an international competition will be awarded in 1881 *for the best paper on the means of improving harbors situated on low and sandy coasts like those of Belgium.*

"Foreigners desiring to take part in the competition should send their papers, printed or manuscript, before the 1st of January, 1881, to the minister of the interior at Brussels.

"The manuscript which will receive the prize will be published in the

List of articles transferred from the Smithsonian Institution to the Corcoran Art Gallery in 1879.

Museum No.		
34776.	Female sitting, with two infants	Plaster cast.
34777.	Equestrian statue, Andrew Jackson	Model.
34778.	Bust of Col. Peter Force	Plaster cast.
34779.	Bust of Hon. Dixon H. Lewis	Plaster cast.
34780.	Medallion of William Wilson	Plaster cast.
34781.	Statue of the Venus de Medici	Plaster cast.
34782.	Female recumbent, with a lamb	Model.
34783.	Female, nude, half rising	Model.
34784.	Two females, standing	Model.
34785.	Do	Model.
34786.	Sleeping child	Model.
34787.	Marble medallion, Bacchante	Marble.
34788.	Female bust, wife of Ferdinand Pettrich	Plaster cast.
34789.	Bust of son of Ferdinand Pettrich	Plaster cast.
34790.	Statuette, Duke of Orleans	Plaster cast.
34791.	Statuette, Daniel O'Connell	Plaster cast.
34792.	Bust, bronzed, of Baron Cuvier	Plaster cast.
34793.	Bust of George Washington	Plaster cast.
34794.	Six small busts of F. Pettrich's children	Plaster cast.
34795.	Statuette, boy holding a ewer	Plaster cast.
34796.	Female crouching	Plaster cast.
34797.	Nude figure, "The hunter," with birds or game	Plaster cast.
34798.	Bust of LeClear	Plaster cast.
34799.	Bust of Laplace	Plaster cast.
34800.	Bust of Ferdinand Pettrich	Plaster cast.
34801.	Bust of Gustav Adolph Pettrich	Plaster cast.
34802.	Bust of Dr. Kane	Plaster cast.
34803.	Bust of Benjamin Hallowell	Plaster cast.
34804.	Nelson monument in London, model	Wood, &c.

BUILDINGS.

Smithsonian Building.—Many of the original plans of this building were either lost or greatly defaced in the fire of 1865, and it was thought desirable to have new drawings made to exhibit the details of the edifice, especially as the interior contruction had been considerably altered: first, in consequence of the falling down of the central part while in process of erection; and, second, as a consequence of the repairs required by the fire of 1865. These drawings have been carefully executed by Mr. Gorham, and, after being photographed, the originals have been deposited in a fire-proof safe. Upon these drawings have been plotted all the pipes connected with the water, gas, and steam apparatus, with the various stops and connections.

New Yale locks have been applied to all the rooms throughout the

Manitoba Library.—The Institution has been informed of the organization of the "Historical and Scientific Society of Manitoba," at Winnipeg, Manitoba, Canada, for the purpose of collecting a library of books, a cabinet and museum, &c., generally illustrative of the civil, religious, literary, and natural history of the lands and territories lying to the west and north of Lake Superior. Aid has been solicited in carrying out these objects by the donation of books and specimens, and the attention of the correspondents of the Institution is especially called to this request.

Zoölogical Society of London.—The services of the Smithsonian Institution were invoked by this Society to assist it in procuring some specimens of American mule deer (*Cervus macrotis*) two males and three females being desired. The commission was intrusted to the Hon. J. D. Caton, of Ottawa, Ill., a gentleman who is better acquainted with the American ruminants, deer, antelope, &c., than any other person, and who has written an admirable treatise upon them. Judge Caton was able to secure a fine specimen in his neighborhood, which was transmitted to the Central Park Menagerie, New York, for safe keeping, Mr. W. A. Conklin, the superintendent, very kindly agreeing to receive and ship anything of the kind which might be sent to him for the purpose. Messrs. Henderson & Co., the agents of the Anchor Line of steamers to Great Britain, with their usual liberality, offered to forward this animal free of charge; and it was consequently shipped per steamer Victoria on the 26th of February.

GALLERY OF ART.

It was not deemed desirable by my predecessor that there should be any antagonism of interests by the duplication of collections in the different departments in Washington, and an arrangement was made, many years ago, by which all specimens of plants and matters derived from the vegetable kingdom, as well as all insects, were to be placed in charge of the Department of Agriculture, and everything relating to the human subject, such as crania, pathological preparations, &c., in that of the Army Medical Museum. These establishments, in return, were to deliver to the Institution all animals, minerals, and articles of ethnology or archæology received by them. This arrangement has been maintained, to mutual advantage. In a similar manner it was proposed to deposit acceptable works of art in the Corcoran Art Gallery, and quite a number of articles have already been placed there. During the past year the following deposits have been made. It is, of course, understood that these are not gifts but simply loans, to be returned whenever occasion requires.

List of articles transferred from the Smithsonian Institution to the Corcoran Art Gallery in 1879.

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New Yale locks have been applied to all the rooms throughout the building, and so arranged that while persons occupying a room, or suite of rooms, are provided with keys that will open them only, a single pass-key opens every door in the building; this, of course, being held only by the proper authority.

Other alterations have been made in the building for the purpose of increasing to the utmost its efficiency and reducing the expense of superintendence and maintenance. The document room has been enlarged, by the removal of numerous obstructions, and refitted. The eastern wing of the building, formerly occupied by Professor Henry as a dwelling-house, has been converted into a series of offices, and a door cut from the old document room to an adjacent apartment, which is now used for the reception and classification of a portion of the exchanges.

Eleven large fire-proof doors have been placed in the building to isolate the different wings and floors.

The laboratory has been rearranged and many other improvements have been made. These were commenced late in the autumn of 1878 and finished in the spring of 1879. It is believed that the building is now in a condition of thorough efficiency and adaptation to its scientific purposes.

Art building and laboratory.—The provision by Congress for an exhibition by the United States Government at the Centennial Exposition, at Philadelphia, in 1876, made it necessary for the Smithsonian Institution to construct a special building for the purpose of preparing its share of the display, and a small edifice was accordingly erected on the grounds for the purpose of giving increased accommodation to the modelers, artists, and photographer. This building has been in use for nearly five years, and has rendered excellent service by the facilities it has afforded. It is, however, now inadequate to its object, and in the new museum building, provision has been made for the various departments referred to. Some suitable occupation will be found for the old building.

Armory building.—Another building in charge of the Smithsonian Institution is that formerly occupied as an armory by the militia of the District of Columbia, but which, ceasing to discharge that function, was placed by Congress in the care of the Institution for the storage of its material which could not be received in the present edifice. This armory building, the dimensions of which are one hundred feet by fifty, is very massive in construction and contains four floors, at present entirely filled with boxes containing the Centennial collections which are to constitute the material for exhibition in the new National Museum building.

The surveys of Professors Hayden and Powell having been discontinued by order of Congress, a portion of the public property belonging to them has been stored in the Armory building and Smithsonian Institution during the past year, Mr. King, the director of the new geological survey, making use of such of these materials as he requires.

SPECIAL DONATIONS.

Among the contributions or donations to the Institution, during the year, are several that do not belong directly under the head of natural history, but of which mention should be made.

Mr. F. B. Sanborn, agent of the Hydropneumatic Fire Extinguishing Company, presented to the Institution a specimen of his apparatus in working order. This has been placed where it will be most available in the very undesirable contingency of a fire in the building.

The Herring Fire-proof Safe Company, of New York, some months ago intimated its willingness to present to the Institution a first-class specimen of its work, and, as among the specimens in the National Museum are some masses of native gold, precious stones, and other valuable property, it was thought best to request that the offer be supplied in the form of a safe suitable for exhibiting such objects.

A plan of a safe was accordingly prepared with doors on opposite sides and when opened revealing series of glass shelves, inclosed and secured by plate glass fronts; the whole apparatus to be seven feet high, four feet wide, and two feet deep. This was put under construction by the company, has been completed, and is now ready for transmission to Washington whenever called for. It is proposed to use this as part of the fixtures of the new National Museum.

Another contribution of a somewhat similar character was made to the Institution by the Yale Lock Company, who constructed and presented a post-office box for the use of the employés. In addition to the clerks and assistants of the Smithsonian Institution and National Museum, there are a number of gentlemen having rooms in the building, who, although receiving no salary, render important service in the supervision of collections and identification of specimens. Nearly all these persons receive their mail at the Institution, and it has heretofore been difficult to properly subdivide and place such matter in the hands of those for whom it was destined. Under the new arrangement each individual now has his own box, with a key which alone will open it, and the mail as received is properly assorted in the boxes. This post-office box constitutes quite an ornamental piece of furniture, and supplies the desired accommodations.

MEETINGS, ETC.

National Academy of Sciences.—For several years after its organization the annual meetings of the National Academy of Sciences were held at the Smithsonian Institution, although, even with the limited number usually attending, it was difficult to furnish the necessary accommodations. In view of the increasing number of members of the academy, and of the visitors attending the reading of papers, it was concluded to make other arrangements for 1879, and, accordingly, the pastor and vestry of All Souls' Church having kindly consented to grant the use of their new and very convenient edifice for the purpose, the meeting was held therein on the 14th–18th of April, 1879, the accommodations being entirely satisfactory. A similar favor will probably be asked of the church for 1880; but it is thought that with the completion of the new National Museum building a suitable room can be furnished in it by 1881, so that the academy will again have its headquarters under the auspices of the Smithsonian Institution.

Anthropological Society of Washington.—An Anthropological Society has lately been organized in the District of Columbia for the purpose of bringing together those especially interested in the study of man, and the use of a room in the Institution was cheerfully accorded, on its application. Here meetings are regularly held every other week throughout the year, and the large and increasing attendance shows the appreciation of the subject in Washington. No similar American society appears to be in a more flourishing condition or more earnest in its investigations.

Lectures.—The Regents' room was also accorded to Prof. C. S. Hastings, of the Johns Hopkins University, for a special course of lectures on astronomical physics. This was attended by the gentlemen connected with the Observatory, Nautical Almanac, Coast Survey, and other scientific establishments in the city.

LOSS OF EMPLOYÉS AND COLLABORATORS.

It is proper to mention the sudden death, by apoplexy, of Mr. Tobias N. Woltz, on the 9th day of March. He had been connected with the Institution, as master mechanic and superintendent of the building for twenty-two years; was always diligent, industrious, and faithful, and, as he left nothing to his family, I would recommend that, on account of his long and useful services to the Institution, an allowance be made for his funeral expenses.

The report for 1877 contained a notice of the death of Mr. Fielding B. Meek, a gentleman who, although not salaried by the Institution, made the building his home for many years, while engaged in his specialty, as a paleontologist, with the government surveys. Mr. Meek died intestate, and letters of administration were granted to Professor Henry upon his property. Diligent search was made in various directions for several years for heirs, but without success. Lately, however, a distant relative has appeared to claim the estate, and the matter is now before the courts.

The library and notes of Mr. Meek were purchased by the Institution to secure them for the use of paleontological students.

Among the collaborators of the Institution whose death has occurred during the past year is Dr. JAMES AITKEN MEIGS, of Philadelphia. He was born in Philadelphia on the 31st of July, 1829, received his education in the public schools of that city, graduated at the Jefferson Medical College in 1851, and devoted himself with zeal and energy to the practice of his profession. He was professor of climatology and physiology at the Franklin Institute for eight years, and during this period lectured frequently on physiological and ethnological subjects before various associations in our prominent cities.

In 1857 he accepted the chair of institutes of medicine in the Philadelphia College of Medicine; and was, after a few years, transferred to the Pennsylvania College. His lectures on physiology attracted much attention, as no sustained systematic attempt to teach physiology experimentally had been made before in either of the four medical schools then existing in Philadelphia. In 1868 he was elected to the Jefferson Medical College to succeed the late Prof. Robley Dunglison, on the recommendation of the highest medical authorities in this country and Europe. He was an active member of the leading scientific societies; contributed numerous and valuable papers to medical and other journals. He arranged and classified the extensive collection of human crania in the Academy of Natural Sciences, and prepared a systematic catalogue of the collection. He also devoted much time to physiological and ethnological researches, and in all his relations in life was eminent for purity of character, clearness and vigor of intellect, and ardor alike in the pursuit of knowledge and imparting instruction to others. He died in Philadelphia on the 9th of November, 1879.

NATIONAL MUSEUM.

The act of Congress of 1846, establishing the Smithsonian Institution, placed under its charge, in proportion as suitable arrangements could be made for their reception, all objects of natural history, mineralogy, and geology, antiquities, &c., belonging to the United States. At the time of the passage of the act the government collections consisted essentially of the objects gathered by the celebrated exploring expedition of Capt. Charles Wilkes, which even to the present time has been by far the most extensive and exhaustive enterprise of its kind conducted by any government. Its results would have been very much larger but for the loss of one of the vessels, the "Peacock," off the mouth of the Columbia River. In this were contained an immense number of articles from the islands of the Pacific Ocean and from the coast of Oregon and California.

The objects brought back to Washington were placed in charge of the Commissioner of Patents, and an appropriation was made regularly by Congress for their maintenance and superintendence.

In 1856 the completion of the central part of the Smithsonian building and the need by the Patent Office of the space in its building occupied by the collections of the Wilkes' expedition, brought about an arrangement between the Committee on Patents in the House of Representatives and the Regents of the Smithsonian Institution, by which the latter agreed to accept the custody of the collections, on condition that the necessary appropriations for their maintenance in the Smithsonian building should be continued by Congress, to include also the expense of the construction of cases and other requirements. This was carried into effect, and in 1857 the government collections were transferred; since which time they have been in the custody of the Institution. Prior to that date, however, large numbers of government and other specimens had been received and cared for at the Smithsonian Institution, but not displayed. These, with the Wilkes' collection and a few others received with them, may be considered as marking the beginning of the National Museum.

The institution now points with great satisfaction to the progress that has been accomplished in about twenty-two years, at the end of which time one of the largest and best appointed collections of natural history and ethnology extant has been developed.

INCREASE OF THE MUSEUM.

Coming now to the consideration of the condition and history of the National Museum for the year 1879, and beginning with its increase, the general nature of the additions to the Museum during the year will be readily gathered by reference to the alphabetical list of donations and the memoranda in regard to explorations. It may be noted that the donations in 1879 very greatly exceeded those of any previous year, amounting to 1,173 separate entries, while those of 1878 were 1,075. A large portion of the number consists of contributions made by the fishing vessels of Gloucester, Mass., as referred to more particularly under the head of operations of the United States Fish Commission. The additions to the Museum are derived from four principal sources, viz: 1. Government exploring and surveying parties. 2. Explorations and researches of the Smithsonian Institution. 3. Miscellaneous contributions. 4. By exchanges of specimens. A fifth element of increase in most museums is by purchase. This, however, amounts to very little in the case of the National Museum, and is for the most part confined to an occasional specimen of archæology needed to fill a gap.

As the Institution has not been hitherto prepared to undertake the gathering of universal collections, but has confined its efforts more particularly to the representation of the animal and mineral kingdom of the New World, there has been less opportunity to increase its display by exchanges, while its own collections from government expeditions and by contributions of its correspondents covered the greater part of what is absolutely desired. The opportunity of extensive exchanges is still open, however, and may possibly be resorted to hereafter.

Among the more important collaborators in the way of exchanges may be mentioned the educational authorities of Japan, who have placed the National Museum under direct obligations by the transmission of well-arranged and preserved collections of the natural history of that country. The most important of these is a series of the fishes, partly preserved in alcohol and partly dried. These came in excellent condition and has been accurately identified by Japanese naturalists attached to the Museum. Already over two hundred species have been furnished, constituting an extremely valuable means of investigating the fishes of the North Pacific coast. Their particular importance is in their relationship in illustration of the ichthyology of the waters of the western coast of the United States.

These specimens were furnished by the Mombusho or Educational Museum of Tokio, which has also supplied a large series of minerals and rocks of the country.

A very valuable collection of the fishes of Norway was presented to the Institution by the University of Christiania, as prepared by Professor Esimark, at the request of Mr. Robert Collett, a correspondent of the Institution. These are particularly acceptable as furnishing the means of comparison with the many species obtained from the off-shore fishing-grounds by American fishermen.

From the National Museum of the City of Mexico some very interesting articles have been received in exchange, principally of an archæological character.

An important exchange of birds with the American Museum of Natural History in New York will be found mentioned further on.

The additions to the museum from the operations of government parties, or those fitted out in whole or in part by the Smithsonian Institution, will be found in a brief mention under the head of Explorations. The details, as also those of the miscellaneous contributions, are given in the alphabetical list of donors and their donations.

Mammals.—The collections of mammals sent by Mr. Turner and Mr. Nelson, from Alaska, and by Lieutenant Wheeler, of the Engineers, from Colorado, &c., are most important.

Birds.—Of birds, an extremely valuable donation of 295 species and 318 specimens was made by the American Museum of Natural History in New York; these being for the most part either specimens not represented in the National Museum or in better condition than any it had been able to procure. A suitable return will be made in duplicate birds and other objects.

The collections of birds made by Mr. Nelson and Mr. Turner, already referred to under the head of Explorations, are of very great interest, embracing, as they do, large numbers of excellent specimens.

Lieutenant Wheeler is also to be mentioned in this series for his deposit of many valuable skins beautifully prepared by Mr. Henshaw, constituting part of the collections of the United States Geographical Survey of the One-hundreth Meridian.

The birds collected by Mr. Ridgway at Cobb's Island, mentioned under the head of explorations, were also of much value.

Among the more important of these researches are those of Mr. George N. Lawrence, Mr. Ridgway, and Dr. Coues, upon American birds; of Mr. J. A. Allen, of Cambridge, upon the mammals; of Professor Gill, Mr. Goode, Dr. Bean, and Professor Jordan, upon the fishes; and Prof. Edward D. Cope, upon the reptiles.

The marine invertebrates collected by the United States Fish Commission are in process of investigation by Prof. A. E. Verrill, assisted by Mr. Oscar Harger, Mr. Sanderson Smith, Prof. S. J. Smith, and Mr. R. Rathbun.

A series of skulls and skeletons of the Central American tapir was sent to Mr. Edward Alston, of London, for a critical examination. By such assignments, facts of more or less importance can be obtained; and it is in this way that the Institution best carries out the will of its founder for "the increase and diffusion of knowledge among men."

An immense mass of duplicate material belonging to the National Museum has been used in the way of a distribution of an educational series of objects to various colleges, academies, and learned societies of the United States, special provision having been made for the same by act of Congress.

NEW MUSEUM BUILDING.

For a detailed account of the measures taken to secure additional accommodations for the collections belonging to the National Museum, especially those gathered for the Philadelphia Exhibition and obtained from other parties at its close, reference is made to the reports of 1876, 1877, and 1878. It will here be sufficient to say that after several fruitless efforts, Congress, in the sundry civil bill of March 3, 1879, made an appropriation for a National Museum, in the following terms:

"For a fire-proof building for the use of the National Museum, three hundred feet square, to be erected under the direction and supervision of the Regents of the Smithsonian Institution, in accordance with the plans now on file with the Joint Committee of Public Buildings and Grounds, on the southeastern portion of the grounds of the Smithsonian Institution, two hundred and fifty thousand dollars; said building to be placed east of the Smithsonian Institution, leaving a roadway between it and the latter of not less than fifty feet, with its north front on a line with the south face of the buildings of the Agricultural Department and of the Smithsonian Institution; and all expenditures for the purposes herein mentioned, not including anything for architectural plans, shall be audited by the proper officers of the Treasury Department."

The estimates had been furnished by Messrs. Cluss & Schulze, consulting architects, as to the cost of such a building, and upon their representations the sum of $250,000 was asked for and granted, with the understanding that it would be sufficient for its purpose, although no limitation to that effect was made by Congress. As soon as possible

The labors of Dr. White in the Northern Pacific also resulted in an important contribution.

Insects.—No extensive collections of insects came to hand during the year; perhaps the most important being that from Central Mexico, furnished by Professor Dugés. These, as before, have been sent to the United States Agricultural Department.

Plants.—Various packages of plants, of no great importance, have been received during the year, and, like the insects, have been transferred to the Department of Agriculture.

Minerals.—Many important collections of minerals, geological specimens, &c., have been received during the year; a valuable contribution being that already referred to, as sent by the Mombusho Museum of Japan, consisting of what professes to be a complete series of the minerals and rocks of that country.

Mr. Thomas Donaldson, a member of the United States Land Commission, while visiting the West in connection with his duties, made a large collection of minerals and ores from Leadville, Deadwood, and other parts of the country; the whole filling some fifteen large boxes. This collection constitutes a very desirable supplement to the immense series of a similar character gathered by him at the request of the Smithsonian Institution in 1874, 1875, and 1876, constituting the larger part of the great display of the mineral wealth of the country made under the auspices of the Institution in the government building at the International Exhibition of 1876.

PRESENT CONDITION OF THE MUSEUM.

The administration of the Museum by the various assistants employed during the year has been entirely satisfactory. The work has been under the special charge of Mr. G. Brown Goode, having as collaborators: Dr. Charles Rau, Dr. E. Foreman, and Mr. F. H. Cushing, for the department of anthropology; Dr. F. M. Endlich, curator of mineralogy; Mr. Robert Ridgway, curator of ornithology; Dr. T. H. Bean, curator of ichthyology; Dr. H. C. Yarrow, assisted by Mr. S. C. Brown, curator of herpetology; Dr. Elliott Coues, curator of mammalogy; Mr. William H. Dall, curator of marine and aquatic invertebrates. Mr. Dall, Dr. Coues, and Dr. Yarrow performed their services without any compensation.

All the collections, as received, have been properly treated for preservation from destruction by insects or otherwise, and entered in the several record books; the total number of entries for the year 1879 being 11,552.

The distribution of duplicate specimens, already referred to, has also been carried on on a large scale. The details will be found in the appended tables.

As usual, the material of the institution has been made use of by experts and specialists for the prosecution of their researches. Although it is most convenient to have this done at the institution, yet wherever the interest of science requires it, collections are sent to any part of the world.

Among the more important of these researches are those of Mr. George N. Lawrence, Mr. Ridgway, and Dr. Coues, upon American birds; of Mr. J. A. Allen, of Cambridge, upon the mammals; of Professor Gill, Mr. Goode, Dr. Bean, and Professor Jordan, upon the fishes; and Prof. Edward D. Cope, upon the reptiles.

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No provision was made in the appropriation by Congress for the construction of the necessary cases, but an estimate has been presented, which it is hoped will be granted, so that this work may be started with the beginning of the next fiscal year. The period of complete installation of collections on hand, and the opening of the building to the public, will depend upon the amount of the appropriation and the rapidity with which the contractors may complete their work. The new building will be devoted more particularly to industrial exhibits, intended to show the animal and mineral resources of the United States and their practical applications to the wants or luxuries of man. The department of anthropology will also be largely represented. How far natural history can find a place in the building will depend upon the space required for the collections mentioned. It is confidently expected that this building when finished will be one of the most attractive objects of the kind extant, and but little inferior to the celebrated museums of foreign countries.

UNITED STATES FISH COMMISSION.

Reference has been made in many previous reports to the part taken by the United States Fish Commission in the investigation of the condition of the sea fisheries and in the propagation of food-fishes in the United States, your Secretary having been appointed by the President, in 1871, to the duty of carrying out the objects designated by a law of Congress in the same year. Serving without any compensation and receiving simply his own board and necessary personal expenses while actually engaged in the work, he has been obliged, in the increasing extent of his Fish Commission work, to devote to it more and more of the hours that would be usually allowed for leisure and recreation, his prime duty being, of course, to the Smithsonian Institution.

The work of the Commission is divided into two branches: First, an inquiry into the condition of the fisheries on the Atlantic and Pacific and Great Lake coasts; and second, the propagation of useful food-fishes

Under the head of "inquiry" the summers of successive years have been spent at various stations from the Bay of Fundy to Long Island Sound, and the information obtained has been published in the annual reports of the Fish Commission. The information obtained by this commission was of great importance to the United States Government at the Halifax convention.

For the work of 1879, Provincetown, at the extreme end of Cape Cod, was selected as the central station, and with the assistance of the steamer "Speedwell," under the command of Capt. Z. L. Tanner, a successful investigation was prosecuted in regard to the natural history and physics of the adjacent seas. The steamer, with its crew, were furnished by Hon. R. W. Thompson, Secretary of the Navy, in accordance with the law of Congress to that effect. It may not be out of place to mention in this connection that of the departments of the government that of the Navy has been especially liberal in its construction of the law, and has rendered the greatest possible aid in the work of the Commission.

The labors of the commission in 1879 were made directly conducive to the success of the efforts in connection with the census, as already referred to.

An incident of the summer's work was, as before, the collection of vast numbers of specimens of marine animals, a full series of which will be reserved for the National Museum, and the duplicates arranged for distribution to various educational establishments throughout the country. At the present time, of all the means of instruction in general natural history—a subject attracting much attention in schools and colleges—there are none more difficult to obtain than objects illustrating the botany and zoology of the ocean. The expense of the apparatus for securing such specimens is far beyond anything but what the most favored persons can command. On this account it was thought proper to do the work as far as possible for the whole country as well as for the National Museum, and numerous objects of this kind have been obtained and are now being properly arranged and packed under competent direction for distribution. Many sets of these will be in this way scattered throughout the country, to the very great advantage of science.

One material result of the work of the past summer has been the discovery of an entirely new food-fish off the coast, both genus and species being previously unknown to science. This is the *Lopholatilus chameleonticeps*, or tile-fish. A bank where this fish is found was discovered near Noman's Land, where it can be taken in any desired quantity; some specimens obtained weighing as much as ninety pounds. As the fish has very much the same general food characteristics as the cod, there is reason to believe that in time it will become an imporant article of trade.

A great extension was also established in the distribution of the new fish discovered in June, 1877, off the coast of Gloucester, namely, the pole flounder, or *Glyptocephalus cynoglossus*. This is a species of flat-fish, the occurrence of which along our shores was entirely unknown at the time, not being taken on the trawls of the fishermen, while at the same time it is possibly the most abundant species of its family on the coast. In the smallness of its mouth, which prevents its being captured by the hook, and the lack of use of the beam-trawl as a fisherman's engine, are to be found the explanation of the ignorance of the fishermen in regard to the species.

The second division of the work of the United States Fish Commission, that of the multiplication and distribution of useful food-fishes, has also been carried on during the year on a greatly enlarged scale.

Special work was done at Avoca, in Albemarle Sound, in connection with the shad and fresh-water herring, many millions being hatched out, of which the greater part were distributed to the interior waters of North Carolina, South Carolina, Georgia, and other States. A very important extension of the work consisted in the successful experiment of the artificial propagation of the striped bass or rockfish, a species of great economical importance, but which had hitherto eluded all our search during its spawning season.

The second station for the hatching of shad was established as in previous years at a point a short distance below Havre de Grace, on the Susquehanna River, where also many millions were produced. About half of the number were planted in the Susquehanna itself, for the purpose of keeping up the supply. The remainder were distributed to numerous States throughout the Union.

The station on the McCloud River, California, for procuring the eggs of the California salmon, was efficiently worked by Mr. Livingston Stone, the superintendent. About eight millions of eggs were obtained and distributed, for the most part, to the commissioners of the different States. One hundred thousand eggs were presented to each of the governments of France, Holland, and Germany, where the California salmon is greatly appreciated from its promise of furnishing a very important addition to the food resources of Europe.

Arrangements are now being made on the McCloud River for the hatching of the California trout, which has some peculiarities which render it desirable for introduction to the Eastern States.

Other stations were at Bucksport, Me., for the propagation of the sea-salmon, and at Grand Lake Stream for land-locked salmon, both being in charge of Mr. Charles G. Atkins, and furnishing their quota of material for the multiplication of food-fishes.

After several years of effort, the commission has been able to obtain a stock of German carp for distribution. This fish promises to be of great economical value, and the demand for it is very great, numerous applications being received every day from all parts of the country. About ten thousand have already been distributed, at the rate of about eight pairs to each applicant, meeting but a small part of the demand. The stock for the year 1880, it is hoped, will supply this in a measurable degree.

The experiments initiated at Gloucester in 1878, looking towards the artificial propagation of the cod, were carried to completion in February, 1879, about one and a half millions of fish having been hatched out and placed in Gloucester Harbor. The experiment was in every way satisfactory, and the experience gained will be of the utmost benefit in the future. The harbor of Gloucester, during the past summer, was full of young codfish hatched out in this way, presenting a palpable feature of the work, which was appreciated by all the inhabitants of that city.

For the purpose of more efficiently conducting the work of the commission in connection with the shad, herring, striped bass, codfish, and other species, an appropriation of $45,000 was made in March last by Congress for the construction of a suitable steamer, which should serve as a floating hatching establishment. This vessel is nearly completed, and will, it is hoped, be ready for the work of 1880.

Mr. Newton P. Scudder was sent, during the summer of 1879, to study the halibut fisheries on the coast of Greenland. For a number of years the Holsteinburg Banks, a short distance south of Disco, Greenland, were visited by from one to seven vessels from Gloucester, annually. These vessels remained three or four months on the fishing-ground, and salted down in their holds the halibut which they caught, and which were brought home to be prepared in the smoke-houses.

Mr. Scudder sailed from Gloucester on the schooner Bunker Hill, June 10, 1879, and on his return arrived in Gloucester September 17. He secured a fine collection of Arctic marine birds, also, an interesting series of Arctic fishes and invertebrates, and some valuable ethnological specimens.

Mr. H. L. Osborne was sent to the Grand Banks to study the methods of the deep-sea cod fishery of that region. He left Gloucester on the schooner Victor, July 10, and returned home in the latter part of October. His natural history collections were quite extensive, especially of the different species of mollusks; and he has in preparation an elaborate report upon the methods of this fishery and the characteristics of the fishermen and the results of his natural history exploration.

Mr. J. P. Gordy made a short cruise on a Gloucester mackerel schooner, and has presented a report upon the mental and moral characteristics of the fishermen and upon the methods of this fishery. He returned to Gloucester August 3, after an absence of three weeks.

CO-OPERATION OF THE UNITED STATES FISH COMMISSION AND OF THE CENSUS OF 1880.

In the previous reports of the Census Department, the almost ludicrous incompleteness of that portion relating to the fisheries has been a matter of notoriety; and it was with much pleasure that I received an invitation, as Secretary of the Smithsonian Institution and United States Fish Commissioner, from General Walker, Superintendent of the Census, to suggest a plan by which this defect might be remedied. At

APPENDIX TO THE REPORT OF THE SECRETARY.

Table showing the number of entries in the record-books of the United States National Museum at the close of the years 1878 *and* 1879, *respectively.*

[These tables show only what has been recorded or entered in the detailed catalogue, constituting but a small proportion of the whole.]

Class.	1878.	1879.
Mammals	13,069	13,144
Birds	76,666	79,093
Reptiles and amphibians	10,015	10,407
Fishes	22,000	23,561
Skeletons and skulls	16,155	16,306
Eggs	17,791	18,049
Crustaceans	2,324	2,324
Annelids	100	100
Mollusks	31,268	33,169
Radiates	3,230	3,230
Invertebrate fossils	8,020	8,075
Minerals	20,135	20,450
Ethnological specimens	34,600	39,017
Total	255,373	266,925
Increase for 1879	....	11,552

Approximate table of the distribution of duplicate specimens to the end of 1879.

Class.	Total to the end of 1878.		Distribution during 1879.		Total to the end of 1879.	
	Species.	Specimens.	Species.	Specimens.	Species.	Specimens.
Skeletons and skulls	540	1,878	46	46	586	1,924
Mammals	2,167	4,822	....	....	2,167	4,822
Birds	27,717	42,014	223	304	27,940	42,318
Reptiles	2,356	3,840	210	318	2,566	4,158
Fishes	6,145	9,651	298	325	6,443	9,976
Nests and eggs of birds	7,906	19,350	328	1,161	8,234	20,511
Insects	4,308	9,741	230	350	4,538	10,091
Crustaceans	1,087	2,664	10	25	1,097	2,689
Shells	90,548	197,347	154	481	90,702	197,828
Radiates	593	793	....	....	593	793
Other marine invertebrates	1,892	5,225	15	15	1,907	5,240
Plants and packages of seeds	29,943	51,984	[illegible]	877	[illegible]	52,861
Fossils	4,391	10,518	....			10,518
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Diatomaceous earths (packages)	874	1				
Total	193,195					

of this information. While the Canadians possessed the fullest data on the subject of the fisheries, as the result of many years inquiry, the United States had nothing whatever but what was gathered with special reference to the emergency. The results gathered in connection with the census of 1880 will, it is hoped, be tabulated and published by the time this is needed for diplomatic use, and it will be of inestimable advantage in strengtheniug any position that the American Government may take in reference to the nature of the American fisheries.

Respectfully submitted.

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

WASHINGTON, D. C., *January*, 1880.

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Fossils	4,391	10,518	....	....	4,391	10,518
Minerals and rocks	9,105	16,869	901	4,538	10,006	21,407
Ethnological specimens	3,623	5,268	226	226	3,849	5,494
Diatomaceous earths (packages)	874	1,628	300	300	1,174	1,928
Total	193,195	383,592	3,440	8,966	196,635	392,558

ADDITIONS TO THE COLLECTIONS OF THE NATIONAL MUSEUM IN 1879.

Adney, W. H. G. Specimens of shells and fossils; from Virginia.

Alaska Commercial Company, San Francisco, Cal. Two heads of sea-lion (*Rosmarus obesus*); from Nushagak, Alaska.

Alden, Capt. Oscar W., and crew of schooner Andrew Leighton. (See Washington, D. C., United States Fish Commission.)

Aldernethy, George. Samples of coal; from Washington Territory.

Allen, C. A. Two specimens *Anser rossii* (purchased); from California.

Allen, George K. (See Washington, D. C., United States Fish Commission.)

Anderson, Capt. Charles, and crew of schooner Alice G. Wonson, Gloucester, Mass. (See Washington, D. C., United States Fish Commission.)

Anderson, John. Insect; from Texas.

Anderson, W. W. Small collection of stone implements; from Sumter County, South Carolina.

Andrews, Miss Fannie. Box of stone implements and minerals; from Georgia.

Ardendall, Edward, schooner Sea Foam. (See Washington, D. C., United States Fish Commission.)

Aspinwall, Dr. F. E. Specimens of arrow-heads; from New York and Ohio.

Atkins, Charles G. Specimen of togue (*Cristivomer namaycush*); from Grand Lake Stream, Maine.

Augir, Viola. Two mounted specimens of birds; from Illinois.

Baird, G. W., P. A. Engineer, U. S. N. Specimens of *Medusæ;* taken at Ville Franche, France.

Baird, Prof. S. F. (See Washington, D. C., United States Fish Commission.)

Babcock, A. L. Specimens of birds (*Cyanura cristata* and *Siulia sialis*), and red squirrel (*Sciurus hudsonius*); from Massachusetts.

Baden, George P. Living milk-snake (*Ophibolus doliatus*); from Washington, D. C.

Baker, J. D. Specimen of insect; from Perry County, Pennsylvania.

Barker, H. L. Living specimens of glass-snake (*Opheosaurus ventralis*), turtles (*Pseudemys scabra*), and amphiumas (*Amphiuma means*); from South Carolina.

Barringer, A. L. Living snakes (*Bascanion constrictor*, *Ophibolus rhombomaculatus* and *Storeria dekayi*) and terrapins (*Cistudo clausa*); from North Carolina.

Bates, W. H. H. Specimens of minerals; from Maine.

Bauermeister, Rev. William. Box of minerals; from Indiana.

Beach, H. Box of stone implements, pottery, &c., from Illinois and Wisconsin.

Beal, William. Two living bull-snakes (*Pityophis melanoleucus*); from Tennessee.

Bean, Barton A. Unfinished dulled stone implements; from Pennsylvania.

Bean, Dr. T. H. Box of Indian implements and terrapin (*Cistudo clausa*); from Pennsylvania.

Beauchamp, Rev. William M. A collection of shells; from Western New York.

Belding, L. Five boxes of birds-skins, eggs, and dried plants; from California.

Belknap, Lieut. C., U. S. N. Samples of the woods of Japan and the Philippine Islands.

Bell, Charles W. Specimen of iron-pyrites; from Texas.

Benner, F. M. Box of stone relics; from Ohio.

Bennett, Henry R. Fragments of pottery; from near Cape Henlopen, Delaware.

Bennett, J. C. Specimens of Indian stone implements; from Ohio.

Benton, John H. A living alligator (*Alligator mississippiensis*; from Florida.

Bessels, Dr. Emil. Alcoholic specimens of *Amphioxus*; from the Eastern shore of Maryland.

Bigelow, Otis M. Cast of Indian bird-shaped pipe; from New York.

Bissel, E. H. Specimens of insects; from North Carolina.

Blackford, E. G., Fulton Fish Market, New York. A large and varied collection of fishes, brought into the New York fish-market, among which are *Cryptacanthodes*, *Centropomus*, *Sargus Holbrookii*, *Pagrus vulgaris*, *Salmo solar*, *Onchorhynchus quinnat*, *Coregonus* sp., *Pomatomus saltatrix*, *Scomber scombrus*, &c.

Bland, Thomas. Specimen of abnormal egg of chicken; from Jamaica, L. I.

Bloomfield, James C. Pharyngeal teeth of *Haploidonotus grunniens*.

Boardman, George A. Two birds-skins, nests, and eggs; from Maine.

Bomar, Thomas H. Specimen of calcite; from South Carolina.

Boars, H. Case fishery apparatus; from Norway.

Bonbright, Stephen L. Three skins of birds; from Iowa.

Booth, A. Specimens of California salmon (*O. Quinnat*).

Booth, M. A. Small package of recent diatoms; from Massachusetts.

Booth, Lieut. S. M., U. S. N. Suit of armor worn by the natives of the Kingsmill group of Pacific Islands.

Bowers, W. W. Sample of meat prepared by the Chinese from the abalone (*Haliotis*).

Boyd, Miss E. S. Human cranium; from the Hawaiian Islands.

Boyd, Dr. S. B. Double-headed snake; from Tennessee.

Boyle, Dr. David, Elora Museum, Ontario. Beads found in cavern on Grand River, Ontario; and slate tablet (lent).

Brace, Lewis J. K. A box of general natural history collections; from Nassau, New Providence.

Brackett, Col. A. G., U. S. A. A specimen of the black-footed ferret (*Putorius nigripes*); from Montana.

Bracking, Alfred. Specimen of mineral; from North Carolina.

Brady, Henry B. Microscopic mountings of Carboniferous foraminifera; from Newcastle-on-Tyne, England.

Brantley, W. S. Living specimen of ground rattle (*Caudisona miliaris*); from Georgia.

Bregazzi, Miss Marie. Living bat (*Scotophilus fuscus*); from Washington, D. C.

Brewer, Dr. T. M. Box of birds' skins.

Brewster, William. Nest and four eggs of brown creeper; from Massachusetts.

Brown, James, Schooner David A. Osier. (See Washington, D. C., United States Fish Commission.)

Brown, Dr. J. J. Jar of alcoholic reptiles; from the West Indies.

Brown, Seavy & Co, Boston, Mass. Specimens of mackerel (*Scomber scombrus*) and viscera of same.

Brownell, W. A. A collection of minerals.

Bruner, J. Human mummy, encased; from Cuzco, Peru.

Budd, James. Specimen of moth (*Enyo lugubris*); from North Carolina.

Bunnell, P. D. Specimen of mineral; from Washington Territory.

Burbage, John. Skin of weasel (*Putorius erminea*), pupa-state of tobacco-worm, living snakes (*Heterodon platyrhinus* and *Eutænia sirtalis*), and mineral concretion; from Missouri.

Burford, H. Specimen of tarantula; from Georgia.

Burnham, E. K. (See Washington, D. C., United States Fish Commission.)

Burr, R. T., A. A. Surgeon, U. S. A. Small box of pottery, and alcoholic specimens of fishes, reptiles, &c.; from Arizona.

Cairns, William. Stone-gouge; from Westchester County, New York.

Cambridge, Mass., Harvard Botanical Gardens, Prof. C. S. Sargent, in charge. Eight species of living water-plants.

Campbell, Capt. David, and crew of schooner Admiral. (See Washington, D. C., United States Fish Commission.)

Campbell, D. H. Specimen of insect; from Illinois.

Campbell, Kent. Cocoons of insects; from Ohio.

Capehart, Dr. W. R. Specimens of rock-fish, shad, alewives, and a jar of herring-roe; from Albemarle Sound.

Capps, C. Henry. Specimens of minerals; from Calvert County, Alabama.

Carlin, W. M. A collection of fishes; from Wyoming.

Carr, J. C. Fragments of fossils; from Tennessee.

Carr, H. H. Specimens of shed skin of snake and rattle of rattlesnake; from Texas and Wyoming.

Carter, C. Shirley. Two specimens in alcohol of *Ancistrodon contortrix*; from Virginia.

Castleman, D. J. Specimen of insect; from Alabama.

Cavanaugh, Capt. John, and crew of schooner Alfred Walen. (See Washington, D. C., United States Fish Commission.)

Chapin, Dr. E. M. Small box of fragmentary mound-pottery; from Scott County, Georgia.

Chesley, Edward. Wooden model of the shad.

Chester, Capt. H. C. Specimen of flying-fish (*Dactylopterus volitans*); from Noank, Conn.

Choate, Warren. Specimen of ore; from Leadville, Colo.

Christiania, Norway, Museum of, through Professors Collett and Esmark. Seventy-one species of Norwegian fishes.

Church, D. F. Specimens of menhaden and menhaden-spawn; from Narragansett Bay.

Clark, E. T. Specimens of fishes and worms; from Gloucester, Mass., Harbor.

Cleneay, Thomas. Collection of Indian stone axes, pestles, hammers, scrapers, &c.; from Ohio.

Collins, Capt. David E., and crew of schooner Gussie Blairsdell. (See Washington, D. C., United States Fish Commission.)

Collins, Capt. John, and crew of schooner Albert H. Harding. (See Washington, D. C., United States Fish Commission.)

Collins, Capt. J. W., schooner Marion. (See Washington, D. C., United States Fish Commission.)

Copley, C. J., Stapleton, S. I., L. I. Specimens of fishes, *Notemigonus chrysoleucus, Argyreiosus capellaris, Catostomus commersonii.*

Cook, Richard E. Specimens of mineral; from Clay County, Alabama.

Cooper, W. A. Box of birds, nests, and eggs, and a few shells; from California.

Cornwall, A. B. Bear's tooth.

Corey, Warren H. Specimens of two water-beetles from Minnesota.

Corson, Joseph K., A. A. Surgeon, U. S. A. Two living turtles; from California.

Coues, Dr. Elliott. Type specimens of *Dendroica kirtlandi;* and two specimens of *Budytes taivanus*, from Formosa; eggs of *Perisoreus canadensis*, from Vermont.

Covert, A. B. Specimens of albino mouse, *Hesperomys leucopus*, from Michigan.

Crane, H. L. Specimens of stone relics; from Florida.

Crawford, S. W. Box of bird-skins from Iceland.

Critchett, Capt. John F., and crew of schooner Commonwealth. (See Washington, D. C., United States Fish Commission.)

Crooks, Nathaniel, schooner Helen M. Dennis. (See Washington, D. C., United States Fish Commission.)

Cunningham, Capt. Augustus, schooner Geo. A. Upton. (See Washington, D. C., United States Fish Commission.)

Curzon, Capt., schooner Mist. (See Washington, D. C., United States Fish Commission.)

Curtis, Capt. George H., and crew of schooner Conductor. (See Washington, D. C., United States Fish Commission.)

Cushing, F. H. Medicine war-dress of "Moon Plume," a Cheyenne chief (purchased), and box of Indian relics; from mound near Saint Louis, Mo.

Dall, W. H. Skull and horns of deer (*Cervus aristotelis*); from the highlands of India.

Davis, A. J., through Thomas Donaldson. Specimens of silver and gold bullion from the Lexington Mine Butte, Montana.

Davis, Henry. Specimens of birds' nests, and eggs, fossils, minerals, and Indian relics; from Iowa.

Davis, Hon. Horace. Pair of Chinese shoes; from California.

Davis, W. E. Fourteen living turtles (*Pseudemys scabra*); from North Carolina.

Dawson, Prof. J. W., Montreal, Canada. Specimen of *Eozoon canadense.*

Dempsey, Capt. William. (See Washington, D. C., United States Fish Commission.)

Derry, C. W. Specimens of silver ore; from Leadville, Colo.

De Tarr, D. N. Skin of neck and heads of double-headed calf.

Dickinson, E. Box of birds' nests from Massachusetts.

Diggs, Meredith, Washington, D. C. Prepared skeleton of fish, *Lutjanus blackfordii.*

Dodd, Andrew W. (See Washington, D. C., United States Fish Commission.)

Dolliver, Capt. Peter, and crew, of schooner Grace L. Fears. (See Washton, D. C., United States Fish Commission.)

Dolph, John M. Specimens of fish parasites.

Dosch, Samuel E. Specimens of minerals; from District of Columbia.

Douglass, Albert. (See Washington, D. C., United States Fish Commission.)

Douglass, W. Grooved stone axe; from Fauquier County, Virginia.

Dowell, John. Specimen of shad (*Alosa sapidissima*); from the Potomac River.

Downman, R. H. A fresh specimen of blue-fish (*Pomatomus saltatrix*) and living snakes (*Ophibolus getulus, Spiloties erebennus*) and turtles (*Chelydra serpentina*); from Virginia.

Driggs, J. W. Collection of birds' skins (purchased) and skeleton of *Tantalus loculatos;* from Florida.

Dybovoski, W., Russia. Box of shells (purchased); Baikal Sea.

Dufer, B. W. Insect from Arkansas.

Dunny, Lathrop, through Thomas Donaldson. Specimens of silver ore; from the Alice Mine, Butte, Montana.

Dugès, Prof. Alfredo. Box of birds, insects, antiquities, shells, &c.; from Mexico.

Dunham, James C. Skins of dog-fish; from Provincetown, Mass.

Dupré, D. A. Specimens of minerals; from Virginia.

Dyer, Captain. (See Washington, D. C., United States Fish Commission.)

Earle, J. W. Box of Indian stone relics, pottery, &c.; from South Carolina.

Earll, R. E. Photographs of pogie steamers and living specimen of *Amblystoma punctatum;* from Maine.

Edwards, Vinal N. Eighteen boxes of general marine collections; from Wood's Holl, Mass.

Edmunds, Hon. J. E., Washington, D. C. Three birds, two linnets, one woodpecker.

Edmunds, Hon. J. M., city postmaster, Washington, D. C. Wings of mallard duck.

Egan, W. C. Box invertebrate fossils; from Niagara Group, Illinois.

Eldridge, Woodbury, through W. Oakes. Vertebra of whale; from Ipswich Bay.

Emanuel, J. M., P. A. Engineer, U. S. N. Specimen of insect; from James River, Virginia.

Ernst, A. Dr. Box of pottery and stone implements; from Venezuela.

Evans, S. B. Three fossils; from Iowa.

Feuardent, Gaston L. A collection of pottery and implements of the Archæolithic, Neolithic, Lacustrine, and Bronze ages.

Ferguson, T. B. Specimens of fish (*Prionotus, Tetrodon, Achirus,* &c.), from the Rappahannock River; box of fishes, from Crisfield, Md.

Ferguson, S. Specimen of *Diemictylus miniatus.*

Ferguson, S. W. Living snapping-turtle (*Chelonura temminckii*); from the Mississippi River.

Fickel, Isaac H. Arrow-head chip.

Finsch, Dr. Otto. Three human skulls, and tooth of *Rhinoceros tichorhinus;* from Western Siberia.

Flaherty, Michael. (See Washington, D. C., United States Fish Commission.)

Forbes, Capt. Maurice, schooner Eastern Light. (See Washington, D. C., United States Fish Commission.)

Fowles, Frank, schooner Young Sultan, of Wiscasset. (See Washington, D. C., United States Fish Commission.)

Fowles, Capt. M. V., and crew of schooner Young Sultan. (See Washington, D. C., United States Fish Commission.)

French, John H., McMinnville, Tenn. Specimen carved stone tube.

Friele, Prof. H. Small collection of shells collected by the Norwegian Deep-Sea Expedition, in the North Atlantic Ocean.

Friel, Joseph. Box of Indian relics from Kentucky.

Friend, George. (See Washington, D. C., United States Fish Commission.)

Friend, Lemuel, through Capt. J. W. Collins. (See Washington, D. C., United States Fish Commission.)

Galbraith, Frank G. Two boxes of Indian implements and water-worn pebble, from Eastern Pennsylvania; sculptured rock, from the Susquehanna River.

Garman, S. W., from Prof. A. Agassiz. Living turtle (*Testudo tabulata*); from Trinidad.

Gartley, A. M. Specimens of minerals; from Pennsylvania.

Gatke, H. Collection of birds' skins; from Heligoland, Germany.

Gatschet, Prof. Albert S. Seven arrow-heads from Rhode Island.

Gecks, A., Hospital Steward, U. S. A. Specimens of fragmentary pottery, and copper disk found in skull taken from mound near Fort Sisseton, Dak.

Gere, J. E. Specimens of copper and stone implements, minerals, hornet's nest, &c.; from Wisconsin.

Gerend, John. Insect; from Wisconsin.

Getschell, Capt. John, Q., schooner Otis P. Lord. (See Washington, D. C., United States Fish Commission.)

Gibbs, George J. A collection of birds' eggs, and seeds of *Corda irex*, sponge, and specimen of gypsum; from Turk's Island, West Indies.

Gill, Capt. Russell G., schooner Maud Gertrude. (See Washington, D. C., United States Fish Commission.)

Gilpatrick, Capt. Briggs, and crew of schooner Herbert M. Rogers. (See Washington, D. C., United States Fish Commission.)

Gilpatrick, Capt. Gilman, schooner Seth Stockbridge. (See Washington, D. C., United States Fish Commission.)

Gilpin, Dr. Bernard. Jar of alcoholic specimens of *Insectivora;* from Nova Scotia.

Glidden, Albert. Hornet's nest; from Damariscotta.

Goldsmith, J. B. (See Washington, D. C., United States Fish Commission.)

Goldsmith, S. Living specimens of garter-snake (*Eutænia sirtalis*); from Maryland.

Goode, Prof. G. Brown. Specimens of fish (*Cynoscion, Lagodon rhomboides, Orthopristis fulvomaculatus*), from Norfolk, Va.; and spinning wheel and appurtenance of the eighteenth century.

Goode, F. C. Can of alcoholic specimens of fishes, reptiles, &c.; from Florida.

Goodwin, Capt. Thomas, and crew of schooner Howard. (See Washington, D. C., United States Fish Commission.

Goodwyn, T. Gray. Eggs of the thrush, blue-bird, and swallow; from West Virginia.

Gore, J. H. Skull of rabbit with prolongated teeth.

Gorham, R. P. Pharyngeal bone of drum-fish.

Gorman, Capt. John, and crew, of schooner Geo. S. Boutwell. (See Washington, D. C., United States Fish Commission.)

Gorringe, Lieutenant Commander, U. S. N. Piece of water-pipe and slab; from the ruins of ancient Troy.

Gorton, C. Specimens of soapstone mask and box of Indian relics (lent).

Goti, Addison. (See Washington, D. C., United States Fish Commission.)

Gourville, Capt. John, and crew of schooner Rebecca Bartlett. (See Washington, D. C., United States Fish Commission.)

Goward, G. An article of apparel, lava-lava, worn by the natives of the Samoan Islands.

Graham, Dr. A. H. A Spanish spear and living specimens of scorpion and centipede; from Bagdad, Tex.

Graves, A. Three jars of fishes, some new to science; from Georgia.

Green, Fred. C. Specimens of chain and honey-comb coral; from the Mississippi River.

Green, Dr. J. B. Living specimen of garter-snake (*Eutænia sirtalis*); from Fairfax County, Virginia.

Green, W. N. Box of minerals from Virginia.

Greenleaf, Capt. Nathaniel, and crew of schooner Grace L. Fears. (See Washington, D. C., United States Fish Commission.)

Greenleaf, Capt. Thomas F., and crew of schooner Chester R. Lawrence. (See Washington, D. C., United States Fish Commission.)

Greenwood, Captain, and crew of schooner Sultana. (See Washington, D. C., United States Fish Commission.)

Gretan, Capt. John. Very large specimen of lump-fish (*Cyclopterus lumpus*); from Kettle Island, Massachusetts.

Gunter, Hon. T. M. Specimen of ore.

Habirsham, F. Microscopic slides of diatoms put up by Prof. P. T. Cleve and J. D. Muller, of Upsala, Sweden.

Habersham, Wm. Neyle. Photograph of a *Histiophorus gladius;* taken off Florida.

Hamilton, A. M. Specimens of minerals; from Virginia.

Hamilton, Hugh. Water beetle; from Pennsylvania.

Hamlin, F. M. Three boxes of general natural history collections; from Bermuda.

Hamlin, Capt. Peter, and crew of schooner Andrew Leighton. (See Washington, D. C., United States Fish Commission.)

Hanna, G. B., through Mrs. N. S. Lincoln. Specimen of mounted owl; from North Carolina.

Hanson, James, schooner Sarah P. Ayer. Specimens of tree-coral, *Paragorgia*, with barnacles attached.

Harrell, Alexander, through Hon. R. W. Townshend. Box of minerals and a stone ax; from Clay County, Illinois.

Harrison, Joseph, estate of. A large collection of paintings, by Catlin, of North American Indians.

Harrison, M. E. Box of Indian stone implements, fossils, &c.; from Missouri.

Harsha, W. W. Specimens of slag; from Illinois.

Hartfield, John M. A living turtle; from North Carolina.

Hartman, Dr. W. D. A collection of shells (*Partulas*).

Hayden, Dr. F. V. A collection of plants of the Yellowstone region.

Hayes, Dr. W. W. A specimen of *Dendrocygna fulva*; from California.

Hayward, F. W. A jar of alcoholic specimens of sirens, frogs, and toads; from South Carolina.

Heffleman, Dorr. Specimen of ore; from Dakota.

Hemphill, Henry. Twenty-two species and varieties of shells; from California.

Hereford, Hon. Frank. Specimens of coal; from Monroe County, West Virginia.

Hering, Dr. C. J. A large collection of plants and alcoholic specimens of reptiles, mammals, &c.; from Surinam, Dutch Guiana.

Herran, Thomas. A box of Indian pottery and specimens of locusts; from Antioquia, United States of Colombia.

Herrick, Capt. William, schooner Augusta Herrick. (See Washington, D. C., United States Fish Commission.)

Hessel, Dr. Rudolph. Living snake (*Tropidonotus sipedon*); from Washington, D. C.

Hess, G. E. Indian arrow-head; from Mississippi.

High, Augustus. Specimen of silver ore.

Hill, H. H. Five casts of Indian relics.

Hitchcock, George N. Head, shell, and claws of turtle (*Chelopus marmoratus*); from California.

Hobbs, George S. Living turtle and snake and bull-minnow; from Washington, D. C.

Hodgdon, Capt. Thomas, and crew of schooner Bessie W. Somes. (See Washington, D. C., United States Fish Commission.)

Hodgdon, Capt. W. F., and crew of schooner Proctor Brothers. (See Washington, D. C., United States Fish Commission.)

Hodgkins, Joshua. Living snake (*Ophibolus doliatus*); from Georgetown, D. C.

Hoffman, Dr. W. J. Bone fish-hook; used by the Indians of Grand River, Dakota.

Holbrook, A. F. Large specimen of sea-cucumber (*Pentacta frondosa*); from off Cape Cod.

Holbrook, Joseph E., schooner Jennie T. Phillips, of Swampscott. (See Washington, D. C., United States Fish Commission.)

Holloman, W. H. Samples of quartz; from Lousiana.

Hoover, Edward. Skins of short-eared owl and albino red-wing blackbird (*Agelæus phœniceus*); from Washington, D. C.

Horan, Henry. Living snakes (*Bascanion constrictor*, *Heterodon platyrhinus*, *Tropidonotus sipedon*, *Eutænia sirtalis*) and stink-pot turtle (*Aromochelys odoratus*); from Virginia. Also specimen of American sole (*Achirus lineatus*).

Horn, Dr. George H. Fragments of fossils (*Orthoceras* and *Favosites*); from the Indian Territory.

House, J. C. and O. A. McClain. Model of fish-hatching box.

Houston, Senator George S. Specimen of mineral; from Alabama.

Howard, E. B. Specimens of ore; from Arkansas.

Hoy, George W., schooner Mary F. Chisholm. (See Washington, D. C., United States Fish Commission.)

Hoyt, Edward F. (See Washington, D. C., United States Fish Commission.)

Hoyt, W. E. (See Washington, D. C., United States Fish Commission.)

Humphreys, Prof. John T. Three boxes of minerals and Indian relics; from North Carolina.

Hurlbert Capt. R. H., schooner Sultana. (See Washington, D. C., United States Fish Commission.)

Hurlbert, Capt. William, schooner Franklin S. Schenck. (See Washington, D. C., United States Fish Commission.)

Huston, S. Box of stone implements; from Ohio.

Ingersoll, Ernest. Four boxes of oyster shells; from New Brunswick and from various places along the New England coast.

Isaac, J. C. Specimen of tufa; from Hot Springs, Arkansas.

Irwin, Dr. B. J. D., U. S. A. Spy-glass case covered with skin of Gila monster (*Heloderma suspectum*).

Jack, J. Allen. Loan of the St. George Stone from New Brunswick.

James, Dr. Frank L. Four boxes of Indian stone implements, pottery, and images; from Arkansas and Mississippi.

Jefferson, Lieut. J. P. A bottle of sea-water; from the Dry Tortugas, Florida.

Jenison, O. A. Box of stone implements; from Michigan. Lent for the purpose of making casts.

Johnson, Captain. Occipital portion of the skull of a whale taken on the Southern coast.

Johnson, Capt. Benjamin, schooner Alaska. (See Washington, D. C., United States Fish Commission.)

Johnson, Capt. Charles, schooner Lucille Curtis. (See Washington, D. C., United States Fish Commission.)

Johnson, Christian, schooner Wm. Thompson. (See Washington, D. C., United States Fish Commission.)

Johnson, Capt. George A., and crew of schooner Augusta Johnson. (See Washington, D. C., United States Fish Commission.)

Johnson, G. W. Five birds' skins (*Vireo pusillus, Melospiza Heermanni*, &c.); from California.

Johnson, Capt. Otis, schooner Helen M. Dennis. (See Washington, D. C., United States Fish Commission.)

Johnson, Capt. P., schooner John Smith. (See Washington, D. C., United States Fish Commission.)

Jones, Mrs. Ellen. Samples of soil from Frederick, Md.

Jones, Samuel H. A specimen of the rare field-mouse (*Hesperomys aureolus*); from Florida.

Jordan, Prof. D. S. A collection of Venetian fishes; also, a collection of fishes and reptiles from Indiana.

Jouy, P. L. A specimen of lizard (*Desmognathus fusca*) and turtle (*Cistudo clausa*).

Joyce, Captain. Specimens of mackerel spawn; from Swan's Island, Castine, Me.

Joyce, John A. Specimen of magnetite; from Montana.

Kaufman, J. Specimen of mineral; from Texas.

Keller, F. K. Duck, hybrid between mallard and pintail.

Kelly, Alfred W. P. Photographs of New Zealand and Australian aborigines.

Kerr, Prof. W. C. Indian stone spade; from North Carolina.

Kilbourne, S. R. Specimens of fishes (*Salmo* and *Cottus*); from Long Lake, New York.

King, T. W. Specimen of mineral; from Texas.

Kingsbury, W. W. Specimens of clay; from Pennsylvania.

Kirby, Capt. W. H., and crew of schooner Wm. V. Hutchings. (See Washington, D. C., United States Fish Commission.)

Kirk, Isaac S. Specimens of stone implements and minerals; from Chester County, Pennsylvania.

Knight, La F. Human bones; from Indian grave.

Koch, L. L. Box of *Unionidæ;* from Illinois.

Kock, August. Parent and nest and eggs of the rough-winged swallow.

Kumlien, L. Specimens of birds, reptiles, and fishes; from Wisconsin and Michigan.

L'Acee. Specimen of mineral; from Florida.

La Barre, Miss Mollie. Living owl (*Bubo virginianus*); from Washington, D. C.

Lamasure, Edwin. Living turtle (*Cistudo clausa*).

Lane, H. B. Specimen of bug; from Virginia.

Langdon, F. W. Two specimens of crania; from Ohio.

Layard, E. L. British consulate of Noumea. Small collection of New Caledonian birds.

Larkin, Dr. Frederick. Flint arrow-heads from New York.

Lawrence, Geo. N. Mounted specimen of Labrador duck (purchased).

Lea, Dr. Isaac. Specimens of fossil (*Goniobasis Lawrencii*); from Arkansas; and minerals from Pennsylvania.

Lee, Thomas, schooner Wm. H. Oakes. (See Washington, D. C., United States Fish Commission.)

Leonard, Albert. Mineral; from Pennsylvania.

Leppelman, Louis (through Mr. Webb Hayes). Loan of a collection of stone implements from Ohio for casting.

Lewis, C. A. Specimen of pompano (*Trachynotus carolinensis*).

Lewis, Dr. James. Box of living shells (*Viviparus*); from New York.

Lewis, L. L. Four eggs.

Ligsworth, Capt. John E., and crew of schooner Mary Story. (See Washington, D. C., United States Fish Commission.)

Lightburne, Dr. R. E., U. S. A. Box of living snakes, horn-toads, and lizards; from Arizona.

Lindahl, Prof. Joshua, and Prof. A. Nordenskjold. Meteorite; from Ovifac, Greenland. (Deposited.)

Lineback, E. W. Water-worn pebble.

Locke, J. H. Specimen of mineral; from New Hampshire.

Locke, Kate H. Specimens of rocks; from New Hampshire.

Locke, W. M. Portion of jaw of *Sciœnoid* fish.

Long, D. B. Specimen of fish (*Etheostoma caprodes*); from Rock Creek, Kansas.

Lord, W. Blaine. Salmon (*Salmo salar*); from Matapediac, Canada.

Loud, P. H. Specimen of salamander (*Amblystoma punctatum*); from Edgefield County, South Carolina.

Love, J. G. Two shells; from Illinois.

Low, Charles F. Box of fragments of pottery; from Ohio.

Low, John. (See Washington, D. C., United States Fish Commission.

Lowe, F. A. Specimens of *Huntite* and *Animitite;* from Silver Islet, Ontario.

Lurvey, William. (See Washington, D. C., United States Fish Commission.)

Lyon, V. W. Fossil (*Calceola*); from Kentucky.

McCaleb, Vinal. (See Washington, D. C., United States Fish Commission.)

McCauley, Mr., schooner Wachusett. (See Washington, D. C., United States Fish Commission.)

McClenahan, R. E. Fresh specimen of pike-perch; from the Susquehanna River.

McCormack, Capt. John A., and crew of schooner Wachusett. (See Washington, D. C., United States Fish Commission.)

McCormick & Connable. Specimens of trout and white-fish.

McCormick, Lewis. Living snake (*Heterodon*), from Virginia; skink (*Eumeces fasciatus*) and newt; from Virginia.

McDonald, Capt. James, and crew of schooner Magic. (See Washington, D. C., United States Fish Commission.)

McDonald, Capt. James, and crew of schooner Willie M. Stevens. (See Washington, D. C., United States Fish Commission.)

McDonald, Lewis (through Boston Fish Bureau). (See Washington, D. C., United States Fish Commission.)

McDonald, Prof. Marshall. Specimens of menhaden (*Brevoortia tyrannus*) with parasites and a model of McDonald's fishway; also specimens of fish and Indian stone implements; from Virginia.

McDonald, Capt. William, and crew of schooner N. H. Phillips. (See Washington, D. C., United States Fish Commission.)

McDowell, W. W. Specimen of pike-perch (*Lucioperca*); from Tennessee.

McEachern Daniel, schooner Guy Cunningham. (See Washington, D. C., United States Fish Commission.)

McEachern, Daniel, schooner Rutherford B. Hayes. (See Washington, D. C., United States Fish Commission.)

McElwain, Robert. Fragments of bone; from Indian mound near Harrisville, Penn.

McGalliard, W. M. Insect.

McGraw, Phillip. (See Washington, D. C., United States Fish Commission.)

McGuire, F. B. Collection of fishes; from Teneriffe.

McGuire, J. D. Skin of bird; from Maryland.

McInnis, Capt. John, and crew of schooner M. H. Perkins. (See Washington, D. C., United States Fish Commission.)

McIntosh, Capt. Colin, and crew of schooner Nathaniel Webster. (See Washington, D. C., United States Fish Commission.)

McKinnon, Capt. Daniel, and crew of schooner Mary F. Chisholm. (See Washington, D. C., United States Fish Commission.)

McKinnon, Capt. John, and crew of schooner Ivanhoe. (See Washington, D. C., United States Fish Commission)

McKinnon, Capt. John, and crew schooner Rutherford B. Hayes. (See Washington, D. C., United States Fish Commission.)

McKinnon, Thomas. (See Washington, D. C., United States Fish Commission.)

McLean, T. P. Living snake (*Coluber obsoletus obsoletus*); from Cheat River, Maryland.

McPhee, Capt. Neil, and crew of schooner Carl Schurz. (See Washington, D. C., United States Fish Commission.)

MacRitchie, Lieutenant, U. S. N. A brick from the house General Washington was born in.

Maddox, W. M. A large hornet nest; from Anacostia, Md.

Main, Mrs. Mary E. Box of fragmentary Indian pottery; from New York.

Mandeville, Walter. Box of stone arrow-heads and minerals; from Pennsylvania.

Mansfield, James, and Sons. (See Washington, D. C., United States Fish Commission.)

Marchant, Capt. Jabez. (See Washington, D. C., United States Fish Commission.)

Markuson, Capt. C. K., and crew of schooner Notice. (See Washington, D. C., United States Fish Commission.)

Marnock, G. W. Specimens of *Lithodytes latrans, Eumeces semilineatus, Holbrookia lacerta*, and *Synophus marnockii;* from Texas.

Marsh, Prof. O. C. Cast of femur of *Atlantosaurus immanis.*

Marshall, George. Living snake (*Heterodon platyrhinus* and *Tropidonotus sipedon*); from Maryland.

Marshall, Henry. Specimens of living snakes (*Eutænia sirtalis, Bascanion constrictor, Heterodon platyrhinus*), skink (*Eumeces fasciatus*), and lizards (*Amblystoma opacum* and *Sceleporus undulatus*); from Maryland.

Martin, Capt. Charles, and crew of schooner Martha C. (See Washington, D. C., United States Fish Commission.)

Martin, Capt. George H., and crew of schooner Northern Eagle. (See Washington, D. C., United States Fish Commission.)

Martin, Capt. S. J. Young catfish (*Anarrhichas*); from Ipswich Bay.

Mason, George E. Nests of humming-bird and swallow.

Massey, Mr., through William Palmer. Living copperhead snake (*Ancistrodon contorrix*); from Virginia.

Mathews, J. H. Small reptile, picked up after rainstorm in Kansas.

Mather, Fred. Model of Mather's box for transporting salmon-eggs.

Mauler, Prof. Eugene. Samples of diatomaceous earths; from Central Europe.

Maw, George. Specimens of North African, Levantine, and Spanish pottery.

Meigs, General M. C., U. S. A. Owl (*Buteo pennsylvanicus*); from Washington, D. C., and saddle used by the Northern Cheyenne Indians.

Mendoza, Prof. G., director Museo Nacional, Mexico. Cast of obsidian vessel and specimens of axolotls (*Amblystoma Mavortium*) and cast of Mexican calendar-stone, and box of dried plants.

Merchant, George, through Procter Brothers. (See Washington, D. C., United States Fish Commission.)

Merchant, Orlando. (See Washington, D. C., United States Fish Commission.)

Merchant, Capt. Phillip, and crew, of schooner Marion. (See Washington, D. C., United States Fish Commission.)

Merrill, Mrs. C. E. Stone and copper relics and concretions; from Mississippi.

Metcalfe, Lieut. H., U. S. A. Drawings of relics found in cave at Silver City, New Mexico.

Metz, Dr. C. L. Collection of crania, pottery, bone tools, and carbonized corn; from Ohio.

Meyer, Julius. Photographs of Indians.

Meyer, Dr. J. S. Sample of composition metal.

Mexico, Museo Nacional. (See Mendoza, Prof. G.)

Mickleborough, Prof. John. Specimens of fossils; from Ohio.

Middletown, Conn., Wesleyan University. Four specimens of Ecuador-birds.

Miller, Mrs. Lois. Specimen of mineral.

Miller, S. B. Two arrow-heads; from Mississippi.

Miller, T. J. Specimen of stone implement from Wisconsin.

Mills, Clark. A collection of casts of the heads of the Indians at Hampton, Va.

Mills, S. V. Spear-head; from Pennsylvania.

Milner, James, W. A large collection of plants, fishes, reptiles, and birds; from Florida.

Moore, N. B. Small viviparous fish (Cyprinodont); from Florida.

Moose, G. W. Specimens of rocks; from South Carolina.

Morey, M. A. A collection of minerals; from Minnesota.

Morrison, Capt. R. L., and crew of schooner Laura Nelson. (See Washington, D. C., United States Fish Commission.)

Morrison, J. M. Decorated buckskin used by the Wichita Indians for shield cover.

Morrissey, Capt. James D., and crew of schooner Alice M. Williams. (See Washington, D. C., United States Fish Commission.)

Morrissey, Capt. James D., and crew of schooner Plymouth Rock. (See Washington, D. C., United States Fish Commission.)

Moulton, Capt. Charles V., and crew of schooner Peter D. Smith. (See Washington, D. C., United States Fish Commission.)

Mueller, Dr. R. Three Indian spear-heads; from Indiana.

Murphy, Capt. C. D., and crew of schooner Alice M. Williams. (See Washington, D. C., United States Fish Commission.)

Murphy, Capt. Thomas, and crew of schooner Wm. H. Oakes. (See Washington, D. C., United States Fish Commission.)

Murphy, James H. Living snake (*Heterodon platyrhinus*); from Washington, D. C.

Mynster, William A. Specimens of quinnat salmon; from Iowa.

Neihardt, M. N. Specimen of quartz from Missouri.

Nelson, Judge. Specimen of *trilobite.*

Nelson, Capt. Andrew, schooner Carleton. (See Washington, D. C., United States Fish Commission.

Nelson, E. W. Twenty-four packages of general natural-history collections; from Saint Michael's, Alaska.

Newcomb, R. L. Feathers from tail of fan-tailed pigeon.

Newlon, Dr. W. S. Specimens of fossils (*Pinna peracuta* and *Terebratula hastata*); from Kansas.

Newman, W. P. Specimen of mineral; from Missouri.

Newton, Edward. A living yellow-bellied boa (*Chilobothrus inornatus*), three living turtles, and a collection of bird skins; from Jamaica, West Indies.

New York, N. Y. Museum of Natural History, Prof. A. S. Bickmore, curator. Two hundred and ninety-five species, three hundred and eighteen specimens of birds.

Nichols, Dr. H. A. A. Specimen of gannet (*Sula piscator*); from Dominica, West Indies.

Nickerson, Capt. James, and crew of schooner Bellerophon. (See Washington, D. C., United States Fish Commission.)

Nickerson, Capt. James, and crew of schooner Commonwealth. (See Washington, D. C., United States Fish Commission.)

Norris, P. W. Specimen of silicified wood; from Yellowstone National Park.

Norwood, Ferdinand. (See Washington, D. C., United States Fish Commission.)

Olmstead, Anthony J. Five arrow-heads and chips of jasper; from Pike County, Pennsylvania.

Olmsted, E. B. Box of Indian relics; from Illinois.

Olsen, Capt. Chris., and crew of schooner William Thompson. (See Washington, D. C., United States Fish Commission.)

Olsen, Capt. George, and crew of schooner Willie M. Stevens. (See Washington, D. C., United States Fish Commission.)

Olsen, Capt. Thomas, and crew of schooner Epes Tarr. (See Washington, D. C., United States Fish Commission.)

Olsen, Capt. Thomas, and crew of schooner Polar Wave. (See Washington, D. C., United States Fish Commission.)

Oram, F. F. Specimens of minerals; from Alabama.

Overall, Capt. M. C. Small box of minerals; from Virginia.

Overton, B. F. Fragments of fossils, &c.; from Indian Territory.

Palmer, Dr. E. Box of ethnologica; from California.

Palmer, William. Specimens of living snakes; from Virginia.

Parks, Capt. Matthew, and crew of schooner Davy Crockett. (See Washington, D. C., United States Fish Commission.)

Parrish, W. J. A small collection of fossils; from Kansas City, Mo.

Patrick, Dr. J. J. R. Two casts of the "Cahokia mound," of Madison County, Illinois.

Pease, W. B. Collection of minerals, skull of swift, and heads and wings of two wild ducks; from New Mexico.

Peck, Dr. T. I. Stone muller and specimen of epidotic sienite; from Tennessee.

Peeples, William A., schooner Addison Center. (See Washington, D. C., United States Fish Commission.)

Peichardière, Prof. O. de la. A collection of birds' skins, nests, and eggs, reptiles, insects, and fishes; from Louisiana.

Perkins, E., of schooner Grace L. Fears. (See Washington, D. C., United States Fish Commission.)

Perry, J. A. Specimen of diatomaceous earth; from Punta de Lobos, Barbadoes.

Pettibone, William. Stone axe; from Maryland.

Phelps, W. W. Flint spear-head.

Philbrick, E. E. Specimens of phosphates; from Florida.

Pirz, Anthony. A large collection of chemicals and products derived from animal matter, canned meats, wax candles, albuminum, &c.

Pitts, A. Skeleton of turtle (*Emys guttata*) and skull of rodent.

Poey, Prof. Felipe. A living specimen of *Emys jamai*, Cope; from Cuba.

Polen, M. Root of herb used by the Indians of San Bernardino, Cal., for heart disease.

Poppelein Silicated Phosphate Company, Baltimore, Md.. Samples of infusorial earths, samples of fertilizers, &c.

Powel, Samuel. Specimen of lump-fish (*Cyclopterus lumpus*); from Newport, R. I.

Preston, R. E., Acting Director of Philadelphia Mint. Annual Assay Medal of 1879; obverse, H. R. Lindermann; reverse, tomb of Joseph Henry.

Proctor, G. H. Specimen of flounder; from the Squam River, Gloucester, Mass.

Pybas, Ben. Box of fossil plants from Alabama.

Quick, Edgar R. Specimens of field mice (*Synaptomys cooperi*); from Indiana.

Ragsdale, G. H. Collection of birds; from Texas.

Randle, Rev. E. H. Two specimens of minerals.

Rea, James H. Specimen of mineral.

Read, E. F. Box of Indian relics; from Alabama.

Reisinger, Lieutenant U. S. N. Fragments of Peruvian and Aztec pottery.

Reynolds, J. H. Specimens of silicified woods and a box of stone implements; from Tennessee.

Rhees, William H. Specimen of living snake and toad; Washington, D. C.

Rhees, William J. Living garter-snake (*Entænia sirtalis*) and toads (*Bufo americanus*); from Washington, D. C.

Rhodes, Thomas. Specimens of leaf-shaped stone implements; from Ohio.

Rhodes, W. E. Fossil shark's tooth; from marl beds near the Bigbee River, Alabama.

Richards, John H. Two boxes of living turtles (*Cistudo clausa* and *Chelopus insculptus*); from Pennsylvania.

Ridgway, Robert. Collections of birds; from Illinois, Florida, and Cobb's Island, Virginia.

Rison, John L. Two bottles of mineral water from Alabama.

Rodgers, John. (See Washington, D. C., United States Fish Commission.)

Roessler, A. R. Twelve boxes of stone implements and minerals; from Tennessee and North Carolina. (Deposited.)

Rogers, Thomas. Specimens of shells; from England.

Roper, Capt. R. I., of schooner Esther Ward. (See Washington, D. C., United States Fish Commission.)

Rose, G. W. Specimens of ozockerite; from Utah.

Rose, Capt. Medeo, and crew of schooner Hiram Powers. (See Washington, D. C., United States Fish Commission.)

Ruth, J. A. Small collection of Indian relics; from Bucks County, Pennsylvania.

Ruckley, Capt. Charles, of schooner Wm. A. Pew. (See Washington, D. C., United States Fish Commission.)

Ruckley, Charles, schooner Electric Flash. (See Washington, D. C., United States Fish Commission.)

Ruckley, Capt. Charles, of schooner Frederick Gerring, jr. (See Washington, D. C., United States Fish Commission.)

Rucker, James S. Two boxes of ethnologica; from Indiana.

Ryan, John J. (See Washington, D. C., United States Fish Commission.)

Ryan, Capt. Joseph, and crew of schooner David A. Story. (See Washington, D. C., United States Fish Commission.)

Ryan, Matt., of schooner Lizzie. (See Washington, D. C., United States Fish Commission.)

Ryan Matt., of schooner Seth Stockbridge. (See Washington, D. C., United States Fish Commission.)

Salvin, Prof. O. Eight species, nineteen specimens, of birds; from the Gallapagos Islands.

Sawyer, David, schooner Constitution. (See Washington, D. C., United States Fish Commission.)

Sawyer, R. J. Specimen of California salmon (*Oncorhynchus quinnat*); from Green Bay, Michigan.

Sayer & Fisher. Samples of adamantine bricks from New Jersey.

Schanno, Joseph. Bulbs of the wild *Camas;* from Washington Territory.

Schneck, Dr. J. Collection of living turtles (*Malacoclemmys geographicus, M. pseudogeographicus, Cistudo clausa,* &c.); from Illinois.

Schuermann, C. W. Pouch of opossum with fœtal young, bottle of reptiles, and a living specimen of the stink-pot (*Aromochelys odoratus*); from Texas.

Schurz, Hon. Carl, Secretary of the Interior. Collection of minerals.

Scott, George W., of schooner Edwin C. Dolliver. (See Washington, D. C., United States Fish Commission.)

Scott, George W., of schooner H. A. Durham. (See Washington, D. C., United States Fish Commission.)

Scott, George W., schooner Mary Story. (See Washington, D. C., United States Fish Commission.)

Scudder, Newton P. Skins of the bobolink and blue-bird; from New York; also large collection of sea birds, marine animals, &c.; from the Grand Banks.

Seiler, D. W. Two trout affected with worms in bladder.

Sellman, Henry. Box of different preparations of sardines.

Sharp, J. M. Fragments of human skulls; from mounds in Louisiana.

Shean, John, schooner Ida May. (See Washington, D. C., United States Fish Commission.)

Shemelia, James P., of schooner Wm. H. Raymond. (See Washington, D. C., United States Fish Commission.)

Shepherd, R. T. Specimens of arrow-heads and Silurian shells; from Ohio.

Sherman, Gen. W. T. Two specimens of silicified wood; from Arizona.

Shoemaker, Ernest. Living snake (*Ophibolus getulus and Eutænia sirtatis*); from Virginia.

Sill, J. M. B. Mounted specimen of bunting; from Michigan.

Slater, Senator James H. Samples of coal; from Oregon.

Slatery, G. A. Stone sinker; from Maryland.

Small, E. E. Humpback whale (*Megaptera*); from Provincetown, Mass. (Purchased.)

Smith, D. Living snake (*Bascanion constrictor*); from Georgetown, D. C.

Smith, Edwin W., schooner Storm King, of Provincetown. (See Washington, D. C., United States Fish Commission.)

Smith, Greene. A large collection of birds' skins.

Smith, Prof. H. L. Mounted diatoms. (Purchased.)

Smith, John P. Eleven arrow-heads; from Maryland.

Smith, Mrs. Ruth L. Stone pestle, lent for casting.

Smith, Capt. Sewell W., and crew of schooner S. R. Lane. (See Washington, D. C., United States Fish Commission.)

Snow A. Specimen of mineral; from Tennessee.

Southwick, J. M. K. Samples of fishing-tackle; from Rhode Island.

Spainhauer, J. M. Insect; from North Carolina.

Spalding, R. W., through Rev. F. B. Scheetz. Hematite celt; from Missouri.

Spangler, George. Fresh specimen of buffalo-fish.

Spencer, Senator George E. Two specimens of minerals.

Spurr, Capt. Alfred, and crew of schooner J. T. Wonson. (See Washington, D. C., United States Fish Commission.)

Stabler, James P. Specimens of living snakes (*Eutænia sirtatis, Ophibolus doliatus triangulus, O. getulus*) and owl (*Scops asio*); from Maryland.

Stacy, Fred. (See Washington, D. C., United States Fish Commission.)

Starr, Frederick. Box of minerals; from New York.

Stearns, Silas. Specimens of fish (*Seriola, Pimelepterus, Batrachus, Carangus, Trachynotus, Ophichthys*), and sponges; from Florida.

Steed, Augustus M. Specimen of insect.

Steedman, Dr. J. G. W. Specimen of catfish (*Amiurus nigricans*), weighing 150 pounds, and two perch (*Morone interrupta*); from the Mississippi River.

Steele, Hon. Walter L. Specimens of rosy quartz crystals.

Steere, Professor J. B. Box of ancient pottery; from Brazil.

Stevens, Levi. Two boxes coke; from Illinois.

Stevenson, James. Large stone pestle; from near Great Salt Lake, Utah.

Stokes, John H. An insect taken from a piece of ore 50 feet below the surface of the ground.

Story, Lieut. J. P., Signal Service, U. S. A. Piece of telegraph-wire melted and disintegrated by lightning; from Texas.

Stout, W. C. Stag-beetle; from Arkansas.

Statford, W. O. Beetle (*Dynastes hercules*); from North Carolina.

Sturm, Isaac. Worm found in Madeira vine, Alabama.

Sumichrast, Prof. F. Box of birds and reptiles; from Tehauntepec.

Sutton, John W. Modern Japanese bow and arrows.

Surveyor-General's Office, San Francisco, Cal. Box minerals; from California.

Swan, James G. Specimens of fishes and shells, fiber of common nettle used by the Makah and Quillehayte Indians for lines and fish nets; also smelt-net made of nettle-fiber; from Neeah Bay, Washington Territory.

Sweet, William. Specimens of minerals; from New York.

Sweet, Capt. William, of schooner Grace C. Hadley. (See Washington, D. C., United States Fish Commission.)

Swigert, Lieut. S. M., U. S. A. Three dried fish skins.

Syme, George B. Specimens of minerals; from Wyoming.

Symmes, Rev. Francis. Cast of Indian stone implement; from Indiana.

Tate, Benjamin H. Specimen of Gila monster (*Heloderma suspectum*); from Arizona.

Taylor, Will. H. Two boxes of stone relics; from Tennessee. (Purchased.)

Tasmania, Government of, through H. M. Hall, Hon. Secretary Royal Commission. Specimens of *Ornithorhynchus* and *Tachyglossus*; from Tasmania.

Teller, Hon. H. M. Specimens of nickel ore; from Colorado.

Temple, J. H. Worked pieces of porphyry designed for implements.

Tevis, J. B. Specimen of fish (*Tetrodon lævigatus*); from Delaware Bay.

Thetford, S. B. Specimens of mineral.

Thompson, C. H., passed assistant paymaster, U. S. N. Silver enameled cigar-case, match-box, and tray of Siamese workmanship; also portrait of H. R. H. Princess Sei Velay Larna received by Paymaster Thompson from the King of Siam.

Thompson, D'Arcy W. Pressed sertularian from Australia and New Zealand.

Thompson, Henry. Specimen of ore; from Utah.

Thompson, Capt. William, and crew of schooner Magic. (See Washington, D. C., United States Fish Commission.)

Thorpe, T. M. Two shad (*Alosa sapidissima*); from the Washita River, Arkansas.

Tibbets, J. H. Mineral; from Washington Territory.

Tokio, Japan, Mombusho Museum, Fujimaro Tauska, Director. A collection of minerals and fishes; from Japan.

Toner, Dr. J. M. Living alligator (*Alligator Mississippiensis*); from Florida.

Townshend, Smith, M. D. A green oyster; sent for examination.

Trevoy, Capt. Edward, and crew of schooner Proctor Brothers. (See Washington, D. C., United States Fish Commission.)

Tristram, Rev. H. B. Specimens of New Caledonian birds.

True, F. W. Specimens of living turtles and snakes; from Washington, D. C.

Tuggle, W. O. Stone implement; from Georgia.

Tuller, A. Eggs of mud hen; from California.

Turin, Italy, Royal Zoological Museum of Turin. A collection of mammals and reptiles, in alcohol; from Italy.

Turner, L. M. Twenty-five boxes of general natural history and ethnological collections; from Alaska.

Tyler, E. Specimens of herring; from Lake Ontario, New York.

Valentine, M. S. Stone ax; lent for casting.

Van Dyck, W. T. Parasite taken from Tamias.

Van Wyck, P. A. M. Specimens of fish (*Pomolobus mediocris and P. vernalis*); from the Hudson River.

Vaux, William S. Specimens of garnets and mica schist; from Fort Wrangel, Alaska.

Velie, Dr. J. W. Box of alcoholic specimens of Florida fishes and two ruddy ducks.

Vibert, Capt. John, and crew of schooner Argonaut. (See Washington, D. C., United States Fish Commission.)

Wadsworth, Capt. Thomas, and crew of schooner Conductor. (See Washington, D. C., United States Fish Commission.)

Walker, H. W. Specimen of mineral.

Walker, S. T. Sixteen boxes of birds, living and alcoholic reptiles, insects, birds' nests, human crania, and ethnological collections; from Florida.

Wallace, John. Mounted *Bassaricyon gabbii* (purchased).

Wallace, Rev. Peter. Indian stone ornament; (lent for casting).

Wallace, Rev. S. J. Small hematite celt; (lent for casting).

Waller, Mr. Specimen of duck; from Virginia.

Washington, D. C.:

Interior Department:

General Land Office. (See under the names of *Surveyors-General A. R. Hardenburg, R. C. Mason*, and *John Mason.*)

Navy Department:

Bureau of Steam Engineering. (See under the names of *Passed Assistant Engineers G. W. Baird* and *J. M. Emanuel.*)

Navigation Bureau, Capt. W. D. Whiting. Box of soundings made by the U. S. S. Essex, W. S. Schley commander, off the coasts of Africa and South America.

United States Navy. (See under the names of *Lieut. Commander H. Gorringe and Lieut. C. Belknap, G. M. Book, Capt. D. G. MacRitchie.*)

Treasury Department:

United States Mint, Philadelphia, Pa. Hon. R. E. Preston, acting director. Copies of the annual assay medal.

Washington, D. C.—Continued.

United States Commission of Fish and Fisheries. (*Prof. Spencer F. Baird, Commissioner.*) One hundred and forty-one packages zoological collections from Provincetown and Gloucester, Mass., and vicinity, put up by *Prof. A. E. Verrill*, *G. Brown Goode*, and *Tarleton H. Bean.* (See also under the names of *Charles G. Atkins*, *Tarleton H. Bean*, *H. C. Chester*, *F. N. Clark*, *Vinal N. Edwards*, *G. Brown Goode*, *James W. Milner*, and *Livingston Stone.*) Specimens have also been obtained by the Commission from the following parties:

Alden, Capt. Oscar W., and crew of the schooner Andrew Leighton. Rock covered with crustaceans and sea-anemone.

Allen, George K., schooner Gertie Foster. Portion of skull of black-fish.

Anderson, Capt. Charles, and crew of the schooner Alice G. Wonson. A large collection of corals (*Primnoa reseda*, *Paragorgia*, &c.), star-fishes, ascidians, barnacles, and rudder-fish (*Palinurichthys perciformis*).

Ardendale, Edward, schooner Sea Foam. Spiny spider-crab (*Lithodes maia*); from off Jeffrey's Ledge.

Brown, James, schooner David A. Osier. Living pipe-fish (*Siphonostoma*); from off Plymouth, Mass.

Burnham, E. K. Several very large cod and hake sounds.

Campbell, Capt. David, and crew of schooner Admiral. A collection of fishes (*Myxine glutinosa*, *Simenchelys parasiticus*, *Petromyzon marinus*, *Scopelus*, *Synaphobranchus pinnatus*, *Anarrhichas minor*), corals, sea-feathers, anemones, star-fishes, &c.; from the Grand Banks and Banquereau.

Cavanaugh, Capt. John, and crew of schooner Alfred Whalen. Rock covered with sponges and shells, hermit crabs, &c.; from George's Bank.

Collins, Capt. David E., and crew of schooner Gussie Blairsdell. Specimens of star-fish, sea-cucumbers, corals, bryozoans, &c., from George's Bank.

Collins, Capt. John and crew, schooner Albert H. Hasting. Specimens of fishes (*Phycis*, *Clupea*, *Trachurus*, *Prionotus*, *&c.*), beetles, lobsters, &c.; from off South Shoal light ship.

Collins, Capt. Joseph W., and crew of schooner Marion. A collection of fishes (*Somniosus*, *Synaphobranchus*, *Zoarces*, *Macrurus*, *Centroscyllium*, &c.) corals (*Alcyonium*, *Paragorgia*), star-fishes, sponges, &c.; from the Grand, George's, and Banquereau banks.

Critchett, Capt. John F., and crew of schooner Commonwealth. Specimens of corals (*Primnoa*, &c.), spider-crabs (*Lithodes*), and star-fishes; from George's Bank.

Crooks, Nathaniel, schooner Helen M. Dennis. Eggs of mollusk; from George's Bank.

Cunningham Capt. Augustus, schooner Geo. A. Upton. Sea-mouse (*Aphrodita*), taken from stomach of cod, caught off coast of Nova Scotia.

Curtis, Capt. George H., and crew of schooner Conductor. Specimens of corals (*Acanthogorgia*), sea-feathers, star-fishes, sea-anemones, &c.; from Banquereau.

Curzon, Captain, schooner Mist. Vertebra of whale; from Grand Banks.

Dodd, Andrew W. Jaw-bone of black-fish, taken on Coffin's Beach, Ipswich Bay.

Dolliver, Captain Peter and crew of schooner Grace L. Fears. Specimens of great northern sea-feather (*Pennatula borealis*), warty sea-rose (*Urticina*), fishes (*Synaphobranchus* and *Alepidosaurus*), &c.; from La Have Bank.

Douglass, Albert. Webb-fingered sea-robin (*Prionotus carolinus*); from off Norman's Woe.

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

Dyer, Captain, of Provincetown, Mass. Piece of skin, two teeth of sperm-whale, and tooth of alligator; from the West Indies.

Forbes, Maurice, schooner Eastern Light. A curious piece of perforated clay slate, in the shape of a horse's hoof, taken from Grand Bank.

Fowles, Frank, schooner Young Sultan. Specimens of fish (*Sebastes, Petromyzon, Anarrhichas, Leptoblennius*, &c.), star-fish, corals, sea-anemones, &c., from off Gloucester, Mass.

Fowles, Capt. M. V., and crew of schooner Young Sultan. Specimens of Norway haddock (*Sebastes*), sea-anemones, holothurians, &c., from off Gloucester, Mass.

Friend, George. Two specimens of split and dried leopard-fish (*Lopholatilus chæmeleonticeps*).

Friend, Samuel. Osseous growth, taken from head of fifty-pound codfish.

Getchell, Capt. John Q., and crew of schooner Otis P. Lord. Specimens of fish (*Sebastes, Ammodytes, Pomolobus, Cyclopterus, Squalus, Myxine, Prionotus, Clupea*), &c.; sponges, corals, crabs, sea-anemones, bryozoans, &c.; from Brown's and George's Banks.

Gill, Capt. Russell G., and crew of schooner Maud Gertrude. Large golden codfish, from Ipswich Bay, and flukes and part of the shank of an anchor of pattern used thirty years ago, covered with varieties of marine animals; taken off Gloucester, Mass.

Gilpatrick, Capt. Briggs, and crew of schooner Herbert M. Rodgers. Specimens of fish (*Alepidosaurus, Synaphobranchus, Myxine, Petromyzen, Centroscyllium*, &c.); corals (*Aconella*), sponges, sea-feathers, &c.; from Banquereau.

Gilpatrick, Capt. Gilman, schooner Seth Stockbridge. Stones covered with sponges and corals, and a crab; from Banquerean.

Goldsmith, J. B. Specimens of fungus (*Phallus impudicus*); from Rockport, Mass.

Goodwin, Capt. Thomas, and crew of schooner Howard. Specimens of fishes (*Centroscymnus, Chimæra, Synaphobranchus, Macrurus, Haloporphyrus, Myxine*, &c.); corals, star-fishes, sponges, sea-feathers, anemones, &c.; from Grand Banks.

Gorman, Capt. John, and crew of schooner Geo. S. Boutwell. Specimens of fishes (*Lophopsetta, Scomberesox, Hemitripterus*), hermit crab, and a large sea-mouse (*Aphrodita*); from Western Bank.

Gourville, Capt. John, and crew of schooner Rebecca Bartlett. Specimens of fishes (*Zoarces, Murænoides, Liparis*), corals, anemones, hydroids, bryozoans, &c.; principally from George's Bank.

Gott, Addison. Rock, taken from George's Bank in 1876 by schooner Rival.

Greenleaf, Capt. Nathaniel, and crew of schooner Grace L. Fears. Specimens of fishes (*Macrurus, Centroscyllium, Anarrhichas*), &c., corals, star-fishes, sponges, sea-feathers, &c.; from Banquereau and the Grand Banks.

Greenleaf, Capt. Thomas F., and crew of schooner Chester R. Lawrence. Specimens of corals (*Paragergia* and *Keratoisis*), star-fishes (*Asterias stellionura*) sponges, hydroids, &c.; from Banquereau.

Greenwood, Captain, and crew of schooner Sultana. Specimens of crabs, lobsters, corals, sponges, sea-lemons (*Boltenia*), and sea-cucumbers (*Pentacta*); from Clark's Bank.

Hamlin, Capt. Peter, and crew of schooner Andrew Leighton. Specimens of corals and fishes; from Banquereau.

Herrick, Capt. William, schooner Augusta Herrick. Specimens of *Hypsiptera argentea*, found on deck while dressing mackerel; lance (*Ammodytes*), &c.; from George's Bank.

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

Hodgdon, Capt. Thomas, and crew, of schooner Bessie W. Somes. Specimens of sea-feathers (*Pennatula borealis* and *Balticina Finmarchica*) and sea-anemones; from the Grand Banks.

Hodgdon, Capt. W. F., and crew, of schooner Procter Brothers. Specimens of fishes (*Synaphobranchus* and *Petromyzon*), corals (*Acanthogorgia, Paragorgia*), sea-feathers, &c.; from Western Bank.

Holbrook, Joseph E., schooner Jennie T. Phillips. Specimen of cramp or torpedo fish (*Torpedo occidentalis*), weighing 250 pounds; taken ten miles south of Gloucester, Mass.

Hoy, George W., schooner Mary F. Chisholm. A very beautiful specimen of great tree-coral (*Paragorgia arborea*), nearly five feet high and three feet broad, and some basket star-fish (*Astrophyton*); from the Grand Banks.

Hoyt, Edward F. A specimen of pipe-fish (*Siphonostoma*).

Hoyt, W. E. Specimen of sea-bass (*Centropristris*); taken in weir off Norman's Woe.

Hurlbert, Capt. R. H., schooner Sultana. Specimens of shells, hydroids, bryozoans, ascidians, holothurians, &c.; from George's Bank.

Hurlbert, Capt. William, schooner Franklin S. Scheck. Specimen of finger-sponge (*Chalina*); from off Sankoty Head, Mass.

Johnson, Capt. Benjamin, schooner Alaska. Specimens of sea-mice (*Aphroditea*); from George's Bank.

Johnson, Capt. Charles, schooner Lucille Curtis. Specimens of crabs (*Neptunus Sayi*); from N. lat. 20° 45′, W. long. 61° 32′; shrimps from N. lat. 25° 14′, W. long. 59° 33′; also specimens of fish from South America and the West Indies.

Johnson, Capt. Christian, schooner William Thompson. A specimen of fish new to science (*Alepocephalus bairdii*); from the Grand Banks.

Johnson, Capt. George A., and crew, of schooner Augusta Johnson. Specimens of fishes (*Macrurus Fabricii, M. bairdii, Scombresox, Centroscymnus, Centroscyllium, Macrurus rupestris, Synaphabranchus*), corals, sponges, sea-feathers, &c.; from Banquereau.

Johnson, Capt. Otis, schooner Helen M. Dennis. Specimen of finger-sponge (*Chalina*); from Brown's Bank.

Johnson, Capt. P., schooner John Smith. Specimen of lamper-eel (*Petromyzon*), sea-corn (eggs of *Buccinum*); from Brown's Bank.

Kirby, Capt. William, schooner Wm. V. Hutchings. Specimens of important food fish new to science (*Lopholatilus chamæleonticeps*); from off Noman's Land; and ghost-fish (*Cryptacanthodes*), barnacles, star-fishes, sea-anemones, &c.; from George's Bank.

Lee, Thomas. A very rare squid (*Loligopsis pavo*); from the edge of the Gulf Stream.

Ligsworth, Capt. John E., and crew, of schooner Mary Story. Specimens of sponge (*Phakellia*) and hydroids attached to rock; from La Have Bank.

Low, John. A large branch of tree-coral (*Primnoa reseda*); from George's Bank.

Lurvey, William. Specimens of sea-corn (eggs of *Buccinum*).

McCalib, Vinal. A young blue-fish (*Pomatomus saltatrix*); from Gloucester Harbor.

McCauley, Mr., schooner Wachusett. Specimens of fishes (*Synaphabranchus* and *Myxine*), sea-feathers (*Pennatula, Balticina*), corals (*Acanella, Keratoisis*), star-fishes, &c.; from Banquereau.

McCormack, Capt. John, and crew, of schooner Wachusett. Specimens of tree-coral (*Paragorgia arborea*), sea-feather (*Balticina Finmarphica*), basket-fish (*Astrophyton*), sea-anemones, sponges, &c.; from Banquereau.

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

McDonald, Capt. James, and crew, of schooner Magic. Specimens of corals (*Acanella, Flabellum*), sponges (*Phakellia*), sea-cauliflowers, &c.; from Grand Banks.

McDonald, Capt. James, and crew, of schooner Willie M. Stevens. Specimens of fishes (*Scomberesox*), basket-fish (*Astrophyton*), &c.; from La Have Bank.

McDonald, Lewis. A large perforated rock covered with hydroids and bryozoans; from North Bay.

McDonald, Capt. William, and crew, of schooner N. H. Phillips. Specimens of fishes (*Lycodes, Macrurus*), corals, sponges, &c.; from Grand Banks.

McEachern, Daniel, schooner Rutherford B. Hayes. Two chicken-halibut (*Hippoglossus vulgaris*), from Jeffrey's Bank, and two small flying-fish (*Exocœtus*).

McEachern, Daniel, schooner Guy Cunningham. Specimens of fishes (*Macrurus, Scopelus, Myxine*), sea-feathers, star-fish, corals, sponges, &c.; from the Grand Banks.

McGraw, Philip. A small stickle-back (*Gasterosteus pungitius*); from Gloucester Harbor.

McInnis, Capt. John, and crew, of schooner M. H. Perkins. Specimens of fishes (*Ammodytes, Myxine, Synaphobranchus*), sea-feathers (*Virgularia, Pennatula*), star-fishes (*Asterias, Hippasterias*), sponges, anemones, &c.; from off Newfoundland, Sable Island, and La Have.

McIntosh, Capt. Colin, and crew, of schooner Nathaniel Webster. Specimens of fishes (*Synaphobranchus*), sea-feathers (*Pennatula*), warty sea-rose (*Urticina*), corals (*Acanella*); from Western Bank.

McKinnon, Capt. Daniel, and crew, of schooner Mary F. Chisholm. Specimens of fishes (*Myxine*), corals (*Primnoa, Alcyonium, Flabellum*), sponges, star-fishes, sea-anemones, &c.; from Banquereau.

McKinnon, Capt. John, and crew, of schooner Rutherford B. Hayes. Specimens of fishes (*Sebastes, Cyclopterus, Myxine, Zoarces, Merlucius, Cryptacanthodes, Melanogrammus, Hippoglossus*, &c.), star-fishes (*Asterias, Ctenodiscus*), worms, crustaceans, &c.; from George's Bank.

McKinnon, Capt. John, and crew, of schooner Ivanhoe. A small devil-fish (*Octopus bairdii*); from Jeffrey's Ledge.

McKinnon, Thomas. A specimen of American sole (*Achirus lineatus*); from Brown's Bank.

McPhee, Capt. Neil, and crew, of schooner Carl Schurz. Specimens of coral (*Acanella*), sea-feather (*Balticina*), sea-rose (*Urticina*), anemones, &c.; from Banquereau.

Mansfield, James, and sons. Specimens of cod-fish, with small fish imbedded in flesh; from Grand Banks.

Marchant, Capt. Jabez. Portion of jaw of shark, with teeth.

Markuson Capt. K., and crew, of schooner Notice. Specimens of fishes (*Macrurus*), corals, sea-feathers, star-fishes, shells, &c.; from Banquereau.

Martin, Capt. Charles, and crew, of schooner Martha C. A fine specimen of honey-comb coral, from off Cape Negro, N. S.; and rock-eel (*Murœnoides gunnellus*); from Gloucester Harbor.

Martin, Capt. George H., and crew, of schooner Northern Eagle. Specimens of fishes (*Zoarces, Raia, Seriola, Cyclopterus*, &c.), star-fishes, &c.; from Ipswich Bay.

Merchant, George. Specimen of cake-urchin (*Echinachnius parma*), from Narragansett Bay; also specimens of quartz and mica, &c., from Barnegat.

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

Merchant, Orlando. A perfect specimen of rock-eel (*Murænoides gunnellus*).

Merchant, Capt. Phillip, and crew, of schooner Marion. Specimens of fishes (*Synaphobranchus, Anarrhichas, Macrurus, Myxine, Stomias, Chimæra*, &c.), corals, sponges, star-fishes, anemones, &c.; from Banquereau and the Grand Banks.

Morrissey, Capt. James D., and crew, of schooner Plymouth Rock. Specimens of fishes (*Haloporphyrus, Centroscyllium*) corals, star-fishes, sponges, sea-feathers, &c.; from Grand Banks.

Morrissey, Capt. James D., and crew of schooner Alice M. Williams. Specimens of fishes (*Sebastes, Scopelus*), sea-feathers (*Balticina*), and basket star-fish; from the Grand Banks.

Morrison, Capt. R. L., and crew, of schooner Laura Nelson. Specimens of slime-eels (*Myxine glutinosa*), corals (*Alcyonium*), sea-anemones, &c.; from the Grand Banks.

Moulton, Capt. Charles V., and crew, of schooner Peter D. Smith. Specimens of fishes (*Squalus, Prionotus, Petromyzon, Centroscyllium, Centroscymnus, Synaphobranchus*), corals (*Primnoa, Paragorgia, Acanella, Acanthogorgia, Alcyonium*, &c.), sponges, &c.; from George's and Clark's Banks.

Murphy, Capt. C. D., and crew, of schooner Alice M. Williams. A collection of corals (*Alcyonium, Primnoa, Keratoisis, Acanella*), sea-feathers, star-fishes, lamp-shells, anemones, &c.; from the Grand Banks.

Murphy, Capt. Thomas, and crew, of schooner William H. Oakes. Specimens of slime-eel (*Myxine glutinosa*), bush-coral (*Primnoa reseda*), sea-feathers (*Balticina Finnmarchica*), and basket star-fish; from Banquereau.

Nelson, Capt. Andrew, schooner Carlton. Rock covered with bryozoans and barnacles, and a finger-sponge (*Chalina*); from Brown's and George's Banks.

Nickerson, Capt. James, and crew, of schooner Commonwealth. Specimens of fishes (*Synaphobranchus, Myxine*), sea-feathers, sponges, sea-anemones, &c.; from the Grand Banks.

Nickerson, Capt. James, and crew, of schooner Bellerophon. Specimens of bush-coral (*Acanella Normani*), sea-feathers (*Pennatula borealis*), warty sea-rose (*Urticina*), and shells; from La Have Bank.

Norwood, Ferdinand. Specimens of sea-robin (*Prionotus carolinus*); caught off Rockport, Mass.

Olsen, Capt. Christian, and crew, of schooner William Thompson. Four alcyonium corals, tube-making actiniana (*Cerianthus borealis*), and a number of basket star-fish; from Grand Banks.

Olsen, Capt. George, and crew, of schooner Willie M. Stevens. Specimens of fishes (*Palinurichthys, Simenchelys, Anarrhichas, Synaphobranchus, Petromyzon, Scopelus*, &c.), corals (*Flabellum Goodei*), sea-feathers (*Pennatula*), star-fishes, &c.; from Banquereau.

Olsen, Capt. Thomas, and crew, of schooner Epes Farr. Specimens of fishes (*Cyclopterus, Simenchelys, Synophabranchus*, &c.), corals (*Primnoa, Keratoisis, Paragorgia*), sea-feathers (*Pennatula, Balticina*), star-fishes, anemones, &c.; from Banquereau.

Olsen, Capt. Thomas, and crew, of schooner Polar Wave. Specimens of pug-nosed eels, eggs of *Buccinum*, sea-feathers (*Pennatula borealis*) and anemones; from the Grand Banks.

Parks, Capt. Matthew, and crew, of schooner Davy Crockett. Specimens of fishes (*Synaphobranchus*), sea-mice (*Aphrodytes*), crabs, worms, &c.; from the Grand Banks.

Peeples, William A., and crew, of schooner Addison Center. Specimens of fishes (*Synaphobranchus, Simenchelys*), corals (*Keratoisis, Paragorgia, Acanella*),

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

sponges, sea-feathers (*Pennatula*), shells (*Terebratulina, Neptunea*), anemones, &c.; from Banquereau.

Perkins, E., schooner Grace L. Fears. Specimens of fishes (*Myxine, Eumicrotremus*), star-fishes (*Asterias, Hippasterias*, &c.), corals, sponges, sea-feathers, anemones, &c.; from the Grand Banks.

Rodgers, John. A living hair-worm (*Gordius*).

Roper, Capt. R. I., schooner Esther Ward. Rock covered with shells, barnacles, and hydroids; from George's Bank.

Rose, Capt. Medeo, and crew, of schooner Hiram Powers. Specimen of Norway haddock (*Sevastes marinus*); from Jeffrey's Bank.

Ruckley, Charles, schooner Electric Flash. Specimens of fishes (*Cyclopterus, Phycis, Lophopsetta, Gasterosteus*), squid (*Ommastrephes*), and sand-fleas; from off Seguin Light, Maine.

Ruckley, Charles, schooner Frederic Gerring, jr. Specimens of slime-eels (*Myxine glutinosa*), corals, sponges, crustacea, star-fishes, &c.; from the Grand Banks.

Ruckley, Capt. Charles, schooner William A. Pew. Rock covered with shells, hydroids, and bryozoans; from George's Bank.

Ryan, John J. Perforated rock; from George's Bank.

Ryan, Capt. Joseph, and crew, of schooner David A. Story. Specimens of sponges, (*Phakellia*, &c.); from the Grand Banks.

Ryan, Matthew, schooner Lizzie. Specimens of fishes (*Scopelus*), star-fishes, corals, and two tube-making actinias; from the Grand Banks.

Ryan, Matthew, schooner Seth Stockbridge. Specimens of sea-anemones, sea-feathers (*Pennatula borealis*), &c.; from Green Bank.

Sawyer, David, schooner Constitution. Ovaries of blue-shark; from Middle Bank.

Scott, George W., schooner Edwin C. Dolliver. Specimens of fishes (*Macrurus, Synaphobranchus*, &c.), sea-feathers (*Pennatula borealis, P. aculata, Balticina Finnmarchica*), craw-fishes, star-fishes, shells, &c.; from Sable Island Bank.

Scott, George W., schooner, H. A. Duncan. Specimens of fishes (*Macrurus, Sebastes, Haloporphyrus, Centroscyllium, Myxine*), corals, sea-feathers, sponges, &c.; from the Grand Banks.

Scott, George W., schooner Mary Story. Specimens of fishes (*Sebastes, Orcynus, Lophopsetta, Achirus, Pomatomus*), shells (*Pecten, Modiola, Cyrptodaria*, &c.), crustacea, sponges, hydroids, worms, &c.

Shean, John, schooner Ida May. Specimens of herring (*Clupea harengus*); from off Norman's Woe.

Shemelia, Joseph P., schooner Wm. H. Raymond. Specimens of fishes and shells; from George's Bank.

Smith, Edwin, W., schooner Storm King. Specimens of coral, sea-fan (*Gorgonia*), and plastrons of large turtles; from Grand Cayman, West Indies.

Smith, Capt. Sewell W., and crew, of schooner S. R. Lane. Specimens of fishes (*Petromyzon, Myxine, Synaphobranchus, Haloporphyrus*, &c.), corals (*Alcyonium, Acanthogorgia*, (star-fishes) *Crossaster*, &c.), sea-feathers (*Virgularia, Balticina*), anemones, &c.; from the Grand Banks and other localities.

Spurr, Capt. Alfred, and crew, of schooner J. F. Wonson. Specimens of star-fishes, anemones, ascidians, hydroids, &c.; from off Chatham Island, Mass.

Stacy, Fred. A large smelt (*Osmerus mordax*), taken in Squam River.

Sweet, Capt. William, schooner Grace C. Hadley. Specimens of fishes (*Sebastes*), star-fishes, sponges, crabs, shells, &c.; from George's and Brown's Banks.

Washington, D. C.—Continued.

U. S. Commissioner of Fish and Fisheries—Continued.

Thompson, Capt. William, and crew, of schooner Magic. Specimens of capelin (*Mallotus villosus*), sea-feathers (*Pennatula, Virgularia*), corals, star-fishes, &c.; principally from Banquereau.

Trevoy, Capt. Edward, and crew, of schooner Procter Brothers. Specimens of sea-anemones and barnacles; from Grand Banks.

Vibert, Capt. John, and crew, of schooner Argonaut. Specimens of sponges, shells, bryozoans, crustaceans, &c.; from the Grand and Western Banks.

Wadsworth, Capt. Thomas, and crew, of schooner Conductor. Specimens of Norway haddock (*Sebastes marinus*), and a perfect individual of a rare fish (*Scopelus* sp.), that was washed on board the vessel; from the Grand Banks.

Wells, Capt. Michael, schooner Water Spirit. Specimens of star-fishes and sea-spiders; from Western Bank.

Williams, Frank. A fine specimen of bill-fish (*Scomberesox saurus*); from the Squam River.

Wilson, Charles. Egg-cases of the shell-fish (*Sycotypus canaliculatus*); from Providence River.

Wilson, Henry, schooner Flash. Specimens of boring-sponge, sea-anemones, warty sea-rose, (*Urticina*), star-fishes, shells, and three Kittiwake gulls, (*Rissa tridactyla*); from the Grand Banks.

Wilson, John J., schooner Polar Wave. Specimens of fishes (*Centroscyllium, Centroscymnus, Synaphabranchus, Lycodes,*) corals (*Primnoa, Paragorgia, Acanthogorgia, Acanella, Alcyonium, Anthromastus*), star-fishes, sponges, anemones, &c.; from George's Bank.

Wonson, Everett P. A fine collection of several varieties of bryozoans (*Flustra,* &c.,) taken by schooner Reporter on the Grand Banks; also a rare holothurian from off Gloucester.

Wonson, John F. A large boulder covered with bryozoans, shells, hydroids, sponges, &c.; from George's Bank.

Wonson, Samuel G., schooner John S. McQuinn. Specimens of fishes, (*Phycis, Palinurichthys, Lophius, Squalus, Petromyzon*), and samples of mackerel-food (*Scomber scombrus*), taken off the coasts of Maine and Massachusetts.

Woodbury, Capt. J., schooner Barracouta. Rock covered with barnacles, hydroids, sponges, and shells from the George's Bank.

War Department:

Signal Service. (See under the names of *Privates E. W. Nelson* and *L. M. Turner*.

Surgeon-General's Office, Army Medical Museum. Specimen of snake from Fort Davis, Tex. (See also under the names of *Drs. R. T. Burr, Elliott Coues, B. J. D. Irwin,* and *Hospital Steward A. Gecks.*

Surveys west of the one-hundredth meridian (*Capt. G. M. Wheeler in charge*). Sixty-four boxes of minerals and volcanic rocks; a large collection of birds' skins, eggs, and nests; specimens of mammals, fishes, reptiles, and insects.

United States Army. (See under the names of *General W. T. Sherman, General M. C. Meigs, Col. A. G. Brackett, Lieuts. H. Metcalfe, S. M. Swigert, J. P. Jefferson.*)

Wasson, Hon. John, surveyor-general Arizona. Specimens of minerals of various mines in Pinal, Pima, and Yamapai Counties, Arizona.

Wayman, J. F. Small box of fossils from West Virginia.

Webb, John S. Specimens of shells from Kentucky.

Weigel, John. Specimen of hair-snake (*Gordius aquaticus.*)

Wells, Capt. M. and crew, of schooner Water Spirit. (See Washington, D. C., United States Fish Commission.)

Wheatley, Charles M. Specimens of minerals.

Wheeler, Capt. George M., U. S. A. (See Washington, D. C., survey west of the one hundredth meridian.)

Wheeler, L. R. Specimen of mineral.

Whitney, Oscar M. Catlinite figure-pipe (lent for casting).

Widman, Otto. Nests and eggs of *Empidonax traillii* and *E. acadicus.*

Wilkinson, E., Jr. Box of beetles; from Central and South America.

Willcox, Joseph. A box of minerals; from Pennsylvania. Crystals of staurolite; from Georgia.

Williams, Charles. Living snake (*Cyclophis æstivus*).

Williams, Rev. C. Foster. Collection of stone relics (lent for examination)

Williams, Frank, through Procter Brothers. (See Washington, D. C., United States Fish Commission.)

Williams, Joseph. Malformed hen's egg.

Wilson, Charles. (See Washington, D. C., United States Fish Commission.)

Wilson, Henry, schooner Flash. (See Washington, D. C., United States Fish Commission.)

Wilson, John I., schooner Polar Wave. (See Washington, D. C., United States Fish Commission.

Wilson, R. A. Specimens of minerals; from Ohio.

Wiltheiss, C. T. Two inscribed tablets; from Ohio.

Windom, Senator William. Specimens of ore; from Minnesota.

Wingate, Dr. J. D. Specimens of fossils; from Pennsylvania.

Woltz, Willie. Specimens of fish (*Acipenser oxyrhynchus* and *Lepidosteus osseus*); from the Potomac River.

Wonson, Everett P. (See Washington, D. C., United States Fish Commission.)

Wonson, John F. (See Washington, D. C., United States Fish Commission.)

Wonson, Samuel S., schooner John S. McQuinn. (See Washington, D. C., United States Fish Commission.)

Woodbery, Capt. J., schooner Barracouta. (See Washington, D. C., United States Fish Commission.)

Woodbury, Eldridge. Specimen of vertebræ of whale; from Massachusetts.

Wood, John E. Specimen of soapstone; from Virginia.

Wood, Preston. Specimens of stone relics; from Illinois.

Woodward, A. J. Specimens of living snakes and skins of rattlesnake *Crotalus adamanteus*); from Florida.

Wooldridge, George. Tail of ray; from Florida.

Wooldridge, Mrs. Two small living alligators; from Florida.

Wooster, A. F. Specimens of birds' nests and eggs, and arrow-heads.

Worthen, C. K. Two boxes of birds' skins.

Yarrow, Dr. H. C., U. S. A. Living snake (*Heterodon platyrhinus*), from New Jersey.

Yates, Dr. L. G. Human crania, &c., from cave in Alameda County, California.

Zimmerman, G. W., through F. G. Galbraith. Carved stone head of Indian design; from Pennsylvania.

Unknown. Specimens of minerals from Virginia, Georgia, &c.; specimens of fish (*Raia* and *Diodon*); two living owls (*Bubo virginianus*); arrow-heads, celts, &c.; insects, cocoons, &c., and plants.

STATISTICS OF EXCHANGES.*

BOXES SENT ABROAD IN 1879.

Country.	Smithsonian exchanges.	Government exchanges.	Total.
AMERICA.			
Argentine Confederation	3	2	5
Bahamas	1		1
Barbadoes	2		2
Brazil	3	1	4
British Guiana	1		1
Canada*		2	2
Chili	2	1	3
Costa Rica	1		1
Cuba	3		3
Ecuador	3		3
Guatemala	1		1
Hayti		1	1
Jamaica	1		1
Mexico	4	1	5
St. Thomas	1		1
Trinidad	2		2
Uruguay	1		1
United States of Colombia	1		1
Venezuela	1	1	2
West Indies	1		1
ASIA.			
Japan	2	1	3
AUSTRALIA.			
New South Wales	2	1	3
New Zealand	3	1	4
Queensland		1	1
South Australia	1	1	2
Tasmania		1	1
Victoria	2	1	3
EUROPE.			
Belgium	5	1	6
Denmark	4	10	14
France	29	11	40
Germany and Austria	63	14	77
Great Britain	52		52
Greece	2	1	3
Italy	13		13
Netherlands	7	1	8
Norway	3	1	4
Portugal	3	1	4
Russia	10		10
Spain	3	1	4
Sweden	7	1	8
Switzerland	7	1	8
Turkey	1	1	2

RECAPITULATION.

America	32	9	41
Asia	2	1	3
Australia	8	6	14
Europe	209	44	253
Total	251	60	311

*The list of Smithsonian exchanges for Canada is contained in the report on domestic exchanges.

NOTE.—Number of boxes, 311; bulk in cubic feet, 2,177; weight in pounds, 69,975; containing 14,659 miscellaneous packages, of which 25 contained specimens of natural history.

PACKAGES RECEIVED BY THE SMITHSONIAN INSTITUTION FROM EUROP ETC., FOR DISTRIBUTION IN AMERICA.

	1879.
ALABAMA.	
Tuscaloosa:	
Alabama University	1
Geological Survey of Alabama	2
ARIZONA.	
Prescott:	
Territorial Library	2
ARKANSAS.	
Holly Grove:	
Literary Institute	1
Little Rock:	
Governor of Arkansas	4
State Library	8
CALIFORNIA.	
Oakland:	
University of California	22
Sacramento:	
Agricultural and Horticultural Society	3
Medical Society of California	1
State Agricultural Society	2
State Library	2
San Francisco:	
Academy of Sciences	105
California Historical Society	1
Mercantile Library Association	1
Geological Society	2
Geological Survey of California	6
Stockton:	
Society of Natural History	5
COLORADO.	
Denver:	
Agricultural Society	1
Governor of Colorado	2
Territorial Library	2
Golden:	
School of Mines	2
CONNECTICUT.	
Hartford:	
Board of Agriculture	1
Connecticut Society of Natural History	1
State Agricultural Society	1
Young Men's Institute	1
Middletown:	
Wesleyan College	2
New Haven:	
American Journal of Arts and Sciences	72
American Oriental Society	39
Connecticut Academy of Sciences	164
Sheffield Scientific School	2
State Board of Agriculture	2
Yale College	27
Yale College Observatory	1
DISTRICT OF COLUMBIA.	
Georgetown:	
Georgetown College	5
Georgetown College Observatory	2
Washington:	
Agricultural Department	119
American Medical Association	37
Army Medical Museum	6
Botanic Garden	1
Coast Survey	53
Census Bureau	11
Columbian University	2
Construction, Bureau of	1

	18
DISTRICT OF COLUMBIA—Continued.	
Washington—Continued.	
Corporation of city	
Education, Bureau of	
Engineer Bureau	
Entomological Commission	
Geological Survey of the Territories	1
Governor of the District of Columbia	
Hydrographic Office	
Indian Commissioners	
Interior Department	
Land Office	
Library of Congress	
Light-House Board	
Marine Hospital	
Mint, Director of	
National Academy of Sciences	1
National Museum	
Nautical Almanac	
Naval Observatory	
Navigation, Bureau of	
Navy Department	
Ordnance Office	
Patent Office	
Philosophical Society	
Provost-Marshal-General	
Signal Office	
Spencerian Business College	
State Department	
Statistics, Bureau of	
Surgeon-General's Office	
Treasury Department	
War Department	
Washington Sentinel	
FLORIDA.	
Tallahassee:	
Academy of Tallahassee	
GEORGIA.	
Savannah:	
Historical Society of Georgia	
Atlanta:	
City Library	
ILLINOIS.	
Carbondale:	
Southern Illinois Normal University	
Chicago:	
Academy of Science	10
American Electrical Society	
Astronomical Society	
Board of Trade	
Dearborn Observatory	
Free Library	
Museum of Natural History	
Observatory	
Public Library	3
Society of Natural History	
University	
State Microscopical Society	
Galesburg:	
Academy of Music	
Lombard University	
Moro:	
American Pomological Society	
Normal:	
State Natural History Society	1
Rock Island:	
Augustana College	
Springfield:	
Geological Survey	
State Board of Agriculture	
State Library	

	1879.
INDIANA.	
encastle:	
University	1
ianapolis:	
y of Science	7
cal Society	1
cal Survey of Indiana	6
Historical Society	2
ibrary	1
mond:	
nd Scientific Association	1
IOWA.	
enport:	
y of Natural Sciences	100
rah:	
ian Lutheran College	5
Moines:	
r of Iowa	4
orticultural Society	2
brary	1
niversity	1
uque:	
stitute of Science and Arts	7
a City:	
istorical Society	2
niversity	17
KANSAS.	
venworth:	
Academy of Music	1
State Academy of Science	1
ka:	
Historical Society	21
KENTUCKY.	
nkfort:	
cal Survey of Kentucky	5
isville:	
al Society of Kentucky	1
ibrary	3
selville:	
emale College	1
LOUISIANA.	
on Rouge:	
niversity	3
Orleans:	
leans Academy of Science	50
brary	4
MAINE.	
usta:	
sioner of Fisheries	2
cal Society of Maine	2
nswick:	
n College	4
iston:	
oggin Natural History Society	1
way:	
hool and Academy	2
tland:	
d Society of Natural History	42
o:	
stitute	1
erville:	
niversity	6
MARYLAND.	
apolis:	
hn's College	1
States Naval Academy	1
timore:	
an Journal of Mathematics	2
y of Sciences	8
al Society of Maryland	4
Hopkins University	22
tile Library	1
y Institute	13
tendent Public Instruction	1

	1879.
MASSACHUSETTS.	
Amherst:	
Astronomical Observatory	1
College Library	1
Massachusetts Agricultural College	1
Boston:	
Agricultural Society	1
American Academy of Arts and Sciences	228
American Gynaecological Society	2
American Statistical Association	1
Art Museum	1
Boston Medical and Surgical Association	1
Boston Observatory	1
Boston Society of Natural History	314
Boston University	1
Bowditch Library	2
Commonwealth of Massachusetts	2
City Library	1
Library of Boston Hospital	2
Massachusetts Historical Society	3
Massachusetts Horticultural Society	1
Massachusetts Institute of Technology	2
Massachusetts State Board of Agriculture	3
Massachusetts State Board of Charities	1
Massachusetts State Board of Health	6
Massachusetts State Library	13
Medical and Surgical Journal	14
New England Historical and Genealogical Society	3
Public Library	48
Sanitary Commission	1
Sanitary Institute	1
Worcester County Horticultural Society	1
Cambridge:	
Entomological Club	1
Harvard College	59
Harvard College Observatory	33
Lawrence Scientific School	1
Museum of Comparative Zoology	135
Peabody Museum	15
Jamaica Plain:	
Bussey Institution	9
Leicester:	
Public Free Library	1
Manchester:	
Literary and Philosophical Society	1
Penekese Island:	
Anderson School	1
Salem:	
American Association for the Advancement of Science	58
Essex Institute	111
Peabody Academy	131
Wellesley:	
Wellesley College	1
Worcester:	
American Antiquarian Society	13
Technological Institute	1
MICHIGAN.	
Ann Arbor:	
Geological Survey of Michigan	3
Observatory	16
University of Michigan	9
Coldwater:	
Michigan Library Association	6
Detroit:	
Geological Survey of Michigan	1
State Agricultural Society	15
Lansing:	
State Agricultural Society	1
State Board of Health	29
State Library	2
MINNESOTA.	
Minneapolis:	
Minnesota Academy of Sciences	18
Saint Paul:	
Academy of Natural Sciences	3
Chamber of Commerce	1
Minnesota Historical Society	8

	1879.
MISSOURI.	
Columbia:	
Geological Survey of Missouri	3
University of Missouri	10
Jefferson:	
Geological Survey of Missouri	8
Governor of Missouri	2
Historical Society of Missouri	1
State Board of Agriculture	4
Kansas City:	
Western Review of Science and Industry	1
Rolla:	
Missouri School of Mines	1
Saint Louis:	
Academy of Sciences	169
Mercantile Library	3
Polytechnic Department of the Washington University	1
Public School Library	2
University	2
NEW HAMPSHIRE.	
Concord:	
New Hampshire Historical Society	4
New Hampshire State Lunatic Asylum	1
Hanover:	
Dartmouth College	3
Observatory	1
NEW JERSEY.	
Burlington:	
Geological Survey of New Jersey	1
Hoboken:	
Stevens Institute of Technology	8
Mount Holly:	
Burlington County Lyceum of History and Natural Sciences	1
Newark:	
Historical Society of New Jersey	1
New Brunswick:	
Geological Survey of New Jersey	4
Rutger's Scientific School	1
Princeton:	
College of New Jersey	22
Green School of Science	1
NEW YORK.	
Albany:	
Albany Institute	13
Adirondack Survey Office	4
Dudley Observatory	18
Governor of New York	1
New York Literary Society	1
New York Medical Society	1
New York Museum of Natural History	7
New York State Agricultural Society	44
New York State Cabinet of Natural History	1
Regents of New York University	5
State Library	58
Brooklyn:	
Brooklyn Library	1
Long Island Historical Society	1
Buffalo:	
Buffalo Historical Society	1
Buffalo Society of Natural Sciences	99
Observatory	1
Clinton:	
Hamilton College Observatory	4
Ithaca:	
Cornell University	10
New York City:	
Academy of Sciences	142
American Agriculturist	1
American Chemical Society	10
American Chemist	7
American Ethnological Society	6
American Geographical Society	89
American Institute	30
American Institute of Architects	7
American Journal of Microscopy	1
American Naturalist	1
American Public Health Association	2

	1879.
NEW YORK—Continued.	
New York City—Continued:	
American Society of Civil Engineers	4
Astor Library	50
Columbia College	9
Cooper Union	1
Engineering and Mining Journal	14
Historical Society	4
Insurance Department	1
Lenox Library	5
Manufacturer and Builder	9
Medical Society	1
Mercantile Library Association	2
Meteorological Observatory	3
Metropolitan Museum of Art	19
Museum of Natural History	16
New York Academy of Medicine	3
New York Medical Journal	1
New York Statistical Society	1
New York Times	1
Numismatic and Archæological Society	6
Prison Association	2
Public School Society	1
Sanitarian	13
Scientific American	1
School of Mines	12
Society of Civil Engineers	7
University of New York	4
United States Sanitary Commission	3
Poughkeepsie:	
Vassar Female College	3
Syracuse:	
University	2
Troy:	
Rensselaer Polytechnic Institute	3
West Point:	
United States Military Academy	3
NORTH CAROLINA.	
Raleigh:	
State Library	1
OHIO.	
Ashtabula:	
Anthropological Society	1
Cincinnati:	
American Medical College	1
Historical and Philosophical Society	1
Mercantile Library	1
Observatory	39
Public Library	3
Society of Natural History	11
Zoological Society	1
Cleveland:	
Academy of Natural Sciences	9
Kirtland Society	5
Observatory	1
Columbus:	
Geological Survey of Ohio	5
Horticultural Society	1
State Agricultural Society	22
State Board of Agriculture	26
State Library	5
Delaware:	
Ohio, Wesleyan University	2
Gambier:	
Kenyon College	1
PENNSYLVANIA.	
Allegheny:	
Observatory	7
Society of Natural Sciences of West Pennsylvania	1
Bethlehem:	
Packer University	6
Carlisle:	
Carlisle Society of Literature	1
Easton:	
Institute of Mining Engineers	8
Germantown:	
Germantown Literary Association	1

	1879.
PENNSYLVANIA—Continued.	
Harrisburg:	
Second Geological Survey of Pennsylvania	7
State Agricultural Society	1
State Library	2
Lewisburg:	
University	1
Media:	
Delaware County Institute of Science	14
Philadelphia:	
Academy of Natural Sciences	276
American Entomological Society	56
American Journal of Conchology	3
American Naturalist	12
American Philosophical Society	187
Board of Public Charities	1
Board of Trade	2
Board of Public Education	3
Central High School	4
Franklin Institute	23
Franklin Journal	9
Historical Society	17
Horticultural Society	1
Library Company	24
Library of Pennsylvania Hospital	1
Medical and Chirurgical Journal	8
Medical Society	1
Medical Times	12
Numismatic and Archæological Society	5
Observatory of Girard College	1
Pharmaceutical Society	28
Royal Bavarian Consulate	1
Society for Alleviating the Miseries of Public Prisons	1
University of Pennsylvania	2
United States Mint	1
Wagner Free Institute	9
Zoological Society	25
RHODE ISLAND.	
Newport:	
Society of Science	1
Providence:	
American Naturalist	12
Brown University	9
Rhode Island Historical Society	4
SOUTH CAROLINA.	
Charleston:	
Charleston Medical Journal and Review	1
Charleston Museum of Natural History	1
College of Charleston	1
Elliot Society of Natural History	16
Library Society	2
South Carolina College Library	1
South Carolina Historical Society	2
South Carolina Medical Association	2
Columbia:	
State Library	1
TENNESSEE.	
Knoxville:	
Tennessee Philomatesian Society	1
Lebanon:	
Cumberland University	1
Nashville:	
Historical Society of Tennessee	1
State Library	2
TEXAS.	
Chapel Hill:	
Soulé University	2
VERMONT.	
Burlington:	
University of Vermont	1
Castleton:	
Orleans County Society of Natural Sciences	50
Montpelier:	
State Library	2

	1879.
VIRGINIA.	
Charlottesville:	
University of Virginia	10
Hampton:	
Hampton Normal Institute	1
Lexington:	
School of Civil Engineers	1
New Market:	
Polytechnic Institute	1
Richmond:	
State Library	3
WISCONSIN.	
Beloit:	
Geological Survey of Wisconsin	2
Galesville:	
Galesville University	1
Inmanville:	
Scandinavian Society	4
Madison:	
Academy of Sciences	83
College of Arts, University of Wisconsin	1
Historical Society	7
State Agricultural Society	44
State Library	1
University of Wisconsin	2
Milwaukee:	
Naturhistorischer Verein	18
Neenah:	
Wisconsin Scandinavian Library	4
BRITISH AMERICA.	
Duhut, Canada:	
Scandinavian City Library	1
Fredericton, New Brunswick:	
Legislative Library	1
Library of Kings College	1
University of New Brunswick	1
Guelph, Canada:	
Ontario School of Agriculture	1
Halifax, Nova Scotia:	
Department of Mines	1
Nova Scotian Institute of Natural Sciences	10
Hamilton, Canada:	
Scientific Association	4
Kingston, Canada:	
Queen's College Observatory	1
Montreal, Canada:	
Canadian Naturalist	3
Entomological Society of Canada	1
Geological Survey of Canada	20
Historical Society	3
Legislative Library	1
L'Union Médicale de Canada	1
McGill College	3
Medical Association of Canada	2
Medical Record	1
Medical and Surgical Journal	1
Natural History Society	18
Numismatic and Antiquarian Society	1
Observatory	2
Société d'Agriculture du Bas, Canada	1
Ottawa, Canada:	
Department of Agriculture	1
Library of the House of Commons	1
Library of Parliament	3
Literary and Scientific Society	3
Surveyor-General	1
Quebec, Canada:	
Bibliothèque de la Province de Quebec	1
Geographical Society	2
Historical Society	1
History and Natural History Society	1
Laval University	2
Literary and Historical Society	14
Literary and Horticultural Society	1
Literary and Philosophical Society	1
Naturaliste Canadien	9
Observatory	1

	1879.
British America—Continued.	
Toronto, Canada:	
Canadian Entomologist	1
Canadian Institute	47
Canadian Journal	2
Canadian Journal of Medical Science	1
Canadian Lancet	1
Department of Marine and Fisheries	1
Entomological Society	1
Fruit Growers' Association	1
House of Assembly	1
Literary and Historical Society	1
Magnetic Observatory	1
Meteorological Office	2
Observatory	3
Trinity College	1
University	2
University College	2
Saint John, New Brunswick:	
Library of the Mechanics' Institute	1
Saint John's, Newfoundland:	
Geological Survey of Newfoundland	1
Total number of addresses	444
Total number of packages	5,786
INDIVIDUALS.	
Abbe, Prof. C	9
Abbot, Colonel	1
Abbott, Dr. C. C	1
Adams, Charles F	1
Agassiz, Prof. A	15
Alberdurgh, F. C. Th	1
Allen, J. A	1
Andrews, R. R	1
Atkins, Mr	1
Bailey, H. B	1
Baird, S. F	25
Bancroft, Hon. George	1
Bansett, P	1
Barlow, Hon. F. C	1
Barnard, President F. A. P	1
Barnard, Gen. J. G	1
Barnard, I. M	1
Barnes, Hon. W	4
Barnes, Professor	1
Bassett, H. F	1
Baxter, Mr	1
Baxter, Col. J. H	1
Beecher, Rev. Charles	1
Bell, Robert	2
Bellows, Rev. H. W	1
Berkmans, Mr	2
Berton, M	1
Bessels, Dr. E	21
Billings, Dr. J. S	2
Binney, W. G	8
Blake, Prof. W. P	1
Bland, Thomas	3
Blandy, John F	1
Blasius, Professor	2
Bleasdale, Rev. Cannon	1
Boardman, S. L	1
Boehmer, George H	1
Botta, Vinzence	2
Brachvogel, Udo	1
Brendel, Dr. F	1
Brewer, Dr. T. M	1
Broadhead, G. C	5
Brooks, W. K	1
Broughton, Fred	1
Brown, John C	1
Brush, Prof. George J	2
Burgess, Edward	1
Burnett, Dr. S. M	1
Canby, W. M	1
Carpwall, Mr	1
Casamap, P	1
Cerpmad, C	1
Chamberlin, C. W	1
Chamberlin, T. C	2
Chandler, Capt. R	1
Chandler, Professor C. F	3

	1879.
Individuals—Continued.	
Clarke, Prof. S. F	1
Clarkson, M	1
Claypole, E. W	1
Clement, M	1
Clinton, George W	3
Coffin, Prof. J. H. C	2
Conn, Dr. G. P	1
Cook, Prof. G. H	2
Cope, Prof. E. D	11
Coues, Dr. E	29
Cox, Prof. E. T	5
Cresson, E. T	1
Crosier, Dr. E. S	1
Dall, W. H	26
Daly, Chief Justice	1
Dana, Prof. J. D	38
Daniells, Prof. W. W	1
Davis, Admiral	1
Dawson, G. M	5
Dawson, J. W	2
Dean, J. W	1
Deane, Dr. R	1
Delefontaine, Prof. Dr	1
Delfosse, Hon. M	1
Denham, Ed	1
Dinwiddie, Robert	1
Dod, A. F	1
Domville, Hon. J	1
Dow, Capt. J. W	5
Downes, John	1
Draper, Prof. D	2
Draper, Prof. Henry	2
Eastman, Professor	1
Eaton, Dr. D. C	1
Edison, T. A	1
Edwards, W. H	3
Ellis, F. B	1
Elsberg, Dr. L	1
Emerson, Prof. B	4
Emerson, Ben. K	1
Emmons, S. F	1
Emory, Gen. W. H	1
Endeman, Dr. H	1
Engelman, Dr. George	3
Ericson, Capt. John	1
Farlow, Prof. W. G	4
Ferrell, Prof. W	2
Firth, A	1
Fisher, Dr. G. I	1
Foerster, Doctor	1
Fortin, Hon. P	1
Frémont, General	3
Franklin, Capt. S. P	1
Gabb, W. M	1
Garman, Doctor	1
Gatschet, Albert S	1
Genth, F. A	1
Gerard, Doctor	1
Gibbs, Mr	1
Gilbert, G. K	1
Gill, Prof. T. N	3
Gilpin, Governor	2
Glover, Townsend	1
Goode, Prof. G. Brown	14
Goottfellow, Ed	1
Gray, Prof. Asa	19
Gray, O. W., & Son	1
Greene, Lieut. F	2
Griswold, S. B	1
Gross, Dr. S. D	1
Guttenberg, G	1
Guyot, Prof. A	11
Hagen, Prof. A. H	12
Hall, Prof. A	2
Hall, Prof. James	14
Hammond, I. L	1
Harkness, Professor	2
Harper Brothers	1
Harrington, W	1
Harrison, W. G	1
Hawkins, C. Rush	1
Hayden, Dr. F. V	138

	1879.
NDIVIDUALS—Continued.	
rof. J. E	3
	2
, E	1
W. Y	1
f. G. J	1
'rof. G	18
Professor	2
John	1
O. J	1
of. E. S	4
ith	1
	1
	1
B.	1
Osgood & Co	2
	1
ian	1
ie	1
tor	4
s, General A. A	2
h. O	1
terry	5
	2
E	37
rof. J. L	1
	1
f. Matthew	1
f., Dr	1
iam	1
man C	1
	2
. P	1
Clarence	27
'rof. J. T	3
heodore	3
. J	1
rofessor	1
George N	4
iac	12
octor	14
lliam	4
Joseph	14
fessor	4
, Leo	3
	1
f. Leopold	2
, W. N	1
f. E	9
f. B. S	6
esident	2
W	3
Prof. G. E	3
f. O. C	13
f. H. N	1
G	1
f. O. T	2
	1
. F	1
f. Aitken	2
aham	1
	3
	1
ral A. J	3
on	2
Dr. J. S	13
Prof. S	6
	1
of. H. A	4
E	4
	1
h	1
	1
f. J. E	3
r. L. G	1
ev. L. E	1
, O	1
	1
v. J. A	1
ctor	1
, Prof. A. S	12
ouglas	2
Captain	1

	1879.
INDIVIDUALS—Continued.	
Peale, Dr. A. C	1
Peale, T. R	1
Pearson, Jonathan	8
Peck, Ch. H	1
Peet, Rev. Stephen D	1
Peirce, Prof. B	3
Peters, Prof. C. H. F	3
Philbrick, John D	1
Pickering, Professor	1
Pinkham, Prof. G. L	1
Poole, Dr. H	1
Porter, Rev. Noah	1
Pourtales, Count	2
Powell, Prof. J. W	8
Praetorius, Doctor	1
Preuss, Rev. H. A	1
Prime, Temple	1
Pumpelly, Raph	1
Putnam, F. W	2
Rau, Prof. Charles	4
Redfield, John H	1
Redfield, Professor	1
Rice, Dr. John A	1
Richardson, jr	6
Ridgway, Robert	8
Riley, Prof. C. V	2
Roessler, A. R	1
Roessler, F. E	1
Rogers, Professor	3
Rogers, Prof. H. B	3
Ross, Prof. A. M	1
Rutherfurd, L. M	1
Rust, Th. N	1
Safford, Prof. I. H	2
Safford, Prof. W. H	1
Salisbury, E. E	1
Salisbury, Dr. J. H	2
Salisbury, Stephen	1
Sanford, John E	5
Sargent, Professor	1
Scudder, Dr. S. H	6
Schott, Charles A	1
Schumacher, Dr. H. A	1
Schurz, Hon. Carl	2
Schuster, M	3
Selwyn, A. R. C	7
Seyffarth, Dr. G	1
Shepard, Prof. Ch. U	1
Shepherd, Prof. H. E	1
Silliman, Professor	7
Simon, Prof. Dr. W	1
Smallwood, Doctor	1
Smith, Dr. Sidney J	2
Smith, Dr. W. M	1
Smith, E. A	1
Smith, Prof. H. L	1
Smith, Prof. J. Lawrence	3
Snow, Dr. E	5
Snow, Prof. F. H	1
Sparks, J	1
Spofford, A. R	3
Squier, E. G	2
St. John, Prof. O	2
Stevenson, Captain	1
Stevenson, William C	1
Stone, Rev. E. M	1
Stone, O	2
Stidham, Rev. J. F	1
Stoecker, H	2
Storer, Professor	1
Sylvester, Professor	3
Thomas, Prof. C	1
Thomson, John H	9
Thurber, Geo	1
Thurston, R. H	1
Tryon, George W	3
Tuckermann, Professor	8
Turner, Doctor T. G	2
Twining, Prof. H	4
Uhler, Prof. P. R	2
Verrill, Prof. A. E	3
Wagner, Prof. W	1

	1879.
INDIVIDUALS—Continued.	
Waldo, Leonard	1
Walker, Prof. F. A	4
Ward, James W	1
Ward, Professor	1
Ward, Townsend	1
Warder, Dr. A	4
Watson, J. C	1
Watson, Professor	1
Watson, Prof. Sereno	1
Wells, M. D	1
Wheatly, Ch. M	2
Wheeler, Capt. George M	17
Whipple, George M	1
White, Dr. C. A	8
White, Dr. C. E	1
White, Dr. E. A	1
Whiteaves, J. F	3
Whitney, Prof. J. D	8
Whitney, Prof. W. D	7
Willey, Henry	1
Williams, Rev. S. Wells	1
Wilson, Dr. Daniel	2
INDIVIDUALS—Continued.	
Winchell, N. H	7
Winthrop, C	1
Winthrop, R. S	1
Witcher, F. W	1
Woodward, Dr. J. J	2
Woodworth, Doctor	1
Worthen, Dr. A. H	4
Wyman, Colonel	1
Wyman, Commodore	4
Yarnall, Professor	1
Yarrow, Doctor	5
Yates, Dr. L. G	1
Youmans, Dr. E. L	2
Young, Prof. C. A	14
Young, C. B	8
Zaremba, Dr. C. W	1
Zehran, M	1
Total of individuals	341
Total of packages	1,185

RECAPITULATION.

	No. of addresses.			No. of packages.		
	1877.	1878.	1879.	1877.	1878.	1879.
Societies	392	292	444	3,868	4,059	5,786
Individuals	374	370	341	1,094	1,233	1,185
Total	766	662	785	4,962	5,292	6,971

ACTS AND RESOLUTIONS OF CONGRESS RELATIVE TO THE SMITHSONIAN INSTITUTION, AND THE NATIONAL MUSEUM.

FORTY-FIFTH CONGRESS, THIRD SESSION, 1878–'79.

AN ACT to aid in the protection of the public buildings and property against loss and damage by fire.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission composed of the Commissioner of Patents, the Supervising Architect of the Treasury Department, and the Secretary of the Smithsonian Institution is hereby constituted and authorized to examine such automatic signal telegraph systems as may be submitted to them by the owners and agents thereof and to ascertain which of the same is best adapted for the purpose of the earliest and most certain transmission by signal of the occurrence of fire, and also the adaptability, usefulness, and need of the same for the further protection of the buildings and property of the government in the several departments in Washington, and to report the results of their examination to the next session of Congress.

Approved, December 13, 1878.

(Statutes of the United States, Forty-fifth Congress, third session, chapter 4, page 257.)

AN ACT authorizing the Chancellor of the Smithsonian Institution to appoint an Acting Secretary in certain cases.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in the case of the death, resignation, sickness, or absence of the Secretary of the Smithsonian Institution, the Chancellor thereof shall be, and he is hereby, authorized to appoint some person as Acting Secretary, who for the time being shall be clothed with all the powers and duties which by law are devolved upon the Secretary, and he shall hold said position until an election of Secretary shall be duly made, or until the Secretary shall be restored to his health, or, if absent, shall return and enter upon the duties of his office.

Approved, January 24, 1879.

(Statutes of the United States, Forty-fifth Congress, third session, chapter 21, page 264.

AN ACT making appropriations for the service of the Post Office Department for the fiscal year ending June thirtieth, eighteen hundred and eighty, and for other purposes.

SEC. 20. That mailable matter of the fourth class shall embrace all matter not embraced in the first, second, or third class which is not in its form or nature liable to destroy, deface, or otherwise damage the contents of the mail-bag, or harm the person of any one engaged in the postal service, and is not above the weight provided by law, which is hereby declared to be not exceeding four pounds for each package thereof, except in case of single books weighing in excess of that amount, and except for books and documents published or circulated by order of Congress, or official matter emanating from any of the departments of the government or from the Smithsonian Institution, or which is not declared non-mailable under the provision of section thirty-eight hundred and ninety-three of the Revised Statutes as amended by the act of July twelfth, eighteen hundred and seventy-six, or matter appertaining to lotteries, gift concerts, or fraudulent schemes or devices.

(Statutes of the United States, Forty-fifth Congress, third session, chapter 180, page 360.)

AN ACT making appropriations for sundry civil expenses of the government for the fiscal year ending June thirtieth, eighteen hundred and eighty, and for other purposes.

* * * And all collections of rocks, minerals, soils, fossils, and objects of natural history, archæology, and ethnology, made by the Coast and Interior Survey, the Geological Survey, or by any other parties for the Government of the United States when no longer needed for investigations in progress shall be deposited in the National Museum.

(Statutes of the United States, Forty-fifth Congress, third session, chapter 182, page 394.)

FORTY-SIXTH CONGRESS, SECOND SESSION, 1879–'80.

JOINT RESOLUTION filling existing vacancies in the Board of Regents of the Smithsonian Institution.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the existing vacancies in the Board of Regents of the Smithsonian Institution of the class other than members of Congress, shall be filled by the reappointment of Asa Gray, of Massachusetts, Henry Coppée, of Pennsylvania, John Maclean, of New Jersey, and Peter Parker, of the city of Washington, whose terms have expired. (Public Resolution No. 2. Statutes of the United States, Forty-sixth Congress, second session, p. 299.)

Approved, December 19, 1879.

AN ACT for the erection of a bronze statue of Joseph Henry, late Secretary of the Smithsonian Institution.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Regents of the Smithsonian Institution be, and are hereby authorized to contract with W. W. Story, sculptor, for a statue in bronze of Joseph Henry, late Secretary of the Smithsonian Institution, to be erected upon the grounds of said Institution; and for this purpose, and for the entire expense of the foundation and pedestal of the monument, the sum of fifteen thousand dollars is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated.

Approved, June 1, 1880.

(Statutes of the United States, Forty-sixth Congress, second session, chapter 116, page 154.)

REPORT OF THE EXECUTIVE COMMITTEE OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, FOR THE YEAR 1879.

The Executive Committee of the Board of Regents of the Smithsonian Institution respectfully submit the following report in relation to the funds of the Institution, the appropriations by Congress for the National Museum, the receipts and expenditures for both the Institution and the Museum for 1879, and the estimates for the year 1880.

CONDITION OF THE FUNDS, JANUARY, 1880.

The amount originally received as the bequest of James Smithson, of England, deposited in the Treasury of the United States, in accordance with the act of Congress of August 10, 1846	$515,169 00	
Residuary legacy of Smithson, received in 1865, deposited in the Treasury of the United States, in accordance with the act of Congress of February 8, 1867	26,210 63	
		$541,379 63
Additional amount deposited in the Treasury of the United States, derived from savings, &c., authorized by act of Congress, February 8, 1867	108,620 37	
Amount received as the bequest of James Hamilton, of Carlisle, Pa., February 24, 1874	1,000 00	
		109,620 37
Total permanent Smithson fund in the Treasury of the United States, bearing interest at 6 per cent., payable semi-annually		651,000 00
In addition to the above, there is invested in Virginia Bonds and certificates, $88,125.20, valued January 1880, at		32,000 00
Also the cash balance in the United States Treasurer's hands, January 2, 1880		20,894 06
Total Smithson funds, January 2, 1880		$703,894 06

Virginia stock.—The Institution owns the following bonds and ce
cates of the State of Virginia:

Consolidated bonds:		
58 bonds, Nos. 11521 to 11578 inclusive, for $1,000 each	$58,000 00	
1 bond, No. 1380, for	500 00	
2 bonds, Nos. 4191 and 4192, for $100 each	200 00	
Deposited with the Treasurer of the United States		$58,70(
Deferred certificates:		
No. 4543, dated July 1, 1871, for	$29,375 07	
No. 2969, dated July 1, 1871, for	50 13	
Deposited with Riggs & Co		29,42
Total of Virginia securities		88,12
The estimate by Riggs & Co. of the value of these bonds and certificates, January 1, 1880, is		32,00(

The coupons on the consolidated bonds for January 1 and July 1, 1
were sold for the Institution, November 12, 1879, as follows:

$3,480 Virginia, $30 coupons, at 83	$2,888 40	
30 Virginia, $15 coupons, at 90¼	27 08	
12 Virginia, $3 coupons, at 92	11 04	
3,522	2,926 52	
Less commission on $3,522, at ½ of one per cent	17 60	
Net proceeds of coupons		$2,90

Hamilton bequest.—James Hamilton, of Carlisle, Pa., bequeathed to the Smithsonian Institution (February 24, 1874) .... $1,00(

This amount is deposited in the Treasury of the United States a
addition to the Smithson Fund, in accordance with the Act of Cong
of February 8, 1867.

Interest received for the year 1879 .... $6(

RECEIPTS IN 1879.

Interest on $650,000 for the year 1879, at 6 per cent	$39,00(
Interest on Virginia bonds:	
Sale of coupons, by Riggs & Co., for January 1 and July 1, 1879, for $3,522 (November 12, 1879), at 83, 90¼, 92, less commission	2,90
Interest on Hamilton fund of $1,000 for the year 1879	6(
Legacy of Simeon Habel, of New York	40
Balance on hand at the beginning of 1879	19,63
Total receipts for the year 1879	$62,00

EXPENDITURES IN 1879.

Building:		
Repairs and improvements	$2,232 28	
Furniture and fixtures (for new offices, &c.)	1,110 25	
		$3,342 53
General expenses:		
Meetings of the Board	580 80	
Lighting the building	74 50	
Heating the building	234 96	
Postage and telegrams	215 38	
Stationery	982 83	
Incidentals, insurance, ice, hauling	918 94	
Salaries	13,150 00	
Extra clerk hire and labor	159 65	
Books and periodicals	567 13	
		16,884 19
Publications and researches:		
Smithsonian Contributions to Knowledge	3,129 49	
Smithsonian Miscellaneous Collections	6,170 24	
Smithsonian annual report	97 86	
Researches	975 85	
Apparatus	14 85	
Laboratory	206 84	
Explorations	683 70	
		11,278 83
Exchanges:		
Literary and scientific exchanges		9,554 47
Gallery of Art:		
Purchase of busts		50 00
Total expenditures in 1879		$41,110 02
Balance in Treasury of United States January 2, 1880		$20,894 06

Among the receipts for the year is a bequest of $402.59 by Dr. Simeon Habel, of New York, the author of one of the Smithsonian Contributions to Knowledge, published in 1878, entitled "The Sculptures of Santa Lucia Cosumalwhuapa in Guatemala." The author was an Austrian physician who relinquished his medical practice to make at his own expense a tour of exploration through Central America. The results of his researches were presented to the Smithsonian Institution for publication. Professor Henry afforded every facility to Dr. Habel for the preparation of his work, by furnishing him a room for several months at the Institution where he could have his drawings copied by a skillful artist, and the doctor in appreciation of this courtesy informed the Secretary that on his death he would leave a part of his property to the Smithsonian Institution.

Notice of his death on the 1st of January, 1879, at New York, hav beeñ received, steps were taken to secure the promised legacy, and sum actually received from the Emigrant Savings Bank of New Y in accordance with Dr. Habel's instructions, was $402.59. To this it is proposed that $97.41 should be added, so that the amount of $ may be deposited in the Treasury of the United States as a part of permanent fund.

Repayments.—The Institution has made temporary advances du the year for freight, &c., the repayment of which, with the amc received from sales of the publications of the Institution, &c., h been deducted from the expenditures for the year.

These repayments are as follows:

To exchanges	$91
To building	1,30
To furniture	4
To stationery	1
To Smithsonian publications	24
To incidentals	1
To postage	
Total repayments in 1879	$2,54

ESTIMATES FOR 1880.

The following are the estimates of receipts by the Institution for year 1880, and the appropriations required for carrying on its operat during the same period.

Estimated receipts.

Interest on the permanent fund, receivable July 1, 1880, and January 1, 1881	$39,000 00	
Interest on the Hamilton fund for 1880	60 00	
Sale of Virginia coupons, due January 1 and July 1, 1880	2,800 00	
		$41,86

Proposed appropriations.

For building	$2,000 00	
For general expenses	14,000 00	
For publications and researches	14,000 00	
For exchanges	10,000 00	
For books and apparatus	1,000 00	
For contingencies	860 00	
		41,86

NATIONAL MUSEUM.

The following appropriations were made by Congress in 1879 for disbursal under the direction of the Smithsonian Institution:

Preservation of collections, Smithsonian Institution: For preservation and care of the collections of the National Museum, including those from the International Exhibition of 1876. (Forty-fifth Congress, third session, chapter 182; 1879, March 3)	$23,000
Distribution of duplicates: For expenses of making up into sets, for distribution to colleges and museums, the duplicate ores, minerals, and objects of natural history belonging to the United States. (Forty-fifth Congress, third session, chapter 182; 1879, March 3)	5,000
Preservation of collections, Smithsonian Institution, Armory Building: For expense of watching and storage of articles belonging to the United States, including those transferred from the International Exhibition of 1876. (Forty-fifth Congress, third session, chapter 182; 1879, March 3)	2,500
Additional security against fire: For providing additional security against fire in the Smithsonian building for the government collections, in accordance with report of the commission appointed to examine the public buildings, December 10, 1877. (Forty-fifth Congress, third session, chapter 182; 1879, March 3)	3,000
For completing and preparing for publication the contributions to North American Ethnology, under the Smithsonian Institution: *Provided*, That all the archives, records, and materials relating to the Indians of North America, collected by the geographical and geological survey of the Rocky Mountain Region, shall be turned over to the Smithsonian Institution, that the work may be completed and prepared for publication under its direction: *Provided*, That it shall meet the approval of the Secretary of the Interior and of the Secretary of the Smithsonian Institution. (Forty-fifth Congress, third session, chapter 182, 1879; March 3)	20,000

For a fire-proof building, for the use of the National Museum, three hundred feet square, to be erected under the direction and supervision of the Regents of the Smithsonian Institution, in accordance with the plans now on file with the Joint Committee of Public Buildings and Grounds, on the south-eastern portion of the grounds of the Smithsonian Institution, said building to be placed east of the Smithsonian Institution, leaving a roadway between it and the latter of not less than fifty feet, with its north front on a line with the south face of the buildings of the Agricultural Department and of the Smithsonian Institution, and all expenditures for the purposes herein mentioned, not including anything for architectural plans, shall be audited by the proper officers of the Treasury Department. (Forty-fifth Congress, third session, chapter 182; 1879, March 3)* $250,

Smithsonian Institution: For the preservation of the specimens of the United States surveying and exploring expeditions 1879. (Forty-fifth Congress, third session, chapter 183, page 417; March 3, 1879)........................... 4,

The following is a statement of the receipts, expenditures, and l ances of the National Museum accounts:

PRESERVATION OF COLLECTIONS AND DISTRIBUTION OF DUPLICAT

Receipts.

1879.			
January 1.	Balance unexpended of appropriation for year ending June 30, 1879.	$11,389 30	
	Appropriation for deficiencies, 1879.	4,000 00	
July 1.	Appropriation for the year ending June 30, 1880....................	28,000 00	
	Cash refunded for coal and freight.	290 76	
			$43,680

Expenditures.

For the quarter ending March 31, 1879........	$6,818 41	
For the quarter ending June 30, 1879.........	8,626 69	
For the quarter ending September 30, 1879....	9,900 40	
For the quarter ending December 31, 1879	6,842 37	
		32,187
Balance available from January 1 to July 1, 1880..........		11,492

FOR ARMORY BUILDING.

Receipts.

1879.			
Jan. 1.	Balance unexpended of appropriation for the year ending June 30, 1879....	$1,171 24	
July 1.	Appropriation for year ending June 30, 1880........................	2,500 00	
			3,671

Expenditures.

For the quarter ending March 31, 1879........	928 27	
For the quarter ending June 30, 1879.........	128 38	
For the quarter ending September 30, 1879....	606 33	
For the quarter ending December 31, 1879....	970 72	
		2,633
Balance available from January 1 to July 1, 1880..........		$1,037

* For a full account of the construction of this building see the report of National Museum Building Commission.

FOR ADDITIONAL SECURITY AGAINST FIRE.

Receipts.

1879.			
July 1.	Appropriation for year ending June 30, 1880		$3,000 00

Expenditures.

For the quarter ending September 30, 1879.....	$461 95	
For the quarter ending December 31, 1879.....	1,230 63	
		1,692 58
Balance available from January 1 to July 1, 1880........		1,307 42

FOR COMPLETING CONTRIBUTIONS TO ETHNOLOGY.

Receipts.

1879.		
July 1.	Appropriation for the year ending June 30, 1880.	$20,000 00

Expenditures.

For the two quarters ending December 31, 1879.........	13,769 00
Balance available from January 1 to July 1, 1880........	6,231 00

FOR FIRE-PROOF BUILDING FOR THE NATIONAL MUSEUM.

Receipts.

1879.		
March 3.	Appropriation for new building..............	$250,000 00
	Expenditures to Jan. 1, 1880................	143,146 38
	Balance available from January 1 to July 1, 1880.	$106,853 62

SUMMARY.

The Executive Committee have examined 687 vouchers for payments made from the Smithson income during the year 1879, and 690 vouchers for payments made from appropriations by Congress for the National Museum, making a total of 1,377 vouchers. All these bear the approval of the Secretary of the Institution, and a certificate that the materials and services charged were applied to the purposes of the Institution.

The committee have examined the account books of the National Museum and find the balances as before stated—preservation, $11,492.19; armory, $1,037.54; security against fire, $1,307.42—to correspond with the certificates of the disbursing clerk of the Department of the Interior. They also find the balance of $106,853.62 of the National Museum building appropriation corresponds with the certificate of the disbursing officer of the Treasury Department January 5, 1880.

The quarterly accounts current, bank-book, check-book, and journal of the Institution have been examined and found to be correct, and show a balance to the credit of the Institution on the 2d of January, 1880, in the hands of the Treasurer of the United States of $20,894.06 available for the current operations of the Institution.

Respectfully submitted.

PETER PARKER,
W. T. SHERMAN,
Executive Committee Smithsonian Institution.

WASHINGTON, *January* 19, 1880.

NATIONAL MUSEUM BUILDING COMMISSION,
OFFICE OF SMITHSONIAN INSTITUTION,
Washington, D. C., January 19, 1880.

To the Board of Regents of the Smithsonian Institution:

GENTLEMEN: For several years past the attention of the Board of Regents has been called to the rapid growth of the collections in the National Museum and the need of increased accommodations for the same. This necessity, however, was not deemed sufficiently imperative to authorize a request for special Congressional legislation until the close of the Centennial Exhibition, when it became evident that the articles gathered by the Smithsonian Institution for the exhibition in Philadelphia, under the act of Congress, added to the numerous centennial exhibits presented to the United States and taken charge of by the Smithsonian Institution, constituted a mass of material for which no provision could possibly be made in the present Smithsonian building. Under these circumstances, the Board of Regents on the, 5th of February, 1877, memorialized Congress for an appropriation of $250,000 for the "immediate erection of a spacious building," and a few weeks subsequently a bill for the purpose passed the Senate, but too late in the session to secure consideration in the House of Representatives. The effort was renewed during the winter of 1877–'78, but likewise without action. On the 3d of March, 1879, however, the desired appropriation was made through a provision in the sundry civil bill, as follows:

"For a fire-proof building for the use of the National Museum, 300 feet square, to be erected under the direction of the Regents of the Smithsonian Institution, in accordance with the plans now on file with the Joint Committee of Public Buildings and Grounds, on the southeastern portion of the grounds of the Smithsonian Institution, two hundred and fifty thousand dollars: Said building to be placed east of the Smithsonian Institution, leaving a roadway between it and the latter of not less than fifty feet, with the north front on a line with the south face of the buildings of the Agricultural Department and of the Smithsonian Institution; and all expenditures for the purposes herein mentioned, not including anything for architectural plans, shall be audited by the proper officers of the Treasury Department."

Anticipating the early action of Congress in the premises, the Board of Regents, on the 17th of January, 1879, adopted the following resolution:

"*Resolved*, That the Executive Committee of the Board, or a majority thereof, and the Secretary be, and they are hereby, authorized and empowered to act for and in the name of the Board of Regents in carrying into effect the provisions of any act of Congress that may be passed providing for the erection of a building for the National Museum."

Accordingly, on the 7th of March, 1879, Hon. Peter Parker and General W. T. Sherman, the resident members of the executive committee, with the Secretary, met in the office of the Institution, and after organizing under the title of "National Museum Building Commission," of which General W. T. Sherman was chosen chairman, proceeded to adopt such measures as in their opinion appeared best calculated to realize, with the least possible delay, the intention of Congress.

The committee at the outset invited General M. C. Meigs, Quartermaster-General U. S. A., to act in the capacity of consulting engineer to the commission, and also selected Messrs. Cluss and Schulze, whose plans for the new building were those approved by Congress, as superintending architects. Mr. Daniel Leech was appointed secretary of the commission.

To remove as far as possible any doubt as to the sufficiency of the appropriation for a building in accordance with the plans approved by Congress, Mr. Edward Clark, Architect of the Capitol, and General Meigs, after carefully considering the provisional estimates of the architects, informed the commission that in their opinion the amount was sufficient for the purpose.

To obtain a clear understanding of the intent of Congress in making the appropriation, as well as to ascertain how far, if desirable, the commission might be authorized to depart from the plans before the Committees of Public Buildings and Grounds when the act was passed, the chairmen of the respective committees (Hon. H. L. Dawes and Hon. Philip Cook) were consulted; whereupon these gentlemen officially informed the commission "that, provided the general design be retained, it was not their intention, nor that of their committees, to confine the Board of Regents of the Smithsonian Institution to the minor details of the aforesaid plans, but to authorize any modifications that might appear to them desirable in the interest of economy or for the better adaptation of the building to its object."

On ascertaining that the appropriation could be made immediately available under the clause directing that the account should be audited by the proper officers of the Treasury Department, the Secretary of the Treasury was, on the 27th of March, requested to designate some one of his force to act as disbursing officer. Accordingly Maj. T. J. Hobbs, disbursing clerk of the department, was selected, and payments were authorized to be made by him on vouchers approved by the Secretary of the Smithsonian Institution as provided for in the following resolution:

"*Resolved*, That the commission appointed by the Board of Regents of the Smithsonian Institution to superintend the construction of a new fire-proof building for the National Museum hereby authorize Prof. S. F. Baird, Secretary of the Institution, to act as their agent to approve for payment by Thomas J. Hobbs, all bills for services and supplies from such funds as are placed in the hands of the latter by said commisssion for such purposes, and the Secretary of the Treasury is hereby respectfully requested to instruct Thomas J. Hobbs, disbursing agent, to pay any bills when thus certified and found to be otherwise technically correct."

Having thus prepared the way to a commencement of active operations, specifications were at once prepared and proposals invited for carrying on the work. Ground was broken on the 17th of April, 1879.

The concrete foundations were begun on the 29th of April, and the brick-work of the walls on the 21st of May, the main walls being completed on the 1st day of November.

In consequence of the low prices of the more important building materials, very favorable contracts were made, especially for the brick required and for the iron-work, since the price of iron advanced very materially within a few months from the date referred to. The same is true with regard to glass, bricks, and, in fact, almost all building materials.

For details of construction, as well as for a statement of expenditures to date, the board is referred to the appended report of the superintending architects.

The estimate of $250,000 for the construction of a museum building did not include the heating apparatus. As the work progressed, however, it became evident that all the underground piping for water, gas, and steam, at least, could be obtained from the fund.

In anticipation of an appropriation for the purpose, it was deemed best to obtain provisional bids for a steam-heating apparatus. Accordingly proposals were invited: first, for the underground pipes; second, for the boilers; third, for the radiators. The aggregate of the estimates for the three items varied from $13,940 to $55,680.

The lowest bid was rejected on account of inadequacy of the supply of heat. The next to the lowest was that of Messrs. Baker, Smith & Co., for $19,768, which was accepted, and a contract made for the underground pipes for $5,770.

An appropriation of $30,000 has been asked of Congress for the completion of the heating apparatus throughout, for the gas and water fixtures and the electric apparatus required for clocks in the building, for signals, alarms, &c.

Before the building can be occupied it must, of course, be furnished and fitted up with cases, of which, as might be expected, a large provision is required. According to a calculation, the cases that will be needed, if placed end to end, will extend to a distance of more than 8,000 feet, with a total of shelving surface of about 75,000 square feet. The frontage of the cases will be over 14,000 feet, so that, allowing for the crossing from one case to another a journey of at least three miles will be required even to take a cursory glance at all the objects in the collection.

The question of the best material for the cases has not been definitely settled, the choice lying between iron and hard wood. In order to assist in determining this question satisfactorily, arrangements have been made to obtain working plans of the cases used not only in a number of museums in the United States, especially in Cambridge, Boston, and New York, but also in Europe. The new building now being erected for the collections of the British Museum is one where it is supposed th best experience has been made use of in the plans of the cases, and a rangements have been made to obtain copies of the same. The new iro cases of the National Museum at Dresden are also under investigatio Iron is more expensive than wood, but involves less danger of decay, an there is also an especial advantage in the fact that the material may b so much thinner as to increase the interior space, while the objects in th cases are less obscured. Of course, it must not be forgotten that th National Museum is expected to discharge its functions for an indefinit period of years.

The provision of Congress directed that the new building should b placed to the east of the present Smithsonian edifice, at least fifty fe from its southeastern corner. The question was considered of havin the interval greater than this minimum, but it was found that this woul involve the extension of the building beyond the boundary of the Smit sonian reservation and carry it to the unassigned portion of the squar Although there was nothing in the act to prevent this encroachmen yet in view of the possibility that the southeastern portion of the publi land between Seventh and Twelfth streets would be required for som other purposes, perhaps for a Congressional Library, it was though best to encroach upon it as little as possible.

In addition to its answering the purpose for which it was primaril intended, it is confidently believed that the new National Museum buil ing will exercise an important function in serving as a model for simila establishments elsewhere.

Of course, in a city where the cost of land is a matter of importa consideration, the one-story plan cannot always be carried out, the usu position of story above story being necessary to secure the desired spac Most colleges and universities, however, have ample grounds belongin to them, the occupation of which by large buildings is allowable. Und such circumstances, the same amount of fire-proof space can be had f from two-thirds to one-half the usual cost.

The office of member of the Building Commission has been by no mea a sinecure, weekly meetings having been held, with scarcely an inte ruption, from the first organization, as shown by the full reports ke of the proceedings. General Meigs, as consulting engineer, until h recent departure on a tour of duty, was present at every meeting a continually aided the Commission by his advice, rendered so valuable b his long familiarity with building operations on a large scale, and wi the whole question of the proper construction of contracts. He visit the grounds nearly every day and closely inspected the progress of t work. To him are also due valuable suggestions on the methods of co ering the roofs and on other details.

The duties of the secretary of the commission have consisted in kee ing the record of the proceedings of the meetings, in assisting in t preparation of contracts for execution, in engrossing the bills for sett ment, and in many other points. These services Mr. Leech has zealously performed, and to the entire satisfaction of the commission.

Mr. William J. Rhees, chief clerk of the Smithsonian Institution, has also rendered valuable services.

Respectfully submitted.

W. T. SHERMAN,
PETER PARKER,
SPENCER F. BAIRD,
National Museum Building Commission.

unfavorable effect which these comparatively low walls would otherwise produce.

In the rear of the curtain-walls, the clerestory rises to the full height of the naves, the roofs of which terminate against the side walls of the dome. The dome is treated in a similar way and strictly in the same character as the curtain-walls above alluded to.

In addition to the windows in the solid masonry of exterior walls, clerestory, and dome, lofty lanterns have been provided above the naves and square halls so as to afford perfect light for this enormous space without resorting to flat skylights, which for various reasons it was well to avoid.

These lanterns, square and oblong, together with those of the kindred features of the pavilions, have been so arranged, in combination with towers, groups, clerestory, and the rising dome in the background, as to produce a picturesque effect in the sky-lines of the building.

All the masonry above ground is composed of brick-work, built with air spaces for outside walls, ornamented and laid in black mortar for the facing of exterior walls. To neutralize the monotony and common-place appearance which could not have been avoided with red brick fronts of such extent, a sufficient quantity of buff bricks, interspersed with a small number of blue bricks, in the cornices have been introduced.

A base-course of granite extends all around the building.

The wrought work of the main entrance, window-sills, inscription-plates, copings, &c., are of gray Ohio freestone. Anything else in the line of decoration is in strict keeping with the principal designs, and executed in substantial metal work.

The floor beams, girders, and roofs consist or are constructed of rolled and shaped iron. The floors are fire-proofed by brick arches and concrete. Of roofs there are no less than thirty seven; many of them are of most complicated construction. The lanterns of the ridges of the naves are large enough to cover moderate-sized dwellings.

The light but solid frame-work of all the roofs will be left in full view, painted in light neutral tints.

The covering of the metal roofs is laid upon fire-proofed gratings, suggested by General M. C. Meigs.

The slates are hung to iron purlines.

The sashes all through the building are each glazed with two panes of glass, with an intermediate air-space. This is done to facilitate the heating of the building.

The floors of the exhibition halls will consist of concrete, but the rooms and smaller halls will, for convenience sake, be floored with Florida pine, laid on concrete.

The interior is to be plastered in sand finish, washed in tints. Its lofty proportions do not require any elaborate decoration, and will thus rather heighten than interfere with the objects on exhibition.

roof and a lantern, crowned by a decorated finial. This room is 77 feet high on the side walls, or 108 feet to the top of the finial.

Four naves, of 65 feet in width and 117 feet in length, radiate from the dome and extend to the outside walls of the building; the naves form in this manner a Greek cross, over the center of which the dome rises, and part of the spaces in the exterior angles of the cross are fitted up with halls of 65 feet square and of same height as the naves.

The side walls of both naves and annexes are 42 feet high, while the height to the ridge of the slate roofs is 56 feet. These roofs are in part constructed double, for the purpose of so perfecting the drainage of the roofs that accumulations of ice and snow can nowhere obstruct it.

The spaces between the high walls of the Greek cross and the exterior walls of the building are allotted mainly to eight halls of reduced height, covered by lean-to metal roofs; the extreme height of which is 32 feet.

By this treatment wall spaces are obtained for the introduction of clerestory windows, which light the square halls and assist in lighting the naves.

The four symmetrical exterior walls of the building are broken by projections in the center and at the corners, and these have been amply utilized for miscellaneous administrative purposes as stated above.

A modernized Romanesque style of architecture was adopted for the new building in order to keep up a relationship with the Smithsonian building, which is designed in Norman, a variety of this style. To modernize this style was found necessary on account of the different building material, and to do justice to the purposes of the building with its modern demands of perfect safety and elegance of construction, of greatest possible available floor space, of easy communications, efficient drainage, a well calculated and pleasing admission of light, free circulation of air, and all other hygienic dicta.

The external architecture is based upon the general arrangement of the interior, and shows plainly the prominence of the four naves and the careful management of the light for the central portion of the building. The main entrances are in the centers of each façade between two lofty towers of 86 feet height, which act as buttresses for the naves. Between the towers, and receding from the doorways, there are large arched windows set with ornamented glass, and above those the gables of the naves are formed; they contain inscription-plates and are crowned by allegorical groups of statuary. The group over the northern gable, designed by C. Buberl, of New York, already in position, introduces Columbia as the protectress of science and industry.

To both sides of these prominent central features there are curtain-walls, 27 feet in height, which have the effect of arcades.

Pavilions are placed at the corners; they are of less height than the towers, but sufficiently raised above the curtain-walls to overcome the unfavorable effect which these comparatively low walls would otherwise produce.

In the rear of the curtain-walls, the clerestory rises to the full height of the naves, the roofs of which terminate against the side walls of the dome. The dome is treated in a similar way and strictly in the same character as the curtain-walls above alluded to.

In addition to the windows in the solid masonry of exterior walls, clerestory, and dome, lofty lanterns have been provided above the naves and square halls so as to afford perfect light for this enormous space without resorting to flat skylights, which for various reasons it was well to avoid.

These lanterns, square and oblong, together with those of the kindred features of the pavilions, have been so arranged, in combination with towers, groups, clerestory, and the rising dome in the background, as to produce a picturesque effect in the sky-lines of the building.

All the masonry above ground is composed of brick-work, built with air spaces for outside walls, ornamented and laid in black mortar for the facing of exterior walls. To neutralize the monotony and common-place appearance which could not have been avoided with red brick fronts of such extent, a sufficient quantity of buff bricks, interspersed with a small number of blue bricks, in the cornices have been introduced.

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The interior is to be plastered in sand finish, washed in tints. Its lofty proportions do not require any elaborate decoration, and will thus rather heighten than interfere with the objects on exhibition.

The heating of the building is to be done by low-pressure steam, on the system of direct radiation.

The wide main entrance doors of walnut and oak open outward on spacious tiled vestibules, with sides and arched ceilings of ornamental brick-work. These vestibules are closed at night and on Sundays by wide double gates, the solid frames of which consist of wrought iron, and the ornaments of cast iron; thus combining the utmost strength with great economy.

The northern entrance has been selected for general use, and hence it was necessary and proper to give it due prominence from the others for the guidance of strangers. The configuration of the surrounding ground helped in this connection. A spacious tiled platform bounded by granite side blocks is constructed in front of this entrance. It is approached by four low and wide granite steps of 37 feet in length, which are flanked by molded base-blocks, carrying stately candelabras.

It should be remembered that in all our steps we were guided by the absolute necessity not to overreach the appropriation at disposal; and hence, to produce the best effect with utmost economy, the exterior decoration was confined to and concentrated on the centers of the fronts.

The erection of this building requires about 5,250,000 bricks, 3,000 barrels cement, 5,600 barrels lime, 4,000 cubic yards of sand, 2,000 cubic yards of rubble-stone, 1,230 cubic yards of concrete, 470 tons of wrought iron, 31,000 square feet of glass, 60,000 plates of slate, of 2 square feet each, 375 boxes of tin, &c.

As soon as we received the required instructions our work was concentrated on the preparation of working drawings, schedules, and specifications, so as to take best advantage of the low prices of material and labor then prevailing, and in this we were successful to a great extent.

We now proceed to give a history of the progress of the work during the past season, operations being classed under a few general heads.

During the whole season we were favored by the weather. From the 1st of May to 31st of December but twelve and one-quarter working days were lost by inclement weather; of these, nine and three-quarter days were rainy, one was stormy, one severely cold, and a half a day was lost on account of sleet and ice.

1. *Excavation.*—The excavation for the foundations was commenced on the 17th of April and finished on the 28th of May. It was carried to solid ground, but nowhere less than 3 feet below surface, that the building should rest on earth below the disintegrating effects of frost and drought. Under the topsoil a thick stratum of hard clay was met, and under this a bed of clean, dry gravel, which was struck wherever cellars were dug; this porous layer drained the site by absorbing the rain-water as fast as it fell.

2. *Foundations.*—The foundations were, under date of April 29, commenced with a heavy bed of hydraulic cement concrete and were completed on the 30th of May. Upon the concrete bed they were continued

up to the surface with rubble-stone work of gneiss, laid in cement mortar; this work was commenced on the 5th of May and was completed on June 9.

3. *Brick-work.*—The brick-laying commenced on May 21, and the principal walls were completed on November 1, after 4,740,000 bricks had been laid under contract. The specifications call for a superior class of brick-work, laid in black mortar on the façades without resorting to the expensive "tucked" or "ruled" joints commonly used in first-class pressed brick-work, and this has been duly enforced. In this we were aided by the commendable ambition of the Washington Brick Machine Company, who have furnished a superior quality of brick for the façades. We, on the other hand, have spent a large amount of money in bringing out the beauty of the material by cleaning down and oiling the façades. Ever since the contract for laying bricks has been declared as satisfactorily completed a large force of brick-layers has been kept at work by the day, under proper superintendence, in finishing the façades, piecing out the walls, building the steam-chimney, walling in the iron-work of the roofs as they progressed, doing plumbers' jobbing, turning and concreting floor-arches, laying foundations for platforms and steps, forming gutters with due grade, &c., &c. This work is all well advanced, but still in progress, and will be finished by the building of ducts for the lines of pipes which will conduct the steam and return the condensed water of the heating apparatus.

4. *Cut-stone work.*—The cutting and laying of the granite base course was commenced on May 19. The cut-stone work has been going on during the whole season as the work of the other mechanics progressed and is now completed, with the exception of part of the outside steps. At intervals of about 5 feet in height, bond-stones of North River grey wacke-bluestone have been introduced in the high piers of the interior archways in order to increase their stability.

5. *Iron-work.*—The floor-beams arrived in good time and were put in place by the contractors as they got ready for them. On August 22, the first "Warren girder" of the lean-to roofs was set in place; on October 9 the roofs of the naves were commenced to be put up; on December 19 those of the square halls were commenced. At this writing all the material for the roofs is on hand; it simply remains for the contractor to display energy and have all the roofs ready for covering.

6. *Galvanized iron-work.*—This consists of a heavy amount of small cornice-moldings, of acroteria, chimney-heads, finials, facings and casings. It is well advanced at the shops and being put up in due time.

7. *Slates and slating.*—Under date of August 19 last, the blue slates have been ordered from Ore Banks, Va., and the red and green slates from the quarries in Vermont. They are virtually all on hand, and the slater avails himself at all times of the first opportunity which offers for laying the slates. The slates are 24 inches in length and expose 10 inches to the weather, thus giving what is termed double cover and 4 inches lap.

8. *Covering of the flat roofs.*—These metal roofs are supported primarily by the wrought-iron trusses laid 13 feet between centers; these again are subdivided and cross-laid by wrought beams of lighter sections so as to cut up the ceilings into spaces of 4 by 13 feet in size. At the suggestion of General Meigs these spaces were bridged by gratings formed in two thicknesses of light tapered wooden strips and fire-proofed by being filled in and inclosed with a non-conducting mixture composed of plaster of Paris, lime, coal-ashes, and cinders. Before actual use we have made ample tests in order to reduce the weight of the gratings and of the composition to a minimum, and on the other hand to increase its non-conductibility. The greater part of this work is done and the metal laid upon it in sheets of 14 by 20 inches in size, having flat joints. Each sheet is clamped down to the gratings by eight clamps of sheet metal, two on each side, in such a manner that each sheet, independent of all others, can expand and contract, which in such large roofs is an important consideration.

9. *Wooden floors.*—All the flooring required has been secured of Florida yellow pine, by contract, at very reasonable terms.

10. *Plastering.*—No scaffolding material being kept on hand by the tradesmen for reaching high walls or ceilings of buildings like this, the poles and lumber of the scaffolds for the brick-work were purchased at a reasonable rate from the contractors for that branch and are now on hand.

11. *Glass, glazing, and painting.*—With the sudden stimulus which the industries of this country received last fall, home-made glass came to be a scarce article, as the proposals received under extensively published advertisements show; the lowest bids were for Belgian glass, imported free of duty, with the approval of the Treasury Department. This glass is shortly expected to arrive, after which the sash will be glazed at an early date. The painting has so far been mostly confined to the metal cornices and piping, the iron-work and window-frames having been furnished, by the respective contractors, all primed.

12. *Carpenter's work.*—This has so far been mostly directed to the making of roof-gratings, described under another head. But, besides, a large amount of centers has been made and put up for turning arches in the brick-work and floor-arches. In the concrete above the floor-arches the thin sleepers have been laid to which the flooring is to be nailed. The setting of door-jambs is about to be commenced and to be followed by all the minor details required for getting the building in readiness for the plasterer.

13. *Sewerage, drainage, and plumbing.*—In the early part of the spring the main sewer on B street was cut out and a 12-inch glazed terra cotta sewer connected with it for the drainage of the new building The numerous branch sewers within the building leading to some sixty conductors from the roofs, and to soil-pipes of closets and basins, were under a decision of the commission delayed until the completion of the walls, but have lately been completed, as also most of the extra heavy

cast-iron piping which forms the conductors of rain-water, and the vertical soil-pipes. All these heavy pipes have air and water tight joints formed of gasket and lead, and are firmly supported by brick piers at their juncture with the sewer-pipes under ground.

During the progress of the brick-work temporary supplies have been taken by tapping the pipes supplying the hose-cocks in the Smithsonian grounds, but in the fall a 12-inch main pipe was tapped outside of the building and near its southeastern corner. Three parallel lines of 3-inch water-pipe running due north through the building were put in with supply for 16 fire-plugs, numerous street-washers, outlets for closets, basins, and bath-tubs, stop-cocks, &c.

Simultaneously with the water supply the supply-pipes for gas were attended to. The gas main was tapped on B street, outside of the southwest corner of the building, and two 4-inch supply-pipes were put in, one running due north and the other due east through the building, at an equal distance of about 20 feet from the outside walls of the building. Both pipes are continued, of reduced sizes, in a similar way until they meet at the northeast corner of the building. They have a regular fall back to the main, the permanence of which is secured by two supporting brick piers under each length of pipe, so that no flickering of gas can ever occur in consequence of the formation of traps by irregular settlements of the pipes. Outlets have been provided for lighting all the rooms and passages, and also for the light required to supervise all the parts of the building at night. Unusually large gas-pipes were found necessary on account of the great lengths on which they are run, and this feature will afford facilities hereafter, in case it should be decided to fit up any of the halls with brilliant light for public use at night.

14. *Underground piping for heating apparatus.*—To avoid the unsightly appearance of exposed large-sized steam and water return-pipes required for the successful heating of the vast building, it was decided to build the necessary ducts and introduce the pipes under ground before the floors were laid, though this part of the work was not included in the estimates on which the appropriation for the building proper was based.

The heating apparatus intended under the estimates, now before the Appropriation Committee of the House, provides for four steam-boilers of 256 nominal horse-power in the aggregate. The generated steam is to be conducted by two separate main pipes of eight inches diameter to about 200 steam-heaters, containing in the aggregate 13,680 square feet of radiating surface. The hot water condensed in these heaters is to be returned and reused in the boiler.

FINANCIAL STATEMENT.

Expenditures up to date.

Earth-work:		
Excavation	$724 43	
Grading	129 25	
		$853 68

Foundations:			
A. Concrete:			
Concrete stone		$2,083 32	
Cement		1,084 24	
Sand		300 00	
Labor		431 46	
			$3,899 02
B. Rubble-stone work:			
Rubble-stone		3,394 36	
Cement		1,000 00	
Sand		295 00	
Labor		2,321 28	
			7,010 64
Brick-work:			
Red bricks		31,512 24	
Buff and blue bricks		3,270 73	
Blackening bricks		1,235 05	
Lime and cement		2,789 65	
Sand		2,240 14	
Pulp-black for mortar		262 95	
Centers		866 37	
Laying under contract		16,799 30	
Laying by day's work		3,597 84	
Miscellaneous expenses		1,447 11	
			64,021 38
Cut-stone work			9,097 60
Wrought and cast iron work:			
Floor-beams		3,230 52	
Hoop-iron for anchors		242 70	
Roofs and anchors		16,401 80	
Setting beams, &c		592 31	
			20,467 33
Galvanized iron-work			2,016 00
Slating:			
Cost of slate for roof		3,972 32	
Cost of slate for isolating course of foundation		245 80	
Cement		88 34	
Labor		123 26	
			4,429 72
Covering of flat roofs:			
A. Fire-proof gratings:			
Plaster of Paris	484 65		
Lime	100 00		
Strips	3,519 65		
Ashes	110 45		
Hair	60 00		

Labor of carpenters	$3,275 11		
Labor of plasterers	819 50		
		$8,369 36	
B. Roofing:			
Manila felt	1,145 96		
Redipped tin	3,043 59		
Labor	400 05		
		4,589 60	
			$12,958 96
Plastering, poles, ropes, and lumber			591 35
Painting:			
Material		213 60	
Labor		216 75	
			430 35
Plumbing, sewerage, and drainage			1,386 96
Carpenters' work, lumber, and hardware:			
Window-frames		1,480 75	
Miscellaneous lumber		935 41	
Hardware		404 89	
			2,821 05
Decorations			2,000 00
Construction and superintendence			5,000 00
Miscellaneous expenses:			
A.—Survey and levels of ground, clearing of site, repairs to roads, &c			1,206 55
B.—Printing, advertising, and photographic copies for circulation among bidders			1,377 14
C.—Platform scales, tools, models, and sheds			1,036 71
D.—Clerical services and watchmen			1,571 00
E.—Stationery, office-furniture, telegraph attachment and service, traveling expenses and other incidentals			970 94
Total expenditures to January 1, 1880			$143,146 38
Amount appropriated by Congress			250,000 00
Balance to credit of the building under date of January 1, 1880			106,853 62
The materials for the completion of the building are mostly engaged under existing contracts, and represent a liability of			58,853 62
Hence, balance remaining for labor of finishing and for completing the required material			$48,000 00

This balance is sufficient to justify the expectation that the building will be completed within the appropriation, ready for receiving the heating apparatus and glass cases.

CONTRACTS.

The contracts entered into and their present condition are enumerated in the adjoining table:

Contracts and accepted proposals entered into and in force during the progress of the work.

Date of contract.	Description of work.	Name of contractor.	Rate.	Specified amount.	Present condition.
1879.					
Apr. 14	Sand	John Miller	73 cents per cubic yard.		In force.
Apr. 21	Gneiss rubble stone	Jos. A. Blundon	$1.69 per cubic yard.		Complete.
Apr. 23	Grading	Gleeson & Himber		$129 20	Do.
Apr. 23	Excavating	do	14¾ cents per cubic yard.		Do.
Apr. 23	Concrete foundations: Labor	do	35 cents per cubic yard.		Do.
Apr. 23	Rubble-stone masonry: Labor	do	$1.15 per cubic yard.		Do.
Apr. 23	Concrete stone: Material	do	$1.69 per cubic yard.		Do.
Apr. 26	Cut-stone work	Rothwell & Lloyd		7, 446 21	
	Material and labor:		75 cents per linear foot for additional window-sills. 45 cents additional per square foot for bond-stones.		Complete.
Apr. 30	Lime	Carson & Son, of Riverton, Vt.	63 cents per barrel of 200 lbs.		In force.
Apr. 30	Cement	Cumberland Hydraulic Cement Company.	87 cents per 300 pounds.		Do.
May 10	Window frames and sash.	Barber, Henderson & Co.		4, 678 80	Do.
May 23	Brick-work (labor)	Gleeson & Himber	$3.37 per M		Complete.
June 12	Bricks	Washington Brick Machine Company.	Common, $6.23 per M.; Face, $8.23 per M.		In force.
June 19	Rolled-iron beams	New Jersey Steel and Iron Co., Trenton.	Extra beams, 2.35 cents per lb., delivered.	2, 865 00	Complete.
July 7	Iron roofs, stairs, railings.	C. A. Schneider & Sons		36, 856 39	In force.
July 12	Galvanized-iron work, material and labor.	Stockstill & Co		4, 399 89	Do.
July 12	Drainage, material, labor.	Blinkhorn & Hannan		2, 312 26	Do.
July 22	Slaters' work and fastenings.	Jno. O. Jones	$.165 per square, and 75 cents additional for any double fastenings.		Do.
Aug. 14	Blue slate	Ed. Roberts, of Ore Banks, Va.	$4.80 per square		Do.
Aug. 14	Red slate and green slate.	Story & Wilbur, of Boston.	Green, $6.20; red, $9. 10 per square.		Complete.
Dec. 9	Interior doors and frames.	Jos. Thomas & Son, Baltimore.		1, 241 00	In force.
Dec. 24	Main-entrance doors	Aug. Grass		730 00	Do.
1880.					
Jan. 10	Underground piping for heating.	Baker, Smith & Co., New York.		5, 770 00	Do.
Jan. 10	Florida pine flooring	Thos. W. Smith	$30.75 per M. B. M.		Do.

In conclusion, we beg to state that in addition to our steady personal attendance we have kept constantly upon the ground, up to the close of the season, a general superintendent in the person of Mr. John H. Bird; and that Mr. W. W. Karr, the clerk in charge of platform scales, time books, and the miscellaneous office duties connected with the progress of the work, has rendered our duties easier by hearty co-operation. We are indebted to him for the record of many of the details contained in this report.

We have the honor to be, very respectfully, your obedient servants,

CLUSS & SCHULZE,

Architects.

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

WASHINGTON, D. C., *January* 17, 1880.

The annual meeting of the Board of Regents of the Smithsonian Institution was held this day at 10 o'clock a. m., in the Regents' room.

Present, the Chancellor, Chief-Justice Waite; Hon. Wm. A. Wheeler, Vice-President of the United States; Hon. H. Hamlin, Hon. R. E. Withers, Hon. N. Booth, Hon. J. A. Garfield, Hon. Hiester Clymer, Hon. Joseph E. Johnston, Dr. John Maclean, Dr. Asa Gray, Hon. Peter Parker, President Noah Porter, General Wm. T. Sherman, and the Secretary, Professor Baird.

(Dr. H. Coppée, the only member of the Board absent, was accidentally detained on the road, and did not reach Washington until after the adjournment of the Board.)

The Secretary made the following announcements relative to the appointment of members of the Board of Regents.

The vacancy in the Board occasioned by the expiration of the term of Hon. A. A. Sargent, of California had been filled on the 21st of March, 1879, by the appointment by the President of the Senate of Hon. Newton Booth, of California.

On the 4th of April, 1879, the Speaker of the House of Representatives, Hon. S. J. Randall, had reappointed as Regents Hon. H. Clymer of Pennsylvania and Hon. J. A. Garfield of Ohio, and had appointed Hon. Joseph E. Johnston of Virginia *vice* Hon. Alex. H. Stephens, who had declined reappointment.

A joint resolution had passed Congress and been approved by the President of the United States December 19, 1879, providing that the "vacancies in the Board of Regents of the class other than members of Congress shall be filled by the reappointment of Asa Gray of Massachusetts, Henry Coppée of Pennsylvania, John Maclean of New Jersey, and Peter Parker of the city of Washington, whose terms have expired."

The minutes of the Board of January 16, 1879, were read, and, after slight amendment, approved.

The Secretary presented a statement of the financial condition of the Institution, and stated that in order to save time this statement and all the accounts of the Institution had been referred to the Executive Committee.

Dr. Parker, from the Executive Committee, presented and read the annual report of the committee relative to the receipts and expenditures of the Institution and the National Museum for the year 1879, the condition of the funds, estimates for the year 1880, &c.

On motion of General Garfield, it was—

Resolved, That the report of the Executive Committee for 1879 be accepted.

Resolved, That the income for the year 1880 be appropriated for the service of the Institution upon the basis of the above report, to be expended by the Secretary with full discretion as to the items, subject to the approval of the Executive Committee.

Dr. Gray, from the committee on the Henry memorial, reported that the material for the volume had been collected, and was now in the hands of the Public Printer.

On motion of Dr. Withers the committee was continued, and further time granted.

Dr. Parker called attention to the fact that the resolution of the 17th of January, 1879, limited the allowance to the Secretary for house-rent, &c., to the 31st of December, 1879.

On motion of Mr. Hamlin, it was—

Resolved, That the Secretary of the Institution be allowed the sum of one hundred and twenty-five dollars per month for rent, fuel, gas, &c.

On motion of Dr. Parker, it was—

Resolved, That an allowance of one hundred and fifty dollars be made to defray the funeral expenses of the late Tobias N. Woltz, who was superintendent of the building for twenty-two years.

General Sherman presented and read the report of the National Museum Building Commission appointed by resolution of the Board January 17, 1879.

He also presented the report of the architects, Messrs. Cluss & Schulze.

On motion of Mr. Clymer, the reports were accepted.

On motion of General Garfield, it was—

Resolved, That the Board of Regents hereby express their high appreciation of the contribution made to science by the late Simeon Habel, and of the bequest which he made to the Smithsonian Institution.

The Secretary presented his annual report of the operations of the Institution for the year 1879, which was read, and, on motion of General Sherman, it was—

Resolved, That the report be accepted and transmitted to Congress.

The Board then adjourned *sine die*.

JAMES SMITHSON AND HIS BEQUEST.

By William J. Rhees.

James Smithson was born in England about the year 1754, the precise date and place of his nativity being unknown.* He was a natural son of Hugh Smithson, first Duke of Northumberland, his mother being a Mrs. Elizabeth Macie, of an old family in Wiltshire of the name of Hungerford. Nothing has been learned of her history.

Hugh Smithson, his father, was distinguished as a member of one of the most illustrious houses of Great Britain, and also because of his alliance with the renowned family of Percy.

The Smithson baronetcy arose with an earlier Hugh Smithson, the second son of Anthony Smithson, esq., of Newscome or Newsham, in the parish of Kirby-on-the-Mount, Yorkshire, who was thus rewarded by Charles II in 1660, for his services in the royalist cause during the civil wars. His grandson, Sir Hugh Smithson, married Elizabeth, daughter of the second Lord Langdale, and had two sons. Hugh, the eldest, died unmarried, before his father; Langdale, the second son, married Miss Revely, by whom he left one son, Hugh. This son succeeded his grandfather as Sir Hugh Smithson, of Stanwick, in 1750, and was the father of the subject of the present sketch. He married Lady Percy on the 16th July, 1740. Her father inherited the Dukedom of Somerset in 1741, and was created Earl of Northumberland in 1749. On his death, in 1750, Sir Hugh Smithson succeeded to these honors and on the 22d of October, 1766, was created first Duke of Northumberland † and Earl Percy, with succession to his heirs male; and finally in 1784 the barony of Lovaine of Alnwick was added to his accumulated dignities.

The Duchess died in 1776. The Duke survived till 1786,‡ and was succeeded by his son Hugh (half brother of James Smithson), as the second Duke of Northumberland.§

Hugh Smithson, the first Duke of Northumberland, had (besides James Smithson) another natural son, who was known as Henry Louis Dickinson. He received a good education, entered the military service, was commissioned lieutenant-colonel on the 1st of January, 1800, and on the 4th of August, 1808, took command of the Eighty-fourth Regiment of Foot. He saw active service on the Continent and in Asia and Africa. His estate was left to the care of his half-brother, Mr. James Smithson, in trust for the benefit of his son, and this was probably the source of a large part of the fund which eventually came to the United States.

*See Appendix. Note 3.

†There was a previous Duke of Northumberland who died without issue in 1716, and the title became extinct.

‡See Appendix. Note 2.

§See Appendix. Note 3.

The possession by the first Duke of Northumberland of titles and dignities only inferior to those of royalty was of little consequence to his son James Smithson. Deprived by the bar sinister on his escutcheon from claiming the family name and honors, he nevertheless aspired to win a fame more universal and lasting than these could have bestowed upon him. He devoted himself to original research in the field of science, and sought to be known and honored by his fellow-men as a discoverer of new truths. Moreover, he resolved to attach his name to an institution unique in its character, noble in its object, and universal in its beneficence, of which John Quincy Adams has well said, "Of all the foundations of establishments for pious or charitable uses which ever signalized the spirit of the age or the comprehensive beneficence of the founder, none can be named more deserving of the approbation of mankind."

Smithson's feeling in regard to posthumous fame was strikingly expressed in the following sentence found in one of his manuscripts.

"The best blood of England flows in my veins; on my father's side I am a *Northumberland*, on my mother's I am related to kings, but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten."

As Prof. W. R. Johnson has well observed in speaking of Smithson: "The man of science is willing to rest on the basis of his own labors alone for his credit with mankind, and his fame with future generations. In the view of such a man, the accidents of birth, of fortune, of local habitation, and conventional rank in the artificial organization of society, all sink into insignificance by the side of a single truth of nature. If he have contributed his mite to the increase of knowledge; if he have diffused that knowledge for the benefit of man, and above all, if he have applied it to the useful, or even to the ornamental purposes of life, he has laid not his family, not his country, but the world of mankind under a lasting obligation."

The eloquent words of John Quincy Adams in reference to the fame to be conferred on Smithson by the successful accomplishment of the great design he had in view by his bequest are appropriate in this connection.

"The father of the testator upon forming his alliance with the heiress of the family of the Percys, assumed, by an act of the British Parliament, that name, and, under it, became Duke of Northumberland. But renowned as is the name of Percy in the historical annals of England; resounding as it does from the summit of the Cheviot Hills to the ears of our children in the ballad of Chevy Chace, with the classical commentary of Addison; freshened and renovated in our memory as it has recently been from the purest fountain of poetical inspiration in the loftier strain of Alnwick Castle, tuned by a bard from our own native land (Fitz Greene Halleck); doubly immortalized as it is in the deathless dramas of Shakspeare; 'confident against the world in arms,' as it may have been in ages long past and may still be in the virtues of its present ossessors by inheritance, let the trust of James Smithson to the United tates of America be faithfully executed by their representatives in Conress, let the result accomplish his object, 'the increase and diffusion of nowledge among men,' and a wreath of more unfading verdure shall ntwine itself in the lapse of future ages around the name of SMITHSON, an the united hands of tradition, history, and poetry have braided round the name of Percy through the long perspective in ages past of thousand years."

The Duke of Northumberland provided a liberal education for his son ames, who pursued his studies at Oxford University, where he became ttached to Pembroke College, distinguished for having among its llows the learned Blackstone, the eloquent Whitfield, and the celerated Dr. Samuel Johnson. Here the young student was noted for iligence, application, and good scholarship, and attracted marked atention by his proficiency in chemistry. His vacations were passed in xcursions to collect minerals and ores which it was his favorite occuation to analyze. At Oxford he received the impulse for scientific esearch which characterized all his future life, and the ardent desire not nly to advance knowledge himself but to devote in after years his whole ortune to provide means by which others could prosecute this high and oble pursuit.

He was graduated at Pembroke College on the 26th of May, 1786, as JAMES LEWIS MACIE,* by which name he seems at that time to have been known, and which he retained for about fourteen years, when he adopted that of JAMES SMITHSON.†

Smithson never married, and as a man of wealth had ample opportunity for leisure or the indulgence of mere personal gratification. But idleness and pleasure were not compatible with the spirit and ardor of the young student of chemistry. He diligently pursued his investigations, and his ambition to become associated with the votaries of science induced him to seek membership in the Royal Society of London.

"The Royal Society of London," says Arago, "enjoys throughout the whole kingdom a vast and deserved consideration. The philosophical transactions which it publishes have been for more than a century and a half the glorious archives in which British genius holds it an honor to deposit its titles to the recognition of posterity. The wish to see his name inscribed in the list of fellow-laborers in this truly national collection beside the names of Newton, Bradley, Priestley, and Cavendish, has always been among the students of the celebrated universities of Cambridge, Oxford, Edinburgh, and Dublin, the most anxious as well as legitimate object of emulation. Here is always the highest point of ambition of the man of science."

*So given in the Oxford Catalogue. In the Philosophical Transactions and the Gentleman's Magazine the name is given as James *Louis* Macie.

†His second paper in the Philosophical Transactions, 1802, is by James Smithson. Sir Davies Gilbert, in his eulogy of him in 1830, calls him James Lewis Smithson.

The following is the official recommendation of his application to the society, bearing the signatures of some of its most illustrious members:

"James Lewis Macie, Esq., M. A., late of Pembroke College, Oxford, and now of John Street, Golden Square—a gentleman well versed in various branches of Natural Philosophy, and particularly in Chymistry and Mineralogy, being desirous of becoming a Fellow of the Royal Society, we whose names are hereto subscribed do, from our personal knowledge of his merit, judge him highly worthy of that honour and likely to become a very useful and valuable Member."

RICHARD KIRWAN.
C. F. GREVILLE.
C. BLAGDEN.
H. CAVENDISH.
DAVID PITCAIRN.

He was admitted a fellow on the 26th of April, 1787, in less than one year after leaving the university.*

Smithson's lodgings for some time were in Bentinck street, a locality famous as the place where Gibbon wrote much of his "Decline and Fall of the Roman Empire." Here, with authors, artists, and savans, Smithson found congenial fellowship. His mind was filled with a craving for intellectual development, and for the advancement of human knowledge. To enlarge the domain of thought, to discover new truths, and to make practical application of these for the promotion of civilization, were the great ends he had constantly in view.

For purposes of scientific inquiry he engaged in extensive tours in various parts of Europe; making minute observations wherever he went on the climate, the physical features and geological structure of the locality visited, the characteristics of its minerals, the methods employed in mining or smelting ores, and in all kinds of manufactures.

These numerous journeys and sojourns abroad gave him a cosmopolitan character, and illustrated one of his own sayings: "the man of science is of no country, the world is his country, all mankind his coun-

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* *Extract from Journal Book of the Royal Society.*

Ordinary meeting, Jan. 18, 1787.—Certificates were read recommending for election Louis Pinto de Sousa Coutinho, Knight of the Orders of Malta and Christ, and Envoy Extraordinary and Minister Plenipotentiary from the Queen of Portugal to the Court of Great Britain. Also Sir Thomas Gery Cullum, Bart., of Bury Saint Edmunds, in Suffolk, and JAMES LEWIS MACIE, Esq., M. A., late of Pembroke College, Oxford, and now of John Street, Golden Square.

April 19, 1787.—Louis Pinto de Sousa Coutinho, Portuguese Minister at the Court of Great Britain, Sir Thos. Gery Cullum, Bart., and JAMES LEWIS MACIE, Esq., Certificates in whose favour had hung the usual time in the Meeting Room were put to the ballot and chosen into the Society,

April 26, 1787.—JAMES LEWIS MACIE, Esq., and Sir Thos. Gery Cullum, Bart., elected at a former meeting attended. They paid their admission fees, compounded for Annual Contributions, and having signed the obligation in the Charter book were admitted fellows of the Society.

trymen." This fact is exemplified by the life of Smithson—born in England, spending most of his time in France and Germany, buried in Italy, and leaving his name and fortune to the United States of America.

Desiring to bring to the practical test of actual experiment every thing that came to his notice, he fitted up and carried with him a portable laboratory. He collected also a cabinet of minerals composed of thousands of minute specimens, including all the rarest gems, so that immediate comparison could be made of a novel or undetermined specimen, with an accurately arranged and labeled collection. With minute balances, his weights scarcely exceeding a gram, and with articles so delicate as to be scarcely visible, he made the most accurate and satisfactory determinations. With a few pieces, not exceeding half a cubic inch in size, of tabasheer, a substance found in the hollow of bamboo canes, he made over two hundred and fifty different experiments.*

The value which Smithson placed on such minute researches is incidentally shown by a remark in his paper on "fluorine." He says, "there may be persons who, measuring the importance of the subject by the magnitude of the object, will cast a supercilious look on this discussion; but the particle and the planet are subject to the same laws, and what is learned of the one will be known of the other."

Smithson's ardor for knowledge and his zeal as a collector of new and rare minerals exposed him sometimes to hardship and privation. An interesting account of one of his journeys is given in his private journal. In 1784, in company with Mr. Thornton, Mons. Faujas de St. Fond, the celebrated geologist of France, the Italian Count Andrioni, and others, he made a tour through New Castle, Edinburgh, Glasgow, Dumbarton, Tarbet, Inverary, Oban, Arran, and the island of Staffa.

As stated in Mr. Smithson's journal, the party had arrived at a house on the coast of Mull, opposite the island, and the journal continues:

"Mr. Turtusk got me a separate boat; set off about half-past eleven o'clock in the morning, on Friday, the 24th of September, for Staffa. Some wind, the sea a little rough; wind increased, sea ran very high; rowed round some part of the island, but found it impossible to go before Fingal's cave; was obliged to return; landed on Staffa with difficulty; sailors press to go off again immediately; am unwilling to depart without having thoroughly examined the island. Resolve to stay all night. Mr. Maclaire stays with me; the other party which was there had already come to the very same determination; all crammed into one bad hut, though nine of ourselves besides the family; supped upon eggs, potatoes, and milk; lay upon hay, in a kind of barn." (The party, be it remembered, embraced two English gentlemen, one French savant, one Italian count.)

"25th. Got up early, sea ran very high, wind extremely strong—no boat could put off. Breakfasted on boiled potatoes and milk; dined upon the same; only got a few very bad fish; supped on potatoes and

* See Appendix. Note 4.

milk; lay in the barn, firmly expecting to stay there for a week, without even bread."

"*Sunday the* 26*th*.—The man of the island came at five or six o'clock in the morning to tell us that the wind was dropped, and that it was a good day. Set off in the small boat, which took water so fast that my servant was obliged to bail constantly—the sail, an old plaid—the ropes, old garters."

On the 29th, the tourists are at Oban, where a little circumstance is noted, which significantly marks the zeal and activity of the collector of minerals and fossils, and the light in which devotion to geology is sometimes viewed.

"*September* 29.—This day packed up my fossils in a barrel, and paid 2*s*. 6*d*. for their going by water to Edinburgh. Mr. Stevenson charged half a crown a night for my rooms, because I had brought '*stones and dirt*,' as he said into it."

A month later he visited Northwich.

"*October* 28.—Went to visit one of the salt mines, in which they told me there were two kinds of salt. They let me down in a bucket, in which I only put one foot, and I had a miner with me. I think the first shaft was about thirty yards, at the bottom of which was a pool of water, but on one side there was a horizontal opening, from which sunk a second shaft, which went to the bottom of the pit, and the man let us down in a bucket smaller than the first."*

These incidents indicate the character of Smithson as a scientific enthusiast, not easily deterred by the fear of personal inconvenience from the pursuit of his favorite object.

Much of his life was passed on the Continent, in Berlin, Paris, Rome, Florence, and Geneva, enjoying everywhere the friendship and respect of the leading men of science,† and always devoting himself to the study of physical phenomena. Distinguished authors, as Gay-Lussac, Marcet, Haüy, Berzelius, and Cordier, presented him with their scientific papers‡ as soon as published, and he enjoyed intimate association and correspondence with Davy, Gilbert, Arago, Biot, Klaproth, Black, and others.§

As a chemist, Sir Davies Gilbert, President of the Royal Society, pronounced Smithson to be the rival of Wollaston, of whom Magendie said, "his hearing was so fine he might have been thought to be blind, and his sight so piercing he might have been supposed to be deaf." It is related of him that he made a galvanic battery in a thimble, and a platinum wire much finer than any hair.

* *Smithsonian Miscell. Coll.*, No. 327, p. 140.

† Galton, in speaking of Erasmus Darwin, remarks: "He was held in very high esteem by his scientific friends, including such celebrities as Priestley and James Watt, and it is by a man's position among his contemporaries and competitors that his work may most justly be appraised." Francis Galton, *English Men of Science*.

‡ See Appendix.—Note 5.

§ See Appendix.—Note 6.

Prof. Walter R. Johnson has made the following remarks respecting Smithson:

"It appears from his published works that his was not the character of a mere amateur of science. He was an active and industrious laborer in the most interesting and important branch of research—mineral chemistry. A contemporary of Davy and of Wollaston, and a correspondent of Black, Banks, Thomson, and a host of other names renowned in the annals of science, it is evident that his labors had to undergo the scrutiny of those who could easily have detected errors, had any of a serious character been committed. His was a capacity by no means contemptible for the operations and expedients of the laboratory. He felt the importance of every help afforded by a simplification of methods and means of research, and the use of minute quantities and accurate determinations in conducting his inquiries."

Smithson says in one of his papers, "chemistry is yet so new a science," what we know of it bears so small a proportion to what we are ignorant of; our knowledge in every department of it is so incomplete, consisting so entirely of isolated points, thinly scattered, like lurid specks on a vast field of darkness, that no researches can be undertaken without producing some facts leading to consequences which extend beyond the boundaries of their immediate object." *

Many of these "lurid specks" in the vast field of darkness of which Smithson spoke so feelingly, have, Prof. Johnson observes, "since his days of activity expanded into broad sheets of light. Chemistry has assumed its rank among the exact sciences. Methods and instruments of analysis unknown to the age of Smithson have come into familiar use among chemists. These may have rendered less available for the present purposes of science than they otherwise might have been, a portion of the analysis and other researches of our author. The same may, however, be said of nearly every other writer of his day."

Although his principal labors were in analytical chemistry, he distinguished himself by his researches in mineralogy and crystallography, in all his work exhibiting the most careful and minute attention to accuracy.† In his second published paper, he observes: "It may be proper to say that the experiments have been stated *precisely* as they turned out, and have not been in the least degree bent to the system."

That he pursued his investigations in a philosophic spirit, and with proper methods, is evident from the favor with which his contributions to the scientific societies and transactions of the day were received by his contemporaries, and the fact that the results he reached are still accepted as scientific truths.‡

* A chemical analysis of some calamines. *Smithsonian Miscell. Coll.*, No. 327, p. 26.

† He carefully noted on the margins of his books mistakes in grammar or orthography, and frequently corrected erroneous statements or improper references in the indexes.

‡ An account of some of Smithson's experiments and copies of his notes on minerals and rocks are given in a paper on the works and character of James Smithson, by Dr. J. R. McD. Irby. *Smithsonian Miscell. Collections*, No. 327, 1879, p. 143.

In one of his essays, he divides the sources of knowledge into, 1st, observation; 2d, reasoning; 3d, information; 4th, conjecture. In all his researches he began the process of acquisition by *observing.*

One of his sentiments has been adopted as the motto on the publications of the Smithsonian Institution; viz: "*Every man is a valuable member of society, who, by his observations, researches, and experiments, procures knowledge for men.*"

In a critical notice of Davy's Elements of Chemical Philosophy in the Quarterly Review for 1812, the writer speaking of recent advances in chemistry, and especially in the establishment and extension of the law of definite proportions, remarks: "For these facts the science is principally indebted, after Mr. Higgins, to Dalton, Gay-Lussac, Smithson, and Wollaston."*

The mineral species "*Smithsonite*," a carbonate of zinc, was discovered and analyzed by him, among some ores from Somersetshire and Derbyshire, England. The name, Smithsonite, appears to have been conferred on it by the great French mineralogist Beudant.

It is interesting to notice the number and variety of specimens from the vegetable kingdom that Smithson subjected to analysis. They include the violet, red rose, red clover, daisy, blue hyacinth, hollyhock, lavender, artichoke, scarlet geranium, red cabbage, radish, poppy, plum, pomegranate, mulberry, cherry, currant, buckthorn berries, elder and privet berries. He also examined the coloring matter of animal greens.

It is perhaps worthy of note that his first paper related to an article of importance in the *materia medica*, and his last to a matter of practical value to artists. He by no means confined his attention to abstract science, but contributed knowledge of improved methods of constructing lamps, and of making tea and coffee. That such practical questions might be considered of little importance by men of science he seems to acknowledge by the remarks he makes in one of his papers.

"It is to be regretted," he observes, "that those who cultivate science frequently withhold improvements in their apparatus and processes, from which they themselves derive advantage, owing to their not deeming them of sufficient magnitude for publication. When the sole view is to further a pursuit of whose importance to mankind a conviction exists, all that can should be imparted, however small may appear the merit which attaches to it."†

A secretary of the French Academy deemed it his duty to offer an excuse for having given a detailed account of certain researches of Leibnitz, which had not required great efforts of the intellect. "We ought," says he, "to be very much obliged to a man such as he is, when he condescends, for the public good, to do something which does not partake of genius." Arago remarked in his eulogy on Fourier, "I cannot conceive the ground of such scruples; in the present day the sciences

* *Quarterly Review*, 1812, vol. viii, p. 77.

† Some improvements of lamps. *Smithsonian Miscell. Coll.* No. 327, p. 78.

are regarded from too high a point of view to allow us to hesitate in placing in the first rank of the labors with which they are adorned those which diffuse comfort, health, and happiness amidst the working population."

In another of his papers Smithson says, referring to practical investigations:

"In all cases means of economy tend to augment and diffuse comfort and happiness. They bring within the reach of the many what wasteful proceeding confines to the few. By diminishing expenditure on one article they allow of some other enjoyment which was before unattainable. A reduction in quantity permits an indulgence in superior quality. In the present instance the importance of economy is particularly great since it is applied to matters of high price, which constitute one of the daily meals of a large portion of the population of the earth."

"That in cookery also the power of subjecting for an indefinite duration to a boiling heat, without the slightest dependiture of volatile matter, will admit of a beneficial application, is unquestionable." *

In the books of his library are found numerous marginal notes, indicating his special attention to subjects relating to the health, comfort, resources, and happiness of the people.

Among his effects were several hundred manuscripts and a great number of notes or scraps on a variety of subjects, including history, the arts, language, rural pursuits, &c. On the subject of "habitations" were articles classified under the several heads of situation, exposure, exterior and interior arrangements, building materials, contents and adornment of rooms, furniture, pictures, statuary, &c. It is not improbable that he contemplated the preparation of a cyclopedia or philosophical dictionary.

Smithson's contributions to scientific literature consist of twenty-seven papers, eight published in the Philosophical Transactions of the Royal Society, in the years 1791, 1802, 1806, 1808, 1811, 1812, 1813, and 1817, and nineteen in Thomson's Annals of Philosophy, a journal of the highest scientific character, in 1819, 1820, 1821, 1822, 1823, 1824, and 1825. These papers have recently been collected and reprinted by the Smithsonian Institution.† Several of them were previously republished in foreign scientific journals translated by himself.

It is highly probable that Smithson contributed articles to scientific and literary journals other than those mentioned, but they have not yet been discovered.

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* An improved method of making coffee. *Smithsonian Miscell. Coll.*, No. 327, p. 88.

† *Smithsonian Miscell. Coll.*, No. 327, 1879, 8 vo., 166 pp.

The following is a list of his scientific writings:

[In the Philosophical Transactions of the Royal Society of London.]

1791. An account of some chemical experiments on Tabasheer, vol. lxxxi, pt. II, p. 368.
1802. A chemical analysis of some Calamines, vol. xciii, p. 12.
1806. Account of a discovery of native minium, vol. xcvi, pt. I, p. 267.
1807. On quadruple and binary compounds, particularly sulphurets, [Philosophical Magazine, vol. xxix, p. 275.]
1808. On the composition of the compound sulphuret from Huel Boys, and an account of its crystals, vol. xcviii, p. 55.
1811. On the composition of zeolite, vol. ci, p. 171.
1813. On a substance from the elm tree, called ulmin, vol. ciii, p. 64.
1813. On a saline substance from Mount Vesuvius, vol. ciii, p. 256.
1817. A few facts relative to the coloring matter of some vegetables, vol. cviii., p. 110.

[In Thomson's Annals of Philosophy.]

1819. On a native compound of sulphuret of lead and arsenic, vol. xiv, p. 96.
1819. On native hydrous aluminate of lead, or plomb gomme, vol. xiv, p. 31.
1820. On a fibrous metallic copper, vol. xvi, p. 46.
1820. An account of a native combination of sulphate of barium and fluoride of calcium, vol. xvi, p. 48.
1821. On some capillary metallic tin, vol. xvii. New series, vol. I, p. 271.
1822. On the detection of very minute quantities of arsenic and mercury, vol. xx. New series, vol. iv, p. 127.
1822. Some improvements of lamps, vol. xx. New series, vol. iv, p. 363.
1823. On the crystalline form of ice, vol. xxi. New series, vol. v, p. 340.
1823. A means of discrimination between the sulphates of barium and strontium, vol. xxi. New series, vol. v, p. 359.
1823. On the discovery of acids in mineral substances, vol. xxi. New series, vol. v, p. 384.
1823. An improved method of making coffee, vol. xxii. New series, vol. vi, p. 30.
1823. A discovery of chloride of potassium in the earth, vol. xxii. New series, vol. vi, p. 258.
1823. A method of fixing particles on the sappare, vol. xxii. New series, vol. vi, p. 412.
1824. On some compounds of fluorine, vol. xxiii. New series, vol. vii, p. 100.
1824. An examination of some Egyptian colors, vol. xxiii. New series, vol. vii, p. 115.
1824. Some observations on Mr. Penn's theory concerning the formation of the Kirkdale Cave, vol. xxiv. New series, vol. viii, p. 50.

1825. Note to a letter from Dr. Black, describing a very sensible balance, vol. xxvi. New series, vol. x, p. 52.
1825. A method of fixing crayon colors, vol. xxvi. New series, vol. x, p. 236.

Smithson's writings all exhibit clearness of perception, terseness of language and accuracy of expression.*

A trait of Smithson's character is exhibited in the allusions he makes in his writings to other scientific men. His expressions are always kind or complimentary, evidently not for the sake of flattery, but from a sense of justice and truthful recognition of merit. He speaks of Mr. Tennant as one "whose many and highly important discoveries have so greatly contributed to the progress of chemical science." Abbe Haüy he refers to as one "so justly celebrated for his great knowledge in crystallography, mineralogy," &c. "The analysis we possess of natrolite by the illustrious chemist of Berlin," &c.

Of Baron Cronstedt he says, "the greatest mineralogist who has yet appeared."

"A query from the celebrated Mr. Vauquelin."

"The celebrated Mr. Klaproth, to whom nearly every department of chemistry is under numerous and great obligations."

"M. Berzelius' elegant method of detecting phosphoric acid," &c.

"M. Werner, its principal and most distinguished professor," &c.

Smithson died on the 27th of June, 1829, at Genoa, Italy. He was buried in the Protestant cemetery, about a mile west of Genoa, on the high elevation which forms the west side of the harbor and overlooks the town of Sampierdarena. His grave is marked by a handsome monument. The base is of pale gray marble, 6 feet and a half long, 3 feet wide, and 3¾ feet high. On the top of this is a white marble urn suitably proportioned to the base. The lot is inclosed by an iron fence, with gray marble corner posts. On one side of the monument the inscription is as follows:

"Sacred to the memory of James Smithson, esq., Fellow of the Royal Society, London, who died at Genoa the 26th June, 1829, aged 75 years."

On the other side is the following:

"This monument is erected, and the ground on which it stands purchased in perpetuity, by Henry Hungerford, esq., the deceased's nephew, in token of gratitude to a generous benefactor and as a tribute to departed worth."

The announcement of his departure called forth expressions of regret from prominent men of science, and as he had been an honored Fellow of the Royal Society, its president, Sir Davies Gilbert, alluded to it on two occasions. At the meeting of the Royal Society November 30, 1829, he remarked, "In no previous interval of twelve months has the society

*A few extracts from his published writings are given in the Appendix, Note 7.

collectively, or have its individual members, experienced losses so severe, or so much in every respect to be deplored." Among the names then referred to were those of Dr. W. H. Wollaston, Dr. Thomas Young, and Sir Humphrey Davy. To these illustrious savans he adds that of James Smithson, who, he says, "has added eight communications to our Transactions. He was distinguished by the intimate friendship of Mr. Cavendish, and rivalled our most expert chemists in elegant analyses."*

At the following anniversary meeting of the Royal Society, November 30, 1830, the president, Sir Davies Gilbert, delivered an address in which, after speaking of the death of Major Kennele and Mr. Chevenix, he says:

* * * "The only remaining individual who has taken a direct and active part in our labours, by contributing to the Transactions, is Mr. James Lewis Smithson, and of this gentleman I must be allowed to speak with affection. We were at Oxford together, of the same college, and our acquaintance continued to the time of his decease.

"Mr. Smithson, then called Macie, and an undergraduate, had the reputation of excelling all other resident members of the University in the knowledge of chemistry. He was early honored by an intimate acquaintance with Mr. Cavendish; he was admitted into the Royal Society, and soon after presented a paper on the very curious concretion frequently found in the hollow of bambû canes, named *Tabasheer*. This he found to consist almost entirely of silex, existing in a manner similar to what Davy long afterwards discovered in the epidermis of reeds and grasses.

"Mr. Smithson enriched our Transactions with seven other communications: A chemical analysis of some calamines. Account of a discovery of native minium. On the composition and crystallization of certain sulphurets from Huel Boys in Cornwall. On the composition of zeolite. On a substance procured from the elm tree, called *Ulmin*. On a saline substance from Mount Vesuvius. Facts relative to the colouring matter of vegetables.

"He was the friend of Dr. Wollaston, and at the same time his rival in the manipulation and analysis of small quantities. *Αγαθη δ' ερις ηδε βροτοισι.* Mr. Smithson frequently repeated an occurrence with much pleasure and exultation, as exceeding anything that could be brought into competition with it; and this must apologize for my introducing what might otherwise be deemed an anecdote too light and trifling on such an occasion as the present.

"Mr. Smithson declared that happening to observe a tear gliding down a lady's cheek, he endeavored to catch it on a crystal vessel; that one-half of the drop escaped, but having preserved the other half he submitted it to reagents, and detected what was then called microcosmic salt, with muriate of soda, and, I think, three or four more saline substances, held in solution.

**Philosophical Magazine*, 1830, vol. vii, p. 42.

"For many years past Mr. Smithson has resided abroad, principally, I believe, on account of his health; but he carried with him the esteem and regard of various private friends, and of a still larger number of persons who appreciated and admired his acquirements." *

This tribute to his memory and worth shows the high standing Smithson had attained in the estimation of his compeers, and that he secured the fidelity and affection of his dependants is evinced by the care with which, in his will, he provides a reward for their attachment and services.

"It has been the lot of the greatest part of those who have excelled in science," says Dr. Johnson, "to be known only by their own writings, and to have left behind them no remembrance of their domestic life or private transactions, or only such memorials of particular passages as are on certain occasions necessarily recorded in public registers."

To the same effect, Wilson, in his life of Cavendish (the warm friend of Smithson), remarks: "So careless has his own country been of his memory that although he was for some fifty years a well-known and very distinguished Fellow of the Royal Society, a member for a lengthened period of the French Institute, and an object of European interest to men of science, yet scarcely anything can be learned concerning his early history. This, no doubt, is owing in great part to his own dislike of publicity, and to the reserve and love of retirement which strongly characterized him. Long before his death however, he was so conspicuous a person in the scientific circles of London that the incidents of his early life might readily have been ascertained. They were not, it should seem, inquired into by any biographer."†

This is eminently true of Smithson. We are unfortunately debarred from acquiring an intimate knowledge of his personal traits and peculiarities by the absence of an autobiography, or even of any sketch of his life by his friends. For this reason we are more ready to avail ourselves of every fact in regard to him that can be ascertained, however trivial or insignificant any one of these might otherwise be considered. Even an inventory of his wardrobe and a schedule of his personal property possesses an interest and serves at least to gratify a natural curiosity. Such a list has recently been found as certified by the English consul at Genoa, after the death of Smithson, with a valuation of the different articles:

	Francs.
A carriage, complete	2,500 00
Twenty-six silver forks, one salad fork, eight desert spoons, eighteen spoons, four sauce-ladles, one soup ladle, four salt spoons, three sugar ladles, one tea shell, three silver-head corks, two silver vessels, one toasting fork, weighing in all 193¼ ounces of silver, valued by Mr. A. Canissa, a goldsmith	1,050 00
An English gold repeater	200 00

* The *Philosophical Magazine*, January–June, 1831, vol. ix, p. 41.

† George Wilson. *Life of Henry Cavendish.* London, 1851.

	Francs.
A Geneva gold watch	60 00
Two gold snuff-boxes, one toothpick case, and two shirt buttons	417 00
One pin with sixteen small diamonds	33 34
One ring with composition set in diamonds	66 73
One ring of agate	3 40
One ring, cameo, head of a Moor	50 00
Two small boxes, one of tortoise shell, the other of amber	6 30
One gold ring	13 00
One small silver pick case	6 00
A clasp of gold with hair	16 67
A clasp with diamonds	203 34
A pin with hair and diamonds	45 67
A cameo	50 00
A ring with diamonds	92 00
Sixteen shirts, nineteen cravats, forty-four pocket handkerchiefs, thirteen pairs of stockings, three nightcaps, two pair of drawers, two pair of sheets, three pillow-cases, seven waistcoats, two flannel waistcoats, six pair pantaloons, two cloth pantaloons, three coats, one nightgown, one dressing coat, two pair braces, four pair gloves	400 00
One telescope	60 00
Many small articles	100 00
Two pasteboard boxes containing medals, coins, stones, &c.	
One parcel containing papers relative to the Grand Canal*	
Several parcels of papers and five books	
112 Napoleons in gold and 34 francs 60 centimes, in the hands of Messrs. Gibbs & Co	2,274 60
Cash in hands of Messrs. Gibbs & Co	3,634 74
One parcel, thirteen certificates Spanish stock, Paris, 4th September, 1822, 350 piastres rente d'Espagne, par value, francs 24,097 50, valued at	3,780 00
Promissory note for 295 francs, dated 1st June, 1824, due by Alexis Silenne	295 00
Bond for 20,000 francs, dated 8th July, 1828, due by Sailly & Sœur, of Paris	20,000 00
Bill for 2,000 francs, dated 8th October, 1822, drawn by Mr. Sailly, accepted by Mr. Smithson	2,000 00
Bank-note for £100, No. 14419, 19th December, 1827, in the hands of Messrs. Gibbs & Co	2,500 00
Parcel containing accounts and letters from Messrs. Drummond & Co.	

* The Grand Canal is 90 miles in length, uniting the rivers Trent and Mersey, with branches to the Severn, to Oxford, &c. It was proposed by Mr. Wedgwood, and was the second one made in England.

Very few of these articles were transferred to Mr. Rush, the agent of the United States Government, who received the bequest. His enumeration of the personal effects of Smithson is as follows:

"A large trunk; a box containing sundry specimens of minerals; a brass instrument; a box of minerals; a box of chemical glasses; a packet of minerals; a glass vinegar-cruet; a stone mortar; a pair of silver-plated candlesticks and branches; a pair of silver-plated candlesticks without branches; a hone, in a mahogany case; a plated-wire flower-basket; a plated coffee-pot; a small plated coffee-pot; a pair of wine-coolers; a pair of small candlesticks; two pair salt-cellars; a bread-basket; two pair vegetable dishes and covers; a large round waiter; a large oval waiter; two small oval waiters; two plate-warmers; a reading shade; a gun; a mahogany cabinet; two portraits in oval frames; a china tea-service, consisting of twelve cups and saucers; six coffee-cups; a tea-pot; a slop-basin; a sugar-basin and lid; two plates; a milk-jug; a tea-canister; two dishes; a landscape in a gilt frame; a Derby-spar vase; a China tub; a piece of fluor-spar; a pair of glass candlesticks; a marble bust; sundry books and pamphlets; two large boxes filled with specimens of minerals and manuscript treatises, apparently in the testator's handwriting, on various philosophical subjects, particularly chemistry and mineralogy. Eight cases and one trunk filled with the like."

With reference to a gun, pieces of china, and articles of a miscellaneous nature belonging to Smithson, Mr. Rush was informed by his attorneys that they were taken in possession by his nephew, Henry James Hungerford.

Mr. Rush, in one of his dispatches to the State Department (July 14, 1838), says: "The boxes and trunk are to go on shipboard to-day. Before knowing anything of their contents, I thought proper to have them opened and examined in the presence of our consul and two other persons. A large portion of the contents proved to be unimportant; nevertheless, all will be delivered over on my arrival as I received them, except to have them better packed for a sea voyage, and so as to prevent further injury to that which time and bad packing have already done to them."

These articles remained in the New York custom house from the 29th of August, 1838, until June, 1841, when, at the earnest solicitation of the National Institute of Washington, they were sent to the latter city.

The trunk contained manuscripts and clothing, the latter consisting of the following articles, according to a list found among the papers of the National Institute: "1 net shirt, 4 sheets, 11 napkins, 5 light vests, 1 bag, 4 roundabouts, 5 light pants and short breeches, 1 bib, 3 drawers, 3 pair garters, 2 light coats, 1 cloth overcoat, 1 cloth military coat, 1 cloth hunting coat, 1 cloth cloak, 1 cloth surtout, 1 cloth pair of pants, 2 cloth vests, 4 pair stockings, 1 chapeau."

The clothing was nearly ruined by moths, and was presented to an orphan asylum. An examination of the effects was made by a committee of the National Institute, who made the following report as to part of them: "A cabinet, consisting of a choice and beautiful collection of minerals, comprising probably eight or ten thousand specimens. These, though generally small, are exceedingly perfect, and constitute a very complete geological and mineralogical series, embracing the finest varieties of crystallization, rendered more valuable by accompanying figures and descriptions by Mr. Smithson, and in his own handwriting. The cabinet also contains a valuable suite of meteoric stones, which appear to be specimens of most of the meteorites which had fallen in Europe during several centuries."

Mr. Francis Markoe, jr., himself an expert mineralogist, in a letter to the American Philosophical Society, 4th August, 1841, says "that among the valuable things contained in the Smithson boxes were found a superb collection, and very large, of precious stones and exquisite crystallized minerals, forming, as far as I can judge, decidedly the richest and rarest collection in this country."

A medallion was found among his effects to which were attached the words "my likeness," written in Smithson's own hand. From this has been engraved the portrait published by the Institution, the great seal ordered by the first Board of Regents, and the vignette which appears on all the Smithsonian publications. The original steel-plate portrait, engraved by J. W. Paradise, of New York, in 1847, was destroyed by fire, but it was finely reproduced for the Institution by Charles Burt, of New York, in 1879.

A full-length portrait (about one-fourth size) in oil, of Smithson, representing him in the costume of an Oxford student, was purchased by the Institution in 1850, for thirty guineas, from the widow of John Fitall, a former servant, to whom Smithson granted an annuity in his will.

Still later, in 1878, the Institution purchased from Mr. George Henry De la Batut, of France, a beautiful miniature in oil, on ivory, painted by Johns, on the 11th of May, 1816, at Aix-la-Chapelle.

The effects of Smithson were exhibited in the Patent Office building, Washington, until 1858, when they were transferred to the Smithsonian Institute, where they were unfortunately destroyed by fire on the 24th of January, 1865, with the exception of his books, a very few manuscript notes on minerals, and an oil painting of a landscape. A list of these books now in the Institution will be found in the appendix.*

The following articles are enumerated as the contents of case 23 in Alfred Hunter's "Popular Catalogue of the Extraordinary Curiosities in the National Institute, arranged in the building belonging to the Patent Office," 1855:

"Silver plate with coat of arms of the Northumberland family; chemical apparatus, test-cups, &c; thermometer, snuff-box, portrait of

* See Appendix—Note 8.

Smithson's father, scales, umbrella-case, and riding-whip, sword-belt and plume, silver spoons and butter-knife, ornamented spools for winding gold wire, copper plate with his name engraved on it; minerals of Smithson, a very superb collection, though small; silver candlestick; an elegant service of silver, containing a great many pieces. These are all very much discolored by sulphurous gas. A marble head of Saint Cecilia, by Thorwaldsen, presented to Mr. Smithson at Copenhagen by Dr. Brandis, physician to the King of Denmark. A fine old original painting by Bergham, cattle piece, peasants, &c.; an old building in the distance. Its subject is rustic and familiar life. The treatment is chaste and mellow. The depth of the foreground is really surprising, and appears to be produced without an effort; the background is transparent and aerial; the middle distance sober and clear; the atmosphere and vapors pellucid and tremulous; the quiet and docile animals, the groups of peasantry, and the strongholds of power are equal to any other great effort of the celebrated Bergham. Many specimens of petrified wood. Notice several beautiful specimens of marble, which it would be difficult to distinguish from a fine landscape painting. Glass model of the great Russian diamond, valued at about 600,000 pounds sterling."

In an "Account of the Smithsonian Institution, &c.," by Wm. J. Rhees, published in Washington in 1859, the following statement is made:

"In the room used by the 'Regents' and the 'Establishment' as a hall for their meetings, are now deposited the personal effects of James Smithson. Here may be seen his trunks, umbrella, walking-cane, sword, plume, riding-whip; a set of silver-plate; a miniature chemical laboratory, which he used when travelling; thermometers, snuff-box, scales, candlesticks, &c. Hanging in this room is an original painting by Bergham, a rural scene, the property of Smithson, a marble head of St. Cecilia, by Thorwalsden, &c."

The will of Smithson was prepared by him on the 23d October, 1826, while residing in Bentinck street, Cavendish Square, London, three years before his death, showing that it was made with deliberation and confirmed by mature reflection. Its provisions are in some respects so remarkable that they have been attributed to a mere whim or eccentricity of character; but knowledge of the man as a scientific investigator, accustomed to the use of precise language, fond of the most minute details, and yet of broad and comprehensive views, precludes this inference. An interesting circumstance has come to light from a recent careful examination of the books in Smithson's library. A volume has been found entitled "Plain advice to the public, to facilitate the making of their own wills, with forms of wills, simple and elaborate, containing almost every description of bequest, especially the various modes of settling property for the sole use and benefit of married women for their lives, with powers of appointment to them by deed or will; tables of the stamp duties on probates and letters of administration; special rules and tables regarding the wills and letters of administration of petty officers, seamen, and marines, and a chapter of useful hints to persons about to make their own wills; the whole illustrated with explanatory notes and remarks, being an intelligible and complete, though summary, explanation of the law of wills and testaments.' By the author of 'Plain instructions to executors and administrators.'" London, 1826, 8vo., 94 pages.

It is noticeable that this book was published in the same year in which Smithson made his will, and that it was carefully studied is evident from his marginal notes, and the fact that he adopted its phraseology in providing an annuity to his faithful servant. His words were not only chosen to accord with the forms of law, but with strict regard to the meaning and scope of the language used. The will, moreover, is in the testator's own handwriting.

It is an interesting subject of speculation to consider the motives which actuated Smithson in bequeathing his fortune to the United States of America to found an institution in the city of Washington.

He is not known to have had a single correspondent in America, and in none of his papers is found any reference to it or to its distinguished men.* It has been alleged that he was more friendly to monarchical than to republican institutions, but there appears to be no foundation for this opinion. It is more probable that, living at a time when all Europe was convulsed with war, when the energies of nations, the thoughts of rulers, and the lives of millions were devoted to efforts for conquest or to perpetuate despotism, he turned to the free American Republic, where he could discern the germs of rising grandeur, the elements of enduring prosperity, and the aspirations of coming generations. He undoubtedly felt that in the United States there would be wider scope for the promotion of knowledge, and that in this new country there would always be free thought and indefinite progress. By selecting the nation itself as the depository of his trust he paid the highest compliment to its intelligence and integrity, and testified his confidence in republican institutions and his faith in their perpetuity.

The period in which Smithson lived was not less marked by the gloom occasioned by long-protracted and almost universal war, and the extent and rapidity of its social changes, than by the luster of its brilliant discoveries in science and its useful inventions in the arts. The leaders of contending nations, who had long absorbed the attention of Europe by their struggles for dominion, were at last forced to relinquish some of their honors to the great philosophers whose achievements then illuminated the page of history, and which have not since been surpassed. It was pre-eminently a period of activity of thought,

* There are only two books in Smithson's library containing references to the United States. Extracts from these relative to the city of Washington are given in the Appendix, Note 9.

of fertility of invention and of original research. Pure abstract science had many illustrious votaries, and the practical application of its truths gave to the world many of the great inventions by means of which civilization has made such immense and rapid progress.

Not only were individual efforts for the welfare of humanity made, but a spirit of association was developed and numerous organizations formed, having for their object the promotion of science, education, and philanthropy. The few existing societies also became inspired with new life and vigor. The "Royal Society of London" entered upon its most brilliant epoch and became the fountain and center of intellectual progress. "The Royal Institution of Great Britain," chiefly indebted for its origin to an American, was founded in 1800, "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life." A glance at the names of a few of the great organizations instituted in different parts of the world at the close of the last and beginning of the present century will show the remarkable scientific activity of that period and the direction of thought towards the establishment of permanent institutions:

1782. Royal Irish Academy.
1784. Royal Asiatic Society.
1788. Linnean Society.
1788. Société Philomatique.
1795. Société Philotechnique.
1799. Academy of Sciences, Lisbon.
1800. Royal Institution of Great Britain.
1805. Société Anthropologique, Paris.
1807. Geological Society of London.
1808. Royal Institute of the Low Countries.
1812. Literary and Philosophical Society, Liverpool.
1812. Royal Academy of Sciences of Berlin (reorganized).
1816. The French Academy of Sciences (reorganized).
1818. Academy of Natural Sciences, Philadelphia.
1819. Philosophical Society, Cambridge.
1820. Royal Astronomical Society.
1821. Société Impériale de Géographie, Paris.
1822. Société Asiatique, Paris.
1825. Société Royale des Antiquaires du Nord, Copenhagen.
1826. Zoölogical Society, London.

The remarkable advances made in science at this epoch were thus alluded to by Arago in his eulogy on Thomas Young:

"In a short space of time the Academy has lost from the list of its members, Herschel, whose bold ideas on the structure of the universe have acquired every year more of probability; Piazzi, who, on the first day of the present century, presented our solar system with a new planet; Watt, who, if not the inventor of the steam-engine, was at least the creator of so many admirable contrivances by the aid of which the little instrument of Papin has become the most ingenious, the most useful, the most powerful means of applying industry; Volta, who has been immortalized by his electric pile; Davy, equally celebrated for the decomposition of the alkalies, and for the invaluable safety-lamp of the miner; Wollaston, whom the English called "the Pope," because he never proved fallible in any of his numerous experiments or of his subtle theoretical speculations; Jenner, lastly, whose discovery I have no need to extol in the presence of fathers of families."

Cuvier also made the following imposing retrospect of the scientific achievements of this era in his eulogy on Haüy:

"The laws of a geometry, as concise as comprehensive, extended over the entire heavens; the boundaries of the universe enlarged and its spaces peopled with unknown stars; the courses of celestial bodies determined more rigorously than ever, both in time and space; the earth weighed as in a balance; man soaring to the clouds or traversing the seas without the aid of winds; the intricate mysteries of chemistry referred to certain clear and simple facts; the list of natural existences increased tenfold in every species, and their relations irrevocably fixed by a survey as well of their internal as external structure; the history of the earth, even in ages the most remote, explored by means of its own monuments, and shown to be not less wonderful in fact than it might have appeared to the wildest fancy: such is the grand and unparalleled spectacle which it has been our privilege to contemplate."

While scientific thought and discovery were thus being advanced, attention was directed to the great ignorance of the masses. The idea of universal diffusion of knowledge had been unknown in England, and many of the upper classes of society cherished and avowed a deeply rooted dislike to the education of the poor, as "tending to discontent and an overthrow of that orderly subordination without which society cannot exist." The principle was held by many, and considered indisputable, that "the ignorance of the people was necessary to their obedience to law."*

The period, however, was one in which revolution was commencing in all directions. Many of the old landmarks of thought, opinion, and fact were in process of removal and new ones were rapidly becoming established. The progress and results of mechanical invention were producing great social changes. Lord Brougham's "Treatise on Popular Education," first published in January, 1825, had reached its twentieth edition in the following year. His vigorous, eloquent, and practical appeals to his countrymen were exciting universal attention, and through his efforts the first of the useful and popular Mechanics' Institutes was established, the University of London was founded, and book clubs, reading societies, and scientific lectures were organized.

At the opening of the session of Parliament in 1828, he proclaimed that it was unconstitutional that almost the whole patronage of the State should be placed in the hands of a military premier. The concluding passage of his speech ran through the country, and dwelt for-

* Lord Cockburn.

ever in men's minds in its axiomatic power. "There had been periods when the country heard with dismay that the soldier was abroad. That is not the case now. Let the soldier be ever so much abroad, in the present age he could do nothing. There is another person abroad—a less important person, in the eyes of some an insignificant person, whose labours have tended to produce this state of things—*the schoolmaster is abroad.*"*

Lord Brougham had declared that "to instruct the people in the rudiments of philosophy would of itself be an object sufficiently brilliant to allure the noblest ambition. To promote these ends and to obtain for the great body of his fellow-creatures that high improvement which both their understanding and their morals fitted them to receive," he urged upon the consideration of the men of wealth of Britain. "Such a one, however averse by taste or habit to the turmoil of public affairs, or the more ordinary strifes of the world, may in all quiet and innocence enjoy the noblest gratification of which the most aspiring nature is susceptible; he may influence by his single exertions the character and the fortunes of a whole generation, and thus wield a power to be envied even by vulgar ambition, for the extent of its dominion; to be cherished by virtue itself, for the unalloyed blessings it bestows." He pressed the subject on the attention "of all men of enlightened views, who value the real improvement of their fellow-creatures and the best interests of their country." He appealed to public-spirited individuals to promote the diffusion of knowledge and the cultivation of intellectual pursuits by devoting some of their means to these objects, and showed how much money had been misapplied by benevolent persons in sustaining certain charitable institutions which only tended to increase the number of the poor and dependent classes.

The "Society for the Diffusion of Useful Knowledge" was established in April, 1825, and at once entered upon a career alike brilliant and successful. "Its publications," says the Edinburgh Review,† "undoubtedly form by far the most important of the contributions from men of science and letters to the instruction and improvement of mankind." "Its efforts were to be extended until knowledge had become as plentiful and as universally diffused as the air we breathe."

It cannot be doubted that Mr. Smithson became impressed with the prevailing and new spirit of his age, and, recognizing as a man of science the inestimable value of knowledge and the importance of its universal diffusion, wrote the words of his will bequeathing his whole fortune "*for the increase and diffusion of knowledge among men.*"

At one period of his life, and when an active member of the Royal Society, he purposed leaving his fortune to that body for the promotion

* Chas. Knight's *Passages of a Working Life.* London, Vol 2, p. 66.
† *Edinburgh Review*, Vol. xlvi, 1827, p. 243.

of science,* but it is said that a disagreement with the council of the society on account of the non-acceptance of one of his papers probably led him to abandon the idea. This circumstance is of importance as indicating the bent of his mind and the mode in which he proposed to benefit mankind. The difficulty referred to, however, undoubtedly led him to give broader scope to his plan, and to choose a trustee for his endowment who would be hampered by no conventional or traditional restrictions, and who would understand and carry out his purposes in the most liberal and practical manner.†

It is peculiarly gratifying to Americans to remember that the *first* award made by the Council of the Royal Society of the Copley medal, the most honorable within its gift, was to our own countryman, Benjamin Franklin, who was adjudged to be the author of the most important scientific discovery. On this occasion the president of the society stated that the council, "keeping steadily in view the advancement of science and useful knowledge, and the honor of the society, had never thought of confining the benefaction within the narrow limits of any particular country, much less of the society itself."

As this was the spirit of the leading scientific organization in existence, of which Smithson himself was an active and honored member, he well exemplified its liberal principles by transferring his foundation of a great establishment for the "increase and diffusion of knowledge among men" from London to the city of Washington.

Smithson received a large estate from his half brother, Colonel Henry Louis Dickinson, in trust for the benefit of the son of this brother as well as of his mother. To this nephew, to whom he was probably attached, or because he had derived a large part of his fortune from his father, he left his whole fortune. Contingent on the death of this young man, he made the remarkable provision of an establishment in the United States which has secured for him the distinction of being a *benefactor of mankind.*

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* The charter states that the Royal Society was founded for the improvement of *natural knowledge*. This epithet *natural*, Dr. Paris remarks, "was intended to imply a meaning of which very few persons are aware. At the period of the establishment of the society the arts of witchcraft and divinations were very extensively encouraged, and the word natural was therefore introduced in contradistinction to *supernatural*." Hooke, the president, declared, in 1663, that "the business and design of the Royal Society was to improve the knowledge of natural things, and all useful arts, manufactures, mechanick practises, engynes and inventions by experiments—(not meddling with divinity, metaphysics, moralls, politicks, grammar, rhetorick, or logick.)"

Dr. Wollaston had made a gift of £1,000 to the Royal Society, the interest of which was to be annually applied towards the encouragement of experiments.

† "Our countrymen do not believe that America is more advanced in knowledge and refinement than Europe; but they know that, with slight divergencies, both hemispheres are in this respect nearly abreast of each other. And they know that, both being yet far from the goal, their generous transatlantic rivals start unencumbered by many old prejudices and social trammels which we cannot here escape from."—(Tait's *Edinburgh Magazine*, 1832, p. 234.)

It has been shown with what zeal and pleasure Smithson himself engaged in the advancement of knowledge, and what general interest had been awakened in England in the cause of scientific organization and popular education at the very time he wrote his will, and it is not unreasonable, therefore, to believe that he contemplated this contingency as a very probable event.

The will of Smithson, dated October 23, 1826, was proved in the Prerogative Court of Canterbury by his executor, Mr. Charles Drummond, a London banker, on the 4th of November, 1829. The value of the effects was sworn to be under £120,000.*

In 1878, a copy of a will also in Smithson's handwriting was procured by the Institution from Mr. de la Batut, almost identical with the one recorded in the courts of London.

It appears from this that the word heretofore printed *Audley* in copies of the will should be "Studley," and that the name of the former servant who kept the Hungerford Hotel at Paris should be Sailly, and not Jailly. In the record of the will at London, the word Smithsonian as the name of the Institution to be established is "Smithsonean," but as it is very plainly written "ian" in what we must consider his original draft, the misspelling referred to is undoubtedly due to an error of the transcriber. In all the proceedings in the court of chancery, and all the negotiations of Mr. Rush, the name "Smithsonian" has uniformly been used.

The first article of the will refers to an old and trusted servant, John Fitall, to whom, in consideration of his attachment and fidelity, Smithson bequeaths an annuity of a hundred pounds sterling. This Fitall died in June, 1834, having enjoyed the benefit of his legacy for five years.

Mr. Smithson next directs that various sums of money he had lent to another of his servants, Henri Honori Sailly, should be allowed to remain uncalled for at five per cent. interest for five years.

He then mentions the fact that all the money in the French five per cents. (*livres de rentes*) then standing in his own name and in that of Colonel Dickinson was the property of his nephew, being what he inherited from the colonel, who died on the 22d May, 1820, with what he had added himself to it from savings made out of the income. To this nephew, Henry James Hungerford, who was also known as Henry James Dickinson, and still later as Baron Eunice de la Batut, he leaves the rest of the income arising from his property during his life. The whole of his fortune is by the next clause of the will left absolutely and forever to any child or children, legitimate or illegitimate, of the said nephew Hungerford. But in case of the death of his nephew without leaving a child or children, or of the death of the child or children he may have had under the age of twenty-one years or intestate, he then says:

* *Gentleman's Magazine*, 1830, vol. c., p. 275.

"I bequeath the whole of my property to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

The nephew, Mr. Hungerford (alias H. J. Dickinson), to whom was bequeathed a life interest in Smithson's estate, brought an amicable suit in chancery against the executors for the purpose of having the assets administered under the direction of the lord chancellor, and these were ascertained to be about £100,000 sterling. The income from this property, which consisted mainly of stock in the public funds of England, was promptly paid to young Hungerford, who led a roving life in Europe, without settled habits or occupation, and died under the name of Baron Eunice de la Batut, at the Royal Hotel in Pisa, Italy, on the 5th of June, 1835, under thirty years of age, never having married, and leaving no heirs who could, even under the broad provisions of his uncle's will, make a claim to his bounty.

The mother of Hungerford, a Mrs. Mary Ann Coates, had married a Frenchman named Theodore de la Batut, and was still living at Port Louis in France. She now made a claim for part of the estate, on the ground that her son had given her an ample allowance while he lived, and that under the will of his father, Col. Henry Louis Dickinson, made in Paris in July 1819, by which he left all his property to his brother, James Smithson, half the income was to be for her benefit during her life. It was shown that young Hungerford lived up to his income, and had left nothing even to pay debts or funeral expenses. It was also urged that if Smithson's will had come into operation then, instead of seven years before, Hungerford would, in consequence of an alteration of the law, have been entitled to a portion of the accruing half-year's income up to his death; and that, in consequence of the change in the law, he could not be said to have enjoyed the income of the property during his whole life. It was also urged as a "moral claim," that as the Smithson bequest was to be applied "to increase and diffuse knowledge among men," the children of Mrs. de la Batut were entitled to an allowance from it until the age of twenty-two for their education.

The claim made was for an annuity of £240; but after long negotiation the decree was made by the court of chancery to allow Mrs. de la Batut £150 9*s.* during her life, with a payment of £526 11*s.* 6*d.* for arrears from the 22d September, 1834, to the 22d March, 1838. To secure this annuity, the sum of £5,015 in three per cent. consols was retained in trust by the court, the interest to be paid on the 22d September and 22d March annually. By the law of France, the life income is apportionable and payable up to the time of death; and Colonel Dickinson having been domiciled in France, this rule applied in his case.

Mrs. de la Batut lived to the year 1861, and the amount retained in England as the principal of the annuity was paid over to the Institution on the 11th June, 1864. This is known as the "residuary legacy" of Smithson, and the sum realized from it by the Institution, by the premium on gold, &c., was $54,165.38.

The first announcement made to the American Government of the fact that the United States had become entitled to the bequest of Smithson was a dispatch, dated 28th July, 1835, from Hon. Aaron Vail, chargé d'affaires of the United States at London, to Hon John Forsyth, Secretary of State, transmitting a letter from Messrs. Clarke, Fynmore and Fladgate, attorneys in that city. This communicated the intelligence that the nephew of Smithson had died, and that the United States was entitled to the estate, valued at £100,000.

These facts were laid before Congress by President Jackson on the 17th December, 1835, who stated in his message that he had no authority to take any steps toward accepting the trust.

In the Senate of the United States the message of the President was referred to the Committee on the Judiciary, which, by its chairman, Mr. Benj. Watkins Leigh, of Virginia, reported, on the 5th of January, 1836, that they considered the bequest of Mr. Smithson a valid one, and they believed "that the United States would be entertained in the court of chancery of England to assert their claim to the fund as trustees for the purpose of founding the charitable institution at Washington to which it is destined by the donor." The question whether it was within the competency of the Government to appropriate any part of the general revenue from the nation at large to the foundation of a literary or any other institution in the District of Columbia was answered by Mr. Leigh by stating that—

"The fund given by Mr. Smithson's will is nowise, and never can become, part of the revenue of the United States; they cannot claim or take it for their own benefit; they can only take it as trustee."

"The United States were to be regarded as the *parens patriæ* of the District of Columbia, and in that character they had a right and were in duty bound to assert a claim to any property given to them for the purpose of founding an institution within the District, and to provide for the due application and administration of such a fund when they obtained possession of it."

Resolutions were reported by the committee providing for the prosecution of the claim. The report was considered in the Senate on the 30th April, 1836, and it was urged by Mr. W. C. Preston, of South Carolina, that the Government of the United States had no power to receive the money. He thought the donation had been made partly with a view to immortalize the donor, and it was "too cheap a way of conferring immortality." He had no idea of the District of Columbia being used as a fulcrum to raise foreigners to immortality by getting Congress as the *parens patriæ* to accept donations from them. He expressed the opinion that Smithson's intention was to found a university.

Mr. Leigh, in reply, maintained that the legacy was not for the benefit of the United States, but only for one of the cities of the District of Columbia, and with this belief he had no difficulty in voting for the bill.

Mr. John M. Clayton, of Delaware, also thought a university was intended by Smithson.

Mr. John C. Calhoun, of South Carolina, was of opinion that the donation was made expressly to the United States, and that "it was beneath their dignity to receive presents of this kind from any one."

Mr. Samuel L. Southard, of New Jersey, advocated the measure, as he thought Congress had the unquestionable right to establish a national university.

Mr. James Buchanan, of Pennsylvania, believed that Congress had the power to receive and apply this money to the purposes intended by the testator, without involving the question whether it was for a university or not.

Mr. Robert J. Walker, of Mississippi, advocated the bill as a measure of justice to the city of Washington.

Mr. John Davis, of Massachusetts, argued that the Senators were mistaken who assumed that Smithson intended his bequest to establish a university. This word was not to be found in the will, and there were other means for diffusing knowledge besides the one referred to. He deemed the establishment of institutions for the promotion of knowledge a vital principle of republican government.

After a somewhat protracted debate the resolutions were finally passed on the 2d of May, 1836, by a vote of 31 to 7, and on the 25th of June they were again passed in the shape of a bill as it had come from the House of Representatives.

The message of the President was referred in the House, on the 21st of December, 1835, to a special committee, consisting of Mr. John Quincy Adams, of Massachusetts, Mr. Francis Thomas, of Maryland, Mr. James Garland, of Virginia, Mr. D. J. Pearce, of Rhode Island, Mr. Jesse Speight, of North Carolina, Mr. Thomas M. T. McKennan, of Pennsylvania, Mr. E. A. Hannegan, of Indiana, Mr. Rice Garland, of Louisiana, and Mr. G. H. Chapin, of New York. In this committee great opposition was manifested at first to the acceptance of the bequest, but this yielded to the arguments and persuasion of the distinguished chairman, Mr. John Q. Adams. A bill was accordingly reported, directing the President to appoint an agent to assert and prosecute for and in behalf of the United States in the court of chancery, England, the legacy bequeathed by James Smithson. The agent was to give bonds in $500,000 for the faithful performance of the duties imposed upon him. The Treasurer of the United States was to take charge of and keep safely all the money received on account of the bequest, and "the faith of the United States was solemnly pledged that the fund should be applied for the purpose of founding and endowing at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." For the cost of prosecuting the claim an appropriation of $10,000 was made.

On the 19th of January, 1836, Mr. Adams made an elaborate report, containing all the facts he had been able to collect relative to Smithson, and expressing in the most glowing and refined language his appreciation of the value of the gift to America and its importance to mankind. Mr. Leigh had convinced the Senate that it was the duty of Congress to accept the bequest, and Mr. Adams brought before the House an account of the life of the testator, the nature of the trust, the character of the trustees, the practical influence of our political institutions upon Europe, and the vast benefits to the world which might grow out of the legacy. The report was unanimously agreed to in the committee, but Mr. Adams had great misgivings whether anything would ever be realized from the bequest. The delays of the English court of chancery were well known, and the opinion had even been expressed that the whole affair was an imposture. Mr. Adams never wavered, however, in his faith in the power of the government to procure the money and its ability to administer it properly. He refers in his diary to it as the favorite and almost absorbing subject of his thoughts, and for many years he devoted untiring activity and personal efforts to its successful accomplishment.

No action was taken by the House on Mr. Adams's report until the Senate had passed Mr. Leigh's resolution; when that was taken up, changed in form to that of a bill, passed on the 25th of June, 1836, and was approved by the President on the 1st of July, 1836.

In accordance with this act the President appointed, on the 11th of July, Hon. Richard Rush, of Pennsylvania, as the agent to assert and prosecute the claim of the United States to the legacy. His salary was fixed at $3,000 per annum, and $2,000 were allowed for contingencies, not including legal expenses. Mr. Rush gave the necessary bond for $500,000, Messrs. J. Mason, jr., and Benjamin C. Howard being his sureties, who were accepted by Mr. Woodbury, Secretary of the Treasury. This appointment was one eminently fit to be made, and its wisdom was proved by the successful accomplishment of the mission. Mr. Rush had been Comptroller of the United States Treasury at a time when the fiscal affairs of the government were in disorder; he was next Attorney-General; then minister to England for a period of eight years; Secretary of the Treasury; and minister to France. "To these great and varied employments," Hon. J. A. Pearce has remarked, "he brought integrity, ability, intelligence, firmness, courtesy, and a directness of purpose which scorned all *finesse* and which served his country to the full extent of all that could have been demanded or hoped."

Mr. Rush immediately proceeded to London, placed himself in communication with the attorneys of the executor of Smithson, and entered with vigor into the measures necessary to assert the claim of the United

In one of his essays, he divides the sources of knowledge into, 1st, observation; 2d, reasoning; 3d, information; 4th, conjecture. In all his researches he began the process of acquisition by *observing*.

One of his sentiments has been adopted as the motto on the publications of the Smithsonian Institution; viz: "*Every man is a valuable member of society, who, by his observations, researches, and experiments, procures knowledge for men.*"

In a critical notice of Davy's Elements of Chemical Philosophy in the Quarterly Review for 1812, the writer speaking of recent advances in chemistry, and especially in the establishment and extension of the law of definite proportions, remarks: "For these facts the science is principally indebted, after Mr. Higgins, to Dalton, Gay-Lussac, Smithson, and Wollaston."*

The mineral species "*Smithsonite*," a carbonate of zinc, was discovered and analyzed by him, among some ores from Somersetshire and Derbyshire, England. The name, Smithsonite, appears to have been conferred on it by the great French mineralogist Beudant.

It is interesting to notice the number and variety of specimens from the vegetable kingdom that Smithson subjected to analysis. They include the violet, red rose, red clover, daisy, blue hyacinth, hollyhock, lavender, artichoke, scarlet geranium, red cabbage, radish, poppy, plum, pomegranate, mulberry, cherry, currant, buckthorn berries, elder and privet berries. He also examined the coloring matter of animal greens.

It is perhaps worthy of note that his first paper related to an article of importance in the *materia medica*, and his last to a matter of practical value to artists. He by no means confined his attention to abstract science, but contributed knowledge of improved methods of constructing lamps, and of making tea and coffee. That such practical questions might be considered of little importance by men of science he seems to acknowledge by the remarks he makes in one of his papers.

"It is to be regretted," he observes, "that those who cultivate science frequently withhold improvements in their apparatus and processes, from which they themselves derive advantage, owing to their not deeming them of sufficient magnitude for publication. When the sole view is to further a pursuit of whose importance to mankind a conviction exists, all that can should be imparted, however small may appear the merit which attaches to it."†

A secretary of the French Academy deemed it his duty to offer an excuse for having given a detailed account of certain researches of Leibnitz, which had not required great efforts of the intellect. "We ought," says he, "to be very much obliged to a man such as he is, when he condescends, for the public good, to do something which does not partake of genius." Arago remarked in his eulogy on Fourier, "I cannot conceive the ground of such scruples; in the present day the sciences

* *Quarterly Review*, 1812, vol. viii, p. 77.

† Some improvements of lamps. *Smithsonian Miscell. Coll.* No. 327, p. 78.

are regarded from too high a point of view to allow us to hesitate in placing in the first rank of the labors with which they are adorned those which diffuse comfort, health, and happiness amidst the working population."

In another of his papers Smithson says, referring to practical investigations:

"In all cases means of economy tend to augment and diffuse comfort and happiness. They bring within the reach of the many what wasteful proceeding confines to the few. By diminishing expenditure on one article they allow of some other enjoyment which was before unattainable. A reduction in quantity permits an indulgence in superior quality. In the present instance the importance of economy is particularly great since it is applied to matters of high price, which constitute one of the daily meals of a large portion of the population of the earth."

"That in cookery also the power of subjecting for an indefinite duration to a boiling heat, without the slightest dependiture of volatile matter, will admit of a beneficial application, is unquestionable." *

In the books of his library are found numerous marginal notes, indicating his special attention to subjects relating to the health, comfort, resources, and happiness of the people.

Among his effects were several hundred manuscripts and a great number of notes or scraps on a variety of subjects, including history, the arts, language, rural pursuits, &c. On the subject of "habitations" were articles classified under the several heads of situation, exposure, exterior and interior arrangements, building materials, contents and adornment of rooms, furniture, pictures, statuary, &c. It is not improbable that he contemplated the preparation of a cyclopedia or philosophical dictionary.

Smithson's contributions to scientific literature consist of twenty-seven papers, eight published in the Philosophical Transactions of the Royal Society, in the years 1791, 1802, 1806, 1808, 1811, 1812, 1813, and 1817, and nineteen in Thomson's Annals of Philosophy, a journal of the highest scientific character, in 1819, 1820, 1821, 1822, 1823, 1824, and 1825. These papers have recently been collected and reprinted by the Smithsonian Institution.† Several of them were previously republished in foreign scientific journals translated by himself.

It is highly probable that Smithson contributed articles to scientific and literary journals other than those mentioned, but they have not yet been discovered.

* An improved method of making coffee. *Smithsonian Miscell. Coll.*, No. 327, p. 88.
† *Smithsonian Miscell. Coll.*, No. 327, 1879, 8 vo., 166 pp.

The following is a list of his scientific writings:

[In the Philosophical Transactions of the Royal Society of London.]

1791. An account of some chemical experiments on Tabasheer, vol. lxxxi, pt. II, p. 368.
1802. A chemical analysis of some Calamines, vol. xciii, p. 12.
1806. Account of a discovery of native minium, vol. xcvi, pt. I, p. 267.
1807. On quadruple and binary compounds, particularly sulphurets, [Philosophical Magazine, vol. xxix, p. 275.]
1808. On the composition of the compound sulphuret from Huel Boys, and an account of its crystals, vol. xcviii, p. 55.
1811. On the composition of zeolite, vol. ci, p. 171.
1813. On a substance from the elm tree, called ulmin, vol. ciii, p. 64.
1813. On a saline substance from Mount Vesuvius, vol. ciii, p. 256.
1817. A few facts relative to the coloring matter of some vegetables, vol. cviii., p. 110.

[In Thomson's Annals of Philosophy.]

1819. On a native compound of sulphuret of lead and arsenic, vol. xiv, p. 96.
1819. On native hydrous aluminate of lead, or plomb gomme, vol. xiv, p. 31.
1820. On a fibrous metallic copper, vol. xvi, p. 46.
1820. An account of a native combination of sulphate of barium and fluoride of calcium, vol. xvi, p. 48.
1821. On some capillary metallic tin, vol. xvii. New series, vol. I, p. 271.
1822. On the detection of very minute quantities of arsenic and mercury, vol. xx. New series, vol. iv, p. 127.
1822. Some improvements of lamps, vol. xx. New series, vol. iv, p. 363.
1823. On the crystalline form of ice, vol. xxi. New series, vol. v, p. 340.
1823. A means of discrimination between the sulphates of barium and strontium, vol. xxi. New series, vol. v, p. 359.
1823. On the discovery of acids in mineral substances, vol. xxi. New series, vol. v, p. 384.
1823. An improved method of making coffee, vol. xxii. New series, vol. vi, p. 30.
1823. A discovery of chloride of potassium in the earth, vol. xxii. New series, vol. vi, p. 258.
1823. A method of fixing particles on the sappare, vol. xxii. New series, vol. vi, p. 412.
1824. On some compounds of fluorine, vol. xxiii. New series, vol. vii, p. 100.
1824. An examination of some Egyptian colors, vol. xxiii. New series, vol. vii, p. 115.
1824. Some observations on Mr. Penn's theory concerning the formation of the Kirkdale Cave, vol. xxiv. New series, vol. viii, p. 50.

1825. Note to a letter from Dr. Black, describing a very sensible balance, vol. xxvi. New series, vol. x, p. 52.
1825. A method of fixing crayon colors, vol. xxvi. New series, vol. x, p. 236.

Smithson's writings all exhibit clearness of perception, terseness of language and accuracy of expression.*

A trait of Smithson's character is exhibited in the allusions he makes in his writings to other scientific men. His expressions are always kind or complimentary, evidently not for the sake of flattery, but from a sense of justice and truthful recognition of merit. He speaks of Mr. Tennant as one "whose many and highly important discoveries have so greatly contributed to the progress of chemical science." Abbe Haüy he refers to as one "so justly celebrated for his great knowledge in crystallography, mineralogy," &c. "The analysis we possess of natrolite by the illustrious chemist of Berlin," &c.

Of Baron Cronstedt he says, "the greatest mineralogist who has yet appeared."

"A query from the celebrated Mr. Vauquelin."

"The celebrated Mr. Klaproth, to whom nearly every department of chemistry is under numerous and great obligations."

"M. Berzelius' elegant method of detecting phosphoric acid," &c.

"M. Werner, its principal and most distinguished professor," &c.

Smithson died on the 27th of June, 1829, at Genoa, Italy. He was buried in the Protestant cemetery, about a mile west of Genoa, on the high elevation which forms the west side of the harbor and overlooks the town of Sampierdarena. His grave is marked by a handsome monument. The base is of pale gray marble, 6 feet and a half long, 3 feet wide, and 3¾ feet high. On the top of this is a white marble urn suitably proportioned to the base. The lot is inclosed by an iron fence, with gray marble corner posts. On one side of the monument the inscription is as follows:

"Sacred to the memory of James Smithson, esq., Fellow of the Royal Society, London, who died at Genoa the 26th June, 1829, aged 75 years."

On the other side is the following:

"This monument is erected, and the ground on which it stands purchased in perpetuity, by Henry Hungerford, esq., the deceased's nephew, in token of gratitude to a generous benefactor and as a tribute to departed worth."

The announcement of his departure called forth expressions of regret from prominent men of science, and as he had been an honored Fellow of the Royal Society, its president, Sir Davies Gilbert, alluded to it on two occasions. At the meeting of the Royal Society November 30, 1829, he remarked, "In no previous interval of twelve months has the society

*A few extracts from his published writings are given in the Appendix, Note 7.

collectively, or have its individual members, experienced losses so severe, or so much in every respect to be deplored." Among the names then referred to were those of Dr. W. H. Wollaston, Dr. Thomas Young, and Sir Humphrey Davy. To these illustrious savans he adds that of James Smithson, who, he says, "has added eight communications to our Transactions. He was distinguished by the intimate friendship of Mr. Cavendish, and rivalled our most expert chemists in elegant analyses."*

At the following anniversary meeting of the Royal Society, November 30, 1830, the president, Sir Davies Gilbert, delivered an address in which, after speaking of the death of Major Kennele and Mr. Chevenix, he says:

* * * "The only remaining individual who has taken a direct and active part in our labours, by contributing to the Transactions, is Mr. James Lewis Smithson, and of this gentleman I must be allowed to speak with affection. We were at Oxford together, of the same college, and our acquaintance continued to the time of his decease.

"Mr. Smithson, then called Macie, and an undergraduate, had the reputation of excelling all other resident members of the University in the knowledge of chemistry. He was early honored by an intimate acquaintance with Mr. Cavendish; he was admitted into the Royal Society, and soon after presented a paper on the very curious concretion frequently found in the hollow of bambû canes, named *Tabasheer.* This he found to consist almost entirely of silex, existing in a manner similar to what Davy long afterwards discovered in the epidermis of reeds and grasses.

"Mr. Smithson enriched our Transactions with seven other communications: A chemical analysis of some calamines. Account of a discovery of native minium. On the composition and crystallization of certain sulphurets from Huel Boys in Cornwall. On the composition of zeolite. On a substance procured from the elm tree, called *Ulmin.* On a saline substance from Mount Vesuvius. Facts relative to the colouring matter of vegetables.

"He was the friend of Dr. Wollaston, and at the same time his rival in the manipulation and analysis of small quantities. *Αγαθη δ' ερις ηδε βροτοισι.* Mr. Smithson frequently repeated an occurrence with much pleasure and exultation, as exceeding anything that could be brought into competition with it; and this must apologize for my introducing what might otherwise be deemed an anecdote too light and trifling on such an occasion as the present.

"Mr. Smithson declared that happening to observe a tear gliding down a lady's cheek, he endeavored to catch it on a crystal vessel; that one-half of the drop escaped, but having preserved the other half he submitted it to reagents, and detected what was then called microcosmic salt, with muriate of soda, and, I think, three or four more saline substances, held in solution.

*Philosophical Magazine, 1830, vol. vii, p. 42.

"For many years past Mr. Smithson has resided abroad, principally, I believe, on account of his health; but he carried with him the esteem and regard of various private friends, and of a still larger number of persons who appreciated and admired his acquirements." *

This tribute to his memory and worth shows the high standing Smithson had attained in the estimation of his compeers, and that he secured the fidelity and affection of his dependants is evinced by the care with which, in his will, he provides a reward for their attachment and services.

"It has been the lot of the greatest part of those who have excelled in science," says Dr. Johnson, "to be known only by their own writings, and to have left behind them no remembrance of their domestic life or private transactions, or only such memorials of particular passages as are on certain occasions necessarily recorded in public registers."

To the same effect, Wilson, in his life of Cavendish (the warm friend of Smithson), remarks: "So careless has his own country been of his memory that although he was for some fifty years a well-known and very distinguished Fellow of the Royal Society, a member for a lengthened period of the French Institute, and an object of European interest to men of science, yet scarcely anything can be learned concerning his early history. This, no doubt, is owing in great part to his own dislike of publicity, and to the reserve and love of retirement which strongly characterized him. Long before his death however, he was so conspicuous a person in the scientific circles of London that the incidents of his early life might readily have been ascertained. They were not, it should seem, inquired into by any biographer."†

This is eminently true of Smithson. We are unfortunately debarred from acquiring an intimate knowledge of his personal traits and peculiarities by the absence of an autobiography, or even of any sketch of his life by his friends. For this reason we are more ready to avail ourselves of every fact in regard to him that can be ascertained, however trivial or insignificant any one of these might otherwise be considered. Even an inventory of his wardrobe and a schedule of his personal property possesses an interest and serves at least to gratify a natural curiosity. Such a list has recently been found as certified by the English consul at Genoa, after the death of Smithson, with a valuation of the different articles:

	Francs.
A carriage, complete	2,500 00
Twenty-six silver forks, one salad fork, eight desert spoons, eighteen spoons, four sauce-ladles, one soup ladle, four salt spoons, three sugar ladles, one tea shell, three silver-head corks, two silver vessels, one toasting fork, weighing in all 193¼ ounces of silver, valued by Mr. A. Canissa, a goldsmith	1,050 00
An English gold repeater	200 00

* The *Philosophical Magazine*, January–June, 1831, vol. ix, p. 41.

† George Wilson. *Life of Henry Cavendish.* London, 1851.

	Francs.
A Geneva gold watch	60 00
Two gold snuff-boxes, one toothpick case, and two shirt buttons	417 00
One pin with sixteen small diamonds	33 34
One ring with composition set in diamonds	66 73
One ring of agate	3 40
One ring, cameo, head of a Moor	50 00
Two small boxes, one of tortoise shell, the other of amber	6 30
One gold ring	13 00
One small silver pick case	6 00
A clasp of gold with hair	16 67
A clasp with diamonds	203 34
A pin with hair and diamonds	45 67
A cameo	50 00
A ring with diamonds	92 00
Sixteen shirts, nineteen cravats, forty-four pocket handkerchiefs, thirteen pairs of stockings, three nightcaps, two pair of drawers, two pair of sheets, three pillow-cases, seven waistcoats, two flannel waistcoats, six pair pantaloons, two cloth pantaloons, three coats, one nightgown, one dressing coat, two pair braces, four pair gloves	400 00
One telescope	60 00
Many small articles	100 00
Two pasteboard boxes containing medals, coins, stones, &c.	
One parcel containing papers relative to the Grand Canal*	
Several parcels of papers and five books	
112 Napoleons in gold and 34 francs 60 centimes, in the hands of Messrs. Gibbs & Co	2,274 60
Cash in hands of Messrs. Gibbs & Co	3,634 74
One parcel, thirteen certificates Spanish stock, Paris, 4th September, 1822, 350 piastres rente d'Espagne, par value, francs 24,097 50, valued at	3,780 00
Promissory note for 295 francs, dated 1st June, 1824, due by Alexis Silenne	295 00
Bond for 20,000 francs, dated 8th July, 1828, due by Sailly & Sœur, of Paris	20,000 00
Bill for 2,000 francs, dated 8th October, 1822, drawn by Mr. Sailly, accepted by Mr. Smithson	2,000 00
Bank-note for £100, No. 14419, 19th December, 1827, in the hands of Messrs. Gibbs & Co	2,500 00
Parcel containing accounts and letters from Messrs. Drummond & Co.	

* The Grand Canal is 90 miles in length, uniting the rivers Trent and Mersey, with branches to the Severn, to Oxford, &c. It was proposed by Mr. Wedgwood, and was the second one made in England.

Very few of these articles were transferred to Mr. Rush, the agent of the United States Government, who received the bequest. His enumeration of the personal effects of Smithson is as follows:

"A large trunk; a box containing sundry specimens of minerals; a brass instrument; a box of minerals; a box of chemical glasses; a packet of minerals; a glass vinegar-cruet; a stone mortar; a pair of silver-plated candlesticks and branches; a pair of silver-plated candlesticks without branches; a hone, in a mahogany case; a plated-wire flower-basket; a plated coffee-pot; a small plated coffee-pot; a pair of wine-coolers; a pair of small candlesticks; two pair salt-cellars; a bread-basket; two pair vegetable dishes and covers; a large round waiter; a large oval waiter; two small oval waiters; two plate-warmers; a reading shade; a gun; a mahogany cabinet; two portraits in oval frames; a china tea-service, consisting of twelve cups and saucers; six coffee-cups; a tea-pot; a slop-basin; a sugar-basin and lid; two plates; a milk-jug; a tea-canister; two dishes; a landscape in a gilt frame; a Derby-spar vase; a China tub; a piece of fluor-spar; a pair of glass candlesticks; a marble bust; sundry books and pamphlets; two large boxes filled with specimens of minerals and manuscript treatises, apparently in the testator's handwriting, on various philosophical subjects, particularly chemistry and mineralogy. Eight cases and one trunk filled with the like."

With reference to a gun, pieces of china, and articles of a miscellaneous nature belonging to Smithson, Mr. Rush was informed by his attorneys that they were taken in possession by his nephew, Henry James Hungerford.

Mr. Rush, in one of his dispatches to the State Department (July 14, 1838), says: "The boxes and trunk are to go on shipboard to-day. Before knowing anything of their contents, I thought proper to have them opened and examined in the presence of our consul and two other persons. A large portion of the contents proved to be unimportant; nevertheless, all will be delivered over on my arrival as I received them, except to have them better packed for a sea voyage, and so as to prevent further injury to that which time and bad packing have already done to them."

These articles remained in the New York custom house from the 29th of August, 1838, until June, 1841, when, at the earnest solicitation of the National Institute of Washington, they were sent to the latter city.

The trunk contained manuscripts and clothing, the latter consisting of the following articles, according to a list found among the papers of the National Institute: "1 net shirt, 4 sheets, 11 napkins, 5 light vests, 1 bag, 4 roundabouts, 5 light pants and short breeches, 1 bib, 3 drawers, 3 pair garters, 2 light coats, 1 cloth overcoat, 1 cloth military coat, 1 cloth hunting coat, 1 cloth cloak, 1 cloth surtout, 1 cloth pair of pants, 2 cloth vests, 4 pair stockings, 1 chapeau."

The clothing was nearly ruined by moths, and was presented to an orphan asylum. An examination of the effects was made by a committee of the National Institute, who made the following report as to part of them: "A cabinet, consisting of a choice and beautiful collection of minerals, comprising probably eight or ten thousand specimens. These, though generally small, are exceedingly perfect, and constitute a very complete geological and mineralogical series, embracing the finest varieties of crystallization, rendered more valuable by accompanying figures and descriptions by Mr. Smithson, and in his own handwriting. The cabinet also contains a valuable suite of meteoric stones, which appear to be specimens of most of the meteorites which had fallen in Europe during several centuries."

Mr. Francis Markoe, jr., himself an expert mineralogist, in a letter to the American Philosophical Society, 4th August, 1841, says "that among the valuable things contained in the Smithson boxes were found a superb collection, and very large, of precious stones and exquisite crystallized minerals, forming, as far as I can judge, decidedly the richest and rarest collection in this country."

A medallion was found among his effects to which were attached the words "my likeness," written in Smithson's own hand. From this has been engraved the portrait published by the Institution, the great seal ordered by the first Board of Regents, and the vignette which appears on all the Smithsonian publications. The original steel-plate portrait, engraved by J. W. Paradise, of New York, in 1847, was destroyed by fire, but it was finely reproduced for the Institution by Charles Burt, of New York, in 1879.

A full-length portrait (about one-fourth size) in oil, of Smithson, representing him in the costume of an Oxford student, was purchased by the Institution in 1850, for thirty guineas, from the widow of John Fitall, a former servant, to whom Smithson granted an annuity in his will.

Still later, in 1878, the Institution purchased from Mr. George Henry De la Batut, of France, a beautiful miniature in oil, on ivory, painted by Johns, on the 11th of May, 1816, at Aix-la-Chapelle.

The effects of Smithson were exhibited in the Patent Office building, Washington, until 1858, when they were transferred to the Smithsonian Institute, where they were unfortunately destroyed by fire on the 24th of January, 1865, with the exception of his books, a very few manuscript notes on minerals, and an oil painting of a landscape. A list of these books now in the Institution will be found in the appendix.*

The following articles are enumerated as the contents of case 23 in Alfred Hunter's "Popular Catalogue of the Extraordinary Curiosities in the National Institute, arranged in the building belonging to the Patent Office," 1855:

"Silver plate with coat of arms of the Northumberland family; chemical apparatus, test-cups, &c; thermometer, snuff-box, portrait of

* See Appendix—Note 8.

Smithson's father, scales, umbrella-case, and riding-whip, sword-belt and plume, silver spoons and butter-knife, ornamented spools for winding gold wire, copper plate with his name engraved on it; minerals of Smithson, a very superb collection, though small; silver candlestick; an elegant service of silver, containing a great many pieces. These are all very much discolored by sulphurous gas. A marble head of Saint Cecilia, by Thorwaldsen, presented to Mr. Smithson at Copenhagen by Dr. Brandis, physician to the King of Denmark. A fine old original painting by Bergham, cattle piece, peasants, &c.; an old building in the distance. Its subject is rustic and familiar life. The treatment is chaste and mellow. The depth of the foreground is really surprising, and appears to be produced without an effort; the background is transparent and aerial; the middle distance sober and clear; the atmosphere and vapors pellucid and tremulous; the quiet and docile animals, the groups of peasantry, and the strongholds of power are equal to any other great effort of the celebrated Bergham. Many specimens of petrified wood. Notice several beautiful specimens of marble, which it would be difficult to distinguish from a fine landscape painting. Glass model of the great Russian diamond, valued at about 600,000 pounds sterling."

In an "Account of the Smithsonian Institution, &c.," by Wm. J. Rhees, published in Washington in 1859, the following statement is made:

"In the room used by the 'Regents' and the 'Establishment' as a hall for their meetings, are now deposited the personal effects of James Smithson. Here may be seen his trunks, umbrella, walking-cane, sword, plume, riding-whip; a set of silver-plate; a miniature chemical laboratory, which he used when travelling; thermometers, snuff-box, scales, candlesticks, &c. Hanging in this room is an original painting by Bergham, a rural scene, the property of Smithson, a marble head of St. Cecilia, by Thorwalsden, &c."

The will of Smithson was prepared by him on the 23d October, 1826, while residing in Bentinck street, Cavendish Square, London, three years before his death, showing that it was made with deliberation and confirmed by mature reflection. Its provisions are in some respects so remarkable that they have been attributed to a mere whim or eccentricity of character; but knowledge of the man as a scientific investigator, accustomed to the use of precise language, fond of the most minute details, and yet of broad and comprehensive views, precludes this inference. An interesting circumstance has come to light from a recent careful examination of the books in Smithson's library. A volume has been found entitled "Plain advice to the public, to facilitate the making of their own wills, with forms of wills, simple and elaborate, containing almost every description of bequest, especially the various modes of settling property for the sole use and benefit of married women for their lives, with powers of appointment to them by deed or will; tables of the stamp duties on probates and letters of administration; special rules and tables regarding the wills and letters of administration of petty officers, seamen, and marines, and a chapter of useful hints to persons about to make their own wills; the whole illustrated with explanatory notes and remarks, being an intelligible and complete, though summary, explanation of the law of wills and testaments.' By the author of 'Plain instructions to executors and administrators.'" London, 1826, 8vo., 94 pages.

It is noticeable that this book was published in the same year in which Smithson made his will, and that it was carefully studied is evident from his marginal notes, and the fact that he adopted its phraseology in providing an annuity to his faithful servant. His words were not only chosen to accord with the forms of law, but with strict regard to the meaning and scope of the language used. The will, moreover, is in the testator's own handwriting.

It is an interesting subject of speculation to consider the motives which actuated Smithson in bequeathing his fortune to the United States of America to found an institution in the city of Washington.

He is not known to have had a single correspondent in America, and in none of his papers is found any reference to it or to its distinguished men.* It has been alleged that he was more friendly to monarchical than to republican institutions, but there appears to be no foundation for this opinion. It is more probable that, living at a time when all Europe was convulsed with war, when the energies of nations, the thoughts of rulers, and the lives of millions were devoted to efforts for conquest or to perpetuate despotism, he turned to the free American Republic, where he could discern the germs of rising grandeur, the elements of enduring prosperity, and the aspirations of coming generations. He undoubtedly felt that in the United States there would be wider scope for the promotion of knowledge, and that in this new country there would always be free thought and indefinite progress. By selecting the nation itself as the depository of his trust he paid the highest compliment to its intelligence and integrity, and testified his confidence in republican institutions and his faith in their perpetuity.

The period in which Smithson lived was not less marked by the gloom occasioned by long-protracted and almost universal war, and the extent and rapidity of its social changes, than by the luster of its brilliant discoveries in science and its useful inventions in the arts. The leaders of contending nations, who had long absorbed the attention of Europe by their struggles for dominion, were at last forced to relinquish some of their honors to the great philosophers whose achievements then illuminated the page of history, and which have not since been surpassed. It was pre-eminently a period of activity of thought,

* There are only two books in Smithson's library containing references to the United States. Extracts from these relative to the city of Washington are given in the Appendix, Note 9.

ərtility of invention and of original research. Pure abstract science many illustrious votaries, and the practical application of its truths e to the world many of the great inventions by means of which civiliza- has made such immense and rapid progress.

'ot only were individual efforts for the welfare of humanity made, a spirit of association was developed and numerous organizations ıed, having for their object the promotion of science, education, and anthropy. The few existing societies also became inspired with life and vigor. The "Royal Society of London" entered upon its t brilliant epoch and became the fountain and center of intellectual gress. "The Royal Institution of Great Britain," chiefly indebted its origin to an American, was founded in 1800, "for diffusing the wledge and facilitating the general introduction of useful mechanical ntions and improvements and for teaching by courses of philosoph- lectures and experiments the application of science to the common poses of life." A glance at the names of a few of the great organi- ons instituted in different parts of the world at the close of the last beginning of the present century will show the remarkable scien- activity of that period and the direction of thought towards the ıblishment of permanent institutions:

2. Royal Irish Academy.
4. Royal Asiatic Society.
8. Linnean Society.
8. Société Philomatique.
5. Société Philotechnique.
9. Academy of Sciences, Lisbon.
0. Royal Institution of Great Britain.
5. Société Anthropologique, Paris.
7. Geological Society of London.
8. Royal Institute of the Low Countries.
2. Literary and Philosophical Society, Liverpool.

1812. Royal Academy of Sciences of Berlin (reorganized).
1816. The French Academy of Sciences (reorganized).
1818. Academy of Natural Sciences, Philadelphia.
1819. Philosophical Society, Cambridge.
1820. Royal Astronomical Society.
1821. Société Impériale de Géographie, Paris.
1822. Société Asiatique, Paris.
1825. Société Royale des Antiquaires du Nord, Copenhagen.
1826. Zoölogical Society, London.

'he remarkable advances made in science at this epoch were thus ıded to by Arago in his eulogy on Thomas Young:

In a short space of time the Academy has lost from the list of its nbers, Herschel, whose bold ideas on the structure of the universe 'e acquired every year more of probability; Piazzi, who, on the first of the present century, presented our solar system with a new planet; tt, who, if not the inventor of the steam-engine, was at least the ıtor of so many admirable contrivances by the aid of which the little rument of Papin has become the most ingenious, the most useful, the st powerful means of applying industry; Volta, who has been immortalized by his electric pile; Davy, equally celebrated for the decomposition of the alkalies, and for the invaluable safety-lamp of the miner; Wollaston, whom the English called "the Pope," because he never proved fallible in any of his numerous experiments or of his subtle theoretical speculations; Jenner, lastly, whose discovery I have no need to extol in the presence of fathers of families."

Cuvier also made the following imposing retrospect of the scientific achievements of this era in his eulogy on Haüy:

"The laws of a geometry, as concise as comprehensive, extended over the entire heavens; the boundaries of the universe enlarged and its spaces peopled with unknown stars; the courses of celestial bodies determined more rigorously than ever, both in time and space; the earth weighed as in a balance; man soaring to the clouds or traversing the seas without the aid of winds; the intricate mysteries of chemistry referred to certain clear and simple facts; the list of natural existences increased tenfold in every species, and their relations irrevocably fixed by a survey as well of their internal as external structure; the history of the earth, even in ages the most remote, explored by means of its own monuments, and shown to be not less wonderful in fact than it might have appeared to the wildest fancy: such is the grand and unparalleled spectacle which it has been our privilege to contemplate."

While scientific thought and discovery were thus being advanced, attention was directed to the great ignorance of the masses. The idea of universal diffusion of knowledge had been unknown in England, and many of the upper classes of society cherished and avowed a deeply rooted dislike to the education of the poor, as "tending to discontent and an overthrow of that orderly subordination without which society cannot exist." The principle was held by many, and considered indisputable, that "the ignorance of the people was necessary to their obedience to law."*

The period, however, was one in which revolution was commencing in all directions. Many of the old landmarks of thought, opinion, and fact were in process of removal and new ones were rapidly becoming established. The progress and results of mechanical invention were producing great social changes. Lord Brougham's "Treatise on Popular Education," first published in January, 1825, had reached its twentieth edition in the following year. His vigorous, eloquent, and practical appeals to his countrymen were exciting universal attention, and through his efforts the first of the useful and popular Mechanics' Institutes was established, the University of London was founded, and book clubs, reading societies, and scientific lectures were organized.

At the opening of the session of Parliament in 1828, he proclaimed that it was unconstitutional that almost the whole patronage of the State should be placed in the hands of a military premier. The concluding passage of his speech ran through the country, and dwelt for-

* Lord Cockburn.

ever in men's minds in its axiomatic power. "There had been periods when the country heard with dismay that the soldier was abroad. That is not the case now. Let the soldier be ever so much abroad, in the present age he could do nothing. There is another person abroad—a less important person, in the eyes of some an insignificant person, whose labours have tended to produce this state of things—*the schoolmaster is abroad.*"*

Lord Brougham had declared that "to instruct the people in the rudiments of philosophy would of itself be an object sufficiently brilliant to allure the noblest ambition. To promote these ends and to obtain for the great body of his fellow-creatures that high improvement which both their understanding and their morals fitted them to receive," he urged upon the consideration of the men of wealth of Britain. "Such a one, however averse by taste or habit to the turmoil of public affairs, or the more ordinary strifes of the world, may in all quiet and innocence enjoy the noblest gratification of which the most aspiring nature is susceptible; he may influence by his single exertions the character and the fortunes of a whole generation, and thus wield a power to be envied even by vulgar ambition, for the extent of its dominion; to be cherished by virtue itself, for the unalloyed blessings it bestows." He pressed the subject on the attention "of all men of enlightened views, who value the real improvement of their fellow-creatures and the best interests of their country." He appealed to public-spirited individuals to promote the diffusion of knowledge and the cultivation of intellectual pursuits by devoting some of their means to these objects, and showed how much money had been misapplied by benevolent persons in sustaining certain charitable institutions which only tended to increase the number of the poor and dependent classes.

The "Society for the Diffusion of Useful Knowledge" was established in April, 1825, and at once entered upon a career alike brilliant and successful. "Its publications," says the Edinburgh Review,† "undoubtedly form by far the most important of the contributions from men of science and letters to the instruction and improvement of mankind." "Its efforts were to be extended until knowledge had become as plentiful and as universally diffused as the air we breathe."

It cannot be doubted that Mr. Smithson became impressed with the prevailing and new spirit of his age, and, recognizing as a man of science the inestimable value of knowledge and the importance of its universal diffusion, wrote the words of his will bequeathing his whole fortune "*for the increase and diffusion of knowledge among men.*"

At one period of his life, and when an active member of the Royal Society, he purposed leaving his fortune to that body for the promotion

* Chas. Knight's *Passages of a Working Life.* London, Vol 2, p. 66.
† *Edinburgh Review,* Vol. xlvi, 1827, p. 243.

of science,* but it is said that a disagreement with the council of the society on account of the non-acceptance of one of his papers probably led him to abandon the idea. This circumstance is of importance as indicating the bent of his mind and the mode in which he proposed to benefit mankind. The difficulty referred to, however, undoubtedly led him to give broader scope to his plan, and to choose a trustee for his endowment who would be hampered by no conventional or traditional restrictions, and who would understand and carry out his purposes in the most liberal and practical manner.†

It is peculiarly gratifying to Americans to remember that the *first* award made by the Council of the Royal Society of the Copley medal, the most honorable within its gift, was to our own countryman, Benjamin Franklin, who was adjudged to be the author of the most important scientific discovery. On this occasion the president of the society stated that the council, "keeping steadily in view the advancement of science and useful knowledge, and the honor of the society, had never thought of confining the benefaction within the narrow limits of any particular country, much less of the society itself."

As this was the spirit of the leading scientific organization in existence, of which Smithson himself was an active and honored member, he well exemplified its liberal principles by transferring his foundation of a great establishment for the "increase and diffusion of knowledge among men" from London to the city of Washington.

Smithson received a large estate from his half brother, Colonel Henry Louis Dickinson, in trust for the benefit of the son of this brother as well as of his mother. To this nephew, to whom he was probably attached, or because he had derived a large part of his fortune from his father, he left his whole fortune. Contingent on the death of this young man, he made the remarkable provision of an establishment in the United States which has secured for him the distinction of being a *benefactor of mankind.*

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* The charter states that the Royal Society was founded for the improvement of *natural knowledge.* This epithet *natural*, Dr. Paris remarks, "was intended to imply a meaning of which very few persons are aware. At the period of the establishment of the society the arts of witchcraft and divinations were very extensively encouraged, and the word natural was therefore introduced in contradistinction to *supernatural*." Hooke, the president, declared, in 1663, that "the business and design of the Royal Society was to improve the knowledge of natural things, and all useful arts, manufactures, mechanick practises, engynes and inventions by experiments—(not meddling with divinity, metaphysics, moralls, politicks, grammar, rhetorick, or logick.)"

Dr. Wollaston had made a gift of £1,000 to the Royal Society, the interest of which was to be annually applied towards the encouragement of experiments.

† "Our countrymen do not believe that America is more advanced in knowledge and refinement than Europe; but they know that, with slight divergencies, both hemispheres are in this respect nearly abreast of each other. And they know that, both being yet far from the goal, their generous transatlantic rivals start unencumbered by many old prejudices and social trammels which we cannot here escape from."—(Tait's *Edinburgh Magazine*, 1832, p. 234.)

It has been shown with what zeal and pleasure Smithson himself engaged in the advancement of knowledge, and what general interest had been awakened in England in the cause of scientific organization and popular education at the very time he wrote his will, and it is not unreasonable, therefore, to believe that he contemplated this contingency as a very probable event.

The will of Smithson, dated October 23, 1826, was proved in the Prerogative Court of Canterbury by his executor, Mr. Charles Drummond, a London banker, on the 4th of November, 1829. The value of the effects was sworn to be under £120,000.*

In 1878, a copy of a will also in Smithson's handwriting was procured by the Institution from Mr. de la Batut, almost identical with the one recorded in the courts of London.

It appears from this that the word heretofore printed *Audley* in copies of the will should be "Studley," and that the name of the former servant who kept the Hungerford Hotel at Paris should be Sailly, and not Jailly. In the record of the will at London, the word Smithsonian as the name of the Institution to be established is "Smithsonean," but as it is very plainly written "ian" in what we must consider his original draft, the misspelling referred to is undoubtedly due to an error of the transcriber. In all the proceedings in the court of chancery, and all the negotiations of Mr. Rush, the name "Smithsonian" has uniformly been used.

The first article of the will refers to an old and trusted servant, John Fitall, to whom, in consideration of his attachment and fidelity, Smithson bequeaths an annuity of a hundred pounds sterling. This Fitall died in June, 1834, having enjoyed the benefit of his legacy for five years.

Mr. Smithson next directs that various sums of money he had lent to another of his servants, Henri Honori Sailly, should be allowed to remain uncalled for at five per cent. interest for five years.

He then mentions the fact that all the money in the French five per cents. (*livres de rentes*) then standing in his own name and in that of Colonel Dickinson was the property of his nephew, being what he inherited from the colonel, who died on the 22d May, 1820, with what he had added himself to it from savings made out of the income. To this nephew, Henry James Hungerford, who was also known as Henry James Dickinson, and still later as Baron Eunice de la Batut, he leaves the rest of the income arising from his property during his life. The whole of his fortune is by the next clause of the will left absolutely and forever to any child or children, legitimate or illegitimate, of the said nephew Hungerford. But in case of the death of his nephew without leaving a child or children, or of the death of the child or children he may have had under the age of twenty-one years or intestate, he then says:

* *Gentleman's Magazine*, 1830, vol. c., p. 275.

"I bequeath the whole of my property to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

The nephew, Mr. Hungerford (alias H. J. Dickinson), to whom was bequeathed a life interest in Smithson's estate, brought an amicable suit in chancery against the executors for the purpose of having the assets administered under the direction of the lord chancellor, and these were ascertained to be about £100,000 sterling. The income from this property, which consisted mainly of stock in the public funds of England, was promptly paid to young Hungerford, who led a roving life in Europe, without settled habits or occupation, and died under the name of Baron Eunice de la Batut, at the Royal Hotel in Pisa, Italy, on the 5th of June, 1835, under thirty years of age, never having married, and leaving no heirs who could, even under the broad provisions of his uncle's will, make a claim to his bounty.

The mother of Hungerford, a Mrs. Mary Ann Coates, had married a Frenchman named Theodore de la Batut, and was still living at Port Louis in France. She now made a claim for part of the estate, on the ground that her son had given her an ample allowance while he lived, and that under the will of his father, Col. Henry Louis Dickinson, made in Paris in July 1819, by which he left all his property to his brother, James Smithson, half the income was to be for her benefit during her life. It was shown that young Hungerford lived up to his income, and had left nothing even to pay debts or funeral expenses. It was also urged that if Smithson's will had come into operation then, instead of seven years before, Hungerford would, in consequence of an alteration of the law, have been entitled to a portion of the accruing half-year's income up to his death; and that, in consequence of the change in the law, he could not be said to have enjoyed the income of the property during his whole life. It was also urged as a "moral claim," that as the Smithson bequest was to be applied "to increase and diffuse knowledge among men," the children of Mrs. de la Batut were entitled to an allowance from it until the age of twenty-two for their education.

The claim made was for an annuity of £240; but after long negotiation the decree was made by the court of chancery to allow Mrs. de la Batut £150 9*s*. during her life, with a payment of £526 11*s*. 6*d*. for arrears from the 22d September, 1834, to the 22d March, 1838. To secure this annuity, the sum of £5,015 in three per cent. consols was retained in trust by the court, the interest to be paid on the 22d September and 22d March annually. By the law of France, the life income is apportionable and payable up to the time of death; and Colonel Dickinson having been domiciled in France, this rule applied in his case.

Mrs. de la Batut lived to the year 1861, and the amount retained in England as the principal of the annuity was paid over to the Institution on the 11th June, 1864. This is known as the "residuary legacy" of Smithson, and the sum realized from it by the Institution, by the premium on gold, &c., was $54,165.38.

The first announcement made to the American Government of the fact that the United States had become entitled to the bequest of Smithson was a dispatch, dated 28th July, 1835, from Hon. Aaron Vail, chargé d'affaires of the United States at London, to Hon John Forsyth, Secretary of State, transmitting a letter from Messrs. Clarke, Fynmore and Fladgate, attorneys in that city. This communicated the intelligence that the nephew of Smithson had died, and that the United States was entitled to the estate, valued at £100,000.

These facts were laid before Congress by President Jackson on the 17th December, 1835, who stated in his message that he had no authority to take any steps toward accepting the trust.

In the Senate of the United States the message of the President was referred to the Committee on the Judiciary, which, by its chairman, Mr. Benj. Watkins Leigh, of Virginia, reported, on the 5th of January, 1836, that they considered the bequest of Mr. Smithson a valid one, and they believed "that the United States would be entertained in the court of chancery of England to assert their claim to the fund as trustees for the purpose of founding the charitable institution at Washington to which it is destined by the donor." The question whether it was within the competency of the Government to appropriate any part of the general revenue from the nation at large to the foundation of a literary or any other institution in the District of Columbia was answered by Mr. Leigh by stating that—

"The fund given by Mr. Smithson's will is nowise, and never can become, part of the revenue of the United States; they cannot claim or take it for their own benefit; they can only take it as trustee."

"The United States were to be regarded as the *parens patriæ* of the District of Columbia, and in that character they had a right and were in duty bound to assert a claim to any property given to them for the purpose of founding an institution within the District, and to provide for the due application and administration of such a fund when they obtained possession of it."

Resolutions were reported by the committee providing for the prosecution of the claim. The report was considered in the Senate on the 30th April, 1836, and it was urged by Mr. W. C. Preston, of South Carolina, that the Government of the United States had no power to receive the money. He thought the donation had been made partly with a view to immortalize the donor, and it was "too cheap a way of conferring immortality." He had no idea of the District of Columbia being used as a fulcrum to raise foreigners to immortality by getting Congress as the *parens patriæ* to accept donations from them. He expressed the opinion that Smithson's intention was to found a university.

Mr. Leigh, in reply, maintained that the legacy was not for the benefit of the United States, but only for one of the cities of the District of Columbia, and with this belief he had no difficulty in voting for the bill.

Mr. John M. Clayton, of Delaware, also thought a university was intended by Smithson.

Mr. John C. Calhoun, of South Carolina, was of opinion that the donation was made expressly to the United States, and that "it was beneath their dignity to receive presents of this kind from any one."

Mr. Samuel L. Southard, of New Jersey, advocated the measure, as he thought Congress had the unquestionable right to establish a national university.

Mr. James Buchanan, of Pennsylvania, believed that Congress had the power to receive and apply this money to the purposes intended by the testator, without involving the question whether it was for a university or not.

Mr. Robert J. Walker, of Mississippi, advocated the bill as a measure of justice to the city of Washington.

Mr. John Davis, of Massachusetts, argued that the Senators were mistaken who assumed that Smithson intended his bequest to establish a university. This word was not to be found in the will, and there were other means for diffusing knowledge besides the one referred to. He deemed the establishment of institutions for the promotion of knowledge a vital principle of republican government.

After a somewhat protracted debate the resolutions were finally passed on the 2d of May, 1836, by a vote of 31 to 7, and on the 25th of June they were again passed in the shape of a bill as it had come from the House of Representatives.

The message of the President was referred in the House, on the 21st of December, 1835, to a special committee, consisting of Mr. John Quincy Adams, of Massachusetts, Mr. Francis Thomas, of Maryland, Mr. James Garland, of Virginia, Mr. D. J. Pearce, of Rhode Island, Mr. Jesse Speight, of North Carolina, Mr. Thomas M. T. McKennan, of Pennsylvania, Mr. E. A. Hannegan, of Indiana, Mr. Rice Garland, of Louisiana, and Mr. G. H. Chapin, of New York. In this committee great opposition was manifested at first to the acceptance of the bequest, but this yielded to the arguments and persuasion of the distinguished chairman, Mr. John Q. Adams. A bill was accordingly reported, directing the President to appoint an agent to assert and prosecute for and in behalf of the United States in the court of chancery, England, the legacy bequeathed by James Smithson. The agent was to give bonds in $500,000 for the faithful performance of the duties imposed upon him. The Treasurer of the United States was to take charge of and keep safely all the money received on account of the bequest, and "the faith of the United States was solemnly pledged that the fund should be applied for the purpose of founding and endowing at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." For the cost of prosecuting the claim an appropriation of $10,000 was made.

On the 19th of January, 1836, Mr. Adams made an elaborate report, containing all the facts he had been able to collect relative to Smithson, and expressing in the most glowing and refined language his appreciation of the value of the gift to America and its importance to mankind. Mr. Leigh had convinced the Senate that it was the duty of Congress to accept the bequest, and Mr. Adams brought before the House an account of the life of the testator, the nature of the trust, the character of the trustees, the practical influence of our political institutions upon Europe, and the vast benefits to the world which might grow out of the legacy. The report was unanimously agreed to in the committee, but Mr. Adams had great misgivings whether anything would ever be realized from the bequest. The delays of the English court of chancery were well known, and the opinion had even been expressed that the whole affair was an imposture. Mr. Adams never wavered, however, in his faith in the power of the government to procure the money and its ability to administer it properly. He refers in his diary to it as the favorite and almost absorbing subject of his thoughts, and for many years he devoted untiring activity and personal efforts to its successful accomplishment.

No action was taken by the House on Mr. Adams's report until the Senate had passed Mr. Leigh's resolution; when that was taken up, changed in form to that of a bill, passed on the 25th of June, 1836, and was approved by the President on the 1st of July, 1836.

In accordance with this act the President appointed, on the 11th of July, Hon. Richard Rush, of Pennsylvania, as the agent to assert and prosecute the claim of the United States to the legacy. His salary was fixed at $3,000 per annum, and $2,000 were allowed for contingencies, not including legal expenses. Mr. Rush gave the necessary bond for $500,000, Messrs. J. Mason, jr., and Benjamin C. Howard being his sureties, who were accepted by Mr. Woodbury, Secretary of the Treasury. This appointment was one eminently fit to be made, and its wisdom was proved by the successful accomplishment of the mission. Mr. Rush had been Comptroller of the United States Treasury at a time when the fiscal affairs of the government were in disorder; he was next Attorney-General; then minister to England for a period of eight years; Secretary of the Treasury; and minister to France. "To these great and varied employments," Hon. J. A. Pearce has remarked, "he brought integrity, ability, intelligence, firmness, courtesy, and a directness of purpose which scorned all *finesse* and which served his country to the full extent of all that could have been demanded or hoped."

Mr. Rush immediately proceeded to London, placed himself in communication with the attorneys of the executor of Smithson, and entered with vigor into the measures necessary to assert the claim of the United

States. It was soon ascertained, on consultation with eminent counsel, Messrs. Thomas Pemberton and Edward Jacob, then at the head of the chancery bar, that it was necessary that a suit should be brought in the name of the President of the United States against the testator's executors, and that the Attorney-General must be made a party to the proceedings in order that he might represent before the court any claim which the Crown might have to the bequest on account of its extension to illegitimate children, or by reason of any part of the property consisting of interests in land. Mr. Rush, in addition to Messrs. Pemberton and Jacob, employed Messrs. Clarke, Fynmore, and Fladgate as his legal advisers, and a suit was commenced in the court of chancery in November, 1836. The first hearing, however, did not take place until the 1st of February, 1837, before Lord Langdale, master of the rolls, this court and that of the vice-chancellor being the two branches of the English chancery system before which suits are brought in the first instance.

The case was fully opened on behalf of the United States by Mr. Pemberton. The King's counsel abandoned at once all opposition on the part of the Crown, and no question was raised under the doctrine of escheats or any other by the representatives of the British Government. The court then decreed that the case be referred to one of the masters in chancery, Mr. Nassau William, Sen., to make the requisite inquiries as to the facts on the happening of which the United States became entitled to the fund left by Mr. Smithson, and also as to the claim of Madame De la Batut.

The United States had never before sued in an English court, but there were precedents of other nations having done so by their executive heads, as, for example, the King of France and the King of Denmark. The United States were therefore allowed to enter the courts in the name of the President.

Advertisements were immediately inserted in the London Times, Herald, and Standard, and in French and Italian newspapers in Paris and Port Louis, in France, and Leghorn, in Italy, asking for information respecting Henry James Hungerford; whether he married, whether he left any child, &c.

Mr. Rush, in August, 1837, wrote to the Secretary of State that there were more than eight hundred cases in arrears in the court of chancery, and he felt much discouraged as to a speedy termination of the suit. While the population of England had increased in a definite period sixfold and her wealth twentyfold, the judicial establishment had remained nearly the same. There were only eleven masters in chancery, while double the number would not be sufficient. The subject of a reform in this court, Mr. Rush stated, had been specially recommended by the Throne to Parliament. It had been said, with truth, that "a chancery suit was a thing that might begin with a man's life and its termination be his epitaph." Still later it will be remembered that Mr. Dickens stated in 1853 that there was then "a suit before the court of chancery which had been commenced twenty years before in which from thirty to forty counsel had been known to appear at one time, in which costs had been incurred to the amount of £70,000, which was a *friendly* suit, and which was no nearer its termination than when it was begun."

Mr. Rush refers in terms of high compliment to the solicitors he had employed on behalf of the United States. He says:

"That more attention, diligence, discretion, and integrity could not have been exerted by any persons than they have shown throughout the whole suit from first to last. Could they ever have forgotten what was due to the United States and to themselves, in the desire to eke out a job, nothing is plainer to me, from what has been passing under my observation of the entanglements and delays natural to a heavy suit in the English court of chancery, than that they might have found opportunities in abundance of making the suit last for years yet to come."

It is therefore to be regarded as one of the most remarkable events in the history of the bequest that the suit of the United States, commenced in November, 1836, should have been brought to a successful issue, in less than two years, on the 12th of May, 1838, which, it may be interesting to note, was the first year of the reign of Her Majesty Queen Victoria.

Mr. Rush was therefore placed in possession of the legacy with the exception of the part reserved as the principal of an annuity to Madame De la Batut. Mr. Rush thus expresses his satisfaction at the result:

"A suit of higher interest and dignity has rarely perhaps been before the tribunals of a nation. If the trust created by the testator's will be successfully carried into effect by the enlightened legislation of Congress benefits may flow to the United States and to the human family not easy to be estimated, because operating silently and radually throughout time, yet operating not the less effectually."

Scarcely had the decision of the court been made and the amount of the award published in the newspapers, when two claimants for the estate of Smithson appeared, neither having any connection with the other; and they desired, rather importunately, to know if the case could not be reopened. They were much chagrined to find that they were a little too late in their application, and nothing more was heard of them.

The American minister to England, Mr. Stevenson, and our consul at London, Mr. Aspinwall, united in testifying to the great tact and ability of Mr. Rush, and in affirming—

"That no litigant ever displayed a more ardent zeal or a more sagacious, devoted, and unremitting diligence in the prosecution of his private suit than *he* did in urging on this public one to a prompt and successful conclusion. The dispatch with which in consequence this purpose was finally accomplished is almost without example in the annals of chancery. His solicitors will long remember his adroit and unsparing application of the spur. Had he not urged them to the top of their speed, he would have had a lighter weight of gold to carry home with him."

The estate of Smithson which was transferred to Mr. Richard Rush consisted of the following securities:

£64,535 18*s.* 9*d.* in consolidated three per cent. annuities, called consols, sold at an average of 95⅜ per cent., yielded £56,175.

£12,000 in reduced three per cent. annuities, sold at 94 per cent., yielded £11,280.

£16,100 in Bank of England stock, sold at about 205 per cent., yielding £32,996 10*s.*

Good-fortune again attended Mr. Rush, for the day when he sold the consols their value was higher than at any previous time for many years or than at any later period. The bank stock also commanded the remarkably high premium of about 205 per cent.

The estate, therefore, independent of the accumulations of interest and notwithstanding the delays in the court of chancery, was worth more than in the summer of 1835, when the right of the United States first attached to it by the death of Henry James Hungerford, and the entire amount of sales yielded an aggregate of more than one hundred and six thousand pounds sterling.

Mr. Rush's next concern was how to transfer these funds to the United States, and he decided to convert the whole into gold coin and send it in this form. This was not only the most judicious course, but it secured an increase of the fund to upwards of a thousand pounds sterling on account of saving the cost of exchange. This sum was enough to cover commissions, insurance, freight, and other charges on the transfer of the gold.

The costs of the suit and expenses connected with the shipment of the proceeds of the bequest were as follows:

Costs of the chancery suit, £490 4*s.* 10*d.*; selling the stock, commission to Thomas Aspinwall, £797 15*s.* 6*d.*; charges for shipping, £6 19*s.* 4*d.*; premium of insurance, £605 3*s.* 10*d.*; brokerage, stamps, &c., £120 4*s.* 6*d.*; freight from London to New York, £393 12*s.*; primage, £19 13*s.* 8*d.*

The proceeds of the sales of the stocks, &c., were converted into gold sovereigns, and these were packed at the Bank of England in bags containing £1,000 each and shipped in eleven boxes by the packet Mediator, of New York, on the 17th July, 1838. Three other boxes sent at the same time contained the personal effects of Smithson.

The ship *Mediator* arrived in New York on the 29th of August, 1838, and the gold, amounting to £104,960 8*s.* 6*d.*, was deposited in the Bank of America until the 1st of September, when it was delivered to the Treasurer of the United States Mint in Philadelphia, and immediately recoined into American money, producing $508,318.46 as the bequest of Smithson.

LEGISLATION OF CONGRESS

IN RELATION TO

THE DISPOSITION OF THE BEQUEST.

On the 6th of December, 1838, President Van Buren had the satisfaction of announcing to Congress that the claim of the United States to the legacy bequeathed to them by James Smithson had been fully established, and that the fund had been received by the government. He now urged the prompt adoption of a plan by which the intentions of the testator might be fully realized. For the purpose of obtaining information which might facilitate the attainment of this object, he applied, through the Secretary of State, to a number of persons "versed in science and familiar with the subject of public education, for their views as to the mode of disposing of the fund best calculated to meet the intentions of Smithson, and be most beneficial to mankind."

He communicated to Congress the replies received, of which the following is a brief abstract.

President Francis Wayland, of Brown University, proposed a university of high grade to teach Latin, Greek, Hebrew, Oriental languages, and a long list of other branches, including rhetoric, poetry, intellectual philosophy, the law of nations, &c.

Dr. Thomas Cooper, of South Carolina, also proposed a university, to be opened only to graduates of other colleges, where the higher branches of mathematics, astronomy, chemistry, &c., should be taught, but Latin and Greek, literature, medicine, and law excluded.

Mr. Richard Rush proposed a building, with grounds attached, sufficient to reproduce seeds and plants for distribution; a press to print lectures, &c.; courses of lectures on the leading branches of physical and moral science, and on government and public law; the salaries to be ample enough to command the best men, and admit of the exclusive devotion of their time to the studies and investigations of their posts; the lectures, when delivered, to be the property of the institution for publication. Mr. Rush also made the excellent suggestion that consuls and other United States officers might greatly aid the institution by collecting and sending home useful information and valuable specimens from abroad.

Hon. John Quincy Adams expressed, in his reply, the opinion that no part of the fund should be devoted "to the endowment of any school, college, university, or ecclesiastical establishment"; and he proposed to employ seven years' income of the fund in the establishment of an astronomical observatory, with instruments and a small library.

The subject of the Smithson bequest was referred in the House of Representatives on the 10th December, 1838, to a special committee of nine members, of which Hon. John Quincy Adams was chairman. Besides the letters transmitted to Congress by President Van Buren, other plans were brought before the committee.

A memorial from Prof. Walter R. Johnson suggested the establishment of an institution for experiment and research in physical science especially pertaining to the useful arts, and the discovery, description, application, and improvement of the natural resources of our country. Another scheme was presented by Mr. Charles L. Fleischmann for the establishment of an agricultural school and farm, and he entered into the most minute detail as to the buildings and estimates for all the parts of the plan. There were also propositions to use the fund "for the instruction of females," for the establishment of "professorships," for "courses of lectures," for "improved methods of rearing sheep, horses, and silkworms," for founding a great library, &c.

Mr. Adams very earnestly opposed the appropriation of any part of the fund to educational purposes, believing that it was the duty of the country itself to provide the means for this important object. His own favorite scheme was the establishment of an astronomical observatory, and this he advocated in the most ardent, able, and persistent manner.

The chairman of the Senate committee, Hon. Asher Robbins, of Rhode Island, proposed the creation of "an institution of which there is no model either in this country or in Europe, to provide such a course of education and discipline as would give to the faculties of the human mind an improvement far beyond what they obtain by the ordinary systems of education and far beyond what they afterwards attain in any of the professional pursuits." His speech in the Senate on the 10th of January, 1839, in presenting his views on this subject is remarkable for its beauty of diction, elevation of sentiment, and classical erudition.

Mr. Robbins's resolutions provided for a scientific and literary institution, and stated that to apply the fund to the erection and support of an observatory "would not be to fulfil *bona fide* the intention of the testator, nor would it comport with the dignity of the United States to owe such an establishment to foreign eleemosynary means."

The plan of Mr. Robbins was not received with sufficient favor in the Senate to secure its passage, and it was laid on the table by a vote of 20 to 15, on the 25th of February, 1839. Among those who favored the bill were Senators Clay, Davis, Prentiss, Preston, Rives, and Walker, and among those opposed to it were Senators Allen, Bayard, Benton, and Calhoun.

Mr. Adams remarks in his diary, October 26, 1839, that his mind was "filled with anxiety and apprehension lest the fund should be squandered upon cormorants or wasted in electioneering bribery." He adds:

"It is hard to toil through life for a great purpose with a conviction that it will be in vain, but possibly seed now sown may bring forth some good fruit hereafter. If I cannot prevent the disgrace of the country by the failure of the testator's intention, I can leave a record of what I have done and what I would have done to accomplish the great design if executed well."

At the beginning of the Twenty-sixth Congress, December, 1839, Mr. Adams again brought up the subject of the Smithson bequest and had it referred to a committee of nine, consisting of Messrs. Adams, Ogle, Shepard, Garland of Virginia, Lewis, Albert Smith, Barnard, Corwin, and Campbell of South Carolina.

A memorial was presented to Congress from the Corporation of the city of Washington, expressing great anxiety "to see the instructions of Smithson carried into effect, believing it impossible to calculate the good which an institution properly founded is susceptible of promoting in the improvement of the intellect, taste, and morals of the country." It was deemed presumptuous, however, to express an opinion as to what should be the character of the institution.

Mr. Hassler, then in charge of the Coast Survey, urged on Mr. Adams the establishment of an astronomical school.

On the 5th of March, 1840, Mr. Adams presented an elaborate and extended report to the House of Representatives, reviewing all that had been done relative to the bequest, and presenting the establishment of an astronomical observatory as the best means of carrying out the purposes of Smithson. He gave in detail the arguments in favor of this plan, with estimates for carrying it into effect, and an interesting letter from Mr. Airy, the Astronomer Royal of England, relative to the origin, history, uses, and expenses of the famous Greenwich Observatory. Mr. Adams also gave a masterly summary of the progress of astronomical discovery, painted in the most brilliant colors the achievements of men of science, and portrayed in glowing language the future glory and renown of our country to be derived from the application of the Smithson fund in the manner he proposed.

The impropriety of devoting any portion of the fund to establish a school or college was strongly urged, and he said, "We should in no case avail ourselves of a stranger's munificence to rear our children." It is not clear how the learned and distinguished gentleman reconciled his apparent inconsistency in advocating the use of the fund for the establishment of "a *national* observatory to be superior to any other devoted to the same science in any part of the world," and which would "make an impression upon the reputation of the United States throughout the learned and scientific world." The desire of increasing the brightness of our name in the eyes of other nations, and of effacing a stain he detected upon the national escutcheon on account of our lack of an observatory, rendered him insensible or indifferent to the merits of any other plan for the increase and diffusion of knowledge. He seems to have been wedded to his favorite scheme, and his whole course in Congress in relation to the bequest was governed by it. After provision had been made for astronomical observations by the general government he still advocated no other plan, and even went so far as to declare that he would rather see the money of Smithson thrown into the Potomac than to have it devoted to the advance of education.

It appears that, without debate or explanation, a section was added to the regular appropriation bill, passed 7th July, 1838, for the support of the United States Military Academy at West Point, by which it was enacted that all the money arising from the bequest of Smithson should be invested, when received, by the Secretary of the Treasury, with the approbation of the President of the United States, in stocks of States bearing not less than five per cent. interest, and that the annual income accruing on the stock should also be reinvested in the same way for the increase of the fund.

In accordance with this law, Mr. Levi Woodbury, Secretary of the Treasury, inserted an advertisement in the Washington Globe of August 6, 1838, asking for proposals from those having State stocks to dispose of. A large number of offers were received. Five per cents. of Indiana were offered at par, 98, and 99; of Louisiana, at 98; New York, 102; Maine, 98½ and par; Massachusetts, 104; Kentucky, par; of five and a quarter per cents., Tennessee, at 99½; of five and a half per cents., Missouri, at 102 and par; and of six per cents., Michigan, at par; Virginia, par; Illinois, 104, and Arkansas, $99\frac{3}{10}$. Mr. Woodbury accepted the offer of Mr. W. W. Corcoran, of the Arkansas bonds, and purchased $500,000 of them for the sum of $499,500. Subsequently he procured $38,000 more bonds of Arkansas, $8,000 Michigan, $56,000 Illinois, and $18,000 Ohio bonds.

The two bills of Mr. Robbins and Mr. Adams, representing the university and the observatory plans, were reported together to Congress. The former was laid on the table, but the latter not acted on, on account of the pressure of other business at the close of the session.

In 1841, Mr. Lewis F. Linn, of Missouri, introduced a bill in the Senate to appoint trustees for the investment of the Smithson fund, and for the organization of an institution with a superintendent and six professors, to be nominated by the "National Institute," a society which had been formed in Washington for the promotion of science, and many of whose members were anxious to obtain control of the bequest. Mr. Linn proposed that all the collections of art and of natural history owned by the United States should be given to the Smithsonian Institution, but all the buildings, collections, &c., should be under the supervision of the National Institute. This bill was referred to the Library Committee, and a substitute was reported by Mr. Preston on the 17th February, 1841, providing for the incorporation of the National Institute, and the establishment of a Smithsonian Institution, with a superintendent and six professors, to be elected by the board of managers of the former, the officers of the institute and the superintendent of the Smithsonian Institution to constitute a board of management of the Smithson fund, to plan and erect buildings, procure books, apparatus, collections, &c. It was provided that all works of art, and all books relating thereto, and all collections and curiosities belonging to the United States were to be transferred to the Smithsonian Institution. The ground known as the Mall was appropriated for the buildings and use of the establishment. Nothing resulted however from this proposition.

Through the efforts of Mr. Adams, the act of 7th July, 1838, requiring the investment of the Smithson fund in State stocks, was repealed, and by an act of September 11, 1841, the Secretary of the Treasury was directed to invest the accruing interest thereafter only in United States stock.

President Tyler, in his message at the opening of the Twenty-seventh Congress, urged the propriety of making a specific application of the funds derived from the will of Smithson, and said he felt confident that "no abatement of the principal would be made should it turn out that the stocks in which the fund had been invested had undergone depreciation."

The Senate referred the message to the Library Committee, Mr. Preston, chairman, and the House to a select committee of nine, of which Mr. Adams was again chairman. Mr. Preston soon after reported the bill he had offered at the previous session for combining the National Institute and the Smithsonian Institution, but this was laid upon the table on the 18th July, 1842. Mr. Adams presented a report and bill in the House on the 12th April, 1842, providing for the incorporation of the Smithsonian Institution; that all the money received from the bequest should be placed to the credit of a fund to be denominated the Smithsonian fund, to be preserved undiminished and unimpaired, and to bear interest at 6 per cent. per annum. The interest of this fund was to be appropriated for the erection and establishment of an astronomical observatory, the publication of the observations, and of a nautical almanac.

About this period memorials were presented to Congress in favor of appropriating the fund for the purpose of awarding annual prizes for the best original essays on the various subjects of the physical sciences, for the establishment of an agricultural school and farm, for organizing a system of simultaneous meteorological observations throughout the Union under the direction of Professor Espy, &c.

No definite action was had on any of these propositions, and President Tyler again called the attention of Congress in his message of December 5, 1843, to their neglect of an important duty. The subject was referred to the Joint Library Committee, of which Hon. Rufus Choate was chairman.

Mr. Tappan, from this committee, reported a bill on the 6th June, 1844, providing that the original amount received as the bequest of Smithson, $508,318.46, be considered as a permanent loan to the United States, at 6 per cent. interest, from the 3d December, 1838, when the same was received into the Treasury; that the interest which accrued to the 1st

July, 1844, viz, $178,604, be appropriated to the erection of buildings and inclosure of grounds for the Smithsonian Institution; that the business of the institution should be conducted by a board of twelve managers from different States or Territories; that a plain and substantial building be erected, with rooms for a museum, library, chemical laboratory, lectures, arboretum; all the objects of natural history belonging to the United States to be transferred to said institution, exchanges of duplicate specimens to be made, a superintendent to be appointed to be professor also of agriculture and horticulture, additional professors of natural history, chemistry, astronomy, and such other branches as the wants of science may require, "excluding law, physic, or divinity," experiments to be made to determine the utility of new fruits, plants, and vegetables, and finally students to be admitted to the institution gratuitously.

Mr. Adams in February, 1844, succeeded in having a select committee of nine appointed to consider the proper disposition of the fund, and in behalf of this committee made a third elaborate and comprehensive report, together with a bill providing for the appropriation of $800,000 as the Smithson fund, to be permanently invested in stock of the United States at 6 per cent. interest, and the income to be devoted, as he had before recommended, for an observatory and nautical almanac.

On the 12th December, 1844, Mr. Tappan introduced a bill in the Senate of a similar character to the one he had offered before, but in addition specified that the books to be purchased for a library should consist of works on science and the arts, especially such as relate to the ordinary business of life and to various mechanical and other improvements and discoveries. In prescribing the duties of professors and lecturers, special reference was to be had to the productive and liberal arts, improvements in agriculture, horticulture, and rural economy. Seeds and plants were to be distributed throughout the country, soils were to be analyzed; the professor of natural history was to refer in his lectures to the history and habits of useful and injurious animals; the professor of geology was to give practical instruction in the exploration and working of mines; the professor of architecture was to give instruction as to the best materials and plans for building; the professor of astronomy was to give a course of lectures on navigation and the use of nautical instruments. It was also provided that works in popular form on the sciences and the aid they bring to labor should be published and distributed.

In the discussion to which this bill gave rise in the Senate on the 8th of January, 1845, Mr. Choate made the brilliant speech which is referred to in the North American Review as "a splendid offering on the shrine of literature by one of her most gifted votaries, and one which, in future times, will render more memorable the day on which it was delivered than that gallant military achievement of which it is the anniversary. No prouder monument than this would be needed for his fame."*

* *North American Review*, vol. 79, p. 459.

In this famous speech, Mr. Choate remarked that "our sense of duty to the dead, the living, and the unborn who shall live; our justice, our patriotism, our policy, common honesty, common decorum, urge us, are enough to urge us, to go on without the delay of an hour, to appropriate the bounty according to the form of the gift." He opposed anything like the school or college proposed by Mr. Tappan on the ground of its narrow utilitarianism, as being wholly unnecessary and in a great degree useless. It would injure the universities already in existence; it would be exceedingly difficult to secure students; the expense of professors, books, apparatus, and buildings would secure a pretty energetic diffusing of the fund but not much diffusion of knowledge. He approved of the suggestion that lectures should be delivered, especially during the sessions of Congress, not by professors permanently fixed on annual salaries, but by gentlemen eminent in science and literature, to be invited to Washington under the stimulus and with the ambition of a special and conspicuous retainer. He preferred however that the one simple object of the Institution should be to accumulate a grand and noble public library, one which for variety, extent, and wealth should be equal to any in the world. 'He claimed that this scheme was the only one that "would prevent the waste of money in jobs, salaries, sinecures and quackeries, and would embody Smithson's idea in some tangible form, some exponent of civilization, permanent, palpable, conspicuous, useful, and than which nothing was safer, surer, or more unexceptionable."

Mr. Choate presented many interesting facts in regard to the public libraries of the world, and argued in his peculiarly forcible and eloquent manner that such a plan as he proposed was within the terms and spirit of the trust.

"That directs us to 'increase and diffuse knowledge among men. And do not the judgments of all the wise; does not the experience of all enlightened states; does not the whole history of civilization concur to declare that a various and ample library is one of the surest, most constant, most permanent and most economical instrumentalities to increase and diffuse knowledge? There it would be, durable as liberty, durable as the Union; a vast storehouse, a vast treasury of all the facts which make up the history of man and of nature, so far as that history has been written; of all the truths which the inquiries and experiences of all the races and ages have found out; of all the opinions that have been promulgated; of all the emotions, images, sentiments, examples, of all the richest and most instructive literatures; the whole past speaking to the present and the future—a silent, yet wise and eloquent teacher. * * *

"If the terms of the trust then authorize this expenditure, why not make it? Not among the principal, nor yet the least of reasons for doing so, is, that all the while that you are laying out your money, and when you have laid it out, you have the money's worth, the value received, the property purchased on hand to show for itself and to speak for itself. Suppose the professors provided for in the bill should gather a little circle of pupils, each of whom should carry off with him some small quotient of navigation, or horticulture, or rural economy, and the fund should thus glide away and evaporate in such insensible, inappreciable appropriations, how little there would be to testify of it! Whereas here all the while are the books; here is the value; here is the visible property; here is the oil and here is the light. There is something to point to, if you should be asked to account for it unexpectedly, and something to point to if a traveler should taunt you with the collections which he has seen abroad, and which gild and recommend the absolutisms of Vienna or St. Petersburgh. * * *

"But the decisive argument is, after all, that it is an application the most exactly adapted to the actual literary and scientific wants of the States and the country. I have said that another college is not needed here because there are enough now, and another might do harm as much as good. But that which is wanted for every college, for the whole country, for every studious person, is a well-chosen library, somewhere among us, of three or four hundred thousand books."

Mr. Tappan, in reply, urged that Smithson's own habits and pursuits should be considered; that it must be remembered that he was an eminently practical philosopher, intimately acquainted with chemistry, mineralogy, geology, and natural history, to the minute study of which he devoted his life. His favorable resort had been the *Jardin des Plantes*, at Paris, and there could be but little doubt that in making his bequest he had in view the establishment of a similar institution. He deprecated the outlay of a large amount in the purchase of books, and asserted that they not only did not promote knowledge, but that one-half of those then in the Library of Congress were to be considered as trash.

Mr. Levi Woodbury, of New Hampshire, favored the employment of lecturers, and the purchase of a moderate-sized library, but preferred that the management of the bequest should be intrusted to the National Institute, a society already in active operation, created by Congress, and the objects of which were appropriate to the trust.

Mr. John J. Crittenden, of Kentucky, thought the purchase of books should be confined to works on science and the arts. Mr. James A. Pearce, of Maryland, concurred in the views of Mr. Choate. Mr. Wm. C. Rives, of Virginia, believed that by knowledge was not merely meant the natural sciences, astronomy, mathematics, &c.; he considered the most important of all the branches of human knowledge that which related to the moral and political relations of man. The field of moral science also embraced a much larger portion of knowledge than the physical sciences. He suggested the "Faculty of letters and sciences" under the auspices of the University of France, as a much better model for the Smithsonian than the *Jardin des Plantes*. He remarked that it was his "firm and solemn conviction that we now have it in our power to do more good to this nation in our day and generation, by a judicious and wise application of this $500,000 which has been put into our hands, than by the application of the twenty-five or thirty millions we are in the habit of annually appropriating."

Mr. Choate's amendments were adopted by the Senate and the bill recommitted to be more fully matured. It was again reported to the Senate on the 2d of January, including Mr. Choate's plan of a great library. Mr. Woodbury endeavored again to place the Institution under the management of the National Institute, but was opposed by Senators Buchanan, Choate, and Tappan, on the ground that it was anti-republican and anti-democratic to surrender all control by the people's representatives in respect to a trust committed to their custody for the people's benefit, and to place it in the hands of a close body wholly irresponsible to either Congress or the people.

Mr. Woodbury replied with warmth that his plan, instead of being antagonistic to Congress, made it more in subordination to it, and placed stronger safeguards against any possible departure from its commands or wishes. He also believed that it would be placing a burden on the Institute rather than conferring a favor upon it.

Mr. Buchanan "could imagine no other mode of using the fund" to advantage, than "the purchase of a great library," and strongly opposed any connection with the National Institute.

Mr. William Allen, of Ohio, expressed his opposition to "any plan whatever for connecting anything called an *institution* with the public treasury." He had never known a single instance of a fund of money, charitable or otherwise, being intrusted to the care of an incorporated body of men "that was not squandered and made to fall short of the object of the donor." He wished to see no institution established in the capital of the United States to teach the American people how to think, and read, and speak, and he therefore opposed the whole project.

Mr. Robert J. Walker, of Mississippi, defended the National Institute against the attacks made upon it; showed that it was worthy of and had received the greatest encouragement and most general favor, and claimed that an institution bearing the name of a foreigner never could concentrate in the same degree the affections and confidence of the American people.

After some further debate the bill was laid over for several days, but was taken up and passed on the 23d of January, 1845. When it reached the House, a substitute was offered for it by Mr. Robert Dale Owen, of Indiana; but in the hurry of a short session of Congress the whole matter was left undisposed of.

On the opening of the Twenty-ninth Congress, Mr. Owen again offered his bill to establish the Smithsonian Institution, and it was referred to a select committee of seven members, viz, Messrs. Owen, of Indiana, John Q. Adams, of Massachusetts, Timothy Jenkins, of New

York, George P. Marsh, of Vermont, Alexander D. Sims, of South Carolina, Jefferson Davis, of Mississippi, and David Wilmot, of Pennsylvania.

On the 28th of February, 1846, Mr. Owen, from this select committee, reported an elaborate bill embracing the principal features of Mr. Tappan's bill of the last session, but adding a section providing for a normal branch to give such a thorough scientific and liberal course of instruction as may be adapted to qualify young persons as teachers of our common schools and to qualify students as teachers or professors of the more important branches of natural science. A library was to be procured composed of valuable works pertaining to all departments of human knowledge. Special reference was to be made by the professors to the increase and extension of scientific knowledge generally, by experiment and research. Essays, pamphlets, magazines, manuals, tracts on science, history, chemistry, school-books, apparatus, &c., were authorized.

In advocating this bill Mr. Owen made a very able and impressive speech, and one of the most memorable occurring in the discussion of the subject of the disposition of the bequest. He condemned the dilatoriness of Congress in waiting for ten years, after solemnly accepting the trust, without doing anything whatever to carry out the intention of the donor.

"Small encouragement," he remarked, "is there, in such tardiness as this, to others, as wealthy and as liberal as Smithson and Girard, to follow their noble example! Small encouragement to such men to entrust to our care bequests for human improvement! Due diligence is one of the duties of a faithful trustee. Has Congress, in its conduct of this sacred trusteeship, used due diligence? Have its members realized, in the depths of their hearts, its duties and their urgent importance? Or has not the language of our legislative action rather been but this: 'The Smithsonian fund! Ah, true! That's well thought of. One forgets these small matters.'"

Mr. Owen reviewed all the legislative proceedings in relation to the subject, the various plans brought forward from time to time for adoption by Congress, and called attention to the fact that the object for which Mr. Adams had labored with so much zeal and perseverance—an astronomical observatory—had already been established in Washington. He then made an elaborate reply to Mr. Choate's arguments in favor of a great library. He admitted that "in books exists the bygone world. By books we come in contact with the mankind of former ages. By books we travel among ancient nations, visit tribes long since extinct, and are made familiar with manners that have yielded, centuries ago, to the innovating influences of time." He would go as far as the farthest in his estimate of the blessings which the art of printing had conferred upon man; but such reasoning had no relation to the proposal embraced in Mr. Choate's scheme.

"It substantiates not at all the propriety of spending half a million, or two or three half millions of dollars to rival the bibliomaniacs of Paris and of Munich.

"Books are like wealth. An income we must have to live; a certain amount of income to live in comfort. Beyond a certain income the power of wealth to purchase comfort, or even wholesome luxury, ceases altogether. How much more of true comfort is there in a fortune of a million of dollars than in one of fifty, or say a hundred thousand? If more there be, the excess is hardly appreciable; the burden and cares of a millionaire outweigh it tenfold. And so, also, of these vast and bloated book-gatherings that sleep in dust and cobwebs on the library shelves of European monarchies. Up to a judicious selection of thirty, fifty, a hundred thousand volumes, if you will, how vast, yea, how priceless, is the intellectual wealth! From one to five hundred thousand, what do we gain? Nothing? That would not be true. A goblet emptied into the Pacific adds to the mass of its waters. But if, within these limits, we set down one book out of a hundred as worth the money it costs, we are assuredly making too liberal an estimate.

"Our librarian informs me that the present Congressional library (certainly not one of the most expensive,) has cost upwards of three dol lars a volume; its binding alone has averaged over a dollar a volume. The same works could be purchased now, it is true, much more cheaply; but, on the other hand, the rare old books and curious manuscripts necessary to complete a library of the largest class would raise the average. Assuming, then, the above rate, a rival of the Munich library would cost us a million and a half of dollars; *its binding alone* would amount to a sum equal to the entire Smithsonian fund as originally remitted to us from England.

"And thus not only the entire legacy, which we have promised to expend so that it shall increase and diffuse knowledge among men, is to be squandered in this idle and bootless rivalry, but thousands on thousands must be added to finish the work; from what source to be derived, let its advocates inform us. And when we have spent thrice the amount of Smithson's original bequest on the project, we shall have the satisfaction of believing that we may possibly have saved to some worthy scholar a hundred, or perchance a few hundred, dollars, which otherwise he must have spent to obtain from Europe half a dozen valuable works of reference!"

The most important feature of Mr. Owen's bill was however considered by him to be the provision for normal-school instruction. He maintained it to be the duty of Congress to elevate to the utmost the character of our common schools. The normal branch was not intended by him to take the place of similar institutions in the States; it would be supplemental to these, but of a higher grade, and would enable young persons who had passed through the former to perfect themselves in "the most useful of all modern sciences—the humble yet world-subduing science of primary education." It would also be the place where we might hope to find trained, competent, and enlightened teachers for the State normal schools.

He also specially urged the importance of scientific researches.

"In these," he said, "Smithson spent the greater part of his life. And it cannot be doubted that were he yet alive and here to-day to explain his wishes, *original researches in the exact sciences* would be declared by him a part of his plan. With the knowledge of his life and favorite pursuits before us, and the words of his will specifying the *increase* as well as the diffusion of knowledge for our guide, it seems nothing less than an imperative duty to include scientific research among the objects of a Smithsonian Institution."

Mr. George W. Jones, of Tennessee, made himself conspicuous on this, as on many other occasions, by bitter opposition to the adoption of any plan for the organization of the Institution. He believed that the whole matter was wrong; that the government had no right to accept of the trust, and he proposed that the whole fund, in whatever form it might be, whether money or State bonds, should be returned to any of the heirs-at-law or next of kin of Mr. Smithson. He maintained that—

"It was neither the right, the power, or the true policy of the government to attempt to rear upon the city of Washington an institution for the education of school teachers, agricultural professors, &c., to send out into the country. . . . Every measure of this kind had the tendency to make the people throughout the country look more to this great central power than to the STATE governments."

Mr. Joseph R. Ingersoll, of Pennsylvania, favored the bill of Mr. Owen, and ridiculed the idea of Mr. Jones of returning the money to England. He thought that a great library was not desirable, and said that the necessary building to contain the greatest library in the world would in its own erection exhaust the entire bequest. The Capitol itself would not contain eight hundred thousand volumes so properly arranged as to be accessible. A library was not the object of Smithson. A plan should be adopted to cover general ground, in which all objects of science should be included. He favored that part of the bill providing for normal instruction, and would add an appropriation for defraying the expense of the delivery of lectures by our most distinguished men at different points throughout the country for scientific instruction.

Mr. Frederick P. Stanton, of Tennessee, in a brilliant and eloquent address to the House, supported the bill in its present form. He maintained that it was the result of the conflicting opinions of wise and experienced men, harmonized by comparison, discussion, and mutual concession. He dwelt at length on the importance of advancing science, the value of experimental research and observation; explained and advocated every section of the bill, and concluded by saying: "By proper management this institution may doubtless be made the instrument of immense good to the whole country. To the government it will be of no slight advantage. It will be a great institution. It may attain a character as high as that of the French Academy, and its authority will then be decisive in reference to numerous questions of a scientific nature continually presented to the committees of Congress and the departments of government for determination and consequent action. Such an institution is greatly needed in the federal city."

Mr. William Sawyer, of Ohio, wanted students to be sent to the Institution selected from the various States and Territories according to the ratio of representation in Congress. He also thought the rate of interest on the fund should be five instead of six per cent.

Mr. D. P. King, of Massachusetts, favored a provision by which students could be educated free of expense, and pay their board by labor on a farm connected with the establishment.

Mr. Jefferson Davis, of Mississippi, advocated the bill as providing for the increase and diffusion of knowledge among men. It was too late to make the objection that the trust ought not to have been accepted. It was our duty to carry it into execution; and as to the fund, it ought to be considered as money still in the Treasury, unconnected with any investment the officers of the government may have made. He regarded *lectures* as the greatest means of extending knowledge which had been adopted in modern times. It was second only to the invention of the art of printing. He would admit that the government had no authority to take charge of the subject of education, but he did not consider this bill as liable to that objection. The normal school system he considered as highly beneficial, serving to produce uniformity in the language, and to lay the foundation of all sciences. The spelling-book of Noah Webster, which had been used extensively in our primary schools, had done more to produce uniformity in our language in this country than anything else. If we sent out good school-books from this institution, it would be of vast service to the country. He enlarged upon the benefits which would result to science and the diffusion of every kind of useful knowledge from an institution which would gather young men from the remotest parts of the country at the common point where every facility for practical instruction would be afforded. The taste of the country would be refined, and he did not consider this as anti-democratic. Knowledge was the common cement that was to unite all the heterogeneous materials of this Union into one mass, like the very pillars in the hall of the House before them.

Mr. Geo. P. Marsh, of Vermont, said that whatever plan was adopted must of necessity be one of compromise, and that though he would have preferred the Senate bill for a library, yet he would cheerfully accede to the present one as proposed to be modified. He regarded it as an experiment which admitted, and which he trusted would hereafter receive, great changes in its conditions rather than as a complete working model. Two objects were aimed at by Smithson: first, the *increase* of knowledge—its enlargement, extension, progress; second, the *diffusion* of knowledge—its spread, communication, dissemination. Of the various instrumentalities for carrying out this noble and imposing scheme, he considered as the simplest and most efficient the collection for public use of a library, a museum, and a gallery of art, and he preferred that for a reasonable period the entire income of the fund should be expended in this way. While appreciating the value of research and experiment in natural knowledge and the economic arts, and including them in the plan of a great national institution for the promotion of all good learning, he dissented from the doctrine implied by the bill, which confined all knowledge, all science, to the numerical and quantitative values of material things.

"Geology, mineralogy, even chemistry, are but assemblages of apparent facts, empirically established, and this would always be true of every study which rests upon observation and experiment alone. True science is the classification and arrangement of necessary primary truths according to their relations with each other and in reference to the logical deductions which may be made from them. Such science, the only absolute knowledge, is the highest and worthiest object of human inquiry, and must be drawn from deeper sources than the crucible and the retort. A laboratory is a charnel-house; chemical decomposition begins with death, and experiments are but the dry bones of science. It is the thoughtful meditation alone of minds trained and disciplined in far other halls that can clothe these with flesh and blood and sinews, and breathe into them the breath of life."

Mr. Marsh then showed the importance and value of a great library, and gave illustrations from his extensive knowledge of the libraries in Europe.

Mr. Isaac E. Morse, of Louisiana, was of the opinion that Smithson was a practical man, and that, although possessed of the highest learning, he condescended to devote his time to subjects of the most domestic and homely character. If his intention had been to establish a university or a magnificent library, and thus to have his name transmitted to posterity, it would have been easy for him to have said so, and nothing would have been left to this country but to carry out his enlightened and liberal intentions. But he had no doubt studied the peculiar character of the American people, and discovered that while they entertained a proper respect for the learning and genius of the German universities and of the sciences taught in the schools of Europe, still there was something in the common sense and practical knowledge of our people which comported with his own notions; and he desired that his money should be devoted to diffusing practical and useful knowledge among them. Mr. Morse then introduced a new bill as a substitute for that under discussion, providing mainly that "an offer be made through the newspapers of the United States and Europe of suitable rewards or prizes for the best written essay on ten subjects, the most practical and useful of which should be printed and widely distributed," thus fulfilling, in the letter and spirit, the wise and comprehensive intentions of the donor for the increase and diffusion of knowledge among men.

Mr. John S. Chipman, of Michigan, spoke earnestly in opposition to the bill. He thought that our great and powerful government, prospering and progressing as it was in original native intellect, fostered by institutions known to no other country and no other people, should not have consented to be the recipient of what was called a munificent donation of half a million from an Englishman to enlightened American republicans in this country. "How did it happen," he exclaimed, "that this government accepted such a boon from a foreigner—an Englishman too!"

After further debate, Mr. Adams moved that until the arrears of interest due from the States in which the money of Smithson had been invested were paid, no appropriation should be made by Congress for the fulfillment of the purposes prescribed by the testator.

Mr. A. D. Sims, of South Carolina, thought that he saw in the will of Smithson only what he had observed in other instances. "After having griped through their lives every shilling that came into their hands, animated at last by some posthumous vanity, they sought to build up a name which should live after them; and such, rather than any feeling for humanity, was the motive that guided them." He then proceeded to contend that the Government of the United States was not instituted for any such purpose as the administration of charities. He would introduce a bill repealing all laws heretofore enacted on this subject and giving authority and direction for the restoration of the money to the British chancery, where it could be devoted to purposes in England similar to those which had been contemplated in the city of Washington. The only difference would be in the location of the institution.

Mr. Adams proceeded to explain and advocate his substitute, and maintained that in the administration of this fund there were two or three principles that should be observed. One was, that it should never cost the people of the United States a dollar—that it should support itself; another, that no part should ever be applied to the ordinary purposes of education. It was unworthy the people of the United States to receive foreign aid for this purpose. There was no way in which the States could more degrade themselves than by relying on foreign aid or on the General Government for the education of their children.

"But an experience of eight or ten years, since we received this money, had shown him that whenever distinguished scientific men were called upon for their opinions, scarcely two agreed.

"In addition to the application of a certain part of this fund to the science of astronomy, there was another provision which he found, and which he was happy to see this bill made, viz, that no portion of the fund should be appropriated—that it should be a perpetual fund. It was the interest which was to be applied.

"But in the mean time, while this delay had taken place, he was delighted that an astronomical observatory—not perhaps so great as it should have been—had been smuggled into the number of the institutions of the country under the mask of a small depot for charts, &c.

"He claimed no merit for the erection of the astronomical observatory; but in the course of his whole life no conferring of honor, of interest, of office, had given him more delight than the belief that he had contributed, in some small degree, to produce these astronomical observatories, both here and elsewhere. He no longer wished any portion of Smithson's fund applied to an astronomical observatory.

"Nor did he think it important to the people that any provision of this bill should be carried into effect immediately, but rather that measures should be taken to induce the States to pay the interest on their bonds, and then let the money be appropriated to any purpose on which Congress could agree more unanimously than on this bill."

Mr. Andrew Johnson, of Tennessee, was opposed to taking any money out of the Treasury of the United States to establish such an institution.

Mr. George Rathbun, of New York, did not feel disposed to object to any plan with seeming plausibility. He was in favor of expending the money in some way and upon some scheme, faithfully and honestly, but, above all, he was in favor of appropriating the money whether the final result should be good or not. He wished to wipe out the stain which rested on the character of this Government of withholding the money because we were not able to discover the best mode of expending it. In his judgment, a library was the least plausible of any of the schemes proposed.

Mr. Orlando B. Ficklin, of Illinois, opposed the bill. He thought however that the good faith of the Government required that this money should be considered as being in the Treasury, and that we could not excuse ourselves by saying that the fund had been loaned out to the States and could not now be realized. He objected, however, to the connection proposed to be established between this institution and the United States Treasury. A million of dollars would be required to meet the deficiency in this Smithsonian bequest. He was willing to expend the money for a library, and for scientific apparatus, or for any plan by which the fund could be disconnected from the Government. He regarded Mr. Owen's bill as one of the most odious and abominable ever presented, and he would rather see this half million returned to the British court of chancery, or ten millions sunk to the bottom of the Potomac, than to have this bill pass.

Mr. Allen G. Thurman, of Ohio, made inquiries respecting the original investment of the fund, and then discussed the duties of a trustee. He could not vote for the bill unless it were most materially changed. He was opposed to the erection of an immense institution at the city of Washington, that would ultimately become a charge upon the Treasury and would necessarily be partial in its operations and benefits. He was inclined to favor the library plan, although there were great objections to it. But "there was one recommendation it possessed that strongly influenced him. That was, that though it might not effect the greatest amount of benefit that could be produced by the fund, it was not liable to the abuses to which all the other plans would probably give rise. It would create no large body of office-holders, no patronage, no favoritism, no partially sectional advantages."

Mr. Owen replied to Mr. Adams, and showed that the position of the latter as to the condition of the fund was entirely inconsistent with the reports and bills he had so often presented. He was not specially wedded to the feature of normal schools, although he believed it was the most important one in the bill. As to the disgrace of educating our children with foreign aid, there was no proposition in this bill to educate children, but the teachers of children. And as to disgrace, it might be said with equal propriety that it was disgraceful to receive foreign aid for founding a library.

Mr. Andrew Johnson renewed his attack on the bill:

"There was something a little farcical and amusing [to him] in this system of normal instruction, which was to provide the country with school teachers. He would like to see a young man, educated at the Smithsonian Institution and brought up in all the extravagance, folly, aristocracy, and corruption of Washington, go out into the country to teach the little boys and girls to read and write! Those young men, so educated, would steal, or play the little pettifogger, sooner than become teachers. Ninety-nine out of a hundred of those who received the benefit of this institution would hang about a law-office, get a license, become a pack of drones instead of schoolmasters. Washington City was not a place for such an institution. He believed that it would result in an injury to the country instead of a benefit."

Mr. John Bell, of Tennessee, held that the United States was responsible for the fund and ought to appropriate it for its object. He hoped that Arkansas would one day pay the money, but he feared it would be a distant day. It was necessary to act now. He did not wholly approve of the bill reported, but he would take it rather than do nothing.

Mr. Hannibal Hamlin, of Maine, regarded this fund as one which had been received by the Government to carry out the intentions of Mr. Smithson, and to which, by their acceptance, they had solemnly bound themselves. He alluded to the difficulty—nay, the impossibility—of any select committee agreeing upon a plan which, in all its details, should be in accordance with the views of all. Notwithstanding this, he trusted we should not let this opportunity go by to make a commencement in this matter. He had not the slightest doubt of the full and unqualified power of this Government to take charge of this money and give it the direction required by the will of Mr. Smithson.

While there were features in the bill with which he was not entirely pleased, he should vote for the bill in case it was not amended. But there were some amendments to the bill of the gentleman from Indiana [Mr. Owen] to which he would fain hope that gentleman himself would lend a favorable ear. One related to the appropriation of a part of it to the science of agriculture. He referred to the general and deplorable want of information of the components of the soil, the proper mode of treating it, the proper adaptation of crops to different soils, &c., and said he wished to see connected with this institution a department of agricultural chemistry and a professor of agriculture proper.

Mr. Bradford R. Wood, of New York, said that if ever there was a point in which the national honor was concerned, it was in carrying out the intentions of the testator in his bequest. He considered it an honor to the country that the subject of a monarchical government should have selected this as the instrument of his expansive benevolence. He thought normal instruction should be left to the States, but responded heartily to Mr. Hamlin's suggestion in relation to agricultural instruction. He would do all he could to increase and diffuse useful knowledge among the masses, but this could not and would not be attained by such education as would be obtained here, or by collecting at this point a splendid library. The latter might, and unquestionably would, benefit those already learned, but not the people.

Mr. William F. Giles, of Maryland, proposed an amendment, providing for the publication and distribution of books for the instruction of the blind.

Mr. W. W. Wick, of Indiana, discussed the duties of a trustee, and took the ground that the Government of the United States had no discretion in this case as to the mode of investment of the funds. There was no power given by the will of Smithson to invest the money in any special manner, and the Government invested it at its own hazard. If, of his own accord and without authority, a trustee made an investment, he was responsible for it. Thus the United States stood in relation to this matter, and to this extent they were responsible, if at all. The honor of the country should be sustained by the faithful execution of the trust.

Mr. Washington Hunt, of New York, entirely concurred with Mr. Wick's view of the subject. It was a reproach to the government to delay carrying out the purposes of this trust.

At length, after a full and exhaustive debate for two days, the House proceeded to vote on the bill and amendments. The normal school section was stricken out, on motion of Mr. Adams, by a vote of 72 to 42; the provision for professors and lecturers by 77 to 42, as also that for students. Mr. Jones's amendment, to return the money to England, received 8 votes in the affirmative to 115 in the negative. Mr. Adams's proposition, to defer the organization of the institution until the State of Arkansas could be induced by "moral suasion to pay up its indebtedness for interest," was voted down by 74 to 57. The provision for lectures was negatived by 72 to 39, while the annual appropriation for a library was increased, on motion of Mr. Marsh, from $20,000 to $25,000. The sections requiring experiment and research in agriculture, manufactures, &c., the publication of books, pamphlets, tracts, &c., and the offering of prizes for essays, were stricken out. An amendment that all copyright books, maps, charts, prints, &c., should be delivered to the institution was adopted, and also one that the Government collections deposited in it should be known as the National Museum.

Before a vote was taken on the bill as amended, a substitute for it was introduced by Mr. William J. Hough, of New York, retaining most of the features already agreed upon, and this was passed in the Committee of the Whole by a vote of 83 to 40. It was then reported to the House, and passed by a vote of 85 to 76.*

Among the prominent men in the affirmative were John Q. Adams, John Bell, Garret Davis, Jefferson Davis, Columbus Delano, Stephen A. Douglas, Solomon Foot, Joshua R. Giddings, Hannibal Hamlin, H.W. Hilliard, George P. Marsh, R. D. Owen, F. P. Stanton, A. G. Thurman, Samuel F. Vinton, David Wilmot.

Among the nays were Howell Cobb, R. M. T. Hunter, J. R. Ingersoll, Andrew Johnson, George W. Jones, Preston King, Alexander H. Stephens, and Jacob Thompson.

On the 10th of August, 1846, the Senate proceeded to consider this bill; amendments proposed were disagreed to, and it passed without debate by 26 to 13. The yeas were, Messrs. Archer, Atchison, Barrow, Berrien, Cameron, Cilley, Thomas Clayton, John M. Clayton, Corwin, Davis, Evans, Greene, Houston, Huntington, Jarnagin, Johnson of Maryland, Johnson of Louisiana, Lewis, Mangum, Miller, Morehead, Phelps, Speight, Spurgeon, Upham, Webster.

Those who voted in the negative were, Messrs. Allen, Ashley, Atherton, Bagby, Benton, Calhoun, Dickinson, Fairfield, McDuffie, Semple-Turney, Westcott, Yulee.

The bill was signed by President James K. Polk on the 10th of August, 1846, and became a law, and the Smithsonian Institution was organized under it with the following Board of Regents:

Hon. GEO. M. DALLAS, of Pennsylvania, *Vice-President of the United States, ex officio.*

Hon. ROGER B. TANEY, of Maryland, *Chief Justice of the United States, ex officio.*

Hon. WILLIAM W. SEATON, *Mayor of the city of Washington, ex officio.*

Hon. GEORGE EVANS, of Maine; Hon. ISAAC S. PENNYBACKER, of Virginia; Hon. SIDNEY BREESE, of Illinois, *of the United States Senate,* appointed by President of the Senate.

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* The Congressional proceedings and debates in relation to the Smithson bequest are reprinted in full in the Smithsonian Miscellaneous Collections, No. 328, 1879. "The Smithsonian Institution: *Documents relative to its origin and history.*" Edited by William J. Rhees. 1027 pp., 8°. 1879.

Hon. WILLIAM J. HOUGH, of New York; Hon. ROBERT DALE O of Indiana; Hon. HENRY W. HILLIARD, of Alabama, *of House of resentatives*, appointed by the Speaker.

Hon. RUFUS CHOATE, of Massachusetts; Hon. GIDEON HAW of New York; Hon. RICHARD RUSH, of Pennsylvania; Hon. WIL C. PRESTON, of South Carolina, *citizens of States*, elected by Con

ALEXANDER DALLAS BACHE, *Member of the National Institute* SEPH G. TOTTEN, *Member of the National Institute, citizens of Was ton*, elected by Congress.

APPENDIX.

NOTE 1.

OBITUARY NOTICE OF JAMES SMITHSON.

(From the Gentleman's Magazine.)

"*Oct.* 1829.—Died: In the south of France, James Smithson, esq., M. A., F. R. S.

"The birth of this gentleman is thus described by himself at the commencement of his will: 'I, James Smithson, son of Hugh, first Duke of Northumberland, and Elizabeth, heiress of the Hungerfords of Studley, and niece to Charles, the proud Duke of Somerset.'

"It is well known that the *wife* of Hugh, first Duke of Northumberland, was Lady Elizabeth Seymour, *grand-daughter* of the same 'proud Duke of Somerset.' It was the Hon. Frances Seymour, daughter of Charles, Lord Seymour, of Troubridge, by his first marriage with Mary, daughter and heiress of Thomas Smith, esq.—and thus half sister to the fifth and sixth Dukes of Somerset, the latter of whom was 'the proud duke'—that was married to Sir George Hungerford; but in the account of the family in Sir R. C. Hoare's Hungerfordiana we find no Elizabeth, nor the name of Macie, which was that which Mr. Smithson originally bore. The family of Macie resided at Weston, near Bath.

"James Louis Macie, esq. [the subject of the present notice], was a member of Pembroke College, Oxford, where he was created M. A. May 26, 1786. He was elected Fellow of the Royal Society in 1787, and appears under the same name in the Philosophical Transactions for 1791; but between that date and 1803 he chose to change his name to Smithson, although he continued to enjoy the property of the Macies. He was, we believe, at one time a vice-president of the Royal Society."*

NOTE 2.

ACCOUNT OF THE FIRST DUKE OF NORTHUMBERLAND.

(Father of James Smithson.)

"Sir Hugh Smithson was one of the handsomest men in England. He possessed much talent, a highly-cultured intellect, and more learning than is generally found among the nobility. His parents, though of gentle blood, did not belong to the nobility. He had raised himself by his marriage with the heiress to the name and fortune of the house of Percy, and he showed that he was worthy of both."

[His matrimonial alliance had somewhat of a romantic origin. Sir

* *Gentleman's Magazine*, March, 1830, vol. c, p. 275.

Hugh had been unsuccessful in a first courtship, and the story of his disappointment reached the ears of Lady Elizabeth Seymour, only daughter of Algernon Seymour, Baron Percy, who was at that time considered, on account of her birth, wealth, and beauty, the greatest prize in the kingdom. Lady Percy expressed to some of her friends 'surprise that any woman should have refused the hand of such a man as Hugh Smithson.' These words soon became known to the rejected baronet, and wrought a change in his feelings and aspirations. He became the suitor of the fair and noble heiress, and married her on the 16th of July, 1740.]

"By his wise economy he improved the immense estates of this family, and increased their value to such an extent that the revenues from them amounted to over forty thousand pounds. He re-established the old grandeur of the Percys by his taste and splendor. The castle of Alnwick, the former residence of the Earls of Northumberland, was entirely ruined. He rebuilt it, and to please the duchess, his wife, he ornamented it in the Gothic style, which he himself did not admire; but he exercised so much taste that he made the castle one of the most magnificent buildings of this kind to be found anywhere in Europe. He improved Sion, a country-house in the environs of London; and he exhausted the resources of all the arts, and of unusual wealth, to fill these two mansions with master-pieces of good taste, and to render them worthy of their possessors. He was created an earl, had the order of the Garter conferred on him, and was afterwards appointed viceroy of Ireland; finally, he was raised to the rank of a duke, and upheld these high positions by an expenditure unequaled at that time.

"The Duchess of Northumberland was of the very highest birth, descending from Charlemagne through Joscelin de Louvain, who had married Agnès de Percy in the year 1168. She brought to her husband, as her marriage portion, several peerages, the name and coat-of-arms of the Percys, and an immense income. She was very high-minded, and of a natural and easy disposition; she was very good-hearted and charitable; above all, she was truly attached to her friends, whom she distinguished and served whenever an opportunity offered.

"The duke was fond of arts and sciences, so I entered into his tastes, discussing all these subjects with him, in which he found that I was well versed, and that he could converse with me on more topics than with any one else. The duchess, on the contrary, had a predilection for little 'jeux d'esprit' in the company of friends, and she found amusement in gathering together engravings, medals, and in collecting a variety of other things. I joined in these pursuits as if I had made them the business of my previous life. In the evening I took part in her social games, and made myself useful to her in her amusements, the only interruption to my attentions being a short trip to Paris."*

From the Gentleman's Magazine for July, 1786, we also learn that "The establishment of his Grace was as magnificent as it was possible for any English nobleman's to be. He had at all times three mansion-houses—and of late four—in occasional use. He spent immense sums in different sorts of very costly decorations; pictures by every master; gardening by Browne; buildings by Adams. . . . More than fifteen

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*[L. Dutens.] "*Mémoires d'un voyageur qui se repose;* contenant des anecdotes historiques, politiques et littéraires relatives à plusieurs des principaux personnages du siècle. Par M. L. D. Troisième édition. 3 vols. 8°. Londres, 1807." Vol. i, pp. 226–228. (This book is in Smithson's library.)

years ago he was able to purchase the property on which Lord Percy had his seat, in Yorkshire; and a few years ago, the mansion, manors, and boroughs of Humphrey Morice, in the West, all were sold to the Duke. In short, the rental, with the dukedom, he left at about 50,000 pounds, and to his second son 10,000 pounds per annum. The duke had negotiated a further improvement of the Northumberland estate, but did not live to see it completed."*

On the death of the Duke of Northumberland, the following obituary notice was given in the same magazine:

"June 6, 1786. At eight o'clock this morning, died at Sion House, in his 74th year, the Most Noble Hugh, Duke and Earl of Northumberland, Earl Percy, Baron Warkworth and Louvaine, Lord Lieutenant and Custos Rotulorum of the counties of Middlesex and Northumberland, and of the town and county of Newcastle-upon-Tyne, Knight of the Most Noble Order of the Garter, and Baronet; who with a princely fortune, sustained his exalted rank through life with the greatest dignity, generosity, and splendor, and will ever be considered as one of the first characters of that age of which he constituted so distinguished an ornament. We are well informed that his annual income was not less than 45,000 l. per annum. His Grace's extensive charities to the poor, his constant encouragement of literature and the polite arts, and his generous patronage of every kind of merit, make his death truly a public loss, and will cause it to be long and sincerely lamented. His Grace was the son of Langdale Smithson, esq., and Philadelphia, daughter of W. Reveley, esq., of Newby, co. York. Upon the death of his grandfather (Sir Hugh Smithson, of Stanwick, Bart.), which happened in 1729, he succeeded to the title of baronet, and to his grandfather's estate; and upon the death of his relation Hugh Smithson, esq., of Tottenham, he came into the possession of other estates in Yorkshire and Middlesex; and also succeeded his relation as knight of the shire for the county of Middlesex, which he represented in three parliaments. Upon the death of his father-in-law, Algernon, Duke of Somerset, whose daughter he had married, he succeeded to the title of Earl of Northumberland, the Duke having been created Earl of Northumberland upon his daughter's marriage, with remainder to her husband, and their issue, after the Duke's death. The reason of this creation was as follows: The Duke's mother (whose third husband was the Duke's father) was daughter and sole heiress of Joscelin, the last Earl of Northumberland, which title was become extinct. Being so great an heiress she was married three times while a minor. First, to the Earl of Ogle, who died in a short time after, leaving no issue. She was next married to Thomas Thynne, esq., of Longleate, co. Wilts, but he was assassinated in Pall Mall by some ruffians hired by Count Coningsmarck, whose object was to marry the widow. Her third husband was the Duke of Somerset, and she was still a minor, as was also the Duke, by whom she had the above Algernon, who succeeded his father as Duke of Somerset, and possessed all the Percy estates. He married Miss Thynne, granddaughter of the first Lord Weymouth, and by her had one son and one daughter. The son died unmarried, and the daughter married in 1740 the subject of this article, then Sir Hugh Smithson. The title of Somerset going to another branch of the Seymour family, the title of Northumberland was revived to the Duke's daughter in consideration of her

* *Gentleman's Magazine*, 1786, vol. lvi, p. 617.

descent from the daughter of Joscelin the last Earl of Northumberland. The Percy estate also settled in her, together with several baronies, such as Percy, Lucy, Poynings, Fitz-Payne, Bryan, &c. The Duke of Somerset dying in 1750 Sir Hugh Smithson immediately took his seat in the House of Lords as Earl of Northumberland. In 1752 he was appointed one of the Lords of the Bed-chamber to the late King. In 1757 he was installed Knight of the Garter at Windsor. In 1762 he was appointed Lord Chamberlain to the Queen, and a Privy Counsellor; also Lord Lieutenant of the counties of Middlesex and Northumberland. In 1763 he was appointed Lord Lieutenant of Ireland. In 1766 he was created Duke of Northumberland. In 1778 his Grace was appointed Master of the Horse, which he resigned in 1781. On Dec. 5th, 1776, which was her birthday, his Duchess died, when she had completed her sixtieth year. She was interred in her family vault in St. Nicholas chapel, Westminster Abbey. They had two sons and one daughter."*

The funeral of the Duke of Northumberland, whose death occurred ten years later, was celebrated with great pomp on the 21st of June, 1786, and his remains were also interred in Westminster Abbey with the following imposing list of titles and dignities inscribed on his coffin.

COFFIN-PLATE INSCRIPTION OF HUGH SMITHSON.

(Father of James Smithson.)

"The most high puissant & most noble Prince
Hugh Percy, Duke & Earle of Northumberland
Earl Percy Baron Warkworth & Lovaine & Bar^{t}
Lord Lieutenant & Custos Rotulorum of the
Counties of Middlesex & Northumberland, of
the City & Liberty of Westminster & of the
Town & County of the Town of Newcastle
upon Tyne, Vice Admiral of the County of
Northumberland & of all America, one of
the Lords of his Majesty's most Hon^{ble}
Privy Council, & Knight of the most noble
Order of the Garter.
Died on the 6th Day of June 1786,
In the 74th Year of his Age."†

NOTE 3.

ACCOUNT OF EARL PERCY, SECOND DUKE OF NORTHUMBERLAND.

(Half brother of James Smithson.)

The first Duke of Northumberland had one daughter, who died unmarried, and two sons—Hugh and Algernon (half brothers of James Smithson)—of whom the elder succeeded his father as the second Duke

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* *Gentleman's Magazine*, 1786, vol. lvi, pp. 529, 530.
† *Miscellanea Genealogica et Heraldica*, London, 1868, p. 271.

of Northumberland. This son was born August 25, 1742, and married, in 1764, Anne, daughter of John, Earl of Bute, but had no issue. The marriage was dissolved, by act of Parliament, in 1779, and in the same year the duke married Miss Frances Julia Burrell, of Beckenham, Kent, by whom he had five daughters and two sons.

Earl Percy, the second Duke of Northumberland, served in the Continental wars under Prince Ferdinand of Brunswick; came to Boston, 1774, in charge of a brigade; commanded the re-enforcements at the battle of Lexington, April 19, 1775; and led the column that reduced Fort Washington, at King's Bridge, near New York, November 16, 1776. He returned to England in May, 1777, devoted himself to improving his estates, died July 10, 1817, and was buried with great pomp in Westminster Abbey.

Of this Earl Percy an oil portrait has recently been presented to the town of Lexington, Massachusetts, by his grandnephew, Algernon George, the sixth and present Duke of Northumberland. The presentation was made through the Rev. Edward G. Porter, of Lexington, who was a guest at the duke's castle in 1879, and was permitted, during his visit, to make extracts from the Percy family papers, especially from the letters written home by Earl Percy during his American experiences. In one of these letters, dated Boston, July 5, 1774, Percy told his parents that the people were very hot-headed and that he feared trouble. On the 27th of the same month he wrote that, owing to the absence of General Gage at Salem, he had been commander-in-chief of the camp at Boston. He also inclosed a view of the town of Boston and the camp, and conveyed the information that the people say much and do nothing. He advised a steadfast government, as the people are worthy subjects, who talk as though they would wipe out the troops every night, but are frightened to death when they see them. The clergy were spoken of as teachers of sedition of the most virulent type. Another letter to his father was dated August 15, 1774, and in this Percy described the scenery around Boston as having the appearance of a park finely laid out. This beauty he considered to be offset by the poverty of the soil, which, in his opinion, was overtilled and scantily fertilized. In this letter symptoms of trouble in the country were noted, and the writer professed his determination to do his whole duty wherever he might be called upon to serve rather than seek preferment where it might most easily be obtained—at the Court of St. James. In a subsequent letter to General Howe, at London, he wrote his serious apprehension of bloodshed and his belief in the necessity of strong government. From the Congress at Philadelphia he said he looked for either a wrangle among its members or for the origin of serious business for the home government. To his father, also, he wrote in the same strain. On the 20th April, 1775, Percy reported to General Gage about the march to Lexington. There, Percy says, he met the troops retreating from Concord, and he ordered two field-pieces to be trained upon the rebels from the heights. The shot from the cannon dispersed them. As the British had but little ammunition, and were fifteen miles from Boston, they were ordered by him to return. They were pressed severely by the rebels until they reached Charlestown, many men being killed. Percy attributed to the rebels cruelty and barbarity, writing that they scalped and cut off the ears of the wounded troops, showing that the British, too, believed that their opponents were cruel and barbarous. Percy, after this disastrous retreat, was of the opinion that the colonists were not an irregular mob, but determined men, accustomed to fight the French and the Indians. The road to Charlestown, Earl Percy said, was taken for the retreat, as it was feared that the rebels, as they actually did, would have destroyed the bridge over the Charles River. In a letter referring to Bunker Hill, Percy mentions the death of Dr. Warren and that of Major Pitcairn. While Percy was in America he was advanced in rank to be a lieutenant-general, yet he was anxious to return home, and he was allowed to do so near the close of the war. He was the first to suggest making peace with the colonists, and he was selected as minister plenipotentiary to secure such an end. Owing to dissensions in the British cabinet, he delined that honor and retired to private life.

NOTE 4.

NOTICES OF SMITHSON'S PAPERS,

On Tabasheer and Calamine.

(I. From the London Monthly Review.)

"The first paper is an account of tabasheer, an article of importance in the *materia medica* of the ancient Arabians, and still a medicine of great note in many parts of the East, though neither the substance itself nor its origin were known in the Western World. Dr. Russell ascertained it to be a natural concretion from the juice of the bamboo cane, and accordingly it is distinguished in different oriental languages by names signifying bamboo milk, bamboo camphor, and salt of bamboo. Dr. Russell had many green canes brought to him at Madras, and on splitting them, found some joints full of a watery liquid, some with the fluid much diminished and in different states of consistence, and others with some grains or particles of tabasher, either loose, in which case the reeds containing it are known by a rattling sound on shaking them, or adhering to the extremities or sides of the cavity. The quantity of the tabasheer appears to be very inconsiderable, the whole produce of twenty-eight reeds from five to seven feet long, not much exceeding two drachms."*

The following account of his paper in the Philosophical Transactions is given in the Monthly Review for January, 1792, vol. vii, pp. 75, 76.

"We have seen in a former paper that tabasheer is a vegetable production, formed by spontaneous concretion from a fluid in the cavities of the bamboo cane. Its chemical constitution, however, is very different from what might be expected in a body of such an origin. The experiments of Mr. Macie, very judiciously executed, and here stated in detail, show it to be a siliceous earth, nearly the same thing with common flint that has been attenuated by artificial solution.

"Neither water, alcohol, nor acids will act on it, but by imbibing water it becomes transparent; the white bits in a low degree, the bluish nearly as much so as glass. It dissolves (as the precipitate from liquor silicum does) in caustic alcaline lixivium; and the solution (like the liquor silicum itself, or the precipitate redissolved) becomes gelatinous on exposure to the atmosphere. In the fire it becomes harder, more compact, and diminished in volume, without any loss of weight, except of a little moisture, which it soon recovers from the air. With two-thirds of its weight of fixed alkali, in a platina crucible, it ran into a transparent glass; phosphorated ammoniac and litharge readily acted on

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* *Monthly Review* for September, 1791, vol. vi, p. 16.

it; borax more difficultly. It melted, also, at the blow-pipe, where the ashes of the coal happened to touch it, or when rubbed over with calcareous earth; and this appears to be the only property in which it differs materially from flint. This fusibility with calcareous earth, and its contracting and hardening in the fire, might lead us to suspect an admixture of argillaceous earth; but no traces of that earth were discovered by the usual process with vitriolic acid.

"The experiments from which these general results are extracted were made on the finest tabasheer that could be purchased at Hydrabad. Several other specimens were examined, and all the genuine sorts were found to consist of the same earth. That which was taken immediately from the cane became black in the fire from some admixture of vegetable matter, but as soon as the blackness disappeared it was in all respects similar to the foregoing, so that the tabasheer of Hydrabad may be presumed to have suffered a degree of calcination before its exposure to sale.

"That a siliceous earth exists in vegetables is evident from their ashes. Mr. Macie obtained a small portion of this earth from the ashes of charcoal, but found it far more abundant in those of the bamboo cane. He mentions a singular circumstance respecting this vegetable which occurred after his experiments were finished:

"A green bamboo cut in the hot-house of Dr. Pitcairn, at Islington, was judged to contain tabasheer in one of its joints from a rattling noise discoverable on shaking it, but being split by Sir Joseph Banks, it was found to contain not ordinary tabasheer, but a solid pebble about the size of half a pea, so hard as to cut glass."

(II. By Sir Humphrey Davy. From the Journal of the Royal Institution.)

On the 18th of November, a paper, by James Smithson, esq., F. R. S., on the chemical analysis of some calamines, was read.

Much uncertainty has hitherto prevailed on the subject of the composition of calamines. The author was induced to carry on his researches by the hopes of obtaining a more certain knowledge of these ores, and he considers his results as fully proving the necessity for new investigations, and that the opinions which had been adopted concerning them were far removed from the truth. Mr. Smithson's experiments were made upon four different kinds of calamine: the calamine of Bleyberg, that of Somersetshire, that of Derbyshire, and the electrical calamine.

The calamine from Bleyberg was white, and had a stalactitical form; its specific gravity was 3.584. It became yellow under the blowpipe; and when exposed to the heat of the interior blue flame was gradually dissipated. It dissolved with effervescence in sulphuric acid, muriatic acid, and acetous acid. It lost by heat rather more than one-fourth of its weight. It afforded oxide of zinc, carbonic acid, and water, in the proportion of 714, 135, and 151; there was besides found in it a minute portion of the carbonates of lead and lime; but these the author considers as accidentally mixed with the ore, and not in combination with the other ingredients.

The calamine from Somersetshire was of a mammillated form. Its color was brown externally and greenish yellow internally; its specific gravity was 4.336. It dissolved in sulphuric acid, with effervescence: and when analyzed by means of reagents, afforded in 1,000 parts, 352 of carbonic acid, and 648 of oxide of zinc.

The Derbyshire calamine was in small crystals, of a pale yellow color; their specific gravity was 4.333. When analyzed, by solution in sulphuric acid, and the action of heat, 1,000 parts of them were found to contain, of carbonic acid 348, of oxide of zinc 652.

The electrical calamine, which Mr. Smithson examined, was from Regbania, in Hungary. It was in the form of regular crystals; the specific gravity of which was 3.434.

They became electrical by heat, and when exposed to the flame of the blowpipe decrepitated and shone with a green light. The electrical calamine differs materially in composition from the other specimens, in being formed chiefly of quartz and oxide of zinc, which, according to the author, are in chemical union. One thousand parts of it gave 250 parts of quartz, 683 of oxide of zinc, and 44 of water; the loss being 23 parts.

From his series of experiments on the calamines, Mr. Smithson has been able to deduce, with a considerable degree of accuracy, the composition of sulphate of zinc, which, when free from combined water, he considers as composed of equal parts of sulphuric acid and oxide of zinc.

In reasoning generally upon the constitution of salts of zinc, Mr. Smithson offers some new observations in relation to affinity; and he thinks that the proximate constituent parts of bodies are not absolutely united in the remote relations to each other, usually indicated by analyses, but that they are universally very considerable parts of the compound, probably seldom less than 2. He applies this theory in accounting for the presence of water in the calamine of Bleyberg, in which there is not sufficient carbonic acid to saturate the oxide of zinc; and he considers this ore as probably composed of a peculiar combination of water with the oxide of zinc, which he names hydrate of zinc, and of carbonate of zinc to each other in the proportions of 3 to 2.

All the calamines, when long exposed to the heat of the blowpipe, are dissipated, with the production of white flowers. This circumstance, the author thinks, ought not to be attributed to an immediate volatilization of the oxide of zinc, but rather to the deoxidation of this substance by the charcoal and combustible matter of the flame, and the consequent immediate sublimation and combustion of the metallic zinc, to which combustion the phosphorescence of calamines under the blowpipe may be owing.

The fibrous form of the flowers of zinc, produced during the action of the blowpipe upon calamine, Mr. Smithson attributes to the crystallization taking place during their mechanical suspension in the air; and he thinks that the fluid state is not at all necessary to the production of crystals, and that the only requisite for this operation is a freedom of motion in the masses which tend to unite, allowing them to obey that sort of polarity which occasions them to present to each other the parts adapted to mutual union.*

NOTE 5.

ILLUSTRATIONS OF PRESENTATION OF BOOKS BY SCIENTIFIC AUTHORS TO SMITHSON.

"Mr. Smithson. Hommage respectueux de l'auteur."
Nouveau système de minéralogie. Par J. J. Berzelius. Paris, 1819.

"Mr. Smithson. Hommage de l'auteur, Gay-Lussac."
Mémoire sur l'iode. 1814.

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* *Journal of the Royal Institution* of Great Britain, 1802, Vol. 1, p. 299.

"M. Smithson. From the translator."
Observations on the mineralogical and chemical history of the fossils of Cornwall. By M. H. Klaproth. Translated by Dr. John Gottlieb Groschke. London, 1787.

"M. Smithson. From the author."
Chemical account of various dropsical fluids. By Alex. Marcet. 1811.

"M. Smithson. From the author."
Letters to Sir Joseph Banks, president of the Royal Society, on the subject of cochineal insects discovered at Madras. By James Anderson, M. D. 1788.

"Mons. de Smithson. Hommage de l'auteur."
Mémoire sur la montagne de sel gemme de Cardonne en Espagne. Par P. Louis Cordier.

"À Mons. Smithson, de la Société royale de Londres. Hommage de l'auteur."
Observations sur la simplicité des lois auxquelles est soumise la structure des cristaux. Par M. Haüy.

"À Mons. de Smithson. Hommage de l'auteur."
Mémoire sur les substances minérales dites en masse qui entrent dans la composition des roches volcaniques. Par P. Louis Cordier.

"Mons. Smithson. De la part de l'auteur."
Mémoire sur les pierres météoriques. Par M. Fleurian de Bellevue. 1820.

"À Monsieur Smithson, amateur éclairé de la chimie et de la minéralogie. Hommage respectueux de l'auteur de cet opuscule, J. A. H. Lucas, membre des sociétés géologique de Londres et Wernerienne d'Edimbourg."
De la minéralogie. 1818.

"Mr. Smithson. From the author."
On some of the combinations of oxymuriatic gas and oxygene, and on the chemical relations of these principles to inflammable bodies. By Humphrey Davy, esq., LL. D. London, 1811.

NOTE 6.

APPRECIATION OF SMITHSON BY BERZELIUS.

Berzelius makes the following honorable mention of Smithson:

"Dans mon *Essai pour établir un système électro-chimique*, avec une nomenclature appropriée (Journal de Physique, Ann. 1811), j'ai fait mention des combinaisons de silice avec les autres oxides, comme de sels que j'ai nommés silicates. Il eût sans doute été prématuré alors d'essayer de diriger davantage l'attention vers les silicates minéralogiques, parce que le cahos où se trouvaient ces derniers eût servi plutôt à prévenir contre de pareilles idées, surtout comme la nature de ce traité ne comportait pas une exposition plus étendue du sujet. J'ai appris depuis, avec une vraie satisfaction, que M. Smithson, l'un des minéralogistes les plus expérimentés de l'Europe, sans avoir eu connaissance de mon Essai, a publié une idée semblable dans un Mémoire [Feb. 9, 1811] sur la nature de la natrolite et de la mésotype. On ne pourra disconvenir qu'une pareille coïncidence dérivée d'une part de la chimie seule, et de l'autre d'un point de vue d'analyse minéralogique, ne fournisse une preuve trèsforte de la justesse de l'idée, ce qui me fait espérer qu'aucun minéralogiste, au courant de l'état actuel de la chimie, ne conservera des doutes."*

Berzelius gives in his "Systematic enumeration of minerals": "*Zinc carbonate.* ZnC^2. Smithson, Phil. Trans., 1803, 17."†

Under *Zinc calamine*, he says:

"Nous devons la connaissance de la composition, tant des carbonates que du silicate de l'oxide de zinc, à un excellent travail de M. SMITHSON, inséré dans les Transact. phil., 1803."‡

NOTE 7.

EXTRACTS FROM SMITHSON'S WRITINGS.

The following extracts from Smithson's papers illustrate his breadth of view and style of composition:

"A knowledge of the productions of art, and of its operations, is indispensable to the geologist. Bold is the man who undertakes to assign effects to agents with which he has no acquaintance, which he never has beheld in action, to whose indisputable results he is an utter stranger, who engages in the fabrication of a world, alike unskilled in the forces and the materials which he employs."§

"More than commonly incurious must he be who would not find delight in stemming the stream of ages, returning to times long past, and beholding the then existing state of things and of men. In the arts of an ancient people much may be seen concerning them, the progress they had made in knowledge of various kinds, their habits, and their ideas on many subjects. And products of skill may likewise occur, either wholly unknown to us, or superior to those which now supply them.||

"A want of due conviction that the materials of the globe and the products of the laboratory are the same, that what nature affords spontaneously to men, and what the art of the chemist prepares, differ no ways but in the sources from whence they are derived, has given to the industry of the collector of mineral bodies an erroneous direction."¶

"No observer of the earth can doubt that it has undergone very considerable changes. Its strata are everywhere broken and disordered, and in many of them are inclosed the remains of innumerable beings which once had life, and these beings appear to have been strangers to the climates in which their remains now exist. In a book held by a large portion of mankind to have been written from divine inspiration, an universal deluge is recorded. It was natural for the believers in this deluge to refer to its action all or many of the phenomena in question, and the more so as they seemed to find in them a corroboration of the event. Accordingly, this is what was done as soon as any desire to account for these appearances on the earth became felt. The success, however, was not such as to obtain the general assent of the learned; and the attempt fell into neglect and oblivion.

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* *Nouveau système de minéralogie*, par J. J. Berzelius, Paris, 1819, p. 23.
† Same work; p. 205.
‡ Same work; p. 255.
§ On a fibrous metallic copper. *Smithsonian Miscell. Coll.*, No. 327, p. 70.
|| An examination of some Egyptian colors. *Smithsonian Miscell. Coll.*, No. 327, p. 101.
¶ On some compounds of Fluorine. *Smithsonian Miscell. Coll.*, No. 327, p. 94.

"I have yielded to a sense of the importance of the subject in more than one respect, and of the uncertainty when I shall acquire ampler imformation at more voluminous sources—to a conviction that it is in his knowledge that man has found his greatness and his happiness, the high superiority which he holds over the other animals which inhabit the earth with him, and consequently that no ignorance is probably without loss to him, no error without evil, and that it is therefore preferable to urge unwarranted doubts, which can only occasion additional light to become elicited, than to risk by silence letting a question settle to rest, while any unsupported assumptions are involved in it." *

"We have no real knowledge of the nature of a compound substance until we are acquainted with its proximate elements, or those matters by whose direct or immediate union it is produced; for these only are its true elements. Thus, though we know that vegetable acids consist of oxygen, hydrogen, and carbon, we are not really acquainted with their composition, because these are not their proximate, that is, their true, elements, but are elements of their elements, or elements of these. It is evident what would be our acquaintance with sulphate of iron, for example, did we only know that a crystal of it consisted of iron, sulphur, oxygen, and hydrogen, or of carbonate of lime, if only that it was a compound of lime, carbon or diamond, and oxygen. In fact totally dissimilar substances may have the same ultimate elements, and even probably in precisely the same proportions; nitrate of ammonia and hydrate of ammonia or crystals of caustic volatile alkali, both ultimately consist of oxygen, hydrogen, and azote. . . . .

"It is evident that there must be a precise quantity in which the elements of compounds are united together in them; otherwise, a matter which was not a simple one would be liable, in its several masses, to vary from itself, according as one or other of its ingredients chanced to predominate. But chemical experiments are unavoidably attended with too many sources of fallacy for this precise quantity to be discovered by them; it is therefore to theory that we must owe the knowledge of it. For this purpose an hypothesis must be made and its justness tried by a strict comparison with facts. If they are found at variance, the assumed hypothesis must be relinquished with candor as erroneous; but should it, on the contrary, prove, on a multitude of trials, invariably to accord with the results of observation, as nearly as our means of determination authorize us to expect, we are warranted in believing that the principle of nature is obtained, as we then have all the proofs of its being so which men can have of the justness of their theories: a constant and perfect agreement with the phenomena, as far as can be discovered." †

"If the theory here advanced has any foundation in truth, the discovery will introduce a degree of rigorous accuracy and certainty into chemistry of which this science was thought to be ever incapable, by enabling the chemist, like the geometrician, to rectify by calculation the unavoidable errors of his manual operations, and by authorizing him to eliminate from the essential elements of a compound those products of its analysis whose quantity cannot be reduced to any admissible proportion. A certain knowledge of the exact proportions of the constituent principles of bodies may likewise open to our view harmonious analogies between the constitutions of related objects, general laws, &c.,

* Observations on Penn's theory of the formation of the Kirkdale Cave. *Smithsonian Miscell. Coll.*, No. 327, pp. 103, 104.

† On the composition of the compound sulphuret from Huel Boys. *Smithsonian Miscell. Coll.*, No. 327, pp. 35, 37.

which at present totally escape us. In short, if it is founded in truth, its enabling the application of mathematics to chemistry cannot but be productive of material results."*

"The name imposed on a substance by the discoverer of it ought to be held in some degree sacred, and not altered without the most urgent necessity for doing it. It is but a feeble and just tribute of respect for the service which he has rendered to science."†

NOTE 8.

CATALOGUE OF THE LIBRARY OF JAMES SMITHSON.

Deposited in the Smithsonian Institution.

Anderson, Dr. James. Letters to Sir Joseph Banks, baronet, president of the Royal Society, on the subject of cochineal insects discovered at Madras. 26 pp. 8°. *Madras*, 1788.

Anderson, Dr. James. Letters on cochineal continued. 36 pp. 8°. *Madras*, 1789.

Anfrye et d'Arcet. Description d'un petit fourneau à coupelle. 48 pp. 8°. *Paris*, 1813.

Antilogies et fragmens philosophiques, etc. Tomes i–iv. 604, 592, 600, 600 pp. 12°. *Amsterdam*, 1774.

Baker, Henry. The microscope made easy. 340 pp. 8°. *London*, 1743.

Becquerel, A. C. Expériences sur le développement de l'électricité par la pression; lois de ce développement. 32 pp. 8°. *Paris*.

Becquerel, A. C. Sur les fils très-fins de platine et d'acier; et sur la distribution du magnétisme libre dans ces derniers. pp. 33–52. 8°. *Paris*.

Bellevue, Fleurian de. Mémoire sur l'action du feu dans les volcans, ou sur divers rapports entre leurs produits, ceux de nos fourneaux, les météorites et les roches primitives. 62 pp. 4°. 1805.

Bellevue, Fleurian de. Mémoire sur les cristaux microscopiques, et en particulier sur la séméline, la mélite, la pseudo-sommite et le selce-Romano. 24 pp. 4°. *Paris*, 1798.

Bellevue, Fleurian de. Mémoire sur les pierres météoriques, et notamment sur celles tombées près de Jauzac, au mois de juin 1819. 24 pp. 4°. *Paris*, 1821.

Bergman, M. T. Opuscules chymiques et physiques. Tomes i, ii. 479, 543 pp. 8°. *Dijon*, 1780, 1785.

Berthoud, F. L'Art de régler les pendules et les montres. Quatrième édition. 126 pp. 12°. *Paris*, 1811.

Berzelius, J. J. De l'emploi du chalumeau dans les analyses chimiques et les déterminations minéralogiques. Traduit du Suédois, par F. Fresnel. 406 pp. 8°. *Paris*, 1821.

Berzelius, J. J. Nouveau système de minéralogie. Traduit du Suédois. 321 pp. 8°. *Paris*, 1819.

Bibliotheca Parisiana. A catalogue of a collection of books formed by a gentleman in France. 172 pp. 8°. *London*, 1791.

Bray, Wm. Sketch of a tour into Derbyshire and Yorkshire. Second edition. 408 pp. 8°. *London*, 1783.

Breve notiza di un viaggiatore sulle incrostazioni silicee termali d'Italia, e specialmente di quelle dei Campi Flegrei nel Regno di Napoli. 35 pp. 8°.

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* A chemical analysis of some Calamines. *Smithsonian Miscell. Coll.*, No. 327, p. 29.
† On the composition of Zeolite. *Smithsonian Miscell. Coll.*, No. 327, p. 45.

Bruxelles, Description de la ville de; enrichi du plan de la ville et de perspectives. 192 pp. 8°. *Bruxelles*, 1794.

Bullock, Wm. A descriptive catalogue of the exhibition entitled Ancient and Modern Mexico. 32 pp. 8°. *London.*

Camus, A. G. Voyage fait dans les départements nouvellement réunis. Tomes i, ii. 198, 229 pp. 24°. *Paris*, 1803.

Catalogue of gems in the collection of Mr. Findlay, Oriental Museum. 43 pp. 12°. *London*, 1802.

Catalogue des livres manuscrits et imprimés de la bibliothèque du feu M. F. A. Quetant. 11 pp. 8°. (Imperfect.) *Paris*, 1823.

Catalogue (A) of a splendid and most select collection of foreign minerals, which will be sold by auction by Mr. Thomas. 59 pp. 8°. *London*, 1826.

Catalogue of a valuable collection of minerals, the property of Mr. Heuland; to be sold at auction by Mr. Thomas. 27 pp. 8°. 1826.

Chambers, E. Cyclopædia, or an universal dictionary of arts and sciences, containing an explanation of the terms and an account of the several subjects in the liberal and mechanic arts, and the sciences, human and divine; with a supplement and modern improvements incorporated in one alphabet by A. Rees. Vols. i–v. Folio. *London*, 1795–1797.

Claubry, Henri François Gaultier. Recherches sur l'existence de l'iode dans l'eau de la mer et dans les plantes qui produisent la soude de varecs. 40 pp. 4°. *Paris*, 1815.

Conformité des coutumes des Indiens orientaux, par M. de la C. 268 pp. 12°. *Bruxelles*, 1704.

Constant, Benjamin de. De la doctrine politique qui peut réunir les partis en France. 43 pp. 8°. *Paris*, 1816.

Cookery, A new system of domestic, formed upon principles of economy and adapted to the use of private families. By a Lady. 375 pp. 8°. *London*, 1810.

Cordier, Louis. Mémoire sur la montagne de sel gemme de Cardonne en Espagne. 15 pp. 4°. *Paris*, 1816.

Cordier, Louis. Mémoire sur les substances minérales dites en masse qui entrent dans la composition des roches volcaniques de tous les âges. 87 pp. 4°.

Cronstedt, Axel F. An essay towards a system of mineralogy. Translated from the original Swedish, with notes by G. von Engestrom; to which is added a treatise on the pocket laboratory, containing an easy method, used by the author, for trying mineral bodies, written by the translator. The whole revised and corrected, with some additional notes, by E. M. Da Costa. 365 pp. 8°. *London*, 1770.

Cronstedt, Axel F. An essay towards a system of mineralogy. Translated from the Swedish, with annotations and an additional treatise on the blow-pipe, by Gustav Engestrom. Enlarged and improved by John Hyacinth de Magellan. Vols. i, ii. 1095 pp. 8°. *London*, 1788.

Davy, Humphrey. On some of the combinations of oxymuriatic gas and oxygene, and on the chemical relations of those principles to inflammable bodies. 35 pp. 4°. *London*, 1811.

Delamétherie, J. C. Leçons de minéralogie. Tomes i, ii. 572, 630 pp. 8°. *Paris*, 1812.

De l'Isle, Romé. Cristallographie, ou description des formes propres à tous les corps du règne minéral, dans l'état de combination saline, pierreuse ou métallique. Tome iv. 96 pp. 8°. *Paris*, 1783.

De l'Isle, Romé. Description méthodique d'une collection de minéraux du cabinet M. D. R. D. L. 336 pp. 8°. *Paris*, 1773.
Dhombres-Firmas, L. A. Nivellement barométrique du département du Gard. 33 pp. 8°. *Nismes*, 1811.
Dubois, C. M. Nouveau voyage de France, avec 24 itinéraires pour les différentes parties de l'empire. Tomes i, ii. 439, 501 pp. 12°. *Paris*, 1806.
[Dutens, L.] Mémoires d'un voyageur qui se repose, par M. L. D. Troisième édition. Tomes i–iii. 369, 329, 354 pp. 8°. *Londres*, 1807.
École d'enseignement mutuel de l'Eglise reformée de Paris. Rapport sur l'état de l'école au 31 décembre 1818. 25 pp. 12°. *Paris*, 1819.
Galignani's traveller's guide through Holland and Belgium. 410 pp. 32°. *Paris*, 1822.
Garnerin, Madame. A circumstantial account of the three last aërial voyages made by M. Garnerin. 36 pp. 12°. *London*.
Gaultier, L. Exercises sur la construction logique des phrases et des périodes contenues dans le texte des six premières époques de l'histoire universelle de Buffon. 60 pp. 24°. *Paris*, 1809.
Gay-Lussac. Mémoire sur l'iode. 160 pp. 8°. 1814.
[Glass, Mrs.] The art of cooking made plain and easy. By a Lady. New edition. 438 pp. 8°. *London*, 1770.
Gmelin, L. Indagationem chemicam pigmenti nigri oculorum taurinorum et vitulinorum adnexis quibusdam in id animadversionibus physiologicis. 72 pp. 12°. *Gœttingæ*, 1812.
Gmelin, L. Observationes oryctognosticæ et chemicæ de Hauyna, etc. 58 pp. 8°. *Heidelbergæ*, 1814.
Harriott, Lieut. J. Struggles through life, exemplified in the various travels and adventures in Europe, Asia, Africa, and America. Second edition. Vols. i, ii. 399, 366 pp. 8°. *London*, 1808.
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NOTE 9.

NOTICES OF THE CITY OF WASHINGTON, FOUND IN BOOKS IN SMITHSON'S LIBRARY.

One of the books in Smithson's library is "Struggles through life, exemplified in the various travels and adventures in Europe, Asia, Africa, and America. By Lieut. John Harriott." 8°. 2 vols. *London*, 1808.

Mr. Harriott (vol. ii, pp. 259–260) says:

"Respecting this intended city [Washington], I question much whether there ever will be a sufficient number of houses built to entitle it to the name of a great city. Reckoning up all the houses I could see or hear of as belonging to the new city of Washington, they did not amount to eighty. Having seen and examined everything, and gained all the information I could concerning this so much talked-of city, I sat down between the President's house and the Capitol, and entered the following in my minute-book, as my opinion, viz:

"Should the public buildings be completed, and enterprising individuals risk considerably in building houses; should the Union of the States continue undisturbed; should Congress assemble for a number of years, until the national bank and other public offices necessarily draw the moneyed interests to it, the city of Washington, in the course of a century, may form a focus of attraction to mercantile and trading people sufficient to make a beautiful commercial city deserving the name of its founder; but I apprehend so many hazards as to be most unwilling to venture any part of my property in the undertaking."

The other work in Smithson's library on America was by Isaac Weld, the Secretary of the Royal Society.

"Mr. Weld," says the London Monthly Review,* "feeling in common with the inhabitants of Europe the desolations of war, and trembling at the frightful progress of anarchy and confusion, was induced to cross the Atlantic for the purpose of examining into the truth of the various accounts which have been given of the flourishing condition of the United States."

Of Washington Mr. Weld remarks: "Were the houses that have been built situated in one place, all together, they would make a very respectable appearance, but scattered about as they are, a spectator can scarcely perceive anything like a town. Excepting the streets and avenues and a small part of the ground adjoining the public buildings, the whole place is covered with trees. To be under the necessity of going through a deep wood for one or two miles, perhaps, in order to see a next-door neighbor, and in the same city, is a curious and, I believe, a novel circumstance. . . . The number of inhabitants is 5,000. . . . The people who are opposed to the building of the city of Washington maintain that it can never become a town of any importance, and that all such as think to the contrary have been led astray by the representations of a few enthusiastic persons. . . . They insist that if the removal of the seat of government from Philadelphia should take place, a separation of the States will inevitably follow."

Notwithstanding the condition of the city of Washington at the beginning of the present century, Mr. Weld indulged hopes of its future greatness. He remarks:

"Considering the vastness of the territory which is opened to the Federal city by means of water communication, considering that it is capable from the fertility of its soil of maintaining three times the number of inhabitants that are to be found at present in all the United States, and that it is advancing at the present time more rapidly in population than any other part of the whole continent, there is good foundation for thinking that the Federal city, as soon as navigation is perfected, will increase most rapidly, and that at a future day, if the affairs of the United States go on as prosperously as they have done, it will become the grand emporium of the West, and rival in magnitude and splendor the cities of the whole world." †

This view was undoubtedly entertained by Smithson, and experience has shown how well-founded were his anticipations. The wisdom of his selection has been fully justified.

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* *Monthly Review* for September, 1799. London.

† Isaac Weld. *Travels through North America.* 1807. Vol. i, p. 80.

GENERAL APPENDIX

TO THE

SMITHSONIAN REPORT FOR 1879.

The object of this appendix is to illustrate the operations of the Institution, as well as to furnish information of a character suited especially to its correspondents and collaborators.

)Y OF THE SAVAGE WEAPONS AT THE CENTENNIAL EXHIBITION, PHILADELPHIA, 1876

By Edward H. Knight, A. M., LL. D.

INTRODUCTION.

bjects illustrated in the following paper are merely those of one ıown at the Centennial Exhibition, in Philadelphia, 1876.
aper, therefore, makes no pretense to completeness, as the weap- wn in the various national sections were in most cases treated › casual objects thrown in as curiosities, and in many cases so ›teemed by the parties in charge that they were huddled away ıbles; surprise was sometimes expressed that any one should er the coarse and clumsy when the best talent of the country ›rted itself on the objects prominently displayed as worthy of

than 700 sketches of the crude and curious implements shown ›xhibition were made by the author; the following were a por- ›luding weapons only, while a much larger, embracing tools of y, were the subject of a series of papers in the Atlantic Monthly, ›77, to April, 1878, inclusive.
› was no concurrence of design in the exhibition, so far as con- ır present subject. In almost all cases the objects were mere ıdditions; in a few the scientific spirit was evident, and some d been taken to illustrate this side of ethnology.
ustrate: The curious collection of musical instruments and weap- ught by Capt. Long (Bey) from Central Africa was almost hidden ner, while the tufted carpets, embroidered robes, and horse-trap- vere prominently shown. In the collection from Java and the ›utch Colonies in the Malay seas, much more was shown of the ces of the semi-savage races of the region. Brazil, which had so ›le a collection of its agricultural and forest products, had scarcely ıg which touches our subject, and Japan had a great deal, though ›ss in the way of its weapons than in its industries and domestic ents.
Centennial Exhibition was mainly of the means and results of industry and art, and the primitive objects were comparatively ıys and occasionals. It is, therefore, not the author's fault that ıibit of the relatively rude is so incomplete, as he has rigidly con-

fined his illustrations to objects actually exhibited there; and he is not responsible for the circumstance that the comparatively unknown and little thought of Portuguese colony of Angola had more in his line of search than the whole continent of South America.

It may be mentioned, however, that the Dutch and Portuguese colonies had a manifold better exhibit in Paris in 1878, and that the former had the finest ethnological display of the mechanical ingenuity of an unlettered people which it has ever been the good fortune of the author to see.

Types of Savage Weapons.—The simplest form of a weapon is a stick; a heavy stick is a club. The club with a knob becomes a mace; the swelling end sharpened on one edge is an axe. Point the stick and it is a spear; if light, it is a javelin; shorter still, it is a dagger for close quarters. Flatten the stick and give it an edge, it becomes a sword; or, if short, it is a knife.

So far the weapon is a single piece of wood; but some ingenious man contrives to mount a stone in a withe, or sling it with a thong or in the skin of an animal's leg, or lash it to a stick; or he learns how to project a light spear from a bow, or a heavier one by means of a stick or a thong. We find all these modifications in the collections from various countries at the Centennial.

Another type of weapon is the stone or club which is thrown; the simplest method is, of course, the mere hurling of stones by the hand. Then there are several forms of slings; the one having two thongs and a pocket, and the other a stick for hurling a perforated stone. The stone on the end of a string may be considered a third kind, and out of this grows the *bolas*—several associated balls on as many strings—which has a whirling motion when thrown. All of these also were exhibited. The lasso of South America naturally occurs to one in speaking of the *bolas*, though the noosed lasso belongs to another class of devices, not exactly a weapon but a snare.

Materials employed.—The statement of Lucretius (*De rerum naturæ*) in regard to the discovery of weapons relates rather to the material than the form. "The first weapons of mankind were the hands, nails, and teeth; also stones and branches of trees, the fragments of the woods; then flame and fire were used, as soon as they were known; and lastly was discovered the strength of iron and bronze. But the use of bronze was known earlier than that of iron, inasmuch as it is more easy to work and its abundance is greater." Bronze has greatly the antecedence of brass, the former being not less than a score of centuries the more ancient.

Brass is an accidental alloy, formed originally by melting copper in contact with calamine stone (silicate of zinc), the practice, purely empiric, producing what was not known as an alloy, but as a bright copper, valued for its color and other qualities. Certain copper mines were valued as producing this gold-colored copper, but it was found out subsequently that by melting copper with a certain mineral (calamine) the same effect was produced. Aristotle, Strabo, and Albertus Magnus refer to an earth which conferred a yellow color on copper. Sulphate of zinc had a place in the pharmacopœia before its metallic base was known. The metal was discovered by that brilliant absurdity, Paracelsus, in the sixteenth century.

Bronze, on the contrary, has always been recognized as an alloy, being made by the fusing together of copper and tin in suitable proportions. It is found in those countries which possess both of these metals, and also in those ancient lands to which the Phœnicians penetrated. The Malay Islands and Cornwall furnished the tin of antiquity and that of to-day. Australia has also supplied it largely of late. The *kassiteros* (tin) of the Greeks gave its name to Cornwall and Scilly, the kassiterides of Herodotus.[1] It was the *kastera* of the Sanscrit, *kasdir* of the Arabs. The Javanese *tinah*, England *tin*, Swedish *tenn*, and Icelandic *den* mark the limits in either direction of the great traders of the earliest period of history. A bar of tin has been recovered from the Swiss lacustrine piles of Estavayer, molds for hatchets have been found at Morges, and remains of bronze foundries have been uncovered in the Canton of Vaud.[2]

Some of the ancient bronzes of England, Ireland, Scotland, and South America have notable proportions or traces of iron and of lead, and some of them have both of these metals in their composition. In the Roman bronze coins of Pompey, Hadrian, and Probus, zinc, iron, lead, and silver are found. One coin of Tacitus is of copper and iron. These are probably accidental impurities rather than intentional.

The lacustrine researches in the Swiss lakes have given rise to the classification of copper, tin, lead, and zinc as the *principal* ingredients of bronze, and silver, iron, antimony, nickel, and cobalt as *accidental*, and, it may almost be said, unsuspected. The Helvetian bronzes were destitute of lead, and the presence of zinc appears accidental. The use of calamine was common in the Levant, and lead was added to the bronze in notable quantities. In the bronze of the Swiss lakes the copper varied from 67 to 95 per cent., and the tin from 3 to 20 per cent (Desor). Sir John Lubbock remarks that lead and zinc are not found in the bronzes of the true bronze age.[3]

The iron of early ages, as well as that made by the native workmen of Asia and Africa at the present time, was obtained by a means analogous to that of the Catalan process. The fragments of rich iron ore are distributed through the mass of charcoal in the furnace, and by means of the bellows the fire is urged until the metal runs into a viscid ball, which is hammered to expel the dross, and the steel obtained by the single operation is purified and shaped by successive heatings and hammerings. An excellent quality is obtained, and native weapons were shown at the Centennial from India, Soudan, Angola, Mozambique,

[1] Herodotus, iii, 115.

[2] Elisée Reclus, Smithsonian Report, 1861, p. 357.

[3] Sir John Lubbock's Introduction to Sven Nilson's "Stone Age," page xli.

Zululand, the Gold Coast, Borneo, and the Philippines; also, ancient bronzes from Egypt.

Copper, which may be held to have preceded bronze, was shown in the Indian relics from Wisconsin, and a modern fish-spear of an Alaskan tribe. Copper implements have been found in the lacustrine deposits at Peschiera on Lake Garda.[4]

TYPES OF WEAPONS DESCRIBED.

1. Clubs and throwing weapons.	4. Spears.
2. Axes.	5. Shields.
3. Knives and swords.	6. Bows and arrows.

I.—Clubs, and Throwing Weapons.

Leaving preambulation, let us begin at the Cape of Good Hope. The *Keerie* of the Kafir is his next best weapon after his favorite *assegai*, the native javelin; he does not use the bow and arrow. The *keerie*, called a *knob keerie* by the colonists at the Cape, is a hurling club, or is used in hand to hand encounters, but principally the former. It varies in length from 14 inches to 3 feet, but has been seen as much as six feet long.[5] It is straight and has a knob at the end. It is usually of acacia (*Acacia capensis*), but sometimes of stick-wood (*Laurus bullata*). A more costly and highly prized material is rhinoceros horn, of which the *keerie* in the Cape of Good Hope exhibit (shown in the illustration) was made. The *keerie* is habitually carried, and is presented to a friend on meeting him; he touches it, and this is the etiquette of salutation. By a modification of the weapon, giving it a slight bend, it is used in ricochet, rebounding from the ground and striking upward.

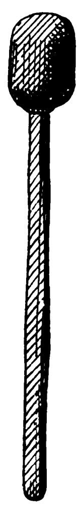


Fig. 1.—*Kafir Keerie. Cape of Good Hope.*

The *knob keerie* of hard black wood is carried by the Bushman also.[6] The *pen bas* of the Bretons has been compared to it.[7]

Coming northward from Zululand we reach the Portuguese Possessions on the east coast of Africa, and find Mozambique weapons; these were shown, together with those from Angola, in the Agricultural Building at the Centennial. Fig. 2 represents two of them; one has a spear-shaped head, and the knob of the other resembles an ear of corn, or the *raceme* of a native plant common in the country. It suggests the idea of maize, but is made by longitudinally grooving, and then notching the protuberant ridges; a not unlikely style of ornamentation for a man to hit upon when amusing himself by carving his weapon. The

[4] Morlot, transl. in Smithsonian Report, 1863, p. 373.

[5] Wood's "Natural History of Man," vol. i, p. 108.

[6] Baine's "South Africa," p. 363.

[7] See frontispiece to Trollope's "Walks in Brittany," 2 vols., London, 1840.

the Dinkas of the Upper Nile[8] are also of hard wood made by and notching so as to leave rows of knobs, like many of the an weapons. The form resembles the chocolate mullers we used nd also suggests the Roman mace *clausula.*

ub of the Dôrs of the Upper Nile[9] has been compared in shape nushroom, having a round disk-shaped head harpened periphery. It is 30 inches in length le of hard wood. The Djibba club has also ed head with a sharp edge, which is guarded ath of hide when not in use. Another club the last-mentioned tribe is champignon-shape, unexpanded mushroom. The King of Da- is versatile in clubs; one favorite form has a end and four square knobs at the side; another has a long sharp spike at the end projecting at right angles from the handle.[11]

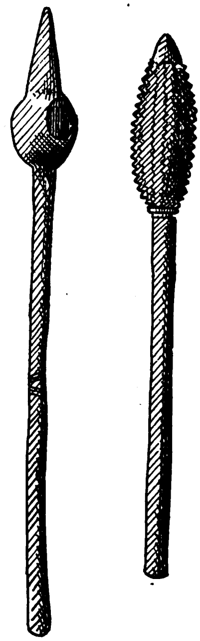


FIG. 2.—*Mozambique Clubs. Portuguese Colonies.*

ire Australian with club hield, Queensland.

A variety of sticks and clubs were brought from the different Australian provinces. The peculiar hurling weapons, the *boomerang* and *kangaroo rat*, will be considered presently. Fig. 3 is a Queensland native, armed with his *waddy* and shield. *Waddy* is a native name for a simple club, as shown in Fig. 3, and *b* and *d*, Fig. 4. The knobbed club is known as the *nulla-nulla*, and is shown in Fig. 5, and at *c*, Fig. 4. When the head is flat and sharpened to an edge, the colonists term them *tomahawks*, from their resemblance to the North American Indian weapon. Fig. 4 shows two wooden tomahawks (*a e*) of New South Wales,[12] a *nulla-nulla* (*c*), and two *waddies* (*b d*). The typical Australian *waddy* is 2 feet 8 inches long, weighs s, and is made of the heavy and tough mountain tea-tree, d gum wood. It has a pointed end so that its thrust is dangerous.[13]

"Natural History of Man," vol. i, p. 524.
"Natural History of Man," i, p. 494.
n's "Western Africa," p. 226.
ob sticks of the Wanyamuezi are shown in Stanley's "Livingstone," plate age 544.
e *li-bil*, R. Brough Smith's "Aborigines of Victoria," Fig. 97.
s "Natural History of Man," vol. ii, p. 29.

Some of them have four grooves extending from the point to the hand grasp, so that the wound is something like that made by a bayonet. Fig. 5 shows two *nulla-nullas* or hunting clubs from the southern part of the island, the colony of Victoria. They are two feet long.[14]

The *nulla-nulla* of the Lower Murray River is the *warra-warra* of the Yarra, and is made of a sapling of the mountain tea-tree, the enlargement at the root forming the knob. A pointed *nulla* is made by fashioning one of the projecting roots into a pointed spike, and is called *langeel.*[15] Sharp-edged wooden maces, which may be termed wooden swords, are also made by the Australian natives, some weighing as high as 41 ounces.[16]

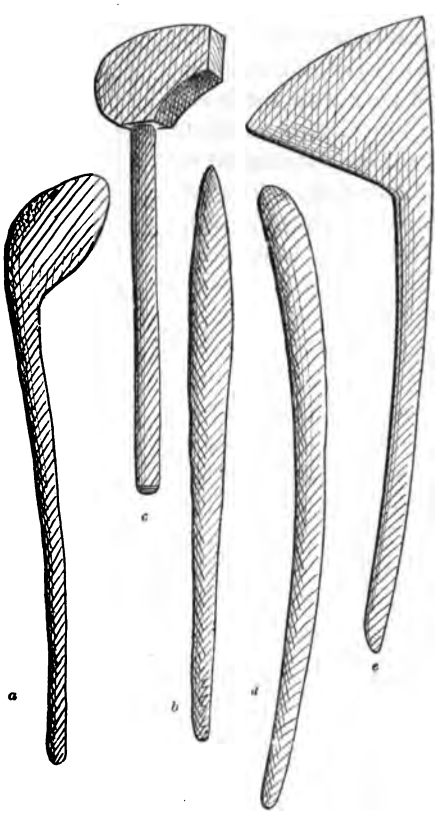


FIG. 4.—*Australian wooden weapons, New South Wales.*

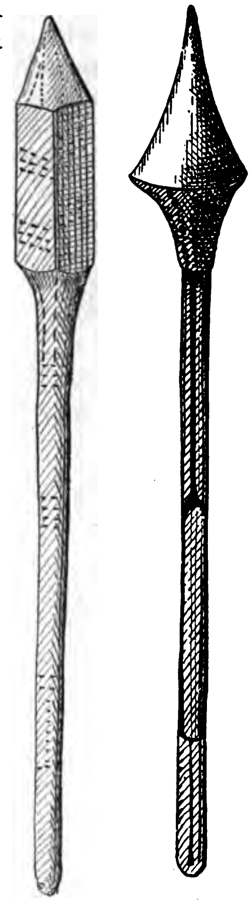


FIG. 5.—*Australian nulla-nullas, Victoria.*

Crossing to New Zealand, we find the Maories to have a much greater variety of material and of shape. The most prized material is the green jade, and it is also wrought with the greatest difficulty. The bone of whale bears a medium character in both respects. Fig. 6 shows two

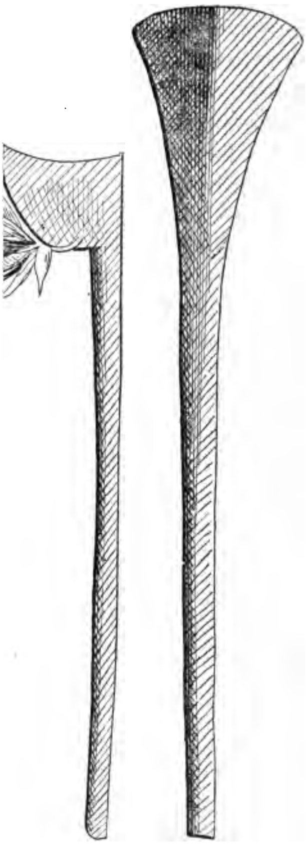
[14] R. B. Smith's "Aborigines of Victoria," vol. i, 299–300, Figs. 56–59.

[15] *Ibid.*, Fig. 62.

[16] *Ibid.*, Figs. 60, 66, 67; see also Figs. 61, 65.

Maori wooden clubs, known as *pátu;* one has a sharp edge to ike head, and a bunch of feathers intended to shake in the face emy and disturb his aim. The weapon to the right is paddle-shaped, and has two edges; a not uncommon form in Polynesia.

The *merai* or *pátu-pátu* of New Zealand is a two-edged club of a prolonged ovoidal shape. It usually has a hole in the neck for a wrist-cord. Fig. 7 is of green jade, very symmetrical, and beau-



Wooden clubs, New Zealand.

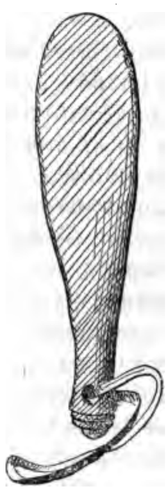


FIG. 7.—*Stone merai, New Zealand.*

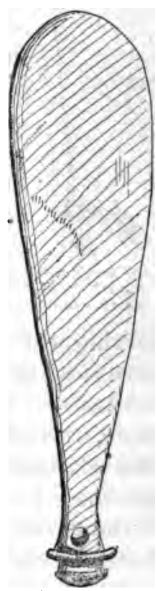


FIG. 8.—*Green-stone merai, New Zealand.*

lished with a species of corundum found in the island. Fig. 8 e, and is also carefully made and polished. Such weapons be- -looms in families, and possess names, much as in former times e given to swords, as, for instance, *Samsamah,* the cimeter of l Raschid, and *Excalibar,* the sword of King Arthur. The stone g. 8, was called *Kororaki.* Fig. 9 is a stone weapon called *Pátu* its wrist-thong occupies a circular depression. Fig. 10 is a eapon, the name of which was *Kaikanohi,* or "face-eater." It rom a bone of a spermaceti whale, and has the reputation of een handed down in the family for twelve generations. *Merais* hape are also made of wood, but are not as much valued as harder and more enduring materials.

been supposed that the "flattened soda-water-bottle shape," as Tylor has called it, was peculiar to this ingenious cannibal race, the antipodes of the British, but it appears that the Peruvians make a weapon of exactly similar shape; one has been found of dark brown jasper,[17] and another of a greenish amphibolic stone.[18] Another of native copper has been found in Michigan, and was shown at the Centennial. It is 16¼ inches long, 2⅝ inches wide for 11 inches of its length, contracts to 1½ inch, and then enlarges to 2 inches, to assist the hand-grasp. No deduction of importance is to be made from this; the blade is but 1⅛ inch wider than the handle, and the probability is that the piece of native copper approximated that shape, the work of the owner consisting in flattening, sharpening, and shaping it symmetrically.

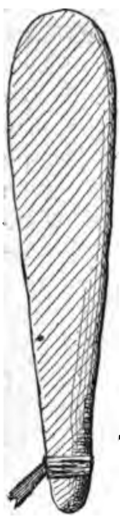


FIG. 9.—*Maori Pâtu Kohatu, New Zealand.*

Crossing the Southern Ocean we reach the Fiji Islands, lately come into the possession of Great Britain. The Fijian is a Papuan race, and remarkable for constructive ability. The club is his great weapon, and upon it he expends his lavish carving, the implements being of various sizes and patterns, the handiwork being all guided by individual taste.[19] The display at the Centennial was not large, the islands not being specially represented. The classification of their clubs into large, small, knobbed, bladed, axe-shaped, straight, or curved gives but a faint idea of the variety. The *dromo* is a spiked mace, and resembles some of the North American Indian clubs. The *dui* is like the double Phrygian axe. The *totokea* is a spiked hammer.[20] The stem of a small tree, with a swelling bole, and the radiating roots trimmed as projecting knobs, is a common style. Another form is made by bending over a young sapling nearly to the ground, so as to bring the tap-root at right angles to the stem. When the tree has sufficiently grown, it is cut and shaped, and the tap-root forms a laterally-projecting knob with a circle of spikes formed of the other roots, shortened and sharpened. Other clubs are like maces; squared and notched; with pyramidal or mushroom tops; ornamented with braided *coir*, with wicker-work, with feathers worked in with *sinnet*, inlaid with shell, bone, hog's tusks, human or whale's teeth.[21]

FIG. 10.—*Kakati Weapon (bone of whale), New Zealand.*

We miss clubs when we come to lands where the more deadly metal is

[17] Klemm, C. N., part ii, page 26.
[18] Rivero & Tschudi.? Plates, pl. xxxiii.
[19] Smythe's "Ten Months in Fiji," p. 120.
[20] Williams, "Fiji," pp. 43–4; 589.
[21] Wood, vol. ii, p. 275.

abundant. Java has, however, two clubs deemed worthy of special names, *Indan* and *Gada*.[22] The "war-fan" of the Japanese is perhaps unique, being of large size and having a sheath of iron so that it may do duty as a club on emergency.

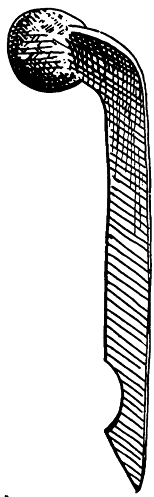


FIG. 11.—*Ojibeway wooden club, Canada.*

Coming to America we find a greater variety, if possible, than Fiji furnishes, for those astute islanders have but a meager choice of materials—wood and shell. Fig. 11 is an Ojibeway war-club from Sagamook, on the north shore of Lake Huron. Fig. 12 shows two wooden clubs, one armed with an iron spike; they are from the Missouri Valley Indians. Spiked weapons have always been in vogue, and a curious example of one is a stag's-horn club with the brow antler left as a spike, found in one of the Swiss Lakes. See memoir by M. E. Desor.[23] Stag's-horn hammers are also very numerous in the *debris* of the lake dwellings. A hammer of serpentine with inserted helve and with a hammering face and pointed peen is mentioned by Nilson.[24] Many other forms are found among the Indian tribes, but the aim has been to place together the wooden clubs made in a single piece. Those in which stones or metal are mounted will be shown presently. Fig. 13 is a pestle-shaped war-club of the Pai-Utes and Mohaves. They are termed "face mashers," since they are carried concealed about the person and used for striking an enemy in the face.

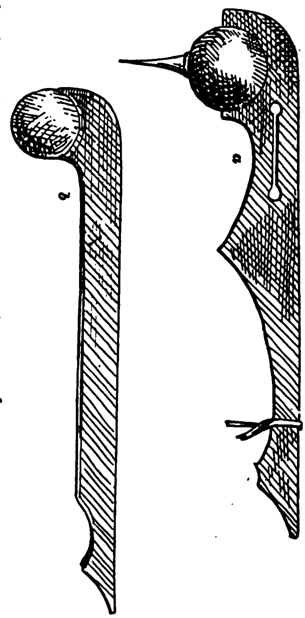


FIG. 12.—*Wooden clubs of Dakotah.—National Museum.*

Figs. 14 and 15 are from the Pacific Coast. They are elaborately carved war-clubs of hard wood from the Haidah Indians of Bella-bella, British Columbia. They are what we should call "grotesquely carved," but the emblems on them are mythological, and the idea of pleasantry does not, we are informed, enter into the work. The canoes, totem-posts, paddles, bowls, and other ob-

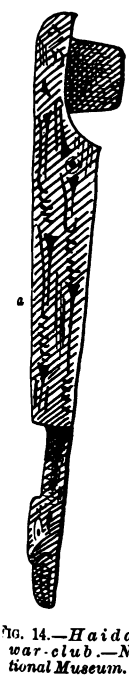


FIG. 14.—*Haidah war-club.—National Museum.*

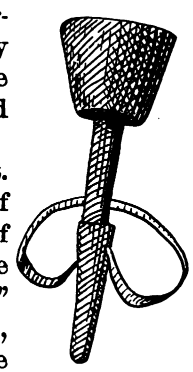


FIG. 13.—*Pai-Ute club.—National Museum.*

[22] Sir Stamford Raffles' "Java," 4to ed., i, 296 (Figs. 8, 9).

[23] Translation in Smithsonian Report, 1865, page 357.

[24] Ibid., page 359.

jects fashioned in wood, exhibit the same style of ornamentation, it must be called.

The Argentine Republic sent a mace, which is shown at Fig. 16. It

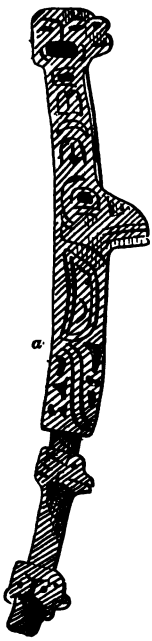


FIG. 15.—*Haidah carved war-club.—National Museum.*

of hard wood resembling *lignum vitæ*, and is 48 inches long. It belonged to an Indian of the pampas. A spear eight feet long, of the same kind of wood and tapering to a point, was exhibited with it. The club of the Gran Chaco Indians[25] of the La Plata region is square in section, larger towards each end, and is grasped in the middle. It is called a *macana*, and is used either as a hurling weapon or as a club at close quarters. The clubs of the Guiana Indians are maces of square section, or paddle-shaped with somewhat sharp edges. The handles are embroidered with cotton string, some in a very ornamental manner. The Uaupé Indians of the Amazon[26] also use carved wooden clubs.

We come now to a class of clubs in which a stone is mounted upon a withe or other kind of handle to form a maul or hammer. We do not in the present article consider those which have sharp edges, and are designed to form axes and adzes. They will be grouped separately. Fig. 17 is about as primitive an affair as can well be devised.

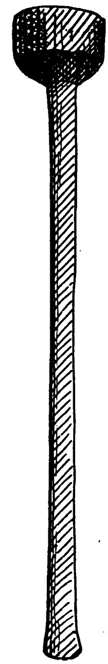


FIG. 16.—*M… from Paragu… Argentine C… federation.*

It is a shell-headed club from a shell-heap on Saint John's River, Floric… The head is a *Pyru…* and the specimen peculiar in this, th… though ancient it st… has the remains of t… original handle.

FIG. 17.—*Shell-headed club from a Florida shell-heap.—National Museum.*

In connection wi… this method of mou… ing, by a perforat… head through whi… the helve is thru… mention may be ma… of hammer ston… sometimes known helved wedges, si… larly handled, a… which have been hu… ing axes. They are more frequent in Europe than in America. So…

[25] Wood, vol. ii, pp. 569, 570.

[26] Wallace's "Amazon," 504

these have their edges in line with the handle and some across it, ıxes and adzes respectively. See Sven Nilson's "Stone Age,"[27] edited Sir John Lubbock. A re- rkable four-pronged stone tle-axe is shown in the mu- m of Lund, Sweden, hav- a diameter of 8 inches, l perforated for a handle.[28] 'ig. 18 is a stone maul ıed with raw-hide thongs ı T-shaped handle which been formed from a forked

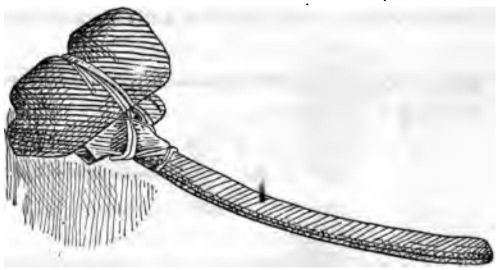


FIG. 18.—*Stone maul, from British Columbia.—National Museum.*

nch. It is from the Haidah Indians, Bella- la, British Columbia. Fig. 19 is a large ne maul lashed to a short handle formed a forked limb. It is from Sitka, Alaska. :. 20 is from New Zealand. It shows that imilar mode of mounting is practiced by Maories, the bowlder being secured in crotch by means of thongs. The pursuit imilar examples leads us a devious dance.

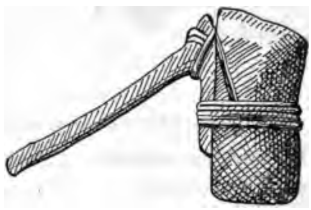


FIG. 19.—*Stone maul, of Alaska.—National Museum.*

find that the Gran Chaco Indians, of South America, have a peculiar thod of embedding a cylindrical stone in a club so that it may project

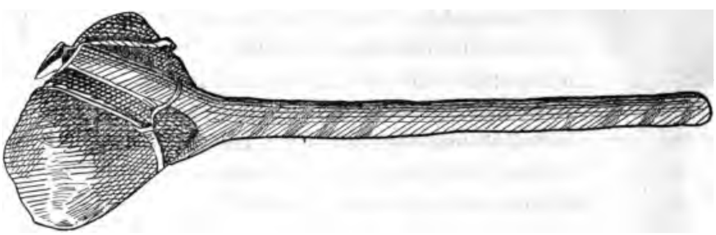


FIG. 20.—*Maori stone club, New Zealand.*

an axe blade. A hole is bored into a sapling of suitable size and the ne driven in. As the tree grows, the wood advances upon the stone l grips it firmly. The sapling is then cut and shaped.

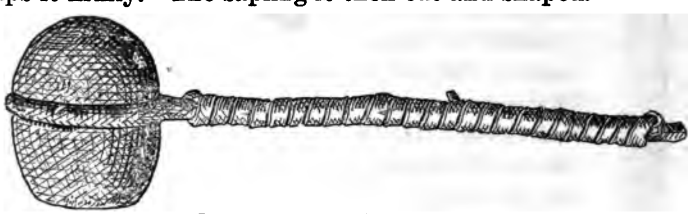


FIG. 21.—*Stone maul of Arickarees.*

'ig. 21 is a stone maul of the Arickaree Indians of the Upper Missouri er.[29] It is a reddish, granite pebble of three and a half pounds

Page 72, and plate ix, Figs. 183, 184; pp. 73, 74; and plate viii, Figs. 180, 181.

Ibid., page 75, and pl. ix, Fig. 159.

See "Twenty-first Report of N. Y. State Cabinet," pp. 31–36, pls. i, ii, iii.

weight. The withe is bent around it, occupying a circumferential depression, which is interrupted opposite the handle. The same kind of hammer was used by the native workmen formerly in the Lake Supe-

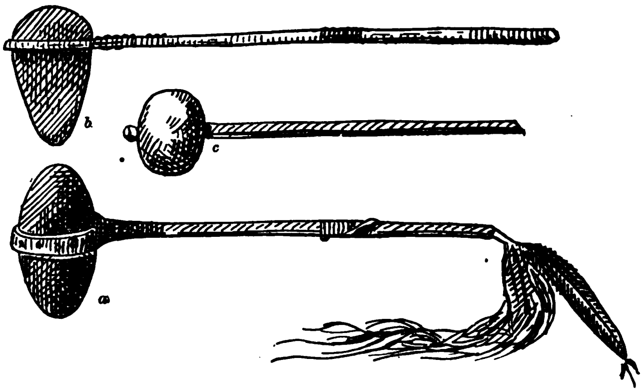


FIG. 22.—*Stone mauls of Missouri Valley Indians.—National Museum.*

rior copper mines. It is used by the Missouri Indians in driving stakes and tent-pegs.

Fig. 22 shows two stone implements of the Sioux, the hereditary enemies of the tribe last mentioned. The upper one is a rude grooved axe mounted in a hickory sapling, the two ends of which are brought together with raw-hide thongs to form the handle. The lower figure is a war-club with an egg-shaped limestone head and a handle of ash; the end of the latter is ornamented with the tuft from the tail of a buffalo. Between the two figures is a representation of the Roman sacrificial *malleus*, which, even in the time of the emperors, was employed in slaughtering the victims. It seems to have come down from times then ancient, the order of procedure admitting of no innovation, just as the knives of flint were used in ancient Egypt and among the Hebrews in performing ceremonial observances and sacrifices. Dr. Schliemann found hundreds of rude stone hammers in the hill of Hissarlik.

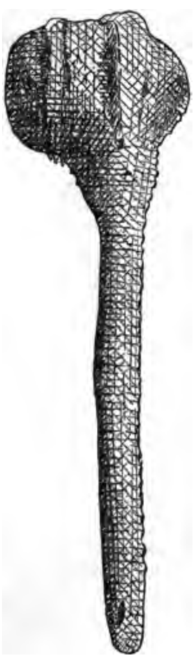


FIG. 23.—*Arickaree stone maul.*

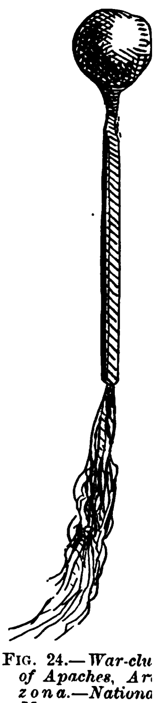


FIG. 24.—*War-clu of Apaches, Ar zona.—Nationa Museum.*

Another mode of mounting a large pebble or wedge-shaped stone is by means of a raw-hide covering to the stone and withe.

Fig. 23 shows an Arickaree weapon made in this manner: The granit pebble weighing 22 ounces is grooved circumferentially and a with bent around it and secured by raw-hide thongs next to the stone. Over the whole of the stone and handle, except the hammer face, a single piece of wet buffalo hide is stretched and sewed with sinew. When the hide shrinks in drying the whole forms a very firm job. The use of a similar tool in driving stakes and tent-pins has been mentioned, but there are many other purposes about an Indian camp, such as breaking bones and pounding pemmican, for which it is well adapted, not to mention the warlike uses.

The *poggamoggon* of the Shoshones is a slungshot.

Fig. 24 shows yet another mode of mounting the stone. The pebble and the withe are covered with the tail skin of a buffalo, the tuft of hair remaining. It resembles the slungshot used nearer home, or the stone in a stocking foot, said to be a favorite with the gentler sex in some places.

Hammer-axes of stone and horn, bored for the helve, are to be found in many museums. See Nilson.[30]

We will now examine the throwing weapons; premising that neither law nor custom prevents the hurling of some already described. The Fijian among the abundance of his clubs has one specially for throwing; it is knobbed at the end like the Kafir *keerie* and is worn in the girdle, sometimes in pairs like pistols. Fig. 25 is the throwing-stick of Uganda

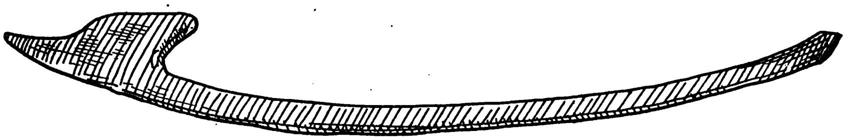


FIG. 25.—*Throwing-stick of Uganda, Africa.—Egyptian Exhibit.*

brought by Capt. Long (Bey) from his expedition south of Khartoom. It is three feet long, has a spear-shaped head, and is hurled with a whirling motion somewhat in the manner of the Australian *boomerang*, but without the peculiar erratic flight of the latter.

The curved throwing-stick was also noticed by Sir Samuel Baker in Abyssinia, and is common among the negroes as far west as Lake Tsad. The *Es-sellem* of the desert[31] is like the curved sticks of the ancient Egyptians[32] and closely resembles the middle stick in Fig. 28.

The *trumbash* or throwing-stick of the Niam-niams of the Upper Nile[33] is a flat projectile used for killing birds or hares, and is carried inside the shield. The war weapon when made of iron is called *kulbeda*, and has three projecting limbs with pointed prongs and sharp edges, the longer blade at right angles to the grip, which is guarded by the shortest prong of the three. This wicked weapon is spun about its axis and

[30] "Stone Age" Pl. viii, Figs. 168–179.

[31] Smith's "Aborigines of Victoria," Discussion on, pp. 321 *et seq.*, vol. i.

[32] Ibid (note *passim*), i, 299.

[33] Schweinfurth.

has a movement of translation in a horizontal plane. It is also a ha
ing hand-to-hand weapon. Somewhat similar weapons with two bla
are found in upper Sennaar and Central Soudan, and are used by
Fans. The *keerie* or knobbed throwing-stick of the Kafirs has b
already described. The *lissan* is the curved throwing-stick of anot

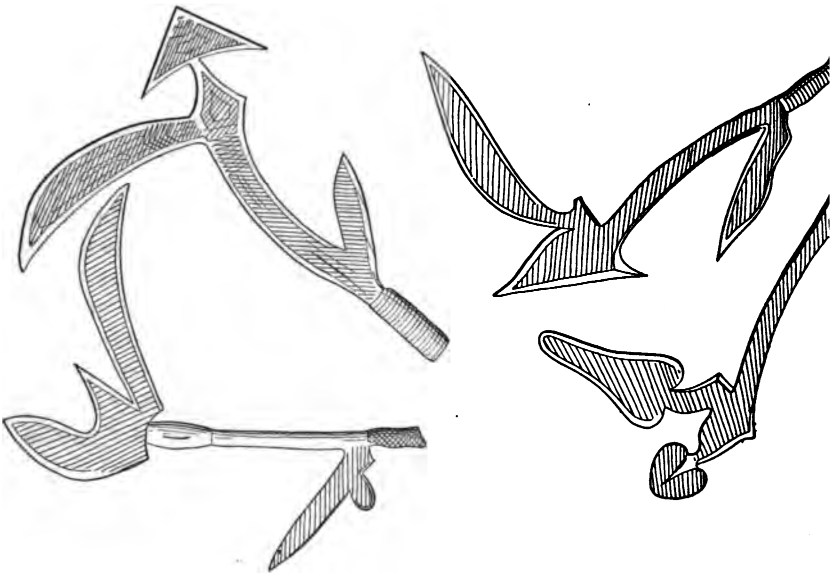


FIG. 26.—*Niam-niam hurling-weapons* (*trumbash*).

African tribe; the iron *hungamunga*[34] of the Tibbus and of Darfur is
a hurling weapon.[35]

It would be singular, indeed, if a cudgel for throwing at game w
found in but one part of the world, and at but one period; but the
covery of the Australian *boomerang*, the most curious of its class,
directed attention to what might otherwise have been passed ove
unimportant. The Egyptian and Assyrian monuments have been
sulted, and in each case the curved stick has been noticed in the ha
of bird-catchers or hunters. An ancient throwing-stick about eigh
inches long is in the Abbott Egyptian collection of the New York
torical Society. A short, crooked stick (*pedum*) was used by the Ron
to throw at hares, and centaurs are represented with a short *pe*
(*λαγωβόλον*) in the other.

In coming to Australia we reach a people living in an almost pr
tive condition, so low, ill-formed, and ignorant that their name has
come a synonym for imbecility. Here, however, the throwing-stick
attained its highest development. The maximum of improvement

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[34] Illustrated in the discussion on the boomerang. Smith, "Abor. Victoria," 3
seq.

[35] Tyler's "Early History of Mankind," 175–6. See also paper by Ferguson in T
R. I. A. Dublin, 1843, vol. xix. Paper by W. Cooke Taylor. The Nat. Hist.
London, 1840, vol. i, page 205; Eyre, vol. ii, p. 308; Klemm, C. G. vol. i, p. 316, plat

not, however, been reached by the natives of all parts of this island, which is almost as large as the United States and Territories. The *boomerang* (Fig. 27), used with such singular dexterity by the "black

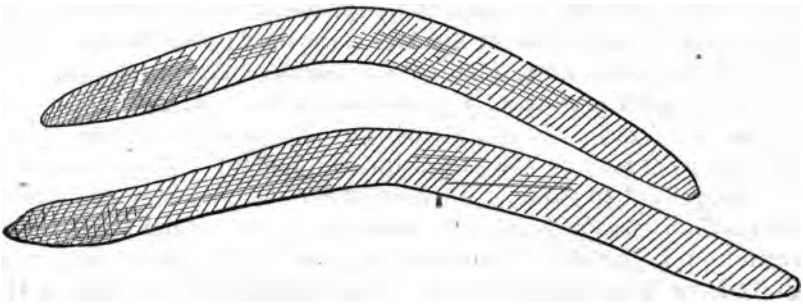

FIG. 27.—*Boomerangs of New South Wales.*

fellows" of New South Wales, is almost unknown to those of the colony of South Australia, which, by the bye, is not the most southerly portion of the island, that position being occupied by the thriving colony of Victoria. The boomerang is, however, used in Western Australia, where it is called a *ky-lie.* This is a true return-boomerang.[36] Even in the districts where the *boomerang* is used there are all grades of throwing-sticks, three of which of different forms were in the New South Wales exhibit, and are shown in Fig. 28. The upper one is carved with raised serpentine figures, the stick being painted red in the intervals. With these weapons the natives give a direct blow, a whirling blow, or a ricochet upward-rebounding blow.

The *boomerang* is made of the wood of the blue gum (*Eucalyptus glob-*

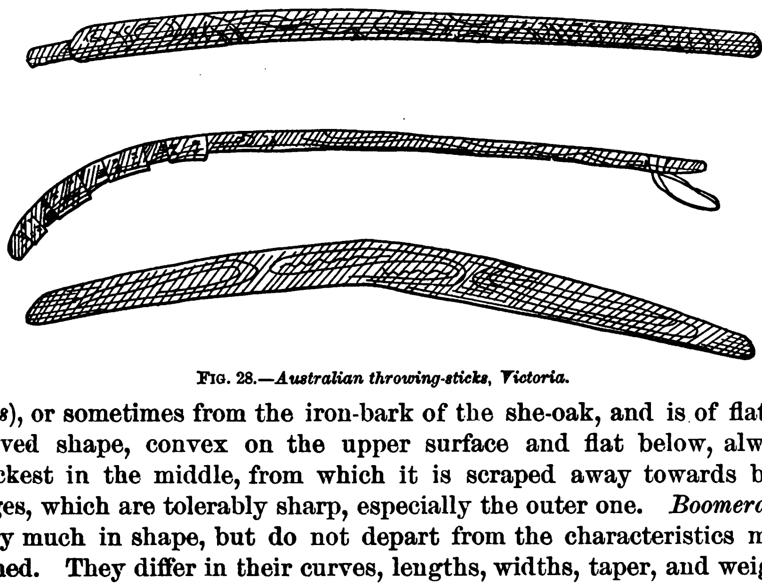

FIG. 28.—*Australian throwing-sticks, Victoria.*

ulus), or sometimes from the iron-bark of the she-oak, and is of flatted curved shape, convex on the upper surface and flat below, always thickest in the middle, from which it is scraped away towards both edges, which are tolerably sharp, especially the outer one. *Boomerangs* vary much in shape, but do not depart from the characteristics mentioned. They differ in their curves, lengths, widths, taper, and weight.

[36] Aborigines of Victoria, vol. i, 336, Fig. 140.

A good specimen may be 33 inches from tip to tip measured along the curve, 2 inches wide, and weigh 12 ounces. There are several ways of throwing the boomerang so as to make it execute its peculiar evolutions. In throwing it, the native grasps it by the handle end, which has some notches upon it, and holds the flat side downward; then balancing it a moment in his hand, and making a few quick steps forward, he launches it with a sharp fling, bringing his hand back so as to make it revolve in the plane of its curve with great rapidity. The peculiarity of the boomerang is in what may be considered its erratic flight. Thrown so as to strike the ground 40 yards in advance of the thrower, it rebounds, describes a high circular backward course, and falls behind the thrower. Thrown high in the air it mounts to a great height, circles backward until its force is expended, and then drops dead at a point behind the thrower. It is also thrown, so as at a given distance to make its rebound in other than an upward circular direction, and curve its flight around an object so as to strike something behind the latter. This is merely an effort of skill. The *boomerang* is thrown against the wind; and, though it is easy enough to hurl it, it is very difficult to make it perform at command all the peculiar evolutions which distinguish it. It is roughly made, so far as mere finish is concerned; but the work upon it in adjusting the curves is most scrupulously and patiently performed by the natives, some of whom never acquire proficiency, while others become celebrated for their skill in the manufacture of the weapon. Like all instruments which have attained something like perfection, the difference between the best and poorest is greater than in the case of some other tools where a more general level of excellence is preserved.

The subject of the *boomerang* has been learnedly and carefully considered in R. Brough Smith's "Aborigines of Victoria."[37] The discussion has elicited the fact that some throwing-sticks move with a spinning or whirling motion, and even pursue a curved path, as a billiard or baseball player can curve the trajectory by imparting rotation to the ball. None of the implements, however, described by Col. Lane Fox (British Association, 1872), or referred to in Mr. Ferguson's learned paper before the Royal Irish Academy in 1838, are fairly comparable to the Australian weapon. It must also be remarked that the distinction between the play weapon and the war weapon is clearly drawn in the mind of the native, though the back-return boomerang cannot always be distinguished from the war boomerang by a novice. The *barnyeet* of the Yarra,[38] for instance, is a war weapon, and not a come-back; nor is it so much curved as the regular boomerang, *wonguim*.[39] A group of the various kinds is shown in Mr. Smith's work, previously referred to.[40]

From the straight round stick, knobbed stick, flat stick, curved stick, edged curved stick (a wooden sword), through every degree of curvature up to the perfect boomerang, the series of Australian hurling weapons occupies the whole ground. The most curiously-curved weapon,

[37] Vol. i, p. 321, *et seq.* [38] *Ibid.*, Fig. 96. [39] *Ibid.*, Fig. 95. [40] *Ibid.*, i, 315, Fig. 99.

which should not be omitted, is the *quirriang-an-wun*, impossible to explain without an illustration, and not shown in Philadelphia. It is a thin flake of wood, curiously twisted and curved.[41]

Fig. 29 shows, for purposes of comparison, an Australian *boomerang* (*a*) from Murray River, and a curved throwing-stick (*b*) used by the Moqui and Shimmo Indians in killing rabbits. These throwing-sticks, though

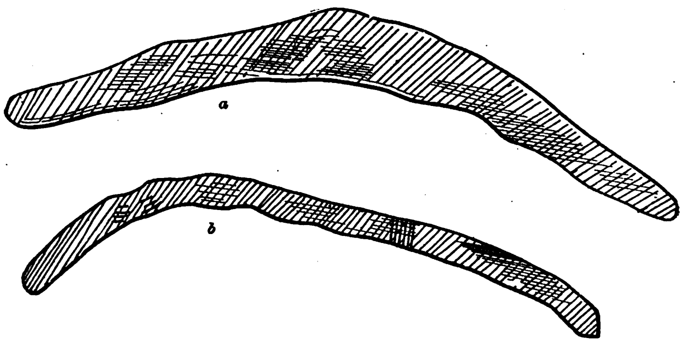

FIG. 29.—*Boomerang and Moqui throwing-stick.*

curved so as to resemble in one important respect the Australian weapon, cannot, like it, be made to describe the peculiar divergent curved course through the air. These sticks were formerly used by many of the Southern California tribes.

The *kangaroo rat* (*weet-weet*),[42] Fig. 30, of the Australians has been

FIG. 30.—*Kangaroo rat, South Australia.*

sometimes spoken of as rather a toy than a weapon, but it is a dangerous missile. Its head is usually a piece of hard wood, of a conoidal or double conical shape, and its tail is a flexible handle a yard long. By this handle it is thrown; the native takes the *rat* by the *tail* and swings it back and forth several times, bending it almost double. Suddenly letting it fly by an underhand jerk, it glides hissing through the air, striking and rebounding like a flat stone skimming the surface of the water—the familiar "ducks and drakes" of our childhood. It does not rise more than nine feet above the surface of the ground, and the distance it reaches depends upon the force of the projection and also upon the angle at which it first strikes the surface of the earth. If the trajectory be too high, it makes a number of high leaps and soon tires; if too low, the force is soon expended in friction on the ground. The body with a trailing tail making flying leaps has much the appearance of a small

[41] *Ibid.*, i, 315, Fig. 315.
[42] Wood, ii, p. 41.

kangaroo, and is well named the *kangaroo rat.* The example illustrated is of wild buffalo horn, heated and pressed to shape.

The kangaroo rat described by R. Brough Smith is about 26 inches long, the tail being 21 inches and the head 4.5 inches.[43]

Something like the kangaroo rat of the Australians is a missile employed in a game of the Fijians.[44] A reed four feet in length terminates in an ovoid piece of hard and heavy wood six inches long. It is held between the thumb and finger and thrown by an underhand jerk, so as to skim horizontally over the ground. A long smooth stretch of turf is kept in good order in the villages for this purpose. This suggests the pitching of quoits and horseshoes, curling stones, hockey, polo, and other ball games, which we merely suggest as we pass, supposing them not to be distinctly savage, though some of them are athletic survivals of ancient barbaric exercises.

The *chakra*[45] or "quoit weapon" of the Sikhs is savage enough to be worth a mention. It is an annular disk of thin steel with a sharp edge all round. It is whirled upon the fore-finger and then thrown, spinning as it flies, and is a formidable weapon when aimed at the face of an enemy, several being hurled in rapid succession and with great force. They can also give it a ricochet flight.

A similar weapon has been brought from Guatemala by M. Boursier, the French Consul. It is disk-shaped, very sharp on the edges, and about 6 inches in diameter. Hurling-disks have been found also in Brittany and Central France.

The Peruvian hurling-disk is of diorite with a central opening 1 inch in diameter and 10 circumferential teeth 2 inches long. It is thrown by aid of a thong like the bolus. The Mexicans have a similar weapon[46] and the Australians a crude affair of the same general idea.

From this cutting disk whirled by the finger we reach by a single step the simple pebble which is hurled by hand. We began with a stick, and after considering the club simple and compound, and the various forms of throwing clubs, have come to simple missiles—the pebble or small bowlder. Some tribes, however, are not content with the stones of the brook, but shape the projectile; the Tahitians,[47] for instance, make oval balls of stalagmite, which they hurl by hand with force and accuracy, not using a sling. The Fuegians, although very skillful with the sling, are adepts at hurling stones by hand.

Incendiary balls were used by the Nervii, who fired the camp of Cæsar, and the balls of charcoal kneaded with clay, and found in the lacustrine village remains in Switzerland, are believed to have been for the same purpose. The arrow with a lighted tow torch is commonly noticed among the ancients, and is found in all parts of the world where the bow and arrow survive.

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[43] Aborigines of Australia, i, Fig. 170, p. 352. [44] Wood, ii, p. 283.
[45] Wood, i. [46] Louvre collection. [47] Wood, ii.

The subject here naturally diverges and takes two separate paths. The projectile is loose and is hurled by a stick or a sling; or it is attached to a string which flies with it. We shall consider these separately and in the order stated.

The sling is an unimpressive object when hung up among a thousand other things in a collection, and how many were overlooked by the writer at the Centennial it is not possible to say. The example, Fig. 31, was in the National Museum exhibit in the Government Building, having been obtained from the Navajoes of New Mexico. Slings are rarely used among this people at present, except by boys. They are, however, mentioned in the old account of the "Journey to the Seven Cities of Cibola." There is no doubt about the antiquity of the device. It is mentioned frequently in the Hebrew writings, and is shown on the Egyptian[48] and Assyrian monuments.[49] The Roman sling was named from its *funda* or purse which contained the projectile. Besides its ordinary use for hurling stones, leaden balls (*glandes*) were used; these were ellipsoidal plummets, often with inscriptions upon them, as "FIR," for *firmiter*, "throw steadily"; Grecian bullets also, marked with the figure of a thunderbolt, or the inscription δεξαι, "take this," have been found. Schliemann[50] recovered from the excavations at Hissarlik sling-bullets of loadstone, copper, alabaster, and diorite. The *fustibolus* was a four-foot pole, which had a sling attached in the center, enabling both hands to be used in throwing.

FIG. 31.—*Navajo sling.—National Museum.*

The sling is not so universal a weapon that a statement of the countries where it is used becomes a mere geographical recitation. The Javan sling[51] (*bandring*) is noticed by Sir Stamford Raffles. The Fijians, as already stated, excel in its use. The sling of the Sandwich Islanders[52] is a double thong with a stone receptacle of plaited sinnet. The stones are egg-shaped and ground for the purpose. Another form of Hawaiian sling has an oval stone with a circumferential groove, and is hurled by a cord passed around it and secured by a sailor's half-hitch so as to be released when the thong is jerked back to discharge the stone. A similar mode of hurling the spear is found in South America. The Marquesas Islanders[53] use slings of plaited grass, as much as five feet in length, and hurl stones of considerable size. The natives of New Caledonia[54] have a sling (*wendat*) which is a double thong with a purse in the middle made of two parallel cords. The stones are a hard kind of steatite ground to an oval shape and polished. They are carried in a net at the right side and are discharged after a half whirl of the sling. Some of

[48] Kitto, i, 370.

[49] Layard's Nineveh, Pls. vi, vii, ii, 263. Xenophon's Anabasis, *lib.* iii, *c.* 3.

[50] Schliemann's "Troy and its Remains," 101. Nos. 66-7-8.

[51] "Java," 4to, Pl. iv, opp. p. 296, vol. i; Fig. 22.

[52] Wood, ii, p. 434. [53] *Ibid.*, ii, p. 390. [54] *Ibid.*, ii, p. 205.

the New Caledonian sling-stones are shaped like two spherical segments, joined at their bases, giving a sharp circumferential ridge. The same form is found in New Zealand and in the stone age missiles of Sweden.

Wooden slings and ribbon slings were used by the ancient inhabitants of Sweden, and slings of bast are in the museums of Lund and Stockholm.[55] Slings of plaited flax are among the lacustrine remains of Neufchâtel.[56]

The Solomon Islanders also use slings. The Fuegians[57] excel in the use of the sling, as well as of the bow and arrow and spear. The sling has a pocket of seal or guanaco skin and two thongs three feet in length of twisted sinews. The natives throw with great force and accuracy.

Pliny ascribes the invention of the sling to the Phœnicians. He always had a guess to make; sometimes a very wild one. The Balearic Islanders[57a] were celebrated for their expertness in its use. The slingers of the Greek and Roman armies were considered an inferior class of warriors, the sling being but an auxiliary weapon.

Another mode of slinging is by means of a stick thrust through a perforated stone and whirled so as to discharge the missile when it has attained a maximum centrifugal motion.

Fig. 32 shows two throwing-stones from Peru, adapted to be slung by a stick which is thrust into the hole. The Peruvians were very expert in the use of the sling.[58] Whorls of star shape were found in great quantities by Schliemann in the excavations at Hissarlik.[59] Although they may be considered spindle whorls, it is altogether probable, so great was their number, that they were ammunition. Disk-shaped and cylindrical throwing-stones perforated for the stick are found among the remains of the Lake Dwellers.[60] The Fijians have a rough game of jerking stones at each other with elastic bamboo.[61]

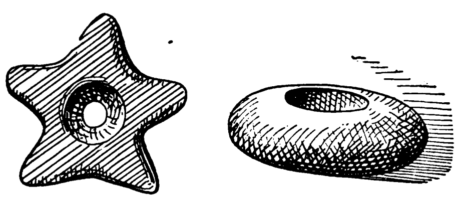

FIG. 32.—*Throwing-stones, Peru.*

Numerous stones fashioned into shapes, and many of them with circumferential grooves, are to be found in European and American collections, labelled *plummets* (net-sinkers), *sling-stones*, &c., according to the fancy or opinion of the discoverer or owner. The same may be said of American perforated stones which may be plummets or gorgets. There is a tendency to give a warlike signification to such finds recovered in the soil, in mounds or in graves. The civil uses of these objects were probably much more frequent than the warlike; as the search for food is a

55 Sven Nilson "On the Stone Age." Ed. by Sir John Lubbock, pl. v, pp. 49, 53.

56 Morlot in Smithsonian Report, 1863, p. 377.

57 Wood, ii, p. 517.

57a Cæsar's Comm., ii, 1.

58 Prescott's "Conquest of Peru," i, 72.

59 "Troy and its Remains," No. 444, Pl. xl.

60 "Culturgeschichte," Taf. 2, Figs. 60–63.

61 Wood, ii.

more constant occupation than war. (Cf. Sven Nilson, edited by Sir John Lubbock, London, 1868.)[62]

We now pursue the other branch of the section, in which the ball remains attached to the cord by means of which it is projected. The simplest form of this is the single stone or metallic ball sewed up in raw-hide and attached to the end of a thong a yard long. This, the *bolas perdida* of the Spaniards, is whirled rapidly around the head and then launched at the enemy or the game. A similar ball at the end of a shorter thong is used as a slung-shot.

The *bolas*[63] of South America consists of two or three balls at the ends of as many raw-hide thongs, about nine feet long, which are tied together. The *bolas* is swung around the head of the rider, the junction of the thongs being in his hand and the balls flying in a cluster. As soon as they are launched at the game, the balls fly apart by their centrifugal force, and, still flying round, have a movement of translation in the direction of their projection. As soon as a thong strikes the object, the balls coil around it in contrary directions, binding and entangling it according to the intention of the thrower. This is not too much to say, for the Patagonian will bind the rider to the horse, or tie the legs of an animal together or to the body at will.

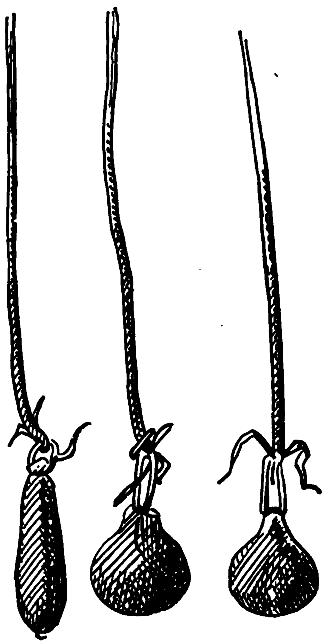

FIG. 33.—*Bolas of Paraguay, Argentine Confederation.*

Stones of ovoid form made of trachytic tufa and perforated for raw-hide straps are used by the California Indians.

Figs. 33 and 34 show the *bolas* exhibited at the Centennial by the Argentine Republic. They consist of stones or balls of clay in raw-hide pockets at the ends of twisted thongs of raw-hide. The specimens differ much in weight, from one-quarter of a pound to one and a half pounds, and in size from one and a quarter inches to three inches in diameter. They are sewed up in their envelopes, and in one case openings are made to expose the bright red color of a peculiar stone of the country. It is the duty of

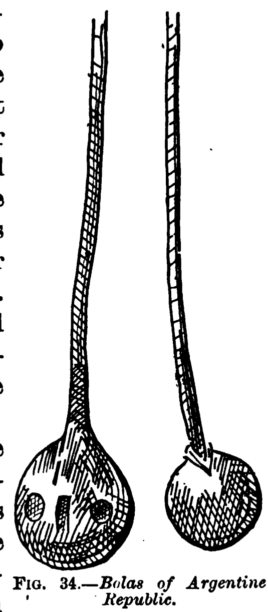

FIG. 34.—*Bolas of Argentine Republic.*

62 Sven Nilson, Pl. ix, Fig. 216; Pl. ii, Fig. 31-35.

63 Page's "La Plata," 112.

the women to cut and grind these stones, but in some cases iron or even copper balls are used, the metal being preferred when attainable on account of its being smaller for a given weight. There is some variation in the arrangement also: (*somai*) two *bolas* at the end of 9-feet thongs; (*achico*) three *bolas*, one on a rather longer thong; or one of the thongs has attached to its mid-length a pair of balls on the end of three-foot thongs. The range of the *bolas* is from 30 to 40 yards. The natives, when in danger, wear several cuirasses of stiff raw-hide as a guard against them, the armor being put on like a poncho—over the head, which is thrust through a slit in the hide. The helmet is of double bull-hide. The *bolas* is used throughout the Argentine Republic, by the Gran Chaco Indians of La Plata, the Araucanians (called by them *laqui*), and the Patagonians; being, in a large portion of the territory mentioned, the principal means of capturing wild animals. The guanaco, a species of llama about the size of a deer, is the main dependence for food and clothing of the Patagonians.[64] See Muster's account of the Tehuelche Indians.[65]

Passing at one bound to the other extremity of the American Continent, we find the Eskimo[66] in possession of the same weapon, but on a smaller scale, as befits the game it is intended to capture. It consists of eight or nine strings, about thirty inches long, and fastened together, their free ends being attached to little weights like plumb-bobs, made of bone, walrus-tooth, or stone. The cords are of twisted sinews or intestines. The balls are whirled around the head two or three times and then sent flying through the air like a large cobweb, lapping with surprising quickness around any object which may be struck by the cords. It is used principally in catching birds.

The lasso was shown in the exhibit of the Argentine Confederation, in the main building. It is a rope 40 feet long, made of raw-hide strips plaited into a round rope, excepting a few feet at the noose end, which is plaited square and is fastened around an iron ring, through which the lasso passes to form the noose. The Araucanians use a lasso of silk-grass fiber from the leaves of an agave. It has no ring for the noose, but a loop of the agave fiber covered with leather. In using the lasso, the ring is taken in the left hand and a noose six feet in length is made; the right hand then grasping the cord and the ring, the rider takes another six feet in his hand and whirls the noose around his head until it becomes circular, when he hurls it at the object, throwing after it the remainder of the rope, which hangs in coils on his left arm. As it passes through the air the noose becomes smaller, so that the diameter of the noose is graduated to the size of the object it is intended to capture. It is not a little singular that this form of lasso, a noose running in a metallic ring, was a weapon in the armies of the former Singhalese monarch.[67]

[64] Wood, ii., p. 532.

[65] "At Home with the Patagonians," p. 166.

[66] Wood, ii., p. 711.

[67] Tennent's "Ceylon," i, 499.

strangling noose, a few feet long, with a bone or wooden pointed at one end and a worked eye at the other, is used by the Australian rrote a sleeping enemy. Passing the noose over the head and ting the skewer through the loop, he throttles his victim, who is less to make a noise, and, throwing him over his shoulder, carries rom the camp.[68]

II.—Axes.

he name of a tool is to be determined by its shape and mode of , the first axe was of wood. The Australian department showed al bludgeons, the enlarged flattened ends of which had sharp edges. of blue gum (*Eucalyptus globulus*), a hard heavy wood, they are nt weapons in war unting, though not le for felling timber. They are shown at n Fig. 35; *c d* are New Zealand, and om the Haidah Indians of Bella-Bella, British Columbia.

transition from one ial to another may ced in many coun yet-existing tools; ange is one of the interesting problems of the archaist and logist, and it is recorded in a Chinese ion: "Fuhi made ns; these were of ; those of Shin were of stone; then u made metallic

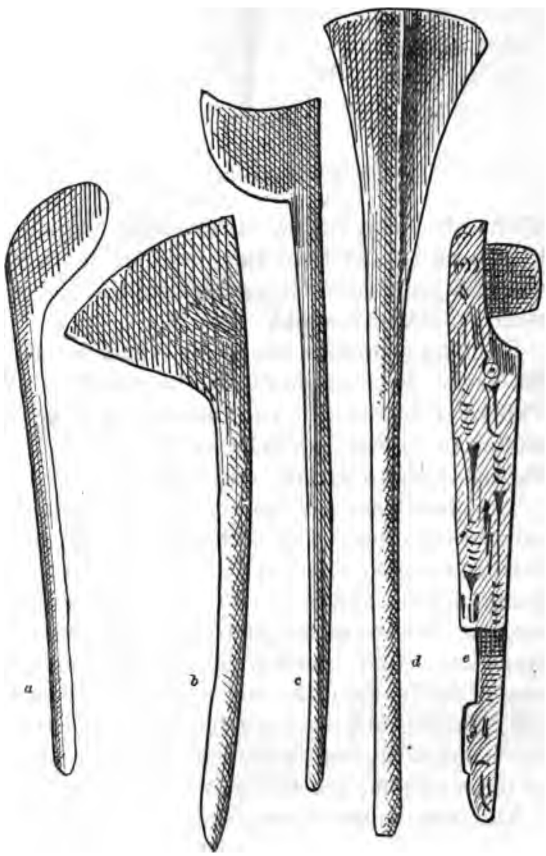

Fig. 35.—*Wooden axes, from Australia, New Zealand, and British Columbia.*

er the club or slung, in which a bowlder unted on a withe, und to a stick, or at the end of a raw-hong, comes an at to give a cutting edge to the tool. It need not be merely as-1, as it is capable of demonstration, that the mounting of un-ght spalls of stone preceded the fashioning of stone axes. The

[68] Smith's "Aborigines of Victoria," i, 351, Fig. 169.

New South Wales exhibit showed a collection of spalls of greenstone and sandstone obtained by the natives by merely dashing bowlders together and picking up the pieces which most nearly approximated the desired form. Those shown in the collection were of sandstone, con-

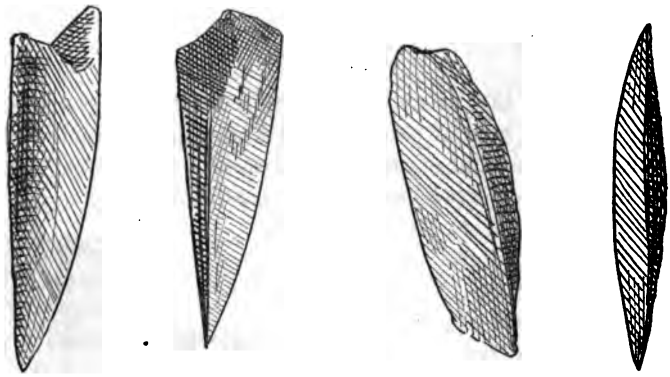

FIG. 36.—*Stone spalls for axes, Clarence River, New South Wales.*

glomerate, slate, basalt, and trachyte. Such axes, when helved, are used by the natives in ascending and for felling trees, cutting firewood, in war and the chase, and for cutting themselves to embellish their bodies with cicatrized wounds.

In many countries are to be found famous localities yielding stones for axes. In Nan-hin-fu, in the province of Kwantong, in Southern China,[69] they find in the mountains a heavy stone, which furnishes materials for cutting-tools for the region around. Obsidian is used in Mexico, Khamschatka,[70] and elsewhere.

The stone axes and adzes of the Philadelphia Exhibition may be considered together. The difference in the tools is in the relation of the cutting edge to the handle. In the axe the line of the edge is in the plane of the handle. In the adze the edge is across the plane of its sweep. The examples afforded us may be classed in two divisions: first, stone and shell; second, metal. The subdivision which will be most useful will be as to the four methods of mounting the axe-head in or on the handle; and we have instances of each in the stone axes, and of three out of the four in the metallic axes, and this without going outside of the crude implements shown in Philadelphia.

The four modes of mounting or helving an axe are:

1. By winding a withe around it.
2. By lashing it to a seat on the handle.
3. By passing the tang through a hole in the handle.
4. By passing the helve through a hole in the head.

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[69] Grosier, "*De la Chine,*" Paris, 1818, i, 191.

[70] Erman, "*Reise,*" iii, 453.

e adducing examples of each of these methods, we may simply he stone hatchet from New Zealand, which is used independently ıdle, and is a hand-to-hand weapon, like some of the *merais* or *pátu-* hown in a previous ar- d considered character- the Maori race.

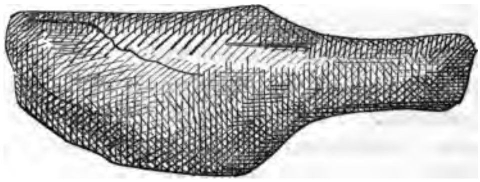


FIG. 37.—*Maori stone hatchet, New Zealand.*

ɔ some of the methods :ing the axe-head to the :e considered indicative ιin tribes and peoples, ɔt be said that any pe- ıode is found at a certain place or in such a tribe and nowhere n fact, it may be stated that among the various tribes of North ın Indians all the modes cited may be found, and specimens from strine dwellings, to be seen in the museums of Europe and Amer- w that all the modes stated were in use among the early inhab- f Europe.

:8 shows three native stone axes: *a* from Victoria, *b* from South ia, and *c* from the ɔuntry of the Mis- ılley. They agree ıode of fastening d to the handle, ɔeing bent around ssion in the stone ıred by lashings; ill depend upon erial at hand. In of the stone axe *a*, from Victoria, ıd is a chipped ɔne 2 by 4 inches, ounted in a withe oss and "black- n." The weapon ır in advance of ɔf the present na- ho use the rudest xes, mere spalls, described, and n Fig. 36. The natives say that this *mogo* was made by a people :ceded them and of whom they have no knowledge. It need not account be necessarily very old, but it seems that it was some- ' a local curiosity to the particular tribe in which it was found.

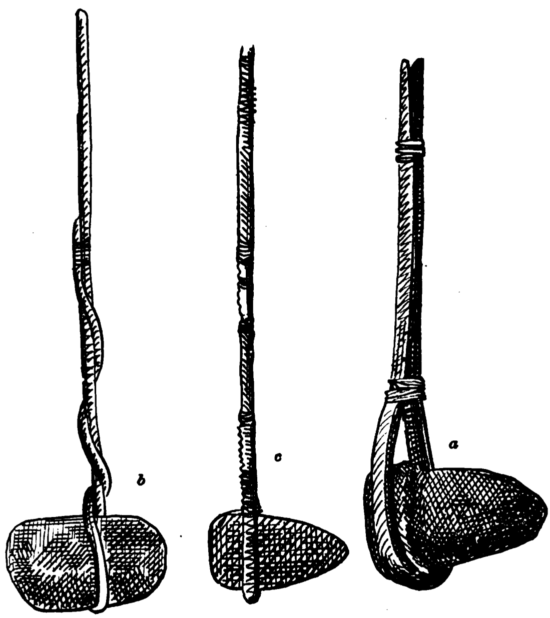


FIG. 38.—*Stone axes of Australia and America.*

kad-jo, *mo-go*, and other stone tomahawks of Australia are well ted and described in a careful treatise just published by R.

Brough Smith.[71] They are of granite, quartz, &c., one edge chipped sharp, a poll left relatively flat; all adapted to be handled with withes, unground, and secured by gum.

In New South Wales the natives take for the handle the flowering stem of the *waratah* or native tulip, or the vine of *pepperoma*, or they carefully split the small water gum of the streams, and, by the action of fire, make the piece pliant and wrap it like a withe around the stone axe-head. They next take the resinous and brittle gum of the grass-tree (*Xanthorhœa*), which they knead and toughen by the fire process. With the heated gum they cover the equator of the stone and take around it one or two turns of the pliant withe, securing its junction with a thong of the bark of the *coorajong* tree; they then fill that part of the handle secured around the stone with the melted gum, and the weapon is ready for duty in a few hours. By the aid of this instrument the natives chop notches for the toes in ascending high trees, cut out the opossum, or tap the trees for honey; with it they also fashion *waddies*, *boomerangs*, and other wooden implements, and crack the bones of animals for the marrow. In some portions of the island, sinews from the tail of the kangaroo do duty as lashings. The sinews are steeped in hot water, pounded between stones to separate them into filaments, and, while yet pliable, they are wrapped around the stone and the handle; in drying they shrink and hold the objects together with great firmness. The lashing is then covered with the "black-boy gum" of the grass-tree.

The *celt* or stone axe is one of the most common objects in museums, and generally shows its adaptation to a withe handle.[72] In the excavations at Hissarlik, at a depth of from 23 to 33 feet below the present surface, Dr. Schliemann recovered well-made axes of diorite and of hard and semi-transparent greenstone.[73] One of these was fractured at the eye, but they were generally adapted for withe handles. So common is the *celt* that it has entered into the superstitions of various nations, and is supposed to be a "thunder stone"[74] and to have fallen from the sky. This idea is prevalent in China, England, India, Brittany, Finland, Japan, Brazil, Madagascar, and elsewhere.

Axes of the second class, lashed to a seat on the handle, had numerous representations at the Exhibition. Fig. 39 is a stone designed to be mounted as an adze, and Fig. 40 shows a greenstone blade lashed to a handle formed of a limb with a portion of the adjacent trunk. The fastening is evidently but a substitute for the original elaborate lashing, which had fallen off. Some of the Maori adzes are of green jade. Another stone, locally known as *toke*, is also used, but is much inferior to the former in quality and appearance. Cf. black basalt adzes found in

[71] "Aborigines of Victoria," Melbourne, 1878, i, pp. 359–380. Figs. 175–198.
[72] Dr. Abbott, in Smithsonian Report, 1875. Figs. 11, 19.
[73] Schliemann's "Troy and its Remains," p. 21, No. 2; p. 94, No. 56.
[74] Tylor's "Early History of Mankind," pp. 208, 210–211, 222–227.

Scania, Sweden,[75] and at Nootka Sound; also, the flint axes of Scandinavia, which are never bored, but are rough chipped and unground.[76] Axes of diorite, greenstone, and basalt have sometimes holes bored through, by which to suspend them.

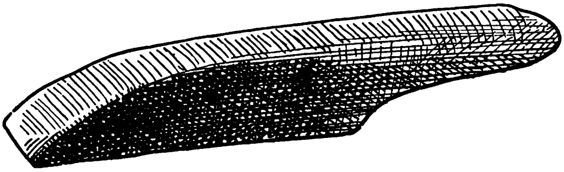


FIG. 39.—*Stone adze (unmounted), New Zealand.*

Fig. 41 is a stone adze (*koipele kainoa*) from the Sandwich Islands; it is nine inches long. Fig. 42 is a shell adze from a shell heap on Saint John's River, Florida. The adze of the Pelew Islanders[77] is made of the shell of the giant clam. Shell is used as a

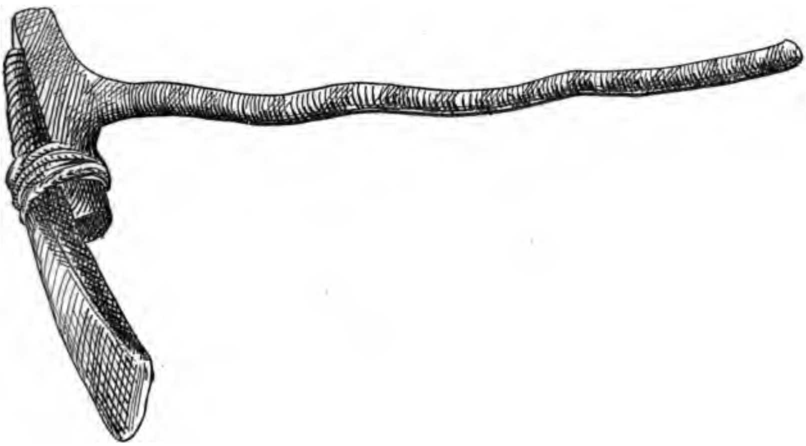


FIG. 40.—*Maori adze, New Zealand.*

material for cutting instruments in many places where stone and metal are rare; such as were formerly some of the West Indies and some islands of Polynesia and Oceanica. The Pelew Island implement may be turned

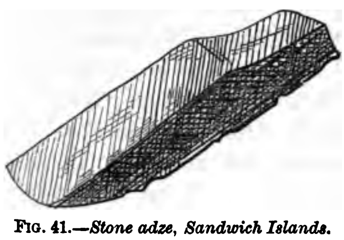


FIG. 41.—*Stone adze, Sandwich Islands.*

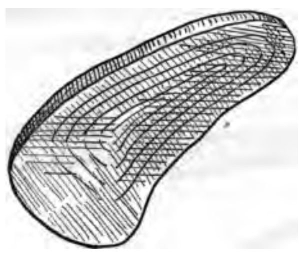


FIG. 42.—*Shell adze, Saint John's River, Florida.*

in the head so as to be used as an axe or an adze. The same adaptability may be found in an iron axe-adze of the Dyak of Borneo. The war axe

[75] Nilson's "Stone Age," Pl. vii, Figs. 147, 150, and page 62.
[76] *Ibid.*, p. 64, and Pl. vii, Fig. 153.
[77] Wood's "Natural History of Man," ii, p. 450.

of the Fijians is shown in Fig. 43. It was exhibited in the Main Building. Its stone head is carefully lashed with braided sinnet to an elaborately carved wooden handle.

The stone adzes of the Marquesas are most accurately shaped and finished, especially those of a ceremonial character. The handles of such are fairly honeycombed with carvings, in such a manner that a central handle appears to be surrounded by a sort of filigree or incrustation of geometrical work. The lashings of plaited coir (*sinnet*) are very elaborate and carefully laid. Specimens obtained by the Wilkes Expedition are in the National Museum of Washington, D. C.

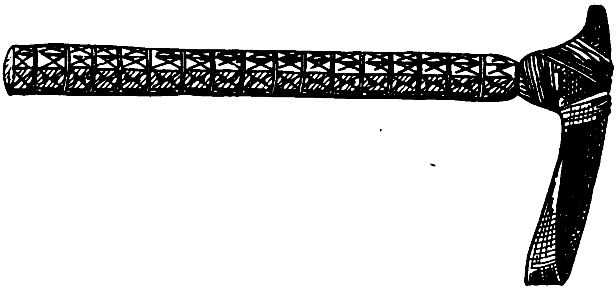


FIG. 43.—*Fiji war axe.*

The stone adze (Fig. 44) of the Makah Indians of Puget's Sound, California, shows an observation of the tools of the white man. The handle is evidently copied from that of a hand-saw which the native mechanic had seen and admired. The use of the stone and the method of lashing are, however, quite characteristic. Fig. 45 is an ice-pick of walrus ivory, lashed to a handle of pine. It is from the Magemut Eskimo of Nunivak Island. Fig. 46 is an Eskimo ice-pick made from a whale's rib, lashed with raw-hide thongs to a massive yew-wood handle. These picks are used for breaking the crust of snow and in keeping the seal-holes open. The specimen is from Anderson River, British America. The example (Fig. 47) shows another variation in the mode of fastening. Like the former, it is made from a whale's rib, and is lashed with raw-hide thongs

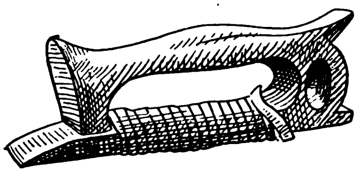


FIG. 44.—*Stone udze, Puget's Sound.*

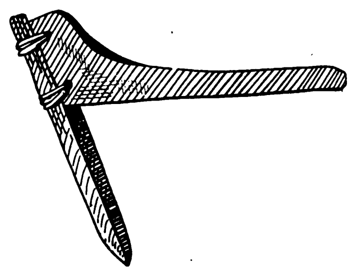


FIG. 45.—*Eskimo ice-pick, Nunivak Island.*

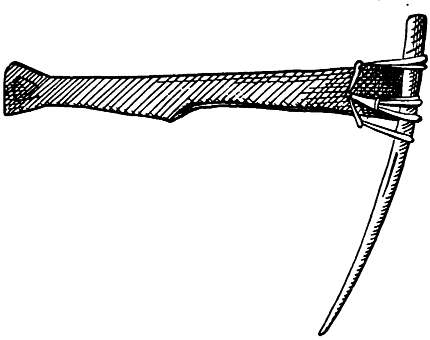
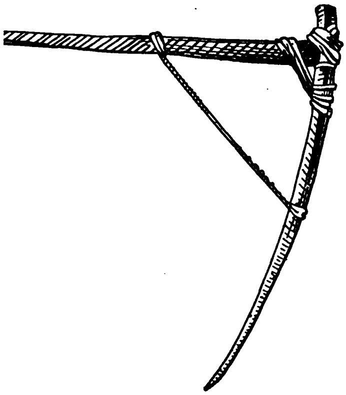


FIG. 46.—*Eskimo ice-pick, British Columbia.*

ıandle. It is from the *chook chees* (*Tschuck-tschis*) of Northeast The mode of fastening is much like that of the old Egyptian hown in Wilkinson's works.



-Ice-pick and skin-dresser, Siberia.

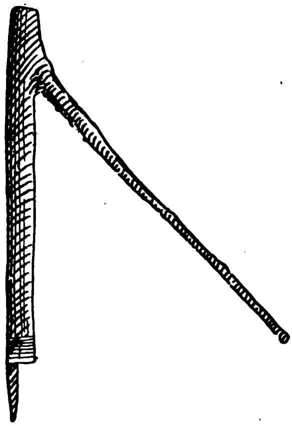


FIG. 48.—*Stone adze, British Columbia.*

is the last illustration we shall offer of this mode of attaching blade to the handle of wood. It is a small adze of argillite h twisted sinews to a handle formed of a forked branch. Such ;s were used in smoothing the insides of canoes. The main grasped by the left hand, and the smaller one by the right. :he Haidah Indians of Bella-Bella, British Columbia.

ch the third class of our first division and notice the single n the Philadelphia Exhibition in which a modern stone axe ted through a hole in the handle. This has been deemed cteristic African method, and with much reason, though of its adoption are found elsewhere; the New Caledonians, ;e, mount their axes like the Africans, putting the tang of the h a perforated knob on the end of the handle. As almost all ın tribes use iron, smelted and worked by native smiths, the instances of the African method will occur more frequently in the second division of the subject, which treats of metal.

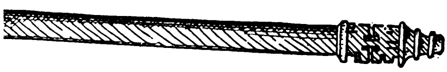


FIG. 49.—*Stone axe of Mozambique.*

The modern axe of greenstone (Fig. 49) is used in Mozambique, a Portuguese colony in ʟfrica. The bit is 8 inches long, and is lashed with strips of ;o a wooden handle, which is carved at the hand-hold. The covered with cowrie-shells, which form in part the currency tives; they answer, we may suppose, the same purpose as the nting of a dress-sword. The inhabitants, though well acquainted with metal, retain old habits, and among them the use of stone implements, in ceremonial uses perhaps, rather than in the business of life. That stone should linger after the advent of metal is not surprising when we reflect that the stone battle-axe was used by many of the Anglo-Saxons at Hastings, and some of the Germans were armed with it at so late a period as the "Thirty Years' War."

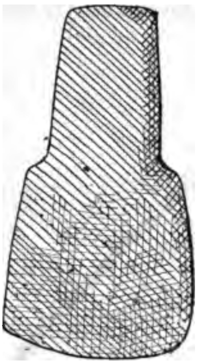


FIG. 50.—*Stone axe.*

Fig. 50 shows one of the articles generally catalogued as a "spade-like implement." It was possibly an axe adapted to pass through the handle and be secured by a lashing of sinew or raw-hide.

Fig. 51 shows five ancient implements obtained in various parts of the United States, from mounds and elsewhere; *a*, *b*, and *d* are from Louisiana; *e* is from Iowa; *c* not noted. The three last examples are double-headed ceremonial axes, and do not materially differ from examples in the figure following, excepting in not being perforated for the handle. The frequency of the omission indicates that the two methods of mounting were simultaneously employed.

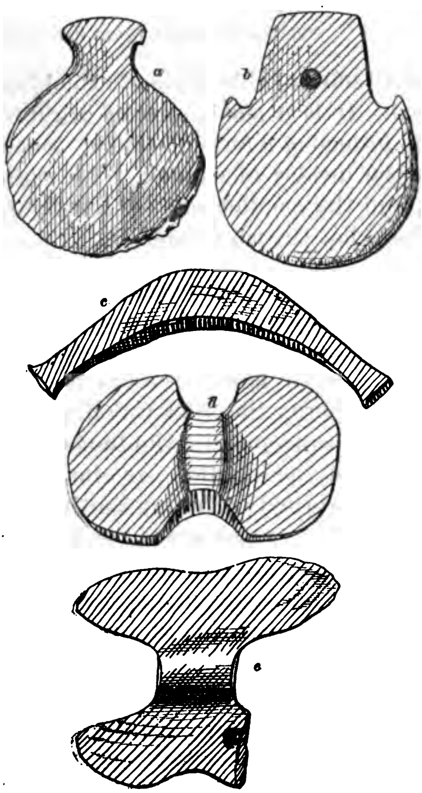


FIG. 51.—*Axes from Indian mounds, &c.*

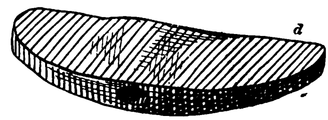
This brings us to the fourth class—perforated axes, which are considered by Sir John Lubbock as probably characteristic of the early metallic period in Europe.[78]

It was long thought that the perforation of the axe-head did not occur until the implement came to be made of metal. It is true that the labor of boring in stone without the aid of metal and the weakening of so frangible a material might exclude that mode of mounting; but it must be recollected that time is of no moment to a savage, never having read Solomon or Dr. Watts, and not taking lessons from insects—which are simply a nuisance and point no moral in Africa.

The examples of perforated stone axes at Philadelphia (Fig. 52) were from various parts of the United States, and were shown in the Na-

[78] Lubbock's Introduction to Nilson's "Stone Age," xxix.

onal Museum in the Government Building. They are ancient and are ›nerally supposed to be of a ceremonial character. It was either not ›ted or was not observed where *a* was from; *b*, *d*, and *g* were from Wis›nsin; *c* from New Jersey; *e* from Connecticut; *h* from Pennsylvania. o the practice of making the perforated *bipennis* in stone was widely ›read. It may be mentioned that the hole in *h*, Fig. 52, is only rudiıentary. A fine selection of per›rated axe-heads from Denmark ı in the Peabody Museum, Cam-



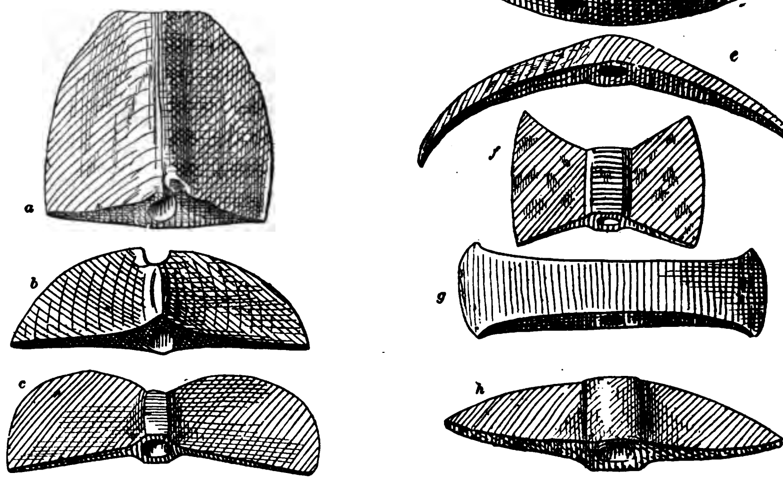


FIG. 52.—*Double-bitted perforated axes.*

›ridge, and a great many more at St. Germain, France, and in the museum of Geneva, Switzerland. This object is called a "banner stone" in Abbott's article on the Stone Age in New Jersey[79]; compare also Nilıon's "Stone Age."[80]

The *bipennis*, or double-bitted axe, was the weapon of the female war'iors of Scythian race known as Amazons. It was also known in As›yria. Its antiquity may also be assumed from its being the sacrificial ıxe of the Roman priesthood: *Dolabra pontificalis*. The old *scena* or *'acena* of the Latins had two cutting edges, large and small, the former *'ecuris;* the latter *dolabra*. It may have been copied from the agricul›ural axe *dolabra*, which was something like our mattock, with an axe ›dge and a pick on the respective ends of the head, and was used in ›utting wood and clearing land of bushes and grubs. The *dolabella* was :he small axe or bill-hook. The sacrificial *malleus* was a round ball per'orated for a handle, and it also seems to indicate the long-sustained ıse of very primitive forms of weapons and implements for ceremonial purposes.

Many copper battle-axes were recovered by Schliemann from a depth of 28 feet in the ruins of Hissarlik.[81]

[79] Smithsonian Report, 1875, p. 332.
[80] Nilson, Pl. viii, Fig. 173 and p. 71.
[81] "Troy and its Remains."

We have now reached the second division of axes, those of metal. In this section we can scarcely preserve the quadripartite subdivisions of the stone group. The collection, however, furnished good specimens of crude workmanship in two classes of axes—those which are lashed to a seat on a handle and those which perforate the handle.

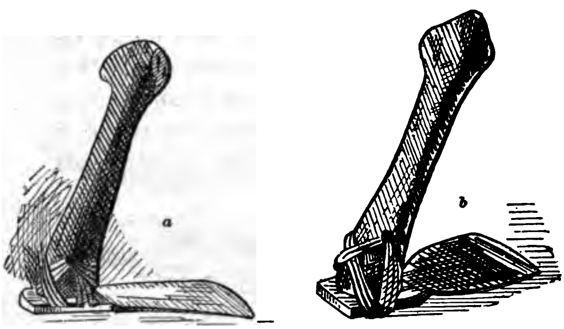


FIG. 53.—*Eskimo adzes.*

The examples of those which are lashed to a seat on the handle are, singularly enough, tools in which iron blades obtained from the whites have been attached to handles in the manner previously adopted with stone tools. Fig. 53 shows two adzes of the Anderson River Eskimo, the handles of which have been ingeniously fashioned to fit the hand. The blades are both made of hatchet heads, in one case (*a*) the eye is made use of in lashing the handle to the iron; in the other case (*b*) the eye has been ground away, and it is secured to the handle by thongs in the manner of a stone celt. The tools indicate both the inveterate habit of mounting and also the preference for the adze method of using.

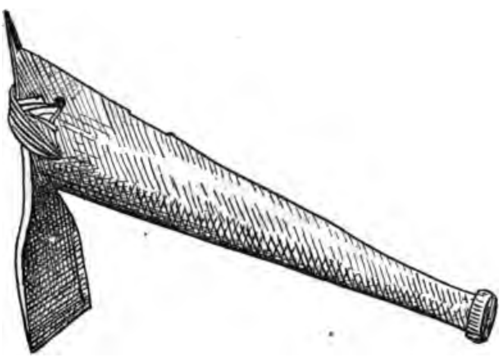


FIG. 54.—*Greenlanders' adze.*

The Greenlander's adze (Fig. 54), shown in the Danish department of the Main Building, is made of a common 2½-inch chisel strapped by a seal-skin thong to a beech wood handle about a foot long. Fig. 55 is a small hand adze or chisel with a bone handle. The blade was originally a hatchet of which the eye has been split and a piece removed. The handle shows an imitation of a saw-handle. It is from the Haidah Indians of Bella-Bella, British Columbia.

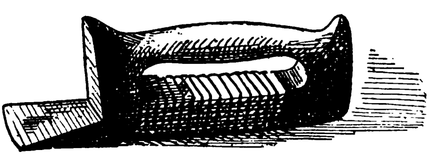


FIG. 55.—*Indian adze, Haidahs, British Columbia.*

The Javan axes[82] are mounted in different ways; two kinds, known respectively as *petel* and *wadung*, are chisel-shaped tools lashed to stocks whose natural growth as a fork facilitates that method; another, called

[82] Raffles "Java," 4to, i, 174, Figs. 1, 2, 4.

k, has an eye for the helve in the manner next in order to be con-
l.

Javan battle-axe (*kudi tranchang*), formerly a principal weapon of
[83] is not now much used, and is suprisingly like a freakish weapon
y the natives of Central Africa.

Japanese axe is a compromise, its bent tang being held by a ring
slips on the handle.[84]

ca furnishes us with the greatest variety of the axes which per-
forate the handle. Beginning at the south, we find the Kafirs[85] in possession of an axe, but their principal weapon is the
, a javelin made by their native blacksmiths. With the *keerie* or
lub, shield, and assegais, a Zulu considers himself well furnished.

apanese
e.

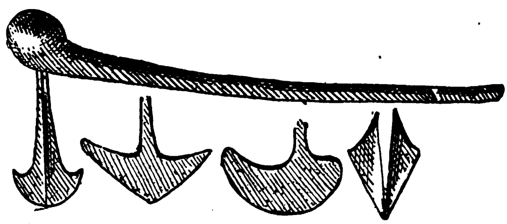


FIG. 57.—*Bechuana axes, South Africa.*

Bechuana axe, Fig. 57, is a steel bit simply fastened by a tang in
arged wooden head. The term Bechuana may be used generally
ıde a number of tribes, embracing the Makololo,[86] who are among
st accomplished workers in metal on the continent.

smaller axes in Fig. 57 are other patterns, made by the Bechuanas;
g. 58 is
l more
l one,
in the
ıguese
es De-
ıent of
ricultural Building. The head is of steel and the handle is in part
ed with fine wire. The blade is peculiar in form and ornamentation, and has what we should consider a rather insecure attachment to the helve. Fig. 59 is another axe of Angola, shown in the same collection; it has a curious curved blade and a long tang inserted in the
African method into the wooden handle.

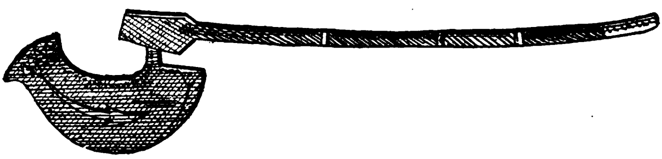


FIG. 58.—*Battle-axe, Angola, Africa.*

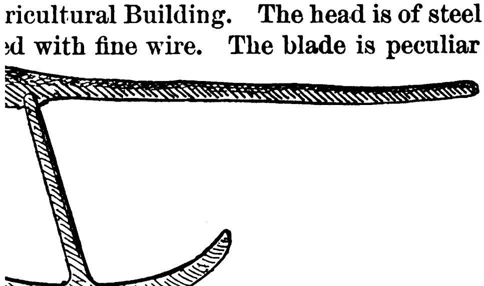


FIG. 59.—*Axe of Angola.*

elephant axe of the Banyai,[87] of the Zambesi, was also snown in

es "Java," 4to, i, Pl. opp. p. 296, Fig. 7.
old's "Nippon," vi, Pl. 6; also ii, Pl. 5 *bis.*, Figs. 14, 9, 15, 16, 13; also ii, Pl. 11, 13.
lis' "Basutos," 132. [86] Baines' "South Africa," 467. [87] Wood i, p. 404.

the group of Angola and Mozambique weapons, Fig. 60. It has a very long tang projecting entirely through the handle, and secured thereto by raw-hide lashing. One end has an axe-blade and the other a spear point. The handle is made by cutting off a limb of a convenient length, and also a small piece of the trunk at the insertion of the branch. A hole for the tang is then bored through the knotty wood, where the limb is as it were rooted into the body of the tree. The handle is then dressed to shape.

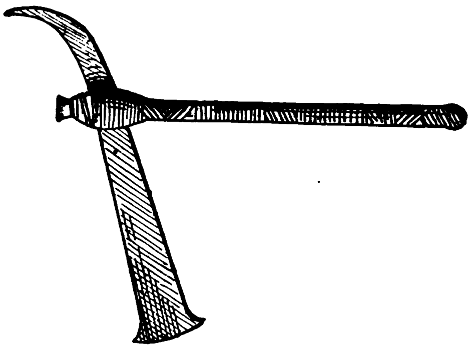


FIG. 60.—*Elephant axe of the Banyai, Zambesi, Africa.*

The blade is sometimes three feet in length, and is carried over the shoulder. It is used in ham-stringing the elephant. The hunters go in pairs, one carrying the axe while the other goes before the animal to distract his attention. The axeman comes up behind stealthily and severs one ham-string of the animal at a single blow. One form of the elephant axe was noticed to have a curved handle and a stay-lashing at a point six inches distant from the socket.

The Banyai of the Zambesi have also a convertible axe and adze. The knob of the handle has two slits at right angles, so that the tang of the blade may be optionally inserted either to bring the edge in line with the sweep of the tool, as with the axe, or transversely, as with the adze. Curiously enough the Water Dyaks, of Borneo, have a chipping tool of the same kind used in boat-building.[88] It has an iron blade, wooden head, and ratan (Malay *rôtan*) lashing. The blade has a square tang, and by taking it out of the socket, turning it one-quarter round, and inserting it again the blade is changed, in reference to the handle, from an axe to an adze, or *vice versa*.

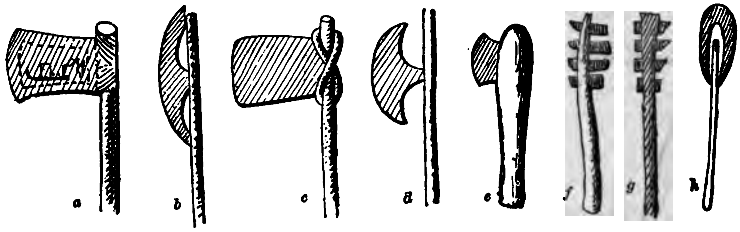


FIG. 61.—*Axes of Egypt, India, Mexico, and Yucatan.*

The Djibba axe has two pointed prongs projecting lengthwise from the head to make it efficient in thrusting. The Monbuttoo axe,[89] following the universal African type, has its tang inserted through the thick end of a knobbed club.

[88] Wood, vol. ii, p. 453.

[89] Schweinfurth's "Africa," vol. ii, p. 112.

Fig. 61 shows that this system of inserting the blade in the handle has been practiced in far distant times and places. *a b* are ancient forms of Egyptian bronze axes.[90] *c d* are ancient axes from the Sachi tope[91] at Bhilsa, in Central India. *e* is an axe shown on a Mexican monument. The obsidian or copper blade is inserted in the handle. *f* and *g* show the instrument known as *mahquahuitl*, a double-headed axe with obsidian

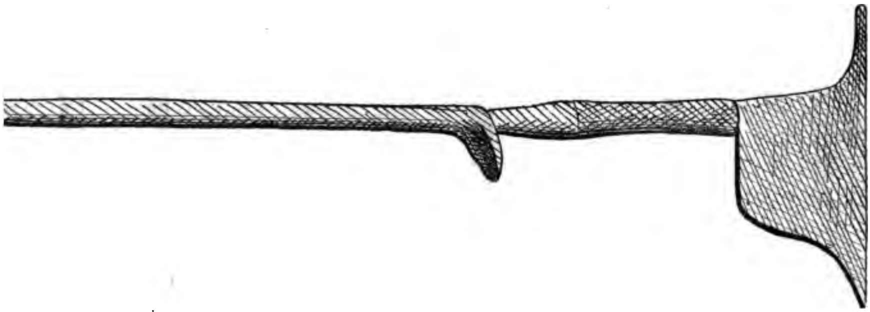


FIG. 62.—*Axe of the Philippines.*

flakes inserted in wooden handles. *h* shows a copper axe of Yucatan, the plate being inserted in a slitted handle. The battle-axe was the weapon of the Peruvian soldiery.[92] Numerous Trojan battle-axes of copper were found by Dr. Schliemann at Hissarlik.[93]

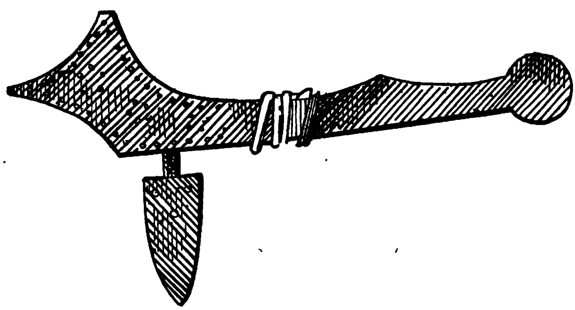


FIG. 63.—*Casse-tête, Dakotah.*

The axe of the Philippines was shown in the Spanish Building. It has a peculiarly shaped head and a long ferrule. The hand-stop on the helve was the only instance of the kind in the exhibition. It is a sort of rudimentary guard, like a partial hilt on the two-handed helve. (Fig. 62.)

The jungle hook of the Singhalese (*wal-dakat*) and a chopping axe (*proa*)[94] are used for clearing brush and cutting trees. Even the poor Veddahs of the interior forests "have a little ax, which they stick in by their sides, to cut honey out of hollow trees."[95]

Fig. 63 is a Dakotah Indian war-club (*casse-tête*) ornamented with carving and armed with a leaf-shaped steel point. The peasant of Brittany carries a knobbed stick resembling the *Kafir knob-keerie*. (Fig. 1.)

[90] Kitto, vol. i, p. 507; "Duleth," p. 7.
[91] Cunningham's "Bhilsa Tope," pl. xv, Figs. 8, 9.
[92] Prescott's "Conquest of Peru," vol. i, p. 72.
[93] Schliemann's "Troy and its Remains," pp. 330, 331.
[94] Knox's "Ceylon," pp. 273–4.
[95] *Ibid.*, p. 61.

It is called a *casse-tête* by the French of the neighboring departments, but *pen-bas* by the Bretons.[96] See also the marble knob for a stick, found by Dr. Schliemann at Ilium.[97]

The same form is shown by Catlin to have been very common among the Blackfeet and other Indian tribes on the headwaters of the Missouri. An axe of Terra del Fuego, shown by Nilson, has a blade of iron inserted in the African manner in a wooden stock which has been dressed by flint tools.[98] Desor also shows hatchets of diorite, serpentine, and quartzite in sockets of buckhorn, which were mounted in a wooden handle by a lateral hole in the side of the club. In another case the stone was inserted endwise in a horn socket which was pierced for the handle.[99] In another case the stone in a horn handle had the position formerly occupied by the brow antler.

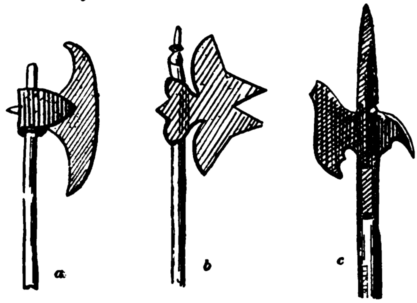


FIG. 64.—*Halberds, India and Norway.*

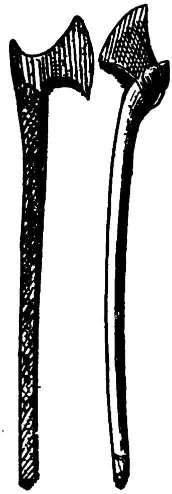


FIG. 65.—*Norwegian axes.*

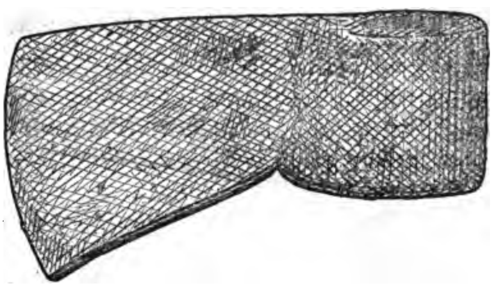


FIG. 66.—*Iron tomahawk, Dakotah.*

Fig. 64 shows three forms of halberds, light axes on long handles: *c* is from Norway and belongs to the class with a tang driven into the handle; *a b* are Sowrah battle-axes from India, and belong to the last class of our list—the handle inserted through an eye in the head. To this also belong the Norwegian axes (Fig. 65) and the Arickaree iron tomahawk (Fig. 66).

III.—KNIVES AND SWORDS.

The knife in its primitive form is a sharp flake of stone or obsidian, a sliver of bamboo or wood, or a shell with a sharpened edge. When the point is the specially engaged portion the weapon is a dagger. Many other crude materials furnish the hand-to-hand cutting or piercing weapons, such as the pointed horns of animals, the tail of the sting-ray,

[96] Trollope's "Summer Tour in Brittany," London, 1840, Pls. opp. pp. 125, 220, 296.
[97] Schliemann's "Troy and its Remains," p. 265.
[98] "Stone Age," Pl. vii, Fig. 155.
[99] Desor. transl. in Smithsonian Report, 1865, pp. 360, 361, Figs. 17, 18, 19.

's teeth tied upon a staff, and sharpened bones. When the dispo- exists a weapon will be found somewhere, and the most curious ose where the choice of material is but small and metal is inacces- Metal once obtained, the variety of weapons decreases, and s, daggers, and swords assume a somewhat uniform character.

persistent ceremonial use of stones for knives, after the use of had been fully established for the ordinary affairs of life, is notice- n many old records and in the observation of late travelers. We nention the stone knives used by the Egyptians, Ethiopians, and ws in circumcision,[100] by the Egyptians in embalming,[101] in obtaining lm of Gilead,[102] in the human sacrifices of Mexico, in the gashing flesh of fanatics,[103] and in inducing the cicatrized wounds which the ornaments or tribal marks of some savages. To these may be the gashing of the flesh New Zealanders in their ing, and the stone fleams y the North American In- for bleeding.

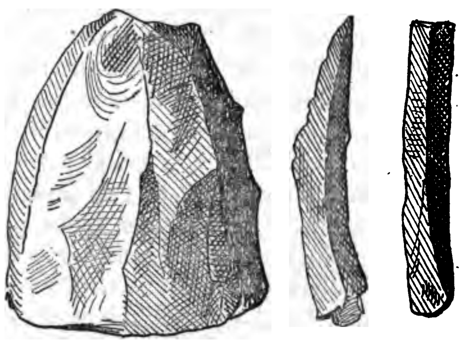
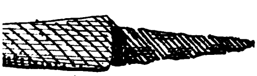


FIG. 67.—*Obsidian nucleus and flakes, Mexico.*

seums have crude stone and well-fashioned knives ne in variety, but we can ppeal for illustrations to llection in Philadelphia. upper and stone periods hill of Hissarlik in Asia , Schliemann found numerous flint knives.[104] Some have edges rdinary knives; others are serrated. At a depth of 23 feet he double-edged knives of obsidian, sharp as razors.



—*Obsidian knife, California.*

Flint flakes and nuclei from the stone age of Scandinavia, and flint knives from Greenland and New Zealand made of spalls, and others of chipped flint, are shown by Nilson[105] and by Dr. Abbott, of New Jersey.[106] idian was a favorite material where obtainable. It was used in o in the manufacture of sacrificial flake-knives, arrow-points, &c.[107] akes were split off by the skillfully applied pressure of a T-shaped n implement. The nucleus and flakes (Fig. 67) were shown in the nal Museum and are from Mexico. The same collection in the nment Building had the obsidian knife (Fig. 68). This has a

odus, iv, 25; Joshua, v, 2.
rodotus, ii, 86; Diodorus Siculus, i, 91; Kitto, i, 81.
iny, xii, 54.
id., xxxv, 46; xi, 109. Compare also Pliny, xix, 57; xxiii, 81; xxiv, 6, 62.
Troy and its Remains," p. 79.
Stone Age," p. 76 and Pl. ii; Figs. 24, 23, and Pl. iii, v.
nithsonian Report, 1875, p. 300.
rquemada.

wooden handle which shows the marks of a similar cutting instrument, and is therefore a veritable specimen of the stone age.

The Yellowstone Park has lately been stated to possess hills of obsidian of different colors, which have afforded for ages the material for the arrow-heads of the Indian tribes in the vicinity.

The flint knives of the Indians of the California peninsula are mentioned by Baegert.[108]

As far away as the Admiralty Islands of the Papuan group we find obsidian used for knives, razors, and spear-points.[109] The natives tie the spear-heads to the shaft with plaited string coated with gum. The knife used by the New Caledonians for carving the human body is called *nbouet*, and is a flat serpentine stone oval in form and seven inches in length. Holes are bored in it, by which it is fastened to a wooden handle. The New Caledonians eat their slain enemies, the women, who are the cooks, following the army and dragging the bodies off the field to prepare them for the supper of their returning husbands and brothers. The palms being considered as tid-bits, are the perquisites of the priests. Each part belongs to certain persons, and the carving is regulated by rules. The body is opened by the *nbouet* and the intestines removed with a fork made of two human arm bones sharply pointed and lashed together. The women cooks prefer to truss the bodies in sitting posture, bake them whole, and serve them in war costume.

Many collections show knives of flakes of silex mounted in wooden and horn backs,[110] and serrated knives or saws made by the insertion of flakes of obsidian, flint, or shark's teeth in a grooved wooden back. Some are mentioned later when referring to spears. Such are found in California, Sweden, the Philippines, Australia, and elsewhere. The knife[111] *dabba* of the Victorian blacks consists of quartz fragments attached to a wooden handle with gum.

Passing to knives of wood, we find none which would make impressive illustrations; in the South Sea islands wood has been the principal material; until lately stone was unknown in some islands, and metal in almost all. The Fijian knife for cutting up *bakolo* (long pig), as the edible human body is called, was a sharp sliver of bamboo.[112] The Ajitas of the Philippines and New Guineans also use the bamboo sliver.[113] The Sandwich Islanders have a battledore-shaped piece of wood[114] like the *merai* of the Maories, but armed on the edge with shark's teeth. It was formerly employed in cutting up the bodies of warriors who fell in battle, or of persons sacrificed. The Mundurucus of the Amazon use a

[108] Translation in Smithsonian Report, 1863, p. 363.
[109] Wood, vol. ii, p. 302.
[110] Desor. transl. in Smithsonian Report, 1865, p. 360.
[111] Smith's "Aborigines of Victoria."
[112] Smythe's "Ten Months in Fiji," p. 85.
[113] Wood, vol. ii, p. 242.
[114] *Ibid.*, vol. ii, p. 435.

amboo knife in decapitating their enemies to prepare the heads as trohies. The gentle savages are, however, not oblivious of the value of ietal when they have an opportunity to see it. Francis Sparrow, whom laleigh left to explore the country of the Orinoco, received eight beauiful young women for a red-handled knife—value in England at that ime equal to one cent.

The Australian dagger is a stick pointed at both ends, grasped by the iidlength, and struck right and left.[115]

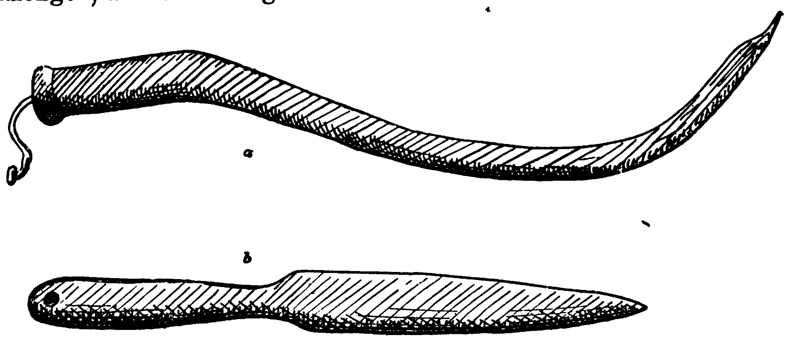


FIG. 69.—*Greenlanders' bone knives.*

In the extreme northern countries no material is so ready to hand as one. The harpoons, knives, and many other domestic implements of the skimo are of bone. Fig. 69 shows the fish and blubber knives of the lajak natives of Greenland. They were shown in the Danish collection ı the Main Building. *a* is made of the bone of a whale, and is 18 inches ing; *b* is of wood, and is 10 inches long. Fig. 70 shows two other bone nplements of the Kajaks, a bone knife used in skinning the seal, and fish scoop. The knife is 14 inches long and two and a half inches wide; he bone spoon is four inches long and two wide.

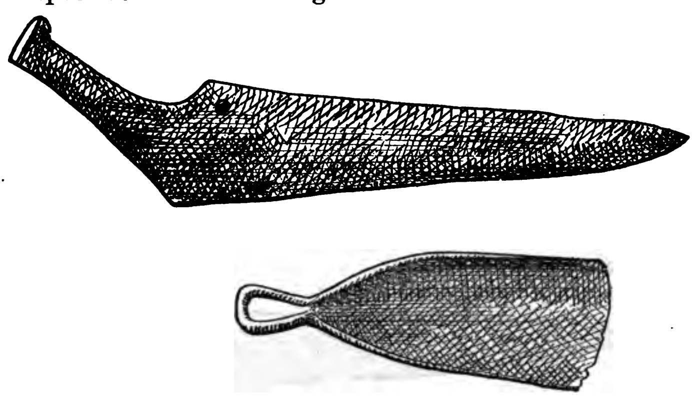


FIG. 70.—*Bone implements of Greenland.*

Some of the bone knives of the Laplanders are very elaborate, espeally those used in preparing skins.

[115] Smith's "Aborigines of Victoria," vol. i, p. 302.

The Eskimo in winter live in dome-shaped houses, called *igloos*, built of blocks of ice or snow. These blocks are *voussoir* shaped, so that they make a safe and symmetrical vaulted structure. They are hewn from the bank or field of solidified snow with large knives like Fig. 71, made of the bones of whales. Several of these knives were shown in the National Museum and in the Greenland department of the Danish collection. Two men, one to cut blocks and one to lay them, will erect a house in two hours. Just above the door a large plate of fresh-water ice is built in so as to illuminate the interior. Inside is a raised bench of snow, on which are laid sprigs and such scanty vegetation as the summer affords, to support the seal-skins which form the bed and bench. The dwellings are sometimes as much as 16 feet in diameter and 8 feet in height. The inevitable lamp is a stone dish with a wick of moss supported in it, and a quantity of oil fed from blubber piled upon it. This lamp is at once the warming and cooking stove, the light, the means of drying the clothes and melting the snow for drink, for the whole family occupying the *igloo*. Above the lamp is the cooking-pot, which also does duty in containing snow to be melted for drinking water. Above the cooking-pot (and by this time we are pretty near the roof) is a net spread to hold wet fur clothes, in order that they may be dried; after which they are chewed to make them supple.

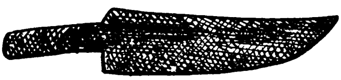


FIG. 71.—*Eskimo bone snow-knife.*

Poniards and pike-heads of bones of deer and urus are described by Desor.[116]

One or two other instances of animal material used in knives and daggers may be mentioned before we reach the metallic. The double dagger of the East Indies has two sharpened antelope horns joined at their bases; or it is a single straight two-ended blade of steel, a circular guard protecting the handle of the weapon, which is intended to strike right and left in a crowd. The Sandwich Islanders use daggers (*pahúa*) of wood, held in the middle and having a point at each end. The large mussel shell is the knife of the Fuegian; the original edge is knocked off and the solid portion made sharp by grinding upon a stone. The dagger of the Pelew Islanders is the tail bone of the sting-ray, and it is carried in a sheath formed of a joint of bamboo. The Tahitian dagger has the tail of the sting-ray as a point; it comes off in the wound and works deeper and deeper.

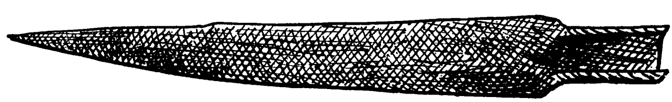


FIG. 72.—*Indian knife of native copper.*

This brings us to metal, of which we first consider copper.

The copper knife, Fig. 72, was taken from an Indian mound. It does

[116] Desor. Translation in Smithsonian Report, 1865, p. 358.

appear that any of the North American Indians who had access to)er worked it by smelting; but they treated it as malleable stone shaped it by hammering. The Greenland Eskimo make knives from copper obtained from Coppermine River, from flint, from walrus y, or from such pieces of iron as they may obtain by barter or may up from whalers or explorers.

ig. 73 shows a number of copper implements—knives, a spear, and

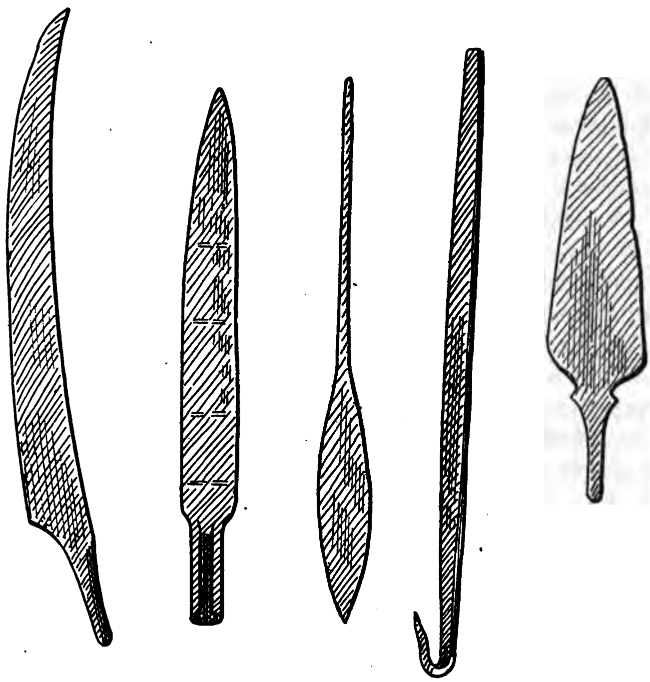


FIG. 73.—*Native copper implements, Wisconsin.*

ok; these are Indian remains from Wisconsin, the metal having btless been obtained from the Lake Superior copper district in ier times. They, together with many other copper tools, were exhib- by the Wisconsin Historical Society in the Mineral Annex of the n Building. We cannot pretend to distinguish carefully between weapon and the domestic implement. A knife is a knife whether the throat of an enemy or of a deer.

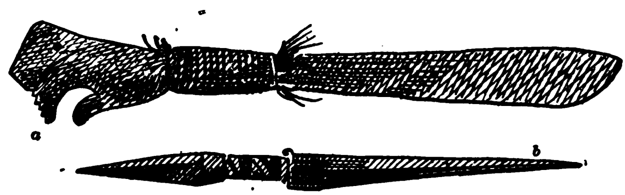


FIG. 74.—*Copper weapon and steel dagger, British Columbia.*

ig. 74 shows a knife-like club *a* of native copper, a hereditary posses- in the family of a Haidah chief in British Columbia. Beneath it is shown a double-ended dagger (*b*), bound with copper, and obtained from the Kutchin Indians of Northwest British America. Such daggers are forged by the Indians from old files obtained from sawmills near the settlements. They are in general use among the northern and northwestern tribes.

Copper seems to have been the earliest metal to be fashioned into tools, and its alloy, bronze, the first efficient tool material. Molds of mica schist for casting copper weapons and ornaments were found by Dr. Schliemann in the hill of Hissarlik.[117] There are also many such specimens in museums. The modern supposition that the ancients had a method of tempering copper as we do steel—or with analogous effects at least—is a myth. The metal acted upon was the alloy, bronze, and the range of effects is far inferior to the capacity of steel.

The Assyrians wore a profusion of daggers, two or more in the same sheath.[118] The handles were elaborate, made of ivory, inlaid, set with precious stones, carved the shape of heads of animals, etc. One of copper was found by Layard at Nimroud. The Assyrians, like the Persians, probably used them as knives.

Copper knives were found by Schliemann[119] in the lowest stratum of the excavations at Hissarlik; one of them was gilt. Also a number of copper daggers at a depth of 28 feet.

Egyptian knives were of bronze and of copper.[120]

A comparison of the forms of knives of the ancients and moderns shows that what may be termed the "leaf-shape" has been very general. It is true that the variety of shapes of leaves is so great that the term may be held indescriptive; it suits the case, however.

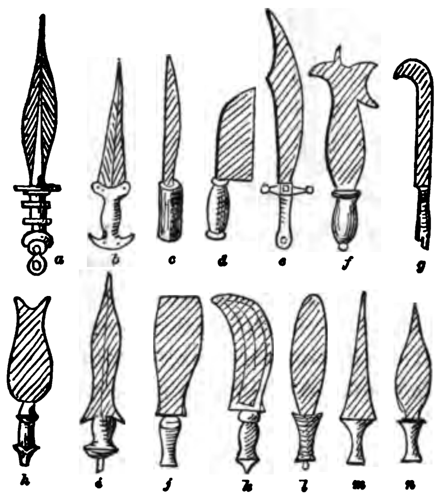


FIG. 75.—*Ancient Roman and modern African knives.*

Fig. 75 shows, in the upper row, a number of Roman knives of the classical period, and in the lower row a number of African knives of the present day. *a* is the *secespita*, a sacrificial knife with an iron blade and an ivory handle ornamented with gold and silver; *b* is the *pugio* or two-edged dagger worn by the officers of the army and by persons of rank; *c* is the *culter coquinarius*, or cook's knife; *d*, the *cultrarius*, for cutting the throat of the sacrificial victim; *e*, the *c. venatorius*, or huntsman's knife; *f*, the *falx vinitoria*, or vinedresser's knife; *g*, the *falx arboraria*, for pruning and hedge-trimming.

The swords of the bronze age, dug up from the lacustrine village

[117] Schliemann's "Troy and its Remains," p. 139.

[118] "Nineveh," vol. ii, p. 264.

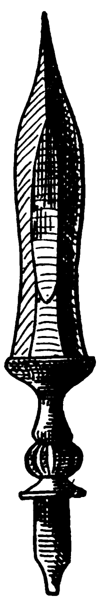
[119] "Troy and its Remains," 150; pp. 332, 333.

[120] Wilkinson. Kitto, vol. i, p. 372.

tes, are many of them like some of the figures, in the upper especially. ee Desor,[121] where they are shown, some with grooved blades and as ıuch as 59 centimeters in length; also bronze poniards and knives with ›ngs and sockets.[122]

The lower row shows *h i j k*, knives of the Fans of Western Africa. hese are sometimes as much as three feet in length and seven inches ı width; they are kept very sharp in a sheath of wood, which is in two alves, and is bound together with strips of raw-hide covered with snake r human skin. *l* is an Unyoro knife of iron, the handle bound with opper wire.[123] *m n* are two two-edged daggers of the Niam-niams.[124] 'he dagger is worn in a sheath of skin attached to the girdle. The lances nives, and daggers have blood-grooves, differing in this respect from ıe Bonjo or Dyoor weapons. Both of the last-mentioned tribes have wo-handled knives. The Bonjo knife[125] is used by the women in peeling ıbers and slicing gourds and cucumbers; it has an oval shape, and is ıarp on both sides, like the Unyoro knife *l*, Fig. 75. The Dyoor nife[126] is spindle-shaped, and is used for similar purposes.

Dr. Schliemann found, in his excavations at Troy, a dagger of steel four inches long. The blade, which is double-edged and in the form of an arrow, is 1.6 inches long, and in a perfect state of preservation, which Dr. Schliemann attributes to the antiseptic power of the red wood ashes, mixed with charcoal, in which he found it embedded, in the large mansion close to the gate, 28 feet below the surface.



G. 76.—*Dagger of Balonda, Africa.*

The Balonda dagger from the Zambesi is shown in Fig. 76, and has a remarkable resemblance to *a* and *i*, Fig. 75, which are respectively Roman and Gaboon. This dagger is 24 inches long, and the handle is partly wrapped with raw-hide. The handle is by no means a convenient one, but no doubt the owner felt well satisfied with its ornamental appearance as it protruded from the scabbard.

Fig. 77 is an Angola dagger, with an iron blade and wooden handle. It looks much more like business than its fellow.

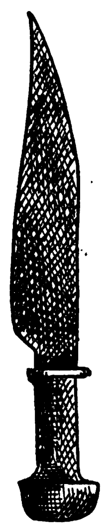


FIG. 77.—*Angola Dagger.*

Fig. 78 shows an Angola dagger, with a strangely-shaped scabbard of sheet copper. It has a copper-covered wooden handle and a ›eel blade. The broad base of the sheath is probably indicative of its

[121] Translation in Smithsonian Report, 1865, p. 374.

[122] *Ibid.*, pp. 374, 371-'72.

[123] Baker's "Ismailia," plate opposite p. 135.

[124] Schweinfurth's "Africa," vol. ii, pp. 10, 27.

[125] *Ibid.*, vol. i, p. 281.

[126] Wood, vol. i, p. 503.

nationality, the same feature not having been noticed elsewhere. Its purpose is not apparent. The sheath of the *kris* has a considerable lateral enlargement at the upper end, but that weapon has a corresponding guard. It will be referred to presently, among swords.

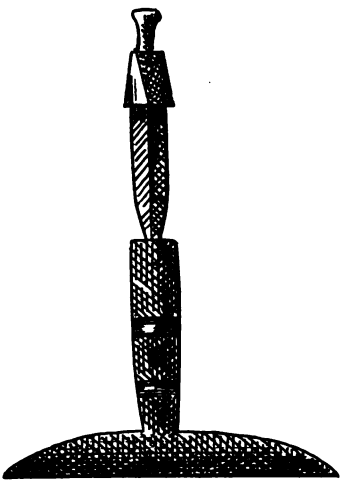


FIG. 78.—*Angola dagger.*

The collection of savage arms from the Portuguese colonies of Angola and Mozambique, exhibited in the Agricultural Building, was not excelled in its kind in the whole Exhibition. With many additions, it was again exhibited in Paris in 1878.

Some of the articles therein shown were from the Banyai of the Zambesi, the Bechuanas, and tribes with which the parties crossing between the western and eastern coasts of the continent come in contact. Passing south and west to Natal, a very warlike people, the Zulus and Basuto Kafirs, are encountered. The articles from this people were shown in the Cape of Good Hope collection, and are noticed among clubs and spears; they do not use the bow and arrow. The *assegai* is the principal knife of the Kafir.[127] It is of semi-steel of soft temper, and will bend and keep its shape, which is taken advantage of by the natives in making bowls, spoons, and pipes. He prefers it to the steel of the white man, which breaks. The Bechuanas make the best knives in that region, and barter them to other tribes. The blade has a long lanceolate shape, with two edges, and the weapon is worn suspended from the neck.[128] The handle, of ivory or wood, is carefully carved, frequently representing an animal, a hyena or giraffe, for instance. The wooden sheath is made of two pieces of wood, hollowed out and bound together with sinews. The same is used among some tribes of Kafirs. The carving tool of the Bechuanas is more like a chisel; a blade like a thumb-nail in the end of a handle. The Japanese knives are numerous and peculiar.[129]

FIG. 79.—*Blackfoot scalping-knife.*

Fig. 79 is a leaf-shaped dagger or scalping-knife, of iron, with a bone handle, such as is used by the Blackfeet and Sioux. C. Carver, in his "Travels," says that the leaf-shaped dagger, made in his time of bone, was peculiar to the Nadowessioux, or that family later known as the Da-ko-tahs or Sioux.

There is one class of weapons for grappling at close quarters, which may be mentioned here, as it was shown in the exhibit from British India. The *baymak* is a five-clawed weapon hidden in the hand, having loops through which the first and fourth fingers are passed. When the

[127] Wood, vol. i, p. 103. [128] Casalis' "Basutos," p. 136.
[129] Siebold's "Nippon," vii, plate 19, Figs. 3, 4, 5, 6.

l is opened, the steel claws, like those of a lion, are exposed, and ntended to rip the naked belly of the adversary. The term *baymak* derstood to include several forms of weapons, such as brass knuckles spikes which are carried in the hand.

ıe Samoans have a somewhat similar weapon—a glove made of coir, having on the inside several rows of shark's teeth, set hooking so they retain anything which is grasped. Like the *baymak*, it is ıded to rip the abdomen of an enemy. To guard themselves against weapon the Samoans use a heavy and wide belt of coir, reaching the arm-pits to the hips. This belt was the nearest to the nature othing of anything in the islands; a number of cords of sinnet are ned on two parallel sticks about 36 inches apart; the sinnet weft is worked in over and under alternate threads.[130]

ıe *bague de mort*, seen by Stendhal in Rome,[130a] is like the East ın *baymak* in the mode of hiding it in the hand, but it has only two s, which are of steel, very sharp and like those of lions. The piece hich the claws are rooted is held in the hand by rings, through h pass the second and third fingers, beneath which the claws are en, nothing appearing but the rings. Poison is placed in grooves neled in the claws, like the poison groove in the fang of a rattle- e.

endhal says: "Dans une foule, au bal par example, on saississait une apparence de galanterie la main nue de la femme dont on voulait enger; en la serrant et retirant le bras, on la déchirait profondément, ı même temps, on lassait tomber la *bague de mort*. Comment, dans foule, trouver le coupable?"

ıe Djibba tribe of the Upper Nile wear bracelets for cutting and ng, the edge being protected by leathern sheaths when the weapon t required for duty. Some of them have double jagged edges and rs a single sharp edge.

ıe Nuehr carry on the wrist an iron ring with projecting blades.

ıe Roman boxing gauntlet, *cestus*, was a much less sanguinary affair, g merely armed with lead or with bosses.

e pass from knives to swords; which is but to an implement of a er kind. The sword proper is a weapon, but the machete of the ıiard, the corn and cane knives of the plantation and farm, are estic implements of similar character, but with less ornamental fur- ing. Where vegetation is as large as that of the corn or sugar-cane, ord-like implement is necessary in gathering it, and the same large e is used in tropical countries in cutting away the vines and creepers h obstruct the narrow passes through the woods.[131]

f the cruder materials, stone and wood, used in swords, the Exhibi- furnished but few examples. Some of the clubs already considered

[130] Wood, vol. ii, p. 354.

[130a] "Promenades dans Rome," vol. i, p. 267.

[131] Raffle's "Java," 4to, p. 113.

had sharpened edges and approximated the sword character. The New Zealand stone sword, Fig. 80, can hardly be classed under any other head, as it has a handle, a back, and an edge, and is adapted to deliver a cutting blow. The swords of the Pelew Islanders are of wood inlaid with pieces of shell.[132] The Kingsmill Islanders have wooden swords, armed on their edges with sharks' teeth lashed with sinnet braided from the fiber of the cocoa-nut. The wooden blade has grooved ridges to receive the teeth, corresponding holes being made in the ridges and teeth through which the braided cord is repeatedly passed to fasten the teeth in this artificial alveolar ridge. The swords are single or double edged, and have guards similarly armed with teeth, so that no part of the weapon except the handle can be touched with impunity. The spears are similarly armed, like some which were shown from the Philippine Islands. A fine assortment of those weapons, obtained by the Wilkes Expedition, is in the National Museum at Washington.

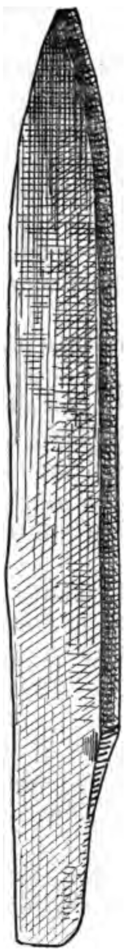


FIG 80.—*Maori stone sword.*

The gold-coast section of the English colonies presented two curious swords with broad, thin blades, especially wide near the point. The perforations make the blade still lighter. The tang is set in a wooden handle with two knobs, between which is the hand-hold. Fig. 82 has a double blade, and is referred to as an "executioner's sword"; a weapon in much demand all around that part of the world, especially Dahomé. The two blades of Fig. 82 are united at a point where the flattening of the blades commences. The blades are 24 inches long; the carved handles are 8 inches long, and one of them is gilded.

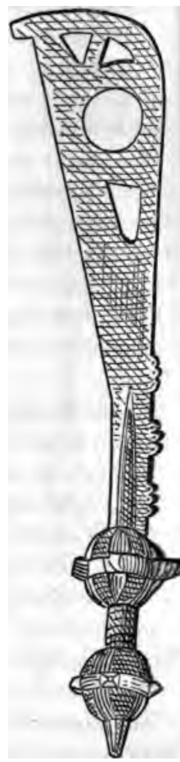
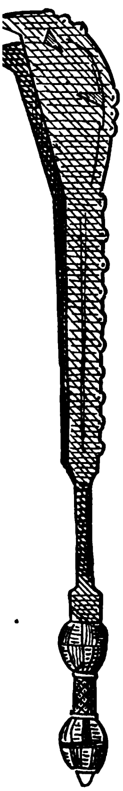


FIG. 81.—*Sword of the gold coast, Africa.*

The swords of Dahomé[133] have knobs on the ends of the blades, so that they may be used as clubs. One noticed had a knob carved like a human head. The back of another had a series of backwardly-curved prongs, intended as hooks to catch a pursued enemy. The classic *harpe*, the sword of Mercury and Perseus, had a similar prong, *hamus*. Another sword of bloody renown is the weapon of the "Razor Women," who form

[132] Wood, vol. i, p. 449.
[133] Duncan's "Western Africa," p. 226.

battalion of the Dahomé Amazons. The weapon is copied from the ite man's razor, but has a blade 2 feet long, and a handle of propor- ıate size. A spring holds the blade open. It is as if, in a jocular spirit, some trader had foisted an absurdity upon them; but the natives claim it as an invention of the late King Gezo. The real razor of the Ashantee is of a nearly trapezoidal form; this latter is for legitimate shaving.



82.—*Two-bladed* *word of the gold* *ast, Africa.*

Coming southwardly along the coast of Africa we arrive at Angola, which, as we have already had occasion to remark, was well represented in the Agricultural Building. Fig. 83 is a sword made by a native armorer of Angola; it has a curiously-shaped hilt, and tufts of horse-hair stained red. The hilt is in part covered with sheet-lead. The gay appearance of the hilt, as it showed when sheathed and worn at the side, was probably its principal recommendation. The general shape the African sword is curved, although of the examples from the Portuese colonies two are straight and but one bent. The specimens illusted from other sections of the continent will amply compensate for the esent larger majority of straight-bladed weapons. Fig. 84 shows a na- e sword of Mozambique. It has a short wooden handle, from which the ıal button on the end of the tang has dropped off. The guard of the t has a peculiar scroll shape, and one branch has been broken. The ord of the Hamram Arabs, of Central Africa,[134] is also straight, double ged, and has a cross-guard. The blade is 36 inches long, and each ge is as sharp as a razor. It is carried in a wooden scabbard made two pieces, hollowed to receive the blade, and covered with leather. ith this weapon the Arab will cut a man in two, or will hamstring an phant.

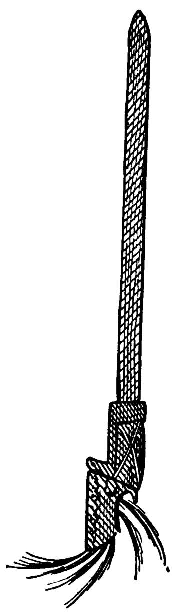


FIG. 83.—*Sword of Angola, Africa.*

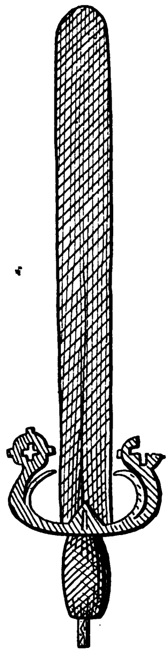


FIG. 84.—*Sword of Mozambique, Africa.*

[134] Wood, vol. i, p. 753.

Fig. 85 is a steel cimeter of Mozambique, with a broad and very thin blade. It has a wooden handle ornamented with sheet brass enchased and jeweled. It is 40 inches long, and has a groove near the back of the blade.

Fig. 86 is a sickle-shape cimeter, brought by Col. Long (Bey) on his return from his expedition into Central Africa in the service of the Khedive. It was shown in the Egyptian Department in the Main Building, and is like the weapon represented by Schweinfurth as held by the Monbuttoo King Munza during the audience which he held with that potentate.[135]

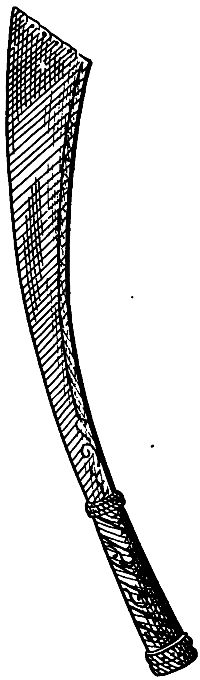


FIG. 85.—*Cimeter of Mozambique, Africa.*

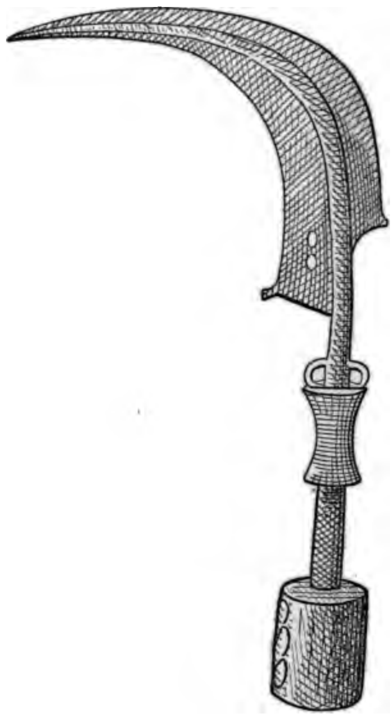


FIG. 86.—*Monbuttoo cimeter, Central Africa.*

It is usually of steel, but on that occasion was a weapon of ceremony, and made of pure copper. The adjacent tribe, the Niam-niams, use implements of somewhat similar shape, curved broad-ended blades, somewhat after the bill-hook order, reminding one of the corresponding Roman implement, the *falx vinitoria.*

The *kookery* of the Ghoorkas, a tiger-fighting hill tribe of India,[136] is another example of a boldly curved chopping-sword, broad near the end, and sharpened on the concave edge, which is, however, of an ogee shape. It is about fifteen inches long, is used either to cut or thrust, and is made of the famous "Wootz" steel. Two little knives are carried in side pockets of the scabbard.

135 "Africa," vol. ii, pp. 9, 10, 107.

136 Wood, vol. ii, p. 760.

Fig. 87 is a saber brought by Capt. Long (Bey) from the Soudan Expedi-
on. It has a boldly curved steel blade and a wooden handle. The
eath and belt are leather. The Nu-an cimeter is, per-ps, even a little ore curved than at shown from oudan; but doubt-ss the weapons of district vary, and re not confined rig-lly to a certain urve, as in some ountries where ich things are de-ned in the "Regu-tions." The curve each case is much reater than that of ie κόπις, the east-

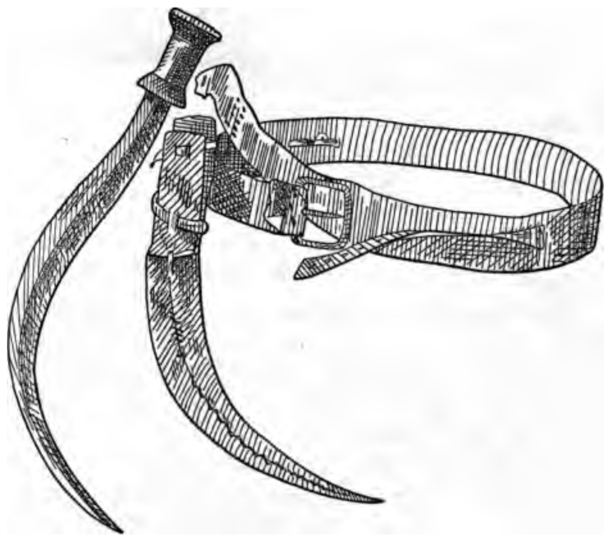


FIG. 87.—*Saber of Soudan, Africa.*

n cimeter of classic times. The Apongos use a cimeter of similar shape, nd with a handle shaped like a dice-box. The blade is 4 feet long. No her cimeter of Africa has so peculiar a bend as the *shotel* of the Abys-nians.[137] The blade is nearly straight for two feet, and then suddenly akes a turn of about sixty degrees. The edge is on the concave side, d it is intended that the point shall reach over the top of an enemy's ield. The blade is wider and heavier toward the point. It is of soft on, has a rhinoceros-horn handle, and is swung on the right side.

Among the most curious weapons of the savage world are the hurling meters—if they may be so called—the *trumbashes* of the Niam-niams.[138] he term is from Sennaar, and refers generally to the missile weapons of ie negroes. The *trumbash* of the Niam-niams (*kulbeda*) Fig. 26, con-sts ordinarily of several limbs of iron with pointed prongs and sharp dges. Somewhat similar implements are used by the tribes of the Tsad asin, and a weapon on the same principle is used by the Marghy and Iusgoo. The Niam-niams carry them attached to the insides of their hields ready for duty, and hurl them with great rapidity, force, and ccuracy. They are made by the skillful smiths of the Monbuttoo tribe f the Welle River. A hurling axe shaped like a sickle is also used by he troops of the scheik of Borneo. It is known as a *hunga-munga* and omewhat resembles the *trumbash* of the Niam-niams. The Tibboos, est of Nubia, use a missile sword, as do also the Fans of Western Africa. he Fan weapon is flat and pointed, and near the handle is a sharp pro-ction.

[137] Wood, vol. i, p. 718.

[138] Schweinfurth's "Africa," vol. ii, p. 10.

The Malays and Dyaks have several swords, as they may be called, of peculiar character. Three of them are cutting weapons; the other is a thrust. The three former are *parangs;* the latter is the *kris.*

FIG. 88.—*The parang of the Malays.*

The *parang*[139](Fig. 88) has a two-edged blade which is small but thick at the handle, and runs broader and thinner to near the point. It is elaborately ornamented with tufts of human hair and charms. The handle is frequently of deer bone neatly carved, but in the present instance is of wood bound with red leather and has a tuft of human hair at the hilt. The scabbard is of red wood, carved. A ratan-splitting knife[140] occupies a pocket in a small sheath attached to the scabbard of the *parang.* This attaching of a knife to the scabbard is also found in Scotland and Central Africa. The *parang-latok* is made of a square bar of ½-inch steel, which is gradually thinned and widened until it reaches a width of two inches near the point. It has a peculiar bend of 30° near the hilt. It is sword, machete, axe, all in one, being the ordinary weapon of the men and many of the women. It is kept in a wooden sheath made of two pieces of wood hollowed out and bound together with ratan. It is the executioner's weapon. The *parang-ihlang* is straight. Its blade has a curious shape, being ogee in cross-section. This shape seems to give it wonderful execution in cutting, but at the same time makes it dangerous to an inexpert swordsman, as the blade glances in a remarkable manner. The beheading sword of the piratical Illaños[141] has a somewhat similar curve. The holes in the Illañoon sword indicate the number of victims.

The most characteristic, however, of the Malay weapons is the *kris*[142] (Fig. 89), which is used in thrusting, as a Spaniard uses his knife. The armorers take as much pride in the making of the weapon as of old did the Toledo or Ferrara workmen. The blade is generally waving, and its grain is more marked than in any other weapon, as much so in fact as the Damascus gun-barrel, and for the same reason, as it is made of steel and iron strips laid together, twisted, doubled, and variously convoluted to give the kind of marking required. These are rendered more plain by etching the blade with lime juice, the acid corroding one metal

[139] Boyle's "Dyaks of Borneo," 114, 115;
Belcher's "Eastern Archipelago," ii, 133 and plate.
[140] Belcher's "Eastern Archipelago," vol. i, pp. 230, 231. [141] *Ibid,* vol. i, p. 266.
[142] Raffles' "Java," 4to, i, p. 296 and plates; Wallaces' "Malay."

;han the other, and hence leaving the surface grooved. The exe-
kris is also used
hrust weapon, the
ʒ-latok being used
ıeading. The cul-
victim, as the case
e, sits in a chair,
is extended arms
ld by two persons.
xecutioner stands
l and places the
ɔf the kris just by
't collar bone, and
ɜ it downward,

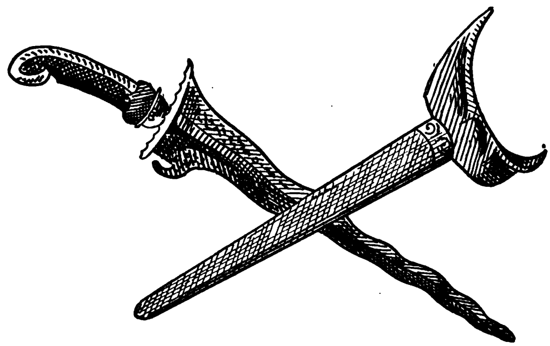


FIG. 89.—*Malay kris.*

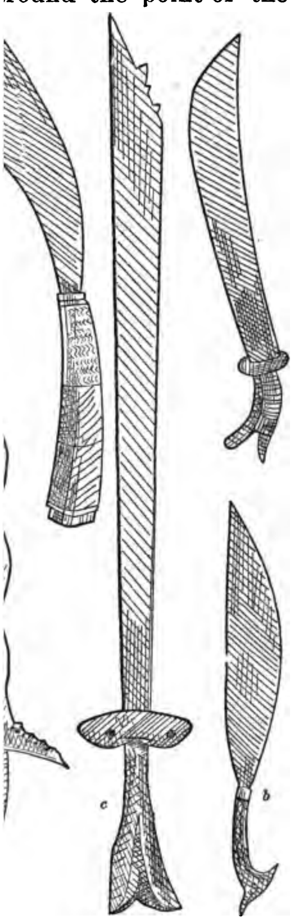
ıg the heart. If he be fastidious he places a pledget of cotton ,round the point of the *kris* before thrusting it into the thorax, holds it there tightly, so as to wipe the weapon on its recovery, thrusts the wool into the gap, and thus avoids shedding a drop of blood.

"A most delicate monster."

It may be added that the kris is the most cherished possession of its owner, and may be worth $20, when his clothing would not command 25 cents. Some krises are heavily inlaid with gold. The sheath is of wood and comparatively plain. The size of the weapon is usually from 12 to 15 inches long, but larger ones are to be seen. Some authorities have told us that the handle is always bent at right angles to the blade. In the Javan collection of the Dutch colonies in the Main Building the handles were as represented in the figure.

Five swords of the Philippine Islands are represented in Fig. 90. They were in the Spanish Government Building. The resemblance to the Malaysian implements is very marked; *a* is evidently a *kris; b* is a *parang; c* is a *parang-ihlang.*

The Siamese sword[143] used from elephant back has a handle four feet long of heavy wood and a screw-joint in the middle to make it more portable. The



90.—*Swords of the Philippines.*

[143] Ruschenberger's "Voyage Round the World," p. 295.

blade is one-edged, two feet long, and gently curved. The guar[illegible] a disk set with gems and the scabbard is enameled.

The Chinese use single swords, sometimes one in each hand; t[illegible] also have two-handed swords.[144] The warrior arm[illegible] with two makes them fly like the sails of a windn[illegible] he leaping and dodging the while. The two-han[illegible] sword is of the same length and weight as the [illegible] exhibited from Norway. The Chinese also use a sw[illegible] blade on the end of a pole. The practice of Japanese of rank in carrying two swords is fami[illegible] from the many illustrations on the fans, whic[illegible] so good and cheap. The swords are known a[illegible] and *katten*. Some of the old Japanese sword[illegible] blood lines.[145]

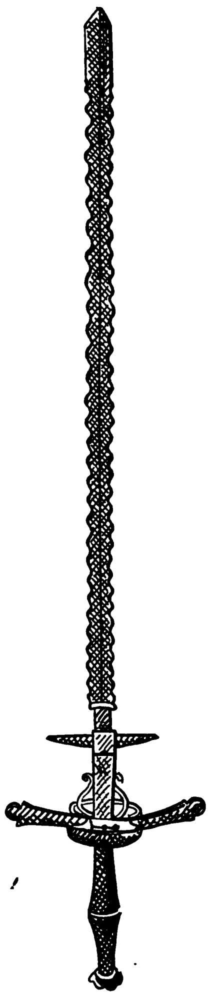


FIG. 91.—*Norwegian two-handed sword.*

The Norwegian two-handed sword of som[illegible] ries since was shown in the collection fr[illegible] country in the Main Building. It has a w[illegible] of 5½ feet and a hilt 15 inches in length. [illegible] hand-holds on the hilt and one above the [illegible] bly to hold it when used as a pike.

IV.—SPEARS.

The spear is found among most sav[illegible] was the knightly weapon in Europe [illegible] duction of fire-arms. It, however, among the Poles, Russians, Turks [illegible] was introduced into the armies [illegible] erick the Great; the Austrians [illegible] troops Uhlans, and lances are [illegible] the European cavalry forces. [illegible] were made for a cavalry regi[illegible] Potomac, but the project [illegible] lances laid away in the ars[illegible]

Perhaps we may assum[illegible] sharpened stick or pole: [illegible] the collection from th[illegible] pole a little larger than [illegible] and 10 feet long. The point was a simple [illegible] hastate form.

A common spear of Borneo and the [illegible] boo, such as shown at *a b*, Fig. 92. [illegible] and in the other a bamboo head i[illegible] The end is so sharpened that the h[illegible] the edge and makes a very effi[illegible] spears *c d* are of cocoa wood. [illegible]

[144] Wood, vol. ii, p. 814.

[145] Siebold's "Nippon," ii, [illegible]

ninishing ears of corn with a round finial point. Similarly ornad spear heads are made in Fiji. The other (*d*) has six gradually sing sets of barbs ed by a finial. Other from the Philippines ıark's teeth tacked to on the head, and some etallic heads. They will wn presently.

or mentions that the *pica*) of the Philippines ıryota wood 2.27^{m} long; ead of bamboo, carved or iron (purchased).[146]

large spear of the Sandslands[147] is 12 or 15 feet ınd is not barbed, but rling spear is 6 or 8 feet f hard wood, and tapers l the butt, to throw the of gravity forward of id-length and enable it straight.

Fijians,[148] who excel in ıity, have several kinds ars. The fishing spear ree or four points set arately. Each point has d, square, or semicircution, is dovetailed into aft and lashed thereto *innet*. The war spear carved head, and barbs, cut in the wood, or of the tail of the stingnd set in separately; brittle barbs come off wound and insure cruel ng and generally death. 'ijian spear is made of od which bursts when so that it is with diffiextracted. The differands, such as the Tonga, ys, Fiji, and the New Hebrides have distinguishable varieties of s.

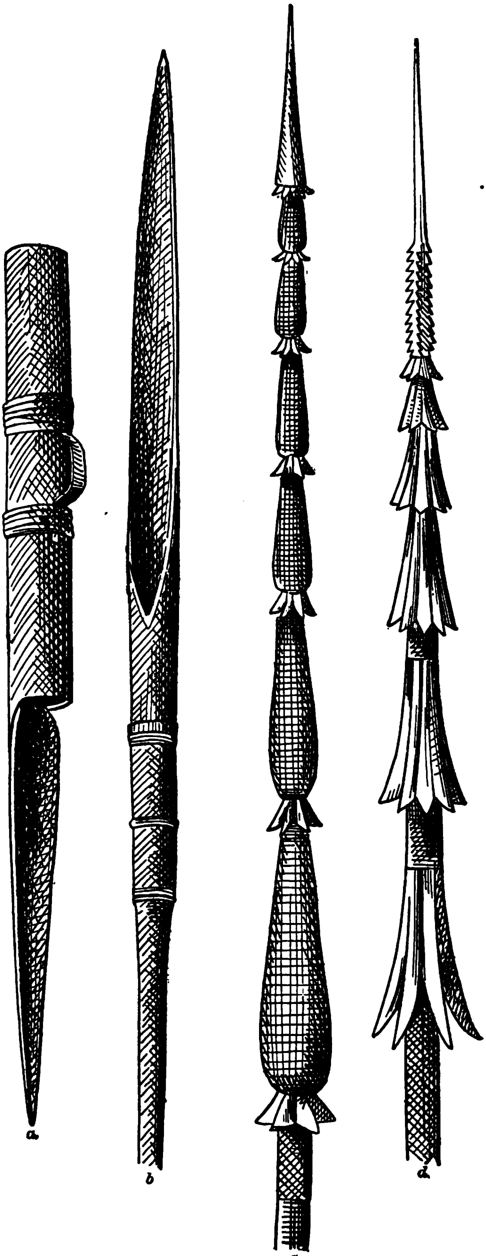


FIG. 92.—*Spears of the Philippines.*

146 'hilippines," p. 210. 147 Wood, vol. ii, p. 434. 148 Williams "Fiji," pp. 44–5.

The Australian spears are of various qualities and shapes: a sharpened stick (*nandum*) with notches for barbs;[149] a spear with a separate head of hard *miall* wood deeply cut with barbs, and fastened to a reed (*phragmetes communis*) shaft;[150] one with a basalt or quartzite head lashed to the shaft with sinews from the tail of the kangaroo,[151] with long projecting barbs on each side, curiously formed from hard wood,[152] a single bone lashed to the head and projecting laterally and backwardly from the point so as to form a barb; the *mongile*, a head armed with sharp basalt or quartzite flakes set with *pid-jer-ong* gum;[153] one with a head piece of bone which is lashed to the shaft so that its respective ends form point and barb;[154] lastly, leisters with from two to four barbed points,[155] and from 6 to 15 feet long.

The flower stalk of the grass-tree furnishes the spear-shaft, which is 9 or 10 feet long. Fig. 93 shows two South Australian spears, one with a double set of inserted barbs made of obsidian or quartz, and a kangaroo spear with a wooden head 30 inches long, and a single row of barbs; the shaft is 8 feet long. Fig. 94 shows two fish-spears, one with two prongs and the other with three. The prongs of hard and tough gum-tree wood are tapered towards each end, pointed, and barbed; their butt-ends are then inserted in notches on the end of the shaft and held in position by black-boy gum, while the prongs are spread apart by wedges driven between them. The prongs are then lashed with sinews. The Australian has a blade on the end of his spear to act as a paddle as he stands in his dug-out canoe and watches the water or quietly moves from place to place. The night is the favorite time for fish-spearing, a fire being made on a bed of wet sand and stones in the bottom of the canoe. The natives also carry torches of inflammable bark; this mode of fishing is common in North America and in Scotland, called "burning the water" in the former, and "leistering" in the latter.

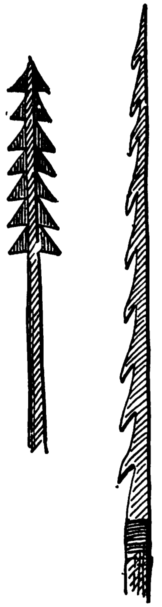


FIG. 93.—*Australian wooden spears.*

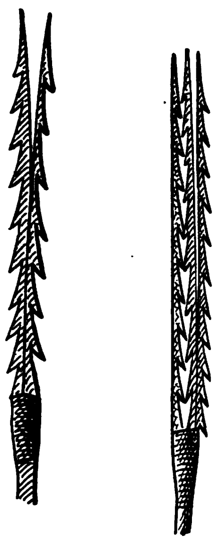


FIG. 94.—*Australian wooden fishing-spears (leisters.)*

149 R. Brough Smith, "Aborigines of Victoria," vol. i, p. 304, Fig. 71–74.

150 *Ibid.*, vol. i, p. 305, Figs. 75, 76.

151 *Ibid.*, vol. i, p. 308, Fig. 85.

152 *Ibid.*, vol. i, Figs. pp. 69, 70, and i, 308, Fig. 84.

153 *Ibid.*, vol. i, p. 304, Fig. 68, and i, 336, Fig. 141.

154 *Ibid.*, vol. i, p. 306, Fig. 77, 78.

155 *Ibid.*, vol. i, p. 306, Figs. 79, 80, p. 337, Fig. 144 *et al.* See also Pl. iv, and pp. 33–5 Nilson's "Stone Age."

The large spear of the Australian, not to be thrown but used as a .ke, is as much as 13 feet in length, the head of hard wood, the shaft ' lighter wood, and as large as the wrist. The Australians also use a ›rked spear, *bobo*, to secure eels and snakes alive.[156] The turtle har- ›on, like the hippopotamus harpoon of Africa, has a head detachable om the shaft. To the head is attached a rope, on the other end of which a buoy. The harpoon for the dugong has a bone head 4 inches long ıd covered with barbs. It becomes detached from the shaft after strik- ıg; the cord attached to the spear-head has no float, but is secured on ›ard the canoe. The simplest form of fish-spear is a long sharp stick sed in gigging fish in water-holes.[157]

The spears in the New Zealand department were all of wood. Some ere simply pointed poles of hard wood; others had carved heads with yramidal points. The spear is not a favorite weapon f the Maoris; in fact is said to have been laid aside. he heads of the spears are understood to be a conven- .onal representation of the human tongue thrust out. 'hat shown in Fig. 95 is destitute of ornament; Fig. 96, called by the natives *taiaha kwra*, has suspended tufts of dyed hair.

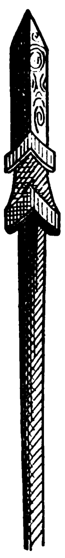


Fig. 95.—*Maori wooden spear.*


Fig. 96.—*Maori spear taiaha kwra.*

The styles of ornamentation peculiar to New Zealand, New Guinea, and Fiji are referred to by R. Brough Smith.[158]

The harpoon of the Andaman Islander[159] is shot from a bow, and has a detachable head with a connected cord, which is held by the archer.

The spears already considered are made of wood, although the use of the tail of the sting-ray by the Fijians and of bone and obsidian by the Australians have been incidentally mentioned. Materials in great variety have been used for the heads or barbs of spears.

Stone spear-heads were shown in the South Australian department. They were obtained from the northern part of the island near Melville's Island. They are genuine specimens of the stone age, which does not represent a specific time but a grade of civilization. Consideration must also be had to the absence of metals in some localities. The stone spear-heads are chipped to shape and lashed to reed shafts with sinews, or with fiber obtained from roots. The reeds are 6 feet long and the heads from 4 to 6 inches.

The spears of the Solomon Islanders are tipped with sharp flints; those of the Admiralty Islanders are of obsidian lashed to the shaft and coated

[156] Aborigines of Victoria, vol. i, p. 307, Fig. 82. [157] *Ibid.*, vol. i, p. 307, Fig. 81.
[158] *Ibid.*, vol. i, pp. 296, 297. [159] Mouat "Andaman," p. 326.

with gum. The Mexican spears were pointed with obsidian. The obsidian spear-heads of the Papuans excited the surprise of Schouten, an early navigator in those seas; he remarks that they had "long staves with very long, sharp things at the ends thereof, which, as we thought, were finnes of black fishes."[160] The aborigines of the Canaries, a race of African origin, when first discovered, used hatchets, knives, lancets, and spear-heads of obsidian, and axes of green jasper.

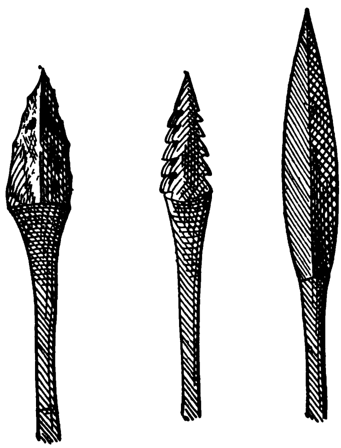


FIG. 97.—*Stone spear-heads, South Australia.*

The lances found in the upper strata during the excavations at Hissarlik[161] were of a very hard black or green stone. The spear of the Northern American Indian was formerly of stone or flint, but is now of steel.[162]

We may refer in a single group to those spears which are tipped with animal material, bone, horn, shell, shark's teeth, claws of beasts and birds (such as of the kangaroo, cassowary, or emu), and the tail of the sting-ray. In the times of Herodotus and Strabo, African spears were headed with the sharpened horns of antelopes,[163] and the practice still obtains.[164] The Canary Islanders, when discovered, in the fourteenth century, had spears and digging-sticks tipped with horns.[165]

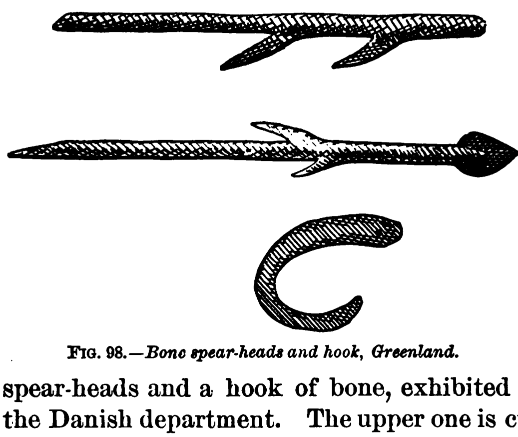


FIG. 98.—*Bone spear-heads and hook, Greenland.*

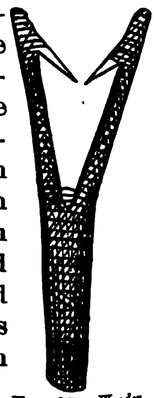


FIG. 99.—*Wooden fish-spear. Makahs of British Columbia.*

Fig. 98 shows two Kajäk spear-heads and a hook of bone, exhibited in the Greenland section of the Danish department. The upper one is cut down so as to leave barbs. The next beneath it has an iron tip riveted to the bone. The lower example is a bone hook about 2 inches across. Barbed harpoons of bone, from a Scanian bog, Sweden, from a cave in Perigord, and from Terra del Fuego, are shown in Nilson's "Stone Age."[166]

[160] Purchas, vol. i, p. 95.

[161] "Schliemann's Troy, &c.," p. 79.

[162] Dr. Abbott in Smithsonian Report, 1875, pp. 269, 274.

[163] Herod., vii, 69–71. Strabo, xvi, 4, 9, 11.

[164] Andersson, p. 15.

[165] Tylor, p. 222, and note *passim*.

[166] Plate iv, Figs. 69, 70, 72.

Fig. 99 is a fish-spear head of wood with incurved points or barbs of bone; the binding is of cherry bark. These hooks are used by the Makahs and other Northwestern Indians.

Fig. 100 is a fish-spear of the Chookchees (*Tschucklochies*) of Northeast Siberia. It has a long stout shaft of pine wood, only one-half the length of which is shown. The head consists of two baleen prongs, on the ends of which are lashed two incurved points of ivory, forming barbs. The same style of fish-spear is used by the Youcon Indians of the Mackenzie River country.[167] The Fuegan fishing-spear is 10 feet long and has an octagonal shaft with a bone head 7 inches in length, with a single barb.

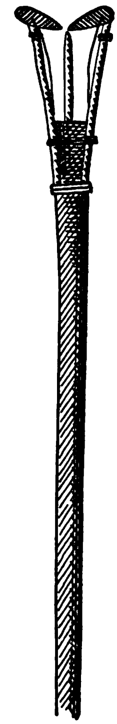


FIG. 100.—*Chookchee fish-spear, Siberia.*

The National Museum in the Government Building had specimens of whale and seal lances from Siberia, Alaska, and Greenland.

Fig. 101 is a seal-spear from the Chookchees of Northeast Siberia. It has a long spliced pine-wood handle and movable point of bone with a metallic tip.

Harpoons with movable[168] and immovable points[169] are shown in Sven Nilson's "Stone Age," edited by Sir John Lubbock.

Fig. 102 is a whaling-lance from the Ponook Eskimo of Alaska. It is pointed with a portion of a marrow-bone cut off obliquely so as to afford a long cutting-edge. The butt-end has a flattened piece to fit the throwing-board, which will be shown presently. The piece on the side is a spur or button to prevent the spear penetrating the whale too far. The Ostiaks, Chookchees, and Keriaks secure the same end

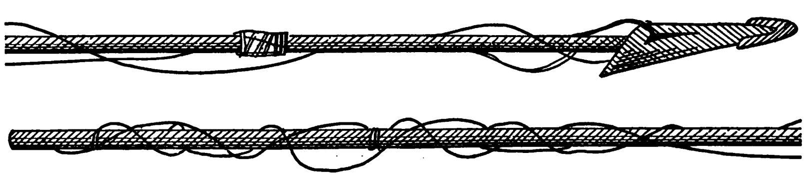


FIG. 101.—*Seal-spear of the Chookchees, Northeast Siberia.*

by binding the shaft with raw sea-lion hide, which, drying, forms an im-

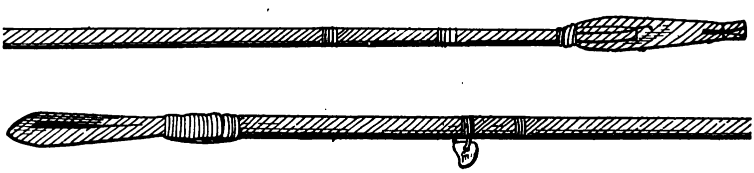


FIG. 102.—*Whaling-lance of Alaska Eskimo.*

movable ridge. Fig. 103 is a whaling-lance of the Greenland Eskimo.

[167] Smithsonian Report for 1866, p. 324.

[168] "Stone Age," Plate iii, Figs. 52, 53 (for bladder spears).

[169] *Ibid.* Plate iii, 41, 50, 51; Plate iv, 69, 72 (bone tips and bone tipped with stone).

It has an iron snow-rest at the end of the wooden stock; the shaft is of iron and has a walrus-ivory point, which comes free of the shaft when the whale is struck. The shaft is dragged by the whale, and a float may be secured to the end of the thong. The thongs for the Eskimo harpoons are made from the skins of a large species of seal. Incisions six inches apart are made completely around the body and the rings of hide removed like so many hoops. These are then cut spirally into thongs of a length equal to the circumference of the body at the part multiplied by the number of times the width of the thongs goes into 6 inches. Fig. 104 is another whaling-lance of the Greenland Eskimo. It has a long bone rod for the attachment of the movable head which comes entirely free of the shaft, but is held by the thong. The shaft has a snow-rest at the butt.

The Makah Indians of the Northwest Coast use a lance and seal-skin buoy in capturing the great bow-head whales of the Pacific. Fig. 105 shows the buoy, rope, and lance-head. The head is placed on the end of a long forked pole and comes off the shaft after the whale is struck. The buoy is made of a seal-skin stripped off entire, sown up at the ends, and inflated. The lance-head is of shell with walrus-ivory barbs and point secured with sinews and pitch. The rope is of spruce root roasted in the ashes, pounded, frayed, and twisted. Fig. 106 shows the seal and fish-spear of the Eskimo of Kodiak, Alaska. It has a long slender ornamented shaft and movable barbed point. The shaft has a bladder float and an ivory knob to limit the penetration of the spear.

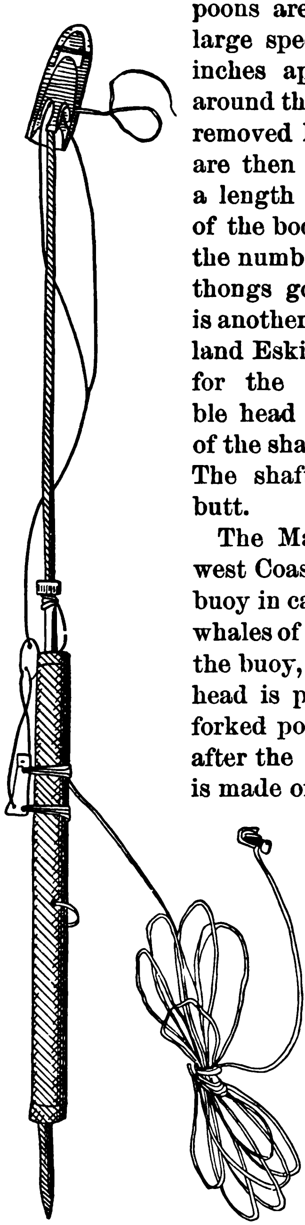


Fig. 103.—*Whaling-lance, Greenland.*

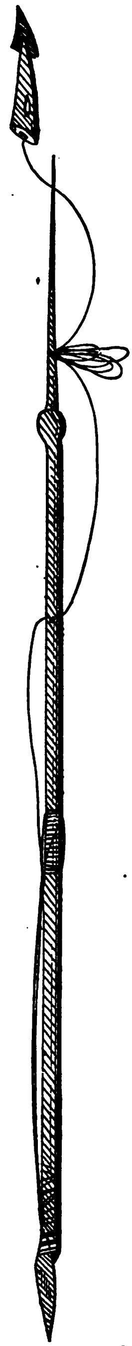


Fig. 104.—*Whaling-lance of Greenland Eskimo.*

The bird-spear of the Greenland Eskimo has, besides its main point, everal supplementary points at some distance from the end of the spear. t has an inflated bladder to prevent its sinking in the water.

A number of dif-erent Polynesian reapons are made rith shark's teeth ished to wooden lubs or lances. ʼig. 107 is a spear-

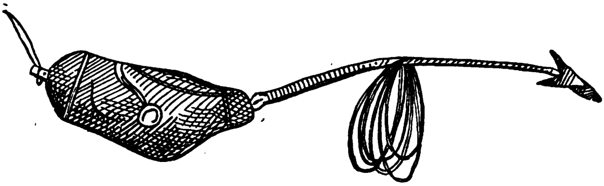


FIG. 105.—*Lance-head and seal buoy, British Columbia.*

ead exhibited in the Philippine Islands section of the Spanish department. ʼhe Kingsmill and Marquesas Islanders also arm the edges of their spears rith sharks' teeth, binding them to the shaft with sinnet, the plaited fiber coir) of the cocoa-nut. One from the Kingsmill Islands has over 200 eeth in a row, the shaft being of light wood and 15 feet long. A spear rom the Philippines had 72 teeth in a row. A saw is made on the same rinciple by the Australians; flakes of obsidian or quartz, about the ize of a quarter-dollar, are inserted in a grooved stick of gum-tree wood nd fastened by gum from the grass-tree, commonly known as "black-

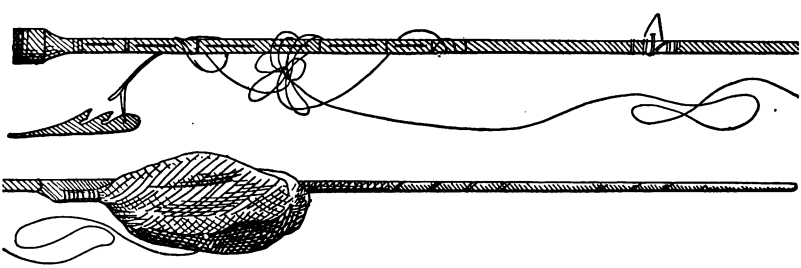


FIG. 106.—*Seal and fish spear, Kodiak Eskimo, Alaska.*

oy" gum.[170] Javelins of bone or wood with longitudinal grooves, in hich are inserted flint flakes, are shown by Nilson.[171]

The spear of the Tonga Islands is barbed with the tail bone of the ting-ray; the same bone is used on the prongs of the Tahitian trident. ʼhe barbs are not fastened, but are slipped into sockets just tight enough o hold them until they are thrust into the body, when they become de-ached and, from their barbed character, work deeper and deeper into he wound.

We have considered wooden spears, and those with stone and bone eads, and incidentally some other materials. We now come to metal, he material of all the best, and which, once adopted, is not again laid side.

Spear-heads of copper were shown among the Indian implements rom Wisconsin. Copper preceded iron, being found native and mal-eable. Copper and bronze implements are among the articles recov-red from the Egyptian tombs, the tumuli of Assyria, and the excava-

[170] Wood, vol. ii, p. 35.

[171] "Stone Age," pl. vi, Figs. 124, 5, 6.

tions of Hissarlik.[172] The spears of the Peruvians[173] were tipped with copper or bone, and those of the Inca lords mounted with gold and silver.

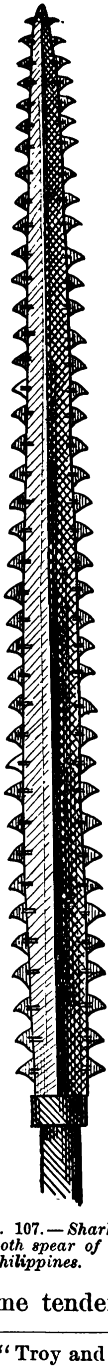


FIG. 107.—*Shark's-tooth spear of the Philippines.*

The Philippine Islands were represented in the Spanish Government building, and had a sheaf of spears, among which were the iron weapons, Fig. 108. One of these has a sword-blade, and a number of ferrules to prevent the tang from splitting the shaft. Another spear has two barbs, and a third one has a lanceolate head. The trident, Fig. 110, was also shown in the same collection. The *mora*, or cross-bar, to limit the penetration of the spears, shown in the Roman *venabulum* or hog spear, does not seem to be in common use in the Orient. The Japanese have as many as 14 kinds of spears,[174] perhaps more.

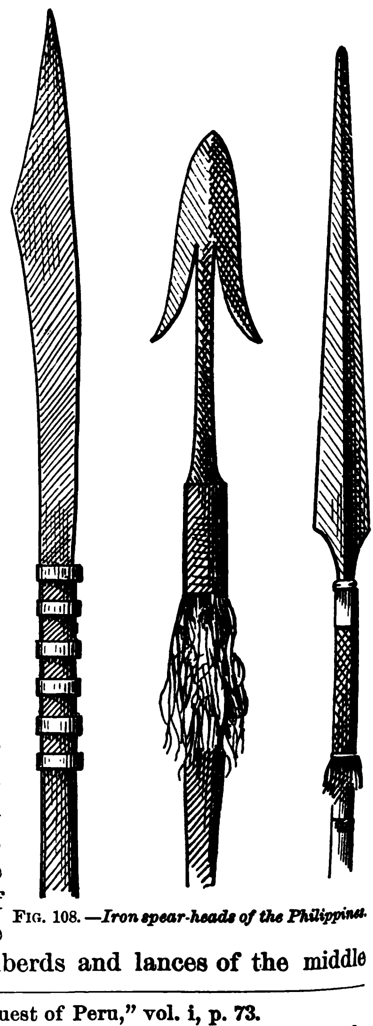


FIG. 108.—*Iron spear-heads of the Philippines.*

Fig. 109 is a three-pointed spear from Timor, shown in the collection from the Portuguese colonies. It has three simple points, the outer ones being on the ends of a cross-bar slipped over the middle prong and bent forward. The Philippine trident, Fig. 110, is used for fishing, but the Illañoon pirates[175] use a bifurcated spear with retreating barbs to catch men by the neck. The three-pointed spear is found in many widely separated parts of the world, and is mentioned in the history of the Saracen conquests, particularly in one of the feats of Ali. Fig. 111 shows three spears of the Island of Timor. They show the same tendency as to shape as the halberds and lances of the middle

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172 "Troy and its Remains," p. 330. 173 "Conquest of Peru," vol. i, p. 73.
174 Siebold's "Nippon," vol. ii, pl. 6. 175 Belcher's "Eastern Archipelago," vol. i, p. 252.

ages. The weapons of Timor and of the Philippines are very similar, as might have been anticipated.

The African spears show a great variety. Over the large portion of the continent iron is either plentiful or readily accessible by means of the native traders. The metallurgic process is a direct one from the ore and the product is a steel. Weights, shapes, and sizes of the weapons differ greatly. The Bongos of the Upper Nile[176] are skillful blacksmiths and make excellent lances, especially considering the crude character of their tools. The spears of the Niam-niams and Monbuttoos[177] are of a hastate shape, and their weapons all have blood-grooves, which distinguishes them from the weapons of the Bongo and Mittoo. The Manganji spear[178] is sometimes made with a paddle or dibble at the end of the handle, and is weighted with iron rings.

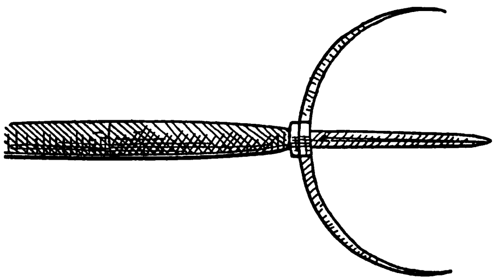


FIG. 109.—*Trident of Timor.*

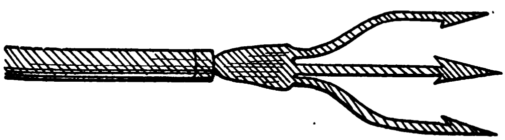


FIG. 110.—*Trident of the Philippines.*

The spear of the Kanemboo infantry soldier of Borneo is 7 feet in length, and armed below the head with a number of hook-shaped barbs. The Abyssinian spear is seven feet long and has four grooved sides. It is used either as a pike or a javelin. The natives have also a way of throwing it at close quarters by letting the shaft pass through the hand and catching the butt-end. The bark of a young tree being removed, the wood is seasoned by fire, greased, then hung in the sun to obtain the desired color.

The hippopotamus spear of the Zambesi[179] is a beam four or five feet long armed with a spear-head or hard-wood spike covered with poison. The spear is suspended from a forked pole by a cord, which, coming down close

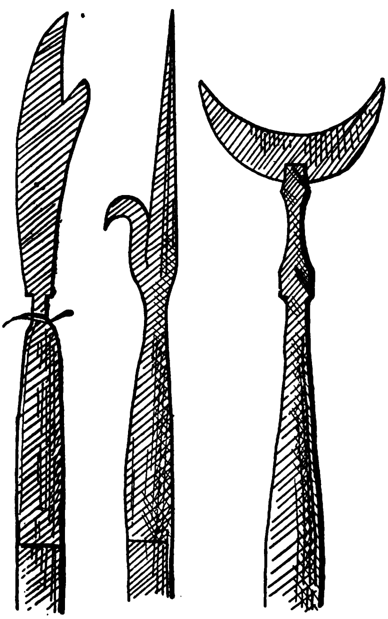


FIG. 111.—*Spears of Timor.*

[176] Schweinfurth's "Africa," vol. i, p. 280.

[177] *Ibid.*, vol. ii, p. 27.

[178] Livingstone's "Zambesi," p. 532.

[179] Livingstone's Zambesi, p. 107; Baker's Ismailia, Pl. opp., p. 135.

to the path frequented by the animals, is held by a catch and is set free when the animal treads upon it. The Banyai of the Zambesi have a hippopotamus spear with a wooden shaft, iron head, and weighted with stones; like the former, it is suspended over the track of the animals. The Fans of the Gaboon have a similar contrivance. The Dôr tribe prepares a similar spear, but the hunter climbs a tree and drops it upon an elephant passing beneath. The elephant spear of Unyoro is similar.

The hippopotamus harpoon of the Zambesi[180] has an iron head inserted in the end of a long pole of light wood. The head has a stout barb and becomes detached from the shaft; the rope attached to the head unreels from the shaft, and when it has all run out the shaft acts as a float to indicate the locality of the animal. An inflated bladder is sometimes used as a float. The rope is made from the bark of the *milola*, an umbrageous hibiscus. The Hamram Arabs use a float of *ambatch*, an extremely light wood. The Makobahs of Lake Ngami[181] attach the rope to the head by a large bunch of loose strands, which cannot be cut clean off by the teeth of the animal. A rope of palm leaf is attached to the shaft, and is coiled up in the boat.

The turtle-spear of the Central American Indians is a heavy palm-wood staff with a notched iron peg at the end, and twenty fathoms of silk-grass line attached.

The *assegai*, the hurling spear or javelin of the Kafirs, was shown in the Cape of Good Hope collection. It is a very formidable weapon in

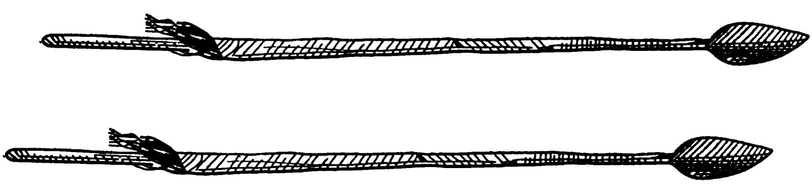


FIG. 112.—*Kafir assegais.*

the hands of this athletic and untamed people. The people of "the Cape" say that the Kafirs are the remains of the lost "ten tribes of Israel," and have fought their way all down through Africa. Their assegais are made from native iron, have wooden shafts, and are decorated with tufts of cow hair. The blade has various symmetrical lanceolate shapes. A ridge passes along the center of the blade, which is concave on one side, convex on the other. This shape is intended to give rotation to the weapon. The head of the assegai is about the size of the blade of a table-knife, and has a tang which is inserted by burning it while red-hot into a shaft of assegai wood (*Curtisia jaginea*), which resembles mahogany. The two parts are secured by lashings of raw hide, which contracts in drying and holds all firmly. The *assegai* is the main weapon of the Kafir, and with it he kills his cattle, skins them, and cuts them up; with it he also carves his clubs, spoons, dishes, pillows, and milk-

[180] Livingstone's Zambesi, p. 44.

[181] Wood, vol. i, p. 379.

ts, and shaves his head—or rather that of his friend. is other weapon is a club; he does not use the bow and row.

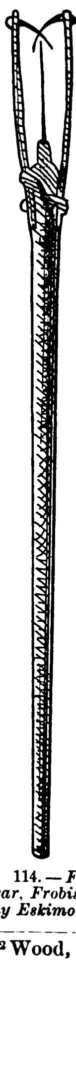
The Bechuana *assegais*[182] have cruel barbs on their shafts, ing originally forged square and the barbs made by cutng and raising the corners. The *assegai* of the Damaras has a broad, leaf-shaped, soft-iron blade a foot in length; it has a strong handle, on which is a flowing ox-tail.

. 113.—*Copper harpoon point, Alaska.*

The spear of the Gran Chaco Inan of La Plata is 15 feet long; it is his principal war weapon, d is also used as a vaulting-pole in mounting his horse. The iegain throwing-spear is shorter and has a row of barbs down e side.

Fig. 115.—*Salmon-spear of Passamaquoddy Indians.*

The harpoon-point of native copper, with unilateral barbs, is shown in Fig. 113. It is from the Atnacs of Copper River, Alaska. The harpoon used by the Ahts of Vancouver's Island in whale-fishing has a yew handle ten feet long, on the end of which is a detachable iron barbed blade; it has a line of deer sinews connecting with the main cord of cedar-bark twine laid up into a rope and having a number of inflated seal skins attached.



. 114.—*Fish-ear, Frobisher ay Eskimo.*

The fish-spear of the Frobisher Bay Eskimo, Fig. 114, has a point of iron, and incurved barbs made from sharpened nails set in flexible bone prongs, which are lashed to the short pine-wood handle. Fig. 115 is the salmon spear of the Passamaquoddy Indians. It has a long stout shaft, wooden prongs, and iron point.

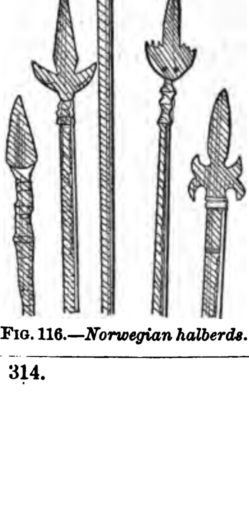


Fig. 116.—*Norwegian halberds.*

Norway sent some relics of the past, the halberds and lances, Fig. 116.

Throwing-sticks are used in many parts of the world to increase the power of flight of the spear by extending the radius of the arm in throwing. The throw-stick of the Australians,

[82] Wood, vol. i, p. 314.

called by them *Wummerah*[183] *midlah*, *meera*, *kur-wuk*, is a stick[184] about three feet long. The spear lies along the arm and the stick, its rear end being against the prong on the outer end of the latter. The butt of the spear has a socket for the tooth on the end of the stick. This is sometimes a tooth of a kangaroo; in other cases of bone or of wood. The form of the *wummerah* varies in different parts of the island, being sometimes a mere stick with a swelled hand-hold at one end and the prong at the other. Other specimens show flat boards, leaf-shaped or tapering. It is of hard and elastic wood, and heavy enough to be used as a club at close quarters. The spear is quivered like the Kafir assegai in throwing, and undulates like a thin black snake in its passage through the air. It is also thrown underhand, skimming and ricocheting on the ground. Figs. 117 and 118 are throwing-sticks of South Australia and Victoria, shown in the Main Building.

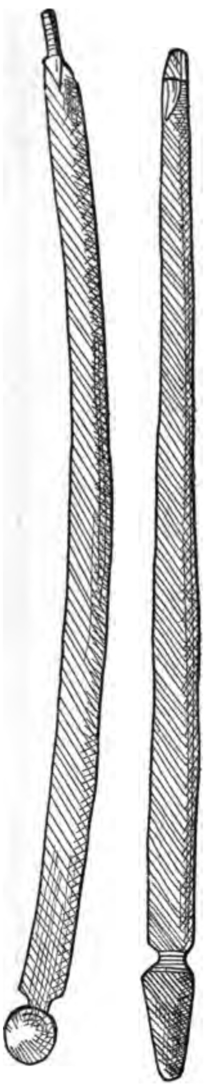


FIG. 117.—*Spear-throwing sticks, South Australia.*

FIG. 118.—*Throwing-stick of Victoria, Australia.*

Fig. 119 shows the way of using it. The plan reminds one of the Spanish method of knife-throwing, in which the fore-arm and hand are used as the projector, the knife lying in the hand, which is extended palm upward.

Although the plan of bending the spears in throwing does not appear to be universal in Australia, it is sometimes adopted to increase the force of the projection. The Pelew Islanders use a throwing-stick about two feet long to hold the butt of the spear, which, in throwing, is bent by the left hand until it is nearly double. The spear is released by the left hand simultaneously with the sweeping motion of the right hand and arm. The Purupurus of the Amazon,[185] unlike all the other tribes of the region, have neither blow-gun nor bow, but project their arrows by means of a throwing-stick (*palheta*). Like the Australian and American implements it has a projection at the end to hold the

[183] Backhouses's "Australia," p. 433.

[184] R. Brough Smith, "Aborigines of Victoria," vol. i, pp. 308, 309, Figs. 88–93, and p. 338, Figs. 146, 147.

[185] Wallace's "Amazon," p. 514.

utt of the arrow. The middle of the arrow and the handle of the *pal-eta* are held in the right hand, and the arrow is projected as from a ing. The natives are very skillful with it.

The throwing-boards used by the Northwestern Eskimo and Indians re shown in Fig. 120. hey resemble the pear-casters (*xuiatla-i*) used by the Aztecs t the time of the Spanh conquest. On the

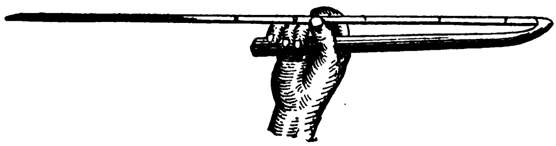


FIG. 119.—*Australian throwing-stick.*

ural monuments of Mexico the gods are generally represented as using e stick to throw the javelin. The Mexican stick most resembles the pper one in Fig. 118. Some other Eskimo throwing-sticks have proections against which the butt of the spear is placed; and others (see he lower in the figure) have holes for the tail end of the spear.

The Romans used the *amentum* (*cf. habena*), a thong fastened at the enter of gravity of the javelin to hurl the weapon. It is mentioned by ivy and Ovid. By giving the thong a few turns around the shaft a rotary motion could be imparted to the javelin in throwing. The *ansa* of the *ansatahasta* was a semicircular strap-handle to a spear, like the bow on a sword-hilt. The *aclis* of the ancient 'sci was a massive spear like a harpoon, with an attached line for recovring it.

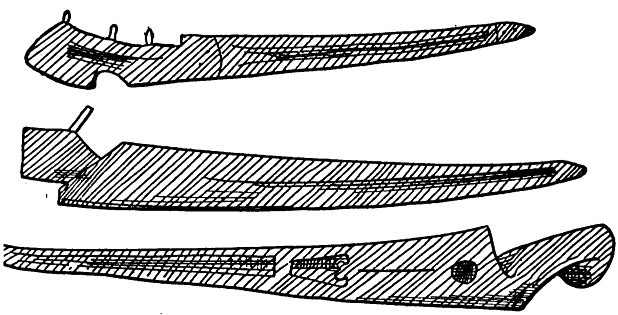


FIG. 120.—*Throwing-boards of Northwestern Eskimo.*

The natives of New Caledonia have a javelin 15 feet long, which is ischarged by a plaited cord (*ounep*) attached a little behind the middle f the spear. This *ounep* (otherwise called *sipp*), answering to the *amenum* of the ancients, but superior thereto, is a plaited cord made of comined coir fiber and fish-skin; it has a knot at one end and is worked nto a loop at the other. It is wound around the spear-shaft so as to give t a rotary motion in flying.[186] When a spear is to be thrown the forefinger f the right hand is put into the loop, and the man balancing the weapon o find the middle takes a sailor's half-hitch at a point behind the center f gravity. Throwing the spear he looses his grasp at once, projecting he weapon by the cord, which becomes detached as soon as the backward pull on it occurs, leaving the cord in the hand of the thrower. The ancient *amentum* was attached to the spear.

[186] Nilson, "Stone Age," p. 174.

V.—Shields.

Shields were in force, in Philadelphia, from Africa, Asia, Malaysia, and Australia. They were of grass, ratan, hide, wood, and other materials. Some were so large as to cover the person; others were smaller and intended to be moved to intercept a weapon; others still were long and narrow, used in parrying spear-thrusts.

Beginning with the South of Africa, the first we find is the Zulu shield in the department of the Cape of Good Hope. It is of ox-hide and of a long elliptical shape. The color denotes service. Black shields are for boys; white, with mottlings, for warriors. The prevalence of color or peculiar markings denotes the regiment to which the warrior belongs. The shield is strengthened by a vertical stake at the rear, which forms a handle, and projects below and above, where it forms a rest and an ornament, respectively. A strip of black hide is passed in and out of a double row of slits, one row on each side of the stick, showing on the front of the shield like oblong markings on a white ground. Standing on its end the shield comes up to the warrior's eyes, the stick to the crown of his head. The shields are the property of the chief, and are apportioned to the deserving. The shapes of the shields vary among the different tribes of what may be called the Kafir race. Some of the shields have depressions in the sides as if a piece had been cut out, resembling the *ancile* or sacred shield of Numa, which was supposed to have fallen from Heaven. In some instances the depressions in the sides are so great as to make them hour-glass shaped. The Basuto Kafirs[187] have a curious shield, resembling a body with two wings. The Bechuana have a shield smaller than the Zulus and cut from the thickest part of an ox-hide. The Barolongs and Batlapis have a rectangular shield, edged at top and bottom with two rounded wings.

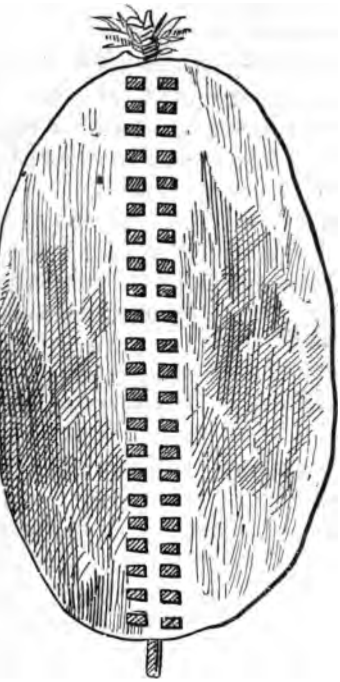


Fig. 121.—*Zulu shield of ox-hide.*

Passing northward and reaching the latitude of Portuguese occupation, we find the mat shield of Angola, Fig. 122, made of a species of grass growing commonly in many parts of Africa. The same style of manufacture is shown almost all along the Western Coast—the baskets and mats of the Gold Coast, for instance. The grass is made into long

[187] Casalis' "Basutos," pp. 63, 135, 136; Livingstone's "Zambesi," Pl. opp. p. 40.

which are laid spirally, being interlaced by ratan strips which ›d from the center radially. The view shows the back of the shield he two sticks which form the ɘ. The shields of Londa-land, uatorial Africa, on the West are made of reeds plaited to-·. The shape is oblong-square, by 2. The Apono shields are ɪr and of basket-work. The of the Fans of the Gaboon[188] ece of hide 3 feet long and 2½ ide from the skin of the ele-'s shoulder. This resists all ɪtive weapons: axes, spears, ·, or even bullets in a glancing :on.

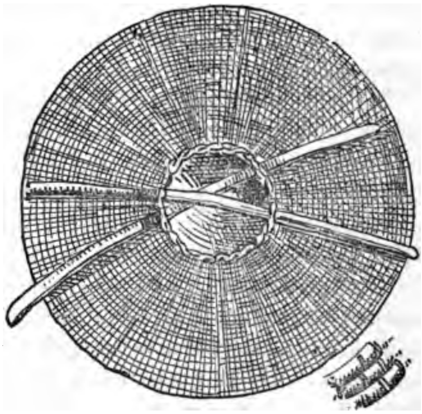
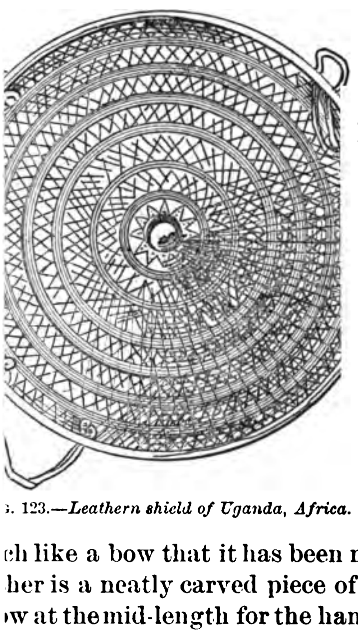


FIG. 122.—*Mat shield of Angola.*

Egyptian collection showed ɪber of shields from Central Africa, trophies brought north by Bey from his expedition beyond Khartoom. Fig. 123 is a leathern l shield with a handle of the same. It is 2 feet in diameter; alti-f cone, 6 inches. It is made of ox hide and has a strong leathern g. It is ornamented to represent basket-work. Another shield ted was of giraffe hide and 1 foot in diameter. The Roman *clipeus* round buckler of several folds of ox hide covered with plates of metal and sometimes on a wicker-work foundation. Fig. 123 shows the strap, answering to the Roman *balteus*, by which the shield was suspended from the shoulder.



·. 123.—*Leathern shield of Uganda, Africa.*

The Dinkas of the Upper Nile[189] use an ox-hide shield like the Kafirs. It is cut in oval form and crossed by a stick secured by being passed through holes cut in the thick leather.

Allied to the shield is an instrument used among the Dinkas and Niam-niams for parrying clubs and lances, rather than actually covering the body. One Dinka instrument looks ch like a bow that it has been mistaken for one; this is called *dang.* her is a neatly carved piece of wood about a yard long and with ›w at the mid-length for the hand-grasp. A similar parrying shield

›od, vol. i, p. 596.

[189] Schweinfurth's "Africa," vol. i, p. 155.

is found in Australia (see *infra*, Fig. 134). The Niam-niams use a spindle-shaped wooden implement 4 inches broad in the middle and tapering to a point at each end. It is carried in the left hand, a handle being scooped out of the center, and is used in parrying lances and spears by means of a dexterous twist.

The wooden shield of Uganda is shown in Fig. 124. The wood is soft, ornamented with ratan and bound with leather. It is 2 feet 10 inches long, 2 feet wide, and half an inch thick. The wood projects in the center to form a boss; the handle is of ratan. A basket-work shield from Uganda, also from the Long Bey collection, is shown in Fig. 125. It is made of cane strips sewed together with ratan over ribs of split wood. It is 3 feet 8 inches long by 15 inches wide. The edge is bound with raw-hide, and in the center is a block 18 by 6 inches with a handle cut in it. It is tied to the shield with ratan,

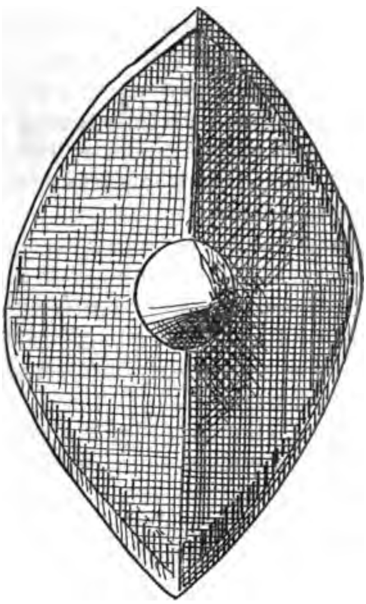


FIG. 124.—*Wooden shield, Central Africa.*

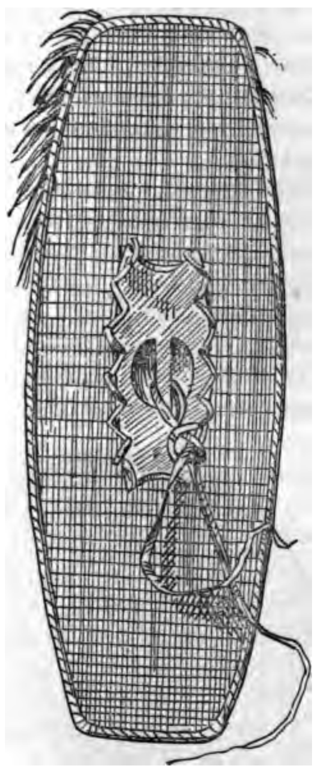


FIG. 125.—*Basket-work shield, Uganda, Africa.*

and serves to strengthen the shield as well as afford a hold for the hand.

The shield of the Niam-niams[190] is plaited from the Spanish reed, and is of a long oval form covering two-thirds of the body. It is plaited in pretty patterns of black and white in crosses and is lined with leopard skin. Inside of the shield the native carries the *trumbash*, a peculiar missile weapon with blades and three projecting points. See *supra*.

The Monbuttoos who inhabit the territory south of the Niam-niams of the extreme Upper Nile waters have a wooden shield of rectangular

[190] Schweinfurth's "Africa," vol. i, p. 441; vol. ii, pp. 9–11.

, somewhat like, but flatter than, the Roman *scutum*.[191] The shield et by 2½ feet, half an inch thick, and is hewn out of the solid block. a ridge-like protuberance across the middle and is stiffened and ιented with transverse plates of cop- ıd *rotang* twist. The shields are usu- ecorated with tails of the guinea-hog *nachœrus*), and are invariably stained

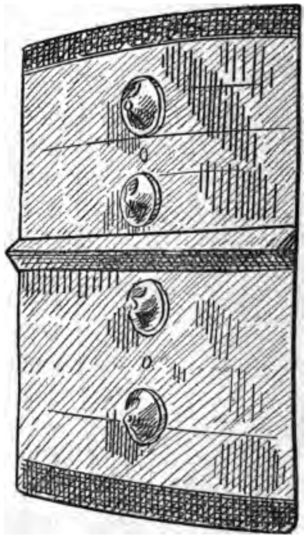


FIG. 126.—*Monbuttoo wooden shield, Central Africa.*

shield of the Kanemboo negroes in my of the Sultan of Borneo is about feet and of an oval shape. It is of an ıely light wood, which grows in the w waters of Lake Tchad. The pieces ch it is made are bound together with of raw-hide with the hair on. These make a vandyked pattern across the and around its edge. The Arab shield ızibar[192] is round, 18 inches in diame- ade of rhinoceros hide, and worn at ck from the left shoulder. The Abys- shield is made of buffalo hide, and ıvex outer surface has a boss in the . It is ornamented with the mane, ıd paw of a lion, if the owner has been so fortunate as to kill one; have silver or brass plates. Around the shield are holes, through passes the thong by which it is suspended. It is changed so as g by a different hole each day, in order that it may not become d. The Nubian shield is made of hippopotamus or crocodile skin, ıs a central projecting boss formed of a separate piece of skin. It tched on a wooden frame-work. The notches in its perimeter are on, probably the remaining impression of some ancient shape. shields of ancient Asia Minor and Assyria and the modern shields ia show the various shapes and materials which we have cited. rge shield of the Assyrians, used at sieges, was of wicker-work or it had a curved point or a projection like a roof. It was held by d bearer.[193] The oblong standing shield was referred to by Herodo- ho said[194] "the Persians made a fence of their osier shields." ssyrians had also circular bucklers of hide or metal. The oval copper found by Dr. Schliemann in the excavations at Hissarlik,[195] 28 feet the surface, is 20 inches in length, quite flat, except a raised rim and Herodotus says[196] that the Carians invented the handle of the previous to which time it had been strung by a strap from the

ith's Dict., Gr. & Rom. Antiq., London, 1875, p. 1013.
schenberger's "Voyage Round the World," p. 31.
ıd, *b.* viii, *l.* 319, 327; 1 Samuel, xvii, 7; Layard's Nineveh, Pls. vii, viii.
rodotus, *l.* 9, *c.* 61.
ıliemann's "Troy and its Remains," Pl. xiv, opp. p. 324.
, *c.* 171.

neck. The bucklers used during the Trojan war had wooden handles.[197]

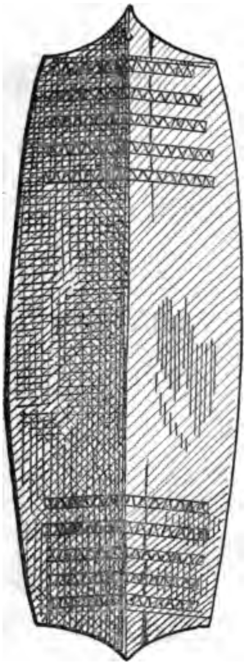


FIG. 127.—*Wooden shield of the Malays.*

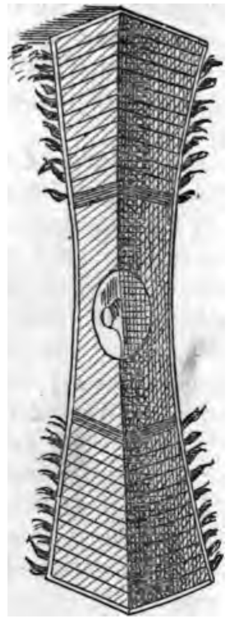


FIG. 128.—*Wooden shield, Dyaks of Borneo.*

One circular shield shown from India was of rhinoceros hide, 18 inches in diameter, and ornamented with circular plates of iron. The round buckler of the Kurds[198] and Arabs are made of the hide of the hippopotamus. The Lepcha[199] (Sikkim) shield is of cane with a tuft of yak hair in the middle. The ancient Singhalese[200] shields were sometimes covered with plates of the chank shell (*Turbinella rapa*). This is yet used as an ornament in some parts of Malaysia. It is a spiral shell,[201] the fishing for which is a monopoly on the Chinese coast, and is rented like the pearl fishery. The great market for the shells is in India, where they are sawed into rings, and worn by the Indian women on their arms, legs, toes, and fingers. In Bengal the shell has a ceremonial use, and is buried with opulent and distinguished persons.

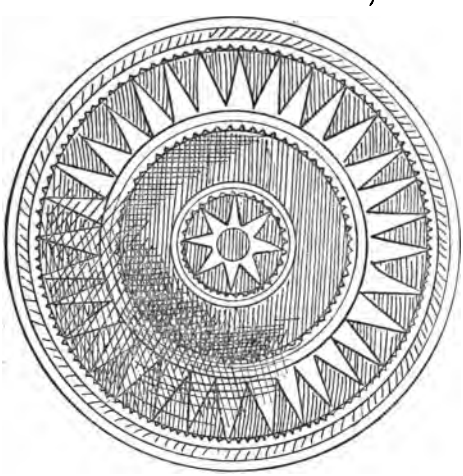


FIG. 129.—*Leathern shield, Philippine Islands.*

The Malaysian shields[202] are usually of wood. Two were shown in the Netherlands colonies collection. Fig. 127 is strengthened against splitting by transverse strips of bamboo sewed on with ratan. The wood is half an inch thick, the shield 4 feet long and 18 inches wide. The other shield, Fig. 128, is also of wood, and belongs to the Dyaks of Borneo.[203] The shape is somewhat peculiar, being narrowed in the middle and pointed above and below. In the example, the wood has bindings of ratan and tufts of human hair set in the

[197] Iliad, viii, 193.
[198] "Nineveh," vol. ii, p. 266.
[199] Hooker's "Himalaya," vol. i, p. 304.
[200] Tennent's "Ceylon," vol. i, p. 500.
[201] Bertolacci's "Ceylon," 261.
[202] Raffle's "Java," 4to, i, Pl. opp. p. 276.
[203] Wood, vol. ii, pp. 475–76.

›s. It is 4 feet long, 10 inches at the widest and 6 inches at the engtb. Other shields have beads and feathers, either separately or the tufts of hair. The plain len surfaces are sometimes ted with geometric figures.

ιe Philippine Islands collection a number of shields—one of and a number of wood. Fig. is a buckler of hide painted geometric figures. Figs. 130 131 are four wooden shields e Philippines. They are from 5 feet long and from 10 to 12 ɜs broad. They may also be ed among the parrying wea-, being evidently intended to ɔe off arrows or spear thrusts. shield (*kalasag*) of the Ygor-, of the Philippines is of wood ɾed on the edge with ratan, s 19 inches in circumference.[204] shield of the Malakus [205] of the ern Archipelago is narrow, of wood, bent to an arc shape, 1 with bits of shell, and pro-1 with a single handle placed e center. The warriors of the non Islands use clubs, spears, and arrows. Their oval ɹls are of rushes so thickly plaited as to resist arrows.

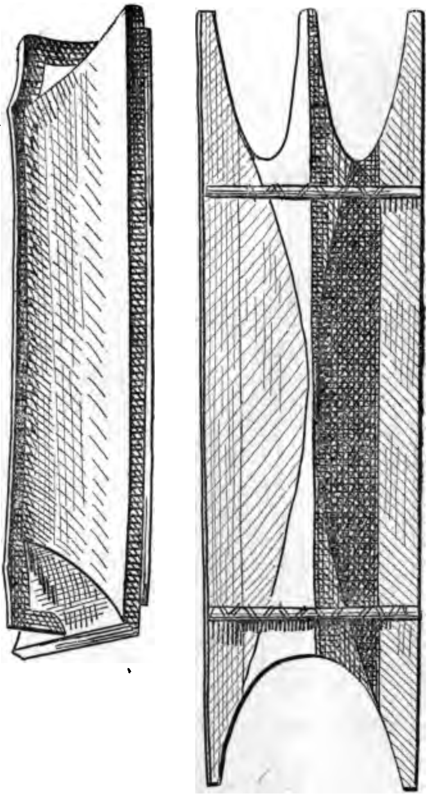


FIG. 130.—*Wooden shields, Philippines.*

e Siamese shield, Fig. 132, is indebted for its lightness, stiffness, ›trength to the bamboo. It is 5 feet in height, 20 inches in width, ıas two thicknesses of plaited bamboo splits, inclosing a layer of ain or bamboo leaves.

e Chinese shield (Fig. 133) is made of ratan cane, coiled from the r outward, and interlaced with ratan splits proceeding in a general l direction. The diameter is 32 inches, the height of the cone 8 s. It has a cross-bar lashed by ratan splits and an arm-loop and ·grasp similarly attached.

ɜ Australian shields are of three general descriptions: The *towerang*, *ılga* (Fig. 134), which is light, long, and narrow, used for warding ιe blows of spears and boomerangs by a circular twist which de-them from their course; the *heilamon* (*gee-am*) or oval shield, which s the person more or less perfectly and receives the impact of the

·gar, "Philippines," p. 210.

ɜlcher's "Eastern Archipelago," vol. ii, p. 376.

weapon; and a smaller shield held like a cricket-bat in the hand by a handle at the end. On this island continent are various tribes, with varying dialects, and the names of the shields are not the same in all districts. The names *mulga* and *gee-am* are those given by R. Brough Smith.[206]

The *towerang* (*mulga*) or parrying shield was shown in the Victoria section of the Australian department. It is 2½ or 3 feet long and used for fencing off the blows of missiles by striking them in flight.

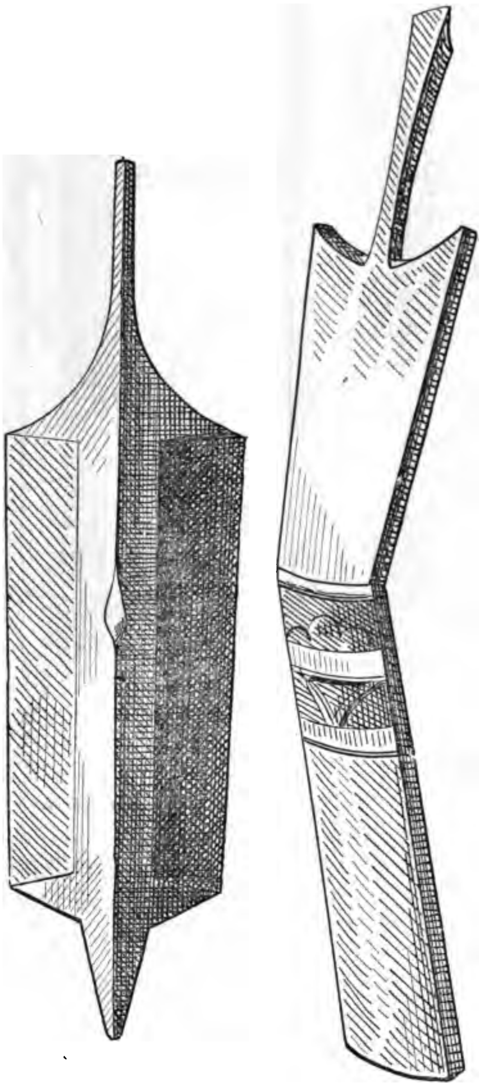


FIG. 131.—*Wooden shields of the Philippines.*

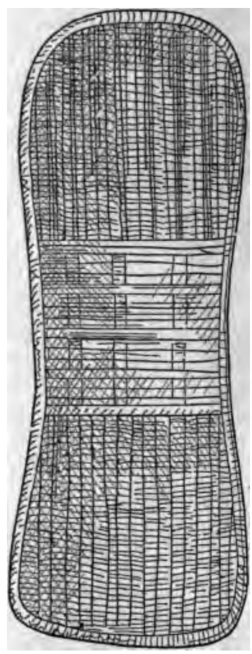


FIG. 132.—*Basket-work shield of Siam.*

It is made from the blue-gum tree, which is relatively hard and heavy, enabling it when it strikes a flying weapon to swerve it from its flight without too great a strain on the wrist. The hand-hold is cut out of the solid back of the shield, or, when the material is thin, the ends of the handle piece are driven through the front of the shield and secured.

The size given by R. Brough Smith is 35 by 5 inches, and he states that they are usually made of iron-wood or the box-wood of the colony.

[206] Aborigines of Victoria, Melbourne, 1878, pp. 330–334.

7e hand-holds, made out of the solid, and the weight is from 2½ to
ads. A variety of sizes and some variation of patterns are shown in Figs. 113–129 of his work.[207]

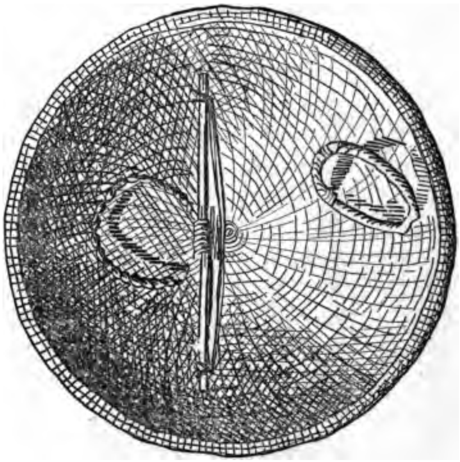


FIG. 133.—*Chinese shield of basket-work.* (*Inside.*)

The *heilamon* (*gee-am*), or war shield, used by the aborigines of New South Wales, is 2 feet long, 10 inches broad, and usually made from a solid block of wood, though sometimes from bark. The depression and hand-grasp are carved out of the wood. That shown in Fig. 135 is made from the wood of the gigantic nettle-tree. In other parts of Australia the bark of some one of the numerous species of gum is bent to form by the application of heat, and a handle or arm-bow is lashed on. The shape is usually a long oval, but some are of a diamond shape. The bark shield is called *mulabakka.* The Murray River blacks make canoes, by means of this bending process, from the bark of the tea-tree (*melaleuca*, *i. e.*, black and white), and from various species of *eucalypti.*

-*Tower-*
parrying
f Austra-

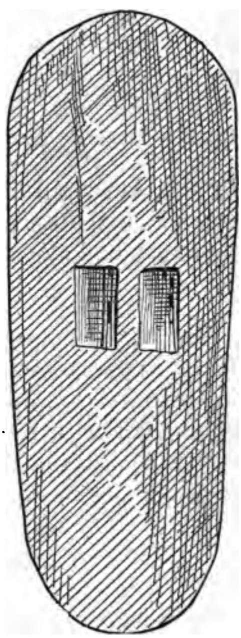


FIG. 135.—*Heilamon or war-shield of New South Wales.*

In the work just referred to,[208] the larger shield, for general protection, is spoken of as generally made of green bark, which is curved by laying it upon an earthen mound of the required shape, covered
ɔt embers; the bark is laid thereon and
ed with stones. It has a hand-grasp of
ginal wood, or one is inserted. The size
y 10 inches.
Victoria section of the Australian department showed shields of

rigines of Victoria, Melbourne, 1878, p. 300 *et seq.*
l., p. 382, Figs. 131–139.

the third kind (Fig. 136), each having a handle, so that it a bat. Such a shield is 24 by 10 inches, and is made by shr into a curved shape by water and heat and stiffening it stick.

The wooden shield of Western Australia is shown in Smitl

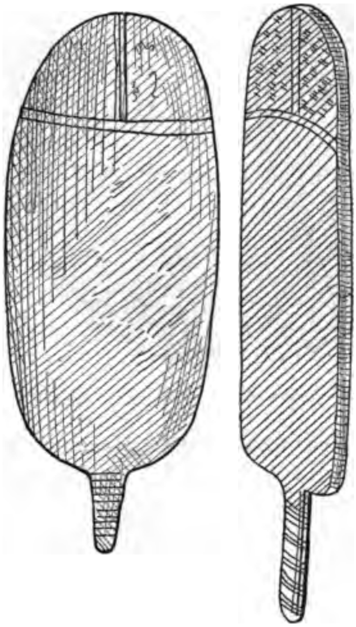


FIG. 136.—*Wooden shields of Victoria, Australia.*

The shield of the North A dian is made of buffalo hide. it, a piece of bull-buffalo skin twice as large as the shield r hole is dug in the ground, as future shield, and a smudge rotten wood is made under the is pegged above. As the skin glue made of the horns and ho in hot, which causes the skin and the pegs are regularly lo low it to shrink, at the same t it stretched. When it has necessary quantity of glu reached the dimensions of th twice as thick as in its natur it is ready for the trimming a which complete it as a shield

The Uaupé Indians of th use shields of wicker-work, covered with tapir skin. So hide of the *vaca marina* or sea by the Amazon Indians for making shields; it is the larges cessible, and its skin fills the place occupied by the rhino potamus, and elephant hide in the torrid regions of Africa.

VI.—Bows and Arrows.

The use of poison upon arrows by savages is very ancien found in many distant parts of the world. The very name f in Greek (*toxicon*)—and the Latin is similar—is derived fr equivalent to "arrow." Commencing our notice of bows and South Africa, the first example we find is the poisoned a *bosjesman*, or bushman.[211]

> "But black as death, the thin-forged bitter point,
> That with the worm's blood fate did erst anoint."
>
> Death of Paris. (EARTHLY

This arrow is in several pieces; the head is a triangula inserted into the end of a short section of reed, which slips

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[209] Aborigines of Victoria, Melbourne, 1878, p. 339, Fig. 148.

[210] Wallace's "Amazon," p. 504.

[211] Casalis' Basutos, xiv; Livingstone's Travels, p. 189; Baine's Sou 144, 150, 164.

of ostrich-bone socket in the reed-shaft of the arrow. In some cases the weapon consists of as many as five parts; a piece of ivory on the end of the section of reed and holding the iron point, which is daubed with poison. In each case the glutinous poison holds the iron tip, and the latter comes off in the wound. The poison is either from the putrified cocoons of an insect, the *'kaa* or *ngwa*, of Livingstone, from the poison gland of the puff-adder, or from the *Euphorbia arborescens.* The arrows are carried in a neat quiver of bark sewed with sinew. The bow and quiver are slipped into a small buckskin, the neck of which is tightly bound round the bottom of the quiver, while the legs serve as belts to swing it over the shoulders. The quiver also contains the fire-stick and sucking-tube of the bushman.

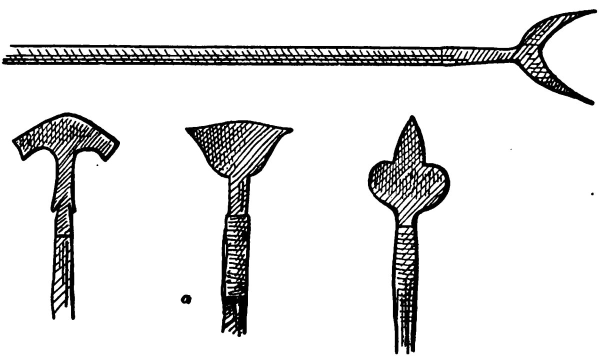


FIG. 137.—*Iron arrow-heads of Angola, Africa.*

The Kafir does not use the bow and arrow, although he suffers from the poisoned arrows of the bosjesman and fears their effects. The Kafir weapons are the assegai and kerrie; that is, javelin and club.

The Angola arrows, Fig. 137, have heads of steel on reed-shafts. The metal is obtained of very good quality by native methods. Their spear and javelin heads for thrusting and throwing are likewise tipped with steel. The arrow-heads shown in Fig. 137 are bound to the shafts with raw hide, grass, or ratan. The arrow-head (*a*) is like one form of the *bosjesman* arrow, in which the base of the triangular steel piece is in advance.

The poisoned arrows of the Zambesi[212] and Mozambique countries are made in two pieces, after the same general plan of those of the bushman of the south. The iron barb is fastened to a wand of wood 10 inches long, which slips into a reed shaft. The wood below the arrow-head is smeared with the poison, and both the barb and the stick remain in the wound while the reed drops off. The poison is obtained from a species of *strophanthus.* The bow of the Zambesi Maravi[213] is intended to act as a shield as well, being from 6 to 8 inches broad, and used in parrying thrusts.

A Central African quiver brought by Long Bey is shown in Fig. 138. Like that of the Gold Coast it is of wood bound with leather, and has tassels of the same. A sheathed knife is attached to the quiver. The Niam-niams,[214] on the extreme upper waters of the Nile, do not use the bow and arrow. The Monbuttoo,[215] immediately south of them, on the

[212] Livingstone's "Zambesi," pp. 109, 491.
[213] *Ibid.*, p. 583.
[214] Schweinfurth's "Africa," vol. ii, p. 9.
[215] *Ibid.*, vol. ii, pp. 103, 111.

Welle River, have both. The shafts of the Monbuttoo arrows are of reeds, and differ from all others of that vicinity in being winged with pieces of genet's skin or plantain leaves. The bows are over 3 feet long, and the strings made of a strip of the split Spanish reed, which possesses more elasticity than any cord. A hollow piece of wood on the bow protects the thumb from the blow of the string. The arrow is discharged from between the middle fingers. The Dinkas[216] of the Upper Nile have no bow and arrow; their weapons are lances and clubs. The Bongos[217] use the lance, bow, and arrow. Their bows are 4 feet long, the arrows 3 feet, made of solid wood, and anointed with the milky juice of *euphorbia*. The Madi and Bari[218] tribes of Central Africa also use

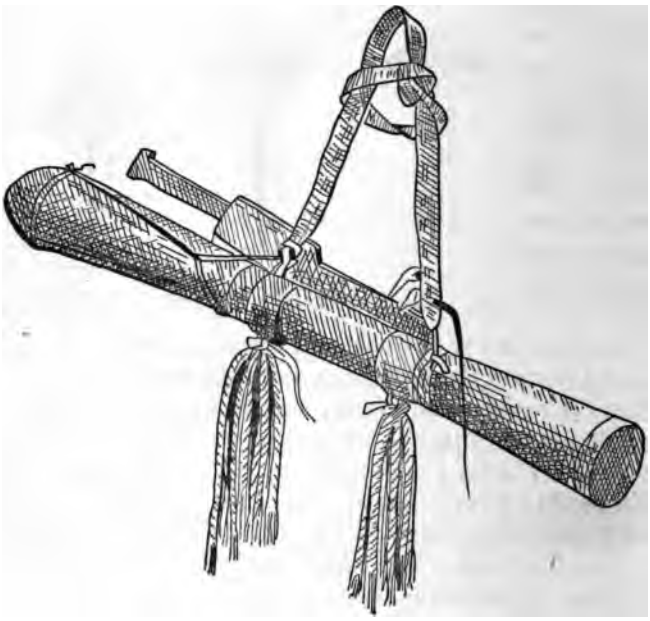


FIG. 138.—*Quiver of Uganda, Africa.*

poisoned arrows; so do the Ashantees, Fans, and Aponos of the West.

The modes of handling the bow in Africa are various, and have always been so. In ancient Egypt[219] several modes were adopted even by the trained troops. The mural monuments show a bowman with three supplementary arrows held by the thumb, the string being pulled to the shoulder by the fingers. An arrow being discharged another one is jerked up, and three are kept in the air at a time. Another figure shows a soldier drawing a longer bow, having a larger arrow, and pulling with the thumb and finger.

The Assyrians drew the bow to the cheek or to the ear, as did the Saxons—not to the breast like the Greeks. The larger Assyrian bow was carried over the shoulder, the man first putting his head through

216 Schweinfurth's "Africa," vol. i, p. 154.
217 *Ibid.*, vol. ii, p. 300.
218 Baker's "Ismailia," pl. opp. p. 135.
219 Wilkinson; Kitto, vol. i, p. 452.

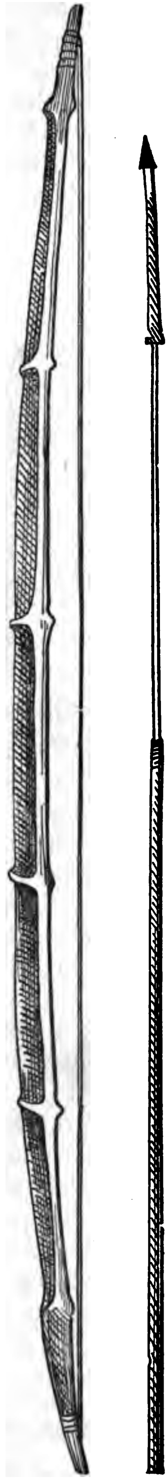
ɔ smaller bow was carried in a quiver by the the chariot along with the arrows, which were ⁊ith heads of iron or copper. A linen guard apped to the inside of the left arm to protect ͺ against the blows of the string.

bow and arrow of Queensland, Australia, are n Fig. 139. The bow is 6 feet long and made male bamboo, which is solid. The string is a ratan, which is beaten to remove the flinty coat- reduce it to a bunch of fibers, which is slightly . The arrow is of reed, from 3 to 5 feet long, nick for the string, nor feathers for the butt. ᐧow-head is of hard wood, smooth, knobbed, or As the bow and arrow are used only in the ly part of Australia,[220] around the Gulf of Car- ɩ and in Queensland, it may reasonably be as- ;hat they are of foreign origin, and the knowl- them imported from Papua.

New Guinean[221] arrow is a reed tipped with eavy wood, grooved to receive a tapered slice ɔoo with a point made by an oblique cut. The ; poisoned. The bow is 6 feet in length, made ɩe cocoa-nut tree, and has a string of ratan. ᐧows of the Solomon Islanders are tipped with .es; those of the Admiralty Islands are of reed ırd-wood heads secured by ligatures of bark. ıga Island arrows are of reed and hard wood, ction of the two being covered with plaited ɩnd varnished. The Andaman Islanders[222] use ɩf tough, strong wood 5 or 6 feet in length, and two flat bulges, one on each side of the central ɔld. The arrows are of ratan with a hard-wood ɩd a barb made of a fish-bone, the tail-bone of g-ray, or a nail when one can be procured. The ˈ the arrow is sometimes poisoned.

ɔow of the Philippine Islands is a slab off the a large bamboo, or it is sometimes made of wood; the string of abacá, 3^{mm} in diameter.[223] ˑ arrows (*pana*) have shafts (*gaho*) of caryota nd points (*buchi*) of bamboo, or sometimes the rrow is of wood 1^{m} to 1.8^{m} in length. The heads tate, barbed, three-pointed, or carved spirally.

Fig. 139.—*Australian bow, Queensland (male bamboo).*



d, vol. ii, p. 46.
, vol. ii, p. 225.
at's "Andaman," pp. 271, 321.
r's "Travels in the Philippines," London, 1875, pp. 657,

They have different names: *bulóg*, *boló*, *serápong*, &c. They aı times dipped in a poisonous mixture looking like tar, and made f mixed inspissated juices obtained from the bark of two trees. Th is of bamboo; the arrow is frequently a cane with a tip of haı (sharpened), bamboo, bone, or metal. The arrows exhibited Spanish Building are shown in Fig. 140.

The bow, club, and sling are not found among the primitive D any other aborigines of Malay nesia, except the Bisayan race. Sagais of Borneo use the *sum* for propelling poisoned arr means of the force of the breat natives called a rocket a "fire tan." The blow-gun, which is to the *zarabatana* of the Macoo of South America, is a tube wood (*Casuarina equisetifolia*) feet long, and with a bore of inch. An iron muzzle-sight upon the upper side and a spe the lower, the latter serving the tube straight, its projectin also serving as a weapon. The *sumpit*, is 9 inches in length, of a leaflet rib of the *nibon* palm. The point of hard wood is s with the deadly poison of the Upas tree, and has brittle barbs tail-bone of the sting-ray, which breaks off in the wound. Th is run through a cone of the pith of the *nibon* wood, which fits t and prevents windage. The range is variously stated at from 4(yards—from 40 to 80 yards is the more probable statement.

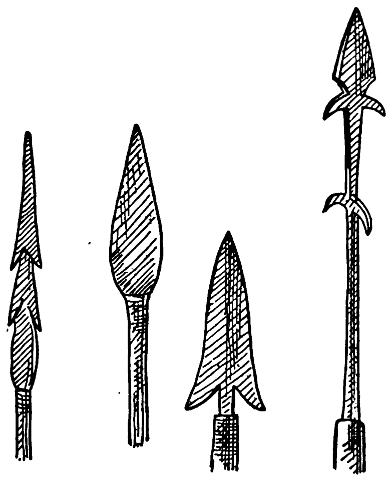


FIG. 140.—*Iron arrow-heads of the Philippines.*

The common bow of India is made from the male bamboo, b intervals with belts of split ratan. Another form is made of h wood. The hand-hold and the ends are wood and the two inte pieces are of a buffalo horn which is sawed lengthwise, flattened and pressure, and fastened by long splice joints to the middle a pieces. It is like the *arcus patulus* of the Romans. Sinews a along the back of the bow and so agglutinated by heat, moistu pressure that they appear to form one piece with the body of tl The whole is then anointed with *glue* and ornamented according t The horn portions are principally involved in the flexure, and wl bow is unbent it recurves and assumes the shape of the letter " back being inward like the *arcus sinuosus* of the classic period bow string is of vegetable fiber. The arrow is of reed with a har

[224] Belcher's "Eastern Archipelago," vol. ii, p. 338.

[225] Boyle's "Dyaks of Borneo," pp. 251, 252; Raffles' "Java," 4to, vol. i, p. Pl.; Belcher's "Eastern Archipelago," vol. i, p. 227; vol. ii, pp. 133, 134.

[226] Wood, vol. i, p. 583.

t and butt, the former receiving a quad-
ular steel piece, and the latter the feathers
the notch for the string. Another Indian
w has a wooden shaft with barbed head
ed to the shaft with twine, and "feath-
," so to speak, with dry leaves set in slits
.e butt of the arrow.

ie maritime people of Ceylon are largely
the Malabar coast of India and are dis-
; both from the Singhalese, the principal
on of the island, and from the Veddahs,
wild aborigines who still inhabit the less
ssible forests. The Singhalese chronicles
rd that the Malabar arrows were some-
s "drenched with the poison of serpents."[227]
ie Veddahs[228] are expert with the bow,
h they hold in the right hand and draw
string with the left. The bow is 6 feet
, and the arrow 3 feet.[229] Iron arrow
es[230] are the only articles of foreign man-
ture which they covet. Another Veddah
is sprung by the feet,[231] the string being
by both hands, the archer lying upon his
. This unusual mode is mentioned by Ar-
[232] and is practiced by the *Cabaclos* of Bra-
' and the *Gran Chacos* of La Plata.

ie Tartars and Chinese use a bow which
mes a recurved form when unstrung. The
aple shown in Fig. 141 was upon the effigy
Chinese soldier in the Mineral Annex to the
ı Building. It is nearly 6 feet in length
a few inches from each end is a bone stud
which the string passes. The bow is
by placing it behind the right thigh and
ont of the left, then bending it by a sud-
stoop of the body throwing the force on
ight leg, and, by a quick motion, catching
string over the end of the bow and into the
h. The body of the bow is a bent bamboo
of the solid variety, and to its ends
len pieces are lashed with sinews. It has
d string. The shape is exactly that of the
hian bow (*arcus scythicus*) as shown on

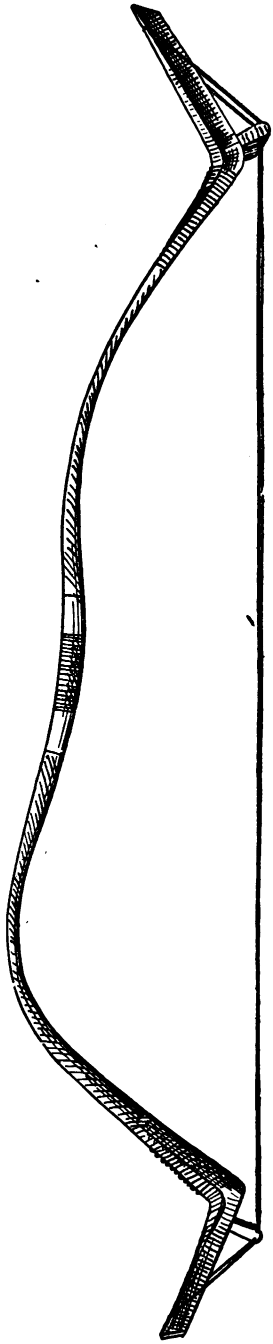


FIG. 141.—*Chinese wooden bow.*

'ennent's "Ceylon," vol. i, p. 500.
Cnox, "Ceylon," 61.
I. S., "Ceylon," London, 1876, vol. i.
'orbes' "Ceylon," vol. ii, p. 78.
[231] Tennent's "Ceylon," vol. i, p. 499.
[232] Indica, *l.* xvi.
[233] Fletcher & Kidder's "Brazil," p. 558.

classic vases and gems. The Japanese bows and arrows are shown in Siebold's great work.[234]

The bow of the North American Indian is seldom much over 4 feet long and is always used on horseback; his aim is not remarkable for accuracy, but he discharges the arrows with great force and rapidity. The bow is made of wood, bone, or iron. An ash bow with the sinews of the buffalo or deer worked into the back is no contemptible weapon either to draw or to face. The bow, Fig. 142, like the Roman *arcus patulus*, is made of several horns spliced together. In the present case, the horns are those of the mountain sheep, *Ovis Montana*. They are made by heating the horns in hot ashes and drawing them out, then splicing pieces together with bands of deer sinew. The joints are hidden by ornamental coverings of cloth, skin, or dyed porcupine quills. Such bows are valued at the price of two horses, as the horns of which they are made must be obtained by barter with Rocky Mountain Indians. The arrow is of wood or reed and headed with flint, bone, or iron. Indian arrow-heads are the most common article in the American sections of ethnological museums, and show wide difference in shape, material, and size. The example, Fig. 143, has a point of chipped chalcedony. Fig. 144 also shows chipped flint arrow-heads of the Pai-Utes of Southern Utah. They are cemented and bound to the wooden shafts.

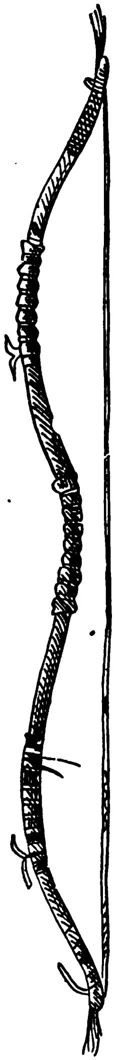


FIG. 142.—*Sioux Indian bow of mountain sheep's horns.*

FIG. 143.—*Sioux stone-pointed arrow, Dakota.*

The Indians of the California peninsula make bows of willow-root, and attach strings of intestines. Their arrows are of reed with triangular hard-wood heads.[235] Flint arrow-heads of Terra del Fuego, and of the stone age of Sweden, are shown and described in Nilson,[236] and those of the dwellers on the pile villages of the Swiss lakes, in Desor's work.[237] Bone arrow points and bows of yew are also found in the same localities.[238]

[234] "Nippon," vi, Pl. 1, *bis;* vii, Pl. 19, Figs. 1, 1, *a*, 2; vii, Pl. 22; see also *Ibid.* ii, Pl. 5, for bows and arrows in great variety. Also upper row in Pl. 15 and 21, vol. ii.

[235] Baegart, in Smithsonian Report., 1863, pp. 362, 3.

[236] Stone age, Plate v, and pages i, 43–5.

[237] Translation in Smithsonian Report, 1865, p. 374, 356.

[238] Morlot. Translation in Smithsonian Report, 1862, p. 376.

The Oregon Indians make their bows of cypress, *Cupressus Lawsoniana*, or of yew, *Taxus brevifolia.* The wood is strengthened on the back with sinew, in the manner so common throughout the Northwest. The string is of sinew and the arrow of reed pointed with obsidian. The arrow-head is chipped to form by a tool similar to that by which the glazier nibbles his glass to shape. The feathers of the arrow are set on spirally. Poison for the arrow-heads is made by causing a rattlesnake to strike its fangs into liver, which is then allowed to putrify and the arrows are smeared therewith. The bow of the Ahts of Vancouver's Island[239] is also of wood fortified with sinews. The arrow is large and has a barbed bone lip; the arrow for fish has two tips barbed on the inside like the Australian fishing-spear, and clasps any object it may come across. The feathering of the arrow is put on spirally. The Ahts have also an arrow with a detachable barbed bone point, connected by two cords with the shaft, with which they form an equilateral triangle; the shaft impedes the seal in its motions and acts as a float. The same feature is common in Eskimo harpoons.

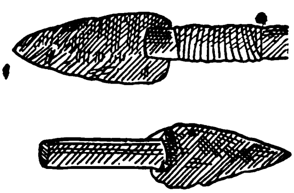


FIG. 144.—*Chipped flint arrow-heads, Utah.*

The bow of the Kutchin tribes of the Mackenzie and Youcon Rivers are of willow, 5 feet long and with an enlargement at the grasp to protect the hand against the snap of the string. The arrows are of pine; arrow-head of bone of wild-fowl, or of bone tipped with iron for moose or deer.[240]

The bow of the Greenland Eskimo is made of horn, bone, or wood, re-enforced on the outer side with a multitude of deer sinews, which are put on so tight as to give the bow some backward curvature. Its average length is 3½ feet. The bow string is twisted deer sinews. The Eskimo arrows are of wood tipped with bone or stone; or in some cases of wood and bone tipped with iron. Bow and arrows are in a quiver of seal-skin. Fig. 145 shows three arrow-heads in the Greenland division of the Danish department; the left-hand is of bone and the others of stone. The Eskimo uses a wrist-guard of bone plates tied together and fastened by a button and loop; it receives the blow of the bow-string.

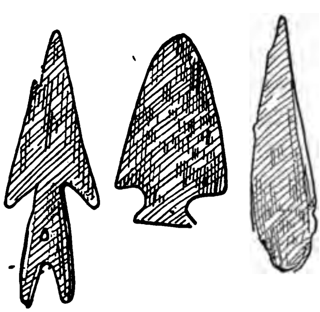


FIG. 145.—*Eskimo arrows, Greenland.*

In the warmer regions of America, like the countries to which we have referred, the poisoned arrow is no new thing. Herrera, the Spanish adventurer, died from the effects of a poisoned arrow. De Soto's historians[241] mention arrows barbed with flint, arrows without barbs, arrows of reed tipped with

[239] Wood, vol. ii, p. 725. [240] Smithsonian Report, 1866, p. 322.
[241] Irving, op. cit., pp. 191, 195, 225.

lozenge-shaped buck's-horn plates, and arrows tipped with fish-bones, with palm spikes, and with hard wood.

The *zarabatana*[243] or blow-gun of the Guiana tribes is made in two pieces, each of which has a semi cylindrical groove, so that the two form a perfect tube when bound together with spiral strips of the pliable *iacitara* wood. The outside is covered with wax and resin. A trumpet-shaped mouth-piece directs the wind from the mouth and lungs into the tube when the lips are suddenly opened; the puff seems to be directly from the chest. The blow-gun is 12 feet long and quite heavy. A lighter gun, *pucuna*, of the same region, is made of a ten or fifteen feet section of a reed (*Arundinaria Schombergii*), which grows in a limited region on the Upper Orinoco, and has a length of over 12 feet between the joints of its lower portion. This reed forms the *ourah* or barrel and is slipped into a stick of palm (*Ireartia setigera*) from which the pith has been pushed out. The mouth-piece end is bound with silk grass and the other end fortified with the half of an *acuero* nut, which also forms the muzzle sight. The breech sight is made of two incisor teeth of a cavy, which are secured with wax to the tube, the depression between the teeth being the valley sight. The gun is held in the left hand, the elbow of that arm resting on the hip. The right hand grasps the tube near the mouth-piece, and the gun is raised by bending the body. It weighs about a pound and a half—but a fraction of the weight of the *zarabatana*. The arrow is made of the leaf rib of the *coucourite* palm. It is 10 inches in length, about the size of a crow-quill, is pointed by means of a fish-tooth scraper, and is fitted to the bore with a pledget of wild cotton (*Bombax ceiba*). The arrows depend, like the *sumpits* of the Dyaks, upon their sharp poisoned tips. The poison is obtained from the *wourali* vine (*Strychnos toxifera*) and a bitter root, the *hyarri*, to which are added poisonous ants, poison fangs of snakes, and other things to give effect to the stuff, or to conceal the real ingredients, as the composition is a secret in the hands of the conjuror. The poison has an instantaneous numbing effect, the victim seeming void of pain or fear, dropping immediately, and dying in a short time without a struggle. The arrows are kept in a "quiver" or in a "roll," and each is cut deeply near the head, so that the poisoned portion may break off in the wound. The range is from 50 to 100 yards. A modification of the arrow is one in which, instead of the cotton, a piece of bark is placed spirally on the stem of the arrow, terminating in a hollow cone, which fills the bore when the cone is expanded by the wind; a singular anticipation of the hollow-base Minie bullet, which is expanded into the grooves of the rifle by the evolution of gases due to the explosion of the powder. A piece or two of bark, laid spirally on the arrow-shaft, feather the arrow, and make it revolve in flying. This is equivalent to the rifling of a gun. This arrow is tipped with a small piece of iron.

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[243] Wood, vol. ii, p. 583.

For war or for killing the tapir or jaguar, an arrow 6 feet long is made of a reed, having for a head a hard-wood spike, an iron point, or the tail bone of the sting-ray. Poison is used on either. The arrow is projected by a bow.

The blow-gun of the Uaupés of the Amazon[243] is called the *gravatana*, and is made of two stems of the small palm *Ireartia setigira*, one slipping within the other so as mutually to correct curvatures. The pith is pushed out, and a conical mouth-piece fitted to one end. Arrows are made from the spinous processes of the *patawa* (*Ænocarpus batawa*), pointed and anointed with poison of the *wourali*. The butt of the arrow carries a little tuft of tree cotton to make it fit in the tube.

The ordinary bow of the Uaupés,[244] the aboriginal Indians of Brazil, is of different kinds of hard elastic wood, and is from 5 to 6 feet long. The string is either of the *tucum* leaf-fiber (*Astrocaryum vulgare*), or the inner bark of trees called *tururi*. The arrows are 5 feet long or over, are made of the flower-stalk of the arrow-grass, and are tipped with hard wood, barbed with the serrated spine of the sting-ray. For war, the head is anointed with poison, and is notched in two or three places so as to break off in the wound. Arrows for shooting fish have usually iron heads, bought of the traders, but others are made of monkey's bones and barbed. The arrows have three feathers laid on spirally.

The Indians of the Amazon also use a two-stringed bow for shooting stones. The pellet bow has a pad or net in the middle of the string, to hold a stone or ball of clay, to project it in the manner of an arrow. Such are used in South America and Africa.[245]

The arrow of the Guianians, used in shooting turtles, is projected by a bow and has a movable harpoon-head of iron detachable from the shaft, but secured loosely thereto by a thong. The turtle-shooting bow of the Central American Indians is made from the Soupar palm, *Guilielma speciosa;* the shafts of the arrows from the dry stalks of the cane, *saccharinum officinarum*, tipped with hard wood or iron.

The Peruvian arrows were tipped with copper or bone.[246]

The arrows of the Paraguayan Indians are of several kinds. Some have block points to kill birds without bleeding them; others with long wooden four-sided heads, sharpened and cut into barbs. These heads are carefully lashed on to the shaft, which is in all cases of cane. The arrows were shown in the Agricultural Building, are from 3 to 4 feet long, and have feather flyers put on straight.

The Gran Chaco Indian of the La Plata region,[247] destitute of habitation himself, employs fire-arrows when attacking a settlement. He binds some cotton around the head of each arrow just behind the head, and then lying down he holds the large bow with his feet while he draws the

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[243] Wallace's Amazon, pp. 214, 215.

[244] *Ibid.*, pp. 486, 487.

[245] See Tylor's "Early History of Mankind," notes, p. 177.

[246] "Conquest of Peru," p. 73.

[247] Wood, vol. ii, p. 570.

string with both hands and lets fly the lighted arrows one after the other, with considerable rapidity. The *malleolus* of the Romans was a large missile like a distaff with an arrow-point; the cage of the distaff was filled with tow steeped in pitch. It was lighted before being discharged, and it was intended that the arrow should penetrate the wooden object or thatch and hold it while the incendiary material should set fire to the building.

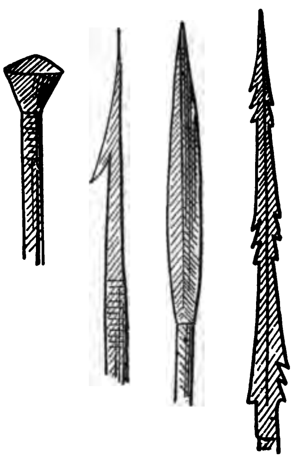

Fig. 146.—*Paraguayan arrows.*

The Fuegian bow is strung with twisted sinews; the arrow is of hard wood and has a notch in the end, holding a piece of flint or obsidian, which comes off in the wound.

We may conclude this account of savage weapons by some references to the cross-bow. This was shown in the Norwegian Department in the Main Building, and is a remnant of mediæval times. The instrument, however, is found in use in several parts of the world, and some of the African and Asiatic examples show more ingenuity than the European weapons with which we are more familiar.

The Norwegian cross-bow, Fig. 147, has a stock 30 inches long with a 24-inch powerful steel bow. The stock is handsomely inlaid with ivory; the string is a covered cord, and the bolt is shown in its groove. The Roman *scorpio* was perhaps the oldest instrument of the kind on record, and was used to discharge stones, plummets, and arrows. We find cross-bows among the Fans of the Gaboons in Western Africa; the Mishni, a tribe of Assam in Eastern India; the Nicobar Islanders[248]; the Chinese and the Japanese[249].

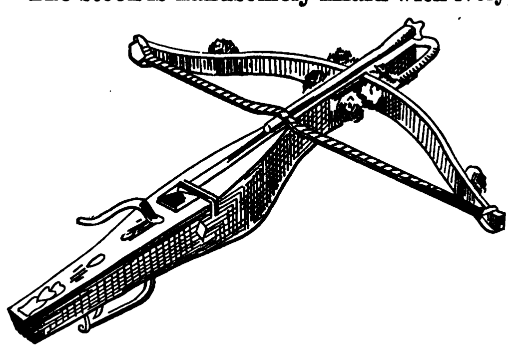

Fig. 147.—*Norwegian cross-bow.*

The cross-bow of the Fans is 5 feet long and has a very strong bow 2 feet long, which is bent by holding it with the feet while both hands strain the string into the notch. The string is thrust out of the notch by a clumsily ingenious arrangement. The shaft is split so that the forward end of the lower portion has a limited motion up and down, the split terminating at a point a little forward of the string-notch. To the lower portion is attached a peg which extends upward through a hole to thrust the string out of the notch. A trigger-pin lies in the split of the shaft and holds the portions apart so that the string can lie in the

[248] Wood, vol. ii, p. 220.

[249] Siebold's "Nippon," vol. ii, Pl. 5 *bis.*

notch; but as soon as the trigger-pin is removed the separated portions fly together, the pin rises, lifts the string, and the arrow is discharged. The Chinese have a somewhat similar method. The arrows of the Fan cross-bow are small and light, and about a foot in length. Their range is about 20 yards, and they owe their efficiency to their poisoned tips. When laid in the groove of the shaft to be discharged, the arrow is slightly held by a piece of wax. A larger arrow with an iron head is used in hunting.

The Japanese have also a cross-bow. The repeating Chinese cross-bow is perhaps the greatest advance in this implement, which has been so entirely superseded in Europe. The magazine is above a movable block which has a slot in which the string moves, and the whole block is movable back and forth in the main stock by a lever attached to the latter and shackled to the block. As the lever is raised the block slides forward until the string of the unbent bow drops into a notch. This allows an arrow to fall out of the magazine into the slot. Now draw back the lever; this action draws upon the bow-string and bends the bow in the first place, and when the lever is depressed to its fullest extent a pin in the block comes against the stock and is pushed up so as to lift the string out of the notch and discharge the arrow. The limit of speed in firing is the quickness with which the lever is lifted and depressed. The bow is made of three thicknesses of the male bamboo, overlapping like the plates of an elliptic carriage spring. The string is a thick twisted gut. The arrows are straight, both with heavy steel heads and very slight spiral feathers. Its utmost range is possibly 200 yards.

ANTHROPOLOGY.

Prepared under the direction of Prof. OTIS T. MASON.

Ɛ PRESERVATION OF ANTIQUITIES AND NATIONAL MONUMENTS IN DENMARK.*

report made at the request of the legation of Austria-Hungary in Copenhagen.

BY J. J. A. WORSAAE.

[From the Memoirs of the Royal Society of Northern Antiquaries, 1877.]

ʟs requests have frequently been received from institutions and individuals in ıy countries, as France, England, Sweden, and Finland, for information relative he measures undertaken in Denmark for ethnological explorations and the preser-ion of antiquities and national monuments, it has been thought proper to publish present report, made at the end of 1875, particularly since there exists no work of milar character in the archæological literature of Denmark.)

A.—ANTIQUITIES.

Jp to the commencement of this century, there was no public collec-ı in Denmark devoted especially to national antiquities. A few ects found in the country were, indeed, preserved in the Cabinet of ts (*Kunstkammer*), founded by King Frederick III, in the latter half he seventeenth century (1648–1670), and containing, according to the hion of the times, antiquities of all lands, medals, specimens of nat-l history, objects of ethnography and art, furniture, and curiosities, own together pell-mell. But these rareties were obtained mainly from idental finds, and not from careful explorations. They were prin-ılly objects of gold and silver exhumed in various places, and be-ging to the class called *dánefæ* (in old Norwegian *dánarfè*, from *fè*, roperty," and *dánar*, "of a dead man"). The Danish law, (5–9–3, horitatively interpreted by the ordinance of March 22, 1737), in effect nted to the king, or to the crown, in accordance with an immemorial tom, all treasure or deposit of gold, silver, and precious objects, hout an owner, found in the earth; and the finder was bound, under tain penalties, to turn over his stock to the treasury without any in-ınity. But since under this system many precious objects were sold melted up secretly, to the prejudice of archæological science, an inance was passed August 7, 1752, which claimed for the crown right of *danefæ*, under the same penalties, but granted to the finder full value of the metal, except when the proprietor of the soil had sed explorations to be made with the express purpose of seeking ısures, or when that which should be discovered in the monuments

Translated from the French translation of E. Beauvois. The Danish text: *Om ıringen af de fædrelandske Oldsager og Mindesmærker i Danmark*, appeared in "Aar-ɪr for nordisk Oldkyndighed og Historie," 1877, pp. 1–19.

explored by his orders, was expressly reserved. Experience has shown that this plan was practical and very advantageous to the public collections, and especially since it is generally known in Denmark that the finder will obtain from the State (the agents of which examine and appraise the articles found) not only a higher price than private persons would pay, but that the care taken in collecting and preserving the objects will be recompensed by an *honorarium* added to the price of the metal. Moreover, in recent times, England, in modifying the ancient rigorous laws regarding treasure-trove, has taken very particularly into account the Danish legislation and experience acquired in this matter.

With the exception of penalties provided against the unlawful detainers of *danefæ*, the law had no provision concerning the bestowal of the objects, nor prohibition against selling them in the country or to foreigners.

At the commencement of this century Professor R. Nyerup, with a view to prevent the increasing destruction of national antiquities, commenced to make a special collection of them, and the people everywhere having been invited to "lay their offerings upon the altar of their country," in order to exhibit the progress of civilization in Denmark from the most ancient times to our day, the government took the affair in hand, and established a royal commission for the preservation of antiquities (1807), charging them to look to the preservation of monuments as well as of antiquities throughout the realm. This commission was replaced in 1849 by a committee of two directors, the curator of the Museum of Northern Antiquities, (M. Thomsen,) and the inspector of ancient monuments, (M. Worsaae,) who were to act in concert in preserving the antiquities of the kingdom in general. In 1866 the two offices were united, together with the historic and ethnographic collections, under the control of one man, Professor Worsaae, in order that the regulations concerning the matter might be applied with more uniformity and efficiency. This organization is still in existence.

The first commission founded the collection which has become the Royal Museum of Northern Antiquities, but it was only after 1815, and under the direction of Thomsen, that it acquired any importance; when, having been made a national institution, under the jurisdiction of the minister of education, it figured annually in the financial report. Besides its regular appropriation, it has, as before, a special fund for the purchase of *danefæ*, and may obtain, when necessary, large sums of money to purchase collections, or to make extraordinary explorations. At relatively little expense the museum has been elevated to great importance. It has acquired successively the national antiquities preserved formerly in the Cabinet of Arts, the Cabinet of Medals, and other collections; moreover, it has been enriched by donations and by the results of diggings in different parts of the kingdom, until it contains between 40,000 and 50,000 articles actually on exhibition in the Prince's palace. The number of relics coming in from all parts of the kingdom is increasing to such an extent that the idea of erecting a grand museum for the national collections becomes more and more popular. To the museum are annexed the public archives, which contain, besides an archæological and topographical library, designs, and descriptions of remarkable finds, as well as of monuments scattered over the country.

It was found necessary to interest the people in the progress of the museum, and to evoke and foster this interest the directors adopted the following means:

1. To admit the public at all times to visit the collections, and to explain the objects to visitors. Later, when the accessions to the museum and the number of visitors no longer permitted giving oral instruction to all, the directors published guide-books in several languages.

2. To publish in the journals the list of objects sent or given.

3. To publish popular treatises upon the antiquities and their signification, a task in which the museum has been ably seconded by the Society of Northern Antiquaries.

4. To hold popular conferences at Copenhagen and elsewhere.

5. To form small collections—especially for the instruction of youth—in the provinces, the principal cities, in scientific schools, high schools, and normal schools.

6. To interest in the work the priests, instructors, and eminent citizens, who have influence with the people, and who will oversee their labors.

7. To distribute money, books, and other presents to those who distinguish themselves by their zeal and care in collecting and preserving antiquities.

As the fruit of these measures, it rarely happens that important treasures when found do not come promptly to the knowledge of the museum: the objects are ordinarily forwarded at once. The small public collections of the provinces, which have a superintendence independent of the state, have adopted the plan of offering to the central museum at Copenhagen such objects as are especially interesting and instructive, and of demanding in exchange duplicates of more common specimens. By reason of a strong national sentiment, the people make it a point of honor to collect material for the history of prehistoric times, so that it is no longer necessary to prohibit the exportation of relics of stone, bronze, and iron. The museum has fostered the spirit of spontaneousness, and, instead of discouraging, has favored the formation of private collections. Experience has shown that this is the proper way to save from destruction many objects which otherwise would have been lost, the private collections sooner or later becoming incorporated into the National Museum.

As to the plan of the museum and its interior arrangement, the details are amply set forth in the printed descriptions.* It should be

*Museet for de Nordiske Oldsager, en kort Ledetraad for de Besøgende. 12mo. Copenhagen, 6th edition, 1874,—Guide Illustré du Musée des Antiquités du Nord à Copenhague. 8vo. 3d edition, 1866,—Das Museum für nordische Alterthümer. 8vo. Copenhagen. 2d edition, 1876. All by M. C. Engelhardt.

remarked that in general this institution aims to explain the method of colonization of Denmark, its relations with other countries, and the progress of its indigenous civilization in pagan times (from the beginning of the stone age to A. D. 1030); in the Catholic period (to A. D. 1536); finally, after the Reformation, in the short period during which the ancient style of the Renaissance obtained, or, indeed, to the establishment of absolute power in Denmark (A. D. 1660).

In the classification of objects, chronology has been rigorously observed as far as this has been gradually worked out. We no longer confine ourselves, as at first, to arranging the specimens of the pagan era into great periods, simply the age of stone, the age of bronze, and the age of iron; but we are forced to distinguish in each of these that which belongs to the commencement or to the end, and also to the transition from one to the other, in order to show clearly the gradual progress of civilization and its passage from one primitive station to another more advanced, and finally to discriminate between foreign influence and the national and more independent labors. It has been a matter of particular importance in this regard only to class by series those objects found isolated, while the great finds of each period have not been dissociated, but preserved in their entirety and arranged geographically. Thus it is possible not only to distinguish the objects of each period, and, indeed, of each subdivision, but to recognize the peculiarities belonging to the different sections of Denmark, whose southern and western provinces were evidently affected much earlier than the northern and eastern by foreign civilization, while the culture, coming from the south, penetrated earlier into Denmark itself than into the more northern and distant countries of Scandinavia—Sweden and Norway.

In connection with the Museum of Northern Antiquities and the Cabinet of Medals,* it is necessary to mention the Museum of Ethnography† and the Cabinet of Antiques‡ as terms of comparison, which from many points of view furnish valuable explanations of Danish antiquities. But, as is perfectly natural in Danish museums, the principal effort is directed toward making the most complete collections possible of all that characterizes particularly the civilization of this country.

But we do not stop in our historico-archæological museums at the year 1660, the limit adopted for the Museum of Northern Antiquities. In the conviction that modern history, from 1660 to the present time, deserves, not less than ancient history, to be illustrated by contempo-

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rary and characteristic specimens (a method of studying the subject up to this time too much neglected in most countries), a historical museum has been established in the ancient castle of Rosenborg, at Copenhagen, built by Christian IV, from 1610-1617, which bears the name of "The Chronological Collection of the Danish Kings." This museum, under the direction of Professor Worsaae, forms the complement to that of the Museum of Northern Antiquities. It embraces, in fact, the period comprised between Christian IV and the death of King Frederick VII (1863), particularly the whole period of the absolute monarchy, from 1660 to 1848. In the halls, which by a happy coincidence have partly preserved the successive styles of the different epochs, there has been arranged around the royal house as a center, and in a rigorously chronological order, a rich and valuable collection of portraits, representing members of the royal family and celebrated men of their times; costumes, furniture, ornaments, arms, and other objects which characterize the style of each epoch, of which the printed descriptions will give a clearer idea.* This museum, in which the crown jewels are preserved contains also valuable materials for the history of industry and art, and of the recent progress of civilization in Denmark. The chronological collection, which is a trust of the royal family placed under the control of the government, has, as such, a distinguished board of managers, consisting of the minister of public instruction, as the representative of the state, and one of the principal functionaries of the court, as the representative of the royal family. Moreover, the expense of increasing and preserving the collection is charged to the public treasury.

B.—MONUMENTS.

It was in the time of Christian IV, from 1610 to 1648, that measures were first taken for the preservation of the principal remains of antiquity going to decay. By order of the king, several great runic stones were transported from different localities to Copenhagen, where many were destroyed in the fire of 1728; those which were saved are now preserved in the Museum of Northern Antiquities. But during the remainder of the seventeenth and all of the eighteenth century the state did nothing for the national monuments, of which a large number disappeared, or were much damaged by pretended restorations.

It was only after the royal commission for the preservation of antiquities had been established, in 1807, that any serious attempt was made to preserve that which there was still hope of saving. After having received from the pastors throughout the kingdom reports—often very

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imperfect—concerning the condition of the monuments, the Danish department of justice (*Chancellerie*), at the instance of the commission, placed under the protection of the law a number of the monuments of antiquity and of the middle ages throughout the country (1809–1810).* At first the legality of this measure was doubtful; the proprietors not being bound by any law to cede their right to these monuments, especially without a provision of indemnity; moreover, in those cases where no opposition was made, the fact that they had been taken by the government was not registered in legal form so as to bar future purchasers of the property. The consequences of this omission did not fail to be felt the more, since the commission, not receiving any salary, and having only small appropriations for their object, had not the means to employ competent men to inspect the monuments scattered throughout the kingdom. Moreover, many objects disappeared, little by little, without the knowledge of the commission, or without their being able to prosecute the guilty parties.

However, an effort was made to induce the proprietors to relinquish, voluntarily, their rights to the relics, and to place them under the protection of the law; and in a great number of cases the end was attained. Specimens were also bought, when the price was not too high. From official inquiries made in 1847, it appeared that a great number of monuments declared national in 1809–1810 were entirely destroyed or partially damaged, and the necessity of having recourse to more efficacious measures was evident. By a royal decree of December 22, 1847, a salaried officer, Professor Worsaae was added to the commission, and charged especially as inspector, and later as director, to look after the preservation of archæological monuments, and under this title he received the royal commission March 20, 1848.† A sum of money was annually placed at his disposal for the purchase, restoration, and sketching of the monuments, and for diggings and expeditions, in which he was authorized to act in the name of the commission.

As the conviction had gained ground that it was unnecessary to prohibit the traffic and exportation of treasures, so it was agreed to follow the same liberal policy as to the seizure of national monuments, and, in 1848, the government did not think it advisable to give sanction to a project designed to apply the right of eminent domain in the case of proprietors who were recalcitrant, or who demanded too much indemnity.

The newly appointed inspectors of archæological remains, after having labored a year and a half in concert with the commission for the preservation of antiquities, up to the dissolution of the last-named body in August, 1849, were afterward placed in an entirely independent po-

* The list of these monuments is printed in the *Antikvariske Annaler* (Archæological Annals), published by the Royal Commission for the Preservation of Antiquities, I. 8vo, Copenhagen, 1812, pp. 133–145, 348–379.

† It is printed in *Antikvarisk Tidsskrift* (Archæological Review), 1846–'48, pp. 150–153, and in *Rescriptsamling* (Collection of Ordinances), by Ussing.

sition, and, indeed, in more favorable circumstances. On the one hand, they had to convert into full proprietorship numbers of leases which had belonged to the state, to public foundations, to fiefs, to trusts, and to private individuals; on the other hand, the increase of prosperity had developed the taste for the restoration of ancient castles, churches, and other remarkable monuments.

I. Relative to the seizure in the name of the state of stone heaps, funereal mounds, runic stones, fortifications, ruins of castles &c., the government passed an ordinance in 1848 that all structures of this kind existing in the royal domains and in the forests of the state should be declared national property, and that if any part of the national domain should be alienated, these structures should be expressly reserved by the state and clearly designated in the articles of sale. At that time the archæological director traveled over the country to make a list and a description of such objects as deserved to be saved. At the instance of the archæological commission (July, 1848), the minister of justice invited the directors of religious foundations and the holders of fiefs and trusts to make the same reservation in favor of the state upon leasing or selling their property. Moreover, the antiquarian commission (July 8, 1849), and later the director of monuments and of the museum (November, 1849), addressed printed circulars to all the landholders of the kingdom to induce them to make the same reservations, and many of them submitted to it with the greatest good will. In this way, without much expense, a great number of important and characteristic monuments were placed under the protection of the law. Although in many cases the reservations announced in the leases and acts of sale were not stated so clearly as to avoid all conflict concerning tenure, yet a basis was established upon which to build in the future. In the numerous excursions made each year by the director of ancient monuments, frequently accompanied by artists who measured and sketched the different kinds of remains throughout the kingdom, and in his personal relations with the people, he acquired for the state a great number of relics, some of which were sold at a reasonable price, others given gratuitously—indeed, by yeomen hardly able to do it. These journeys, which helped greatly to call the attention of the people of different localities to the fact that such monuments had been declared national property, had also the effect of bringing to light movable objects, such as runic inscriptions, tombs, fragments of architecture, &c., which were exposed to great risks, and of securing for the National Museum important works of antiquity.

By reason of the close connection of the Archæological Bureau with the National Archæological Museum, in the archives of which all the sketches made in the journeys of inspection were deposited, it was agreed to prepare as soon as possible an archæological chart of each parish, on which should be indicated with precision the structures subjected to the ravages of time, and to prepare thus the material for the great archæological chart of the kingdom. To guide the pastors, teachers, and others who desired to cooperate in this work, a circular was distributed in 1849, upon which were noted the signs adopted for the different classes of objects. As the needed funds were not voted for the enterprise, which was paid for by private subscription, archæological topography was executed but slowly.

Notwithstanding the progress of the work of preservation, it was evident that a director residing at Copenhagen, could accomplish but little and would not be able to inspect properly the numerous monuments scattered throughout the country, now more than ever exposed to destruction by reason of clearings, restoration of buildings, construction of railroads, &c. By a circular of November 20, 1866, the directors of monuments addressed the curators of the archæological collections in the cathedral cities of Denmark and Iceland and proposed to them to form diocesan commissions, composed of residents having the greatest taste for archæology, and to nominate diocesan inspectors to work in concert with the central directory at Copenhagen for the preservation of the monuments of each diocese. But although this project obtained numerous adherents, by reason of the failure of pecuniary resources it was not put into execution, as it was desirable that it should be, and as it probably will be in the future.

Meanwhile justifiable complaints continued to be made concerning the destruction of national monuments, and as the directors had not sufficient funds to arrest these ravages, they made an appeal, through the minister of public instruction, to the Danish parliament, which had often given proof of its good will in this matter, and solicited the means for making a complete investigation and for placing under the protection of the law all the most important monuments of the country; the proposition, amply seconded, February 8, 1873, expressed the following views:

1. That an inquiry as thorough as possible should be made into all the relics of antiquity existing in Denmark.

2. That this inquiry should be confided to archæologists and designers, whose duty it should be to make plans, sketches, and descriptions of the most important monuments, notably of those which deserve to be in the future placed under the protection of the law.

3. That in order to arrive at this result, if it could not be obtained otherwise, the government should negotiate with the proprietors for the purchase of the said monuments.

4. That there should be annually appropriated for these acquisitions, for about ten years, a sum of 3,500 rigsdalers ($1,900).

These propositions were adopted unanimously by the parliament, as well for the fiscal year from April 1, 1873, to March 31, 1874, as for the following years.

In consequence, the archæological bureau has been able during the past few years to send out several committees of inquiry, composed each of an archæologist and a draughtsman, in the different divisions of the kingdom, where they have met the heartiest reception. Many relics have been already bought by the state, and others have been offered gratuitously by the farmers. Besides the archæological charts, which have been prepared, sketches of many objects have been made, which will be of inestimable value in the future study of art in Denmark, and which, in a practical point of view, will be useful in the restoration of ancient edifices which are now undertaken in our kingdom to a previously unknown extent.

II. Private individuals, as well as the state, are exhibiting great activity in the restoration of ancient forts and castles, churches and other edifices of the middle ages and modern times. This movement has manifested itself in the last twenty years as the outgrowth of the development of artistic taste, of a national sentiment, and of the religious life, and in concert with the continued improvement in business. While formerly little account was made of the architectural style appropriate to different edifices, the directory of monuments is obliged to consider it in all those restored by the state, and, moreover, has had, in this respect, all the co-operation necessary on the part of public institutions and great corporations. As to the restorations undertaken by private individuals the directory has abstained from acting officiously, but has ordinarily met with a good degree of success. It is quite rare that it has failed in its war against false taste, which prevails only in the petty communities.

Among the great civil structures, for the restoration of which the state has made provision during these late years, we may cite: the ancient tower called *Gaasetaarn* (goose tower), of the fourteenth century, forming part of the ruins of the castle of King Valdemar the Great, at Vordinborg, in Seeland, to the expenses of which a private benefactor has generously contributed; the remarkable castles of Seeland, in the style of the Renaissance, called Rosenborg, Kronborg, and Frederiksborg, burned in December, 1859. For the last, however, the expense has been borne by the King, Frederick VII, or covered by a national subscription. While speaking of royal castles, it should be mentioned that the government has also caused to be restored and adorned in a proper manner nearly all the royal sepulchres throughout the kingdom.

But incomparably more important is the restoration of churches, which has been going on everywhere, so to speak, although many of them, on account of their extent, could not be rebuilt without great difficulty and expense. The establishment of the Reformation (1536), which deprived the churches, and above all the cathedrals and monasteries of the greater part of their revenues, for a long time brought architecture into neglect. A very few of these edifices remained in the possession of the state, the greater part fell into the hands of those who paid the tithe, and many were abandoned to private individuals with the tax levied for their maintenance, but they were obliged to give them suitable care. In order to compel them to fulfill their obligations, the state has reserved the right to inspect these buildings, and it has annually imposed this duty upon the first pastor of the canton with several skilled workmen. These inspectors, however, were generally devoid of all elevated artistic taste, and, moreover, the revenues were far from covering the enormous expense for the proper maintenance of these large buildings. It is only in very pressing cases, after fires or great accidents, that the churches receive extraordinary aid obtained by general subscription, by subsidies furnished by the state, and, as much as possible, by the parish itself. In such circumstances many of the most remarkable religious edifices have fallen into a sad state of dilapidation.

The law of February 19, 1861, on the inspection of churches was a grand step for the better. It established general rules to be followed hereafter for the restoration of churches in their primitive style, and for the preservation of their furniture and their monuments; and it reserves, for the benefit of the National Museum, the right to acquire objects of no further use; furthermore, it prescribes the nomination of a special committee competent to inspect the most remarkable churches. This committee, which was composed of several distinguished architects and a practical archæologist, and which exercised a great influence upon the restorations commenced already or undertaken after their appointment, has for its president the director of monuments.

A progress not less important was the authority granted to the minister of public instruction to divide among the poorer churches the surplus of receipts from the richer, which were placed as independent institutions under the direction of the diocesan authorities. Finally, it was made possible to proceed to the restoration of churches without resources, and which were in bad state of decay, by the contribution of extraordinary credits on the part of the state, by the increase of taxation on the part of the parishes, and by the voluntary subscriptions of individuals. In this way there has been collected during the past few years about 140,000 francs ($28,000) to restore the ancient church of the monastery of Maribo, in the island of Lolland, constructed at the commencement of the fifteenth century. In the same manner the remarkable brick church of Kallundborg (Seeland), built in the form of a Greek cross in the twelfth century, has been restored with its five towers, of which the largest, that in the middle, had fallen down. The expense has amounted to 170,800 francs ($34,000). Next year the restoration of the cathedral of Viborg, in Jutland, which was constructed of granite in the twelfth century, will be terminated, at a total expense of about 1,057,000 francs ($211,000), after which the oldest Danish brick churches will be repaired, to wit, that of the monastery of Ringsted, in Seeland, dating from about 1160, and the cathedral of Ribe, in Jutland, built in a semicular form, in the first half of the twelfth century.

Jutland the interior of the cathedral of Aarhus, a brick structure originally semicircular, dating from the thirteenth century, has been restored by the church or by the community at a cost of 84,000 francs, ($16,800), and the exterior now being repaired will demand about 280,000 francs ($56,000).

In Fionia, through the same agency, the church of Saint-Knüd, at Odense, a brick structure, with a crypt recently discovered, in ogival style, dating from the thirteenth or fourteenth century, has been repaired at a cost of 238,000 francs ($47,600).

In Seeland, the cathedral of Roskilde, a brick edifice transitional in style, dating from the commencement of the thirteenth century, has cost for reconstruction 420,000 francs ($84,000).

The rich academy of Sorae, in Seeland, which belongs to the state, has restored at great cost the imposing church of its ancient monastery, a remarkable brick structure, dating from 1170 or thereabouts, and of the still more ancient church of Fjenneslevlille, of which it has the patronage, the academy has rebuilt in its primitive style the twin tower, previously much injured.

In all these churches the paint which covered up the ancient figures or mural decorations has been removed, the old altar scenes, the baptismal fonts, the epitaphs, the monumental stones, the paintings, and other relics of antiquity have been carefully restored and preserved. From what has been said, particularly concerning the church of the village of Fjenneslevlille, it is scarcely worth while to remark that the example of the restoration of great churches has had a very salutary influence upon the refitting of the smaller ones.

THE FRENCH HALF-BREEDS OF THE NORTHWEST.

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INTRODUCTION.

The power of France in North America has passed away, but the memory of its *régime* still endures throughout the vast territories discovered and colonized by the hardy Canadian pioneers, with the blood, language, and character of a large proportion of their inhabitants.

Always the friends of the Indians, the French explorers, traders, and *voyageurs* often became identified with their interests and fortunes, and freely intermarried with them. Their mixed-blood descendants, found mostly north and west of the great lakes, scattered throughout the British Possessions and the Northwestern States, have been, in their humble way, playing an important part in the colonization and civilization of the Far West.

Sailing down the Red River of the North into the Canadian province of Manitoba, the traveler finds himself at their headquarters. He observes men and women with almost the dusky complexion of the aborigine, but dressed in a civilized garb. They speak a French dialect, readily understood, but unlike any of the *patois* of France. He is surprised at their demonstrativeness and pleased with their urbanity. He discovers in them the instincts of the Indian blended with and modified by many of the moral and mental traits of the white, so that he is often unable to tell which blood preponderates. Such are the first general impressions made upon him by the French half-breeds.

I.

ORIGIN AND DEVELOPMENT.

I shall first outline the history of their origin and gradual increase, beginning with the various causes which sent their fathers from Canadian towns and settlements into the wilderness to adopt savage life.

Canada, during the seventeenth century, was a poor and suffering colony. Severity of climate, wily savage foes, bad government, all conspired against its prosperity and happiness. It became a severe training-school in which was developed an enduring, hardy race of men, eminently adapted to the hazards and toils of the life which awaited them.

The fur-trade was then the main resource of New France. In its pursuit lay the only path to advancement and wealth, and the energy and enterprise of the colony were bent in that direction. Daring canoemen, not content to trade with the Indians at the settlements, set out for the wilderness in quest of savage fur-hunters, and met with great success. The charms of this roving life, seasoned by danger and coupled with a lucrative traffic, soon allured many of the strongest men into the western wilds.

The population comprised a large proportion of disbanded soldiers, ruined *gentilshommes*, and lawless adventurers. To such men the narrow confines of Canada, then a mere strip of land on each side of the Saint Lawrence from Quebec to Montreal, was too restricted a sphere of action, and the fur-trade gave a vent to their restless activity. On the other hand, the paternal solicitude of the home government and the zeal of its clergy bound the infant colony within a net of ordinances and regulations from which many were glad to break loose.

The bold and greedy spirits who, towards the middle of the seventeenth century, began thus to range forests and lakes for beaver skins were known as *coureurs de bois*. It soon became evident that their example was pernicious; but in spite of stringent repressive laws their number constantly increased, and as the nefarious trade could not be stopped it was deemed best to regulate it.

The *coureur de bois*, or bush-ranger, would, at rare intervals, visit the settlements of Montreal and Three Rivers and squander in a few wild orgies the accumulated gains of a whole campaign; but, impatient of restraint and fearful of the law, he would soon take in a cargo of provisions and trinkets, and again set the prow of his canoe westward.

In the forest, among the Hurons or Ottawas, he gave himself up to the ease and abandon of his adopted-home life, and let loose the current of his lower instincts. Divested of all the proprieties of his former civilized life, painted and tattooed, with feathered hat and beaded garments, he gaily danced with the braves or gravely smoked the calumet at the council of the tribe.

The first admixture of French with Indian blood was the natural result of the bush-rangers' mode of life; admitted to all the privileges of members of the tribes, they courted the facile dusky beauties and won them either as wives or concubines. They visited the natives of Sault Ste. Marie as early as 1654, had made a rendezvous of Mackinac before the establishment of the mission in 1671, and had a stockade at Detroit long before Du Shut fortified it in 1686. In all their migrations a cordial welcome was always extended them by the Indians of the lakes and of the Illinois country, and their first mixed-blood offspring can be traced back to about the middle of the seventeenth century.

We have strong evidences that, before the conquest, the French had explored the Northwest, along the Saskatchawan and the Missouri, as far as the Rocky Mountains. They had important trading-posts in the Winnipeg Basin and on the Upper Mississippi. After their downfall, shunning their conquerors, they emigrated from Canada, in large numbers, to the distant Western settlements, and were thus thrown into still more intimate relations with the Indians. Then was organized the famous British Northwest Company, which enrolled under its flag all the Canadians who had served at the various posts on the frontiers. It occupied the regions hitherto held by the French and, later, extended its operations even beyond the Rocky Mountains. When it became absorbed by its more powerful rival, the Hudson Bay Company, in 1821, the Canadians continued to be the most numerous and valuable servants of the new organization. They were likewise a very important element in the formation and management of the various American fur companies. It may be safely stated that, at the end of the first quarter of the present century, French *engagés* were found at all the posts of the British and American fur companies from Lake Superior to Vancouver's Island, and from the Great Slave Lake to the Lower Missouri.

Whenever they became independent they generally formed settlements in the neighborhood of the companies' posts. The Lake Winnipeg Basin, first discovered and colonized by De la Verendrye, in 1743, and, after the conquest, the center of the operations of the Northwest and Hudson Bay Companies, has always contained a large population of French Canadians and half-breeds. Before Lord Selkirk began his settlement on Red River, in 1811, they had considerable villages at Pembina and Fort Rouge, later Fort Garry. From Winnipeg they spread most along the great arteries of trade and travel the Assiniboin and Saskatchawan Rivers. On the Pacific coast their principal colonies were at Fort Vancouver, Walla Walla, and other points on the Columbia.

The great majority of Canadians who, more particularly in the early times of the colony, left the settlements as traders, hunters, *voyageurs*, or *engagés* were single men who cut themselves loose from kith and kin to seek fortune in congenial pursuits at the advanced posts and among the Indians. As already intimated, they were not strict monogamists. They would sometimes abandon the mother of their offspring to the care of her tribe and seek a second or a third wife (wherever chance carried them,) to be perhaps forsaken like the first. Such conduct, favorable to the production of a numerous progeny, was very objectionable to the missionaries, who combated it with all the weight of their influence. They generally succeeded in giving the sanction of law and religion to one of their illegitimate unions, so that, however loose in his morals, the *voyageur* had one lawful wife who, after the vicissitudes of a toilsome life, would share with him in his declining years the comfort and rest of the settlements.

It may be apposite to our purpose to notice here the contrast between the French and the English colonies in their relations with the Indians. The latter, independent of the Indians from whose intercourse they could derive no benefit, regarded them simply as an obstacle to their progress, a natural foe, against which they waged a war of extermination. The former, from the first, recognized in the red man a fellow being, and as such entitled to consideration. They treated him with firmness, tempered by strict justice. Of a more gentle and sympathetic nature, the French felt kindly disposed towards the natives and had less repugnance to overcome to associate with them. Their religion, also, as exemplified in the self-immolating life of the missionaries, must have taught them impressive lessons of tolerance and Christian charity.

As the result of their intercourse with the Indians there was not in New France a single tribe whose alliance and friendship they did not win and retain, even long after their power had passed away. They, however, as already stated, had less worthy motives to conciliate them. Having neglected agriculture for the sake of trade, the Indians were necessary auxiliaries. It was only through them that furs could be procured and prosperity maintained in the colony; only with their help that the King could extend his dominions westward and check the encroaching English and Dutch colonies. The cultivation of their friendship was therefore earnestly enjoined upon all the officials of New France, on political and commercial grounds, while the missionary preached forbearance and justice in the name of humanity.

The tribes of Canada, of the Lakes, of the Winnipeg Basin, and of the Illinois country, all belonging to the great Algonquin family, were most subjected to French influence. It was among them that the *coureurs de bois* loved to rove; with their guidance the voyagers explored the northwest, and it is from them that the great majority of half-breeds derive their Indian blood.

Early in the eighteenth century, after all the lakes had been explored and the tribes' friendship secured, families began to emigrate into the northwest. A great number settled at Detroit, others at Mackinac and Sault Ste. Marie; some even as far as Green Bay, in Lake Michigan, and the Mississippi settlements. It was only in 1818 that one or two Canadian families moved to Fort Garry, and it appears that when Bishop Toché arrived at that place in 1845 there had been so far but four Canadian women on the Red River.

At the present day it seems certain that of the descendants of these numerous families very few, if any, can boast of pure white blood. The admixture proceeded very slowly, but surely. It was immediate, of course, in the case of the wandering *coureurs* and *voyageurs;* it advanced more gradually in colonies formed of emigrant families. Detroit had still a preponderance, and Kaskaskia a large proportion, of incontaminate families at the time of the conquest.

Afterwards Detroit and its environs increased considerably by new accessions from Canada, but through Indian alliances the French there eventually lost their identity as a white race, to such an extent that there is scarcely any portion of the large Canadian-descended population of Eastern Michigan not infused with Indian blood.

The French colonies on the Illinois shore of the Mississippi, at Kaskaskia, Cahokia, Fort Chartres, &c., had acquired considerable importance in 1763, and counted several thousand inhabitants. Speaking of the Illinois mission, the historian, John G. Shea, says: "More than in any other part the settlers intermarried with the Indians, and there are few of the French families in Illinois and Missouri that cannot boast their descent from the noble tribe which has given its name to the former State." Michael Ako, one of the members of the La Salle's expedition, married, in 1693, the daughter of the chief of the Kaskaskias.

II.

THE OFFSPRING OF INTERMARRYING RACES.

The blood of intermarrying races becomes mixed in various proportions. A white man marrying a squaw begets half-breeds; these by successive marriages with either white or red blood will procreate quarter-breeds or quadroons in the second, and eighth-breeds or octoroons in the third generation. Marriages between the first and second generations are common, producing three-eighth breeds, either white or red. Of course, marriage between the offspring of the same generation, as between half-breeds, would not alter the relative proportion of either blood.

From these possible combinations it is seen that the caste of Indian mixed-bloods is neither fixed nor well defined. Like all hybrid races, it is liable to many changes, and generally tends to approximate one or the other of the types of its progenitors. If a district, inhabited by half-breeds or quarter-breeds, becomes settled by white people, and correspondingly abandoned by the Indians, the reversion, naturally, will be towards the white race, and the red blood may become so diluted as to scarcely give traces of its presence either in the complexion or intellectual acquirements. Such is the case in parts of the States of Illinois and Missouri, as well as in Eastern Michigan and other places about the lakes.

Again, if half-breeds live exclusively among Indians, the reversion will be towards the red type, so that a point is reached when it is impossible to discriminate between a mixed-blood and a pure-blood native. We find such individuals among the Northwestern tribes, of which they are a component part. Between these extremes is a large middle ground occupied by intermarried mixed-bloods, ranging from quarter-white to quarter-red, and including many half-breeds. These true representatives of the race are most numerous on the Red River of the North and the Winnipeg Basin.

Appellations of French mixed-bloods.—The French mixed-bloods of the Northwest are known under the several names of half-breeds, métis, and bois-brulés. Métis is probably derived from the Spanish *mestizo*, itself traceable to the Latin *mixtus*. Bois-brulé (burnt-wood), an appellation mostly used in the British provinces, is explained by referring to the maternal dialect of a large proportion of half-breeds. In Chippewa they are called Wisahkotewan Niniwak (men partly burned, or half burned), that is, I infer, men tinged with Indian blood, but not quite burned into the coppery complexion. The usual name of half-breeds used by English and Americans presupposes blood from the paternal and maternal ancestors, mixed in equal proportion; but, as mentioned before, this is not often the case. The term mixed-blood is too vaguely comprehensive. Métis, when referring to French mixed-bloods, seems the most appropriate name. The designation of French is often indifferently applied to Canadians, métis of all grades, and even pure Indians who associate with métis and speak their *patois*. It should also be stated that in Manitoba and other places a certain proportion of mixed-bloods, from English and Scotch fathers, bearing such names as Grant, Grey, Sutherland, &c., are classified as French, from their language, religion, and associations, while occasionally such names as Lambert and Parisien are found among English half-breeds.

III.

GEOGRAPHICAL DISTRIBUTION AND POPULATION.

I have endeavored to form a near estimate of the population and ascertain the geographical distribution of the métis. Their uncertain status as to nationality, their wide scattering over large areas, and the constant shifting of many families from one place to another, make this no easy task. My own observations have been supplemented by information gathered from missionaries, travelers, and Indian agents and other government officials, so that I have reason to believe the following summary to be tolerably full and correct.

Michigan.—There are about 8,000 people of French origin in the city of Detroit, and 2,000 more in its neighborhood. Farther off are Canadian colonies, at Bay City, Saginaw, Monroe, and other places, with a population of 5,000. Total in Eastern Michigan, 15,000. As explained before, very few, if any, of these people are free from Indian blood.

We find many métis along the straits which connect the Great Lakes. At various points of the southern coast of Upper Michigan, from the Bay des Moquets to Point Detour; on the islands of Mackinac and Bois Blanc; at the towns of Saint Ignace, Pointe la Barbe, and Gras Cap; south of the straits, near old Fort Mackinac, and at the village of Cheboygan. By including those who have only one-eighth Indian blood, their probable number is 1,000. Others are also scattered on Saint Mary's River, Sault Ste. Marie (Michigan and Ontario sides), Garden River (Ontario), Whisky Bay, and Sugar Island; on Saint Joseph and Drummond Islands; at several points in Georgian Bay (French River, Killarney, Little Current, &c.); at l'Auxe, in Keweenaw Bay; in all, about 400. Total in Michigan and the adjoining Ontario shore, 16,400. Of this number from 300 to 400 live on Canadian territory.

Wisconsin.—In this State we find métis at the two old French settlements of Green Bay and La Pointe. Green Bay, settled by Augustin de Langlade and his son Charles in 1763, was the cradle of the State of Wisconsin. About 350 half-breeds live at several places on the bay, principally Menomonee, and on the Indian Reserve. La Pointe received a Jesuit mission as early as 1665, where flocked thousands of Indians, and became a great trading emporium. Half-breeds are numerous there and at other points of the Wisconsin coast from Fond du Lac to Montreal River, also in the interior, on the Wisconsin, Black, and Chippewa Rivers; in all, about 1,100, giving a total of 1,450 for the State.

Minnesota.—In Minnesota they are distributed as follows:

At and near White Earth Agency, 400; Red Lake Agency, 25; north shore of Lake Superior (Bay de Goulet, Badjiwanang, Fort William, Grand Portage) and northern line, 100; in Saint Paul and vicinity, 100; about Crookston, 6 families; at Morehead and Fargo, 10 families; along the Red River (Minnesota side), 15 families. Total, 780 (counting five persons to a family).

Dakota.—In this Territory we find French half-breed guides and interpreters at most military posts and agencies; a few families scattered on the Missouri, mostly between Green River and Yankton; a small settlement about the Lower Brulé Agency; about 15 families on the Sisseton Reservation, and as many at Devil's Lake Agency, partly settled on Cheyenne River and partly roaming with the Indians.

The earliest marriage on record on the Lower Missouri between French and Indian is probably that of Sergeant Dubois, of De Bourgmont's company, who, before 1725, had wedded a girl of the tribe of the Missouris. He was afterwards left in command of Fort d'Orleans, erected on an island in the Missouri 5 miles below Grand River. At Berthold Agency I can hear only of 2 or 3, which is rather surprising, as the French had relations with the Rees, Mandans, and Gros Ventres long before Lewis and Clarke ascended the Missouri, in 1804. The Mandans were first visited by De la Verendrye's sons in 1738. There are also a few at Spotted Tail and Red Cloud Agencies.

Pembina, first colonized by discharged Canadian servants of the Northwest Fur Company at the end of the last century, consequently the oldest settlement in Dakota, contains 110 half-breed families, whose houses line Red and Pembina Rivers. There are 6 families at Salt River and 14 at Grand Fork. On the upper part of the Pembina River, at Saint Joseph, and on the Pembina Mountains are about 70 families. Total in Dakota, estimating each family at 5 persons, 1,280.

Montana.—In Montana there are as follows: About 15 at Crow Agency and adjacent points on the Yellowstone; about 20 near Fort Benton, settled on Teton and Maria's Rivers; 1 or 2 at Wolf Point, on the Missouri. On Milk River, below Fort Browning, near the Big Bend, is a large, moving camp of about 150 lodges, or 650 persons. They probably migrated from Manitoba, and subsist mostly on the products of the buffalo hunt. At Fort Belknap reside 1 or 2 families; at Carroll, on the Missouri, 1 family. In Missoula County, originally settled by Canadian fur traders, we find about 300 half-breeds, principally located at the Flathead Agency, Saint Ignatius Mission, Flathead Lake, and French Town. Total in Montana, 1,008.

Iowa.—At the Sac and Fox Agencies a few families, about 25 persons.

Nebraska.—We find Canadian mixed-blood guides and interpreters at several of the military posts; at the Santee Agency about 45, who removed there after the Minnesota outbreak of 1862; at the Winnebago Agency about 40; at the Pawnee Agency and Fort Laramie, a few. Total, about 130. The French had pretty thoroughly explored Nebraska at the end of the last century. Lewis and Clarke met several of them on the Missouri who had been wintering on the Platte and other western tributaries, and engaged as interpreter one Durion, a half-breed, who had lived twenty years with the Sioux.

Wyoming.—About 12 at the Shoshoni Agency, and 2 or 3 hunting in the vicinity of Fort Fetterman. Total, 15.

Indian Territory.—About thirty settled on North Fork of Canadian River, and the Cheyenne and Arapahoe Reservation. Most of these are probably the descendants of the 8 Canadians, employés of the Hudson Bay Company, who at the beginning of this century, having wandered in a southern direction in quest of furs, were captured by a party of Mexicans and afterwards allowed to settle in New Mexico. Canadian River was named after them.

Idaho.—About 15 at the Nez Percés Agency, and 8 near Fort Lapwai. Total, 23.

Oregon.—The Northwest and the Hudson Bay Companies, during the first quarter of this century, imported many Canadians into this Territory, then the seat of an active fur trade. When Wilkes visited Oregon in 1838 he found there 700 or 800 Canadians who had preceded, by several years, the American emigration. Their half-breed offspring number about 300, and are found at French Prairie and in its neighborhood, in Marion County, and in the valleys of the Willamette and Kaoulis Rivers.

Washington Territory.—In this Territory they are also in the majority; being the descendants of the Canadian employés of the fur companies named above. They have a village at Cowlitz and settlements in the Colville Valley, on the Okanagon River, at Tulalip, and Lummi. The total for the Territory is estimated by Father Chirouse at 250.

Adding the numbers obtained in each State and Territory we have a total of 21,691 for the Northwestern States.

British Possessions.—The province of Manitoba, extending from the boundary line to Lake Winnipeg, is the great center and rendezvous of French half-breeds. They are mostly settled at the following places: Winnepeg, or Fort Garry, St. Boniface, St. Vital, St. Norbert, St. Agatha, St. Anne, St. Charles, and St. Francis Xavier. Their population in the province is about 6,500. On the shores of Lakes Winnipeg and Manitoba and in the Rainy Lake district are probably 500.

In the Saskatchawan district we find many scattered along the Saskatchawan, clustering about the Hudson Bay Company's posts. They are most numerous at the base of the Rocky Mountains, near Fort Edmonton, at the two missions of St. Albert and St. Anne, and number in all about 2,500. On little Slave Lake and vicinity are 500; on Lake Labiche and vicinity, 500: on Peace River and vicinity, 300.

Scattered families are seen as far north as the Great Slave Lake, but seldom beyond it. As early as 1778, the first employés of the Northwest Company who arrived on the shores of that lake found one François Beaulieu who had been born there. On Turtle and Wood Mountains are about 100; on Cypress Mountains and head of French Creek about 80.

In British Columbia we find half-breeds on Fraser and Okanagon Rivers, Lakes Kamloops, Babine, and Stuart, in all about 250.

Total in the British Possessions, 11,230; grand total for the Northwest, 32,921.

If we could obtain the number of métis in Canada, New Brunswick, Nova Scotia, Labrador, and in the northern part of New England, as well as that of the French-descended families tainted with Indian blood in the States of Illinois and Missouri, I doubt not the total would reach at least 40,000 as the strength of the population of French-Canadian mixed-bloods in North America.

IV.

TRIBES FROM WHICH MÉTIS DERIVE THEIR INDIAN BLOOD.

In a general way it may be asserted that, north of the fortieth parallel, from Quebec to Vancouver's Island, there is scarcely a native tribe, from the Sioux to the Esquimaux, that has not been tinctured with French blood. The Canadians showed preferences in the choice of Indian mates, yet seem to have slighted no tribe, and generally made selection wherever fortune and circumstances led them.

Along the Saint Lawrence they took wives among the various hordes of Montagnais, Ottawas, and Hurons, and, at a later period, the Iroquois.

In Michigan most of the métis derive their Indian blood from the Ottawas and Chippewas; some from Pottawatomies and Menomonees; one or two families from Crees; one or two from Sioux. Along the shores of Lake Superior, mostly from Chippewas, a few from Sioux, Assinaboines, Illinois, and, in Green Bay, from the Menomonees. From Lake Superior to Red River, and in Minnesota, from various bands of Chippewas, especially the Saulteaux, so named from their place of origin, Sault Ste. Marie.

The Crees, the largest tribe in the British Possessions, roaming over the plains of the Saskatchawan, were always held in high esteem by the French, and united to them in close friendship. It was found that Cree women were superior to those of other tribes in moral and mental qualities, and they are generally preferred by white traders. The majority of the métis of Fort Garry, Saint Boniface, and other points on the Red River are of Cree, and the balance mostly of Chippewa-Saulteaux blood.

Around Pembina and Saint Joseph the Chippewa element predominates, also around Lakes Manitoba and Winnipeg, and westward to the northern branch of the Assinaboine. On the Saskatchawan, at the missions near Fort Edmonton, and northward to the Great Slave Lake, the métis are almost exclusively of Cree origin.

North of Lake Manitoba are some Maskegon métis, and where the Saskatchawan issues from the Rocky Mountains are a small number of Iroquois métis. The settlement of a band of Iroquois in the Rocky Mountains is a striking illustration of the roaming propensity of savages.

A small proportion of Blackfeet and Montagnais métis are found at the base of the Rocky Mountains; the former south, the latter north, of the Crees.

The Assinaboines have also mixed-blood representatives in Southern Manitoba, on the river of that name, and in the Red River Valley.

In Dakota the métis are mostly Chippewa and Assinaboine on the Red River and at Devil's Lake, and Sioux at other places. In Montana they are Gros Ventre on Milk River, Flathead in Missoula County, Cree and Chippewa elsewhere. In Iowa they are from the Sacs and Foxes, and in the Indian Territory from the Cheyennes and Arapahoes. Farther west, and on the Pacific coast, they derive their Indian blood from the various tribes among which they live.

V.

OCCUPATION.

The capacity of the métis for work and industry is great, and is exercised over a wide range, from the highest callings of civilized life to the miserable shifts of the sensuous savage. In Michigan and Wisconsin, many hold positions of trust and responsibility, requiring education and integrity, while the majority live in towns and villages, occupied in the same pursuits as their white neighbors. Probably one-half of those living at Detroit, Green Bay, Mackinac, La Pointe, and Red River are permanent settlers and honored tax-paying citizens. About one-fourth or one-fifth of the Northwest half-breeds, mostly hired men, hunters, and trappers, although hovering about the settlements, have no fixed home, and lead a semi-nomadic life. A smaller proportion, in the remote Western States, on the Saskatchawan and other points in the British Possessions, have not yet severed their tribal relations, and live like Indians. In Upper Michigan and on Lake Superior, the greater number rely principally on farming and fishing for a livelihood. Only few give to agriculture their exclusive attention and depend altogether on the produce of their farms. There are none who subsist exclusively by hunting and trapping, though a number are thus occupied for a part of the year.

Métis carpenters, blacksmiths, shoemakers, &c., are not uncommon. Many work in the saw-mills during the summer and go out lumbering in winter. A certain proportion are boatmen on the lakes.

In Manitoba they occupy a due proportion of the government offices. Until very recently they had a large majority of members in the provincial parliament. Farming, stock-raising, and fishing are their principal means of support. Formerly many went buffalo hunting on the plateau of the Missouri during the season, but this resource has been exhausted.*

On the Assinaboine, Saskatchawan, and the lakes north of the latter river, the half-breeds perform all the menial duties at the posts of the Hudson Bay Company, where they also act as guides and interpreters. They are hardy and sagacious *voyageurs*, either with ox-cart, dog-sleigh, or canoe. They hunt and trap, and often make a dash at the buffalo. At the Catholic missions of St. Anne and St. Albert many are tilling the soil, and begin to reap the fruits of patient industry.

Their women are expert in bead-work and very skillful in the ornamentation of furs and buckskin. The colonies on Milk River, Wood Mountains, Frenchmen's Creek, and Maria's River are nearly altogether dependent upon the buffalo. They cure robes with great skill and make

*These annual hunts were on a large scale, as may be seen from the following illustration, condensed from the "History of the Red River," by Alexander Ross: "In June, 1840, 1,630 half-breeds, including a few Canadians and Indians, rendezvoused at Pembina with 1,210 carts and 542 dogs. After organizing into a sort of military command, with ten captains and one president, they journeyed 250 miles before striking the buffalo. In the evening of the first day's hunt no less than 1,375 tongues were brought into camp. In the *mêlée* one rider broke his shoulder-blade, another lost three fingers by the bursting of his gun, and the third received a spent ball on the knee. Scarcely one-third of the animals killed were turned to account. The party returned with about 900 pounds of meat per cart."

excellent pemmican. Their fall and winter trade averages from seventy-five to one hundred robes per family, each robe selling at from $3 to $5.

Pemmican, a peculiar half-breed produce, is made as follows: The lean meat of the buffalo is cut into thin slices; these are dried in the sun, then pounded and compressed into a rawhide sack. An equal amount of hot fat is poured upon the meat and the sack is closed. Sometimes the berries of the amelanchier are added to the mass. Each sack weighs from 100 to 150 pounds. The food thus prepared is tasteful, wholesome, and keeps many months.

VI.

CHARACTER AND HABITS.

In intellect, as in physique, the métis occupies a middle ground between the races from which he is issued. Combining many of the faculties of both white and Indian, yet identified with neither, he is, in most respects, a member of a distinct class of our population.

Wherever I have met him, he has always appeared to me endowed with many qualities of heart and of mind which readily develop and ripen on contact with civilization. Even in the wilderness he bears within himself the germs of a higher life which make him aspire to a better state. Unfortunately many circumstances have hitherto been adverse to his advancement. His paternal ancestors, from whom he derives the better part of himself, were but too often indifferent and careless parents, noted for greediness and licentiousness. On the other hand, until a very recent period, he had never felt the gentle and refining influence of civilized woman, either inside or outside the family circle. Even to-day many métis in the remote Northwest are still strangers to it. Schools have also been scarce at many of their settlements, and attendance at them often difficult. Their present degree of cultivation in Manitoba and on the Saskatchawan is mainly due to the missionaries who since 1818 have been laboring among them with unremitting zeal.

In the character of the métis, when not perverted by bad associations, we discover a guileless nature, easily swayed; a clear, but not strong moral sense; good purposes, but weak will. Fickle and impulsive, they are mostly free from greed, egotism, and seem incapable of deliberate, calculating fraud.

They are kind-hearted, genial, and sympathetic, practicing in all its patriarchal fullness the virtue of hospitality. Generous even to a fault, often prodigal, they cheerfully share all they have with friends or even strangers, sometimes to the point of depriving themselves of necessities. Such generosity is often indiscreet; it encourages a set of idlers and drones who are a burden upon the community. Whenever destitute, they ask from their neighbors as freely as they give. There is among themselves a sort of spontaneous freemasonry which unites them in the bonds of good-fellowship, but without any prejudice to the claims of their other fellow-men. They resent an injury quickly, but are as quick to pardon and do not treasure up animosity.

Like Indians, they have a quick and discerning eye for "the lay of the land." From its general outlines they readily infer its minor topographical accidents, and this faculty enables them to reach any objective point, through virgin forests and over untrodden prairies, by the most direct and practicable route. While on the way they notice minutely all the details of the landscape, and these seem to remain indelibly printed on their memories.

They are fruitful in shifts and resources on the plains and in the woods, and no accident or danger will dishearten them; they may change their purpose, but will not lose their temper. They are wary trappers, experienced hunters, and daring warriors. In the fight they exhibit all the native craft of Indians combined with better disciplined valor. For this reason, as well as on account of their kinship, they are very seldom molested by the latter.

Theft is not one of the vices of the métis. They freely ask and beg, but do not steal, neither from one another nor from the whites. Their cottages, on the Red River, are mostly without lock and key and under the sole safeguard of mutual honesty. This regard for the rights of property is duly appreciated by their employers.

By the side of these lights let us place a few shades to complete the picture.

The great moral infirmity of the half-breed seems to be his inability to exercise self-control. Of a light-minded, gay, and passionate disposition, he is ever ready to enjoy himself and would fain reverse the trite maxim: "Duty before pleasure." He does not avoid and does not know how to resist temptation, which makes him an easy prey to his appetite; hence, waste of time, neglect of duties, and a certain inconstancy of character which renders him the facile dupe of designing men. This love of pleasure leads frequently to drunkenness, often excessive and violent; it is also adverse to daily work and steady industry, hence the poverty and low social status of many.

Morality.—The morality of the half-breeds depends very much upon their bringing up and surroundings. Credulous and impressionable, they quickly reflect whatever influence is brought to bear upon them. Submissive to their spiritual teachers, whenever roused into sufficient determination, they become better Christians and more worthy citizens than the white frontiersmen of their neighborhood. Unfortunately, as already stated, they exhibit a lurking infirmity of purpose and debility of will which often defeat the best resolutions.

Their immorality, however, is never of a gross kind; the women sin, but do not become deeply corrupted and completely abandoned to a life of shame; they never lose a certain fund of native modesty, which, under proper guidance, easily leads to reform and to a better life. The amount of illegitimacy and crime among them is less in proportion than in most civilized countries.

Religion.—In religion, the métis are Roman Catholic almost to a man. They inherited their creed from their fathers, and through all the vicissitudes of a hard life cling to it with great fondness and tenacity.

On account of their remoteness and scattered condition, many have been, and still are, cut off from religious instruction, but there must be few who never heard the voice of the missionary. As early as 1818, Canadian priests were ministering to them on the Red River, and, to-day, a band of zealous missionaries, under the direction of Archbishop Taché, of Saint Boniface, preach the Christian faith to Indians and métis alike, at numerous missions, from Lake Winnipeg to British Columbia, and nearly to the mouth of the McKenzie River.

Education.—The education of the métis varies according to their means and opportunities. It may be said, in a general way, that their innate love of roving freedom indisposes them greatly to the restraint and confinement of school life. The children are naturally apt and intelligent scholars, but seem incapable of the sustained application which the study of books requires. The little influence and authority of the mother over the boys is regretable, as, in the absence of the father, often called away by the necessities of his life, no coercion is brought to bear upon them, and they find it easier to play than to learn. Wherever schools have been opened in their midst a majority of the children are sent to them, but their attendance is often irregular and seldom continued long. As it is, however, the result is already gratifying and promises well of the next generation. Of the present it may be said that in the British Possessions and the remote Western States the great majority of adults can neither read nor write.

A French weekly paper is published at Winnipeg in the interest of the métis.

VII.

PHYSIQUE.

The métis are of middle stature, well proportioned, with dark complexion, regular features, and open, pleasing countenance, smiling more readily than it frowns. The peculiarities of the Indian face, such as salient cheeks, hooked nose, semi-lunar profile, &c., can often be noticed, but are very much softened, and in many individuals unapparent. The hands and feet are small and neatly shaped. The muscles concerned in locomotion are well developed, but the whole body is rather slender and free from all superfluous flesh. Their complexion, generally tawny, varies greatly in its shades from quasi-coppery to pure white. Many, in color and cast of features, bear a striking resemblance to the border Mexicans. The women are fairer than the men, somewhat pale and sallow; some have a skin as white and delicate as that of any European lady. They are well featured and comely; I have seen among them girls with faces of classic beauty.

The men, Indian-like, are beardless and cultivate long hair. They are not stronger than the whites, and, for a short time, perhaps capable of less powerful exertion, but they possess extraordinary powers of endurance, and, in the long run, would easily outstrip the whites. They are indefatigable *voyageurs*. During the long northwestern winter they travel immense distances on snow-shoes, at the rate of 30 and 40 miles a day. With a dog-sled, now trotting by the side of their team, then over smooth ground standing on the rear of the sled, and again over rough places, pushing from behind with a pole, and launching at the panting team a few rolling imprecations, they make from 50 to 60 miles a day. As boatmen they display a vigor, skill, and a sum of endurance unexcelled by any other class of men.

VIII.

HABITATIONS; ETC.

The average half-breed house, such as the traveler notices along the banks of Red River, is a small one-story log structure, with often but one, seldom more than two or three apartments, scantily furnished. In one corner of the principal room is the bed of the heads of the family, painted in some vivid color; an open fire-place, tall and narrow, so as to accommodate logs placed upright, occupies the middle of one of the walls; a table, dresser, and a few boxes, doing duty as chairs, constitute the furniture. In this room, if it be the only one, eat and sleep all the members of the family, seldom a small one. This promiscuous mode of living, however objectionable, is not attended with the lowering of morals which one would expect, nor does it harden young girls out of their native coyness and modesty. Métis, who can afford to build larger and more commodious houses, often have them painted red and blue with sharp contrast of colors.

Vehicles.—The vehicles ordinarily used by the métis deserve mention. They are during the summer the *charratte* or cart, and during the winter the *carriole* and dog-sled. No better description of the cart can be given than in the words of Assistant-Surgeon E. Woodruff, U. S. A.:

"These singular vehicles were composed entirely of wood, and consisted of two wheels nearly 6 feet in diameter, with very broad tires, and a small body resting on the axle and shafts. Both ponies and oxen were used to draw them, attached by a peculiar harness of raw hide. These carts would carry from 600 to 800 pounds, and one man could drive five or six of them in a train. No grease was used, and as a long train crept over the prairie an indescribable noise was made by the creaking of the wheels. * * * The broad felloes of the wheels prevented their sinking in the soft ground, and the driver, with only the most primitive tools, could at any time or place repair a broken cart or even construct a new one. When progress was interrupted by a swollen stream, the cart could be taken to pieces and floated across."

As late as 1870, although steam navigation had already begun on the

Red River, the trade of Fort Garry and the Selkirk settlements with St. Paul, a distance of 600 miles, was carried on in these carts. It was estimated that 3,000 of them passed through Pembina in one season going south, freighted with furs, and returned loaded with various supplies.

The *carriole*, or sleigh, is simply the body of a cart laid on the snow, with shafts raised in front, and drawn by oxen or ponies. The dog-sled, or *tabawga*, used for long journeys through the British Possessions, consists essentially of a broad board raised up in front, and is drawn by three or four dogs harnessed in tandem fashion. The collars and traces, usually of moose skin, are ornamented with brass bells, fox tails, and ribbons. Three good animals can pull a load of 300 pounds, with blankets and provisions, and now and then the driver, many miles a day. The *tabawga*, with its canine team, is independent of roads; it selects its course over the boundless expanse of the great "*Lone Land*" as does the mariner at sea. These dogs, of a breed akin to the St. Bernard's, are fed on frozen fish or pemmican; at night they burrow their bed in the snow.

Before the running of the steamers on the Red River, a daily mail was received at Fort Pembina, brought from Saint Paul in dog-sleds.

Dress.—In their dress the métis show no marked peculiarities, but betray, in a tempered way, the fondness of the Indian for finery and gaudy raiment. In Manitoba the men usually wear a blue overcoat or *capot* with conspicuous brass buttons, black or drab corduroy trowsers, a belt or scarf around the waist, leggings, and moccasins, the whole variously adorned with colored fringes, scallops, and beads. The legging is an important article of the young buck's toilet; it is usually made of blue cloth, extends to the knee, below which it is tied with a gaudy garter of worsted work, and has a broad stripe of heavy bead work running down the outer seam.

The women generally dress in a black gown with a black shawl thrown over the head, in a manner at once comfortable and becoming. The girls often wear a colored shawl about their shoulders and a showy handkerchief upon the head; they like scarlet petticoats and prize gaudy ribbons and cheap jewelry.

Marriage.—The métis marry young. At twenty the young men seek mates, and the girls are eligible at fifteen. The ceremony usually takes place during the winter, which is with them a season of leisure and festivities. The conjugal knot is tied in the chapel of the parish by the resident missionary, after which there is dancing and feasting for several days, often to the great detriment of the provisions accumulated against a long winter. When all the guests have dispersed, the young husband takes his bride home to begin life on a capital stock of the merest necessities of life, and they are happy.

The métis are prolific and raise large families of healthy children, seldom less than two or three, often as many as seven or eight, thus controverting the statement sometimes made that hybrid races are sterile. The mothers love their children dearly, and bring them up with care; but the boys, fond of roving freedom, escape early from their influence and become often guilty of gross filial ingratitude. The daughters are more dutiful and generally reciprocate the affection of their parents.

IX.

LANGUAGE.

The métis generally speak several languages, one or more Indian dialects, French, and often English. In the States most of them understand English, and use it when conversing with Americans, but seldom when among themselves. On the Red River, the Saskatchawan, and Milk River settlements, English is only exceptionally spoken.

All the métis, from Lake Superior westward, speak more or less Indian; in Manitoba many prefer it, and this preference becomes more general as we near the Rocky Mountains. The Cree principally, and, in a much less degree, the Chippewa, are the ordinary languages of the half-breeds in the British Northwest.

The Cree is easily learned, expressive, and euphonious, and for these qualities has become the universal medium of conversation among the Northwestern tribes and their kindred, the métis. In Minnesota the latter speak Chippewa; in Dakota, Sioux and Cree; and at the other places the dialect of the tribe from which they originated.

French is understood by all Canadian half-breeds; it is their ordinary language in Michigan, Wisconsin, and around Lake Superior, and everywhere their official medium of communication. At all the parishes on Red River, on the Assiniboin, and even at Saint Albert, on the Saskatchawan, the sermons are usually preached in French.

The French of the métis is a patois, somewhat analogous to that of the poorer classes in Canada. It is not comprehensive but contains a large number of peculiar words and expressions grown out of the character of the land they live in, and their mode of life. The pronunciation, although very defective, is not as bad as that of many of the provincial patois of France. It is readily understood by a Frenchman in spite of its grotesqueness, but correct French, unless made very plain, is not readily understood by the average métis. Whether spoken about the lakes, on the Saskatchawan, or in British Columbia, it is very nearly identical.

Many words in common use are obsolete French, but may still be heard to-day in Normandy and Picardy; for instance: *Aller cri (quérir)*, to fetch; *fleur*, flour; *patate*, potatoe; *pâtir*, to suffer; *mouiller*, to rain; *raisonner*, to grumble; *grouiller* (of persons), to stir; *brailler*, to weep; *jongler*, to think; *magauer*, to maltreat; *boucane*, smoke; *moucher*, to beat.

A large number belong to the vocabulary of the prairie: *Fourcher*, to branch off; *fourches*, forks of a stream; *charrette*, cart; *carriole*, sleigh; *traine*, sled; *embarquer*, to get aboard cart or sleigh; *faire* *chaudiére*, to cook; *coulée*, ravine or gully; *butte*, bluff or cliff; *mauvaises terres*, bad, broken lands; *tétons*, small, round peaks; *plateau*, table-land; *plateau du coteau*, land system of a river or lake; *travail*, the Indian conveyance, consisting of a frame resting on two poles dragging on the ground; *poudrer*, to storm and snow; *babiche*, strip of raw hide; *cabresse*, lasso; *pemmican*, meat dried and pounded; *capot*, overcoat with hood; *equipage*, team; *train*, outfit.

Some originated with the fur-trade: *Coureurs de bois*, bush-rangers; *voyageurs*, fur carriers, collectors, and boatmen; *engagés*, employés, laborers at trading posts; *portage*, place where canoes are carried over shoals or to another stream; *bourgeois*, proprietor or manager of a post; *mangeurs de lard* (pork eaters), green, inexperienced hands; *plut*, peltry; *bateau*, barge.

Some are English words with a French termination and pronunciation: *Salon*, saloon; *biter*, to beat; *settler*, to settle, &c.

The métis avoid grammatical difficulties in the use of verbs and pronouns, by using as few tenses as possible, and these preferably in the third person singular; for instance: *çā dit çā*, they say so; *ou va aller*, we shall go, &c.

As peculiarities of bad pronunciation I may mention the diphthong *oi*, always pronounced as *ai*, with the sound of the final consonant, thus: *Froid*, *droit*, &c., are *fraite*, *draite*, &c.; also the broad, nasal sound of the *a*, as in the following sentence: *çā ne va pas*. The latter peculiarity is characteristic of the Canadian pronunciation of French.

Names.—The names of métis are those of many Canadian families, and are mostly found in those western and northern provinces of France from which Canada received its first settlers.

We find here and there a scion of aristocracy. On the Lakes and in Manitoba: Saint-Luc de Repentigny, Bonaventure Saint-Arnaud, Charles de Montigny, Louis Saint-Cyr, Pierre Saint-Germain, de la Morandiére, de la Ronde, &c. Farther north: Le Camarade de Mandeville, de Saint-George, de Laporte, de Saint-Luc, de Chaumont-Racette, de Lépinais, de Charlais, &c.

Among the most common family names, we notice on the Red River: Boucher, Bois-Vert, Bourassa, Boyer, Cadotte, Capelette, Carrière, Delornie, Deschambeau, Dumas, Flamand, Galarneau, Gosselin, Grand-Bois, Gaudry, Goulet, Hupé, Larocque, Lucier, Lagemodière, Laderoute, Lepuie, Laframbaise, Letendre, Morin, Montreuil, Martel, Normand, Rinville, Villebrun, &c.

At Mackinac and other place on the Lakes: Saint-André, Brisebois, Bellanger, Bonneau, Boucher, Baudry, Biron, Chevalier, Cadotte, Chenier, Deschamps, Frichette, Giroux, Gendron, Grondin, Hamelin, Lapierre, Lavallée, Lécuyer, Lévéque, Lusignau, Labutte, Lépine, Mainville, Nolin, Plaute, Pelletier, Perrault, Pilotte, Piquette, Riel, Saintonge, Thibault, &c.

At French Prairie (Oregon): Gregoire, Maison, Lachapelle, Delorme, Vaudal, Lucier, Gervais, Rondeau, &c.

In Missoula County (Montana): Asselin, Jaugras, Moriceau, Laderoute, Lafontaine, Larose, Lavallée, Poirier, Dupuis, Bisson, Houille, Carrier, &c.

In British Columbia: Allard, Boucher, Boulanger, Danant, Dionne, Durocher, Falandeau, Gagnou, Giraud, Lacroix, Lafleur, Napoleon, Perault, &c.

It is probable that many of these names, especially those beginning with the article *la*, originated in the wilderness, and, when applied to individuals whose paternity was unknown, were made to designate some peculiarity of body or of mind, or some circumstance of birth or parentage.

PREHISTORIC REMAINS IN MONTANA, BETWEEN FORT ELLIS AND THE YELLOWSTONE RIVER.

By P. W. NORRIS, *Superintendent of the Yellowstone National Park.*

While crossing from Fort Ellis to the Upper Yellowstone River, through Trail Pass, in the spring of 1870, I diverged from the main route upon an ancient, nearly abandoned trail, through an eroded valley, some five miles, to Eight-mile Creek, and thence over the second basaltic terrace to Bottler's.

Upon and between these creeks I then, and again in 1875, observed not only the usual stone heaps for winter guides in snowy passes, but also scattered groups of what I supposed to be burial cairns, but had neither time nor tools to examine them. But in July of this year, learning that Squire Ferrel, who now has a fine ranch in Trail Pass, had seen some apparently ancient excavations, we together sought and found several, and I subsequently alone found some larger ones. Within an area of somewhat over a square mile, midway between Trail and Eight-mile Creeks, near the ancient trail, are four distinct groups of ancient shafts, or rather drifts along a vein. The *débris* was thrown out below the entrance as in the ancient copper drifts of Lake Superior. The largest are 40 feet long, 20 wide, and 8 deep, but most of them are much smaller. But as an excavation, 5 feet deep, which I made in the largest, failed to reach either bottom or side walls, they are all doubtless very ancient and much filled in with eroded materials from the crumbling basaltic terraces.

One set of drifts was made through the crumbling basalt, for a red or brown mineral paint, evidently not recently, if ever, used by the present red Indians. Another is a line of drifts along the nearly horizontal outcrop of a 6 or 8 inch layer of rock as hard as flint and as beautiful as moss agate, along a hillside of vitreous limestone.

The other two groups of drifts are upon veins of a wavy, variegated, colored rock, but it, like the flinty agate last mentioned, splits with a fracture apparently wholly unsuited for any kind of implement, and none were found there.

Most of the stone heaps are from 3 to 5 feet high and 8 to 12 in diameter at the base. In every case fragments of charcoal, a half cart-load of coarse square gravel, evidently arrow heads, and of other tools or weapons of merely the *débris* of rocks there fractured by fire, and fragments of flint, jasper, obsidian, and other materials were found, but no human or animal bones.

About ten miles from this locality, upon the basaltic terrace back of Bottler's ranch, and along the basaltic terraces above a chain of lakes between Emigrant Gulch and Dome Mountain, and on the West Gallatin, are long, and frequently, though not always, parallel lines of very small stone heaps.

Long and patient investigation failed to develop any definite form or apparent object in them, though they are always continuous, connected, and tolerably uniform in shape, average from one-half to a whole bushel in size, and are situated about a pace apart, so that a man can walk for miles upon them. They are *seldom* inclosures and *never* squares, circles, or other regular forms. They never, in any remembered case, show, by their position on summits of hills, on forks of cañons, or on slopes of terraces, the slightest attempt at defense, often passing around and below crests, rocks, and bowlders, which now absolutely overlook and command them.

That they are the work of human hands cannot be for a moment doubted, and, being somewhat eroded and imbedded, I suppose them also to be very ancient. These are my only conclusions in reference to them.

THE SHOSHONIS, OR SNAKE INDIANS, THEIR RELIGION, SUPERSTITIONS, AND MANNERS.

By Col. Albert G. Brackett, U. S. A.

The different bands of Shoshonis roam throughout Wyoming, Montana, Idaho, Northern Utah, Northern California, and Southern Oregon, Taken as a whole, they number fully 8,000 souls, but are broken up and never operate together. While some have always been friendly to the whites, others have been their enemies, and the renegades living in Oregon pursue the pale-faces with peculiar rancor. The party of Indians which gave so much trouble to the whites in 1873 near the boundary line between Oregon and California, under the name of Modocs, was made up in part of Snake Indians. The. Snakes living near Stien's Mountain, in Oregon, hunt and fish for a living, and never let an opportunity pass without doing what damage they can to the white settlers. Why one portion of this nation should be so hostile and another so friendly is not easily explained.

These Indians were first encountered by Lewis and Clark's party while on their way to the Pacific, in 1805. They were very poor, but assisted our people as well as they were able. They lived in the valleys and long the courses of the streams, and had but little idea of laying up tores for winter. Their bread was made of sunflower (*Helianthus an-nuus*) and lambs-quarter (*Chenopodium album*) seeds, mixed with service erries (*Amelanchier canadensis*). They had a few horses, which they alued highly, that had been brought from the south by the Comanches, vho speak the same language as the Shoshonis, and may, therefore, e considered as belonging to the same stock. The Shoshonis traveled ar to the south, the greater portion of the tribe living, in fact, at that ime, in the territory belonging to Mexico, or New Spain.

The tribal relationship between the Comanches, Shoshonis, and Ban-nacks is very close; and any one speaking the Shoshoni language may ravel without difficulty among the wild tribes from Durango, in Mexico, o the banks of the Columbia River. Of course, each band has its pecu-iarities, but in the main they are much alike, and, if they could be com-bined, would form one of the most powerful Indian confederations in America. Some are richer in Indian property than others—having all that is desirable in an aboriginal point of view—while others are very poor indeed, living in the fastnesses of the mountains, and afraid to be seen by any one. A more utterly forlorn and friendless race of people than those last mentioned cannot be conceived.

The Shoshonis love to fish in the spring time, in the streams which flow into the Colorado of the West; in the summer and fall they wander off to the buffalo-grounds to the east of the Wind River Mountains. They are a contented race, and are on friendly terms with all the Indian tribes except the Sioux, Arapahoes, and Cheyennes.

Their lodges are made of dressed buffalo-skins; that is, skins that have had the hair taken off, and which have been rendered pliable by pound-ing and rubbing. Some of them are very elaborately made, painted on the outside, and divided into different compartments, answering the pur-pose of rooms in more pretentious dwellings. In each compartment there is a good bed made of buffalo, beaver, or bear skins, and blankets. In the center of the lodge is a fire, the smoke from which makes its way through a hole in the top. Each family has several brass kettles and drinking cups, &c. In the evenings the fires give a ruddy light, making everything look cheerful inside, and the children play about in as good spirits as any on earth. They have their little plays and games, and laugh and chatter away as merrily as crickets. There is a great degree of freedom in all of their movements, and I cannot see but that they enjoy themselves as well as any people I have ever met.

At present the Shoshonis occupy several reservations. One band, in company with the Bannacks, is on the Lemhi farm in Montana, where they have some land under cultivation, and a good fishing place in the Lemhi Fork of Salmon River, a tributary of Snake River. The Eastern Shoshonis have a reservation in Wyoming Territory, which embraces the Wind River country from its source to Owl Creek, a large tributary of the river itself. These Indians are under the leadership of Washakee, one of the ablest red men now living. At the Fort Hall Agency, in Idaho, there is another band that is thoroughly mixed up with the Bannacks. The Northwestern Shoshonis have an agency in Utah; but this band does not seem to be united at all, and is scattered over Western Utah and Eastern Nevada. The Walpahpe and Yahooskin bands of Shoshónis are in Oregon and formerly roamed about with the Modocs, before their removal from Oregon, as they now do with the Klamaths and Pi-Utes.

Nearly all of them receive annuities from the government, and some effort has been made toward teaching them how to carry on farms, but the farming land is generally so badly located, the frosts so severe, the grasshoppers so plentiful, and the altitude so great, that, in most instances, but little can be said in favor of these farming operations. It would be difficult for the best American farmers to raise crops on some of the reservations that have been set apart for the Indians, and I do not think that we ought to expect more from them than we can from our own race.

By far the larger portion of the eastern reservation is barren and mountainous. The valley of the Little Wind River, in which the agency is situated, contains eight or ten sections of land which can be irrigated and cultivated. There is little or no wood except on the mountain-sides, distant some ten or twenty miles from the agency, if we except some fine shade-trees along the course of the river. The Wind River Mountains are supposed by the Indians to be the home of the spirits, and they believe a person can see the spirit land, or the land they will occupy after death, from the top of them. They are fond of describing the beauties of this land, and the enjoyments and pleasures they will find therein: fresh and pure streams; wide prairies covered with grass and flowers, and abounding in deer; beautiful squaws to wait upon them; horses, always ready and never tired, to take part in the chase; new lodges supplied with every comfort, and provisions and meat so plentiful that they will never again suffer the pangs of hunger.

These Indians have not much of an idea of God, though they believe in Tamapah, or Sun-Father, who is the Father of the Day and Father of us all, and lives in the sun. They believe that when a good Indian dies, he falls into a beautiful stream of bright, fresh water, and is carried to the pleasant grounds I have described, whereas when a bad Indian dies, he falls into a stream of muddy, filthy water, and is borne off to a dark and noisome swamp, where he is unhappy, dirty, and miserable. When an old man is dying he finds himself near the top of a high hill on the Wind River Mountains, and, as the breath leaves his body, he reaches the top of it, and there, in front of him, the whole magnificent landscape of eternity is spread out, and the Sun-Father is there to receive him and to do everything in his power to make him happy. They recognize the fact that there is a difference in the future state made between the good and the bad, though the idea of eternal torment they do not entertain at all. Material pleasures alone are those which a Shoshoni understands. He can conceive of none aside from those which go towards nourishing the body or appeasing the appetite. The young man after death continues to hunt, while the old man has everything necessary for himself without labor.

A Shoshoni warrior dressed in all his finery is a picturesque object. He has a fine blanket of blue; blue leggings heavily trimmed with red cloth and masses of white beads; a hunting-shirt of tanned buckskin adorned with heavy fringes of the same along the seams, on the shoulders and around the waist and skirts, and dense rows of white and pink beads on the shoulders and outside of the sleeves. His hair is braided up and adorned with brass bosses; huge hoops of brass wire are in his ears, and his fingers are plentifully adorned with brass rings—as many as ten frequently being on one finger. His moccasins are well beaded over, and his broad-brimmed black hat adorned with feathers. His horse, too, comes in for his share of adornment; the check-pieces of the bridle being made of red cloth; the brow-band finely ornamented, and the bit heavy with curved horse-shoe nails. The stock of his rifle is studded with brass nails, as is also the sheath of his knife, while the saddle is covered with heavy cloth. No people in the world are more fond of display. These beaux of the wilderness have a high opinion of themselves, and are as grave and dignified as can be; they think the world beside does not contain such finery as is done up on the outside of a Shoshoni brave.

They are not bloodthirsty as a race, but are inclined to be peaceful, nor are they quarrelsome, but love to take their ease. They know how to appreciate a good horse, and some of them have small herds of cattle. Their history, so far as known, is not a bloody one, they as a general thing preferring to seek the fastnesses of the mountains to fighting. But it must not be inferred from this that they are a cowardly race, they being brave, adventurous, and excellent guides. Until the last few years they were very poor indeed. Words can scarcely express their extreme poverty when first met by white people. They seemed to have very few worldly goods, were indifferently armed, and with great difficulty succeeded in taking a few buffaloes. In the fishing season they caught great quantities of salmon-trout in Snake River, which they preserved as well as they could for winter use. At times, too, they succeeded in capturing many antelopes, but still they often suffered from hunger and cold, being improvident and unskilled in the ways of preserving fish and meat.

The men among the Shoshonis are true republicans, each one being a sovereign, and subject to no man. He is sole owner of his wives and daughters and can dispose of them as he sees fit. The children are seldom if ever chastised, as the Indians say it breaks their spirits, and they are ever afterward cowed down. Plurality of wives is very common, an Indian buying as many as he can maintain. Female children are betrothed when very young, and sent off to the lodges of their husbands as soon as they get old enough. The price of a squaw varies considerably, but generally amounts to three or four horses or mules, and several plugs of tobacco. Sisters are not usually married to the same man, as it is considered better to change about, and have relatives in as many families as possible. The squaws collect roots, and cook, put up the lodges and take them down, dress the skins, and make clothing. They also make parfleches, or heavy bags of buffalo skin, in which buffalo meat and fat are packed away, and manufacture bowls and baskets from wood and grass. They collect seeds and wood, and take care of the horses, load and unload the animals, and have general charge of the baggage. The whole drudgery of camp devolves upon them, and the life which women lead among the savages is one of abject slavery. An Indian thinks it beneath his dignity to do any kind of work except hunting, fishing, and engaging in war.

In the long and dreary days of winter the Indians sit in their lodges, where there is a good supply of meat, and pass the time as best they can. They tell stories of their hunting expeditions and war parties, and embellish their narratives as much as possible. They tell of the Great Brown Bear of the Mountains, who dwells amid the snows that hang about their summits, and whose howls mingle with the thunders of summer and the wild wailings of the winter storm; of Giant Big Horn, who roams through the deep gorges of the Sierras, and climbs the rugged rocks, whose feet are swifter than the north wind, and as untiring as the rushing waters. They tell of the ghosts, or Tsoaps, who haunt the meadows and forests, and are ever ready to give them warning of the time of their departure to the land of spirits. They tell of the Big Beaver, who dwells in the marshes near Green River, whose breath can split the hardest rock, and the fire from whose eyes can melt the thickest ice. They tell of the Black Raven, who sits above the battle-ground where so many Shoshonis were killed by the Sioux in 1869, who croaks over the remains of the dead and flaps his broad wings noiselessly through the dreary nights when the moon is dead. These stories and many more they tell each other, until, like children, they cower near the lodge-fires and are afraid to go out alone. Never were there more marvelous story tellers, and never were there more willing listeners. Almost every summer they get thoroughly frightened by some prophet predicting the speedy end of the world.

Old and young mount their ponies, and, crossing the mountains, assemble near Bear River, where they go through a series of dances, incantations, and rites until they are almost beside themselves with excitement. This excitement disappears as quickly as it makes its appearance, and then all hands pack up again and bundle themselves off home as contented as can be. Instead of doing harm, these meetings seem to do a great deal of good. They stir up the Indian blood and the excitement exhausts itself. Were it not for these displays the Indians might consider it their duty to make a raid upon some white man's flocks and herds, and carry off a few head of horses by way of variety; but after having glorified themselves sufficiently they are willing to remain quiet for a considerable time and smoke their pipes with renewed pleasure.

RUINS IN WHITE RIVER CAÑON, PIMA COUNTY, ARIZONA.

By R. T. BURR, M. D., *Acting Assistant Surgeon, U. S. A.*

In White River Cañon, situated in the Chirachui Mountains, in Southeastern Arizona, about 35 miles south of Camp Bowie, and 25 or 30 miles north of the Mexican line, I discovered the remains of an ancient settlement shortly after the establishment of Camp Supply, May 1, 1878. White River Cañon is near the southern portion of the mountain chain opening to the west. There are many indications that this cañon and vicinity have in the past been occupied by a race much superior to the Apaches.

The ruins are located in the forks of two branches of White River, or where Henley's Branch joins the main stream from the south. The land is at present a military reservation. They are less than 100 yards from either branch of the stream, on a ridge 40 or 50 feet above the river-bed. The land is rather rocky, but in many places there is excellent alluvial soil along the streams. In the vicinity of the ruins are at least 1,000 acres susceptible of irrigation. The cañon has now a growth of pine, oak, juniper, some walnut, and a few sycamores. The surrounding mountains are well covered with pine and oak. It is impossible to tell what changes have taken place since these ruins were occupied. They must have been considerable, as the water supply in the dry season is now limited, the river ceasing to run, and only holding water in a few places.

Rucker's Spring is a large basin of water that contains as much at one season as at another. The water is strongly impregnated with sulphur.

The remains occur in groups, some consisting of from two to four or five squares or circles, showing that at the time they were built defense was not a primary object. Isolated in the heart of the mountains, this community would be first exposed to the hostiles, and probably fall a prey to the Apache invasion from the north.

The other two isolated groups are small, the nearest having three or four squares and no circles; the second, on the east of Rucker's Branch, having five or six squares from 10 to 15 by 20 or 30 feet. The ruins described seem to be the most important ones. I took a sketch of the ground-plan of the ruins. I traced out the walls of the main building as well as I could, the only guide I had being the upright stones placed singly from 6 to 12 inches apart. No remains of a wall exist save these stones that are placed on end and partly buried in the ground. Walls or lines are, with one exception, due north and south, and east and west. I tested this by means of a compass, and, making allowance for variations of the needle, they are certainly wonderfully correct. The walls, if they were walls, must have been made of adobe, and the heavy rainfalls of the cañon, about 30 inches this year, would have destroyed all traces, as this building was erected on the incline of the ridge, while the circles are on the level ground. The large circles, all about 30 feet in diameter, have the walls much better preserved than the squares. The mounds are from 12 inches to 2 feet higher than the surrounding land, and, in some cases, spread out some 4 to 10 feet. The walls seem to have been made of adobe and stones.

Near the center of most of the mounds is quite a depression, caused, I suppose, by the washing down of the walls. I can see no evidence of special construction in the center. The materials could be obtained in abundance in the immediate vicinity. None have been explored, as labor is so high here that I have not been able to bear the expense, and, indeed, had but little hope of finding anything worth the while. On the ground I have found an abundance of pottery in small pieces, some of it glassy, one piece ornamented in colors, many bits carved or marked.

For eight or nine months of the year White River would afford, at the present period, abundance of water. Rainfall begins in the latter part of June or the first of July, and continues almost every afternoon for sixty days, and the river remains full many months after.

These mountains have long been the stronghold of the Apaches, and, so far as I can learn, none of our scouts ever noticed the remains. The Indian scouts have a tradition that this cañon has evil men living in it. There are no recent signs of occupation by Apaches.

In conclusion, I would remark that I have thought that the quadrangles and the circles were to be attributed to different peoples and different dates. The circles, seemingly more recent, may have been built by the Apaches in ages past, or by people less advanced in civilization than the first inhabitants. The small circles, about 3 feet in diameter, were ovens. They have a floor of flat stones well fitted, around which a wall is built up 8 to 12 inches high. There is no indication of a covering. In one I discovered some charred juniper-wood.

I found here a stone mortar weighing about 100 pounds. The cavity is four inches in diameter and as many deep, perfectly round. It is conveniently located near the four ovens. On the hillside I also found another mortar that had been turned over, and two broken metatés.

Near the mouth of the cañon, and distant from camp about 6 miles, are some ruins that I have not examined with care. They consist principally of quadrangles of small size, 15 by 20 feet, and but few together. One group that I came across was at some distance from permanent water. There is a small ravine close by that now affords water in the wet season. This last group was on a high hill, and no agricultural ground was near, the ravine having precipitous banks. Other ruins are scattered along the banks of White River after it reaches the open plain outside the cañon; but where they are placed no water is to be found in the dry season, it being at least 2 to 5 miles to the nearest permanent supply.

MOUNDS IN WINNEBAGO COUNTY, WISCONSIN.

By THOMAS ARMSTRONG, *of Ripon, Fond du Lac County, Wisconsin.*

There are many "ancient aboriginal structures" in this section; mounds of various shapes, and designed for various uses, being very plentiful.

The only other indications of the occupation of this region by the aborigines are stone axes, arrow and spear heads, chips of flint, and pieces of broken pottery, which may be found in almost any newly-plowed field, or in gullies washed by the rains.

The mounds which are especially to be noticed in this communication are in the southwest quarter of the northeast quarter of section 34, township of Nepeuskun, Winnebago County, Wisconsin, on the property of a Mr. Hintz.

They are situated about ten rods from the shore of Rush Lake, 60 feet back from the edge of a steep bank, which undoubtedly at one time formed the shore of the lake, whose waters have now receded, and are every year becoming more and more shallow, and giving place to marsh.

The mounds were originally covered with a heavy growth of oaks, which have been cleared off within the last ten years, and the land cultivated. Some stumps of trees of from 100 to 150 years' growth remained on them until this last summer.

The mounds are in a group, of which No. 1 is isolated, and Nos. 2, 3, and 4 are in a line, the nearest about 200 feet from No. 1.

Nos. 1 and 4 are about 15 feet in diameter, and 2½ feet high; No. 2, 56 by 42 feet, and 3½ feet high; No. 3, 30 by 40 feet, and 3½ feet high; Nos. 2 and 3 are 75 feet apart. A quadrilateral ridge, indistinct in some places, but quite prominent enough to be easily recognized, and having on it several small mounds, at irregular intervals, passes through Nos. 1 and 2. The mounds 2, 3, and 4 are the only ones which are very distinct and striking.

The shape of all was once circular, or nearly so, but it has since been changed to oval by long cultivation.

All except No. 2 are composed of the same sort of material as the ordinary surface soil of the surrounding fields, and these fields were undoubtedly the source whence it was derived.

No ditches or hollows from which such a quantity of earth could have been taken are now to be seen in the vicinity, and it must therefore have been scraped uniformly from the surface.

No. 2, however, is of different material, having in its center a stone heap covered with the same sort of earth as the others. This is the largest mound on Rush Lake, and peculiar in this regard, for in most of the other mounds not even a pebble could be found, and in none were there rocks of any great size; but here was a conical pile of bowlders, such as the farmer to-day hauls off his fields, built in the exact center of the mound, and reaching to within a few inches of the surface. We explored the four mounds. In 1 and 4 we found nothing; but in 2 and 3 human remains were plentiful enough, and a quantity of these, in a tolerably good state of preservation, we were able to obtain. Some of these are now in the cabinet of Ripon College, Ripon, Wis., and some are in my possession.

No account of these mounds has, so far as I know, ever been published; certainly no examination of them prior to ours has ever been made, though similar mounds on the sections adjoining these, and likewise situated on the shore of Rush Lake, were described by me in a paper read before the Lapham Archæological Society in 1877.

Mound No. 2, as I have said, is a conical stone pile, built of bowlders weighing from 5 to 100 pounds, and perhaps 50 in number. Underneath this stone pile, and somewhat mingled with its lower layer, was a large quantity of ashes and charcoal, and also human remains; most distinct among them was the skeleton of a full-grown man of ordinary size—his thigh-bone measuring 17 inches—lying in a doubled-up position, with his head toward the west, and near it the remains of three or more other human beings. These bones were in such a crumbling condition that it was very difficult to save any of them, but, nevertheless, by careful work we were enabled to get out two skulls and several long bones. These were all found at the depth of 3 feet 6 inches, and had evidently been placed on the original surface and the mound heaped over them.

Mound No. 3 was more fruitful in relics than its larger neighbor. On and near the surface were a few small rocks, weighing from 1 to 30 pounds, not arranged in any order, and not found after we had dug a foot or two into the mound.

At the depth of 2 feet we found a few small and much broken pieces of pottery, made of a reddish clay mixed with fine particles of broken stone. The pieces were too few, small, and badly broken to admit of even a guess at the articles of which they once formed a part. They had never been burned, as it seemed to us, and were very fragile, ready to crumble at the slightest touch. A piece of red chalk, or soft chalk-like stone, with which a red mark can be made on wood or paper, and a small chip of flint were the only other relics found in this mound, except the bones which we came upon at the depth of 3 feet. These were much better preserved than those in No. 2, and we were able to obtain a large number in tolerably good condition, among them several skulls.

So far as we could determine, there seemed to be no order whatever observed in the arrangement of these bones; skulls and long bones, ribs and finger and toe bones were mixed in utter confusion. In no case did a skeleton seems to have been placed in the mound entire. The bones of twenty-five or thirty individuals had evidently been gathered into a heap on the original turf, and a simple mound raised over them. It was very evident that no pit had been dug to receive them, and the only question is why the bones were in this confused condition.

That these were not the remains of warriors slain in battle is evident from the number of bones of children found in the mounds, and also from the very great number of bones to be found in these and neighboring mounds.

No other bones than those of human beings were found, nor did any of them bear marks of fire, though ashes and charcoal occurred in a layer about 6 inches above the remains.

A skull obtained from this mound, the pieces of which we have been able to put together so as to get some idea of its original shape, is of fair size, with low forehead and very narrow across the eyes; the great bulk of the head, and by far its highest part, being back of the coronal suture. From the forehead the skull slopes rapidly up to this highest portion, and on its summit, an inch from the coronal suture, and $\frac{1}{8}$ of an inch to the left of the sagittal suture, is a remarkable circular depression, an inch in diameter. It shows no signs of fracture or violence, and the inside of the skull shows no corresponding elevation. What could have occasioned this thinning of the bone we cannot tell; we only know that it must have been done long before the death of its owner, for the wound, or whatever it is, is perfectly healed, and the bone in the depression as smooth and of the same sort as the remainder of the skull. Viewed as a whole the cranium appears very one-sided.

Several lower jaws with teeth still in them were also obtained from this mound, but not much could be learned from them except that the jaw was massive, and the teeth large, strong, and well preserved. In fact, in many cases, the enamel was completely worn through on the crown of the teeth, and yet they showed no signs of decay; we found no defective teeth whatever. In the case of one individual the teeth on one side of the jaw were very badly worn off, while on the other no wearing at all was visible.

All the bones we obtained were of ordinary size, and could be matched in any collection of modern bones. A general characteristic of the skulls was the very low and narrow forehead.

The gentlemen who accompanied me on this expedition, and to whom much of its success is owing, were Prof. A. H. Sabin and Mr. Everett Martin, both of Ripon, Wis.

The following are extracts from my paper on the Gleason mounds, as read before the Lapham Archæological Society last year:

"These mounds are situated on the southern shore of Rush Lake, on land belonging to Mr. Gleason, in the southeast quarter of the southeast quarter of section 27, and the southwest quarter of the southwest quarter of section 26, township of Nepeuskun, Winnebago County, Wisconsin, and were visited by a party of students from Ripon College, May 12, 1877.

"The mounds, sixteen in number, are ranged in an irregular line running essentially east and west, about 20 rods from the shore of the lake, which is here high and steep, though all the adjacent shores are low and marshy. The mounds are in what is now a wheat field, formerly covered with timber—an oak tree, some 60 years old, having been cut from the summit of one of them. All these mounds are circular in form, varying from 15 to 30 feet in diameter, and from 2½ to 5½ feet in height, though not much can be said with certainty about this latter dimension, the land having been cultivated for a number of years, and the mounds plowed down as much as possible every year.

"We selected the largest and most conspicuous mound we could find, the fourth or fifth from the eastern end of the line, and sank a trench into it. Each shovelful of the soil thrown out was carefully examined, but it was found to present no different appearance from that of the surrounding field, until we had reached the depth of 18 inches, when a few pieces of coarse-grained charcoal were found. The earth now began to show the action of heat, it being harder and of a reddish hue, until at the depth of 2 feet 6 inches layers of ashes mixed with earth began to present themselves. These appearances were not the same all through the trench on the same level, being only seen near the ends of it, as if separate fires had been built. These appearances continued until we had reached the depth of 3 feet 9 inches, the ashes meanwhile growing more plentiful, when we found charred bones, evidently those of human beings, mixed with the earth and ashes. A few inches more of calcined earth were passed and then we struck bones in earnest.

"Within the space of 3 feet square we uncovered 7 skulls, mingled with the various long, short, and flat bones of the human body. These, unlike those in the upper stratum, did not show the action of fire in the least, but were so badly decayed that we could get none of them out entire.

"The bones were not arranged in any order whatever; no single skeleton even could be traced through the mass. We did not uncover all the bones in the mound, but, finding that none of them could be taken out entire, contented ourselves with digging through the layer of bones and earth, which was about 4 inches thick, to the hard subsoil underneath, which we found so compact that we concluded it had never been disturbed, and so did not go deeper.

"A careful search failed to bring to light any ornaments or implements of any kind.

"We now abandoned this mound, and, selecting two nearer the eastern end of the line, which in size were most unlike the first and unlike each other, proceeded to sink trenches into them. In the larger of these at the depth of 4 feet human bones were found, which were much better preserved than those in the first mound opened, though they showed the same lack of arrangement and dearth of ornaments and implements. Fewer ashes were found in this mound and no charcoal or burnt bone.

"In the third mound, at the depth of 2½ feet, a skeleton was found lying with its head toward the west. This was in so good a state of preservation that many of the more heavy and solid bones could be taken out; this skull, like all the others, could not be gotten out except in small pieces.

"This was the only mound of the three into which we dug, in which a skeleton could be traced, and even in this the bones were somewhat crowded together, the skeleton not lying extended at full length, and also somewhat mixed up with others, though, I think, fewer bones had been buried in this mound than in any of the others.

"I would mention that the second and third mounds were much smaller than the first.

"The bones belonged to individuals of ordinary size, the largest to a man perhaps 6½ feet tall, but certainly not any taller than that.

"As to how the bones came to be placed in these mounds we can, of course, only conjecture; but from their want of arrangement, from the lack of ornaments and implements, and from their having been placed on the original surface (for the old turf was visible just under the lowest bone layer in the second mound) we are inclined to believe that the dry bones were gathered together—those in the larger mounds first and in the smaller ones afterward, and placed in loose piles on the ground, and then earth heaped over them until the mounds were formed. Where the earth came from, if it was not scraped uniformly from the surface of the surrounding fields, is more than we can say, for there are no hollows anywhere about the mounds from which such a quantity could have been taken. It also seemed, from the ashes and charred bones near the surface, that the larger mounds had been used as a place for sacrifices or feasts."

Professor Sabin, Mr. Martin, and I afterward made an investigation into another of these Gleason mounds. This one is situated near the center of the group; is 30 feet in diameter and 3½ feet high. Like the others, it contained nothing but bones, was built of the same material, and had its full share of ashes and charcoal. But unlike the others, however, the bones had not been placed on the original surface, but in an oval pit 18 inches deep, 8 feet long, and 5 feet wide, its major axis lying in a general northwest and southeast direction. In this case some arrangement was apparent, the bones of the lower extremities being, as a rule, near the center of the pit, and those of the trunk and upper extremities ranged around the sides.

THE GREEN LAKE MOUNDS.

On the shores of Green Lake, 6 miles west of this place, are a large number of mounds, which have not as yet received any thorough investigation. They consist, first, of circular, flat-topped mounds built on a high bank at the northeast end of the lake, mostly in section 27, township of Brooklyn, Green Lake County, Wisconsin. They were evidently built for observation, as they command a view of the whole length of the lake; and careful digging has failed to reveal relics of any kind buried in them.

about half an inch in height, and in comparison with the skulls found in the center of the mounds show that they are of a much lower grade. The bones of the late Indians are in good condition and are easily removed. Scattered through the mounds are found shells, broken pottery, and flint. In some cases it is hard to say whether the pottery belongs to the mound-builders or the late Indians, as it is found with both. The shells are evidently fresh-water species, and are brought from quite a distance, as they are not found in this vicinity. When found they are white and crumble easily. On account of age the outside has fallen off, thus leaving only the pearl. A large quantity of flint is also scattered through the mounds. The flint is of no particular shape and is broken in small pieces. This is, however, not properly flint, but chert. One excavating finds the earth very compact and solid, and can even with a pick do but little work. Just before reaching the center of the mound the remains of charcoal are found in small quantities. As a general rule the bodies are found in a rude coffin which can hardly be called a sarcophagus. This coffin is made of rude slabs of limestone, which is found in this neighborhood in abundance. The slabs were at one time fastened together by what seems to be a cement. The whole inside of the coffin was plastered with the same kind of cement, thus making it for a time perfectly tight. The body was placed in the sarcophagus with its head pointing toward the east, and with the body were buried a few valuables, such as necklaces, pottery, &c. The skeletons of small animals resembling squirrels and rabbits have also been found buried with the bodies. Urns were placed at the head, evidently containing food of some kind. The necklaces were made of pieces of shell and the claws of wolves. Two bodies have been found in one coffin with their heads pointing east and west. These coffins when found are broken and fallen to pieces, and the bones of the mound-builders are so far decayed and so damp that to remove them is almost an impossibility. They crush when any weight comes in contact with them, but on being exposed to the air they turn white and become hard. The weight of one of these coffins is about 1,700 pounds, and they cannot therefore be removed.

The pottery found in these mounds is made of clay and rudely decorated, but contains no hieroglyphics. The vessels hold from 2 gills to several gallons. A few pipes have also been found. Two were filled, but with what could not be ascertained. It was evidently not dirt. Quite a number of pieces of wood are found in the mounds, but too far decayed to be removed. From one mound an image was taken weighing 1½ pounds. It was made of a greenish stone resembling granite, nicely polished, and very perfectly made. In one end a hole was bored, through which a thong or string was passed, evidently for the purpose of suspending it from the neck. The base was oval-shaped, sloping upward to a figure which, in its general appearance, resembled a lamb, but what it was intended to represent is difficult to say. The exact nature of the stone was not ascertained, but there is no stone in these regions resembling it.

In none of these excavations have copper or copper implements been found. Three pieces of lead have been dug up, weighing 6, 8, and 11 ounces respectively. The lead had no special shape, but had evidently been melted and thrown into the mounds. Lead is found in these regions, but not in abundance. A few stone adzes and flint arrow-heads, &c., have been unearthed. In the center of one mound a body was found in a sitting posture, its head resting on its knees and the hands clasped around the ankles. Around the body was a limestone box, which had fallen to pieces. With this body were buried two pipes and a quantity of broken pottery.

In opening the mounds one thing is noticeable in regard to the position of the skeletons. Some of them have been found with their feet lying as near as 6 inches from the head, and the whole skeleton in a disordered condition. Around it the coffin was disturbed in a similar way, the stones lying far apart. In several cases the skeletons and the coffins have the appearance of having been disturbed by a movement of the earth.

About three miles north of Quincy, built upon the highest of a range of hills, is a lookout mound. The tumulus itself is about 15 feet in height, while the hill is over 300 feet high. This is the highest mound in this vicinity, and from the top one can obtain a view for nearly 18 miles around.

WISCONSIN MOUNDS.

Near Madison, Wis., there are hundreds of animal mounds, averaging about 3½ feet in height. The burial mounds are very low and poorly made. Eight of these have been opened, and all without exception have been built in the same way, with only one layer of earth, and that a large layer of simply black dirt. The earth is very firm and hard, making the work of excavation exceedingly laborious. These mounds are about 4 feet high, and are all circular. Skeletons are found as near as 12 or 13 inches from the surface, but are in a very poor condition and can hardly be removed.

There are no sarcophagi or coffins of any description, nor were the bodies buried as most of the bodies of the regular mound-builders were. In all cases the head points toward the west. On the foreheads of two skeletons there were found two stones weighing about two pounds each. Pottery is found buried in these mounds, rudely decorated and generally broken. One vessel, when restored, was found to hold about a gallon.

From one mound was taken a large clay platter 14 inches in diameter and 1 inch in thickness. This was covered with charcoal, and the ground around it for a radius of about 8 inches had the appearance of having been burned. But in this mound there were no skeletons, only some flint. About a foot under the surface of the ground was found a layer of thick gravel, and under this simply a layer of sand, a characteristic of the ground in that vicinity.

These mounds are of a much poorer quality than those farther south. On the largest mound visited, near the center, was found a stump of a tree 20 inches in diameter, but too far decayed to note accurately the annular rings (125 were counted). Near the edge of the mound stands a tree 11 inches in diameter.

Out of these eight mounds only five skeletons were taken. Two or three whole arrow-heads were found, also a large quantity of broken pottery.

The animal mounds represent many figures, which were probably but the conceptions of the builders. In many cases it is hard to tell what they represent, on account of the brush and trees which have grown over them. On the sloping shores of Lake Mendota are many of these mounds, and running parallel to the lake are ridges about 260 feet long, forming rude steps.

There is one mound, having the shape of a bear, 60 feet in length and about 3 feet high. Also, a snake mound, with four curves, is noticeable. At the head of the mound two stones, weighing about 500 pounds each, indicate the eyes.

Mounds made to represent bears, snakes, alligators, deer, &c., are very numerous.

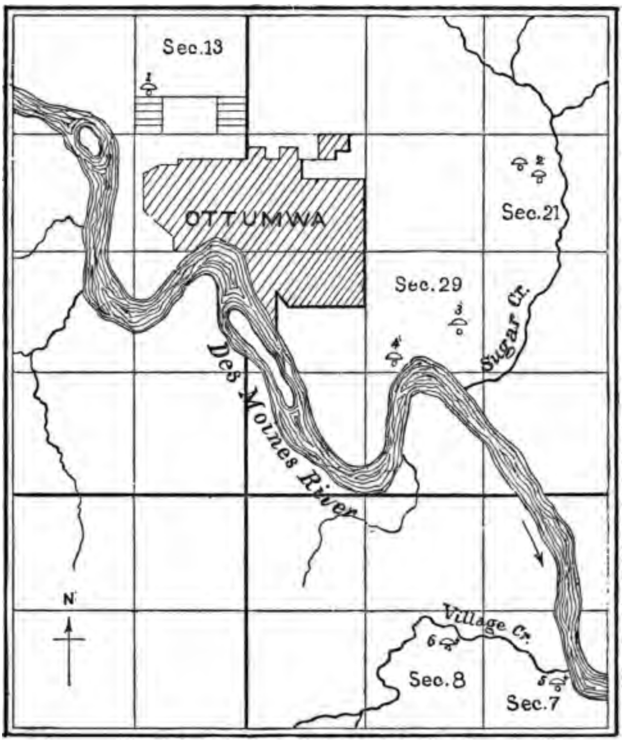
NOTES ON SOME OF THE PRINCIPAL MOUNDS IN THE DES MOINES VALLEY.

By SAMUEL B. EVANS, *of Ottumwa, Iowa.*

The opinion held by some writers that successive peoples are attracted to the same localities and build towns on the ruins of those of their predecessors holds good in the Des Moines Valley. The writer has passed almost a quarter of a century in this region, which he has partially explored in the search of relics of the unknown race. Who the mound-builders were, or whence they came, is the problem we wish to solve; and in the narration of simple facts by observers at different points there may be collected a mass of testimony which may lead to clearing up the mystery. It has been my privilege to examine rather critically some of the mounds in the vicinity of Ottumwa, Iowa, the exact locations of which are shown in the diagram on the next page.

In the group known as the Sugar Creek mounds are two which I have personally examined. My mode of examination was to dig a trench 2 feet in width, beginning at the outer limit of the base, and thence to the center, digging down to the original soil. These mounds measured 50 feet in diameter and 150 feet in circumference, and are about 3½ feet in height. In Mound No. 1 of the Sugar Creek group I found nothing but bits of charcoal and decomposed ashes. This mound is on the highest point in the vicinity, and may be termed for convenience a mound for observation, as it overlooks the one lying north of it, and from its summit the Trawell group is visible. No. 2 of the Sugar Creek group was also examined and a few bones discovered. It is 60 feet in diameter and 180 feet in circumference, and has growing on it trees over one foot in diameter. The decayed trunk of a large tree was found lying on its summit. A few bones were discovered here, including a portion of the skull bone, which was so much decayed as to fall to pieces upon exposure to the air. No implements, not even broken arrow-heads, were found

DIAGRAM.



ANCIENT WORKS IN THE VICINITY OF OTTUMWA, IOWA.

No. 1. Mound on section 13, township 72, range 14.
No. 2. On section 21, township 72, range 13; known as the Sugar Creek mounds.
Nos. 3 and 4. On section 29, township 72, range 13; known as the Trawell and Stiles mounds, respectively.
Nos. 5 and 6. On sections 7 and 8, township 71, range 13; known as the Village Creek mounds.
Scale of diagram: Five-eighths of an inch to the mile.

here. East of Mound No. 1, and one-fourth of a mile distant, the remains of an ancient furnace or hearth were found, and in the vicinity of the hearth a number of arrow-heads. This furnace presented the appearance of great age, and was first brought to my notice by Capt. W. H. Kitterman, a very intelligent observer and an old settler in the vicinity, who would have known of it long before had it been used by the whites who came on the heels of the departing Indians.

The Trawell group has only been partially examined. It consists of three mounds, of about the same size and appearance as those last described, and perhaps of the same character. One of them was opened in 1877 by Mr. Trawell, who obtained from it one small hatchet of greenstone. From the Trawell group the Stiles mounds may be seen. These, as indicated by the diagram, are in the suburbs of the town of Ottumwa, and were examined by me in 1878; nothing of importance was found in them except a few broken arrow-heads, a small hatchet of greenstone, and some small bits of obsidian. If the valley and the intervening ridges were cleared of the growing young timber, one group of the Village Creek mounds, three and a half miles away, would be plain to view from the Stiles mounds. In the fall of 1877, in company with Mr. Richard Williams and Mr. A. T. Holly, of Ottumwa, I examined rather critically three of the Village Creek mounds. They are situated as shown in the sketch, and include seven or eight in each group. The eastern group embraces the mounds which we examined with the most care. They are on a high ridge or promontory which juts out toward the river, presenting a view of the valley below for miles in extent, and suggests to the observer that they might have been a system of signal stations, communicating by the way of the Trawell and Stiles groups with the Sugar Creek mounds on the north side of the river. These mounds (the Village Creek group) are about 150 feet in circumference, 4 feet high, and 150 feet apart. They contain evidences of fire, and under the following conditions: after removing about 1 foot of earth we discovered a stratum, about 2 inches in thickness, of decomposed ashes, small bits of charcoal, and what appeared to be calcined bones. Two similar strata of ashes and charcoal were discovered on going down deeper into the mound, each occurring at intervals of about 1 foot. It is important to note that these strata extended to the outer circumference of the mound, indicating that successive fires had been kindled covering the entire upper surface; substances were reduced to ashes and then covered with earth. A partial examination of mounds in the western section of the same group was made, and the same evidences of fire were obtained. White-oak trees 16 inches in diameter were found growing on mounds in this section, and stumps of decayed trees of larger circumference were found on two mounds of the eastern section.

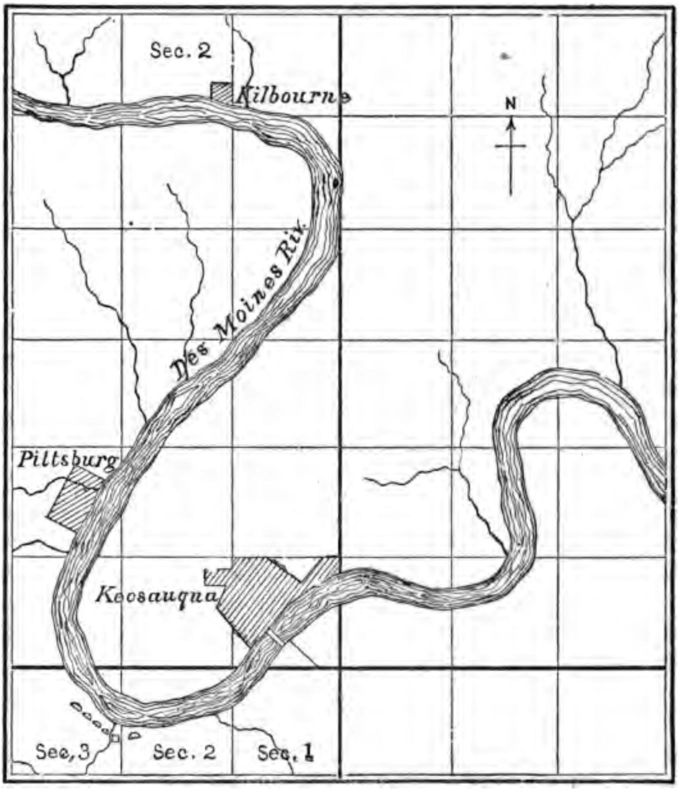
In the month of July, 1878, in company with Hon. Robert Sloan and D. C. Beaman, esq., I visited the Ely Ford mounds, near Keosauqua, in Van Buren County. I here present a sketch of the ancient works and the surroundings.

No. 1. Shell-heap. In northeast quarter of the southeast quarter of section 3, 20 rods, N. 55° W., from mouth of Ely's Creek; 20 feet above river bed; 40 feet from water's edge. Large quantities of fresh-water ıells, pieces of pottery, broken arrow-heads, bones of animals, such as ɜer, wolf or dog and bear, and birds of various kinds.

No. 2. Mound in northeast quarter of southeast quarter of section 3, 10 ›ds, N., 60° W.

No. 2. On bluff point 100 feet above river bed, 200 feet from water's lge; timber, large white oak and young jack oak. In this mound und human skull entire except lower jaw, and leg bones; also fragents of pottery. Position of head southeast, 2 feet under mound surce.

DIAGRAM B.



MOUNDS, NEAR KEOSAUQUA AND PITTSBURG, VAN BUREN COUNTY, IOWA.

Explanations.

A bluff extends over sections 2 and 3, township 68, range 10.
Mounds on section 3 are known as Ely Ford mounds, from their vicinity to creek .d old ford.
The square on the creek, near its mouth, is the shell-heap referred to herein.
The stream running thr··ugh Pittsburg is Chequest Creek.
Scale: Five-eighths of an inch to the mile.

No. 3. Half-moon-shaped mound 15 rods, N. 55° W., from No. 2; 200 et from water's edge; found thigh bones.

No. 4. Mound 15 rods, N. 45° W., from No. 3. No discoveries made ɪcept small piece of pottery.

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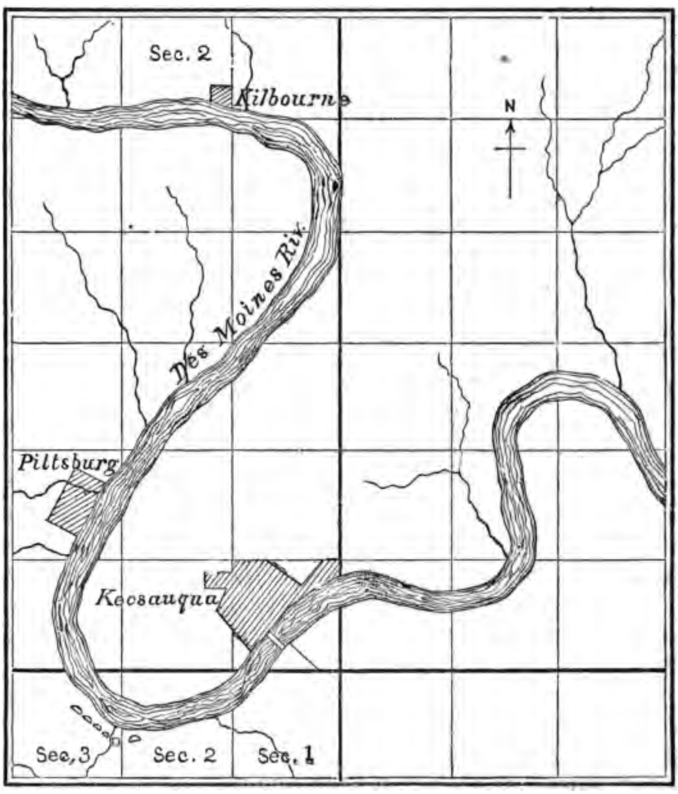

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No. 4. Mound 15 rods, N. 45° W., from No. 3. No discoveries made cept small piece of pottery.

No. 5. Large mound, 60 feet in diameter, 5 feet 6 inches high; in northwest quarter of southwest quarter of section 2, 30 rods, S. 45° E., from mouth of Ely's Creek; 100 feet above river bed; 20 rods from water's edge. Decayed white oak stump, 24 inches in diameter, on mound 12 feet, N. 10° W., from center. Decayed oak stump, sixteen inches in diameter, 4 feet from center. Found human thigh bone by the south side of stump 5 feet below surface; also shells (fresh water) and upper arm bone.

The following are the measurements taken of the skull found in mound marked No. 2: Horizontal circumference, 20 inches; longitudinal arc from nasal depression along middle line of skull to occipital tuberosity, 13 inches; transverse measurement, 5 inches; vertical height, 3.75 inches; longitudinal measurement, 8 inches. On comparison it will be found that this skull resembles in some particulars the celebrated Neanderthal or cave skull of Prussia. It was found badly decayed, and was with difficulty removed.

The description of ancient pottery found near the mouth of Chequest Creek, given in the next article, will also answer as a description of all the pottery mentioned in the foregoing.

Since writing the above I have explored the mounds near this city on the grounds of General J. M. Hederick, which are indicated in the sketch north of the city of Ottumwa. There are two prominent mounds, 50 feet in diameter, situated on the highest point in this vicinity; of which the southern one, which we shall denominate No. 1, was rather critically examined. A shaft 6 feet in length and 4 feet wide was sunk in the center, revealing nothing of interest to the ordinary observer; but the mere fact that few relics were found makes the mound mystery still more profound. The material of which the mound was composed was foreign to the surroundings, and had been carried there. Beyond a few chips of flint nothing was found in it. It is of interest to note that signals could have been established between this mound and those heretofore described.

My attention had been frequently called to the presence of numerous mounds in the vicinity of Eldon, in Washington township, in this county. They were on the river-bottom, and I attached no importance to them from the fact that they were so situated. I could not believe that they were ancient works, as my experience had led me to believe that the mound-builders proper always selected the highest points for the erection of their tumuli. But I was prevailed upon to make an examination, and during the month of November, 1878, surveyed and examined them. On the farm of Saul Hearn, one and a half miles east of Eldon, on a level piece of ground of forty acres, now used as a sheep pasture, are three lines of mounds ranging east and west and varying in size from 10 feet to 50 feet in diameter. There are fifteen of them, five in each range, and the ranges about 80 yards apart. They are composed of loose sand and mold, and three of them contained human long bones, but no skulls were found. They vary in height from 1½ to 2½ feet. So soon as I thrust the spade into one of them my suspicions were confirmed that they were not ancient, and my interest in them correspondingly decreased. I knew that I was on the old camping-ground of Black Hawk, and after examining the principal one rather critically I left the laborers, with instructions to them to open one of the smaller ones, and made a visit to the home of Mr. James Jordan, an old Indian trader, who lives two miles below on the same farm he has occupied for nearly half a century. Mr. Jordan was intimately acquainted with Black Hawk; was his chosen friend and companion, and from that distinguished chieftain learned that these mounds were the burial places of the slain Omahas, whom he (Black Hawk) had surprised and defeated in battle soon after his expulsion from Illinois. I particularly inquired of Mr. Jordan if he had ever talked with Black Hawk and other Indians about the mounds on the hills. He told me that he had, and that they had no knowledge of them; that they regarded them with awe and superstition and as having been made by people long ago and beyond any of their traditions. Investigations of hill mounds made the next day after talking with Mr. Jordan convinced me more fully of the antiquity of these works and with the idea that they were not made by any modern tribe of Indians. In returning to Ottumwa I stopped at Cliffland, a station on the Des Moines Valley Railroad, six miles distant from this city. On the highest point, and in view of the Village Creek mounds, on the opposite side of the Des Moines River, I discovered three mounds about forty yards apart lying in a range east and west. The eastern mound I excavated, discovering that it was composed of nearly the same material as the Village Creek mounds, viz, ashes and clay intermingled. These mounds are 50 feet in diameter and nearly 4 feet high. I found in the eastern mound several small stones of magnesian limestone, yellow and red sandstone, a few pieces of flint, and all showing unmistakable evidences of having been exposed to considerable heat. There were no bones, but indistinct traces of bone material reduced to a gray pulpy mass. It is a noteworthy fact that after digging down one foot I found the interior material dry, very hard, and compact; so dry was the material that it seemed there was not a particle of moisture. Beneath this and at the bottom of the mound, and where the surface should have been, I found no traces of soil, but *wet* clay which seemingly had never been disturbed.

COMPOSITION OF ANCIENT POTTERY FOUND NEAR THE MOUTH OF CHEQUEST CREEK, AT PITTSBURGH, ON THE DES MOINES RIVER.

By Robert N. and Charles L. Dahlberg.

The pieces of pottery found are composed of clay and sand mixed with small pebbles, forming a cement which appears to be baked rather than burned. The most of the pieces found show that the heat applied in its construction was not sufficient to melt the sand or pebbles, or in any way affect their original condition. No glazing appears on the pottery, and yet it is of a hard, firm, and durable substance which is impervious to water. One piece of pottery is about four inches square, but of an irregular shape. At one point it is shown to be a part of the top of a wide-mouthed vessel, evidently about two inches less in diameter at the neck than at the top. Judging from the arc described by the piece in question, the neck of the vessel must have been at least 18 inches in diameter. This piece also shows attempts at ornamentation, having a horizontal row of dots or beads about an inch and a half from the top of the vessel; these have the appearance of being made by punctures from the inside of the vessel, and are about half an inch apart, or seven-eighths from center to center. There are also parallel lines running about it horizontally about half an inch apart, which have evidently been made by some blunt instrument about one-eighth of an inch square pressed into the clay, leaving little ridges between each impression of the instrument that would average about one-sixteenth of an inch thick. There are a number of small pieces; one showing distinctly the neck, and rim of the vessel above it, to be quite flaring; but this rim does not show entire. The rim is ornamented by diamond-shaped figures, made by lines crossing each other, which lines are formed very much like the parallel lines in the larger piece. Another piece shows parallel lines. One small piece is corrugated as the Ely Ford pottery, and shows distinctly the application of heat sufficient to fuse the silex in the composition of the pottery, making it a very hard and firm substance; this piece is thinner than the baked pieces. Another piece shows bead work distinctly about an inch from the top of the vessel; the body of the vessel ornamented with parallel lines running at right angles with the top of the vessel, made as in the first piece described, and the top itself ornamented in the way our mothers ornamented the edge of a pie. Several other pieces show the application of heat sufficient to fuse the silex used in their composition.

Several pieces, including the larger one described above, show on the edges glittering particles which appear to be small pieces of isinglass. This pottery was nearly all found on the surface of the ground, having been washed out by the action of the water. In the river bank in front of the village is also a bed of ashes and charcoal about 3 inches in depth and about 2 feet from the surface of the ground.

PREHISTORIC EVIDENCES IN MISSOURI.

By G. C. Broadhead.

In many portions of the State of Missouri we find evidences of the existence, in years long past, of a now extinct race, in the form of rock vaults, earth mounds, stone axes, flint arrow and spear heads, and bones. In Pike County my attention was directed to an ancient walled burial place situated on the summit of a ridge 250 feet in height, which rises on the north side of Salt River, in the southeast quarter of section 11, township 55, range 3 west. The walls were constructed of rough limestone taken from the subjacent strata of the hill, and they inclosed two vaults, each 9 feet square, and from 2 to 3 feet in height. The vaults were not exactly in the same line, but varied about 5°. Some of the stones had been removed and carried off. I saw only a few fragments of human bones, but was informed that other and very large bones had been found. The annexed sketch exhibits the form and relative position

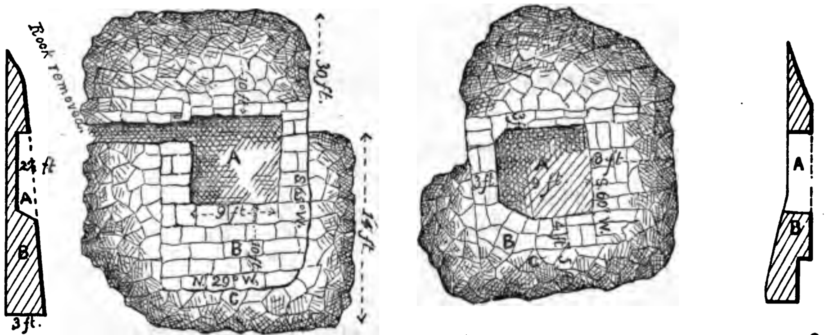


Fig. 2 Plan Fig. 1 Fig. 3

Fig. 4

of the two vaults, with their dimensions in feet marked thereon. They appear to have been originally built with a step on the outer face, as shown at B. The outer portion of the wall lies partly tumbled as if pulled down. Other similar burial places have existed in the county, but at present their sites only remain, the stones having been used for building purposes.

Beck's Gazetteer of Missouri, published in 1823, on pages 305 and 306, mentions curious ancient rock works two miles southwest of Louisiana, on the bluffs of Noix Creek. He describes them as having been built with great regularity on the top of a high bluff of the creek. As this book is now out of print and but few copies can be found, I thought it but proper to notice the account. I would add also that I have heard old citizens speak of these now demolished walls. The figure I copy from Beck. All the walls were of rough stone.

E is a chamber, 3 feet wide, which was probably arched the whole way, as portions of the arch still remained. It was made as represented in Fig. 7, and was probably about 5 feet above the ground. In F, a similar chamber, a portion of the arch was still remaining. H was a larger room with two entrances, I and K. The walls of this room were partly remaining, from 3 to 5 feet high. Trees 2 feet in diameter were growing on the inside. Fig. 6 was a similar structure 80 rods due east, with two rectangular closed chambers and an oval chamber having no communication with the others. A few human bones were found in G, but that does not determine it to be a place of sepulture.

In Montgomery County, on the bluffs of Prairie Fork, near its mouth, in the southeast quarter of section 9, township 47, range 6 west, there

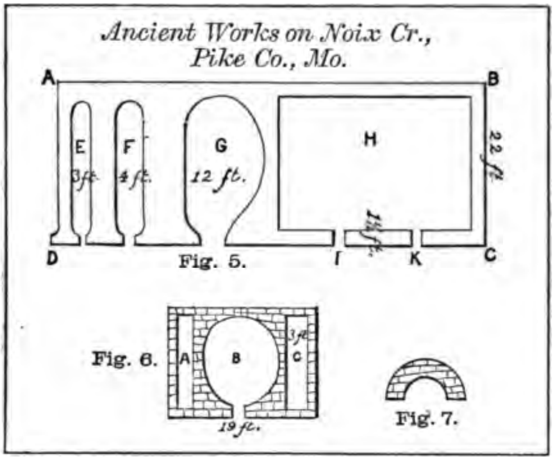


Fig. 5.
Fig. 6.
Fig. 7.

are remains of a similar walled burial place to that on Salt River, Pike County. The walled space is 10 feet square, and the walls were 2 feet high when I saw them in 1859. A few pieces of human bones were found.

MOUNDS OF CLAY COUNTY, MISSOURI.

Mr. E. P. West, of Kansas City, has enumerated about twenty-five mounds situated near the boundary line of Platte and Clay Counties, Missouri, located on the highest points of the Missouri Bluffs, most of them containing concealed rock vaults, generally directed north and south.

In the summer of 1878, in company with members of the Kansas City Academy of Science and the Kansas State Academy of Science, I spent a day in exploring certain of these mounds, which were found to be located on the tops of the higher bluffs, 250 feet above the Missouri bottoms, from which there is a fine view of the river above, below, and across. We noted seven mounds, as represented in the annexed sketch, Fig. 8.

Three of these (1, 2, and 3) form a nearly equilateral triangle, and are about 40 to 45 feet apart. Externally they seemed to be nicely rounded earth mounds, but digging into them each disclosed regularly-built walls about 3 feet high, exactly at right angles to each other, and inclosing a space 7 feet 9 inches square. The walls were constructed of thin even layers of limestone laid flat upon each other, and built up with a regular, perpendicular face, in fact much more true to the line than many so-called masons would place them. The crypts ppeared to have been built above ground, the stone having been orne up the hill not less than a quarter or perhaps a half mile, and rom a location at least 100 feet lower. The rock in its original beds

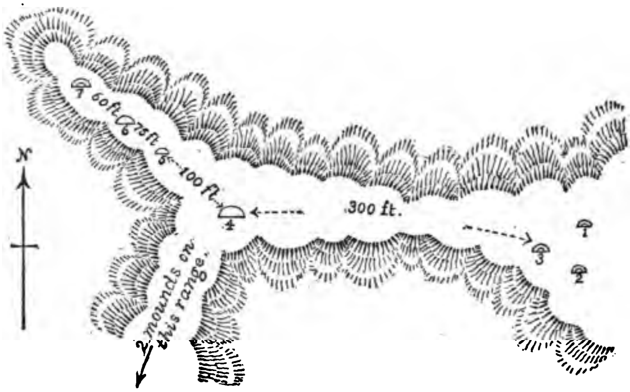


FIG. 8.

s not found above 150 feet from the base of the hill, the hill above eing covered with loess clays supporting a growth of large trees. Both of the mounds 1 and 3 contained human bones. In No. 3 several skulls and one good skeleton were found, together with fragments of others. With the exception of this one skeleton all seemed to have been buried in a sitting posture, or with knees bent, the hands close to or resting on the knees.

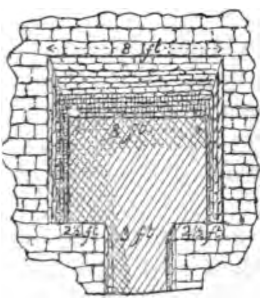


FIG. 9.

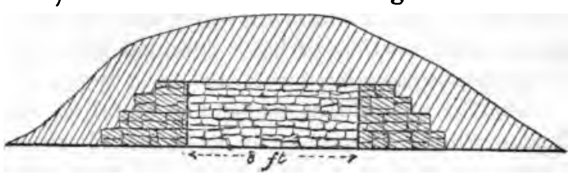


FIG. 10.

The bones, from long decay, could with difficulty be removed. This vault had an entrance 3 feet wide opposite the eastern side, as represented in Fig. 9.

The vault in mound No. 2 contained a large quantity of charcoal, with fragments of charred bones, and much of the clay was reddened by burning. This was evidently a cremation vault.

The vault of Mound No. 1 is similar in shape and contents to that of No. 2, but had been previously excavated and partly filled up. The vaults in each of the mounds 1, 2, and 3, had entrances or openings in the wall 3 feet wide, extending to the bottom of the wall. The skulls contained full sets of sound teeth worn off smoothly.

Mound No. 4, the largest, is about 5 feet high and 40 feet in diameter, and is built entirely of earth. Excavations revealed one black flint spear-point, a little charcoal, and a fragment of ochre. The stump of an oak 3 feet in diameter stood on the side of the mound, the trunk having been broken off apparently many years ago.

On Mound No. 5 there stood a red-oak stump, which showed 200 rings of growth.

Mound No. 6 was similar to 1 and 2, and contained a concealed vault 7 feet 9 inches square, but without an entrance. Eight human skulls were obtained from this vault, but no complete skeleton, although some pieces of bones were exhumed in a fair state of preservation. In digging into this vault a few flags of limestone were found a few inches below the surface. Eighteen inches below was another fragmentary roof of limestone, beneath which skulls and portions of vertebræ were disclosed. The flagstones were not regularly arranged nor quite close to each other, but only a few appeared to have been placed above the bones and then earth was heaped upon them. Some fragments of flagstones were also found in No. 2, perhaps the remains of a former roof.

The bones in the several mounds, or rather vaults, were generally soft, and as easily cut through with the spade as the earth itself; but some of them were firm. A few of the bones had been gnawed, probably by rodents, and do not furnish as some might say, evidences of cannibalism.

JOHNSON COUNTY MOUNDS.

These I have not seen. They are located on the bluffs of Blackwater River, and are described as being very similar to those of Clay County, but of larger dimensions, with vaults built of stone, and having lids of the same kind of material, the whole covered over with earth so as to present the contour of large rounded mounds. Some pottery and flint implements have been obtained from them.

Ancient mounds or graves are found on the tops of the bluffs of all the principal streams of the Missouri. I have noticed them on the Mississippi at various places; on the Missouri, from Saint Charles County to Holt County; on the Osage, the Gasconade, the Sac, and Shoal Creek, and along other smaller streams. They are generally built of earth, being often constructed of stones arranged in a circle, their tops inclined towards the center, with earth heaped on the outer side. When rocks abound and earth is not easily obtained, I have observed them constructed solely of stones piled in a rough circular mound on the hilltop.

Rock mounds have been observed on the summits of the highest bluffs, where the material had to be carried up 50 or 75 feet above the ledges.

It is but rarely that a single mound is found at a place, but there are generally several; three or four, or even a dozen, may be found arranged in a line, with their bases contiguous.

The earth mounds are generally circular, from 15 to 40 feet in diameter and from 3 to 6 feet high, and are often found with large trees growing upon them. When dug into, they disclose bones, and sometimes weapons or trinkets.

On Spencer's Creek, Ralls County, near Fisher's Cave, are mounds 7 feet high and 40 feet in diameter, with trees 2½ feet in diameter growing upon them. From this place, I was informed by Mr. Fisher, mounds can be traced in nearly a direct line to the mouth of Peno Creek, 6 miles off, none of them being over 300 yards apart, excepting across the bottom-lands, for they were all built on high ground. These are chiefly built of stones set on edge, sloping outward, and covered with about 2 feet of earth. Mr. F. also informed me that bones of men of large frame had been found there, buried with their feet to the east and head to the west, the grave roughly arched over with rock.

On the west side of Cedar Creek, on Missouri Bluffs, Boone County, are six mounds arranged nearly in a line and closely touching, three of them in a line N. 60° E., the others N. 65° E. They are from 20 to 30 feet in diameter, and from 4 to 7½ feet high, all circular. On them were growing sugar trees from 1 to 2½ feet in diameter.

A mile east, on the top of a bluff 206 feet high, is another mound, 8 feet high, bearing a white-oak tree 2½ feet in diameter.

Five miles east, also on the top of a high bluff, is another mound, 8 feet high, with a Spanish oak 2 feet in diameter growing upon it.

On the bluffs of Crows Fork, in Callaway County, are mounds with white-oak trees 2 feet in diameter growing upon them.

On Aux Vases Bluffs, in the same county, are many mounds yet unopened, and on Little Aux Vases Bluffs, near the Missouri bottoms, are mounds 3 to 4 feet high, bearing N. 65° W.; two of them with white-oak trees 3 feet in diameter growing upon them.

On Middle Aux Vases and Missouri Bluffs we observed a mound 6 feet high, with a black oak 2 feet in diameter growing upon it. One mile east and on Missouri Bluffs, are three mounds in a line, N. 65° E., built of stones and covered with earth. Sometimes, though rarely, flint arrow-heads have been found in these mounds, and at Saint Auberts, Osage County, a pipe and stone-beads were obtained.

But mounds are sometimes found on lower ground, though not on low bottoms. They are then often much larger than those above named. One at Ashburn's, near the Mississippi River, in the northeast part of Pike County, is 6 feet high, and 50 feet in diameter. Another, unopened in 1858, two miles west of Côte Sans Dessein, Callaway County, is represented in Fig. 11.

In Franklin County, on the "flat" west of Berger Station, Pacific Railroad, are two mounds, each about 400 by 200 feet and 12 feet high, formed of dark clay. The excavation indicated a curved line of stratification parallel to the surface, showing that the earth had been regularly laid up and packed; and pursuing the same line was a stratum of calcareous concretions resembling those sometimes found in the "bluff" formation. The railroad excavations cut through these mounds, and 6 feet below the surface of one, a pipe and earthen pot were found. The pipe was made of a soft stone of a light-red color, and the earthen vessel apparently had been partially baked. It was 1⅝ inches in diameter on the inside, ¼ inch thick, 2½ inches deep, and 2½ inches in greatest diameter, outside measurement. The bottom was ⅜ of an inch in thickness. Around the top were notches or tubercles ¼ inch long, and extending around the vessel was a punctured band having a hieroglyphic apppearance.

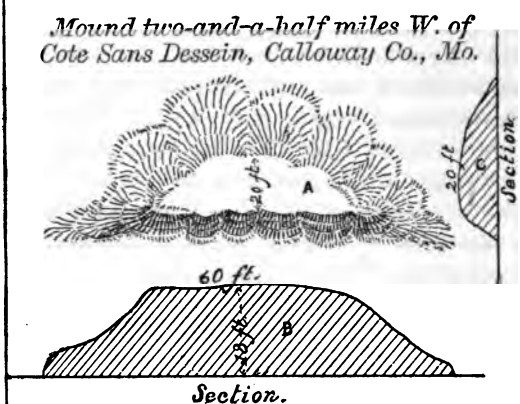


Fig. 11.

In Saline County, Missouri, four miles southwest of Miami, I visited, in 1872, an interesting locality showing ancient earthworks, walls, and ditches on high ground in a dense wood. The outline was somewhat of a circular shape, though quite irregular, caused by ravines breaking off near the outer rim, the walls being re-entrant at such places. The inclosed space is about 40 acres, around which there partly extended three ridges and two valleys, or rather depressions, where at one time existed deep ditches. We have first a ridge 8 feet wide and 3 feet high, then a ditch 6 feet wide and 3 feet deep, then a ridge 8 feet wide and 3 feet high, then a ditch 10 feet wide and 3 feet deep, and lastly a ridge 10 feet wide and 1½ feet high. The ridges were apparently entirely formed of earth dug from the ditches, and two of them extended entirely around the space. No rocks appeared near by or in the inclosure. Black-oak trees 3 to 5 feet in diameter were growing over the walls, ditches, and inner area, and the whole surface was covered with a dense and luxuriant growth of bushes, vines, and trees. The ridges had certainly been at one time much higher, and the ditches much deeper. This overlooked the well-known Petite Osage plains on the west, celebrated for their beauty and fertility.

IMPLEMENTS.

Flint arrow and spear points are found throughout Missouri. In the timbered districts they seem to be more abundant than elsewhere. They are generally made of flint found in the neighborhood. In Western Missouri we find them of black and of flesh-colored flint, the latter obtained from coal-measure rocks; in Central and Southern Missouri they are chiefly of white chert from the magnesian limestone series. In Madison County I have found them of porphyry. Hatchets are rarely found, but are almost invariably of syenite—a few have been found made of red hematite. Disks or shallow mortars are generally made of syenite.

On the Moreau, in Cole County, I found a number of flint implements of various sizes and workmanship, some quite regularly and carefully made, others from which but few chips had been taken, thus showing the various stages of workmanship. It is very probable that this was a place where the natives resorted to make their arrow-heads, as the proper flint is abundant in the neighborhood. At another place in Morgan County I also obtained flint implements in all stages of workmanship.

Some years ago Mr. B. B. Holland, of Bear Creek, Montgomery County, plowed up a deposit of flint implements all set on their edges and arranged in a small circle, and buried about a foot beneath the surface of the ground. They were about 2 inches long, with sharp edges and a heart-shaped point.

An article of the disk variety from Morgan County deserves mention. It is nearly cubical, being about 2 inches square, with corners and edges rounded off, and a shallow depression on one side, from which circumstance it is probable that it was used for pounding medicine. It is of hard syenite and smoothly polished.

Stone clubs are sometimes found. I have seen one from Henry County, of red quartzite, that would weigh 8 to 10 pounds.

Flint implements are often found on hill slopes where the bluff formation is deep, but I cannot certainly say that I have found them in the bluff, though some observers positively report having found them in an undisturbed position in the bluff.

HUMAN FOOT PRINTS.

Some of us have seen the sculptured foot-print in possession of Mr. Mepham, of Saint Louis. It is cut in magnesian limestone from De Soto, Jefferson County. There is another in possession of the Smithsonian Institution at Washington City, presented by Mr. John P. Jones, of Keytesville, Mo., who obtained it from Gasconade County.

Another and more remarkable one is noticed by H. R. Schoolcraft, in Travels in Missouri in 1821. In chapter viii he speaks of seeing in possession of Mr. Rappe, at Harmony, Ind., a stone with sculptured impressions of two human feet. This stone had been obtained from Saint Louis by Mr. Rappe and carried thence to Harmony. Schoolcraft thought the tracks represented those of a man in an erect position, with the left foot a little advanced and the heels drawn in. The distance between the heels measured 6¼ inches, and between the extremities of the toes 13½, the toes being spread and the foot flattened. From this circumstance

Mr. Schoolcraft thought they might belong to a race anterior to the present Indians, or to a race unacquainted with the method of tanning skins. The outlines of the muscles of the feet were represented with great accuracy, hence Mr. Schoolcraft seemed to incline to the belief that they were impressions. The length of each foot was 10¼ inches, the breadth across the toes at right angles to the former line 4 inches, and the greatest spread of toes 4½ inches, diminishing to 2½ inches at the heel. Directly in front of the prints and approaching within a few inches of the left foot is a well impressed and deep mark, having some resemblance to a scroll, whose greatest length is 2 feet 7 inches and greatest breadth 12½ inches. Mr. Schoolcraft addressed a letter to the Hon. Thomas H. Benton in regard to the foot-marks and received an answer, which I copy, as follows:

"WASHINGTON CITY, *April* 29, 1822.

"SIR: Yours of the 27th was received yesterday. The prints of the human feet which you mention I have seen hundreds of times. They were on the uncovered limestone rock in front of the town of Saint Louis. The prints were seen when the country was first settled, and had the same appearance then as now. No tradition can tell anything about them. They look as old as the rock. They have the same fine polish which the attrition of the sand and water have made upon the rest of the rock which is exposed to their action. I have examined them often with great attention. They are not handsome, but exquisitely natural, both in the form and position—spread-toed, and were of course anterior to the use of narrow shoes. I do not think them 'impressions,' but the work of hands, and refer their existence to the age of the mounds upon the American bottom and above the town of Saint Louis. My reasons for this opinion are: 1, the hardness of the rock; 2, the want of tracks leading to and from them; 3, the difficulty of supposing a change so instantaneous and apropos as must have taken place in the formation of the rock, if impressed when soft enough to receive such deep and distinct tracks. Opposed to this opinion are: 1, the exquisiteness of the workmanship; 2, the difficulty of working in such hard material without steel or iron.

"A block 6 or 8 feet long and 3 or 4 feet wide, containing the prints, was cut out by Mr. John Jones, in Saint Louis, and sold to Mr. Rappe, of Indiana, and under his orders removed to his establishment called Harmony, on the left bank of the Wabash.

"Very respectfully, yours,

"THOS. H. BENTON.

"H. R. SCHOOLCRAFT, Esq."

A letter from Prof. E. T. Cox, of Indiana, informs me that he remembers the stone very well; that it is still at New Harmony; it is 6 by 4 feet superficially and 8 inches thick, and rich in fossils of the Saint Louis group of the Sub-carboniferous. Professor Cox is of the opinion that the foot-prints were carved, and Dr. D. D. Owen was of the same opinion.

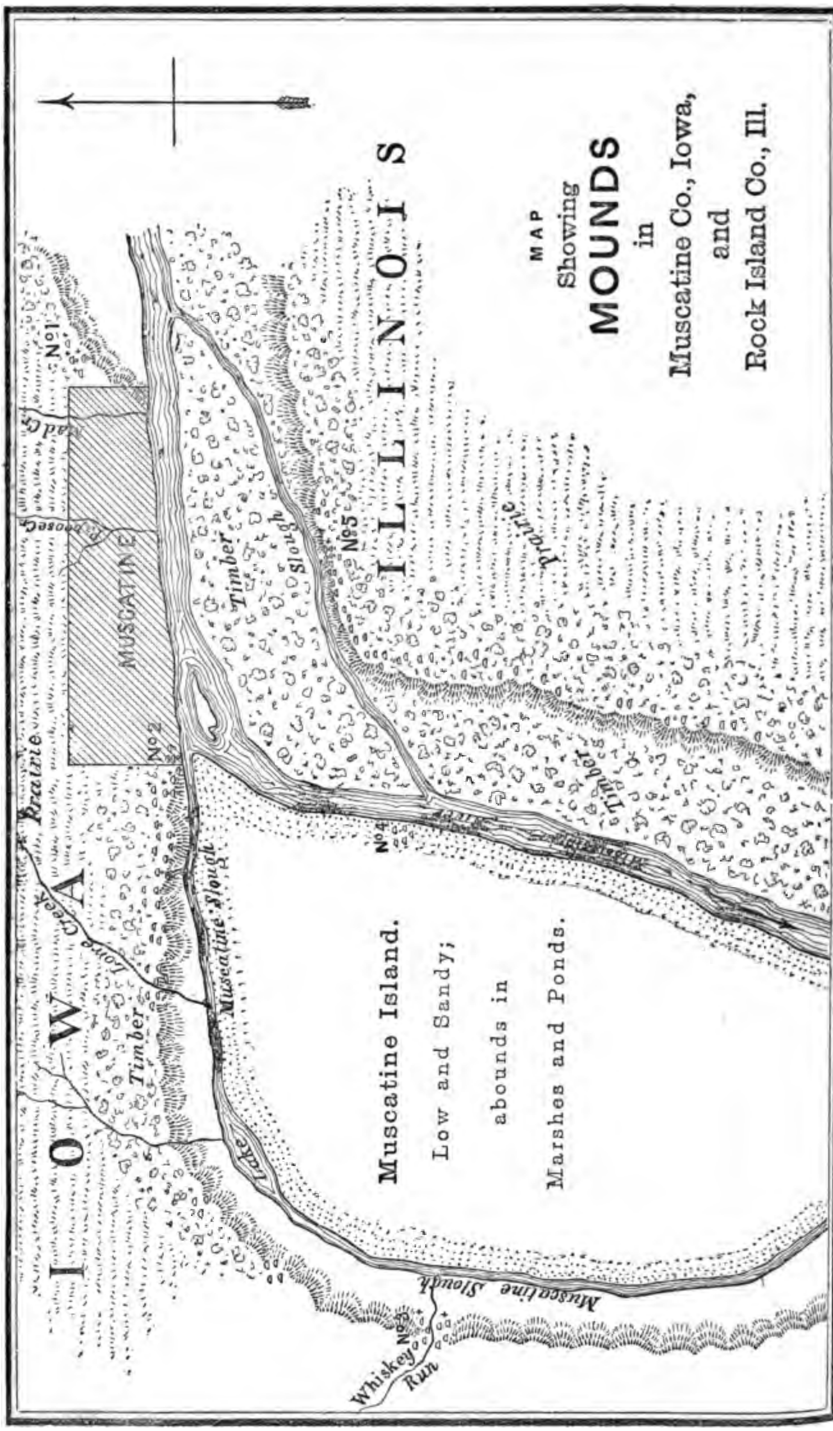
Mantell, in the first edition of his Wonders of Geology, vol. i, p. 66, copies the account and figure from Schoolcraft, but he falls into the erroneous opinion that they were actual impressions of feet.

MOUNDS IN MUSCATINE COUNTY, IOWA, AND ROCK ISLAND COUNTY, ILLINOIS.

BY THERON THOMPSON, *of Muscatine, Iowa.*

Along the bluffs of the Mississippi River, near Muscatine, Iowa, for a distance of 10 miles, is a series of mounds and earthworks. Opposite this point, in Illinois, is a similar series of mounds running down the river for a distance of 20 miles. The mounds on the Iowa side are all in Muscatine County; those opposite are in Rock Island County, Illinois.

The mounds are now surrounded by a growth of young timber, principally oak, which shows no evidence of an older growth before it. The localities were no doubt prairie lands before, or when the mounds were constructed. The land is all tillable, except the more precipitous bluffs. The river runs east and west at this place, and the mounds are generally upon the most commanding positions. There are, however, some remains of mounds upon a large island known as Muscatine Island. They have been very much reduced by cultivation. The river below Muscatine formerly followed the Iowa bluffs in the shape of an elbow for a distance of 20 miles; but at some remote period it cut a new channel across this elbow, making, as it were, an island, low, flat, and sandy, about 20 miles long by 8 miles wide. The old channel along the bluff remains deep and full of water. It is around these bluffs, which formerly bordered the river, and upon this island that the mounds are situated. Those on the island are on the river side overlooking the river, and were evidently built after the river changed to its present course, which may serve as a clue to the age of the mounds. In some places gullies have washed back into and past the mounds, and, upon Muscatine Island, the river has encroached so far as to frequently wash out pieces of pottery, &c. The mounds are in size from 3 feet to 30 feet in diameter and 6 inches to 5 feet in height. They are generally in groups and covered with timber. Nine out of ten are round, the others resembling remains of earthworks from 6 to 20 feet in length and 5 feet wide, placed end to end, with a gap of 5 feet between. There are quite a number of them in group No. 1. They are composed of the same material as the surrounding surface, which is clay and sand on the bluffs, and on the island sand and gravel. In exploring the mounds we sometimes find in the center some evidence of fire, bits of charcoal, &c. In none of those that I have thus far examined is there evidence of layers of other earth than that of which the mounds are composed. There is


MAP
Showing
MOUNDS
in
Muscatine Co., Iowa,
and
Rock Island Co., Ill.
IOWA
ILLINOIS
MUSCATINE
Muscatine Island.
Low and Sandy;
abounds in
Marshes and Ponds.
No1
No2
No3
No4
No5
Timber
Timber
Timber
Prairie
Prairie
Slough
Muscatine Slough
Muscatine Slough
Lake
Whiskey Run

no evidence of ditches or excavations of any kind near the mounds whence the earth might have been obtained, but as it is similar to that in the vicinity it must have been scraped up from the surface near the mounds, but so taken as to leave no traces at this late day of any depression or hollow.

In group No. 1 nothing was found. I opened ten mounds in a group of twenty; went from 2 to 3 feet below the surrounding surface; opened both by trench and by leveling the entire mound. I found, once in a while, a bit of charcoal or a fragment of common river mussel very much decayed. In No. 2 I found one skeleton almost decayed, and some small pieces of broken pottery. The body was evidently buried in a reclining position, as we found by following with our tools the remains of bones through the clay. Near No. 3 there have been several mounds opened. I was not able to be present and do not know the position of the mounds, &c., only that they are situated on the bluffs overlooking what is known as "Whiskey Hollow." A creek runs through this hollow into Muscatine Slough, which surrounds the island of the same name. Only one of the mounds opened here yielded anything—a skeleton so much decayed that it was impossible to tell position, &c., and underneath the head of the skeleton a stone ax, very much in shape like others discovered in this locality. But we had never before heard of an ax being found in a mound in this region. The ax weighed 2½ pounds.

No. 4, on the island, is so leveled that the shape of the mounds cannot be ascertained. Pottery abounds all over the surface, also very small triangular arrow-points. The ground is also strewn with flint chippings, and in no instance are the points found so large nor of the same shape as the specimens from higher ground. The points are all alike and have no variation of design. This, with the softness and rudeness of their pottery and their low position on the island, leads one to believe that they were of a more recent period, and their constructors somewhat degenerated from the Mound Builder of the overlooking bluffs.

No. 5 is in Illinois. In this group, so far, only one mound yielded anything. The mound in question is one of a group of five, all large mounds, upon a prominent bluff, situated at the extreme upper end of the series. They are not arranged with any noticeable regard to position. We went to work on the smallest (two had been carelessly opened by some unknown party before). We deviated from the usual manner of opening by a trench (as in that way we would have missed the contents), and proceeded to reduce the mound to a level with the surrounding surface. At a distance of 2½ feet from the center, a little below the natural level, we discovered the remains of three bodies. With great care, we were enabled to see their position, &c., and to obtain parts of the skull and of the large bones of the legs and arms. By the head of the center one was deposited an earthen pot holding about two quarts, which had been crushed by the weight of earth. The pot was empty, but immediately surrounding it we found some half dozen arrow-points of curious construction, also a slate pipe. Three of the arrow-points are different in shape or style from any in my collection of about a thousand. This is the first instance in this region of flint implements being found with remains in mounds.

The few fragments that occurred in No. 2 are in my possession; the ax found in No. 3 is in the possession of Mr. Leverch, of this city (Muscatine). The pipe, arrow-points, and skull found in No. 5 are in the Academy of Science in this city. Nearly all the articles of value found in this region are picked up on the surface, or found in excavating for buildings, tilling, &c. Young timber is growing on nearly all the mounds. The oldest I have seen shows one hundred and twenty years of annual growth. The mounds upon Muscatine Island have been washed out within the last seven years by tillage and the washing of the river. The dead are found in mounds. No plan whatever seems to have been followed in their burial. They are scattered among the mounds as if by chance, sometimes found in one large mound, while the next will be destitute of all traces of burial, while a little mound off to one side, apparently but half completed, will contain remains. I have made the utmost effort to discover a law in the shape of the mound and its situation in reference to other mounds, whether overlooking the valleys or situated back from the edge, whether surrounded or on the outskirts, but am as far from any decision in the matter as in the beginning. I do not believe that they were all used for burial places; since the dead must have been buried in the midst of the village. All those of which I have knowledge were lying stretched out. In No. 5 the body was lying on the right side with the face to the west. Although, generally, it is almost impossible to determine the position of real Mound-builders' remains—as they are generally so disintegrated—I have frequently found the remains of the modern Indian in mounds near the surface buried in a sitting position. In Nos. 2 and 5 the bodies had the head to the north. In No. 5 they were lying on the right side with the face to the west. I think they are always found with the head to the north in this locality. They were simply buried in the earth, although in No. 2 we thought we discovered an arch-like crust over the remains, as if some pasty substance had been spread above the body and allowed to dry. They are generally on a level with or a little below the present natural surface.

Nests or pockets of arrow-points, &c., are said to have been found in Illinois opposite the city of Muscatine. I have been told by farmers who first tilled the land opposite that "they sometimes plowed up from a peck to a half bushel of arrow-points, &c." Sometimes these would be nearly all perfect, at other times but partly completed. This occurred in early times when the country was new. They say they have never plowed up stone implements, such as axes, &c., under the same circumstances. The refuse here consists of thousands of flint chippings and flakes, also broken triangular arrow-points, all of white flint. They are scattered over a space of about five acres; a great deal of pottery also is lying around which is fast being dissolved by the action of rain, &c. There is no locality near here where this flint could be obtained in such quantities as must have been worked up at this point.

ANTIQUITIES OF ROCK ISLAND COUNTY, ILLINOIS.

By ADOLPH TOELLNER, *of Moline, Ill.*

Rock Island County is especially rich in aboriginal remains. In the vicinity of Moline I have discovered about 80 mounds, single and in groups. I have also found shell-heaps several miles in length, three pits dug in the clay, workshops for preparing spear and arrow heads, old cemeteries, together with stone and copper implements in abundance. The mounds are found generally on the banks of rivers and their tributaries, or on islands, seldom in the interior. On Campbell Island,

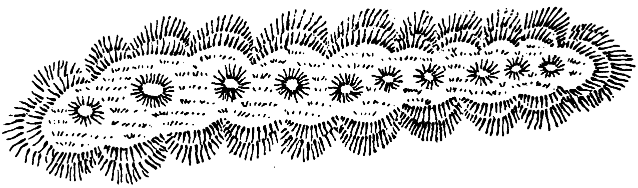


FIG. 1.

Hampton Township, is a cemetery containing 200 or 300 graves. I have seen 10 mounds in Hampton, on Dr. Ottman's farm (Fig. 1); 2 on Tohead Island (Fig. 2); 4 at Valley City, in Scott County; 7 on Hubbard's farm, six miles east of Moline; 28 at Deere's farm, one mile east of Moline, as well as many shell-heaps (Figure 4); 40 near Black Hawk Tower, Milan; 1 large one five miles east of Moline, on Deere's land;

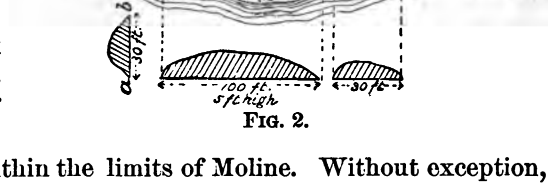


FIG. 2.

4 on Davenport's land, within the limits of Moline. Without exception, the mounds occupy the most beautiful prospects in the country. The graves occur indiscriminately on high and low ground.

One large mound, five miles east of Moline, on a bluff, was opened, and disclosed the following structure: (1) 3 feet of soil; (2) 22 inches of wood-ashes, mingled here and there with fragments of burnt bones; (3) 12 to 14 inches of unburnt bones and charcoal. This stratum has a very unctuous appearance. The skeletons of four Indians were found 2 feet below the top of the mound (Fig. 3).

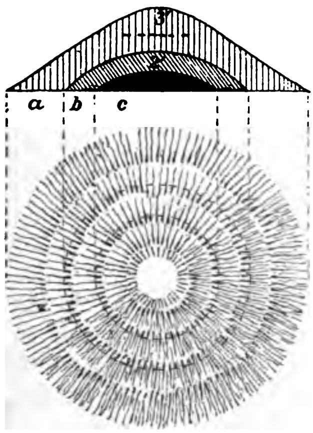


FIG. 3.

In the vicinity, blocks of limestone or sandstone furnished the material for the sculptured slabs found in the mound.

About one-half of the mounds with which I am acquainted have been explored. I myself have found in thirty mounds two entire skeletons, five more or less decayed, fragments of bones, a part of a broken pot, spear-heads, lead ore, and shells.

In seven mounds I found all the bodies buried with the knees drawn up to the chin, and laid on their right side, with the head to the west and face to the south, excepting one that had the face directed to the north. The bodies were two feet below the surface. In two cases the lower jaws were lying near the feet, while another had the bones of his feet between his teeth.

Shell-heaps near the banks of the Mississippi and the Rock River are

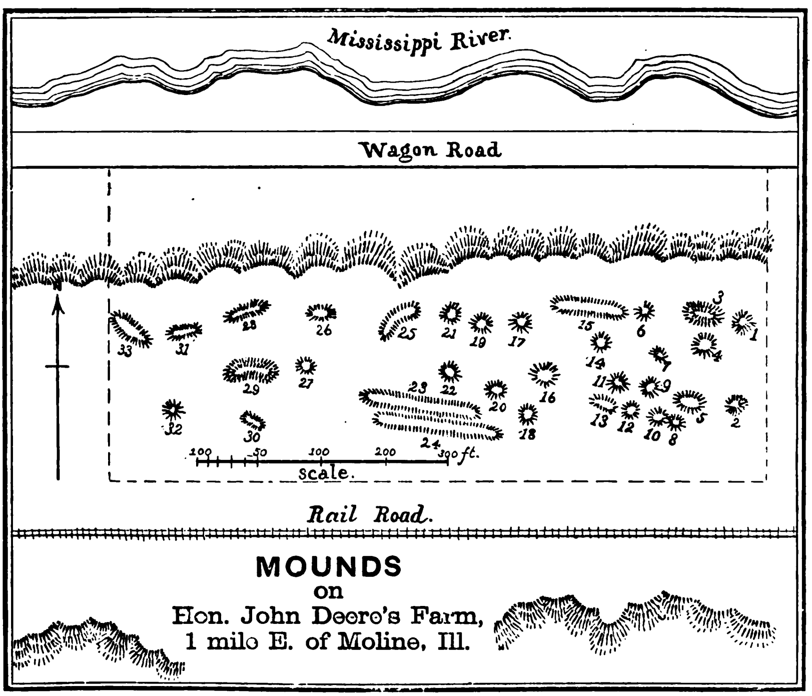


FIG. 4.

very plentiful, and extend for miles without interruption. They are commonly located in the neighborhood of mounds. They are composed of recent shells and contain few implements.

Mounds near Black Hawk Tower, at Milan, are scattered along for the distance of a mile. They are about 3 feet high, from 30 to 60 feet in diameter, and, for the most part, are undisturbed. They are all burial mounds, and follow no particular arrangement, lying in rows on a bluff 130 feet above Rock River. Black Hawk Tower is an elevated spot near the falls of Rock River, on the southeast corner of Rock Island Bluffs. The view from this point extends 8 or 10 miles up Rock River, and 6 or 8 miles northward to the Mississippi. Black Hawk is said to have used this site in the war as a lookout for his enemies.

The following is a list of mounds on the land of the Hon. John Deere, one mile east of Moline (Fig. 4):

No.	Size.	Shape.	Height.		Remarks.
	Feet.		*Feet.*	*In.*	
1	25	Circular	3		
2	27	do	2	6	
3	60 x 18	Oblong	1	6	
4	36	Circular	3		Dug; found a stone ornament.
5	36 x 15	Oblong	1	3	
6	30	Circular	4		Dug; found nothing.
7	21	do	1	3	
8	21	do	1	3	
9	24	do	1	6	
10	12	do	1		
11	21	do	1	6	
12	24	do	2		
13	36 x 18	Oblong	2	6	
14	30	Circular	2	6	Dug; found a few decayed bones.
15	147 x 15	Rectangular	1	6	
16	30	Circular	2		
17	30	do	2		Dug; found bones, lead ore, arrow-head, and stone image.
18	30	do	2	6	Dug; found bones and stone images.
19	30	do	2		
20	24	do	1	6	
21	30	do	2	6	
22	24	do	2		
23	186 x 15	Rectangular	1	6	
24	186 x 15	do	1	6	
25	69 x 15	do	1	6	
26	40 x 16	Oblong	1	6	
27	27	Circular	2	6	Explored; no remains.
28	69 x 15	Rectangular	1	6	Found skeleton.
29	60 x 18	do	1	6	
30	40 x 15	Oblong	1	6	
31	36 x 24	do	3		Skeleton and pottery found.
32	24	Circular	1		Found a few bones.
33	60 x 15	Rectangular	1	6	

P. S.—The mounds are made of limestone slabs from the river shore. In Nos. 18, 21, and 23 the rocks were 9 inches below the surface. The limestone belongs to the Hamilton Group of the Devonian age.

STONE CISTS NEAR HIGHLAND, MADISON COUNTY, ILLINOIS.

By ARTHUR OEHLER, *of Highland, Ill.*

I beg leave briefly to call attention to some lately-discovered Indian graves in the southeastern part of Madison County, Illinois. They are situated in the southeast corner of the southwest quarter of section 10, township 3 north, range 5 west of the third principal meridian, on the present property of Mr. John F. Rodt, about 4 miles southeast of the town of Highland.

There are two of them, of the same shape and size, lying in exactly the same direction. The first discovered lies about 400 feet south of the northern and about 500 feet east of the western boundary of the above-described parcel of land. Sugar Creek, which at that point makes a bend westward toward the graves, is due east about 400 feet distant, while to the south it is farther away. About two and a half years ago the proprietor plowed up several limestone rocks and fragments of slabs of different sizes, mostly small ones. This excited his curiosity, and as the same thing happened every time he plowed, last spring he got a hoe and shovel and went to investigating; but, having no idea of what was coming, did it in such a manner as to entirely unfit the contents for any further careful examination. He then called the attention of my friend, Mr. A. F. Bandelier, to it, who, as near as could be learned from the circumstances, reports: "That the grave contained the complete skeletons of two persons, one superposed upon the other."

Mr. B. then exacted from the proprietor the promise that if any more graves were found he should immediately be notified, they, meanwhile, not being disturbed. About May 20, Mr. Bandelier received word that another had been discovered and awaited his further pleasure. We then went there and carefully investigated the place, an account of which is given below. It is situated about 350 feet due west of No. 1, on the top of a hill that slopes southward toward Sugar Creek, which is about one-fourth of a mile due south. It has the shape of a rectangle, 2 feet 3 inches by 3 feet, the longer side lying north-northeast by south-southwest. It is made of limestone slabs, of which two are at the bottom, two on each longer side, two on top as a lid, and one on each shorter side. These slabs show no signs of incisions or workmanship whatever, but are simply limestone slabs. The grave is about a foot below the surface. There were five skulls and the skeletons of five adult persons. There was no trace of charring or fire about the remains, which had evidently been placed in the grave after the flesh had by some process or other become decomposed. The skeletons show that the people were of rather small stature. The skulls lay in a semi-circle along the southeastern longer side. All the other bones lay transversely to the skulls, and were very closely packed. Some of them were so far decayed as to crumble while being handled. There were no arms or ornaments found in the mound except a little burnt, partially glazed, clay object, having the shape of a cylinder, about 2 inches long and ½ inch in diameter, one small flint chip, and several fragments of limestone slabs. Three feet to the east of the grave is an oak stump, measuring 2 feet in diameter, from which several roots, as thick as a finger, penetrated the fissures of the slabs and worked their way between the bones. One of the skulls was examined by Dr. George J. Engelmann, of Saint Louis, Mo. From this he judges that they are of great age, and that they appear as normal Indian skulls, with the exception that the superciliary ridges show great development. A rather striking circumstance is that on all the jaw bones seen, the two front lower teeth are missing, as if artificially knocked out. On the skull examined as above, the left parietal appears to show a rather prominent protuberance, while on the right is a corresponding flattening. Whether this is artificial or natural, cannot for the present be decided. As far as we know, this mode of burial is more or less different from those of other Indian tribes at present known. A great many flint chips and arrowheads of different shapes and sizes are found in the neighborhood of these graves, also a short distance southward along the creek, which fact, most probably, indicates a battle-ground, possibly a settlement.

MOUNDS IN PIKE COUNTY, ILLINOIS.

By Brainerd Mitchell, *of Pearl Depot, Ill.*

The mounds are generally on bluffs along the west side of the Illinois River, with here and there one in the valleys. There are hundreds of them between the mouth of the river and Pearl Depot, the bluffs being lined with them, separated in some instances only a few feet apart. Those back from the bluffs are isolated, while those along the edges follow the breaks and stand on the highest ground. They are round or oval, and vary from 6 feet in diameter to 20 or 30, and are from 2 to 8 feet high. The isolated mounds back from the river are composed of a light-colored clay, almost white, directly over the remains; on the top of this is a stratum of yellow clay and soil. Those along the bluff have first a layer of lime rock, then a layer of clay and soil; the rocks are arranged in a row set on edge around the body, and a covering of rocks placed over this. Those explored furnish stone implements, shell beads, pottery, bone needles, and copper implements.

The dead found in graves were evidently stretched out, while those interred in mounds were buried doubled up or in a sitting posture. In one cemetery the dead were found inclosed in rocks very carefully set on edge and covered over. In one spot thirteen graves were arranged in the form of a crescent on a slope facing south. The site has been plowed over for fifteen or twenty years, and washed down so that the plow turned up the rocks. In some places fire seems to have been as we find only charred pieces of bones and burnt rocks with fragments of pottery.

One mound explored contained the remains of 25 or 30 persons. Most of the bones were charred or burnt to ashes. One had been buried in a sitting posture, the rest lay indiscriminately. They had been inclosed by placing rocks on edge around them and two in the middle for the flat rocks that formed the cover to rest upon. Pieces of pottery were found on the top of the rocks that formed the cover, which had fallen and rested on the bones.

MOUNDS IN THE SPOON RIVER VALLEY, ILLINOIS.

By W. H. ADAMS, *of Elmore, Ill.*

The most important group of mounds is situated on the northeast quarter of the southwest quarter of section 9, township 11 north of the base line, range 5 east of the fourth principal meridian. They are nine in number, commencing at a point 126 feet west of the southeast corner of the first-mentioned tract of land; thence following the brow of the ridge in a northeast course to a point on the east side of said 40-acre tract, 564 feet north of the southeast corner. The ridge is composed of the usual yellow clay of which the bluffs of Spoon River are composed. For convenience we have numbered the mounds, commencing at the south. The east and west line crosses the north side of No. 1. The distances here given are from center to center. From No. 1 to No. 2 is 50 feet, from No. 2 to No. 3 is 46 feet, from No. 3 to No. 4 is 67 feet, from No. 4 to No. 5 is 67 feet, from No. 5 to No. 6 is 225 feet, from No. 6 to No. 7 is 72 feet; No. 7 is northwest of No. 6; from No. 6 to No. 8 is 67 feet, from No. 8 to No. 9 is 55 feet. Opened No. 3 at a depth of 2 feet 6 inches; found a flat stone in an upright position; a few inches below this found a thin layer of ashes with small fragments of charcoal. At a depth of 5 feet 4 inches found human bones, very much decayed, the articulations all wasted away. Found one skull to the east and two to the south; all the bones occupied a space less than 3 feet in diameter. The bones were very fragile; the teeth in a good state of preservation; the grinding surface very smooth and even. The base diameter of this mound is 55 feet; the apparent height above the surrounding surface 3 feet. Opened No. 4 with about the same result as No. 3, except the flat stone. In company with W. Lewis opened No. 7; found large quantities of ashes at a depth of 3½ feet and one or two small fragments of charcoal. At a depth of 5 feet 3 inches found human bones, which fell to pieces on exposure to the air. No. 6 was opened by S. Swenny, George Lappan, and George Miller. At a depth of 3 feet they found a layer of flat stones nicely fitted together, having a diameter of 6 feet; they were unable to determine whether any one had been buried in this mound.

This group of mounds, distant from Spoon River about one-third of a mile, is on land owned by Samuel S. Seward. On the northwest quarter of the northwest quarter section 14, township 11 north, range 4 east of fourth principal meridian, is a tumulus, which we shall designate as the Sam. Parker Mound. This mound is 25 rods south of the north line and 15 rods east of the west lines of said tract and 80 rods north of Spoon River, which is 125 feet wide at this place. It has a base diameter of 90 feet, and an apparent height of three feet above the surrounding surface. I opened this mound in company with W. J. Morris. At the surface we found a few small fragments of pottery; at a depth of 2 feet some ashes; 1 foot below this a layer of ashes 1½ inches thick; below the ashes a compact layer of clay; below the layer of clay a thin layer of what I supposed to be red ochre; below this was a layer of dark yellow clay about 12 inches thick; below the clay a layer of the red material about to 1 inch in thickness and 18 or 20 inches in diameter. In this red material we found two spear points, one 7 inches in length and one 5 inches, very thin, the larger notched at the butt, the smaller not notched; five arrow-points of dark flint or hornstone notched at the base or heel, very smooth, as if polished, 3½ inches in length; twenty-two arrow-points of the leaf pattern, of white jasper or chert, from 2¾ to 3¾ inches in length; one copper needle or awl 3 inches in length, rounded at the point, the remainder of the blade being what the harness-makers term diamond bladed; the spear and light-colored points have every appearance of being new. Mr. Julius Johnson, who formerly owned the land on which this mound is situated, found a gorget or breast-plate (now the property of the writer) 6 inches in length, 2 inches in width in the middle, and 1¼ inches wide at each end, with two small holes through it about 2 inches from each end, and ⅜ inch in thickness, and composed of a material resembling greenstone. The pottery found is of superior quality. Near the south line of section 11, township and range aforesaid, is a low mound on land owned by a Mr. Mackey. This we thoroughly examined to the depth of the original surface soil, and found a small fragment of a stone implement, highly polished on one side, a small piece of charcoal, and some ashes. On section 10 of this township, at the foot of a high bluff facing the south, occurs what is designated by archæologists as a kitchen-midden. On the south side of the tumulus is a bayou; this was the former channel of a creek, now some 40 rods to the east. In the material composing this tumulus we found arrow-points; one or two skinning-stones; fragments of pottery, with some attempts at ornamentation. One piece had the appearance of having been marked below the rim when in a plastic state with an implement similar to the point of a three-cornered file; the tool with which the marking was done was moved in an upward direction. No evidence of glazing appeared on any of the fragments. One small implement of jasper, about 2¼ inches in length by ¾ inch in thickness, was discovered, supposed to be a drill, and a disk of syenite 1¾ inches in diameter by about 1 inch in thickness, similar to No. 209 described by C. C. Abbott in the Stone Age in New Jersey. We found two or three fragments of the antlers of a deer; also the bones of a deer. These were all split except a small part next to and including the articulation; and a large quantity of fresh-water unios, now common to Spoon River. These were very fragile and offered but little resistance to the spade. In the center of the find was a layer of ashes 2 or more inches in thickness, at a depth of 15 inches from the top of the mound; below the ashes there was a layer of brick-dust 2 inches in thickness; below this the soil had no appearance of having been disturbed. Only part of these tumuli were examined. I am somewhat inclined to believe that it would be profitable to make a more extensive investigation. Mrs. A. J. Reed, who has resided near this place for the past twenty-four years, says her children have found many Indian relics in this immediate vicinity. The most extensive kitchen-middens that we have met with are on the land owned by W. J. Ghross, to wit, the southeast quarter of the southwest quarter section 6, township 11 north, range 5 east of the fourth principal meridian, and a small strip of land between this and Walnut Creek on the east. The kitchen refuse is scattered over three or four acres of land at various depths, from a few inches to 3 feet. The creek washes the land on the east side, with Spoon River 40 rods distant on the south. In these heaps are great quantities of shells, now common to the creek and river, of one of which I have never seen a living specimen. The shells of helix are very plentiful; one variety marked with bright red or scarlet spots. This was then the most abundant species, but is now rather rare. Besides these are found antlers and bones of deer, shields—or rather fragments of them—of the turtle, bones of small animals, &c., and of implements, stone axes, hammers, whetstones, pestles, skinning-knives of flint, fragments of what Mr. Abbott denominates as gorgets, arrow-points, spear-points, &c. The writer found a carnelian pebble in one of those heaps; also a peculiar implement, composed of an unknown material which has some characteristics of a low form of limestone.

MOUNDS IN FRANKLIN COUNTY, INDIANA.

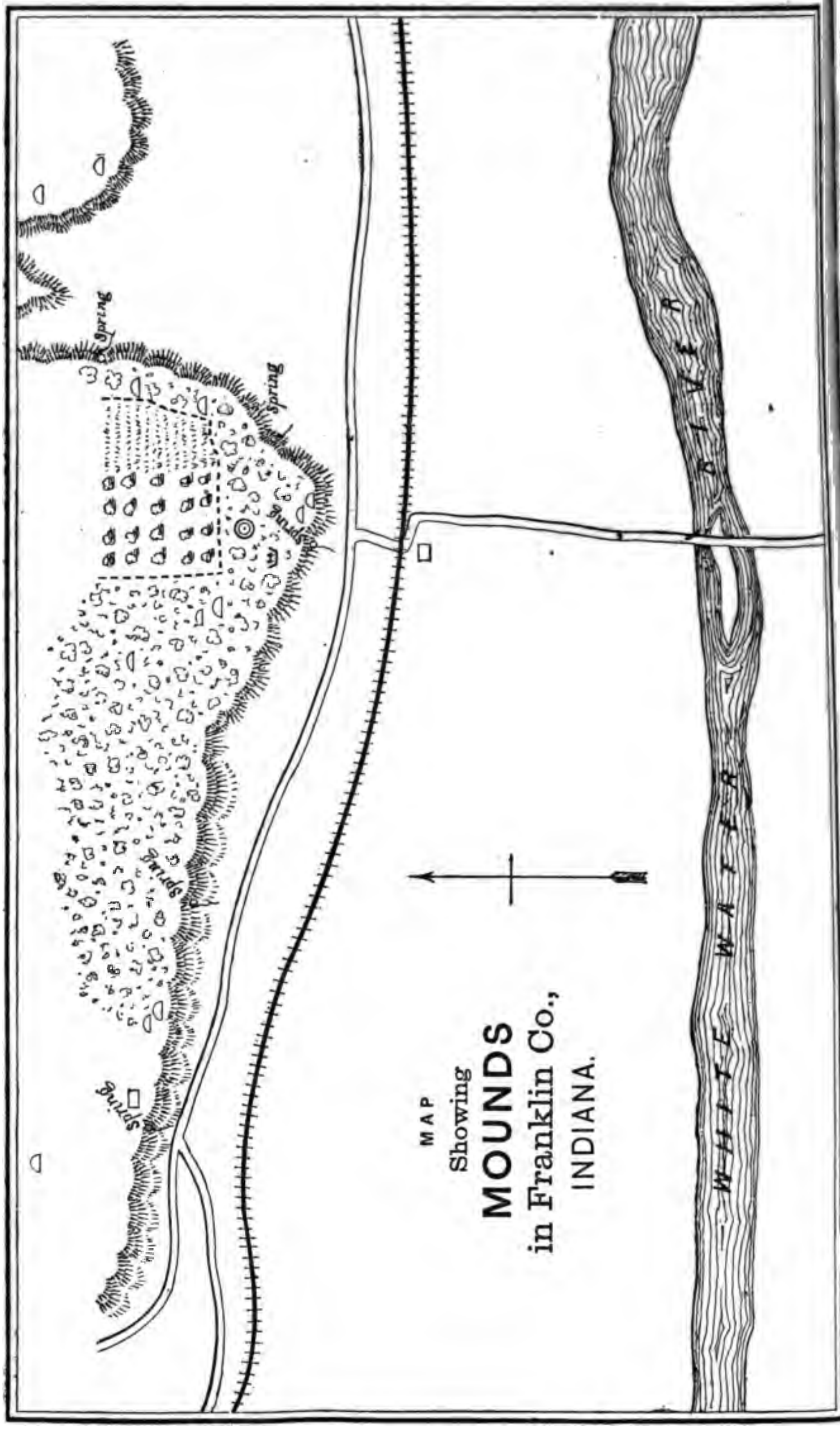
By Edgar R. Quick, *of Brookville, Ind.*

In Franklin County, Indiana, are remains of ancient mounds and earthworks, and other indications of former occupation of this locality, consisting of stone implements of various kinds. The most noticeable group of mounds is on the land of H. Bruns, one mile and a half south of Brookville. Other mounds are scattered singly or in pairs all over the county, wherever a suitable place seems to offer.

The only earthwork (enclosure) which I know of in the county is situated three miles north of Brookville, on a hill nearly 350 feet high, which juts out against the west bank of the east fork of the White Water River, immediately beside the bridge at that place.

The mounds of this county are nearly all situated on prominent points or headlands overlooking the valley below. The site does not seem to have been selected with reference to convenience of water or ease of access. The land in most cases is in the same condition as found by the present inhabitants, except that a part is used as pasture and is cleared to some extent. I know of but one case of the grouping of mounds which has been before referred to. This group is situated on a terrace about one mile and a half south of Brookville. This terrace is about 90 feet above the river, and 250 feet below the tops of the hills and level of the adjacent country. It contains about 250 acres of land, most of which is cleared and under cultivation. The part which is occupied by mounds is at present covered by a heavy growth of sugar trees (*Acer saccharinum*). The mounds are all low, none being more than 4 feet high by 40 feet across. Approaching along the brow of the terrace from the west, we first come to a pair of low mounds almost on the edge of the terrace. They are situated so near each other that their bases almost blend together, one a little smaller than the other. Going on directly east about 200 yards, we find another pair about 50 yards from the edge of the terrace. These two are almost exactly like the first in relative size and position. About 40 yards north of this pair is a small heap of earth, which I am certain is of artificial origin, but being so small is hardly worthy of being called a mound. Southeast of the last pair, on the edge of the terrace, is another pair similar in every respect to the others.

Near these, and nearly north of them, is a curious circle of earth. The center is slightly below the surrounding level, while the edge is as much above. The circumference is about the same as that of the mounds. The outline of the terrace here turns to the north, and following it we find three more mounds situated singly, at intervals of 200 or 300 yards, on the brow of the terrace. Northwest of the first pair about 500 yards, in a field, is another, almost obliterated by plowing. The mounds are composed of a mixture of sandy clay and loam taken from the surrounding surface. In the single one which I have examined the material is heaped together without respect to arrangement. Slight depressions about the mounds show that the material was obtained from the surrounding surface. One mound has been explored (by digging a pit in the center) by the writer and others; all appear to have been opened, but by whom is unknown. Nothing was found but charcoal and a few charred bones. No account has ever been published, with the exception of the one mentioned before. No trees grow upon them at present.


MAP
Showing
MOUNDS
in Franklin Co.,
INDIANA.
Spring
Spring
Spring
Spring
WHITE WATER RIVER

earthwork.—In describing this work I can do no better than to ɔt from Dr. Rufus Haymond's Report of Franklin County, in the gical Report of Indiana, by E. T. Cox, 1869:

ıree miles north of Brookville, and immediately west of the east f White Water River, upon the top of a hill nearly 350 feet high, is a semicircular wall of earth 300 yards in length. It is built a narrow ridge, which is formed by two deep ravines, one on the the other on the north, which, with the river on the east, isolate at on top of the hill (containing 15 or 20 acres) from the level ry to the west, and was built probably to protect the inhabitants ıny enemy approaching from that direction. The "wall of earth" is points low, being in its present condition not more than 3 feet high, ıe ditch from which the material was taken is 3 feet deep, and being ıtside the embankment makes it more of an obstacle to overcome defended from the inside. The stump of a tree which had been ı the embankment showed about two hundred rings, and there ɔthers much larger standing near it. The hill toward the top is so that one can scarcely climb up without assisting himself by hold- ı to shrubs or some support, making this part naturally fortified. nclosure is undoubtedly a work of defense, the building material all taken from the outside."

dead of prehistoric people in this locality are nearly all found in ıall mounds which occupy every prominent point along the valley. ɔnerally find in exploring a mound, near the original surface of ırth, from one to several skeletons very much decayed and not ɔd by fire. Above and around them are human bones charred and ɔned, also charcoal, ashes, &c., and in one case the earth was ɔd, so great had been the heat. The bodies were generally stretched ithout reference to points of compass.

rries.—In regard to aboriginal quarries, quite a mistake has crept ur literature on this subject. A great many pieces of worked stone striped slate are found in this State and in Ohio. Archæologists say obtained far to the north, in the lake region. This was not *always* se, if it *ever* was. I have seen in a field where a great many un- ɔd implements were found, and which to all appearances had been rkshop," bowlders of this same striped slate, from which large nall pieces had been flaked. Small caches of "flint disks" have ound, one cache containing twelve, another eighty or ninety disks leaf shape.

eral localities in this county have the appearance of having been hops, the surface being covered all over with flint chips and spalls rite or greenstone and slate; also unfinished pestles, axes, &c.

MOUNDS AND EARTHWORKS OF RUSH COUNTY, INDIANA.

By F. JACKMAN.

The remains of the early inhabitants of this and its adjoining counties are quite numerous, and in most respects similar, though it is evident either that different races dwelt here at about the same time or that they had different modes of burial or worship, for it is my opinion that these mounds were places of burial made in accordance with their religious rites. The only traces of these lost races in this section are small circular mounds, from 25 to 40 feet in diameter, and 7 to 10 feet in height, except one set of earthworks, which seem to have been some kind of fortification or works of defense. They are located about two miles south of Rushville, near the Rushville and Moscow pike, on what is well known as the Hilligos farm. The surrounding country is rough and broken for miles around, but this is the highest point. A small stream fed by a spring runs on the south side of them, and Flat Rock River is half a mile to the east. The works

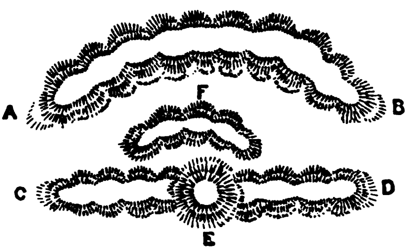


FIG. 1.

are in a woods-pasture, but the adjacent land is mostly tillable. No geological changes have taken place since their erection. They consist, first, of a curved elevation (Figure 1, A, B) 300 yards long, about 5 feet high at one end and 25 feet at the other, making the top perfectly level with the horizon, the site sloping to the south. It is perfectly level, smooth and rounded on top, and 30 feet wide. Second, a straight bank behind the one just mentioned 200 yards long, 5 feet high at one end, and 25 feet at the other. In the middle of this bank is a circular mound 80 feet in diameter and 5 feet high (above the top of the bank). Extending from the mound, between the two grades, is a semicircular plain on a level with the base of the straight ridge, and extending towards the larger semicircle 50 yards. The intermediate space is a gully 60 yards wide, sloping to the south. The south half of the larger semicircle I think to be a natural elevation smoothed down. The others are undoubtedly artificial. The spaces between A and C and B and D are open, but would be very easily guarded. The country immediately south and west is very hilly and broken for about two miles. The works are mostly covered with large ash, poplar, and beech trees, and have never been explored.

Most of the mounds in the immediate vicinity of Milroy I have explored. One group, which I have not opened, is on the farm of Thomas Meek, four miles southeast of Milroy. It consists of one large mound 30 feet in diameter, 6 feet high, surrounded by five smaller ones 10 feet across and 3 feet high. The country is level, covered with trees, and exhibits no geological change.

Another is in a woods-pasture on the farm of Reuben Farlow, 3½ miles southwest of Milroy. It is 40 feet in diameter and 10 feet high; not explored.

A third one on the farm of Finley Carter, 3 miles west of Milroy, in a woods ½ mile south of his house. It is 25 feet across, 5 feet high; not opened.

A fourth on the farm of John Overleese, Sr., 1½ miles south of Milroy, on the Greensburg road, 50 yards north of a grave-yard on the same farm. It is in a cultivated field and nearly plowed down. Several arrow points and stone hatchets have been found near it; not opened.

Several others are scattered over the country, but they are so nearly alike that I will not take the time and space to describe them.

The first one of these curious remains which I opened was on Reuben Farlow's farm, 3½ miles southwest of Milroy, on a bluff 20 feet high, at the foot of which flows the stream Little Flat Rock. It was about 30 feet in diameter, and 5 feet high; round. Inside of it was what might be termed a stone wall inclosing 10 feet square of the mound. Though the wall was not of perfect masonry, yet very evidently it was built for some purpose, and was not a mere accidental arrangement of stones, of which there were a goodly number scattered through the mound. On top was common soil 18 inches deep, then clay, next clay and ashes, with coal mixed in it 2 feet thick; then a "hard pan" of clay, on top of which were three human adult skeletons and the skull of an infant, all side by side, with their feet toward the east. Around the neck of one were a number of copper and bone beads, the latter of which crumbled immediately. The copper ones were made of sheet copper rolled up, with a hole left through the center by which to string them. The land around was level, and there was no trace left to show where they procured the earth. A maple tree 15 inches in diameter grew on the side of it.

No. 2 was on the farm of Frank Power, 1 mile west of Milroy. It was situated on a small rise about 150 yards from a small stream. It was of precisely the same structure as No. 1, with the exception of the rock wall. Nothing was found in it, save a stone maul or hammer and some arrow points. On the "hard pan" I found, all in one place, nine flint arrow points, no two of the same color, and a plate of mica which I call a "looking glass." It is of an oval shape, 10 inches in long diameter, and 7 inches in short diameter, and ¼ inch in thickness. Also two slate specimens were found 4½ inches by 2 inches by ⅜ inch. About 6 feet east of them was a copper needle or awl 6 inches long and ⅛ inch thick, three-cornered at one end. Four feet north of first batch was a stone hammer—merely a bowlder shaped up to fasten a handle on. No bones found.

No. 3, on the farm of James Brown, 1 mile west of Milroy, of about the same size and structure as No. 2, surrounded with trees 2 feet in diameter on an elevated spot ¾ of a mile from any stream. I found nothing in this but a small piece of galena.

No. 4, on the farm of George Brown, 3 miles southwest of Milroy, on an elevation ½ mile from a large spring. This is different in structure from any of the others. It is 40 feet across and 7 feet high. Directly in the center and bottom of it was a small mound 10 feet in diameter and 3 feet high, of hard red clay, so hard as to be difficult to dig with a mattock. All over this was a layer of charcoal 2 inches thick, yet so perfect that I could easily distinguish the oak, ash, and poplar wood from which it had been burned. Over this was a stratum of ashes mixed with clay, and the remainder was yellow clay. Near the bottom was a skeleton lying with its feet towards the west (all the others lay in the opposite direction). On one wrist were two copper bracelets made by rolling up sheet copper, and close by, a bear's claw, probably an ornament. The right forearm was absent. Though this skeleton crumbled and could not be saved, the others were gotten out in a nearly perfect condition. Nothing strange about them except the peculiar bottle-shaped teeth, especially the bicuspid and molars, and the fact that the larger of the two bicuspids on both upper and lower jaws came first, contrary to the fact in the white and modern Indian races. From the appearance of the frontal bone they evidently possessed a fair degree of intelligence.

I have opened a number of other mounds, but they are all about the same, and I found nothing in them.

PRIMITIVE MANUFACTURE OF SPEAR AND ARROW POINTS ALONG THE LINE OF THE SAVANNAH RIVER.

By Charles C. Jones, Jr., *of Augusta, Ga.*

In selecting sites for the manufacture of arrow and spear points, respect was had to the convenience of the localities. Ready access to the raw material and to food and water, and the physical advantages offered for transporting their implements, when manufactured, entered largely into the calculations of the primitive artificers and determined their particular fields of operation. That such is the fact, may be readily inferred from the presence of extensive and numerous open-air workshops along the line of the Savannah River, and especially that portion of it bordering the counties of Richmond, Columbia, Lincoln, and Elbert, in Georgia, and the counties in South Carolina lying opposite. Here milky quartz, chert, and some varieties of jasper abound. The substance from which the implements were to be fashioned was at hand, and in quantities practically inexhaustible. The Savannah River, with its numerous tributaries, was a never-failing storehouse of food. Its islands and banks, adjacent forests, and dependent swamps afforded ample cover for game of various sorts. At that early period the woods and waters were far more replete with animal life than they are at present. Then, the Savannah was a limpid river. At regular times the shad and sturgeon ascended and descended the river in countless numbers, while all the year round, perch, bream, catfish, trout, suckers, gar-fish, sun-fish, eels, and other varieties of fishes were found in it in abundance. These waters teemed also with turtles and mussels, which constituted favorite articles of food among the primitive peoples of this region. The buffalo, the black bear, the deer, the raccoon, the opossum, the wild-cat, the wolf, the mink, the otter, the beaver, and other wild animals, the turkey, the eagle, the fish-hawk, owls, and various birds had here their habitat. Reptiles, some sorts of which were utilized as articles of food, crawled beneath the shadows of the forests. The mulberry, plum, haw, crab-apple, and other native fruits yielded their annual tribute, while from the nuts of the walnut and hickory trees were obtained generous supplies of oil. It was a region attractive to man in a state of nature. Here, under temperate skies, the battle for life was not severe. Intermediate between the mountain ranges of Upper Georgia and the sterile pine-barren belt to the south, running parallel with the coast, this territory was well suited for the abode of primitive peoples. Many are the indications that it was occupied for an indefinite period by a by no means insignificant aboriginal population.

That the Indians resorted in considerable numbers to the banks of the Savannah and its tributaries to hunt and fish is attested by frequent and large refuse piles, still existent at many well-selected points, by ancient burial-grounds, by occasional tumuli, and by the sites of abandoned villages upon the islands, and the high grounds adjacent to the streams.

With a view, therefore, to easy subsistence, companionship, and a ready sale at home of the manufactured articles, it must be admitted that the primitive arrow-makers were wise in here locating their most extensive open-air workshops. Surrounded by multitudes engaged in the capture of birds, animals, and fishes, the demand for stone darts was necessarily continuous and very general. The loss and destruction of such projectiles must have been constant and great, and hence extensive manufacture was requisite, especially during the seasons set apart for hunting and fishing, to supply the waste thus occasioned. In exchange for them food and skins were freely offered. While to the women was mainly committed the fabrication of fictile ware and domestic utensils, and while nearly all the male members of the community were able, on an emergency, to chip implements of hunting and fishing, the manufacture of spear and arrow points was in large measure monopolized by certain men in each tribe. In such labor were they constantly and professedly engaged, acquiring a degree of skill born only of an accurate knowledge of material and continual practice. Day by day were these chipped barbs bartered away for food, clothing, and ornaments, and when the products of manufacture accumulated beyond present and local demand they were stored away in the ground, in places known only to the artificers, whence they could be taken as occasion required.

It must not be forgotten that the occupation of the primitive worker in stone was deemed not only useful but honorable. For the purpose of disposing of his surplus stock he frequently made long journeys, and the knowledge of his mission and avocation secured him a welcome among, and hospitable treatment by, the tribes he visited.

While along the coast may occasionally be seen nuclei or parent blocks of jasper, transported from a distance, and there kept to be manufactured into implements, and while at some points, even in the depths of the swamp region, may still be noted traces of small open-air workshops, it appears entirely probable that the Indians inhabiting the sea-islands and the adjacent territory were largely supplied with arrow and spear points and other stone objects manufactured in the interior and furnished by the ancient trader. Stone implements found along the coast, as a general rule, are beautiful in material and of admirable construction. This suggests and seems to justify the idea that these primitive merchantmen brought with them in their trading expeditions articles well selected, attractive to the eye, and calculated to command the highest price in the way of exchange. From the dwellers near the salt water were obtained beautiful ocean shells, large drinking cups made from conchs, beads, gorgets, shell ornaments, and shell money. This interchange of commodities was very extensive, and prevailed from a remote antiquity. By means of long rivers traversing vast regions and finally emptying into the sea were these trade relations most easily conducted. Geographically considered, the location of workshops in the region we have indicated was most judicious. The territory permeated by the Savannah was extensive. Its tributaries, capable of navigation by canoes from single trees, were neither infrequent nor indifferent. The population permanently established in this region was considerable, and when the mouth of the river was reached, the network of inlets afforded ample opportunity for communicating by water with widely separated communities. All the outer islands guarding the coasts of Georgia and Carolina, and the headlands where these primitive peoples delighted to congregate, were thus rendered accessible. In the light of discovered relics it appears impossible to prescribe limits to the peregrinations, by land and water, of these traders of the olden time. To the knowledge of the writer, within a limited area in the heart of Georgia have been found copper implements from the Lake Superior region, a bead and pipe of catlinite, not of recent manufacture, large beads made of the columns of shells native to the Gulf of Mexico, and stone implements, whose material must have been transported from great distances.

From long experience, and after frequent and careful examination, *we are persuaded* that we can in many instances designate with certainty the locality on the Middle and Upper Savannah where many forms of arrow and spear points were manufactured, which have been found on the sea islands and in the territory of Southern Georgia adjacent to the coast. Despite the similarity in forms and style of manufacture which characterizes all objects of this class, to the practiced eye and to one critically conversant with the archæological products of particular localities there are certain marks or *indicia* which proclaim unmistakably the home not only of the material, but also of the artificer. It is curious and interesting to trace and recognize the indestructible proofs of these trade relations among these primitive peoples, and to note with what confidence the origin of the bartered article, alien to the locality where found, may often be assigned.

These open-air workshops exist not only along the line of the Savannah River, but frequently occur on the banks of the Oconee, the Ocmulgee, the Flint, the Chattahoochee, and other southern streams. While possessing a remarkable similarity in construction and identity in material, the products of these various factories often indicate diversities which, to the eye of the careful observer, are capable of ready recognition. In the particular region to which our attention has been directed, by far the greater number of arrow and spear points were chipped from milky quartz and chert. Many rude specimens occur made of slate, and attain unusual dimensions, some of them being a foot long and four inches wide across the wings. In the Flint River region these points are broader, thicker, and generally made of beautiful varieties of yellow and striped jasper. Not content with utilizing the milky quartz, chert, and slate which lay at their very doors, the primitive workmen of the Savannah obtained from a distance material of varied hue and much beauty, and from it fashioned implements which, for excellency of workmanship and intrinsic attractions of surface and color, challenge admiration. Those manufactured from pellucid crystals, chalcedony, rose-colored and black quartz, and jasper of brilliant hues, are peculiarly attractive. Within the past few years not less than eight thousand well-formed arrow and spear points have been collected on both banks of the Savannah where it separates the counties of Columbia and Lincoln in Georgia from Edgefield County in South Carolina. Even now the supply is by no means exhausted. The annual plowings and constantly recurring freshets reveal each season new examples of the taste and skill of these ancient workmen. In the enumeration of the implements taken from this locality we do not include multitudes partially formed and broken, which, with quantities of chips, still mark the spots set apart for the manufacture. Sometimes we encounter a locality, many yards long and several wide, the surface of which is covered to the depth of several inches with fragments struck off during the process of manufacture, and with cores and wasters abandoned from some inherent defect in the material or broken by the workman. Some idea may thus be formed of the extent and duration of the labors of these primitive workers in stone.

We can but regard these workshops as the places whence were obtained, and that for centuries, many of the darts used not only by the peoples who resorted for supplies of fish and game to the banks of the Savannah, but by the tribes of Southern and Southeastern Georgia and Southern Carolina.

If we may credit Adair and other early observers, the Savannah River at certain times of the year must have presented an animated scene. Upon its banks, at appointed seasons, multitudes of Indians from the interior congregated. Weeks were spent in the general and active pursuit of fishes and game. All accumulations beyond present subsistence were smoked and dried, and in the end transported to their homes. It was during these periods, when these riparian abodes were thronged by peoples from a distance, that the primitive arrow-makers reaped their richest harvests. Some of these spear-points are 14 inches in length, while arrow-points are occasionally seen scarce half an inch long. These last are marvels of delicate flint chipping; and, attached to a very small arrow-shaft, and feathered with thistle-down, were probably blown from a tube. Swamp-canes supplied the ordinary shafts, and these were guided by feathers. Into the larger end a spike-shaped flint tip was sometimes inserted, but in most instances a slit or notch was made for the reception of the barb, which was securely fastened by means of moistened threads of deer sinews, or glue made from the soft horns of a buck, or small thongs of deer skin. Reserve arrows were carried in a quiver made of fawn or cougar skin, suspended from the left shoulder, and hanging just behind the right hip, where most convenient access could be had. Hickory, locust, white oak, ash, and red cedar are said to have been the favorite woods employed by these peoples in the manufacture of their bows. These, the customary shape of which was that of a single curve, they seasoned well, and frequently anointed with bear's grease to render them flexible and to keep them from cracking.

Upon the use of these bows and arrows the Indians relied for subsistence and for defense. They "never lack meat," says the Hidalgo of Elvas. "With arrows they get abundance of deer, turkeys, conies, and other wild animals, being very skillful in killing game." Cabeça de Vaca describes the Florida Indians as being all archers, admirable in their proportions, spare, and of great activity. Their bows were as thick as a man's arm, eleven or twelve palms in length, and capable of projecting arrows for a distance of two hundred paces, and with such precision as to miss nothing. Even the good armor of the Spaniards proved an insufficient protection against these missiles; and a buffalo or bear could not withstand the fatal effect of these well-directed shafts. But the history of the use of the bow and arrow among these primitive peoples, and their various methods of hunting and fishing, are foreign to our present purpose. We desire simply to call attention to the manifest proofs of the extensive and long-continued manufacture of arrow and spear points along the line of the Savannah, and we conclude with the remark that almost every known type here finds rich expression. The triangular, the leaf-shaped, the shark-tooth form, the spike-shaped, the one-winged, the chisel-ended, those with bifurcated tang, the repointed, and many other forms are here seen. As we write, no less than twenty-three varieties lie before us, all indicating the skill, the taste, and the fancy of the aboriginal workmen.

In his "Last Rambles amongst the Indians," Catlin furnishes us with the following account of the manner in which arrow-points were made among the Apaches. We presume the method adopted among the Southern Indians was not dissimilar:

"Every tribe has its factory in which these arrow-heads are made, and in those only certain adepts are able or allowed to make them for the use of the tribe. Erratic bowlders of flint are collected (and sometimes brought an immense distance), and broken with a sort of sledge-hammer made of a rounded pebble of hornstone set in a twisted withe, holding the stone and forming a handle. The flint, at the indiscriminate blows of the sledge, is broken into a hundred pieces, and such flakes selected as, from the angles of their fracture and thickness, will answer as the basis of an arrow-head.

"The master workman, seated on the ground, lays one of these flakes on the palm of his left hand, holding it firmly down with two or more fingers of the same hand, and with his right hand, between the thumb and two forefingers, places his chisel (or punch) on the point that is to be broken off, and a co-operator (a striker), sitting in front of him, with a mallet of very hard wood, strikes the chisel (or punch) on the upper end, flaking the flint off on the under side below each projecting point that is struck. The flint is then turned and chipped in the same manner from the opposite side, and so turned and chipped until the required shape and dimensions are obtained, all the fractures being made on the palm of the hand.

"In selecting a flake for the arrow-head a nice judgment must be used or the attempt will fail; a flake with two opposite parallel or nearly parallel planes is found, and of the thickness required for the center of the arrow point. The first chipping reaches near to the center of these planes, but without quite breaking it away, and each chipping is shorter and shorter until the shape and the edge of the arrow-head are formed.

"The yielding elasticity of the palm of the hand enables the chip to come off without breaking the body of the flint, which would be the case if they were broken on a hard substance. These people have no metallic instruments to work with, and the instrument (punch) which they use, I was told, was a piece of bone, but on examining it I found it to be a substance much harder, made of the tooth (incisor) of the sperm whale, which cetaceans are often stranded on the coast of the Pacific. This punch is about six or seven inches in length and one inch in diameter, with one rounded side and two plane sides; therefore presenting one acute and two obtuse angles, to suit the points to be broken. This operation is very curious, both the holder and the striker singing, and the strokes of the mallet being given exactly in time with the music, with a sharp and rebounding blow, in which, the Indians tell us, is the great *medicine* (or mystery) of the operation."

MICA BEDS IN ALABAMA.

By WILLIAM GESNER, *of Birmingham, Jefferson County, Alabama.*

In Clay County, township 19, range 7 east, section 26, in a corn-field on the east bank of a small stream flowing into Gold Mine Branch, a tributary to Talladega Creek, is a stone heap, many of the rocks from which have been used in forming a retaining wall on the lower side of a wagon-way into the Talladega and Ashland road. It is supposed by the residents here to have been formed by the followers of De Soto to mark the locality of an ancient excavation in one of the mica-bearing beds of quartz and feldspar belonging to this neighborhood, and that they obtained silver from it, and from others of like character.

The geology of this region is Huronian, being constituted in this immediate vicinity of gneissoid and mica slate, and hornblendic rocks. This excavation is in a stratum of mica-bearing quartz and feldspar exceeding 8 feet in thickness, and, judging from the apparent area given to its entrance, the aborigines must have worked in it for a long time, and without any of our appliances for quarrying, as no marks made by metallic tools or pieces of them are found, though the place has been searched time and again for silver, and latterly for mica, affording sheets of the latter (Muscovite) squaring from 1 to 10 inches, and in one instance 11 by 14 inches.

Southeasterly from this place about 300 yards, in the same range, township, and section, occurs a smaller excavation in a similar micaceous bed, trending parallel with the former, both of them being easily traced on their outcrop for miles in a northeasterly and southeasterly direction, with a dip of 62° toward the southeast. In Talladega County, township 20, range 6, section 12, there is another one of these excavations of as large dimensions as the first mentioned, and in a similar bed of mica-bearing quartz and feldspar, from both of which it is evident the aborigines obtained large quantities of mica.

It is observable in these three instances that these beds were attacked by them at their outcrops on the banks of streams, where denudation had revealed them, and that the entries were made on them in the most simple manner.

MOUNDS IN WASHINGTON COUNTY, MISSISSIPPI.

From notes by JAMES HOUGH, *of Hamilton, Ohio.*

The following description of mounds in Washington County, Mississippi, is prepared from rough memoranda of surveys made by the late James Hough, of Hamilton, Ohio, and sent to the Smithsonian Institution by Mr. John M. Millikin.

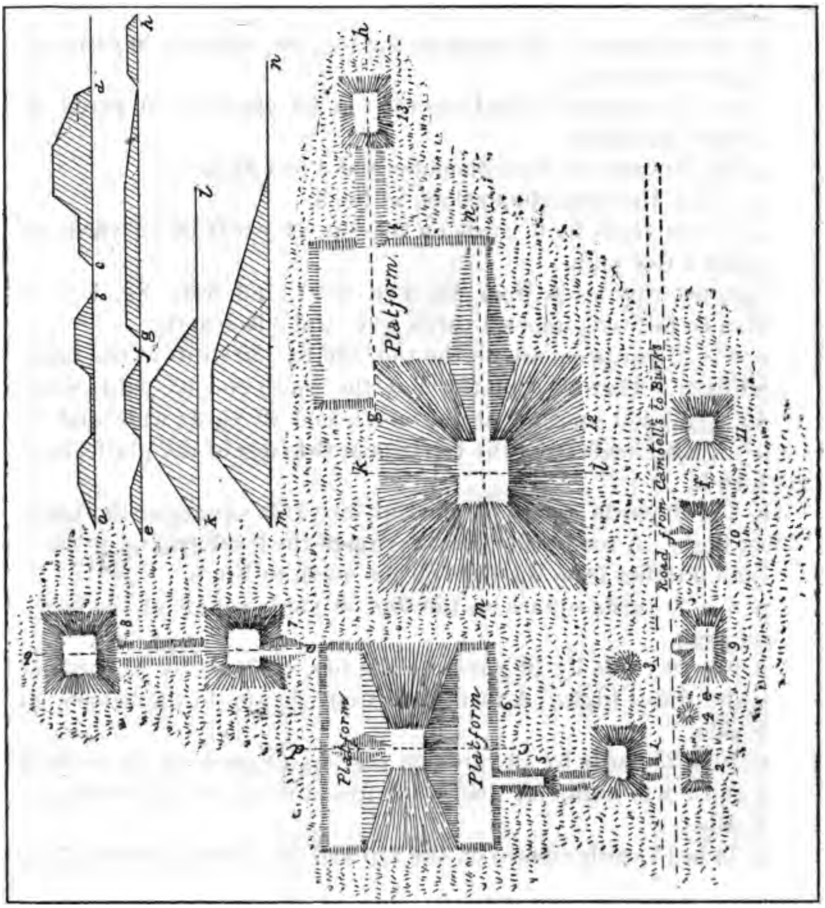


FIG. 1.

On page 115 of "Ancient Monuments," by Squier and Davis,* will be found a description of a group of graded mounds situated upon the

* Ancient Monuments of the Mississippi Valley. By E. G. Squier and E. H. Davis. (*Smithsonian Contributions*, vol. i.)

right bank of Walnut Bayou, in Madison Parish, Louisiana, seven miles from the Mississippi River, surveyed by Mr. Hough for Mr. McBride. Plate XXXIX of that work gives a graphic representation of the group. The mounds described in the present sketch are situated about four miles east of the Mississippi River, nearly opposite Point Chicot, about latitude 33° 30′ N., a mile or more from Williams on the west, and two miles from the Black Bayou in the same direction, and near the road leading from William R. Campbell's plantation, on the Mississippi River, in Washington County, Mississippi, to the Mississippi River above, at Colonel Wm. Perkins's plantation, in Choctaw Bend, Bolivar County, Mississippi.

No. 1 is 20 yards by 15 yards on the top, 40 yards by 30 yards at the base, and 8 feet high.

No. 2 is 12 yards by 9 yards on the top, 25 yards by 20 yards at the base, and 6 feet high.

No. 3 is 10 yards in base diameter and 4 feet high.

No. 4 is of the same dimensions as No. 3.

No. 5 is 10 yards by 6 yards on the top, 20 yards by 15 yards at the base, and 5 feet high.

A graded way leads from No. 2 to No. 1, and from No. 1 to No. 5, and thence to No. 6, about 5 yards wide and 3 feet high.

No. 6 is 25 yards square on the top, 110 by 130 yards at the base, and 35 feet high. There is a platform at the south end 25 yards wide and 10 feet high, and another at the north end 10 yards wide and 6 feet high. A road leads from the top to near the edge of the platform at the north end.

No. 7 is 20 yards square on the top, 50 yards square at the base, and 15 feet high. A road leads from the top to the level ground at the south end, and another from the base on the north to No. 8.

No. 8 is 20 yards square on the top, 50 yards square at the base, and 13 feet high.

No. 9 is 20 yards by 10 yards on the top, 40 yards by 30 yards at the base, and 6 feet high. A road leads from the top to the bottom on the north side.

No. 10 is 25 yards by 10 yards on the top, 40 yards by 30 yards at the base, and 9 feet high. A road leads from the top to the bottom on the north side.

No. 11 is 15 yards square on the top and 35 yards square at the base.

No. 12 is 40 yards by 30 yards on the top, 140 yards by 130 yards at the base, 55 feet high, with a platform at the northeast corner 25 yards wide and 10 feet high. A road leads from the top at the east end by a regular grade to the outer edge of the platform. At the west end of the top there is an excavation 25 feet by 30 feet and 6 feet deep. A road 25 feet (yards?) wide and 4 feet high leads to No. 13.

No. 13 is 25 yards by 15 yards on the top, 40 yards by 30 yards at the base, and 8 feet high.

In "Ancient Monuments," page 116, is a small sketch of graded mounds encircled by an earthwork, situated in Bolivar County, Mississippi, near Williams's Bayou, in the Choctaw Bend, one mile and a half from the Mississippi River. In Mr. Hough's notes is a rough sketch of a similar group in the same locality, and said to be on the plantation of Mr. William P. Perkins (Fig. 2).

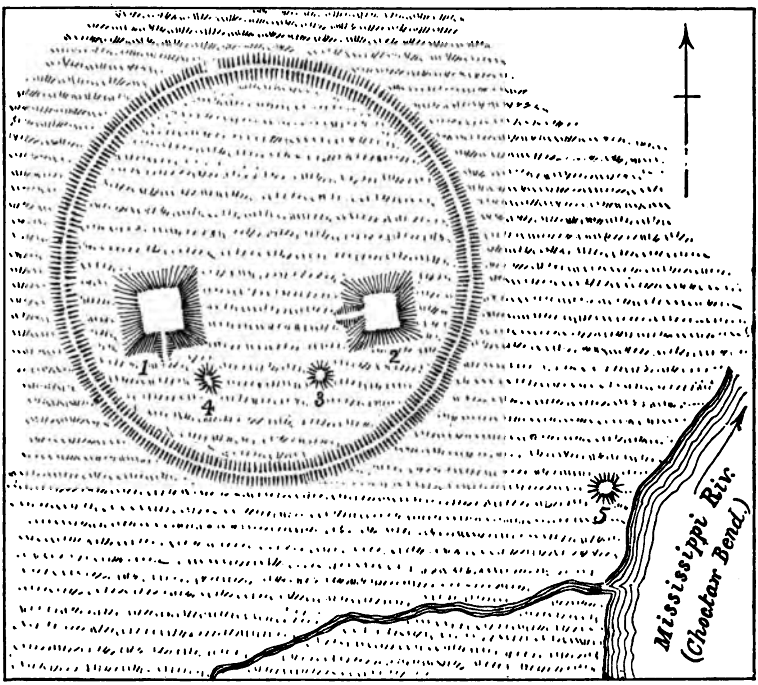


FIG. 2.

No. 1 is 25 yards square at the top and 50 yards square at the base, with a graded way reaching from the top to the bottom.

No. 2 is 20 yards square at the top, 45 yards at the base, 15 feet high, with a road leading from the top to the base.

Nos. 3 and 4 are circular at the base, with a diameter of 10 yards, each 5 feet high.

The circular earth wall surrounding the group is 250 yards in diameter and 3 feet high.

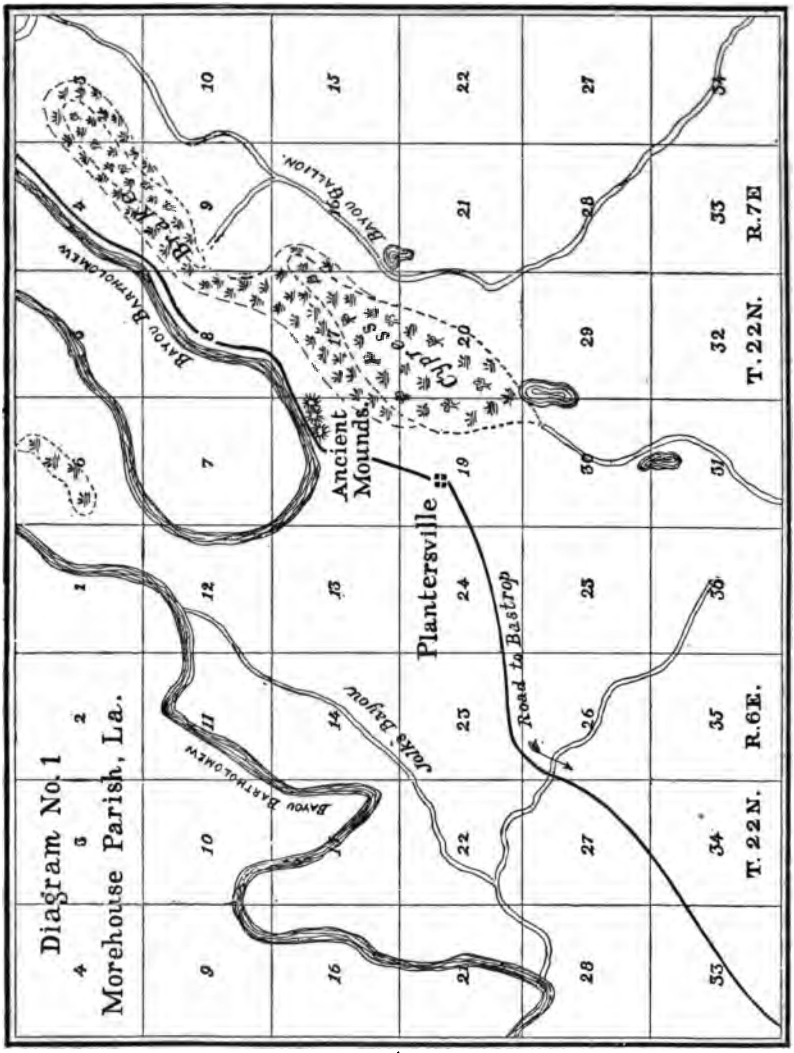
No. 5 is a circular mound on P. Williamson's plantation 20 yards in diameter and 6 feet high.

The similarity of these measurements with those given in "Ancient Monuments," page 116, leads us to believe that the two sketches are meant for the same group. The difference of position in the graded ways makes it desirable to have the ground resurveyed by a competent topographer.

MOUNDS IN MOREHOUSE PARISH, LOUISIANA.

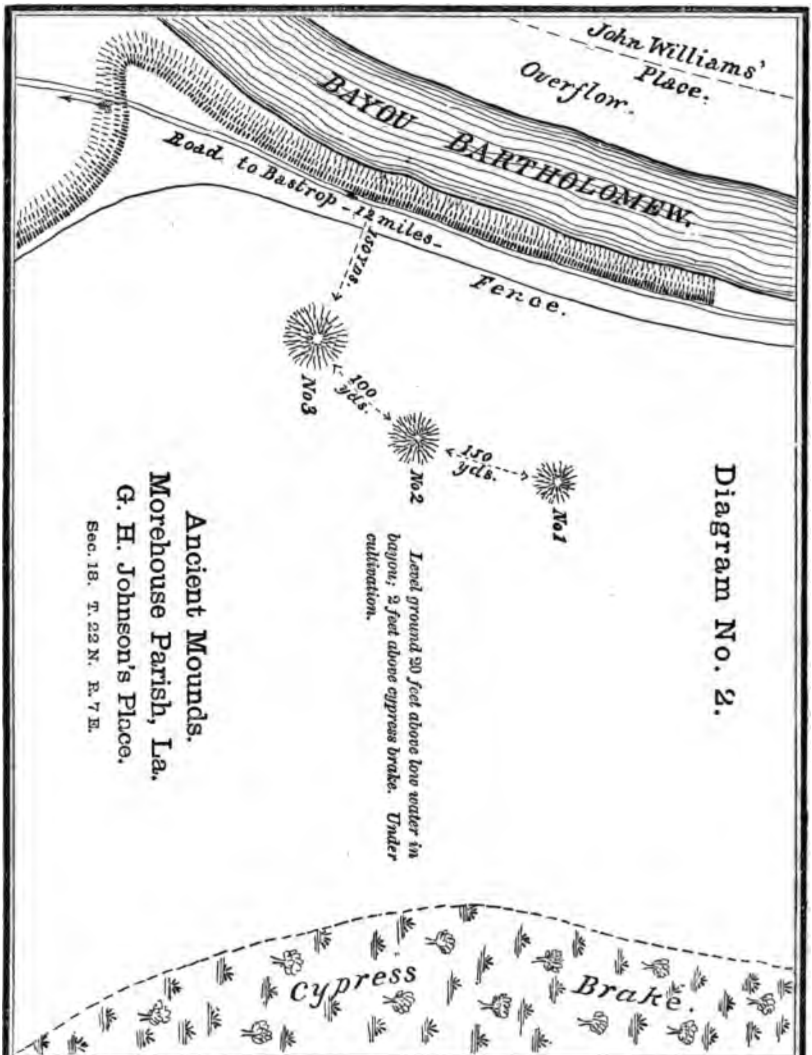
By Benjamin H. Brodnax, *of Plantersville, La.*

In reply to your circular relative to an exhaustive work on the "Archæology of America," containing a request for "information concerning any mound or other ancient remains in our parish," I annex the following: I have carefully gone over all the mounds, camping places, &c., that I can find in our parish, having traveled over 100 miles in so doing. There



are only two clusters of mounds, one of them on the plantation of Dr. William P. Harrison, one mile west of Oak Ridge, and the other on the plantation of Mr. G. H. Johnson, in section 18, township 22 north, range 7 east, formerly the "Raleigh Lassiter Place." (Diagrams I, II.)

The sketch (Diagram II) shows correctly the relative height of mounds in the latter location. In mound No. 1 human bones have been found, a skull, teeth, &c. I tried to get the skull, but the negro who plowed it up told me that, although nearly perfect when he found it, it crumbled into dust on the shelf where he placed it, in less than twenty-four hours. A small pottery jar or jug was also found in it, and a round ball of lead-



colored mica, 3 inches in diameter. The jar was broken in the tines, about one-half only remaining; it is made of soft grayish-blue clay, mixed with ground shell (I think); at least there were shiny and flaky patches mixed with the gray-blue clay.

The mounds are about 200 yards from the present east bank of the bayou, which, however, seems to have gradually encroached on the bluff about 150 yards. The distance from No. 1 to No. 2 is 150 yards; from No. 2 to No. 3, 100 yards. The land has been in cultivation for thirty-five years, and the mounds are much broken down in height and spread out at the base from washing down.

In No. 2 and No. 3 nothing except some rough arrow-heads have been found, and a polished broken quartz ax or tomahawk. It must have been a place of resort for fishing, &c., as there are remains of the river mussels found in the ground around the mounds, and in the mounds themselves.

These mounds have never been dug into, and I find no burnt clay about them to show that fire was used during their construction. The cypress brake east of the mounds is the head of a considerable chain of brakes and lagoons extending about 12 or 15 miles in a curve south and southeast, and on its banks are numerous camping places in which are found arrow-heads, broken pottery, shells (fresh-water) not now found in the brakes. This would show that either the brakes were once running water, or that the shells were brought from the bayou. This country is peculiar in its formation. From the Mississippi, extending west, is a vast level expanse of rich land, covered with luxuriant vegetation, cut up by sloughs, bayous, and brakes, with perhaps not 20 feet elevation above the Mississippi until you reach what are called the bluffs. These elevations were once the banks of the immense lake which formed the backwater from the Mississippi River. On both banks of the bayou, on the hills as well as on the low lands, are evidences of a once numerous population, extending back to the hills. Beside all the little rivulets are remains of camps and places where pottery was burnt and arrowheads chipped.

These mounds appear, however, to have been the center of civilization, as the villages seem to be more scattered as you leave them.

I have prepared a plot of sections in my immediate neighborhood, where are camps, &c., marked down. These mounds are the only places in which there have been found bones (G. H. Johnson's place), and from the paucity of them, I think that either the common people buried their dead promiscuously or burnt them on piles of wood. Only one skull has thus far been found in these mounds.

The mounds at Oak Ridge, in the southern part of this parish, were described by a former representative of this district, and sent to your institution just after the war.

They stand in the Mississippi bottom-lands, about 20 miles from the bluff, 2½ miles from Lake Le Fouche, and must have been sacrificial mounds, as evidences of piles of dry canes having been burned on damp clay are found in them. They seem to have been built in layers, covered with clay, and the canes (such as we now use for fishing-poles) were burnt on them, the impressions of the joints of the canes remaining in the burnt red clay. Bones and human remains found in them show great age. Quantities of celts, arrow-heads, chisels, wedges, &c., have been found in the fields and plantations for miles around.

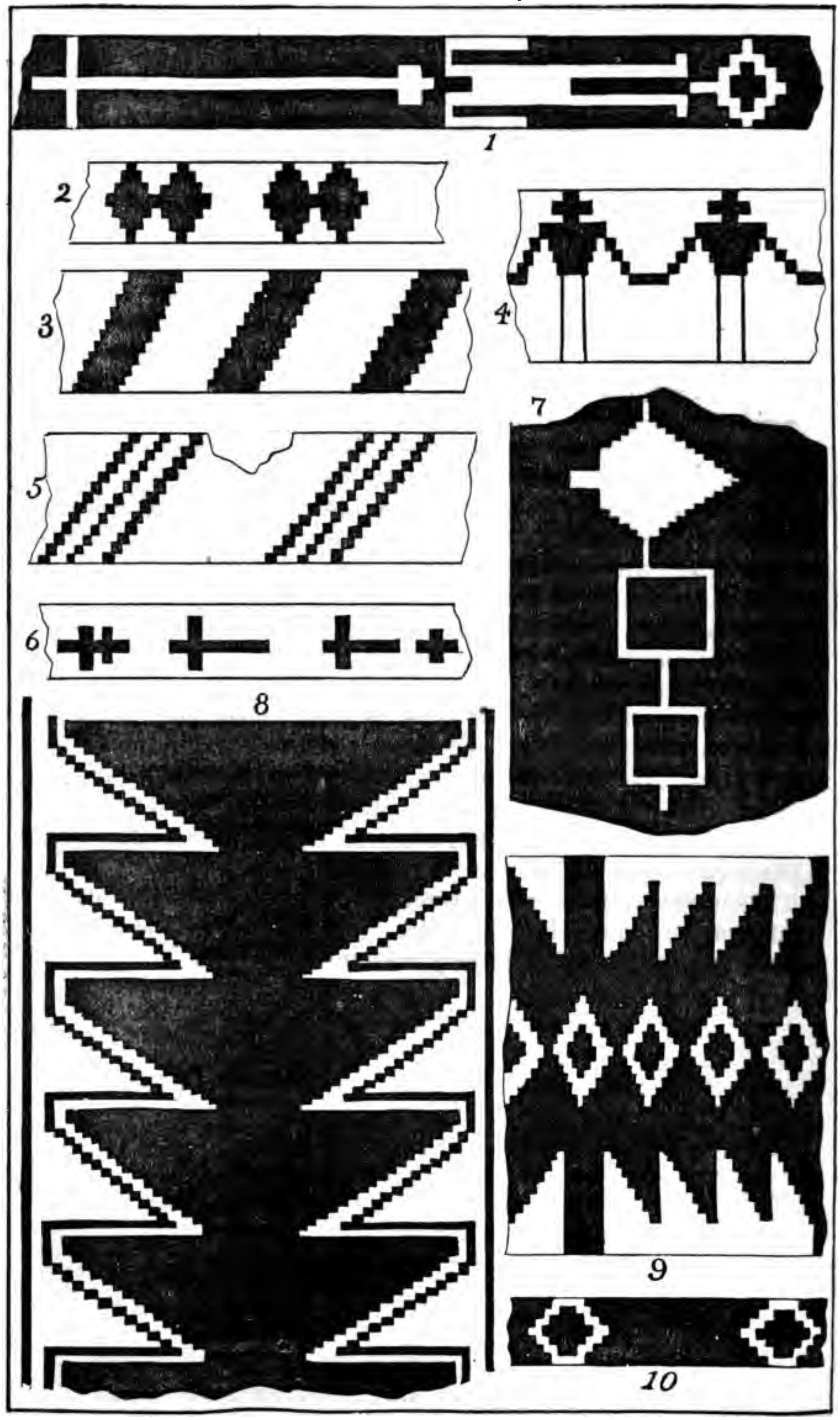
WAMPUM BELTS OF THE SIX NATIONS.

By W. M. Beauchamp, *of Baldwinsville, N. Y.*

Some of these wampum belts of the Six Nations are remarkable for their great width; a belt of 30 rows being called "a prodigious large belt," while the widest of them contains 49 rows.

No. 1, formed of white beads on dark ground of wampum, is about half of a belt of 7 rows, supposed to have been brought by the French missionaries. The "Long House" represents the Five Nations, and the cross, the French. No. 2 is a belt of 7 rows, with 4 pairs of diamonds remaining. No. 3 has 12 rows, and there are now 7 dark bars. No. 4 has a house in the center, with two small men inside. On one side without, are seven men clasping hands; on the other, six. This is several feet long, and contains 15 rows. No. 5 is considerably broken; it has 13 rows of beads and 4 bars. No. 6 is of 7 rows, quite long, but not complete; the general design is a series of dark crosses. No. 7 represents the league of the Iroquois. It is of 38 rows, having white figures on purple ground. The league has but one heart, and each nation (a square) is united to that and each of the others. There are but two squares on each side now. No. 8 is of 49 rows. The figure shows about half of it. No. 9 is of 45 rows, about one-third of it is here represented. No. 10 is of 7 rows, and has 5 hexagons, one for each of the Five Nations. Both sides of the belts are alike, deer-skin thongs running through the length of the belt, the shell beads being sewed between. There are two others of 6 and 8 rows respectively, without particular design.

The outlines will give the general patterns accurately, but it would be difficult to show their real beauty. The beads themselves are of delicate colors, and the belts are very substantially made.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INDIAN RELICS FROM SCOHARIE, N. Y.

BY FRANK D. ANDREWS, *of Vineland, N. J.*

While collecting fossils from the limestone rocks of Schoharie, N. Y., my attention was attracted by the numerous chips of hornstone which I noticed on crossing a cultivated field, and I determined upon giving some time to their investigation.

About 50 rods west of the bridge crossing the Schoharie Creek, and at an elevation of about 75 feet, there issues from the rocks of the Lower Helderberg formation a fine cold spring. In the immediate neighborhood the soil, when under cultivation, appears dark and rich compared with the rest of the field. Here the Indians must have lived for some time, judging from the chips and fragments of their arrow-points and larger implements so plentifully scattered about.

Having visited the place only during the summer season, when the ground was partially covered by growing crops, I have never been able to give the locality as thorough a search as I would wish. Notwithstanding the unfavorable circumstances, I have found nearly one hundred arrow-heads in perfect or nearly perfect condition; a large number of broken spear and arrow heads, knives, and scrapers in various stages of completion; also whetstones, sinkers, and hammer-stones in abundance.

The arrow heads do not show very much skill in their execution, though most of the types are found. The material used is hornstone and comes from the corniferous rocks of this locality. I have seen another workshop close to the creek, not far distant from the Cold Spring, where are abundance of chippings, and where I have found bits of pottery, arrow-heads, scrapers, and an ax of rude manufacture.

Down the creek a half mile or more, and on the eastern side, are fields—showing evidence of having been the sites of Indian encampments—from which I have gathered many of the articles mentioned above. Some of them are of material not found here, indicating that they must have been brought from a distance, by exchange or otherwise.

From the banks of a small stream emptying into the creek I have dug a number of fragments of pottery evidently belonging to one dish; with these occur ashes and burned pieces of bones. I have not been able to find any burial places. In building the railroad, and in making the road near the Cold Spring, bones were found.

PRELIMINARY EXPLORATIONS AMONG THE INDIAN MOUNDS IN SOUTHERN FLORIDA.

BY S. T. WALKER, *of Clear Water, Florida.*

INTRODUCTORY REMARKS.

Much of the work reported in the following pages was done during the spring and summer of 1879, at intervals snatched from business engagements, and whatever was obtained in the way of relics at once transmitted to the Smithsonian Institution, together with letters fully explanatory, written while the whole affair was fresh in my mind.

I have endeavored to keep my imagination in subjection to reason, and whatever is offered in the way of theory is the result of much thought, and supported by many facts.

It is also necessary, perhaps, to state that the mounds were not examined in the order adopted in this report, as the first on the list were among the last examined. I have pursued the present plan in order that the reader may follow them in regular order along the coast as they occur, going south, into and around the shores of Tampa Bay. I have purposely omitted any descriptions of mounds composed entirely of shell, as I believe them to belong to an entirely different class. These will be described in a separate paper devoted especially to their consideration.

1. MOUNDS AT THE MOUTH OF KOOTIE RIVER.

This little stream is known by various names. The older maps designate it as the Achaskotie, others as the Pith-le-ches-kotie, but it is commonly known among the people as the Kootie. It empties into the Gulf of Mexico about ten miles north of Anclote River, in Hernando County. Its mouth is filled with oyster bars, which extend up the river some distance, making navigation difficult for the smallest craft. On the south bank of this stream, one-fourth of a mile above its mouth, are two mounds of considerable size. The one nearest the sea is oblong in shape, 168 feet in length, 55 feet in breadth, and 5 feet high. It lies with its longest diameter nearly due north, and is composed of alternate layers of sand and shell, each layer being from 8 to 12 inches in thickness. The superincumbent soil was 8 inches thick. The shells used in its construction are those of the common oyster principally, with a slight admixture of small conchs and scallops. Figs. 3 and 4, Plate I, will give a good idea of this mound in ground plan and in section. The dotted portions show where excavations were made by me. No relics whatever were obtained from this mound, and, from its level top and general construction, I class it as a mound for residence. About 300 feet east of this lies another mound, somewhat longer and higher than the preceding, remarkable for its singular shape, which is somewhat like a club,

PLATE I

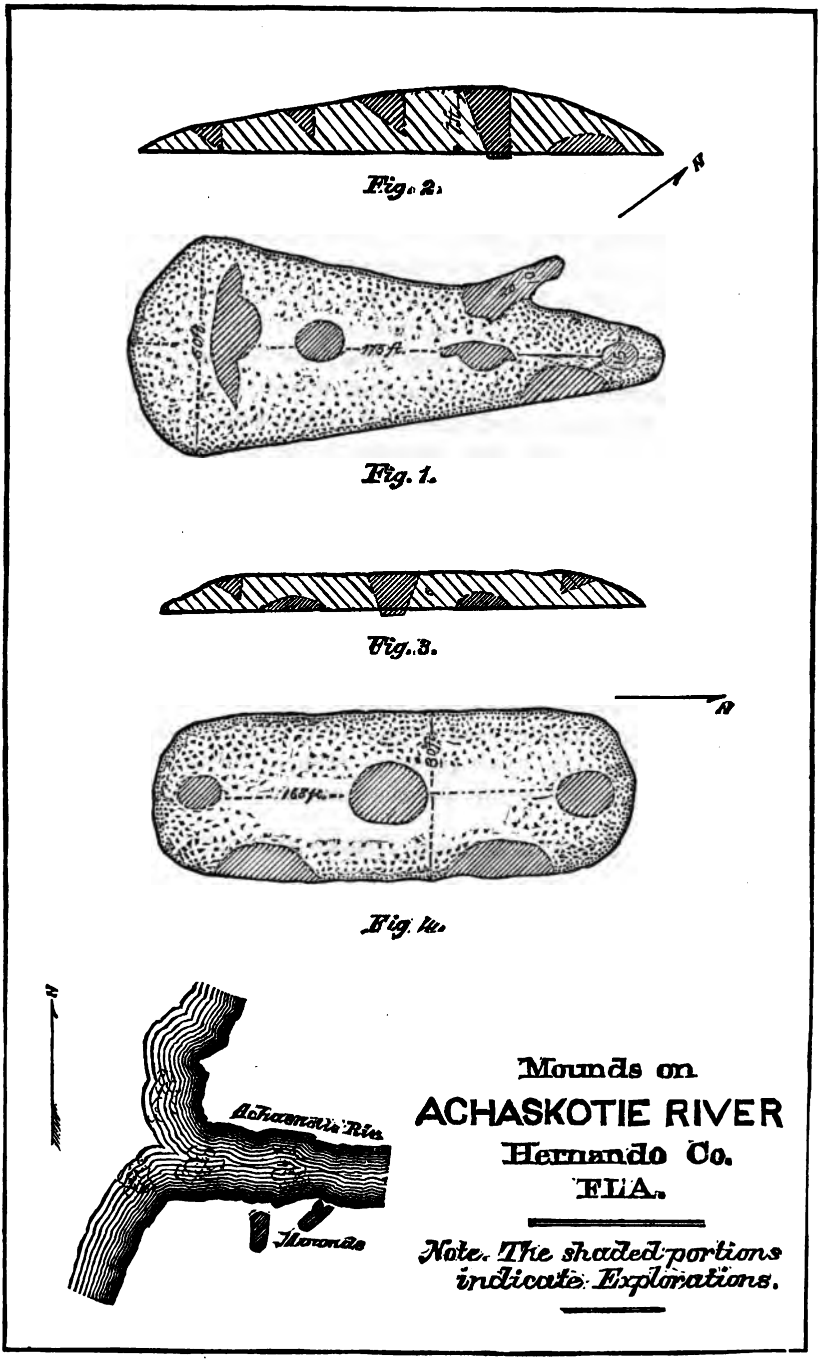


Fig. 2.
N
Fig. 1.
175 ft.
Fig. 3.
N
165 ft.
Fig. 4.
N
Achaskotie Riv.
Mounds
Mounds on
ACHASKOTIE RIVER
Hernando Co.
FLA.
Note. The shaded portions
indicate Explorations.

with a projecting branch or horn near the smaller end. The structure is 175 feet long. The larger or wider end is 50 feet wide and the smaller 15 feet across. The horn or branch leaves the main structure at an angle of about 45 degrees, 58 feet from the smaller end, and extends due north 20 feet, having an average width of 10 feet. Figs. 1 and 2, Plate I, represent this mound in ground plan and section. The whole structure slopes gently from the wide end, attaining its greatest height opposite the projecting horn; from this point it slopes rapidly away to the narrow end of both the horn and main mound.

Excavations systematically conducted revealed human remains in vast quantities in every part of the mound, but, owing to their great age, they crumbled at a touch, and it was with great difficulty that I obtained one perfect cranium. This skull was that of an adult. One side of the head had been broken in, and imbedded in the sand. Inside the head I found a rusty iron spike about 3 inches in length, and a broken arrow head. Excepting some highly ornamented fragments of pottery these were all the relics I obtained. These fragments were scattered throughout the mound.

The mode of burial was interment at full length, with the heads directed toward a common center, the body reclining on its right side; I discovered three of these circles of bodies, each containing from seven to fourteen adult skeletons.

These mounds are situated convenient to good water, and in a vicinity that afforded their builders easy access to oyster bars and shell-fish of every variety. No large trees grow on or near them, and the growth upon them consists of scrubby bushes and saw-palmetto.

2. ANCIENT ARROW-HEAD FACTORY.

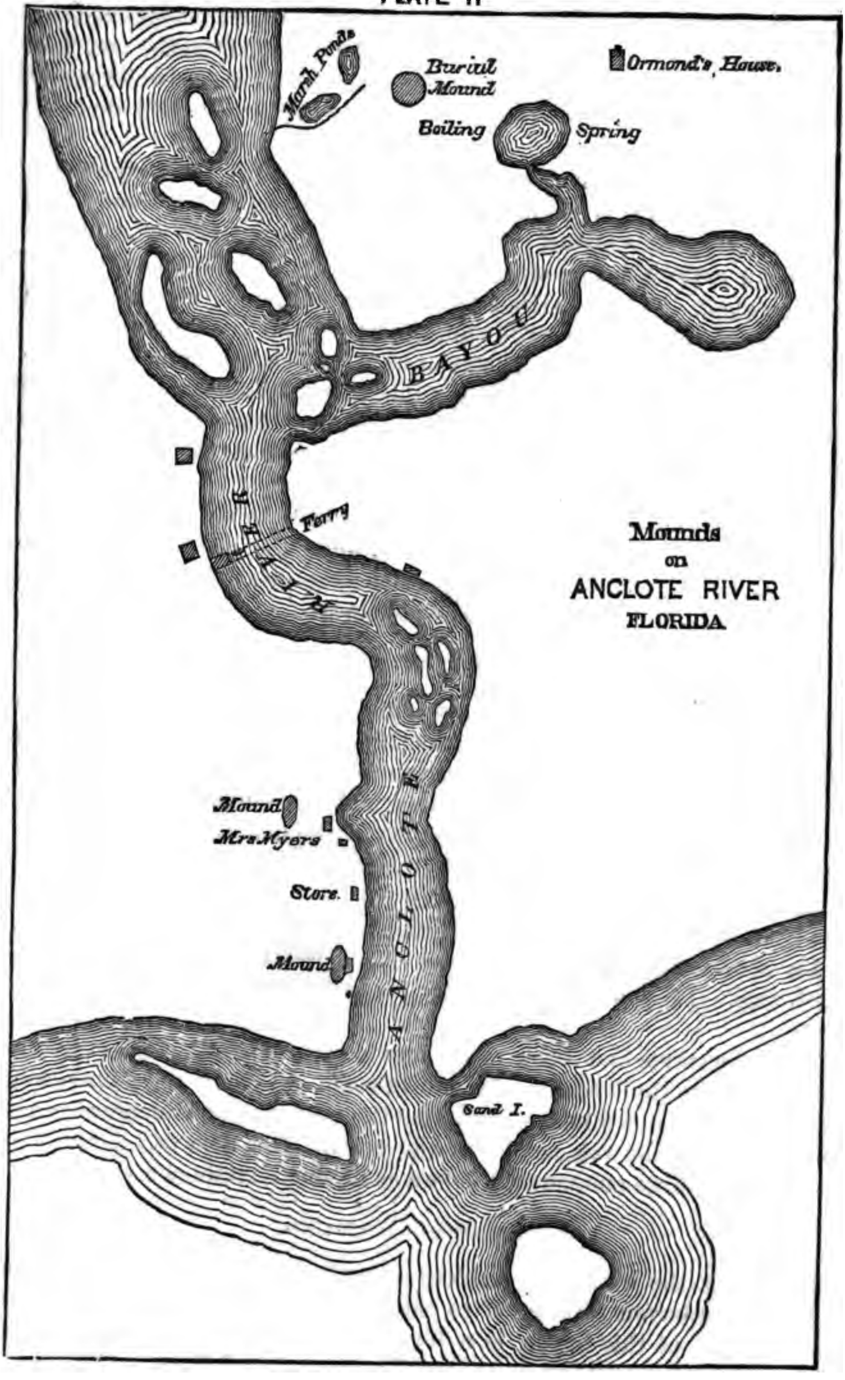
About five miles south of the Kootie River, and some two miles north of the mouth of Anclote River, is a small stream called Trouble Creek. A considerable body of blue flint-rock occurs here, cropping out along the shores of the creek, with scattering nodules lying in all directions. This point was evidently used for a long time by the aborigines as a factory for arrow and spear heads. Bushels of chips and fragments strew the ground, and large quantities have been washed from the banks of the creek and cover its bottom. A long search revealed nothing except a few arrow points and spear heads spoiled in making, and a lot of broken pottery.

No doubt excavations along the banks would bring other relics to light, as the Indians must have resorted to this place in large numbers, and have worked here for a long series of years, judging from the depth of soil over the chips.

3. MOUNDS ON ANCLOTE RIVER.

In ascending Anclote River one of the most prominent objects that attract the eye is a large oblong mound on the northern shore, which,

PLATE II.


Marsh Ponds
Burial Mound
Ormond's House.
Boiling
Spring
BAYOU
Ferry
RIVER
Mounds
on
ANCLOTE RIVER
FLORIDA
Mound
Mrs Myers
Store.
Mound
ANCLOTE
Sand I.

rising abruptly from the level coast, looks both larger and higher than it really is. (Plate II.) It is situated about half a mile from the mouth of the river, and about the same distance from Mr. Hope's dwelling and store, very near a well-known spring of water called the "Old Spanish Well."

The length of this mound is 235 feet, its breadth 166 feet, and its height 10 feet, and it is composed of alternate layers of sand and shell. The surface soil is 18 inches in depth, followed by a layer of shell one foot thick; below this is a stratum of sand two feet in thickness, followed by shell. This is as deep as I penetrated, but long experience convinces me that this order is maintained to the base, which begins with a foundation of shell. The shell used in the construction of the mound is that of the common oyster, doubtless obtained from the river close at hand. A well-defined roadway on the southern side led to the top, which is perfectly level, and no doubt contained the residence of the chief of the tribe.

No explorations had been attempted previously to my visit, and I obtained no relics of any sort. The growth upon the mound was similar to that of the surrounding country, consisting of small stunted pines 10 or 12 inches in diameter, and saw-palmetto.

4. THE MYERS MOUND.

This mound is situated about one mile higher up the river, on the north bank, near the residence of Mrs. Myers, and about one-fourth of a mile from the stream. (Plate II.) Some fresh-water ponds close at hand supplied the builders with fresh water, and the numerous shell heaps in the vicinity attest the productiveness of the fishing grounds.

The length of this structure is 168 feet, its breadth 88 feet, and its height 5 feet; it is composed entirely of sand. The pits from which this sand was obtained are three in number, located on the western end, and it is probable that a portion was excavated from the pond on the north side. The mound lies with its longest diameter nearly east and west.

No explorations had been made previously. I sunk a shaft in the center quite to the bottom; also one in each end below the foundation. The soil on top was 8 inches deep, and the timber upon it similar to that on the mound near the mouth of the river. This also will have to be classed with those enumerated before as having contained a residence.

5. THE ORMOND MOUND.

Following the course of Anclote River to the eastward, above the ferry a large bayou breaks off to the south and southwest. Near the head or end of this bayou is a deep round pond called the "Boiling Spring." This spring is known for miles around, and is said to be of unfathomable depth. The water is deep blue, intensely salt, and before storms the spring boils in the center like a caldron. I saw sharks, tar-

PLATE III

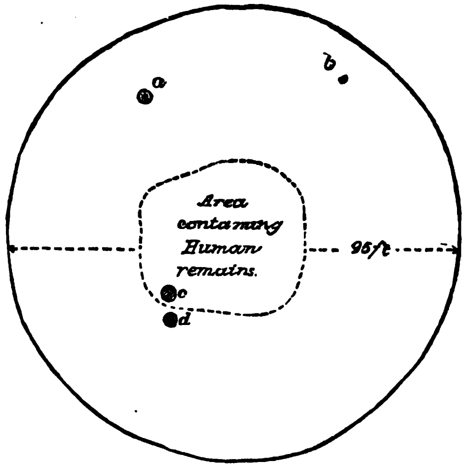


Fig. 1.

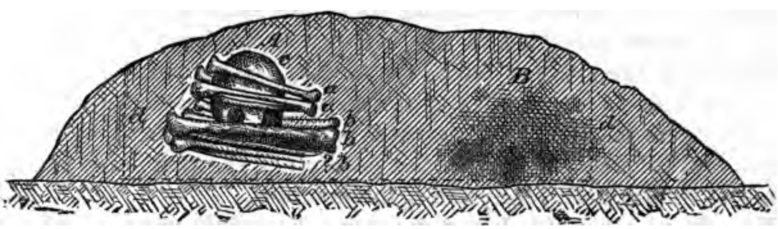


Fig. 2.

Mound at Ormond's,
ANCLOTE RIVER.
FLORIDA.

pum, and other large fish in it. Half a mile northeast of this spring is a circular sand mound, built at the foot of a low sand ridge. (Plate II.) Close at hand on the northeast is a series of shallow ponds, surrounded by marshes.

The mound is 95 feet in diameter, and is now about 5 feet high. Originally it was probably surrounded by a ditch, which is nearly filled up and obliterated, though faint traces of it can be seen on the southern and southwestern sides.

Partial explorations had been made by the ladies of Mr. Ormond's family, who informed me that they had found numerous skulls, pottery, &c., which were thrown about until destroyed. The growth upon the mound is precisely similar to that of the surrounding forests, consisting of tall pines from 18 inches to 2 feet in diameter.

I began operations on the southern side, intending to cut a wide trench entirely across the mound nearly to the foundation; but, after spending considerable time and finding nothing, a closer examination revealed the fact that interments had only been made in a small area about the top and a short distance down the northern slope. So, abandoning my ditch, I went to work on the other side, and soon came upon large numbers of bones, fragments of pottery, &c., seemingly mingled in heartless confusion and disorder; arm, leg, and thigh bones being piled on top of skulls or wedged beneath them. As the work progressed, however, I began to see order arise out of the apparent confusion, and at length I found a skeleton in pretty good preservation, entirely separated from the others. I set to work to solve the problem in earnest. The entire absence of vertebræ, ribs, shoulder-blades, &c., had struck me as very singular in the outset. Working away the sand with a small trowel from the bones imbedded in the wall before me, I got a perfect view, in section, of the mode of burial pursued by the aborigines. Plate III, Fig. 2, will give a correct idea of the method—A representing the bones as they lay in the earth; B, a mass of ashes, cinders, partly burned vertebræ, and calcined sand; *a*, *a*, the position of the arm bones; *b*, *b*, the bones of the leg and thigh; and *c*, the cranium.

Now, let us see if this does not unravel the whole mystery. We will suppose the mound-builders are about to perform the burial ceremony. First, a shallow grave is dug long enough to accommodate the body at full length, as at *c*, *d*, Fig. 2. A fire is kindled at B, and the body laid upon it, the legs, arms, and head projecting beyond it. The fire is confined entirely to the trunk of the body and kept burning fiercely until it is completely destroyed. This being accomplished, the legs are doubled as represented at A, the head placed face downward between the thighs, and the arms laid on or by the side of the head. Cooking vessels, cups, dishes, &c., are now broken and thrown into the grave, which is filled with sand, and the ceremony is completed.

As to the age of the interments in this mound, I can only state that it is extremely probable that they were made previously to European settlement, and before the growth of the present forest. In Plate III, Fig. 1, *c* and *d* represent the relative position of two large pine trees growing about two feet apart; near the roots the distance is reduced to one foot or less, making it impossible for an interment to have been made between them at any time. I made a careful examination between and beneath these trees, and at a depth of about 3 feet I found fragments of pottery and bones. A portion of a human cranium lay rather under the roots of the tree marked *d*, and I also obtained quite a large piece of the inferior maxillary, all of which were sent properly labeled to the Smithsonian Institution, together with ten crania and other objects of interest obtained from this mound.

6. MOUND NEAR DUNEDIN.

Leaving Anclote River and proceeding south into Saint Joseph's Bay, we come to the little village of Dunedin. Half a mile north of this village, and about 300 yards from the beach, is a large mound, with a wide roadway leading to the top, evidently built for a residence. It is situated near some fresh-water ponds, and in the immediate vicinity are several springs of good water. The face of the country is low and flat, and the growth is the usual saw-palmetto and pine, though at no great distance is a small hummock of good land, containing live-oak, &c. It lies with its longest diameter to the northwest, and is 156 feet in length, 80 feet wide, exclusive of the roadway, and is 9 feet high. The roadway commences 50 feet from the mound on the southwest side, and makes a gentle rise to the top of the main structure. It is composed entirely of sand. Explorations to a small extent had been made previously to my visit, but nothing valuable was found.

I sunk a shaft in the center 6 feet in diameter, quite to the foundation, and many smaller ones at various points along the crest, but found no relics whatever. Several large trees grow upon the mound of similar appearance to those in the surrounding forest. Plate IV gives a good idea of the shape of this mound and the ditches from which the sand of which it was built was obtained.

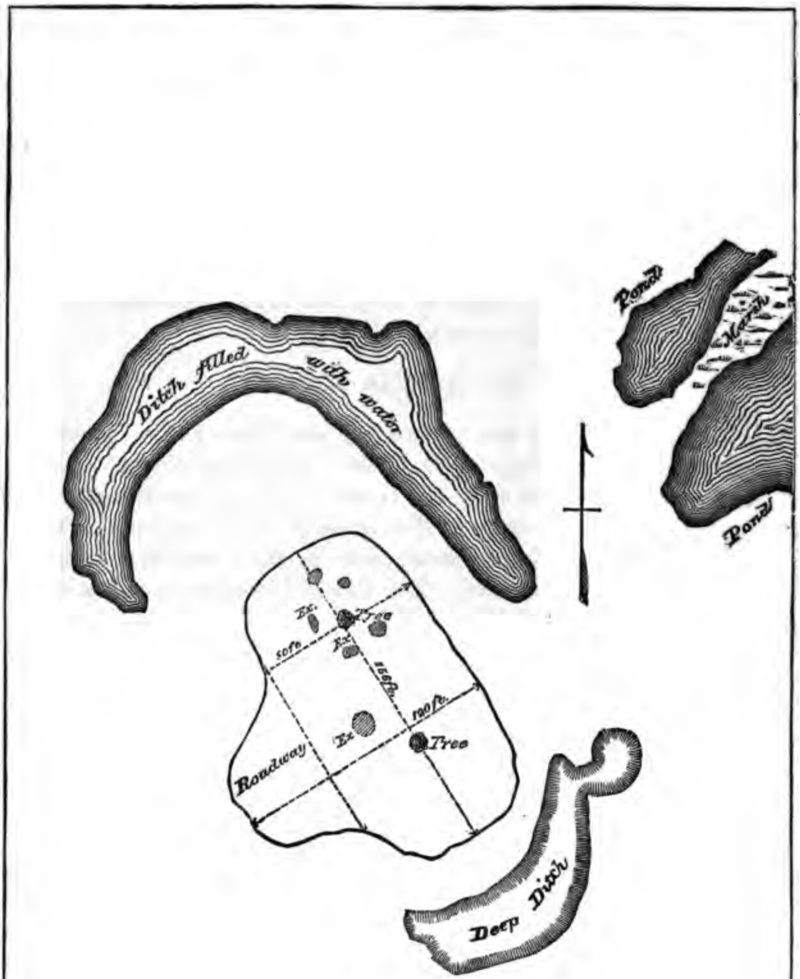
7. BURIAL MOUND NEAR SAXE'S.

About two miles south of Dunedin is the mouth of Stevens' Creek, a small stream which rises about four or five miles inland. Due east from the head of tide-water in this creek, on land belonging to Mr. John Russell, is a small burial mound, situated in a "rosemary scrub," between two fresh-water ponds.

The mound is circular, 46 feet in diameter and 3 feet high. It is composed entirely of the snow-white sand peculiar to "rosemary scrubs."

Explorations had been made previously to mine, and the few human remains it contained thrown out upon the surface, where they had crumbled into fragments. The remains found, I was told, consisted of four or five human skeletons in a pretty good state of preservation.

PLATE IV



PLAN OF
Mound at
DUNEDIN
Hillsboro Co.
FLA.

After digging up the entire surface, I found nothing worthy of note. My predecessor left little excepting a few fragments of crania, teeth, and broken bones. Signs of fires were visible in several places, and as I saw no fragments of vertebræ, I suppose that partial cremation was practiced here as it was on the Anclote River.

8. BURIAL MOUND AT JOHN'S PASS.

No other mounds occur, that I am aware of, until we reach John's Pass, 18 miles south of Clear Water. Here, on a low mangrove island just inside the pass, lying nearly east and west, is a small burial mound. The situation of this mound is peculiar in several respects, as the island contains very little habitable land and no fresh water whatever. The larger portion of the island is covered daily by tide-water, leaving only two low narrow ridges of dry land parallel with the northern and southern shores. These ridges are not over 25 yards in width in their broadest parts, and in most places they are not more than that number of feet in width.

The ridge running parallel with the southern shore is very low and narrow, and at its eastern termination is not more than 2 feet above tide-water. At this point is situated the burial mound under consideration, covered by a dense growth of sea-grape and Spanish bayonet.

The mound is oval in shape, 50 feet long by 25 feet wide, and not exceeding 3 feet higher than the original level of the ridge upon which it is built. The material used in its construction is sand, which was obtained by cutting away the ridge to the east and west, and heaping the sand thus obtained upon the land left between the ditches.

The mound had never been explored, but many bones and skulls lay exposed upon its surface, the result of weathering, or possibly of invasions of the sea, or both. The surface about the base was thickly strewn with fragments of pottery; in fact, it seemed that the whole foundation of the mound was covered with broken pottery previously to the interment of any of the bodies.

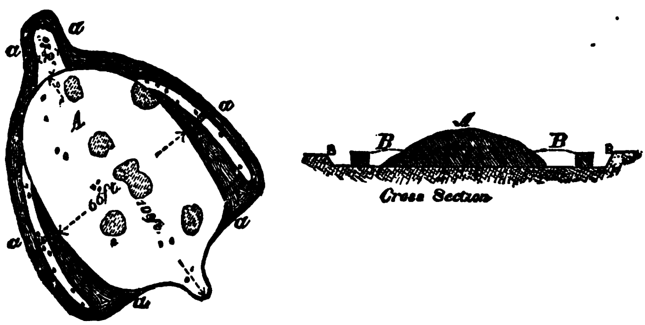
Here the mode of burial changed. There were no signs of fire whatever, and the skeletons reposed at full length, generally resting on the right side. Another point of difference was the large number of children and infants buried here—only about fifteen adults to some forty interments. I succeeded in obtaining nine perfect crania from this mound, among them those of several children, but no ornaments except a solitary glass bead and a short tube of silver formed by rolling a thin plate into a cylinder.

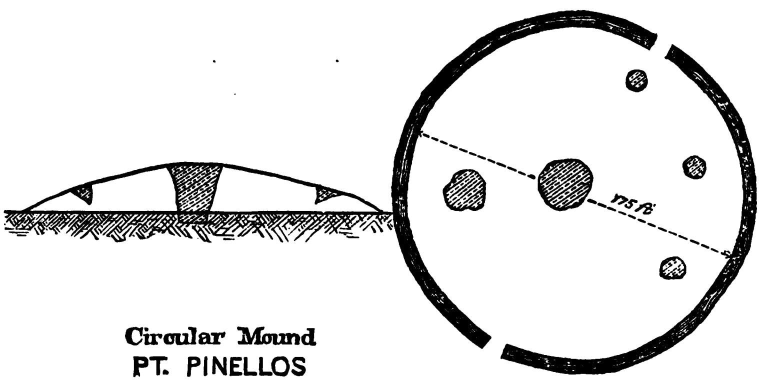
There are no large trees on the island, excepting a few scraggy cedars; consequently, the growth upon the mound consisted of small bushes similar to those growing along the higher ground. On either side mangrove flats stretch away, where the soldier-crabs hold high carnival. The finding of the glass bead does not prove conclusively that the interments do not antedate the period of European emigration, as it lay upon

PLATE V

Turtle shaped Mound
— on —
LONG KEY, BOCA CIEGA BAY
FLORIDA

Note. The dotted portions on the figures show location of excavations.





Circular Mound
PT. PINELLOS
FLORIDA

Note. The dotted portions on the figures indicate the places where shafts and pits were sunk.

Photo-Engraving Co., New York.

he surface and may not have constituted a part of the interments. It s possible, as it was alone, that it might have been lost there long after he burials were made.

9. MOUNDS ON FOUR-MILE BAYOU.

Nearly opposite John's Pass, upon the mainland, on the south side of Boca Ciega, or Four-Mile Bayou, at or near the mouth of a small creek which empties into the bayou, are two large mounds, one of shell and the other of sand. As the owner of the land required pay for the privilege, I made no examination either into their structure or contents. As t is not at all probable that any person will pay the required tribute, the mounds will no doubt remain intact until they fall into the hands of a more liberal owner.

10. TURTLE-SHAPED MOUND, LONG KEY.

Long Key is a narrow island, about five miles in length, lying between Boca Ciega, or Blind Pass, on the north, and Pass A'grille, on the south. About midway between the passes a tongue of land makes out into Boca Ciega Bay toward the southeast, covered by a dense forest of cabbage-palms. The land is good and there is an abundance of oysters and shell-fish along the shores and on the adjacent flats.

It is not without some hesitation that I attribute to this mound a turtle shape, as such an occurrence among the mounds in this part of Florida is an anomaly. Whether the shape depicted in Plate V, Fig. 1, was the result of deliberate design on the part of the builders, or was the accidental result of irregular ditching, I cannot say. The mound proper consists of a structure of sand 108 feet long and 66 feet wide. It is about 5 feet high at the point marked A in the figure. This constitutes the body, or carapace, and tail of the supposed turtle. The ditches, *a*, *a*, *a*, are distinct and leave the flippers, B, B, and the head, C, at the natural level of the land. The view in section, Fig. 2, will convey an idea of what I mean, A being the mound and B, B, the ditches, leaving the flippers as before stated. In other words, the flippers are not the result of heaping up sand, their shape being given by the ditches. Whether the design was to give the form of a turtle or not, the result was precisely the same, the whole structure having a wonderful resemblance to that animal. It is not at all improbable that the ancient architects had that form in view in the construction of this mound, as the beaches of this island are still the resort of hundreds of turtle, which come up to lay their eggs in the sand during the summer; and successful turtle fisheries are now carried on in Boca Ciega Bay, immediately opposite this point.

Some one had dug into the mound before me, but with what result I know not. The excavation was about 6 feet in diameter and 3 feet in depth. I explored it thoroughly in every portion, finding all parts of the human skeleton except the skull. The bodies were buried at full length, and no signs of fire were to be seen. I found several lower jawbones and many teeth, but fragments of crania were not discovered.

One large cedar grew upon the mound, and many tall palm trees, the positions of which are indicated by small circles in the figure. A few oyster-shells were scattered through the sand, but no utensils or ornaments of any kind were found. Pottery was also wanting, and the whole structure and contents indicated a different race, or, at least, different customs, mode of burial, and building, from any of the mounds hitherto described.

11. MOUNDS ON PINE KEY.

About three miles further south, below Pass A'grille, are two islands, divided by a narrow bayou, which are known as Pine Key. On the older maps the northern key is named Cabbage Island and the other Pine Key. On the southern key, below the bayou, is a long lagoon called the Duck Pond. At the southern extremity of this pond, in a dense wilderness of cabbage-palms and saw-palmetto, is a mound of imposing height and considerable size. The view from the top is quite extensive, and looking thence one would suppose that the mound could be seen for a long distance, but such is not the case; in a search of two days I frequently passed within 100 yards of it without finding it.

Explorations had been made previously along the top by persons who professed to have found numerous arrow-heads and ornaments of bone, human skeletons, &c. In my own work I was not so fortunate, as it was with great difficulty that I obtained four crania and one bone ornament inlaid with copper. The bone of this ornament decomposed rapidly upon exposure to the air, but before this happened I was successful in obtaining a pretty correct drawing of it, which was sent to the Smithsonian Institution along with the other relics obtained.

This mound is 135 feet in diameter, and is about 15 feet above the level of the island. However, it is built upon a natural elevation, and the actual structure is not above 5 or 6 feet high. The material was obtained close at hand, and the outlet of the pond appears to have been artificially enlarged by ditching. The evidence is positive that the aborigines visited this island in vast numbers, as the eastern side is strewed with shells, which in many places lie in masses many feet in thickness. Several large palms and a large live-oak grow upon the mound.

12. MOUND AT MAXIMO POINT.

At Maximo Point, on the mainland, is an immense mound, entirely hidden from view by the rank growth of the hummock in which it is situated, surrounded by embankments of shell, winding in all directions like modern fortifications. On the eastern side there is a deep excavation, perhaps 200 feet in diameter, which contains water. The situation for obtaining food was excellent, as the land is fertile and the fishing grounds good.

I did not attempt to make any drawings of this complicated affair, as the growth upon and around it is so dense that a person is obliged to crawl through it, and after following the winding banks for half an hour one is about as likely to come out exactly where he goes in as anywhere else. Cabbage-palms of all sizes, intermingled with thorny bushes, prickly pear, and Spanish bayonet, make progress slow, painful, and unsatisfactory, at the same time obstructing the vision totally.

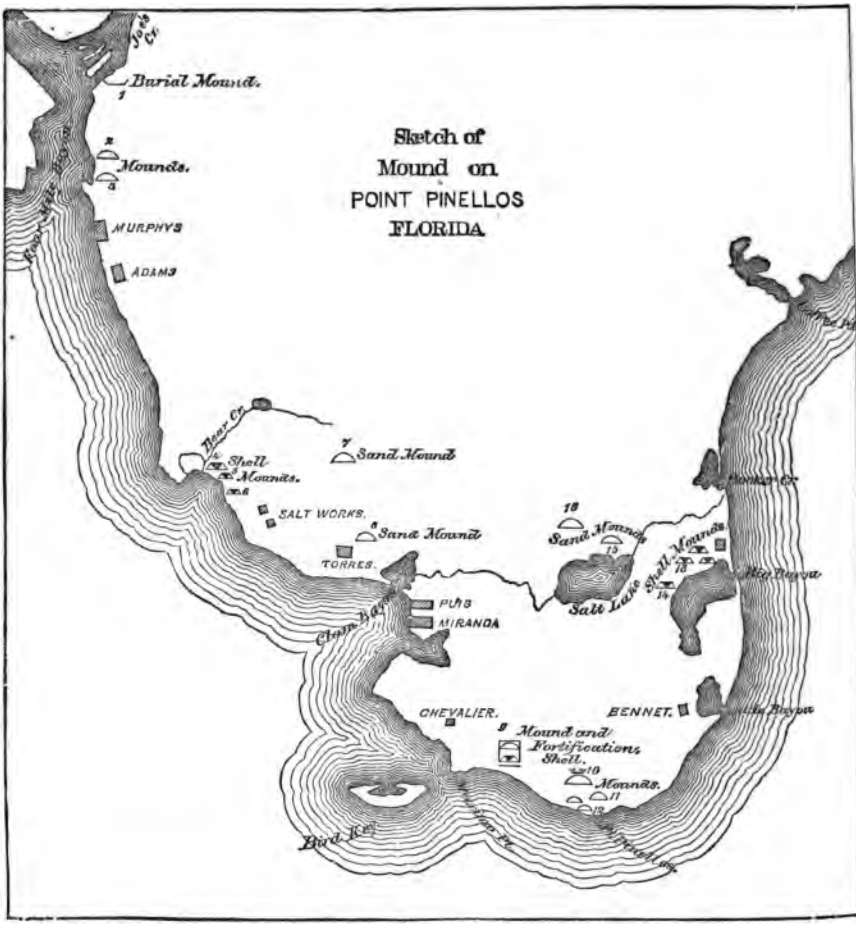
After three or four hours of hard labor, I arrived at the following conclusions: the mound proper is a structure 15 feet in height and several hundred feet in length, level on the top, with three sides almost precipitous. On the south the usual roadway reaches the top by a gentle slope. It is composed of alternate layers of sand and shell, the sand being obtained from the beforementioned excavation on the eastern side, which is surrounded, except in one place, by an embankment, the break in which constitutes an outlet for the water. Along the beach, and extending back to the mound, there are winding banks of shell from 3 to 5 feet high. These continue at intervals along the coast to Point Pinellos, three miles below.

After digging in many places, and finding nothing excepting a few fragments of pottery and the sharpened end of a cedar post, which no doubt formed a part of an ancient building, I gave up the search until fortune should favor me with more leisure and fewer mosquitoes. In the bluffs along the beach, half a mile below, I picked up a skull that had been washed out by the sea, but diligent search failed to reveal anything more.

13. MOUND AT BETHEL'S CAMP.

One mile south of Maximo Point is the most beautiful mound that I have seen in South Florida. It stands about one-fourth of a mile inland, immediately opposite a place known as Bethel's Camp. There are good springs of water along the beach, between which and the mound is a narrow strip of hummock. The mound is situated in a "rosemary scrub," and rises to an imposing height above the low trees in its vicinity. Its outlines are beautifully regular, and all its angles are sharp and well defined.

Its length (estimated) is about 200 feet along the top, and its height 20 feet. It is about 30 feet wide on the top, with a beautiful inclined roadway leading up its western side. Figs. 3 and 4, Plate VI, will give an idea of its ground plan and end elevation. At A, Fig. 3, an excavation was made many years ago, consisting of a ditch 25 feet long. No one could tell me who dug it. On a pine tree at *a*, Fig. 3, the date "1840" is cut in the bark; the tree is about twelve inches in diameter, and is about as large as any of the trees in the vicinity. At the point B, same figure, another pit had been dug, and I was informed by reliable parties that the skeleton of a man had been taken from it—also an Indian pipe. The bones had long since fallen into dust and the pipe been lost. I extended this pit in all directions, but found nothing excepting a few pieces


Sketch of
Mound on
POINT PINELLOS
FLORIDA
Burial Mound.
Mounds.
MURPHYS
ADAMS
Bear Cr.
Sand Mound
Shell
Mounds.
SALT WORKS.
Sand Mound
TORRES.
MIRANDA
CHEVALIER.
Mound and
Fortification,
Shell.
Mounds.
Bird Key
Sand Mounds
Salt Lake
Shell Mounds
Big Bayou
BENNET.

of pottery. I also opened other points, as at *c* and *d*, with a like result. This mound is probably more modern than any of the domiciliary mounds, and may be considered typical of its class.

14. MOUNDS OF POINT PINELLOS.

Nos. 1, 2, 3 are large mounds composed of shell and sand.

Nos. 4, 5, 6 are low shell-heaps (very ancient) on sand flats.

Nos. 7 and 8 are sand mounds, one 2 feet the other 5 feet high.

No. 9 is an immense mound over 20 feet high, built of alternate layers of shell and sand, surrounded by an irregular wall from 5 to 10 feet high, partly shell and partly sand. The dense growth prevented an accurate plan during my short visit, but this is the most stupendous work I have seen anywhere in Florida, slightly explored.

No. 10 is a large oblong mound 25 feet high, built of sand and shell, with a graded way on west side sloping to the top. The sides are precipitous. A pine tree on the summit bears date 1840.

Nos. 11 and 12 are low sand mounds 5 or 6 feet high and 100 feet in diameter.

No. 13 three large shell mounds 25 feet high.

Nos. 14, 15, and 16 sand mounds about the height and dimensions of 11 and 12.

No. 10 is very interesting from the fact that it contained skeletons. An old excavation is visible, probably made in 1840, and one quite recent. One skeleton was obtained a few years ago. I dug in the old ditches extending them in all directions, and obtained numerous specimens of pottery, arrow-heads, and implements, but all were lost in the wreck of our boat. I also explored slightly Nos. 9, 11, and 12, but found nothing valuable.

As the circular sand mounds on Point Pinellos are precisely similar, except in dimensions, I have selected one out of the seven located there for description, that one being in the best state of preservation and combining all the peculiar characteristics of the class.

This mound is situated at the foot of a gentle slope, near a series of shallow ponds, on the northwest quarter of the northeast quarter section 28, township 12, range 31 east, half a mile from the residence of John H. McLauchlin. The structure (Plate V, Figs. 2 and 3) is a perfect circle, 175 feet in diameter and 5 feet high, surrounded by a ditch 6 feet wide and 3 feet deep, except at two points exactly opposite, where the ditch is discontinued and a pathway 6 feet wide left to the interior. The mound is built of sand, and contains no pottery or relics whatever; no signs of fire could be seen, nor any clue, however small, to lead even to a guess as to the uses to which these structures were applied. I have examined four out of the seven mentioned here, with a like result. The growth upon all these mounds consists of large pines, similar in size and age to those in the surrounding forests.

The locations of the remaining six are as follows:

PLATE VI

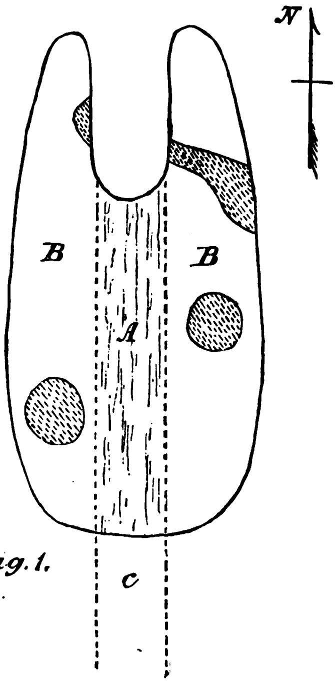


Fig. 1.

Fig. 2.

Mound
— at —
PAPYS BAYOU

Note. The Shaded portions indicate explorations.

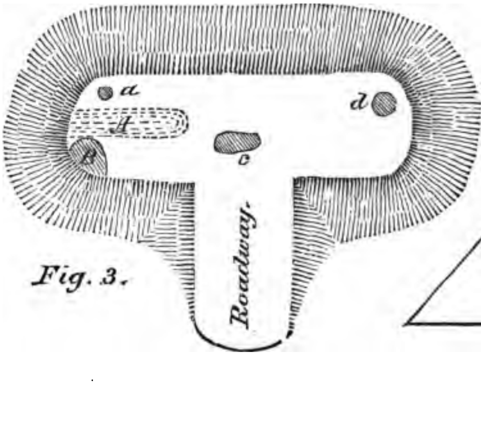


Fig. 3.

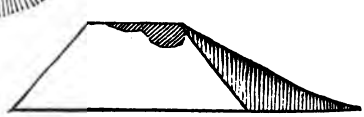


Fig. 4.

One in section 33, same township; one in section 26, ditto; two on the land of Mr. Vincent Leonardi, near Pinellos Post Office, and half a mile from the Salt Lake; and two on the extreme point one mile south of the large mound at Bethel's Camp.

The one in section 26 is the largest and highest, being perhaps 250 feet in diameter and 7 feet high. The neighborhood school-house stands upon it. The others are similar in dimensions to the one described.

15. MOUNDS AT PAPY'S BAYOU.

These mounds are situated on a narrow peninsula on the north side of Papy's Bayou, on Old Tampa Bay. The place is known as Pillan's Hummock, and had been settled at some time in the past, but I presume the settlers fled before invading hosts of mosquitoes and sand-flies. A few tumble-down houses in a small clearing, surrounded by straggling orange and lemon trees will serve as a starting point to any one seeking the mound. From these "improvements" a due north course will bring one into the neighborhood of this rather singular structure.

It is an oval-shaped mound, about 5 feet high, situated on a low ridge in a very dense hummock. For 100 feet a ditch 2 feet deep runs in the direction of its longer diameter. At this point the structure forks, and two embankments 5 feet high continue for 50 feet, making the entire length of the mound 150 feet. The shorter diameter is 75 feet in the center, and at the southern end it is 60 feet wide. The central trench is 15 feet in width, and from the southern end traces of a ditch or ancient road may be followed several hundred yards into the hummock. The embankments forming the forks are 20 feet wide where they leave the main structure, gradually narrowing down to 10 feet at the ends. Fig. 1, Plate VI, represents a ground plan of the mound, A being the central depression, and B, B, the higher portions. C represents the trail or roadway leading to the mound. Fig. 2 is a section across the end, looking down the ditch.

Excavations revealed human bones in every portion of the mound, but by far the larger part occupied the central trench. They were in a bad state of preservation, and I succeeded in getting out only three sufficiently sound to bear transportation, after thorough saturation with boiled oil. I also found one whole bowl, but on my taking it out the bottom crumbled into powder, and the rim broke into several pieces; enough was preserved, however, to make restoration possible.

The mode of burial was precisely the same as that described minutely in the history of the Ormond mound, and represented in Fig. 2, Plate III, which renders repetition unnecessary.

The growth on the mound consisted of small oaks, and was precisely similar to that around it. It lay with its longer diameter toward the north.

Three or four hundred yards west of this is another mound, composed of alternate layers of sand and shell, 150 feet in length, by 45 in width, lying in the same direction as the other. It differs from other mounds of this class in sloping gradually from the southern to the northern end. No doubt the northern end was once level and contained a dwelling. At the highest point it is about 4½ feet above the level of the earth. Excavations here brought nothing to light worthy of note.

MOUND AT BAYVIEW.

We now have arrived at a mound which, though of insignificant size, yielded a rich and valuable collection of Indian relics. It is situated on the south side of Alligator Creek, which empties into Old Tampa Bay, one mile north of Bayview Post Office. It is located in a dense spruce-pine scrub, on the northeast quarter of the southeast quarter section 8, township 29, range 16 east, half a mile north of the residence of Mr. Rufus McMullen. So low and flat was this mound previously to the excavation that one might have walked over it without noticing it. I am indebted to the courtesy of Mr. McMullen for my knowledge of this mound, for without his assistance I should never have been able to find it.

The mound was circular in shape, 46 feet in diameter, and not above 3 feet above the level of the ground in its highest part. It was a mass of human bones, disposed in three strata or layers, the mode of burial differing very slightly from that figured in Plate III.

In the lower stratum I found no ornaments and but little pottery, but in the middle and top layers, especially the latter, nearly every cranium was encircled by strings of colored beads, brass and copper ornaments, trinkets, &c. Among other curious objects were a pair of scissors and a fragment of looking-glass. By using patience and care I obtained many strings of beads in the order they were worn by their owners. In two cases fragments of string remained in the beads, preserved by the copper. The beads, many of them being of cut glass and of various colors, were very beautiful.

The latest interments in this place evidently took place after the invasion of the peninsula by the Spaniards, and cannot possibly be older than three hundred and forty years—probably much less. The peculiar pattern of the scissors may throw some light on the subject when examined by persons competent to judge. It is possible that many of the beads and trinkets may have been obtained from De Soto's expedition, for tradition points out Phillippi's Point, eight miles north of this, as the place of his landing. I also obtained thirty-four skulls, carefully selecting the best specimens from each layer, together with numerous fragments of ornamental pottery. These, all carefully labeled, were sent to the Smithsonian Institution at the time.

MOUND AT PHILLIPPI'S POINT.

This is one of the largest mounds on Tampa Bay, and it is unfortunate that there are impediments in the way of exploration. The structure is nearly half an acre in extent, and four different men claim an interest in it, a land corner being located on it; besides this it supports an orange grove. The location is beautiful, the land fertile, and fresh water abundant.

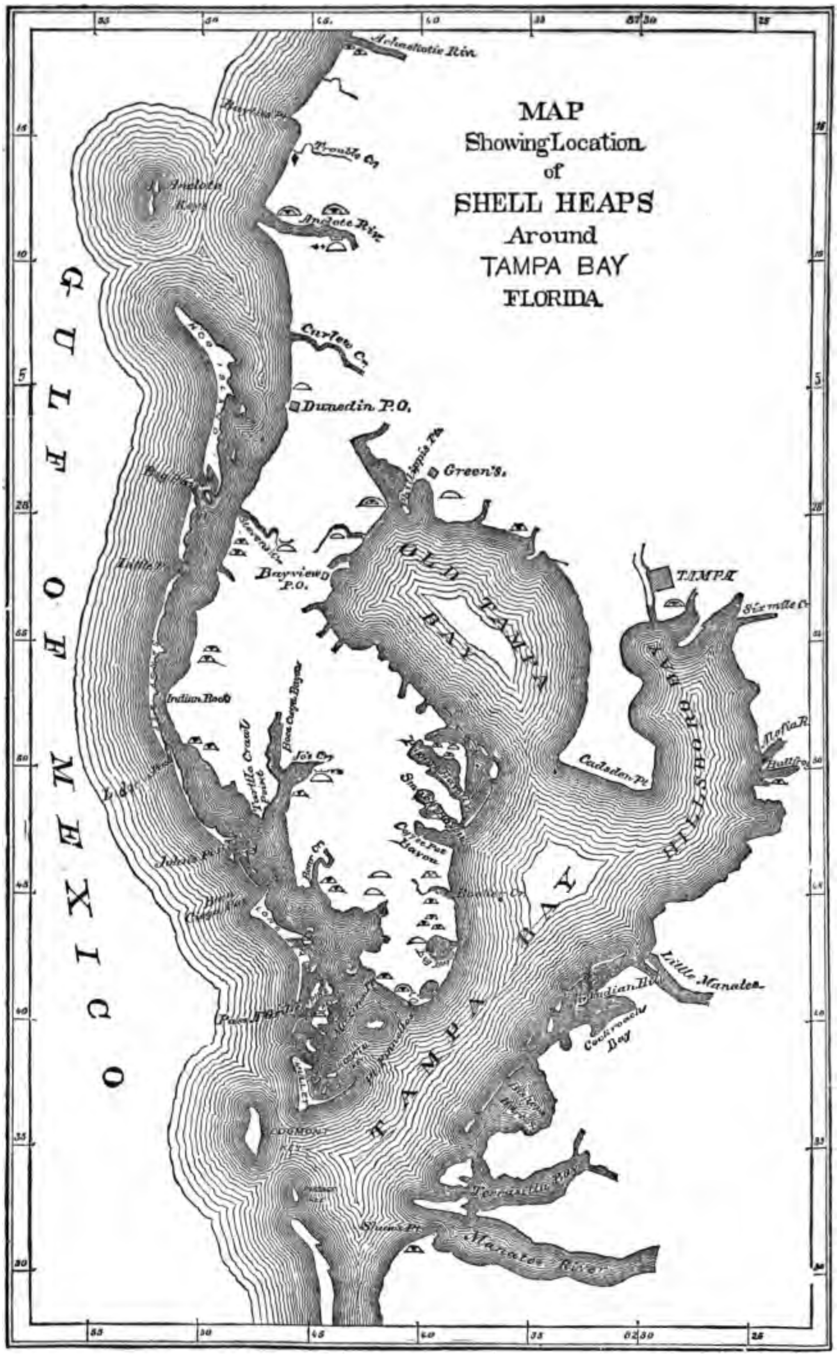
Some years ago a storm drove the waters of the bay against it, carrying away a portion of the eastern base and exposing its internal structure. It is built of sand and shell in alternate layers. It is said that many bones were washed out of it at the time; but its structure and general appearance indicate that it was designed as a domiciliary mound, like others of its class. As the permission of the owners was necessary before anything could be done, I did not take any measurements or make any explorations.

VOGDES' MOUND AT TAMPA.

I will conclude the present report with a description of this mound, copied from the Tampa Sunland and Tribune of November 18, 1876, written by Lieut. A. W. Vogdes, of the Fifth Artillery, U. S. A., not that I agree with any of his deductions or conclusions, but simply because it contains a very minute description of what he found in the mound. I will further state that it is *not* a shell mound proper, but is built of alternate layers of sand and shell, like all the domiciliary mounds hitherto described. The measurements, which he neglects to give, are: Length, 108 feet; width, 100 feet; height, 7 to 9 feet. The sand was obtained close at hand from excavations along the western base. I examined the shells taken from several layers, and found none that are not common and abundant in the bay to-day, and I see no good reason for attributing to this mound a greater age than any described in this report because some of the shells are found fossil in the Pliocene. Partial cremation, which I have shown to have been common in this region, will account satisfactorily for the charred bones, and relieve the aborigines of the unnecessary charge of cannibalism.

"On the military reservation of Fort Brooke, near the sea-shore, there are several shell mounds, the largest of which the writer has spent many spare moments investigating. After carefully measuring this mound we dug into its center, and at a depth of 5 feet struck a layer of oyster shells (*Ostrea virginianum*) about one foot in depth. Below this heap we found the remains of a mound-builder, a male, giving us the following measurements: The greatest longitudinal diameter [of the cranium], 7¼ inches; breadth between the points of parietal bones, 4½ inches; internal capacity, measured with No. 8 shot, 21 pounds, avoirdupois; circumference, taken by tape measure on a plane, including glabella, occiput, and lateral points, 21 inches. The body lay at an angle of about 10°, the head lowest and towards the east. No ornaments were found deposited with or near the remains.

"During other visits to this mound, and after making many excava-


MAP
Showing Location
of
SHELL HEAPS
Around
TAMPA BAY
FLORIDA
GULF OF MEXICO
OLD TAMPA BAY
TAMPA BAY
HILLSBORO BAY
TAMPA
Dunedin P.O.
Bayview P.O.
Green's.
Anclote Riv.
Carter Cr.
Cadsden Pt.
Little Manatee
Cockroach Bay
Manatee River
Terraceia Bay
Shaw's Pt.
Indian Rock
Six mile Cr.
Trouble Cr.

tions on the crest and at its base, we were enabled to find the position of former fires, which give some evidence of the former cannibalism of the ancient people of Florida. We found near this fire but few remains of implements, consisting of one arrow-head, very primitive, broken pieces of pottery, a few ornamented with very rude stamped figures, which generally consisted of raised lines drawn at equal distances from each other.

"The animal remains consisted of the bones of the dog, a claw of the common crab, and a human tibia burned and split, which discovery almost directly points to the cannibalistic habits of the mound-builder. We were so fortunate as to procure several specimens, one having the anterior process, which shows some tendency to flatten above the nutrient artery.

"The evidence we have to offer regarding the age of the mound is very unsatisfactory, consisting of rude pottery which would point to a greater age, or parallel with the mounds on Saint John's River; but we find this pottery in another place on the same mound. (Plate I, *a*, *b*.)

"The shells point more or less to the Pliocene age, although the mound gives us a limited genera. We find the *Busycon carica*, a common shell on the Atlantic coast, but occurring as a fossil in the Miocene of Maryland, South Carolina, and North Carolina; *B. perversum*, fossil in the Pliocene of South Carolina; *Ostrea virginianum*, common to the coast, but fossil in the Pliocene; *Pyrula pyrum*, fossil in the Pliocene of South Carolina. The larger specimens are still common (according to Holmes and Toumey) to the Atlantic coast. We find in this mound the larger and smaller specimens mixed."

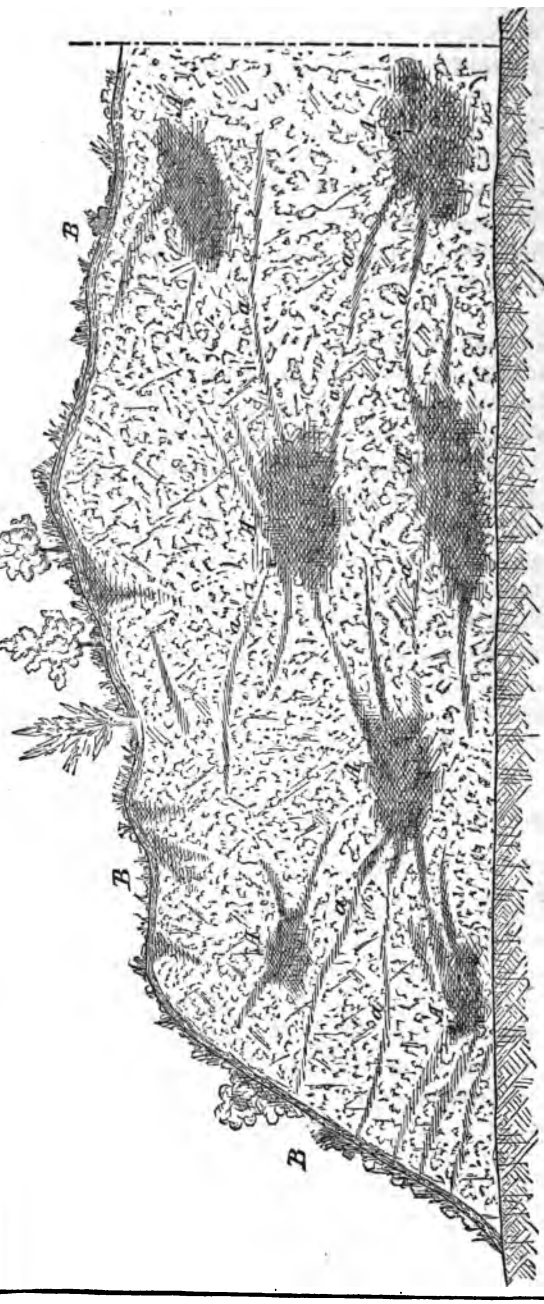
REPORT ON THE SHELL HEAPS OF TAMPA BAY, FLORIDA.

By S. T. Walker, *of Clear Water, Florida.*

No little speculation has been expended upon those vast accumulations of shells which line the coasts of Florida, and stand as silent witnesses of the labors of an ancient people that once inhabited this peninsula. These immense mounds strike the mind of the beholder with amazement when he considers the limited resources of the savages who constructed them; for in the presence of these great monuments the largest domiciliary mounds of sand sink into utter insignificance, and it becomes hard to realize how the united efforts of a savage people, the larger part of whose time must have been occupied in procuring a bare sufficiency of food, could have been concentrated on such useless works for a sufficient time to erect them.

It was thoughts like these which first led me to examine them critically, in order to discover the object of their erection and the method of their construction. Mound after mound was explored with pick and shovel, and every object that presented itself, however minute, was ex-

PLATE I



SECTION OF SHELL HEAP

AT

SHAW'S POINT. MOUTH OF MANATU RIV. FLORIDA.

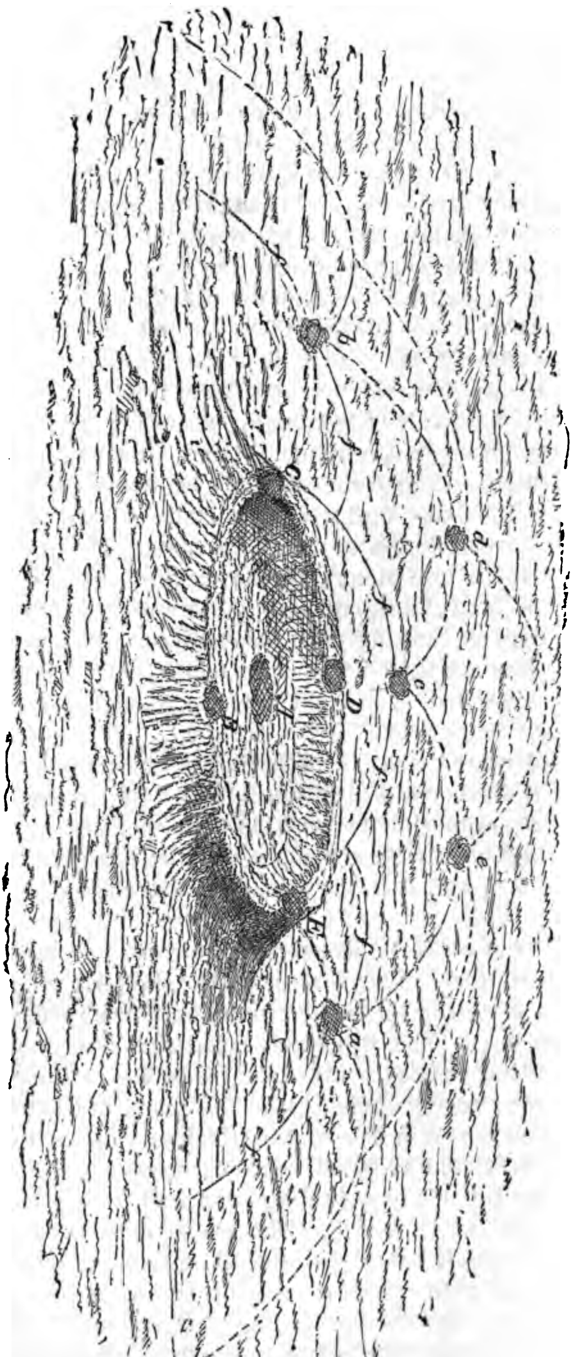


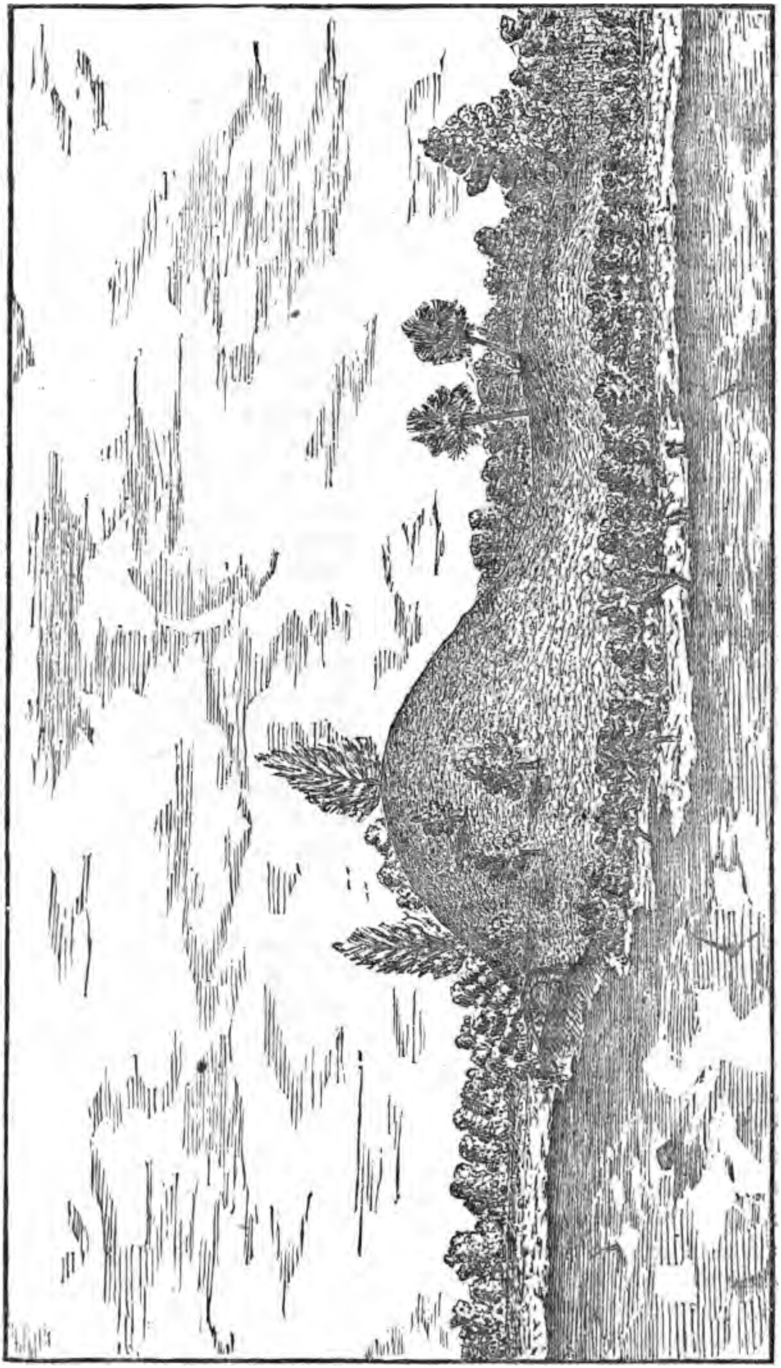
PLATE II.

amined with care and interest; but the mystery remained, and its solution seemed as difficult as at the beginning. These explorations were continued for two years, at intervals snatched from business, and during that time I examined many mounds of various sizes; but, owing to their great dimensions, and the extreme difficulty of opening them with the limited means at my command, I was very little wiser than when I began, except that I became familiar with their contents, and was prepared by some experience and thought to grasp the secret when opportunity threw it in my way. This opportunity occurred in November, 1879, while I was connected with the United States Fish Commission, at Shaw's Point, mouth of Manatee River.

The shell heaps or mounds at this place extend along the shore 564 feet, and are from 15 to 20 feet in altitude at the highest points. The encroachment of the sea upon the northern front has cut away the slope and left a perpendicular wall 15 feet high, presenting a perfect section of the mound through its greater diameter, and affording a better view of its internal structure than could possibly be obtained by anything short of many months' labor and the expenditure of many hundreds of dollars. Here the archæologist may read the history of the shell heaps, as the geologist reads the history of the earth, in the sections presented by bluffs or land-slides, and on that crumbling wall is written the prosy, practical fact that, far from being witnesses of industry and of patient labor, they are the mighty monuments that want and hunger have erected to appetite! The shell heaps are simply the *débris*, the fragments, of former feasts.

In order to understand what is to follow, the reader is referred to Plate I, where a rude sketch of a portion of the wall is presented. The shaded points A A, represent the position of former fires; *a*, *a*, *a*, thin strata of soil in which are scattered bones of the turtle, crabs' claws, spines of the sea-urchin, &c.; and B B, the surface soil on the top and sides of the mound.

Referring now to Plate II, let us suppose a company of savages to encamp and build fires at A. They feast upon the shell-fish procured upon the adjacent flats, throwing the shells around the encampment at some distance from the fires. The fishermen bring shark, drum-fish, crabs, &c., and the hunting parties bring deer, birds, &c., whose bones are added to the ever-increasing circle around the camp, until in the course of time the wall has grown in height and thickness so as to encroach upon the central fires, and removal becomes necessary. The fires are now removed to the top of the encircling heap, and occupy its periphery at many points, as B, C, D, and E. The shells and fragments again being thrown on all sides, but the center, A, receiving half the shells from all the fires along the crest, it naturally grows to be the highest, the dotted lines *f*, *f*, *f* showing the outline of the mound at this stage. The shells having again encroached upon the fires, another removal becomes necessary to higher points, and so the structures ascend, always



Mound at Bullfrog Florida

growing highest in the center, until in the course of long ages they attain their present imposing altitudes and dimensions. Whenever a fire-place was abandoned for any considerable time, a thin stratum of soil accumulated, in which we find occasional bones, shell, &c. These strata, which are quite thin, are represented by shaded lines as *a*, *a*, Plate I.

In confirmation of this view, I refer to the circles of shell E E, in the ground plans of the mounds at Shaw's Point and Indian Hill, Plates III and IV, which are the beginnings of new mounds.

I do not wish to be understood as affirming that the plan I have described was pursued in the regular order I have indicated. Far from it. The irregularity of their shapes proves rather that their erection was due to chance rather than design, and the long irregular walls running parallel with the beach show that in many cases the fires were scattered along the shores, and that it was only when forced by the accumulating mass that the fires were removed to the top of the heap. Indeed, where room was afforded we generally find walls or banks, and in most cases the largest shell-heaps occur where the savages were crowded together on the higher grounds nearly or quite surrounded by water, as at the mouth of Bullfrog, and notably at Indian Hill, but there are, of course, exceptions to this rule.

The materials of which the shell heaps are composed are indicated by the name applied to them, shells constituting by far the larger portion of the mass, differing only in the species composing them; and here I will state that, after diligent search, I have never discovered a shell in these heaps belonging to a species that is not common in Tampa Bay to-day. The kinds of shell that predominate are those which are most abundant in the immediate vicinity. Thus, if the mound be located near oyster-bars, as on bayous, or near the mouths of creeks or rivers, we find that shell constituting the mass of the structure. If on or near sand-flats, we find conchs, clams, scollops, &c., predominating. Intermingled with the shell, but forming only a small part of the mass, are crabs' claws, and the bones of the turtle, shark, drum-fish, deer, and sea-birds, occurring as named, the bones of the turtle being most plentiful. Broken pottery of a very thick, heavy pattern, without ornament, is scattered about the sites of former fires. Stone ornaments and arrow-heads are sometimes found on the surface, but never, to my knowledge, in the interior of these mounds.

In one instance only I discovered human bones in a shell-heap, viz, in the small detached mound marked E, Plate IV, Fig. 2, where a ground-plan of the shell-heaps at Indian Hill is given. The bones were those of women and children buried in a doubled position face downward. The bones were all crushed and broken by the weight of the superincumbent mass, and I obtained but one partially perfect skull. The short time at my disposal here did not permit me to make the work at all thorough. At every point opened on this mound I found human bones, even along the sides and near the base, and in such close proximity to ancient fires that the advocates of the "cannibalistic propensities of the ancient inhabitants" would need no further proof. I admit that the finding of human bones in the fragments of a feast looks, to say the least, a little suspicious, especially as they occur in company with those of the turtle and deer, but I think we can account for it satisfactorily without resorting to the repulsive theory of cannibalism.

In the first place, it must be remembered that these heaps are composed of very loose materials liable to move and change position at the slightest touch, and it is not only possible but extremely probable that the bones found near the sites of former fires along the sides and base had been carried there by the sliding down of the shell along the crest where they were originally decently interred. All the bodies found upon the crest had been buried in the usual manner and none of them were on or near a fire-place; hence I argue that these were chance burials made long subsequently to the erection of the mound, and in no manner connected with the history of its erection.

Having now considered the origin and construction of the shell-heaps nothing remains but to give a list of the principal ones along the shores from Clear Water Harbor, on the Gulf coast, around Tampa Bay, to the mouth of Manatee River.

The first shell-heap of any consequence occurs at Dwight's orange grove, one mile north of Clear Water post-office. It consists of two long heaps lying nearly parallel with each other, and at right angles with the coast, and one rather small one between them. These heaps are 300 feet long and from 10 to 15 feet high. From these heaps a well beaten roadway extends 150 yards to a fresh-water pond. The roadway is still distinct, although the land has been in cultivation for ten years.

Two small heaps occur five miles south of this, near Indian Pass Church.

The next of importance is on Four-mile Bayou, near Murphy's.

Two more occur near the water's edge on the sand flats at the mouth of Bear Creek, Boca Ciega Bay.

Extended banks of shell wind along the shores in every direction at Maximo Point, Boca Ciega Bay, and continue at intervals all the way to Point Pinellos, occasional mounds occurring here and there at different points.

At Pinellos post-office, on Big Bayou there are three immense shell-heaps, 25 or 30 feet high, and from 300 to 400 feet in diameter, composed almost entirely of oyster-shells.

One mile north, on the land of Mr. Cox, is a large shell-heap nearly a mile inland. It is about 15 feet high and 200 feet in diameter.

On Booker Creek, one mile north of this, are several large shell-heaps on the premises of Mr. Williams. These heaps are from 25 to 30 feet high, and from 300 to 350 feet in diameter. The largest can be seen for several miles.

PLATE III

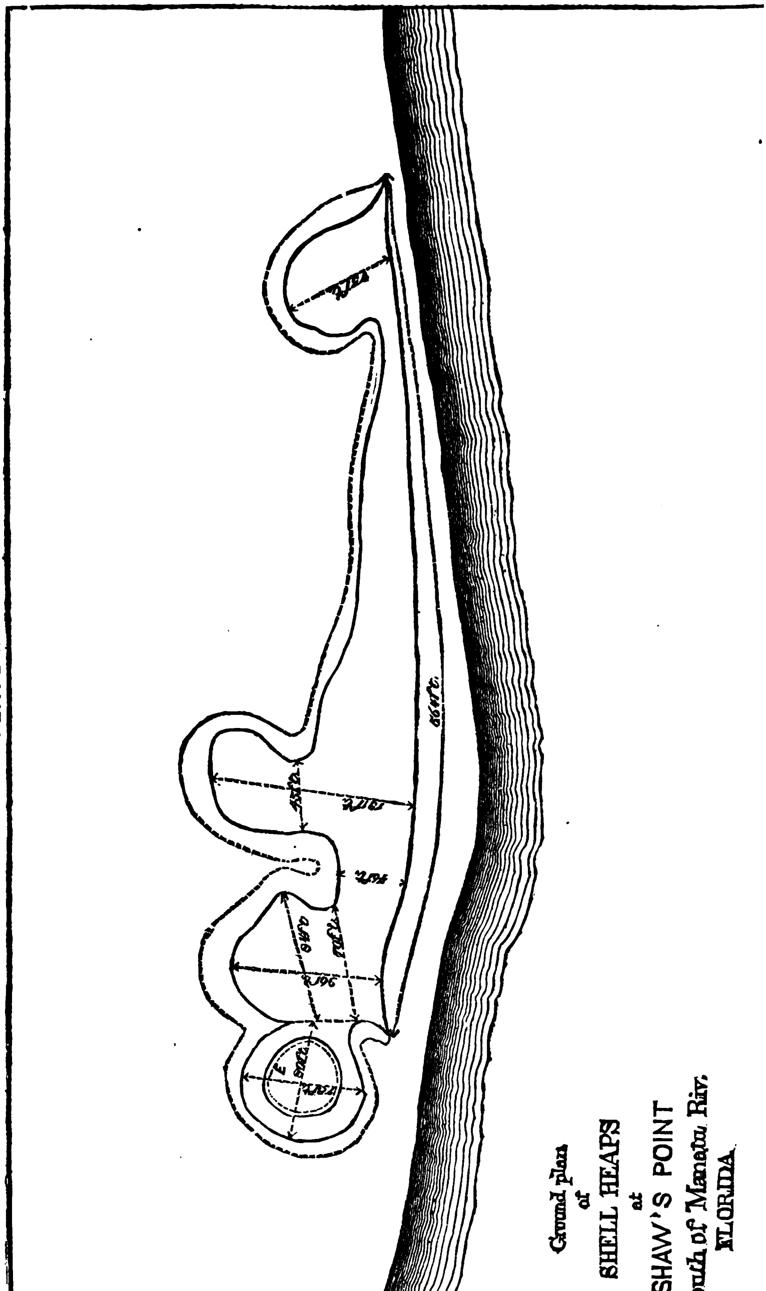

Ground plan
of
SHELL HEAPS
at
SHAW'S POINT
Mouth of Manatee Riv.
FLORIDA

PLATE IV

Fig. 1

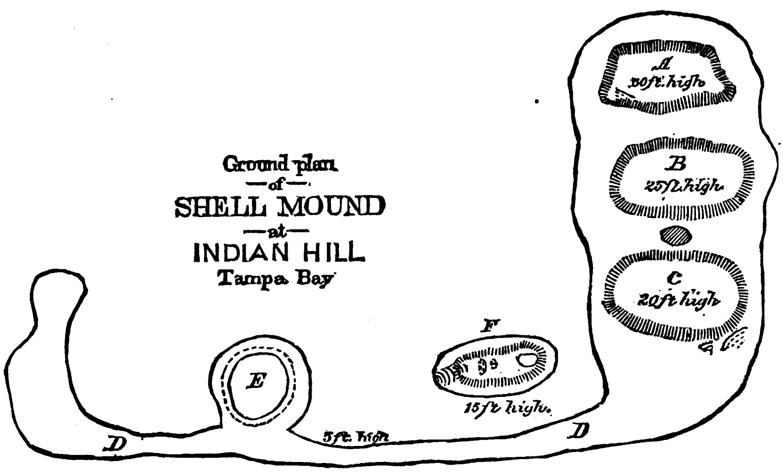


Fig. 2

Passing over many small collections, we come to the great shell-heap at the mouth of Bullfrog Creek, 10 miles southeast of Tampa. This mound is 30 feet high and 200 feet in length by the same in breadth.

Next in order is the shell-heap at Indian Hill. This mound, with the shell banks connected, is 700 or 800 feet in length and from 20 to 30 feet high. The three highest pinnacles rise above the trees and may be seen four or five miles at sea.

The last of the great shell-heaps of Tampa Bay is the mound at Shaw's Point, mouth of Manatee River, which has been described at length in this report. The ground-plan, Plate IV, gives all the dimensions of the crest. Of course the base is much greater.

MOUNDS ON GIDEON'S FARM, NEAR EXCELSIOR, HENNEPIN COUNTY, MINN.

By Frank H. Nutter, *of West Roxbury, Mass.*

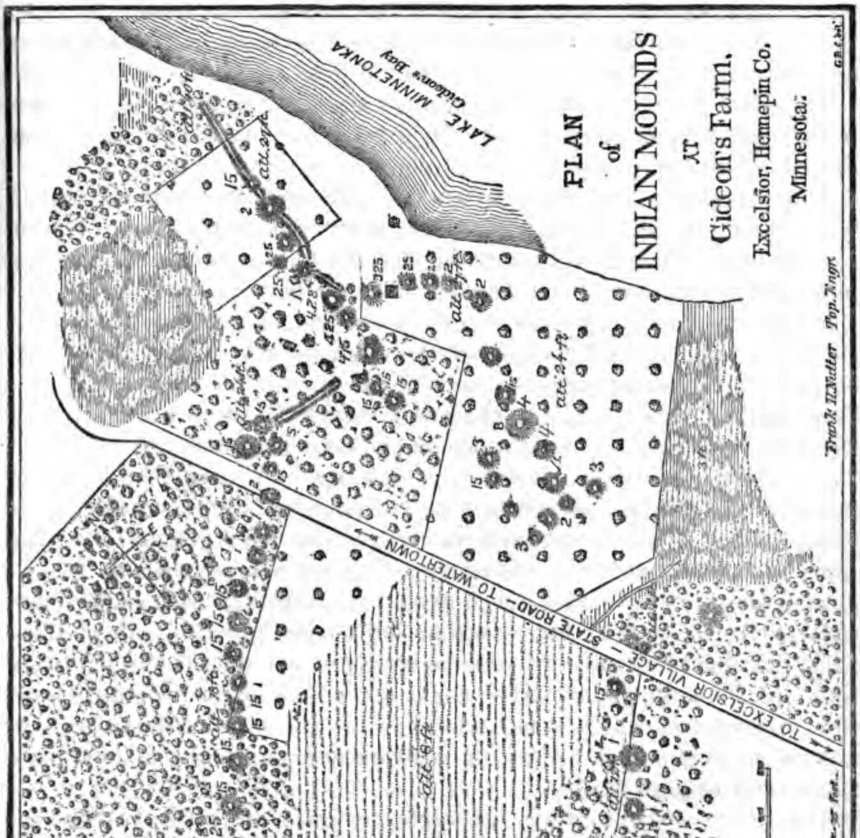
The accompanying plan shows one of the groups of Indian mounds on the shores of Lake Minnetonka, in Excelsior Township, Hennepin County, Minnesota.

Excelsior is in the same county as Minneapolis, and is, by road, eighteen miles west of that city. It lies in the edge of the "big woods," a belt of hard-wood timber extending nearly across the State. The country is very rolling, though the hills are not generally of much height, and, except where cleared by the farmers, or in the sloughs around the numerous lakes, are covered by a heavy growth of hard wood, mostly of the following varieties: white, burr, red and black oak, rock and rarely white maple, white and slippery elm, basswood, and ironwood, or hop hornbeam. Except on the shores of the lakes, rocks and stones, even of small size, are very scarce.

This lake was in former years the hunting-ground both of the Dakota and Chippewa Indians, and as they were deadly enemies, has doubtless been the scene of many battles. The last one was fought about twenty years ago at Shakopee, on the Minnesota River, about eight miles south of this point, in which several lives were lost.

The group of mounds shown on the plan is located about one and a half miles (by road about a mile farther) northwest of Excelsior Village, at the head of a branch of the lake, known as Gideon's Bay. In the map the location is marked by a cross. As shown on the plan, there can now be distinguished sixty-nine mounds (one was leveled to afford a site for the house), and two lines of embankment, one running nearly north, the other about west. The largest, together with the embankments, are found mostly in the grove and the orchards overlooking the lake, and on the height of ground, as shown by the figures on the plan, giving approximate heights above the present level of the water.

The trees of the grove are fine forest trees, left when the land was


PLAN
of
INDIAN MOUNDS
AT
Gideon's Farm.
Excelsior, Hennepin Co.
Minnesota.
LAKE MINNETONKA
Gideon's Bay
STATE ROAD — TO WATERTOWN
TO EXCELSIOR VILLAGE
Scale of feet
Frank H.Nutter Top. Engr.
MOUNDS AT LAKE PARK One Mile N.E. of Gideon's.
Lake Minnetonka

cleared, twenty-five years ago, and are of very large size. I have shown on the plan several whose position on the mounds would indicate that the work was finished before they took root upon them. These trees are elm and bass-wood, and from 1½ to 2 feet in diameter.

The wood land, except an occasional culling for fire-wood, has not been touched since the country was settled, and no difference can be distinguished between the growth upon the mounds and that elsewhere.

The "grass-meadow," though now dry and used for pasturage, was, when the farm was settled, impassable, but by opening it more freely to the light and air, and on account of the subsidence of the lake, it has now become dry land. There seems to be no doubt that at a comparatively recent date this tract and the other sloughs around the lake were submerged and formed portions of the main body of water. This fact may account in some degree for the peculiar arrangement of the mounds. The rapidity with which the shallow portions of protected bays and small bodies of water in this section become land is very wonderful. The pioneer plant is the wild rice, growing in almost impenetrable masses, in from 1 to 3 feet of water. Other aquatic plants and mosses follow, which afford a foothold for sedge and wild grass, while the gradual fall of the water, owing to continued winters without heavy snows, assists in hastening the process. I myself this season went dry-shod across a meadow where seven or eight years ago a boat was necessary. A short distance to the north of these mounds, but beyond the limits of the map, are sloughs, which extend to the "Upper Lake," so the two sheets of water, which, measured on an east and west line, are now about a mile apart, probably were once separated by a much narrower neck of high land.

These mounds, excepting the scattering ones south of the "grass-meadow," are located about on the height of land and on the brow of the slope running down to the low land inclosed within their circle. Those within the woodland are not generally of much height, as will be seen by the figures on the plan, and as they are unprotected by turf or grass, every severe rain assists in washing them down, and must finally obliterate them, as the last twenty-five years has plainly shown.

The necessary cultivation of the orchards is also destroying these interesting remains of some former race, although the owner of the farm takes much pride in them, and does all he can to preserve them.

The embankment which runs parallel with the lake shore once extended nearly across the orchard south of the house, but now all trace of it is lost. It is, in section, a ridge, sloping equally on either side, and where best preserved is about 25 feet wide and 2½ feet high.

A little mound in the north orchard has been opened. At the depth of 5½ feet, somewhat below the original surface of the ground, were found between thirty and thirty-five skulls, arranged in a circle of from 5 to 6 feet in diameter, and embedded in and covered with sand, evidently brought from the lake shore, as the soil is a clay loam. These skulls rapidly crumbled on exposure to the air, so they were returned to their resting-place, and again covered with earth. One of these skulls was cloven from the top of the head to the jaw, as though by an ax, and a lower jaw, which, though in two portions, seemed to belong to the skull, also bore witness to the force of the blow.

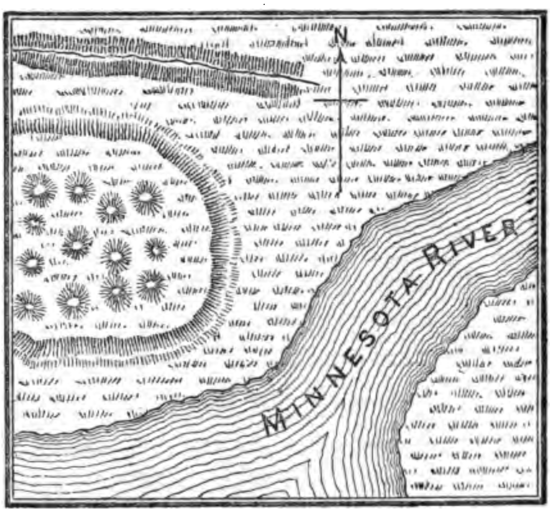
To Peter M. Gideon, esq., owner of the farm where the mounds are located, and superintendent of the State Experimental Fruit Farm, which adjoins it, many thanks are due for his kindness in giving information, and for assistance rendered in making the survey.

The group of mounds shown in the upper left-hand corner of the plan are, as their title shows, at Minnetonka Lake Park, and about one mile in a straight line to the northeast of the larger group. They are situated where the strip of high land between the upper and lower lakes has diminished to the narrow limits shown in the plan. About a quarter of a mile farther north it ends at a large slough, through which winds the narrow creek which connects the two lakes. These mounds have not been explored.

I am informed that about two miles southwest of "Gideon's" there are about forty or fifty mounds, thrown up close together, and covering two or three acres of ground. They are not on the shores of the lake, but some distance inland.

At the west end of the "Upper Lake," and about seven miles from the group shown on the plan, is Mound City, a small settlement so named from the number of the mounds which are found there.

At Ferguson's Point, about two miles north of Excelsior Village, on the east shore of the lake, is another collection of mounds, and at many of the prominent points and headlands of the lake shore may be found one or more mounds. Other employment however, has prevented me from finding opportunity to visit them or obtain further information in regard to them.



Mounds at Eden Prairie, Minn.

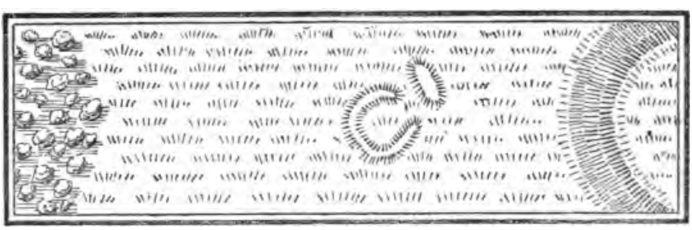
The following information, which is of rather a miscellaneous character, I have obtained through the kindness of a friend, who is also a civil engineer. "The Indian mounds which in a former letter I located at Eden Prairie, are in Bloomington Township; about twelve miles southeast of Excelsior. I give a rough sketch taken from my note-book, which will give some idea of the locality.

"These mounds, thirteen in number, are of the usual size, and are situated in what is now an open field, on a level plateau, from which the land slopes rapidly away on the south to the banks of the Minnesota River, and on the north into a deep, narrow ravine, through which flows a brook. I do not think these mounds have ever been examined in any way."

This engineer was also engaged in the survey and subdivision of the reservation assigned to the Sisseton and Wahpeton tribes of Indians, in Dakota Territory, and in the work found the mounds to be very abundant and located some of them in the survey. The Indians, though unable to explain their origin, have a great reverence for them, and will not allow them to be disturbed if they can prevent it.

The mounds which I mention are all on or near the summit of the Dakotas, and overlooking the valley east of them. The first one noted was on the eastern edge of the hills, and was about 20 feet in diameter and 3 feet high. It had been occupied by foxes, and at the mouths of their burrows human bones were abundant. Near the corner of section 16, township 126, range 52, was a large mound 50 feet in diameter and 4 feet in height, located exactly on the top of the Dakotas, and overlooking the whole valley. A pit was sunk in the center of this, and scattered through the soil were found bones, but so thoroughly decomposed as to be but little more than deposits of lime. At the depth of 4 feet, the original surface of the ground, was struck what seemed to be a layer of lime cement, and so hard that a couple of hours' labor with spades only penetrated to the depth of 3 or 4 inches. At this point time failed, and the workmen were obliged to abandon their investigations.

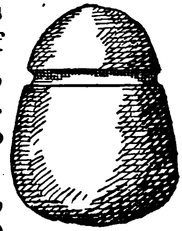
About one and one-half miles northwest of this mound was another, 75 feet in diameter and 10 feet high, but there was no opportunity to examine it.



Earthwork near Sisseton and Wahpeton Res., Dak. Ter.

In this vicinity they also found an earthwork, which, in its shape and good preservation, seemed to be of rather more recent origin, and to be the work of white men rather than Indians; although the military officers connected with the reservation could not account for it, as there had never been an Indian war in that vicinity. It may have been erected by some of the early pioneers or explorers. It was about 75 feet in diameter, with the entrance also protected, but it was almost useless for defense, as it was commanded by a hill-top about 600 feet distant, and 49 or 50 feet above it. On the other side was a belt of timber about a rifle-shot away. Within the enclosure was found a human skull with a metal arrow-head embedded in it, thus hinting at the fate of its builders. I give a rough sketch of the locality.

Around Lake Minnetonka arrow-heads and other implements are sometimes found. I was shown a stone hammer this summer, but was unable to obtain it. It was made of an egg-shaped quartzose pebble, was $4\frac{1}{4}$ inches long, $3\frac{1}{4}$ in diameter, and would weigh about four pounds. It had a deep groove around it, probably to bind it to its handle.



Stone hammer from Lake Minnetonka.

I also examined the skull, probably of an Indian, which was found while excavating for a street in the city of Minneapolis. There were three or four bodies close together, which had evidently been buried for a long time. The appearance of the teeth showed it to be that of a person in the prime of life. It measured in circumference 21 inches, and from ear to ear, over the top of the head $12\frac{1}{2}$ inches.

SUMMARY OF CORRESPONDENCE OF THE SMITHSONIAN INSTITUTION PREVIOUS TO JANUARY 1, 1880, IN ANSWER TO CIRCULAR NO. 316.

By Otis T. Mason.

The following report is a collection of abstracts from the replies made by archæologists in various parts of our country previously to 1880, in answer to Circular No. 316. Allusions to collections of fine specimens are purposely omitted.

The readiness with which many have responded to the circular is a good omen for the future. It is designed, at some future time, to prepare an exhaustive work upon our North American antiquities. This, however, cannot be done until every township is heard from, and the antiquities of those which contain remains accurately described.

If in the present summary any incorrect statements occur, or if the authors wish to make more extended observations, it is hoped that all interested in the subject will keep the Institution posted upon the very latest results of exploration.

It may be that, in this first effort to epitomize the labors of many correspondents, the names of some are omitted. If such be the case, they are invited to let the Institution know of it, and the correction will be made.

OREGON AND THE NORTHWEST COAST.

Eells, M.—The Twana Indians have a tradition that the agate arrowheads found about here were made by the wolf before he degenerated into his present form.

Felserthal, L.—Is collecting facts and traditions relating to the use of shells by the Nez Percés and Klikatats, Pelouses, Spokanes, and Columbia River tribes, Oregon. The writer describes a shell used by the Indians to ward off the "evil eye," and to keep them from being made sick by their "medicine men."

Swan, J. G.—Is collecting photographs of the Indians of Queen Charlotte's Islands with a view to studying the tattoo marks. On shaving a young chief of the Clyokwat tribe, near Nootka, he observed the close resemblance of some of the marks to Habel's drawings. The bird of the sun devouring a human victim is the Thukloots, or Thunder Bird, of all the coast Indians, and the only difference is that Thukloots devours whales. The coast Indians serve their enemies as the priest is serving his victims in Habel's plate I. They do not scalp their enemies, as do the Indians of the plains.

CALIFORNIA AND ARIZONA.

Barton, Stephen.—No large remains are found in Tulare County. The only earthworks are small ditches and cavities such as are now used by Indian doctors for the erection of "sweat-houses." The tribes now here seem to have been the true aborigines and claim to have sprung from the adjacent hills. Rock paintings are found in abundance. One on the north bank of Kaweah River, eighteen miles northeast of Visalia, contains pictures of fishes, owls, and rabbits. The paint is about the color of red lead and very durable. The natives bury their dead in cemeteries, the graves grouped by families. The body is folded in a sitting posture with the head between the knees. After burial the ground is leveled off, and small stones which the family can identify mark the grave. Large pots or basins have been found carved in granite rock, from 1 to 3 feet deep, and from 5 to 8 feet in diameter, holding from one to ten barrels of water each. They are thought by some to have been used in the same manner as the *trapiche* of Chili, for grinding ore. The exact locality of the most noted group of these pots is forty-five miles east of Visalia, three miles north of the east fork of the Kaweah River, and near the head of a creek called Lake Canyon.

BRAYTON, G. M.—Gives information of old ruins five miles north of Camp Verde, Arizona, on a point of rock 50 feet high and 300 feet from the Rio Verde.

COOPER, J. G.—Describes cave in Kern County, California.

MCALLISTER, A. A.—Mentions a shell mound in Berkeley, Alameda County, California, on the block bounded by Second and Third, and University and Bristol streets.

POSTON, C. D.—Correspondence with reference to the preservation of the Casa Grande in Arizona.

YATES, L. G.—Describes crania from mounds in Alameda County, California.

NEW MEXICO AND UTAH.

ALDRICH, CHARLES.—Describes pottery pipe, from ruins on San Juan River, New Mexico.

DELLENBAUGH, F. S.—Remarks that many hundreds of groups of picture-writings are to be seen on the rocks in Southern Utah, Nevada, and Arizona.

MEIGS, General M. C.—Describes stone mound on the summit of a pass through a range of mountains two or three miles east of Mohave stage station, on the Gila River, Arizona, sixty or seventy miles above Yuma. It is of rough heaped stones, 12 feet long, 6 feet wide, rudely resembling a tortoise, with smaller mounds resembling the head and neck, legs and feet, and tail. There are many mounds in Arizona; one on the Pinal Mountains gives evidence of extensive buildings divided into numerous departments, around which may still be found broken pottery and stone implements.

METCALF, HENRY.—Long correspondence from, concerning cave near Silver City, New Mexico.

OLMSTED, FRANK.—Mounds on Fort Cameron United States military reservation, township 29 south, range 7 west, Salt Lake meridian, Utah. The most important system is in Parowon Valley, fifty miles south of Fort Cameron, township 35 south, range 12 west.

PEASE, W. B.—Speaks of a cave in southwestern part of New Mexico; same mentioned as belonging to Mr. Metcalf.

POPE, GEORGE.—Inscription on rock in Provo Cañon, Utah, described.

NEBRASKA AND MINNESOTA.

ALLEN, C. P.—States that no remains whatever have been found near Red Lake, Beltrami County, Minnesota.

BOWDISH, W. M.—Reports having opened graves in Houston County, Minnesota, but they are evidently quite modern.

BRUNER, LAWRENCE.—Many mounds are scattered all through the country between the town of Norfolk and the Verdigris country in Nebraska, situated on the level bottom lands close to the bluffs and invariably near the mouth of a ravine running into the bluffs. They vary from 30 to 100 feet in diameter, 3 to 8 feet high, and are covered with vegetation.

BUNNELL, L. H.—Reports a number of mounds on Maggie Burns's farm, Winona County, Minnesota, and in nearly all the larger valleys. At the fertile points adjacent to water a few may be seen. There are no mounds in and about Homer, but shellheaps are found. The mussels were brought out of the Mississippi River by muskrats for their winter food. Opposite Homer, in Wisconsin, a large area is covered with mounds and earthworks. At La Moille there are several small mounds, and a number on Cedar Creek. On Money Creek they are quite numerous, and on Pine Creek they are to be seen at intervals all the way down from Lilly's, New Hartford, to La Crescent. The largest mounds, a group of ten near Homer, are ten miles below La Crosse, at the mouth of Coon Creek Valley. The Winnebagos here have lost all tradition even of the use of stone arrowheads by their ancestors. White Snake, a chief of the tribe, said in all sincerity that they were not made by the Indians.

CLARK, MARTIN.—No ancient earthworks are at present known in Clay County, Nebraska.

CRAMY, T. G.—Quite a number of mounds occur in Meeker County, Minnesota, near Litchfield.

HURLBUT, W. D.—No archæological remains have been found in Olmsted County, Minnesota.

MOREY, C. A.—The region around Winona, in the county of the same name, Minnesota, is rich in aboriginal remains.

WILLIAMS, F. G.—Large stone hammers in Minnesota were hafted by means of an elastic sapling to grind food.

IOWA.

ALLIS, SAMUEL.—Lodge cavities are frequently found on bluffs of the Mississippi River, Mills County. The usual mode of burial is to dig a large hole in the ground projecting under at the bottom similar to their corn caches. The dead are wrapped in a robe or blanket, placed in the niche in a sitting posture, with implements and ornaments. Sticks are stuck crosswise at the mouth of the cave, covered up, and the earth heaped in a small mound. The burials are in groups on high bluffs. The women weep daily at the graves for about six months. Once Mr. Allis witnessed the burial of a distinguished woman, the wife of a French trader. Something to eat and a bottle of whisky were deposited in the grave. Her favorite horse was choked to death and the tail hung over the mound.

BANTA, W. V.—Furnishes a brief report on mounds in Henry County, Iowa. Further information desired by the Smithsonian Institution.

BASSETT, LESLIE.—Describes stone and copper implements from Keokuk County.

BEAMAN, D. C.—Explored mounds on the Des Moines River, near Keosauqua, Van Buren County. Account published in Ottumwa Democrat. None sent to Smithsonian Institution.

CANDEE, F. C.—Describes copper implements from one of a group of mounds on the farm of P. Hass, two miles west of Grandview.

DAVIS, HENRY, and W. A. MACDONALD.—Explored mounds in Clayton County, on high bluff, overlooking Mississippi River, 350 feet above the water, opposite Prairie du Chien, on land of Girard Land Company. On another bluff, one-fourth mile south, are two circular mounds 25 feet in diameter, 4 feet high; and 70 feet back of them is still another mound. All were evidently for lookouts, as there were no relics in them.

EVANS, SAMUEL B., *Ottumwa*.—Sends notes of works in sections 2 and 3, township 68 north, range 10 west, fifth principal meridian, near Keosauqua, Van Buren County. Locations, course, and distance approximated.

No. 1. Shell heaps and pottery.—On south bank of Des Moines River, in northeast quarter of southeast quarter section 3, 20 rods north, 55° west, from mouth of Ely's Creek, 20 feet above river bed, 40 feet from water's edge. Found mussel shells in large quantities, pieces of pottery, arrow-heads, bones, part of jaw, teeth, leg and foot bones, &c.; fair degree of preservation. Two feet from mound surface generally.

No. 2. Mound.—In northeast quarter of southeast quarter section 3, south bank of river, 10 rods north, 60° west from No. 1, on bluff point 100 feet above river bed, 200 feet from water's edge; timber, large white oak, young jack oak. Found human skull entire (except lower jaw), part of an upper jaw, and one tooth; bones of the leg, &c. Position, two feet from mound surface; head southeast; burial horizontal. Also same pottery as in No. 1.

No. 3. Half-moon shaped mound.—Fifteen rods north, 55° west, from No. 2, on same bluff, 120 feet above river bed, 200 feet from water's edge. Found thigh bones.

No. 4. Mound.—Fifteen rods north, 45° west, from No. 3. No discoveries except small piece of crockery, probably modern.

No. 5. Large mound.—Fifty feet in diameter, 5 feet high, in northwest quarter of southwest quarter section 2, 30 rods south, 45° degrees east, from mouth of Ely's Creek, on high bluff point 100 feet above river bed, 20 rods from water's edge. Decayed white oak stump, 24 inches in diameter, on mound, 12 feet north, 10° west, from center; decayed oak stump, 16 inches in diameter, on mound 4 feet north from center. Found thigh bones (human) under south side of 24-inch stump, 5 feet from surface of mound; also shells as in No. 1; also upper arm bone; position of thigh bones, horizontal; head west; lower leg bone doubled under.

KETTERMAN, W. H.—Wapello County. Mounds, township 72, range 13 west, on a line almost north and south through the county, on highest bluffs, from 75 to 100 feet in diameter, and 4 to 5 feet high.

MANSFIELD, J. M.—There are mounds in Henry County, near Mount Pleasant, but no report has ever been made on them.

WITTER, F. M.—Describes mound in prairie, 40 rods from bluff of Iowa River, in Toolesboro, Muscatine County, 100 feet long, 40 feet wide. Copper implements and bones found. Promises map of Muscatine County in the name of the Academy of Sciences.

MISSOURI AND KANSAS.

BALLOU, W. H.—Reports progress upon a complete report of the mound-builders of Mississippi County, Missouri.

BEACH, J. W.—On northwest quarter section 32, township 57, range 35, Buchanan County, 1½ miles south of Saint Joseph, at King Hill, are earthworks on a high bald point, facing the Missouri River, partly obliterated by weathering. The dead were buried very closely together, at length, on the back, east and west, not deep. A plot of the ground promised.

BLACK, J. W.—Surveyed an earthwork in Lawrence County, Missouri.

DRAKE, I. S.—There are ancient mounds near Mount Vernon, Lawrence County, Missouri.

DUNLAP, J. N.—Mounds and earthworks are common in Saline County, Missouri, crowning almost every hill along Missouri River, isolated and in groups; fortification four miles southwest of Miami, on summit of a ridge which terminates in one of the so-called Pinnacles. The following account is from the Miami Index, Saline County, Missouri:

"It crowns the summit of a ridge which terminates in one of the so-called 'Pinnacles' of this region. There is a double ditch and double embankment, embracing an oval area of 15 acres, and also a secondary ditch and embankment adjoining on the west, with an area of perhaps 8 or 10 acres. The ditch is now, after the lapse of centuries, in many places 5 or 6 feet deep. Our reason for using the word centuries is the fact that in the ditch we found stumps of black-oak trees recently felled, measuring from 45 to 50 inches in diameter, and a growing tree that could not be encircled by the extended arms of two large men.

"The approaches of the elevation on which this fortification is situated are exceedingly steep.

"At the base of the pinnacle in which the ridge terminates is a spring which we are informed is subject to periodical ebbs and flows; its basin when seen by us was probably 20 feet in diameter. We think that the water was designed to be protected by the fortification. About one fourth of a mile south of 'the old fort' was evidently an old battle-ground, as shown by a large quantity of crumbling bones which are turned up by the plow, together with arrow-heads, stone axes, pikes, and other Indian equipage. There is also found much pottery of a peculiar sort, being made of shells, comminuted and mingled with clay without being subjected to fire."

NEWLON, W. S.—On Shoal Creek, in Jasper County, Missouri, at Reddin's water-mill, are twenty or thirty mounds on each side of the stream. Shoal Creek is a branch of Spring River, flowing through Kansas and Missouri lead mines.

SERVISS, E. F.—There are a number of mounds near Wyandotte, Kans., of which a map is in preparation. A workshop one acre in extent and covered with chips and sherds is reported.

SMITH, Q. C.—Several mounds occur in Stoddard County, Missouri, about 14 miles south of Bloomfield, near the road leading to West Prairie, unexplored.

STEPHENS, J. L.—Found three mounds in northeast portion of Boone County, Missouri, on east bank of Cedar Creek, ten miles below the head of the stream; also three mounds two miles southwest of Columbus, on the south bank of Hickson Creek. A single mound one mile southwest of the first-named group is located on a high point.

WATKINS, J. C.—Reports mounds on bluffs of Mississippi, near Ashley, Pike County, Missouri.

ARKANSAS.

BOYD, C. H.—Examined mounds at the mouth of Saint Francis River, Phillips County.

BUCHANAN, S. H.—Reports mound near Galley Rock, on Arkansas River. There are round mounds on Stuart farm, near Washington, Hempstead County, and a similar one on Little Missouri River, in Nevada County, near Prescott, 50 to 75 feet diameter, 20 feet high.

CHASE, JOHN R.—Reports many large mounds in Crittenden County.

GREENE, ED.—Found rock inscriptions in Johnson County.

JAMES, F. L.—The makers of vases in Arkansas used gourds as molds. Drawings of gourd-shaped vessels given.

MCCORMICK, E. G.—Reports a stone image from Evansville, Washington County.

WARNICK, J. R.—Small mounds are found in abundance in Lawrence County.

WISCONSIN.

BEACH, H.—Describes a mass of obsidian dug from mound in Wyalusing, Grant County, together with 12 large shell beads. The whole valley of the Mississippi around Prairie du Chien, and for miles up and down the river, is full of the remains of an ancient population, and it would take months of labor to give a description of the mounds and earthworks. Nearly all examined were burial mounds. One opened contained remains of about a dozen persons whose bodies had been burned.

DUNLAP, SEYMOUR.—Reports copper implements in Walworth County.

HENRY, WILLIAM T.—Found many mounds in Iowa County.

LEWIS, C. H.—Describes four groups of mounds near Mount Vernon, Dane County; also several workshops. There is a group of mounds, four in number, on section 15, in Springdale Township, 50 feet base diameter, 6 feet high, 50 feet apart, extending east and west, commencing at a distance of 50 feet from the most eastern and extending in a direct line eastward, is a long low ridge, 100 feet in length, 4 feet high, and 6 feet wide.

MARVIN, D. S.—Reports Earthwork near Watertown, in the forks of two small streams, four or five miles from the village.

PARKS, WARHAM.—Examined mounds near Oconomowoc, Waukesha County; one evidently a lookout, the other in shape of a swan, 20 feet in length. They are one mile apart, near the banks of Washotah Lakes, and in one of the most beautiful spots in Waukesha County. All through the county occur cemeteries.

MICHIGAN.

ANDERSON, ABEL.—Numerous mounds are found in Muskegon and adjoining counties, but few have been explored. There are three mounds located on the north bank of Grand River, about 20 rods east of the Chicago and Michigan Lake Shore Railroad. They form a semicircle, and are about two rods apart. The two largest were excavated. Upper layer sand, then clay taken from the river bottoms, then vegetable mold overlying the bones. Six skeletons were found, and with them copper hatchets and awls, large plates of mica, shells, pipes, and pottery. A large mound in the town of Bridgeton, Newaygo County, lies near the county line. On the banks of Muskegon River, southwest corner of Newaygo County, are a number of mounds.

BARNES, CHARLES E.—The works of the mound-builders are meager in Calhoun County. Further information promised.

BRADY, SAMUEL.—Is making explorations of mines at Minong, Isle Royale.

DAY, JOHN E.—Has in preparation, a paper on the forts and mounds of Macomb County.

FOWLER, S. W.—There are no earthworks in Manistee County. Shell heaps are found near mouth of Manistee River. Mounds are common. Several are at the west of Bear Lake; one on Sauble River, two miles south of Manistee Lake.

HUBBARD, LUCIUS.—Three mounds are in southwest quarter section

17, range 18 west, near Indiana State line, Berrien County, from 20 to 50 feet across.

JENISON, O. A.—Sends drawings of Michigan relics, accompanied with descriptions.

JONES, JOSHUA.—Describes mound in Livingston County, three miles from Howell, on west bank of Shiawassee River, 40 to 50 feet base diameter. Five skeletons were found in the mound.

STOCKWELL, G. A.—Has traced out a triple series of mounds along the lake shore, five miles above Fort Gratiot; map in preparation.

ILLINOIS.

ADAMS, W. H.—Describes examination and excavation of mounds, Peoria County.

ANDREWS, S. J. M.—Mounds in Effingham County extend over twenty miles on either side of the Wabash. They vary in height from 2 to 15 feet. Large trees are growing on them. The bones are sometimes charred, and frequently animal bones are found with them.

ARTES, C. F.—Images, pottery, and stone implements occur in Vandenburg County. A skull found with one of the images.

ATKINSON, CHARLES.—Carved image found in Adams County in a mound. Mounds in Calhoun County. Further information desired for the Smithsonian Institution.

CONLY, J. D.—Describes shoe-shaped stone and cemetery in Macoupin County. Promises map of the mound in that region.

FOSTER, A.—Reports numerous mounds in Cass, Schuyler, and adjoining counties. One mound, 25 or 30 feet high, covering nearly an acre, from the apex of which a view can be had of parts of five counties. Within the limit described every form of mound relics is obtained. Cache of chipped implements on the land of Mr. George Trauman, containing two barrels of specimens.

FRENCH, G. H.—Mentions stone fort near Carbondale, Jackson County.

GETTENS, W. H.—Shell beds occur near Hamilton, Hancock County; also a number of mounds.

GRAY, W. B. D.—Lake County is very rich in aboriginal remains. In the northern and northwestern portions, in the lake regions, are many mounds. One examined contained fifteen skeletons in a circle, face downwards, heads to the center. There are several trails passing through the county from the Lake Superior region. One fortification, not located, 200 feet on each side.

HENDERSON, J. G.—Antiquities of many new and beautiful forms of stone implements described.

HITT, D.—Quite a deposit of hornstone disks was discovered on the south end of the east half of the northeast quarter section 29, township 33 north, range 5 east of third principal meridian, about three miles southeast of the town of Marseilles, about the same distance west of the town of Seneca, La Salle County, and very close to the bluff bordering the Illinois River. The bottom is very wide at this point, and so high as never to overflow. There were 65 found in the center of a pond on the south side of the river, which ranged in size from about 2 inches wide by 2¾ inches long to about 3 inches wide by 4 long, and were manufactured undoubtedly from nodules, as they show the circles plainly, similar to fortification agates, and were most likely made and used for the same purpose as those described by J. F. Snyder, M. D., in the Smithsonian Report for 1876, that were found near Frederickville and at Beardstown, in this State. They were probably placed in this pond for safe keeping or as a place of concealment, as it was a number of years ago running water, fed by a large spring or springs. It is now drained, and in digging the ditch to the center of it these disks were found two feet below what is now the surface, in a pile, as though they had been placed there. The proprietor, Mr. Osborn, thinks they were being transported in a canoe, which was capsized at this point.

HOLBROOK, W. C.—Is preparing map of all the groups of mounds and earthworks along Rock River and its tributaries in Whitesides County.

KILIAN, ED. A.—States that there are near Edwardsville, Madison County, remains of many ancient earthworks, of which an investigation will be made.

LOCKE, W. M.—Wabash bottom, White County, is full of mounds; Mr. Locke has opened many, but in the low bottoms they are poor in relics. In a row of seven opened nothing was found.

MCADAMS, WILLIAM.—Caverns exist about the Grand Pass, Greene County.

MCCLELLAND, M. A.—There are but few mounds within the limits of Crawford County. In Scott Township, Vanderburg County, Indiana, is a group of five or six mounds, and near by a conical pit, from which they were probably constructed. Northeast, about half a mile, occur two other mounds, much larger.

ONG, J. L.—Several mounds in the vicinity of Coulterville.

PARTRIDGE, H. E.—Lake County abounds in mounds, mostly circular, solitary and in groups.

ROGERS, O. P.—Mounds are found near Clintonville (South Elgin), forty in number, near bank of Fox River, four miles below Elgin City, Kane County. Survey and plots are promised.

SCHNECK, J.—Wabash County is rich in mounds, Indian towns, &c. Mr. Schneck is preparing a map of the county.

SHALLENBERGER, J. M.—A group of fifteen mounds occurs east of Cambridge, not surveyed.

SIBLEY, H. F.—Two deposits of disks were found in Wayne County, one in White County, and one in Jefferson. The first contained 37, the second 46 specimens. Examined a group of fifteen mounds in Massillon Township, on west side of the river, on a high bluff. Seven mounds in Barnhill Township, just east of Fairfield, Wayne County.

Examined one, which contained nothing but charcoal. The mound in Big Mound Township, three miles from Fairfield, is the largest one on the prairie. It is supposed to have been a natural mound, shaped up and finished by the mound-builders. It contains many graves, and several bodies seem to have been placed in one grave. The graves are stone cists, made of slabs brought seven or eight miles, from Skillet Fork. Two trees growing on the mound, one a catalpa, the other an oak, were probably planted there. The other mounds in the same township are also large. They are in the bottoms. One contained human remains, mixed with river shells, deer horns, wolf jaws, &c., united with charcoal and small stones. Group of mounds in Four-mile Township are near Skillet Fork; two explored contained remains and bright-red pottery. These mounds are on Fleming's Ridge, above the overflow. Just below is the best ford on the river. A more accurate description, with map, is in preparation.

SMITH, H. K.—There are many mounds and earthworks near Clear Creek, Putnam County, between Hennepin and Peoria. They are in groups of five to eight, running parallel with the river, from one-quarter to one-half an acre in extent, and 5 to 12 feet high. Further explorations in progress.

TANDY, MARK.—Mounds occur in Hancock and Henderson Counties. Part of them are close to the Mississippi River, mostly on bottom lands or flats, but some are on high bluffs or eminences. Quite a number are along Camp Creek. They are generally formed of loam; a few of shell-rock. One mound examined was composed of loam the first 2 feet, the rest was sand; no bones, but charcoal mingled with flint chips. A stone mound, one mile below Dallas, made of very large flat rocks, was examined; bones, teeth, and stone relics found.

TOWNSHEND, R. W.—Mound explored in the northern part of Clay County, two miles south of Effingham County line, on Little Wabash River.

TROUSLOT, R. B.—Describes two mounds, five miles from Plano, Kendall County, ten miles south of Post Mills, five miles from Sandwich. See the "History of Kendall County," published at Aurora, by Rev. E. W. Hicks.

WALLACE, S. J.—Three mounds occur two miles northwest of Carthage, Hancock County, section 11, 5 north, 7 west. One 30 feet base diameter, 30 inches high; the second similar in dimensions; the third larger, unexplored. A group on Mississippi River, same county, near Pontoosuc, and others on bluff between Nauvoo and Montebello. Mr. Wallace sends many drawings of flint implements.

WHITNEY, L.—Describes ancient burial-ground within the limits of Morris, Grundy County. A cedar pole still standing on one of the streets, protected by an iron railing, marks the spot.

WILCOX, P. W.—Will carefully prepare diagrams and measurements of mounds in La Salle County.

WITTER, F. M.—Mounds occur on both sides of Mississippi River, from near New Buffalo, Iowa, and opposite in Illinois, to Toolsborough, in Iowa, and New Boston, in Illinois. Topographical survey in progress.

INDIANA.

ARTES, C. F.—Opened burial mound near Evansville. Two burials, one above the other, at length; crania preserved.

IRWIN, J. W.—Has surveyed and promises sketches of groups of works on White River, on the east and west forks of White River, and several in the valley of the Great Miami not hitherto described.

HOLLAND, JOSHUA.—Is making survey of mounds and inclosure near New Castle.

LONG, T. P.—Mentions extensive remains near Terre Haute, running through Sullivan and the southern part of Vigo Counties, and on the opposite side of the Wabash, in Clark County, Illinois, and thence down the river for many miles.

RERICK, JOHN H.—Describes village of Pottawatomies named Mongoquinong, formerly at Lima, in Lagrange County. There are but few traces of the mound-builders. One mound, 50 feet base diameter, 2 feet high, near Brushy Prairie post-office. Human remains, potsherds, and flint implements abound.

STINSON, FLOYD.—Is preparing map of Henderson, Daviess, and Hancock Counties, Kentucky, and Posey, Vanderburg, Warwick, and Spencer, in Indiana.

QUICK, EDGAR R.—Describes group of mounds on land of H. Brun, one and a half miles south of Brookville, Franklin County. Earthwork three miles north of Brookville, on hill 350 feet high, jutting out on west bank of east fork of White Water River. Mounds nearly all on prominent points.

OHIO.

BRANT, B. K.—Reports investigations of mounds in Butler County.

CRIDER, F. E.—Is making a complete survey of all mounds, earthworks, &c., in Hamilton County, numbering about 200.

ELLENBERGER, D.—Mentions ruins of old block-house near Wooster, Wayne County, described in letter of December 6, 1879.

GREEN, S. C.—Sends description and drawings of stone implements in Morgan County.

HILL, F. C.—Mentions three mound localities in Greene County: Xenia, or more properly Tawawa Springs, four miles north of Xenia; Cedarville, in the township of the same name; and Miami Township.

HEMPSTEAD, G. S. B.—Sends interesting correspondence concerning the Portsmouth work, accompanied by a new survey of the works.

HILL, H. H.—Gives description of Sixth and Mound streets mound, Cincinnati.

KITE, J. L.—Describes flint deposits, 30 acres in extent, southwest section of Smith Township, Manning County, which have been largely worked. Several excavations were found 15 to 20 feet across and 10 to 12 feet deep. Deposit about 1 foot thick; land around strewn with fragments.

MACLEAN, J. P.—Author of a work on the antiquity of man, and a series of articles on the Star in the West. Is preparing a full account of the earthworks, &c., in Butler County.

METZ, C. L.—At the junction of the two branches of the Duck Creek, near Red Bank Station, in the vicinity of Madisonville, a kind of oven was uncovered; that is, two parallel lines of stone set on edge and covered over with large, flat limestones, all showing effect of fire. In section 11, Columbia Township, west of the railroad, is a precipitous range of hills, along the face of which is an ancient roadway extending from the creek to the top of the range, 600 yards long, 4 to 10 feet wide. Has in preparation a chart of Anderson Township, where mounds and works abound.

MILLER, R.—Describes mound three-quarters of a mile north of West Farmington, Trumbull County; 100 feet base diameter, 20 feet high, on a ridge 80 feet above surrounding country.

MORROW, JOSIAH.—There is another ancient work (beside Fort Ancient) in Warren County, on the west bank of Little Miami River, containing 15 or 20 acres, of which no description has ever been published. It is situated at Foster's Crossings, in Warren County. The most remarkable feature is the fact that the walls were constructed of baked earth. Wherever excavations have been made, or trees uprooted, the clay is very red and bears evidences of fire. This occurrence of burnt clay is confined to the inclosing bank. The work is on the top of the river hill.

PEASE, A. P. L.—Gives minute description of stone implements from near Hamilton.

POCOCK, E. D.—There are several mounds near Shreve, Wayne County, which will be mapped and described for the Smithsonian Institution.

RANDOLPH, T. C.—No mounds or earthworks occur in Columbiana County, but stone implements abound.

READ, M. C.—Describes rock shelters, three miles west of Hudson Village, Summit County. Accumulation of 4 to 5 feet of ashes mixed with burnt soil, fragments of bone, stone implements, &c. The bones represent nearly all the native mammalia. The shaft bones and larger jawbones were all broken. The pottery is of two kinds, one thin, the other very thick, and all mixed with powdered quartz. The stone implements, drawings of which accompany the letters, were mostly rude. Mr. Read will prepare a monograph upon these shelters. The author also mentions a cache of 200 black chert disks found on the land of Mr. M. Graham, in Summit County, and draws attention to a speculation published by him in the American Antiquarian, to the effect that these enigmatical disks are a step in the division of labor in arrow-making. At a meeting of the State Archæological Society at Wooster, September 5, 1878, Professor Read was appointed to co-operate with the Smithsonian Institution in preparing the ethnological and archæological history of Ohio.

ROSS, A. C., and Col. W. H. BALL.—Flint Ridge lies in Licking and Muskingum Counties, about three miles southeastward from Newark, and twelve to fifteen miles west-northwest from Zanesville. It extends eight miles southwest by northeast, and is from one-fourth of a mile to one mile wide. The ridge is cut by hollows, ravines, and gorges. Portions of the highest land are comparatively level, and this plateau is underlaid by a stratum of flint rock from 15 inches to 3 feet in thickness. Besides this stratum are numerous flint bowlders standing up several feet above the surface of the ground. On the exact level of the flint are the "diggings," hundreds of which may be seen, which range in depth from 1 or 2 to 30 feet, their depth depending upon the relation of the flint stratum to the surface of the earth. The very deep diggings are from the top of a hillock on the summit of the ridge. The trenches are from a few feet to 30 feet across at the top, all sloping so gradually that it would be easy to walk down them. From the deeper cuts the earth appeared to have been carried out; the one from the top of the hillock is still very deep, and was about 40 feet in perpendicular when completed, with proportional width. In one portion was a drift 60 to 80 feet in length, 6 to 8 feet wide, and 4 to 5 feet high. The excavation was pursued with the same diligence when there was no flint as when the stratum was found, and was of the same character, to the same level. Of course, when the earth is below the flint level there is no evidence of digging, but when the earth is above that level the work extends to the flint. These works follow the dip of the flint towards the east-northeast until the hills became too high above the stratum. In a meadow, and near a stream of water, on land very much lower than the ridge, occurred a bed of crumbled flint and sandstone. This bed was about 14 inches in depth, 7 feet across, and 15 to 18 feet in length. The sandstone was near the north part and had been subject to great heat. A quantity of ashes was mixed through the whole bed. Several such beds are reported in that vicinity, and were generally near water. No arrow-heads or other objects made of flint occurred. Old, gnarly, full-grown oaks, some of them three hundred years old, have sprouted and grown since these excavations were made. There has not been any signs of a workshop discovered in the last sixty years, but at the point usually sought by visitors and curiosity hunters flint spalls cover the ground for acres. Only one arrow-head has been found there for years.

WILKINSON, E., Jr.—Sends notice of a fortification near Mansfield, Richland County; survey in preparation.

WILTHEIS, C. T.—Tablets of burnt clay were found on farm of W. Morrow, near Piqua.

WEST VIRGINIA.

CAMPBELL, S. M.—Describes mounds on Meadow River, a tributary of the Gauley, eight in number, 20 feet in diameter, nearly plowed down.

LACY, T. H.—Mentions mounds in Mason County.

MARSHALL, T. M.—Mounds occur in Gilmer County, near Glenville.

NUTTER, I.—Explored graves near Worthington.

PAGE, W. N.—Discovered wall in Fayette County, near Chesapeake and Ohio Railroad, between Loup and Armstrong Creeks, one mile from their confluence with the Great Kanawha.

KENTUCKY.

FRIEL, JOS.—A mound is located five miles east of Bennettsville, Breckinridge County, and, near by, is a rock-shelter. Mr. Friel sends description of stone implement of his county.

HARRIS, S. A.—There are in the eastern portion of Kentucky several earthworks and other aboriginal remains which have not been investigated.

LAMPTON, W. J.—Mounds occur in the corporate limits of Ashland, Boyd County.

MIDDLETON, G. B.—Mentions ancient wall in La Rue County, on one of the bluffs of the Rolling Fork River, northeastern portion of the county, seven miles from Hodgensville, and five miles from Buffalo. It is 432 feet long, and extends northeasterly from cliff to cliff. Its southwest end rests upon the solid rock of a ravine just above a cliff 20 feet high. A small stream pours over this precipice. The wall is approachable only from the northwest. About 270 feet behind the wall are three pits parallel with it, now 5 feet deep, 20 feet apart. Just behind the two smaller pits, 6 feet diameter, 3 feet deep, appearing to have been walled up. A mound of flint is near these smaller pits. The ruins are now from 3 to 5 feet high, and from 17 to 20 feet wide. See Collins's History of Kentucky, under Lake County.

MUMFORD, R. S.—Mounds and relics were found near Rowlett's Station, Hart County.

TENNESSEE.

BAILEY, W. B. F.—Several mounds occur near Chattanooga.

CLARKE, W. M.—Describes a mound near Franklin, Williamson County. At the bottom, 22 feet below the top, a circle of flints was found with the points to the center, and around these was another circle of twenty-five shells (*Busycon carica*) with the large ends out.

RICHIE, R. W.—Explored a mound in Hardin County; mica, burned earth, skull inclosed.

ROESSLER, A. R.—Speaks of a mound near Big Creek, Cocke County, 60 feet base diameter, 5 feet high. Near the center, 3 feet from the top, a skull was lying, face upward, top eastward. Near by, another was found lying on left side, face southeast, other bones lay at random. Lower down, two more crania. No arm or leg bones. Surface covered with pottery shards, flint chips, &c.

THE GULF STATES.

BIDDLE, HENRY J.—Describes mound on Saint John's River, Florida, four miles below Palatka; the most northern mound on the river, except one; 200 feet long, 40 feet wide, 10 feet high.

BOMAR, THOMAS H.—Spartanburg County, South Carolina, is singularly barren of any vestiges of prehistoric man.

BRACHT, V.—Aransas County, Texas, reports that there are no antiquities on Live Oak Peninsula, but many mounds and graves near Salt Creek, on Hynes Bay, where the Carancahua Indians formerly dwelt.

CADLE, C.—On the eastern shore of Mobile Bay, Alabama, one mile from Point Clear, are banks of shells, 10 to 30 feet wide, 1 to 3 feet thick, and one-quarter mile in length. On this bank are two annular elevations of shells 2 feet above the surface and 60 feet in diameter. There are other shell banks in the vicinity.

FLOYD, HENRY.—Unexplored mounds occur on Ouachita River, Louisiana, on Mississippi and Yazoo Rivers, in Warren County, Mississippi, and on Deer Creek, in Sharkey County. They are situated on streams, near springs. They are in groups of threes, oval in shape, or nearly circular, flat on the top, the largest occupying over an acre.

CLARKE, S. C.—On the Halifax and Hillsborough Rivers, in Volusia County, Florida, are great numbers of shell heaps, almost every important bluff and landing place being thus occupied. Although called "rivers," these stretches of salt water are more properly sounds or bays, being shallow expanses, separated from the sea by narrow beaches of sand. Some of these mounds have been described; turtle mound, for instance, on Musquito Lagoon, by Dr. Brinton, of Philadelphia. There is one of these shell heaps on the Halifax River, near the inlet, which differs in form from any other that he has seen, being in the form of a circular bowl, the walls of which are perhaps 20 feet in height, and the inclosed space from 50 to 100 feet in diameter. The mound lies about 50 yards from the river, and has an opening on the river front, as if for a gate or sallyport, the whole structure giving the idea of a military work. It consists principally of oyster-shells, all of which have been separated and opened by human hands. It may be here remarked that these mounds consist either of oyster or clam shells—seldom of both. Among these oyster-shells are mingled those of conchs (*Pyrula*, *Busycon*, and *Strombus*) now occurring in the vicinity; also those of the Thorny Conch (*Melongena corona*), which is at present very rare on this coast. Charcoal and the bones of small mammals and birds are found among the shells, as also many fragments of pottery, some samples of which have been sent; the whole mound is covered with a natural grove of wild orange trees. Flint arrow-heads have been found here also, which must have been brought from a considerable distance, the nearest deposit of flint being, it is believed, in Georgia, some hundreds of miles away. In Albany, Dougherty County, Georgia, are great beds of the purest flint or hornstone, which splits easily; and here seems to have been a great manufactory in old times of arrow-heads, which are still found on the banks of Flint River.

GALLOWAY, J. C.—Little is to be found in Jefferson County, Georgia, in the way of relics, or noted landmarks. Vestiges of large cemeteries still remain, and a broad trail leading to Old Town, eight miles from Louisville, and on the eastern side of the Ogeechee. It runs east and west, is 12 or 15 feet wide, and deeply worn, resembling an old abandoned road.

GARRETT, W. M.—Three groups of mounds are in Lowndes County, Alabama. The first is in the southern part of the county, and in the southern part of township 12, range 14, on Muscle Creek, land of Mr. Fisher Merritt; all explored. The second group is on Big Swamp Creek, in the center of the county, township 14, range 14, on the Cheek plantation. The third group is in the northern part of the county, on the Alabama River, not far from Whitehall and Benton. Several "workshops" are near Mount Willing; one on Mr. Hartley's plantation, section 36, township 18, range 13; and one on Mr. Lee's plantation, section 32, township 13, range 14.

GESNER, WILLIAM.—Describes mica mine and stone wall in Clay Township, Jefferson County, Alabama. In Talladega County, township 20, range 6, section 12, another mica pit. "Workshop" in Lee County, Alabama, east of Youngsborough, on the Western Railroad, at the foot of Story's Mountain, in the fields, township 19, range 27 east.

GLASCO, J. M.—There are many ancient remains, such as mounds and earthworks, in Upshur and Camp Counties, Texas. One in southeast corner of Camp County, on property of Nathan Lee, three miles east from the town of Lafayette, and a road-bed 8 feet wide and from 1 to 2½ feet high leads from this to another about one mile northeast. Still another road leads from the first named to a mound four miles off on the land of W. R. D. Ware. This road passes through a square inclosed by a bank 18 inches high. There are twenty-five or thirty mounds on the Sarah Powel league in a group. Near a large one is a raised burnt clay floor. Another group is on the property of S. P. Monyhhon, with a burnt place. They are on Walnut and Gum Creeks, tributaries of Little Cypress. A few of the mounds examined indicate a wooden pen covered with soil. Mr. Glasco also mentions rock-carvings and other interesting remains which he has not visited.

HAYNES, HIRAM.—Mentions an old Indian fortification on southeast quarter section 16, township 17, range 1 east, Saint Clair County, Alabama.

HARRIS, T. K.—Describes a mica quarry in Hall County, Georgia.

HOXIE, WALTER.—There is an Indian mound near Way's Station, Bryan County, Georgia, and one on Saint Helena, Island. There are a number of mounds on Bryan's Neck, lying south of the Ogeechee River and bordering on Ossabaw Sound. One or two lie near Fort McAllister, and some on the road between Sweet Hill and Flandersville.

JOHNSON, H. F.—In Rankin County, Mississippi, is a ruin known as the "Platform;" in Claiborne County the remains of a wall; and in Marion County mounds of great size.

KUYKENDAL, JOHN C.—No mounds are near Yorkville, York County, South Carolina.

LE BARON, J. FRANCIS.—Sends map of prehistoric archæology of Eastern Florida. [A masterpiece of patience, locating 173 mounds, shell heaps, &c.]

MCKLEROY, JNO. M.—Reports several mounds in Barbour County, Alabama, near Eufaula. Promises fuller examination.

MACSWAIN, L. D.—There are mounds in Thomas County, Georgia, from which skeletons and stone implements have been taken.

PRATT, R. H.—Sends brief account of explorations in the Diego and Jenks mounds, near Saint Augustine, Fla.

QUINN, MOSES.—In Whitfield County, Georgia, on Conasauga River, eight miles from the Tennessee line, is an old fort on the top of a mountain, inclosing three or four acres, encircled by a deep ditch and earth embankment.

SHARP, J. M.—Describes a mound near Wyko, Morehouse Parish, Louisiana, 35 feet base diameter, 5 feet high. Anywhere one digs from base to summit bones and pottery are found. The pots are generally between the legs of the skeleton, against the pelvic bones. This mound is two miles north of Lake Lafourche. Mounds and pottery are found all about Prairie Jefferson. One on the land of Mrs. V. C. Harrison is 50 feet in base diameter and 30 feet high.

STEERUWITZ, W. H.—Artificial dug-holes are found in Harris County. Texas, twenty-eight miles from Houston, formed as follows: The rain-water stands in the depressions after the surrounding prairie is dry. The cattle and horses bring out of the bottom a portion of mud every time they go to drink. The dam on the edge is 18 to 24 inches high, depth of dug-hole 24 to 30 inches, width of dam 18 to 24 feet, size of pit about 300 yards square. [This fact, for the first time brought to the knowledge of archæologists, may be useful in the regions once roamed over by thousands of buffaloes.—O. T. M.]

STELLA, J. P.—Texas now presents the finest field for the archæologist in the United States.

WADE, J. D.—There are several mounds in Leon County, Florida, unexplored.

NEW YORK.

ALEXANDER, J. W.—Sends stone gouge from Saint Lawrence County, with the following statement as to its use: "That it was used for tapping the American maple (*Acer saccharinum*) there can be no reasonable doubt. A comparison of one of these implements with the iron and steel gouges used by the early settlers for fixing the spout confirms the view. A piece of pine, cedar, or other soft wood was selected of the width of the cutting part of the gouge. From this block spouts were split, the gouge being the instrument of cleavage. In this manner the concavity of the spout corresponded with that of the gouge. When the tree was tapped a box was chipped in the trunk, the gouge was driven in two or three inches below, and the spout afterward placed in the cut thus made in order to conduct the oozing sap to a bucket below."

ALLEN, A. W.—Describes an image and stone relics from Cayuga County.

BEAUCHAMP, W. M.—An extended and valuable correspondence upon the stone implements of Onondaga County. Describes, May 5, a visit to a large aboriginal manufactory of flint implements, on the Canada side, opposite Buffalo, N. Y.; also refers to ground arrow-points and copper implements, as well as ancient forts and palisades.

BRIGGS, H.—Sends newspaper clippings, Ulster County.

BYRNS, E. A.—Reports Indian cemetery, near Belfast, Allegany County.

CHAPMAN, RUFUS T.—Promises map and plan of works along the Cuyahoga River.

CLARKE, JOHN S.—Is preparing a map of New York on which will appear every position where indications exist of an Indian residence, town, or hamlet, the trails intersecting the State connecting the several towns, the Indian names of rivers, lakes, mountains, localities, &c.

COLE, NORMAN.—Describes copper spear-head found near West Mountain, Warren County. Reports also collections of stone implements.

KELLOGG, D. S.—Near Plattsburg, Clinton County, on the western shore of Cumberland Bay, Lake Champlain, near mouth of Dead Creek, are mounds of sand which have been formed by the wind. Some years ago the pine trees were cut from these sand hills, and the wind entirely changed the face of these dunes. Pottery and stone implements in abundance mark this as an ancient camping ground.

LEWIS, W. H.—Sends description of a large rock in North Salem, Westchester County, supported on three cone-shaped stones, resembling a dolmen.

MARVIN, D. S.—Describes mound on Black River Bay, four miles above Sacket's Harbor.

TOOKER, W. W.—Mentions fort at Montauk, Suffolk County, described in Prime's "History of Long Island" and in the "Chronicles of East Hampton."

WATKINS, G. L.—Describes ancient fort located ten miles south of Auburn, two and a half miles from Scipioville.

WRIGHT, S. H.—In Yates County are four ancient works. No survey has ever been made. Map in preparation.

NEW JERSEY AND PENNSYLVANIA.

ANDREWS, F. D.—Found workshops near Vineland, N. J.

BAKER, S. C.—Finds no vestiges of ancient occupation at Altoona, Pa.

BRUNNER, D. B.—Workshops and burial grounds occur in Berks County, Pennsylvania.

HAY, CHARLES A.—Describes aboriginal settlement near Gettysburg, Pa.

HAZZARD, T. L.—Mentions cemeteries, fort-fields, and pictured rocks near Monongahela City, Pa.

KERVEY, D. K.—Explored Indian graves near West Chester, Pa.

MCELWAIN, R.—There are stone piles and an ancient trail near Harrisville, Butler County, Pennsylvania.

MEYER, ABRAHAM.—Describes a quarry, or mine, and caches, Lycoming County, Pennsylvania.

PHILIPS, D. A.—Numerous circular forts and mounds occur near Linesville, Crawford County, Pennsylvania, mostly surrounding Pymaturing Swamp. Human remains, mica, stone implements, and evidences of fire abound.

RUTH, J. A.—Sends archæological map of Durham, Bucks County, Pennsylvania, with letter of June 3, 1879.

SHANNON, S. G., and JOHN SWARTZELL.—Describes a burial mound near the junction of Kishacoquillas Creek with Juniata River, near Lewiston, Mifflin County, Pennsylvania.

WIDEMIRE, S.—The mound-builders appear not to have reached as far as Clearfield County, Pennsylvania.

MARYLAND, VIRGINIA, AND NORTH CAROLINA.

COFFMAN, J. J.—Mentions workshop near Sharpsburg, Md.

HUMPHREYS, JOHN T.—Found a cone of baked earth in a mound near Morganton, N. C. Mounds at a mill eight miles from Morganton are unexplored.

KIRK, C. R.—No mounds or works exist in Northeastern Maryland, but many stone implements. In the Susquehanna River, near Conowingo Bridge, at the mouth of the creek, is a sculptured rock.

KRON, F. C.—There is an old zigzag stone ford across the Peedee River, just below the mouth of the Moharree, in Stanley and Montgomery Counties, North Carolina.

LEAKIN, GEORGE A.—The tribe of Susquehannocks occupied the land in the vicinity of Sassafras and Elk Rivers, and they had a fort on Spesutiœ Island, about 1660. Refers to a paper on the Susquehannocks prepared for the Historical Society of Baltimore.

MCGUIRE, J. D.—Describes shell heaps in Howard and Anne Arundel Counties, Maryland, and alludes to polished arrow-heads.

On a fine branch of spring-water one-fourth of a mile above Eleysville, and within 200 yards of the Patapsco River, Maryland, is a small cave, the floor of which is about 10 feet wide, and runs back 20 feet—an excellent shelter for any one; and as proof of its having been occupied, the floor is covered with ashes in places as much as 18 inches deep. A white quartz cutting tool was found here, finely chipped from a pebble, 2½ inches long by $1\frac{3}{4}$ wide, $\frac{1}{4}$ thick; a small broken rose-quartz pebble, possibly a scraper; a large piece white quartz with one sharp edge; an implement, probably, but if found elsewhere, this would have been doubtful; six small pieces of pottery, very rude, with shell mixed in the clay. Pottery in this neighborhood only found in three other places. Several small pieces of bone were discovered. This cave is about 15 feet from the branch and 5 or 6 feet above it. On the opposite side of the branch, and distant from it about 40 feet and 30 above it, is quite a shelter, perfectly dry, with surface earth to a depth of 4 or 5 inches, dusty and dark; under it is a reddish colored earth. On top of this red earth, and below the dark, a broken arrow found of the same material as the spear found opposite, a scraper 3 inches long by $1\frac{1}{2}$ wide, and several pieces of bone. The stones appear to be of the character described as cave implements by Lubbock and Evans, but from their proximity to the surface they can hardly be more ancient than many of our surface finds, but they are distinctive in their features.

OFFUTT, F. M.—Near Cumberland, Md., there are several large stone mounds that have never been disturbed.

PEYTON, Miss ANNIE L.—Mentions an ancient Indian settlement, cemetery, and workshop near The Plains, Fauquier County, Virginia.

THE NEW ENGLAND STATES AND CANADA.

CHERRY, N.—Is working up the stone age of the Connecticut Valley through the State of Massachusetts.

CURRIER, J. M.—Gives an account of stone implements in Rutland County, Vermont.

CUTTING, H. A.—No ancient remains occur in Eastern Vermont. There are rock sculptures near Brattleborough.

ELLSWORTH, C. W.—Describes a cache of chipped implements from East Windsor Hill, Connecticut, and sends many engravings of relics.

FROST, A. L.—No aboriginal remains are found in York County, Maine.

GORTON, CHARLES.—Describes stone implements of Connecticut. No permanent remains mentioned.

GREGORY, JAMES J. H.—In the town of Marblehead, Mass., are remains of shell-heaps, fortified villages, and a cemetery, also the vestiges of a palisaded fort, and the quarry from which most of the porphyry used in making arrow-heads, &c., was taken.

McDANIEL, B. F.—In the town of Salisbury, Mass., is a line of shell-heaps stretching from the Merrimac River, in a northeasterly direction, about one mile inland.

OSGOOD, ALBERT.—Describes a stone structure on north bank of Merrimac River, near the bridge connecting Deer Island with Salisbury, Mass. Stones 4 to 8 inches in thickness are laid without any foundation.

RICHARDSON, E. P.—Mentions a cache of 40 chipped implements near Manchester, N. H. More information needed.

RICHARDSON, W. S.—Draws attention to an extensive earthwork near Bridgeport, Conn.

SLADE, ELISHA.—No antiquities occur in Bristol County, Massachusetts, excepting the Dighton Rock.

SPRINGFIELD REPUBLICAN (slips with no date).—Large aboriginal cemetery near Holyoke, Mass.; the dead buried in sitting posture; stone implements and even copper spear-points were found with the bones, as well as paint and strings of wampum.

TEMPLE, J. H.—Is making a complete survey of Indian remains in the town of Framingham, Mass. Reports a cache of a peck of chipped implements near that town.

THOMPSON, Miss MARY F.—No mounds occur near Brattleborough, Vt. There is a rock inscription three-fourths of a mile from B., on a rock near the mouth of West River, 100 yards southwest and 550 yards west of its junction with Connecticut River. The figures represent fish-hawks or eagles, and are hammered in depth one-eighth of an inch.

IRISH, WILLIAM. C.—Mounds and graves occur two miles east of Brighton, Northumberland County, Ontario, on Presque Isle Point. Similar mounds are on the lake shore near Redeck's farm, four miles west of the first.

JACK, J. ALLEN.—Describes stone images from New Brunswick, and sculptured slabs from St. John's, New Bruswick.

CENTRAL AMERICA.

FLINT, EARL.—Has discovered near Grenada, Nicaragua, a cave in which the author claims to have found inscriptions upon the walls made before the cave was filled by a tertiary deposit, which petrified after the inscriptions were made. The sandstone and sedimentary rock of the cave were formed subsequently to man's occupation, from which is argued man's existence in Nicaragua long before his advent in Europe, at least 180,000 years ago.

ANTHROPOLOGICAL INVESTIGATIONS DURING THE YEAR 1879.

By Otis T. Mason.

The investigations of anthropologists may be divided into several classes. The first relates to the origin of the race, and this again deals with very different questions, such as, 1, the method by which the human animal made his appearance upon this planet; 2, his mental and social condition at that time; 3, the geological epoch when this remarkable event took place; 4, the locality or localities of his first appearance.

Another class of inquiries, following closely upon the last named, relates to the oldest manifestations of culture in gravel-beds, caves, mounds, graves, and sepulchers, by means of which it is hoped to reconstruct the history of the past.

A third class of investigations has reference to the human body as it now manifests itself. Beginning with the very first germ or embryo, the biologist traces the life history of man to maturity. The anatomist and the physiologist follow up the work of the biologist and study the resemblance between the human structure and that of the lower animals.

Next comes the psychologist, comparing the mental manifestations of one race with another and of each race with those of animals. This branch of the subject has but just begun its scientific career, under the direction of such students as Galton, Bertillon, Lindsay, Maudsley, and a few others.

The fifth class of studies relates to the various races of men. Though no broad spaces separate the human groups, yet all men recognize racial differences. If all the human beings that present marked characteristics were arranged in groups, and those that nearly resemble them were placed near those to whom they bear the greatest likeness, we should have a series of irregular masses merging into one another. These would be races. The form, the extent, and the number of the groups would vary somewhat with the characteristics selected as the basis of the classification. The progess of scientific observationis bringing other portions of the body than the brain and skull into prominence as racial marks. Of the two words commonly used to designate this branch of the subject, I employ ethnology as the generic term, including ethnography, or the description of races, and all discussions with reference to the best methods of classifying mankind.

The next division of the subject is language, the basis of which is phonology; the relation of sound to sense, or sematology, and the peculiar adjustment of the sentential elements, or morphology, at present occupying a subordinate position. It cannot be denied that more is being accomplished in the way of collecting material than at any time previous.

The seventh class of anthropological phenomena embraces all of the occupations, crafts, and arts of man, without regard to race. Looking over the whole race as a propagating garden for the arts of life, we study each industry or æsthetic action in its historic development and in its correlation with other arts and industries. Mr. Spencer's Sociology, Mr. Tylor's Primitive Culture, and works of that class, have done a great deal toward explaining the orderly manner in which even those things which seem fortuitous are brought about.

Very closely allied with the foregoing class is that which relates to sociology proper, or the evolution and regulation of the family, the tribe, the society, and the state. With this division of the subject are connected some of the gravest problems that we have to settle.

The ninth and last class, for want of a better term, we call religion. It includes not only the philosophic inquiry into the cause of all phenomena, but beliefs with regard to morality and the future state, and all those acts and paraphernalia which are associated with worship, together with the organization of society growing out of the same.

In conclusion, a science so comprehensive and so popular must have its corporate agencies, its organs, and its schools. A knowledge of the locality and scope of these is highly important, especially to beginners.

A list of the principal papers of the year, in the order indicated, will serve not only as a bibliographical list, but also to indicate the scope of investigation in each class of inquiries:

Class I. Anthropogeny.
II. Prehistoric Anthropology.
III. Biological Anthropology.
IV. Psychological Anthropology.
V. Ethnology.
VI. Linguistic Anthropology.
VII. Industrial Anthropology.
VIII. Sociology Proper.
IX. The Science of Religion.

I.—ANTHROPOGENY.

ALLEN, GRANT. A "hairless" problem in human evolution. (Fortnightly.) The Century, May 24. *See, also*, Pop. Sc. Month. June.

B., J. P. Spiritual evolution. Trübner.

BEGOUEN, ———. La création évolutive. 8°. Toulouse.

BUTLER, ———. Old and new evolution. Scribner & Welford.

COOK, JOSEPH. Heredity, with preludes on current events. Houghton, Osgood & Co., Boston. 272 pp. 12°.

DELANEY, MARTIN R. The origin of race and color. Harper & Bros.

DE QUATREFAGES, A. The human species. Translated from the French, and forming No. 27 of "The International Scientific Series." D. Appleton & Co.

DUMONT, A. Haeckel and the theory of evolution in Germany. Paris, Germer-Baillière.

VOLUTION, the fallacies of. Edinburgh Review, July. (A review of Haeckel, Wallace, and de Quatrefages.)

ISKE, JOHN. Darwinism, and other essays. Macmillan & Co.

OMES, G. Da degeneração das actuaes raças humanas. Correio med. de Lisb., viii, 66.

EIKIE, ARCHIBALD. Geographical evolution. Proc. Roy. Geog. Soc., July.

AECKEL, Prof. ERNST. The evolution of man. A popular exposition of the principal points of human ontogeny and phylogeny. Translated from the German. With numerous illustrations. 2 vols. 12°. Appleton.

——. Popular conferences on evolution. 2e fasc. 8°. Bonn.

ENSLOW, Rev. GEORGE. The theory of evolution of living things. McMillan.

INSLEY, W. W. When did the human race begin? Penn. Month. Sept., Oct.

E BON, GUSTAVE. L'homme et les sociétés: leur origine et leur histoire. 8°. Paris, Rothschild.

IVART, ST. GEORGE. On the genesis of species. Macmillan.

UDGE, B. F. Another view of the antiquity of man. Kansas City Rev., Aug.

AGLIANI, L. Lo sviluppo umano per età, sesso, condizione sociale ed etnica, studiato nel peso, statura, circonferenza toracica, capacità vitale e forza muscolare. Gior. d. Soc. ital. d'ig., Milano, i, 357.

CHMIDT, OSCAR. Une controverse transformiste. Rev. scientifique, janvier 25.

OPINARD, PAUL. De la notion de la race en anthropologie. Rev. d'anthrop., octobre.

IRCHOW, R., and Prof. TYNDALL. Evolution. Eclectic, Jan.

ARD, LESTER F. Haeckel's genesis of man. E. Stern & Co., Philadelphia. (From the Penn. Month., Ap., May, July, 1877.)

ILSON, DANIEL. Some American illustrations of the evolution of new varieties of man. J. Anthrop. Inst., May.

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7OOLLEY, CHAS. F. Sand-fields and shell-heaps. Am. Antiquarian, i, 4.

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——. Sur la ptérion chez diverses races humaines et les primates. Bull. Soc. d'anthrop., Paris, 1878, i, 330.

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ENEDIKT, MORIZ. Anatomical studies upon the brains of criminals. Vienna.

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LAKE, Dr. CARTER, Prof. OWEN, and Prof. BUSK. Notes and observations on skulls brought by Capt. R. F. Burton from the East. J. Anthrop. Inst., Feb.

ORDIER, H. Étude anthropologique sur une série de crânes d'assassins. Rev. d'Anthrop., avril.

RABROOK, E. W. On an Échelle de couleurs published by the Société sténochromique of Paris. J. Anthrop. Inst., Aug.

ROCA, P. Instructions relatives à l'étude anthropologique du système dentaire. Bull. Soc. d'anthrop. de Paris, 3. s., ii, 128.

RICHARDSON, W. S.—Draws attention to an extensive earthwork near Bridgeport, Conn.

SLADE, ELISHA.—No antiquities occur in Bristol County, Massachusetts, excepting the Dighton Rock.

SPRINGFIELD REPUBLICAN (slips with no date).—Large aboriginal cemetery near Holyoke, Mass.; the dead buried in sitting posture; stone implements and even copper spear-points were found with the bones, as well as paint and strings of wampum.

TEMPLE, J. H.—Is making a complete survey of Indian remains in the town of Framingham, Mass. Reports a cache of a peck of chipped implements near that town.

THOMPSON, Miss MARY F.—No mounds occur near Brattleborough, Vt. There is a rock inscription three-fourths of a mile from B., on a rock near the mouth of West River, 100 yards southwest and 550 yards west of its junction with Connecticut River. The figures represent fish-hawks or eagles, and are hammered in depth one-eighth of an inch.

IRISH, WILLIAM. C.—Mounds and graves occur two miles east of Brighton, Northumberland County, Ontario, on Presque Isle Point. Similar mounds are on the lake shore near Redeck's farm, four miles west of the first.

JACK, J. ALLEN.—Describes stone images from New Brunswick, and sculptured slabs from St. John's, New Bruswick.

CENTRAL AMERICA.

FLINT, EARL.—Has discovered near Grenada, Nicaragua, a cave in which the author claims to have found inscriptions upon the walls made before the cave was filled by a tertiary deposit, which petrified after the inscriptions were made. The sandstone and sedimentary rock of the cave were formed subsequently to man's occupation, from which is argued man's existence in Nicaragua long before his advent in Europe, at least 180,000 years ago.

ANTHROPOLOGICAL INVESTIGATIONS DURING THE YEAR 1879.

By Otis T. Mason.

The investigations of anthropologists may be divided into several classes. The first relates to the origin of the race, and this again deals with very different questions, such as, 1, the method by which the human animal made his appearance upon this planet; 2, his mental and social condition at that time; 3, the geological epoch when this remarkable event took place; 4, the locality or localities of his first appearance.

Another class of inquiries, following closely upon the last named, relates to the oldest manifestations of culture in gravel-beds, caves, mounds, graves, and sepulchers, by means of which it is hoped to reconstruct the history of the past.

A third class of investigations has reference to the human body as it now manifests itself. Beginning with the very first germ or embryo, the biologist traces the life history of man to maturity. The anatomist and the physiologist follow up the work of the biologist and study the resemblance between the human structure and that of the lower animals.

Next comes the psychologist, comparing the mental manifestations of one race with another and of each race with those of animals. This branch of the subject has but just begun its scientific career, under the direction of such students as Galton, Bertillon, Lindsay, Maudsley, and a few others.

The fifth class of studies relates to the various races of men. Though no broad spaces separate the human groups, yet all men recognize racial differences. If all the human beings that present marked characteristics were arranged in groups, and those that nearly resemble them were placed near those to whom they bear the greatest likeness, we should have a series of irregular masses merging into one another. These would be races. The form, the extent, and the number of the groups would vary somewhat with the characteristics selected as the basis of the classification. The progess of scientific observationis bringing other portions of the body than the brain and skull into prominence as racial marks. Of the two words commonly used to designate this branch of the subject, I employ ethnology as the generic term, including ethnography, or the description of races, and all discussions with reference to the best methods of classifying mankind.

The next division of the subject is language, the basis of which is phonology; the relation of sound to sense, or sematology, and the peculiar adjustment of the sentential elements, or morphology, at present occupying a subordinate position. It cannot be denied that more is being accomplished in the way of collecting material than at any time previous.

The seventh class of anthropological phenomena embraces all of the occupations, crafts, and arts of man, without regard to race. Looking over the whole race as a propagating garden for the arts of life, we study each industry or æsthetic action in its historic development and in its correlation with other arts and industries. Mr. Spencer's Sociology, Mr. Tylor's Primitive Culture, and works of that class, have done a great deal toward explaining the orderly manner in which even those things which seem fortuitous are brought about.

Very closely allied with the foregoing class is that which relates to sociology proper, or the evolution and regulation of the family, the tribe the society, and the state. With this division of the subject are connected some of the gravest problems that we have to settle.

The ninth and last class, for want of a better term, we call religion It includes not only the philosophic inquiry into the cause of all phenomena, but beliefs with regard to morality and the future state, and all those acts and paraphernalia which are associated with worship, together with the organization of society growing out of the same.

In conclusion, a science so comprehensive and so popular must have its corporate agencies, its organs, and its schools. A knowledge of the locality and scope of these is highly important, especially to beginners A list of the principal papers of the year, in the order indicated, wil serve not only as a bibliographical list, but also to indicate the scope o investigation in each class of inquiries:

Class I. Anthropogeny.
II. Prehistoric Anthropology.
III. Biological Anthropology.
IV. Psychological Anthropology.
V. Ethnology.
VI. Linguistic Anthropology.
VII. Industrial Anthropology.
VIII. Sociology Proper.
IX. The Science of Religion.

I.—ANTHROPOGENY.

ALLEN, GRANT. A "hairless" problem in human evolution. (Fortnightly.) The Century, May 24. *See, also*, Pop. Sc. Month. Jun

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BEGOUEN, ———. La création évolutive. 8°. Toulouse.

BUTLER, ———. Old and new evolution. Scribner & Welford.

COOK, JOSEPH. Heredity, with preludes on current events. Houghton, Osgood & Co., Boston. 272 pp. 12°.

DELANEY, MARTIN R. The origin of race and color. Harper & Bro

DE QUATREFAGES, A. The human species. Translated from th French, and forming No. 27 of "The International Scientific Series." D. Appleton & Co.

DUMONT, A. Haeckel and the theory of evolution in Germany. Pari *Germer-Baillière*.

EVOLUTION, the fallacies of. Edinburgh Review, July. (A review of Haeckel, Wallace, and de Quatrefages.)

FISKE, JOHN. Darwinism, and other essays. Macmillan & Co.

GOMES, G. Da degeneração das actuaes raças humanas. Correio med. de Lisb., viii, 66.

GEIKIE, ARCHIBALD. Geographical evolution. Proc. Roy. Geog. Soc., July.

HAECKEL, Prof. ERNST. The evolution of man. A popular exposition of the principal points of human ontogeny and phylogeny. Translated from the German. With numerous illustrations. 2 vols. 12°. Appleton.

——. Popular conferences on evolution. 2e fasc. 8°. Bonn.

HENSLOW, Rev. GEORGE. The theory of evolution of living things. McMillan.

KINSLEY, W. W. When did the human race begin? Penn. Month. Sept., Oct.

LE BON, GUSTAVE. L'homme et les sociétés: leur origine et leur histoire. 8°. Paris, Rothschild.

MIVART, ST. GEORGE. On the genesis of species. Macmillan.

MUDGE, B. F. Another view of the antiquity of man. Kansas City Rev., Aug.

PAGLIANI, L. Lo sviluppo umano per età, sesso, condizione sociale ed etnica, studiato nel peso, statura, circonferenza toracica, capacità vitale e forza muscolare. Gior. d. Soc. ital. d'ig., Milano, i, 357.

SCHMIDT, OSCAR. Une controverse transformiste. Rev. scientifique, janvier 25.

TOPINARD, PAUL. De la notion de la race en anthropologie. Rev. d'anthrop., octobre.

VIRCHOW, R., and Prof. TYNDALL. Evolution. Eclectic, Jan.

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WILSON, DANIEL. Some American illustrations of the evolution of new varieties of man. J. Anthrop. Inst., May.

——. The ethnical influences of physical geography. Am. Assoc. Saratoga.

II.—PREHISTORIC ANTHROPOLOGY.

ABBOTT, C. C. Pliocene man. Kansas City Rev., Nov.

AMEGHINO, FLORENTINO. L'homme préhistorique dans La Plata. Rev. d'anthrop., avril.

ASSYRIA and Babylon, recent discoveries in. Builder, Aug. 2.

BARBER, EDWIN A. Antiquity of the tobacco pipe, in Europe. Am. Antiquarian, i, 1.

——. Examination of Indian graves in Chester County, Pa. Am. Naturalist, May.

——. Native American architecture. Am. Antiquarian, Jan.

BARNABEI, F. Excavations and discoveries of antiquities in the te tory of Sybaris. Academy, July 19. (Signor Barnabei is a re lar contributor to the Academy upon Italian archæology.)

BASTIAN, A. Die Culturländer des alten Amerika. 2 vols. Be 1878.

BAUX, A. Note sur des antiquités sardes. Matériaux. 4e livr.

BERTHER, ÉLIE. The prehistoric world. From the French, by M J. Safford. Porter and Coates.

BHANDARKAR, R. G. Antiquarian remains in a mound near Kolha J. Bombay Branch Roy. As. Soc., No. 36.

BINKLEY, S. H. Prehistoric manufacturing village in the Miami ley, and mound-builders' relics. Am. Antiquarian, i, 4.

BLACKBURN, HENRY. Breton folk: an artistic tour in Brittany. ill. Scribner & Welford.

BOSCAWEN, W. ST. C. Assyrian explorations. (Athenæum.) Cent Aug. 9.

BOUCHER, HENRI DU. Matériaux pour un catalogue des stations historiques landaises. Matériaux, 5e livr.

BROADHEAD, G. C. The walled lakes of Iowa. Kansas City Rev., F

BURNOUF, EMILE. Mémoires sur l'antiquité (l'âge du bronze—T Santorin, Delos, Mycene, etc.). Paris, Maisonneuve.

BURTON, R. F. The Carinthian barrows. Athen., Nov. 22.

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CARTAILHAC, M. Review of Evans's "Stone age." Rev. scientifiq février 15.

CHANTRE, E. Les nécropoles du premier âge du fer des Alpes fr çaises. Lyon. 8°. Georg.

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INDEX TO PAPERS ON ANTHROPOLOGY PUBLISHED BY THE SMITHSONIAN INSTITUTION, 1847 TO 1878.

BY GEORGE H. BOEHMER.

The letters and dates in the margin indicate whether the paper was published in the Contributions to Knowledge, quarto, and in which volume (S. C., i to xxii); in the Miscellaneous Collections, octavo (M. C., i to xvii); or in the Annual Reports, octavo (R., 1847 to 1878, &c.); while the figures in the last column refer to the number assigned to the communication in the List of Publications of the Smithsonian Institution.

Authors, localities, and subjects.	Publication.	Date.	Number in list.
Col. A. G., on the Sioux or Dakota Indians	R.	1876	299
marrow of animals, uses of, among the Indians of North America, by eale	R.	1870	244
E., earthworks in Wisconsin	R.	1872	271
E., pits at Embarrass, Wis	R.	1877	323
n, Laura, vocal sounds of, by Francis Lieber ... ii	S. C.	1850	12
D. G., artificial shell deposits in the United States	R.	1866	214
merica, Tinneh Indians of	R.	1866	214
ul, troglodytes in the valley of the Vezère	R.	1872	271
., on shell-heaps in Georgia	R.	1871	249
G., Indian engravings along Green River Valley	R.	1872	271
iver N., antiquities of Charles County, Maryland	R.	1874	286
ound and ancient fort in Tompkins County, New York, by David Trow-	R.	1863	187
und in Indiana, by William Pidgeon	R.	1867	215
an Indian squaw, account of, by W. M. King	R.	1874	286
, aboriginal inhabitants of	R. R.	1863 1864	187 188
, cave in Calaveras County, by J. D. Whitney	R.	1867	215
, graves and shell-heaps, by Paul Schumacher	R.	1874	286
, Indians of, by Stephen Powers	R.	1876	299
, Santa Rosa Island, by Rev. Stephen Bowers	R.	1877	323
'est, Prescott, remains near, by W. E. Guest	R.	1856	91
George L., antiquities of Colorado	R.	1877	323
tery, Indians of, by James G. Swan ... xvi	S. C.	1870	220
ntesca, of Yzamal, Yucatan, remarks on, by Dr. Arthur Schott	R.	1869	228
guage, by Dr. C. H. Berendt	R.	1873	275
Major, excursion to Abó, Quarrá, and Gran Quivira, N. M	R.	1854	75
llefs. See Troglodytes.			
alaveras County, California, by J. D. Whitney	R.	1867	215
B., flint implements in Holmes County, Ohio	R.	1877	323
n Indians. See Tinneh.			
argon, dictionary of, by G. Gibbs ... vii	M. C.	1863	161
M., antiquities of Tennessee	R.	1877	323
J., antiquities of Mason County, Illinois	R.	1877	323
ancient remains in, by E. L. Berthoud	R.	1867	215
antiquities of Clear Creek and Jefferson Counties, by George L. Cannon	R.	1877	323
Weld County, antiquities on the Cache la Poudre River, by E. L. Berthoud	R.	1871	249
Dr. A. J., mounds near Fort Wadsworth, Dakota	R.	1871	249
ut, ancient implement of wood, E. W. Ellsworth	R.	1876	299
inity and affinity, systems of, by L. H. Morgan ... xvii	S. C.	1869	218
guage, introduction to the study of the, by M. Kabis	R.	1867	215
s march in search of the "seven cities of Cibola," &c., by General J. W. , U. S. A	R.	1869	228
lvetica, by Fred. Troyon	R.	1864	188
neral George, arrow and fire making	R.	1871	249
n, Thadd. A., Sioux of the Upper Missouri	R.	1850	28
am, K. M., shell-heaps on Mobile River	R.	1867	322
Frank H., antiquities of Orleans County, New York	R.	1874	286
B., ancient relics in Northwestern Iowa	R.	1872	271
'ort Wadsworth, mounds near, by Dr. A. J. Comfort	R.	1871	246
ammar and dictionary, by S. R. Riggs ... iv	S. C.	1852	40
dians. See Sioux.			
incoln County, mound in, by A. Barrandt	R.	1872	271
I., on later prehistoric man in Alaska ... xxii	S. C.	1878	318
A. F., mound in East Tennessee	R.	1863	187
Charles, anthropological inquiry	R.	1867	215
C., antiquities of Isle Royale, Lake Superior	R.	1874	286
. E. H., on ethnological research	R.	1866	214
ee E. G. Squier.			
. A., explorations in Tennessee	R.	1870	244
K., on mound in Wisconsin	R.	1872	271
f arrow-heads near Fishkill, N. Y., by Edw. M. Shepard	R.	1877	323
of flint implements in the United States, by J. F. Snyder	R.	1876	299
palafittes of Lake Neuchâtel	R.	1865	209
, J. H., ancient pottery from Arkansas	R.	1872	271
, J. H., relics presented to the Smithsonian Institution	R.	1872	271
sketch of ancient earthwork in Ohio	R.	1866	214
f Columbia, Washington, prehistoric remains in the vicinity of	R.	1872	271
. W. E., on Indian forts and dwellings	R.	1876	299
a stone without metal, by Charles Rau	R.	1868	224
E. O., antiquities in Tennessee	R.	1870	244
k, double-walled, in Ashtabula County, Ohio, by Stephen D. Peet	R.	1876	299
ks, ancient, of Ashland County, Ohio, by George W. Hill	R.	1877	323
ks, ancient, on the Upper Missouri, by A. Barrandt	R.	1870	244
ks in Wisconsin, by E. E. Breed	R.	1872	271
ks on the Arkansas River, Arkansas, by Mrs. Gilbert Knapp	R.	1877	323
ks, ancient, sketch of, by I. Dille	R.	1866	214

Authors, localities, and subjects.	Publication.	Date.	Number in list.
Sculpture, Maya, ancient relic of, by Dr. Arthur Schott	R.	1871	249
Sculptures of Santa Lucia Cosumalwhuapa, Guatemala, by S. Habel........xxii	S. C.	1878	269
Shaw, James, mound-builders	R.	1877	323
Shell-deposits in New Jersey, by Charles Rau	R.	1864	188
Shell-deposits, artificial, of the United States, by D. G. Brinton	R.	1866	214
Shell-heaps, ancient graves and, in California, by Paul Schumacher	R.	1874	286
Shell-heaps in Georgia, by D. Brown	R.	1871	249
Shell-heaps on Mobile River, Alabama, by A. S. Gaines and K. M. Cunningham	R.	1877	323
Shell-heaps. See Kjoekken-Moedding.			
Shepard, Edw. M., deposit of arrow-heads, Fishkill, N. Y	R.	1877	323
Simpson, General J. W., U. S. A., Coronado's march	R.	1869	228
Sioux or Dakota Indians, by Col. A. G. Bracket	R.	1876	299
Sioux Indians, language of the, by F. L. O. Roehrig	R.	1871	249
Sioux Nation of the Upper Missouri, by Thadd. A. Culbertson	R.	1850	28
Skull and long bones from mounds near Albany, Ill., by Dr. R. J. Farquharson	R.	1874	286
Skull, human, from Rock Bluff, Ill., by Dr. J. A. Meigs	R.	1867	215
Skull, human, form of the, present state of ethnology in relation to the, by Prof. Anders Retzius	R.	1859	110
Skull, shell-bed, from Rock Island, Ill., by A. S. Tiffany	R.	1874	286
Smart, Capt. Charles, notes on the Tonto Apaches	R.	1867	215
Smith, Dr. C. D., ancient mica mines in North Carolina	R.	1876	299
Smith, J. W. C., antiquities of Yazoo County, Mississippi	R.	1874	286
Snyder, J. F., deposits of stone implements in the United States	R.	1876	299
Social and religious condition of the lower races of man, by Sir John Lubbock	R.	1869	228
Southern States, antiquities in, by H. C. Williams	R.	1870	244
Spainhour, J. Mason, antiquities in North Carolina	R.	1871	249
Squier, E. G., aboriginal monuments of New York........ii	S. C.	1850	15
Squier, E. G., antiquities from Nicaragua	R.	1850	28
Squier, E. G., ancient monuments, &c........i	S. C.	1848	1
Stanley, J. M., portraits of North American Indians........ii	M. C.	1852	53
Stelle, J. Parish, aboriginal ruins at Savannah, Tenn	R.	1870	244
Stelle, J. Parish, aboriginal ruins in Hardin County, Tennessee	R.	1870	244
Stephenson, M. F., mounds in Bartow County, Georgia	R.	1872	271
Stephenson, M. F., mounds in Georgia	R.	1870	244
Stock in trade of an aboriginal lapidary, by Charles Rau	R.	1877	323
Stone age and the troglodytes of Breckinridge County, Kentucky, by R. S. Robertson	R.	1874	286
Stone age in New Jersey, by Dr. C. C. Abbott	R.	1875	298
Stone celts in the West Indies and Africa, extract from letter of George J. Gibbs	R.	1877	323
Stone image in Tennessee, by Edw. M. Grant	R.	1870	244
Stone implements, North American, by Charles Rau	R.	1872	271
Stone period, North American, agricultural implements of the, by Charles Rau	R.	1863	187
Strong, Moses, antiquities in Wisconsin	R.	1877	323
Strong, Moses, mounds of Grant County, Wisconsin	R.	1876	299
Swan, James G., Haidah Indians of Queen Charlotte Islands........xxi	S. C.	1874	267
Swan, James G., Indians of Cape Flattery........xvi	S. C.	1870	220
Switzerland, Concise, researches made at, by Fred. Troyon	R.	1861	149
Switzerland, Crania Helvetica, by Fred. Troyon	R.	1864	188
Switzerland, lacustrian cities of	R.	1861	149
Switzerland, lacustrian settlements in, by A. Morlot	R.	1863	187
Switzerland, Lake of Neuchâtel, palafittes, or lacustrian constructions of the, by E. Desor	R.	1865	209
Switzerland, Lausanne, cantonal museum at, antiquarian and ethnological collections of the, by Fred. Troyon	R.	1861	149
Symbols for charts of prehistoric archæology, international code of	R.	1875	298
Syria, Beirut, sarcophagus from	R.	1870	244
Taylor, William M., ancient mound in Western Pennsylvania	R.	1877	323
Tennessee, antiquities in, by E. O. Dunning	R.	1870	244
Tennessee, antiquities of, by Dr. Joseph Jones........xxii	S. C.	1876	259
Tennessee, antiquities of, by Dr. Daniel F. Wright	R.	1874	286
Tennessee, antiquities of, by W. M. Clark	R.	1877	323
Tennessee, Blount County, antiquities of, by Miss Annie E. Law	R.	1874	286
Tennessee, Chattanooga, ancient mound near, by M. C. Reed	R.	1867	215
Tennessee, East, mound in, by A. F. Danilson	R.	1863	187
Tennessee, explorations in, by E. A. Dayton	R.	1870	244
Tennessee, Hardin County, aboriginal ruins in, by J. Parish Stelle	R.	1870	244
Tennessee, image of stone in, by Edw. M. Grant	R.	1870	244
Tennessee, Jackson County, antiquities of, by Rev. Joshua Haile	R.	1874	286
Tennessee, Savannah, aboriginal ruins at, by J. Parish Stelle	R.	1870	244
Tiffany, A. S., shell-bed skull from Illinois	R.	1874	286
Tinneh, or Chepewyan Indians of British America, by B. R. Ross	R.	1866	214
Tonto Apaches, notes on, by Capt. Charles Smart	R.	1867	215
Trade, ancient aboriginal, by Charles Rau	R.	1872	271
Troglodytes, or cave-dwellers of the valley of the Vezère, by Paul Broca	R.	1872	271
Troyon, Fred., collections of the museum at Lausanne, Switzerland	R.	1861	149
Troyon, Fred., Crania Helvetica	R.	1864	188
Troyon, Fred., lacustrian cities of Switzerland	R.	1861	149
Troyon, Fred., report of researches made at Concise	R.	1861	149
Trowbridge, David, ancient fort and burial ground in New York	R.	1863	187

ON THE PRESENT FUNDAMENTAL CONCEPTIONS OF PHYSICS.

'WO LECTURES DELIVERED IN VIENNA ON THE 10TH AND 17TH OF DECEMBER, 1879.)

BY PROF. DR. FRANZ JOSEPH PISKO.

[Translated from the German by L. STOERZER.]

LECTURE I.

He who compares the fundamental principles of physics accepted present with those prevalent several decades ago must necessarily astonished at the changes which have occurred within the domain of ese branches of science. The "Imponderables" have fallen to the ound and have made way for the various motions and forms of motion a hypothetical universal æther and the ultimate atoms of matter. ıe single natural force, or rather one single original universal motion recognized, which manifests itself in various forms, such as cohesion, hesion, chemical affinity, gravitation, heat, light, electricity, and mag- tism.* This changed fundamental principle lends to modern physics coherent and attractive form, which essentially distinguishes it from e incomplete and unsatisfactory system of the older physics. The new stem has a very simple basis, and the modern structure of natural ilosophy appears accordingly much more connected, comprehensive, d translucent than the old defective and disjointed edifice.

The physics of to-day is shaped into a logically-constructed theory of otion or kinematics (dynamics). It is however not merely the outward rm of the science which is altered, but the comprehension of natural enomena and laws has also undergone a far-reaching and radical ange. For instance, if formerly the falling of a stone was observed, was believed that on the stone's reaching the ground all its motion d ceased; it was, according to this, considered possible that motion

* [The hypothesis advanced by many popular expounders of science, that all the ces and properties of matter are to be ultimately resolved into molecular or atomic tion, is a remarkable instance of premature and over generalization. In the Smith- ian Report for 1876 (pages 275–279) reasons were given for believing that *gravitation* nnot be resolved into any form of *motion;* and further, that without an inscrutable orce" underlying all motion and antecedent to it, no rational conception of dynamics possible. Without the ultimate (irresolvable) fact of "elasticity" in material ele- nts (for example), neither transformation of motion nor conservation of energy could ve any conceivable basis.—*Ed.*]

might be destroyed; now it is known that the visible motion of the fallen stone transforms itself into the invisible one of its molecules by which its temperature is somewhat increased. Light falling on a black cloth, being, so to speak, swallowed up or absorbed by it, was formerly considered as absolutely extinguished or completely annihilated by it; now it is known that the rays of light are not destroyed thereby but they are transformed into heat.

Such examples might be indefinitely multiplied, tending to show that an apparently destroyed force can never be lost in reality, but that the effects of these forces are only changes or transformations. By ingenious tests in measurements, these hidden and reappearing actions of natural forces (that is the motions of bodies and their ultimate particles) can be traced; it can be proved that in nature no part of the action of force—(or of the motion of bodies and their ultimate particles) can ever be lost; and at the same time that no force—no action of force or motion—can ever be created anew; but that all natural phenomena are the various effects of the original force or existing motion, present in the universe in an invariable quantity.

If we search for the beginnings of this reformation in the fundamental conceptions of natural science we must, in order to understand them, turn to the theory of heat. It is familiar, that the peculiar condition of bodies by which they produce in us the sensation of warmth and cold, and in other bodies a change of volume, is called their thermal state. We distinguish by our sense of feeling the different degrees of heat of bodies and designate them thereby as hot, warm, tepid, cool, or cold. There are then degrees or grades in the heat of bodies. The definite degree of heat of a body is called its temperature. To ascertain the temperature of different bodies thermometers are used. These however indicate only the different *degrees* of heat in a body, but cannot indicate directly the *amount* of heat contained in it. To do this a particular apparatus is needed which is called a calorimeter. In this, thermometrical measurements, of course, are also included, but there are in addition certain calculations necessary to elucidate the amount of heat in question.

The following is a very simple example of a calorimetrical test, and the calculation referring to it is also annexed; we thereby arrive at a correct idea of a heat-unit and consequently the possible numerical expression of amounts of heat. On mixing one kilogram (*kg.*) of water at 0° C. with one *kg.* of quicksilver at 34° C., the mixture will show 1° C., the water taking 33° C. from the quicksilver, and these raise its own temperature by only 1° C. One *kg.* of water, then, should have 33 times as much heat supplied to it as one *kg.* of quicksilver if the temperature of the water is to rise 1° C. This example shows that a thermometer cannot directly indicate what amount of heat is needed to raise the temperature of a weight unit of a body by 1° C.; on the contrary there are needed, to this end, tests by mixture like the above, or other similar methods.

In order to be able to give amounts of heat in numbers a heat-unit must be selected. For the heat-unit (or *calorie*) that amount of heat is chosen which has to be imparted to the weight-unit, that is, the 1 *kg.* of water, in order to raise its temperature 1° C.* If 1 *kg.* of water needs 1 heat-unit to raise its temperature from 0° C. to 1° C., then 2, 3, 4, &c. *kgs.* of water will need for the same temperature 2, 3, 4, &c. heat-units. If, for instance, a body contains 100 such heat-units, we say its amount of heat is 100. Any apparatus which permits an accurate measurement of such amounts of heat is called a calorimeter. In the example herein quoted, the vessel containing the mixture, carefully guarded against cooling and provided with accurate thermometers, would be the calorimeter.

If similar calorimetric mixture-tests as the one above cited are made with different substances and water it will be found that equal weights of different substances require different amounts of heat in order to raise their temperature by 1° C. Iron and nickel require only $\frac{1}{10}$; tin, silver, and antimony only $\frac{1}{20}$; bismuth, lead, gold, platinum, and quicksilver, only $\frac{1}{33}$ part of the amount of heat which the same weight of water requires to raise its temperature 1° C. The quantity of heat which is required to raise the temperature of a weight-unit (*i. e.* 1 *kg.*), of a body is called its specific heat or heat capacity. The specific heat of water is taken as the unit in quoting the specific heat of various substances. According to the preceding examples, the specific heat of water is 1; that of iron and nickel $\frac{1}{10}$; that of tin, silver, and antimony $\frac{1}{20}$; that of bismuth, lead, gold, platinum, and quicksilver $\frac{1}{33}$. From this it will be seen that water possesses the greatest specific heat, and that metals possess only a small amount of it. A small amount of heat can consequently raise their temperature perceptibly. In receiving equal amounts of heat the temperature of that body will rise most rapidly which has the least specific heat.

The knowledge of the specific heat of bodies is of high importance, theoretically and practically. In regard to the latter, the following example will illustrate what has been said: Supposing there were equal weight amounts of water and quicksilver in separate vessels which, having the same temperature from the beginning, were to be warmed in the same space of time by small flames which produce an equal amount of heat in a time-unit, 33 such flames would have to be placed under the

* [More generally stated, a "heat-unit" is the amount of heat necessary to raise a weight-unit of pure water at maximum density—a unit of temperature. The heat-unit above given is that employed by *French* physicists. The *British* heat-unit is only about one-fourth as large; being expressed by one pound of water raised in temperature one degree Fahrenheit. The reason for the limitation to the temperature of *maximum density* of water (about 39° F. or about 4° C.) is that the heat-capacity (specific heat) of liquids increases slightly with their temperature.—*Ed.*]

water vessel, and but 1 under that containing the quicksilver. For the same reason 33 times the quantity of coal would have to be burned under the water that the quicksilver would require, if the temperature of these fluids were to be increased to the same degrees of heat.

Because quicksilver requires only $\frac{1}{33}$ of the quantity of heat which is required by water to raise its temperature one centigrade degree, the quicksilver will, if equal quantities of these fluids are placed on a heated stove in separate vessels, acquire a higher temperature in a much shorter time than the water. If however equal quantities of water and quicksilver, the temperature of which has been raised in this manner, are both allowed to cool and are put in a place having a constant temperature the temperature of the quicksilver will fall much more rapidly than that of the water, for the reason that the latter, on account of its 33 times greater specific heat, has to give back again this 33 times greater amount of heat for every degree of falling temperature, which had previously been absorbed by it for each 1° C. of heat. Under otherwise similar circumstances the temperature of a body possessing but a small degree of specific heat rises or falls more rapidly than that of a body possessing a higher degree of the same. The difference in the amount of the specific heat of different bodies is not directly apparent; the existence even of specific heat has to be determined, as was previously observed, by peculiar mixture tests or other processes. Though, from other considerations than the above, the varying heat-conducting capacity of bodies (causing their more or less rapid heating and cooling) was known, the existence of specific heat was for a long time unknown to natural philosophers. Indeed, it was only discovered as late as 1760–1765 by the Scottish professor of chemistry, Joseph Black. The discovery was made during his researches concerning another important law of heat discovered by him, of which more hereafter. Black discovered the fact which is now accepted as specific heat. The designation of this fact as "specific heat," however, originated with Wilke (1772). Crawford (1779) used the expression "comparative heat" or heat capacity. The latter word refers figuratively to the varying capacity of different bodies, by virtue of which they absorb different amounts of heat for each 1° of increased temperature.

It had not escaped the notice of the discoverer of specific heat that an equal quantity of heat absorbed by a body for each degree of increased temperature, and (so to speak) concealed in it, is given back at exactly the same rate when the temperature of a body decreases one degree. What becomes of the heat absorbed by bodies in the increase of their temperature, and which is given back so precisely in the process of cooling? This is about the question Black asked, and in order to arrive at a correct answer he examined the two principal theories in regard to the ultimate cause of heat which at all times had been more or less obscurely expressed.

The ancient philosophers, in explanation of heat phenomena, had assumed the existence either of an excessively rare elastic heat substance (the element "fire"), which, by penetrating into the body according to its amount, heated it more or less, or they tried to explain heat phenomena by the assumption of a continuous motion of greater or smaller amount of the ultimate corpuscles of bodies. Their idea was however too general, too indefinite, and confused in both directions. Black and his adherents in principle shared the first-named opinion, and believed that the important fact of specific heat (discovered by Black) could only be explained by the hypothesis of an extremely rare, elastic, all-penetrating, and imponderable "caloric." It was supposed that this caloric repelled its own molecules while it attracted those of foreign bodies. If this caloric, by virtue of the attraction exercised by it and the molecules of these bodies, penetrated the pores of substances, it expanded the molecules by means of its elasticity, thus increasing the volume of bodies by the supply of heat, and in this manner the expansion of a body by heat was explained. Black and his scientific friends thus defined specific heat: Caloric is present in smaller quantities in cold bodies than in warm ones; it possesses a certain degree of elasticity dependent on its accumulation and the degree of attraction existing between it and the molecules of matter. The greater the latter the feebler the elasticity of the caloric between the molecules will appear, consequently the thermometrical degree of the body will prove the smaller, although the same amount of heat be present, and will therefore require the more heat to raise its temperature one degree; in other words, its specific heat or heat capacity will be the more considerable.

The fact that with the condensation of a body its specific heat diminishes, harmonized with this explanation. The caloric hypothesis made the following assumption: If a body is condensed the elasticity of the caloric is thereby increased; a part of this becomes free and raises the temperature of the body. In the same measure as the heat capacity of a body is diminished or increased the heat will become free or latent.

The opinion in regard to the existence of a caloric was confirmed, in addition, by the fact of radiation of heat, as far as it was known at the time; the caloric rays (like the rays of light) being regarded as exceedingly rare material emanations from heated bodies, moving with infinite rapidity, penetrating the bodies with which they came in contact, in part combining with their substance (as previously indicated) and remaining latent, or in part free and acting as thermometrical heat in the bodies.

In Black's time all the then known heat phenomena harmonized with this heat hypothesis, or at least they were not in opposition to it; therefore at that time the caloric theory was almost universally accepted, and this all the more as the terrestrial sources of heat, formerly so difficult to explain (including the development of heat by percussion or compression or by chemical processes) after Black's discovery of specific heat, might be appropriately reduced to a diminution of the heat capac-

. . . . almost simultaneously from . . . . and James Prescott Joule (Aug . . . . physician in Heilbronn, ... thoroughly conversant with practi . . . . . . subject mainly from a theoreti . . . . . . conclusions by experimen . . . . . . happily arrived, in a str . . . . . . more powerful in ferti . . . . . . of experiment, a . . . . . . determination of numeri . . . . . . as far as the expe . . . . . . well aware that the hon . . . . . . is almost generally c . . . . . . away. We say "alm . . . . . . of Mayer in this importa . . . . . . particularly by some E . . . . . . the fact that Mohr, in . . . . . . that is five years earlier th . . . . . . that also Seguin (1839), Fa . . . . . . reached earlier than Mayer t . . . . . . mechanical power. Att . . . . . . on Force" by Colding, whi . . . . . . year 1843, in which the auth . . . . . . natural forces and their tra . . . . . . forces; and, by his own sta . . . . . . years before on the ground . . . . . . inert forces."

. . . . . . Mayer. The relation of t . . . . . . been indicated above. In whichev . . . . . . be decided, it is certain that o . . . . . . with this problem, and th . . . . . . celebrated as the first discoverer . . . . . . mechanical work into heat. Inde . . . . . . before him recognized and p . . . . . . and clearly, and no one before h . . . . . . the consequences as he did.

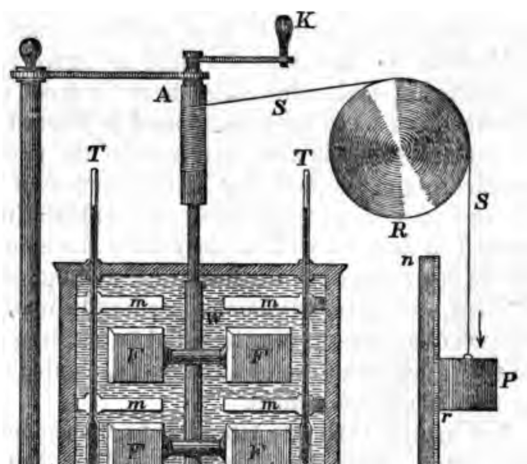
. . . . . . devoted on the discussion . . . . . . appropriate place here, and of t of the tube and shavings could not with propriety be attributed to the diminution of the heat capacity; the less so, as Rumford, by his own tests in drilling, succeeded in bringing nearly 10 pounds of water to the boiling-point after a continuous friction of two and a half hours. To what extent would the heat capacity of the metal subjected to the frictional test have had to be diminished to explain this heating of the water! At the same time it had been demonstrated, as previously mentioned, that the heat capacity of the substances subjected to the friction had not perceptibly diminished. Whence then came these enormous quantities of heat? How is it that they show themselves incessantly as long as friction continues? Can it be that bodies contain caloric accumulations in inexhaustible quantities, or could these be called forth by friction simply? Could a substance be created by friction, or rather by the cause of it, that is, by a moving force? That would mean that the immaterial effect of force was transformed into caloric! Is this conceivable? Because it is inconceivable, Rumford supposed that heat was in essence a motion of the constituent particles of bodies, which had been increased by friction in such a manner that the visible motion of the body subjected to friction had been transformed into the invisible motion of their ultimate particles—that is, of their molecules, and thus manifested itself as an increased temperature. It is very clear from this, that as long as friction, *i. e.* the visible motion of the body subjected to it, continues, so long there can and must appear free heat, which means increased molecular motion in the bodies in question.

Only one year later (1799) Davy took sides with Rumford. Davy, by means of a clockwork, had two pieces of ice rubbed on each other; they were placed under a nearly air-tight glass globe which was constantly kept at a temperature below zero; they melted at the frictional planes. As they melted only at these, and since any influx of heat to the ice was carefully guarded against, the cause of the melting could only be the heat called forth by the friction. It was known even at that time that the specific heat of water was double that of ice, so it could not be presumed that this was a case of diminution of the heat capacity by friction. There was, on the contrary, the proof of its being doubled. In addition, it was known from previous calorimetrical researches, which had also originated with Black (1760–1765), that in order to melt one kilogram of ice, greater quantities of heat would be required (79 heat-units). The question then arose, whence originated the quantities of heat required to melt those frictional surfaces of ice? "Caloric" could not introduce itself either from within or without, owing to the excellent arrangement, and yet there was heat present. It could only originate in the transformation of the visible exterior frictional motion of the mass, into the invisible, interior molecular one. After these experiments of Davy the idea of the existence of an independent caloric could no longer be entertained.

It was now but natural to examine whether there were not a definite, calculable relation between the conversion of the entire visible motion of the frictional mass into that invisible motion of the ultimate molecules, *i. e.* its transformation into heat. Rumford himself had made the experiment of such an estimate of the mechanical value of the increase of the temperature of a given quantity for each thermometrical degree. At that time, however, the scientific conception of "work" had not as yet found a place in mechanics; therefore an exact definition was only possible at a later period. It came almost simultaneously from Dr. Julius Robert Mayer (May 1842–1851) and James Prescott Joule (August 1843–1849). The former was a practicing physician in Heilbronn, the latter a physicist in Manchester, thoroughly conversant with practical mechanics. Mayer took up this subject mainly from a theoretical point of view, and verified his ingenious conclusions by experiments. Joule took the opposite direction. Both happily arrived, in a striking manner, at the great object; the former more powerful in fertile, logical ideas, the latter stronger in the province of experiment, and for this reason, more accurate in the final determination of numerical results. We will attach ourselves to Joule, as far as the experimental part of this subject is concerned, well aware that the honor of originating this highly important matter is almost generally conceded to Dr. Mayer, who has now passed away. We say "almost generally," because recently the priority of Mayer in this important matter has been disputed on several sides, particularly by some English physicists. Attention was called to the fact that Mohr, in his "Ideas on the nature of heat" (1837), that is five years earlier than Mayer, had advanced as far as the latter, that also Seguin (1839), Faraday (1839), and Liebig (1841) had approached earlier than Mayer the theory of the transformation of heat into mechanical power. Attention was especially directed to "Essays on Force," by Colding, which appeared in the Danish language in the year 1843, in which the author asserted, *à priori* the imperishability of natural forces and their transformation into equivalents of the other forces; and (by his own statement) he had conceived these ideas four years before on the ground of d'Alembert's theorem, of "The active and inert forces."

Finally Joule was put in opposition to Mayer. The relation of the labors of the two last named has been indicated above. In whichever way the question of priority may be decided, it is certain that only Mayer and Joule have successfully grappled with this problem, and that Mayer is by almost general consent celebrated as the first discoverer of the calculable transformation of mechanical work into heat. Indeed, according to existing records, no one before him recognized and proclaimed this great truth so plainly and clearly, and no one before him made such far-reaching application of the consequences as he did.

For reasons above referred to, we have decided on the discussion of Joule's experiments, which have their appropriate place here, and of the conclusions to be drawn from them. The short space of time allotted us obliges us to use economy, and therefore we limit ourselves to the indispensable in this direction. First, however, it will be necessary to define what (according to Poncelet and Coriolis) is termed "work" in scientific language, how it is measured and calculated. Whatever effect of any power we may subject to analysis, we shall always arrive at the result that the "work" performed by a force consists in the overcoming of a resistance within a given distance. For instance, if a force has to overcome a ten times greater resistance over the same space, its work will be ten times greater, and so the labor of a force is three times greater if it overcomes a uniform resistance over a three times greater space. The amount of work by a force, therefore, increases in proportion to the resistance which is overcome and to the length of way over which the resistance has been overcome. If the work of forces is to be expressed by numbers, it is necessary to name a work unit. The work required to lift 1 *kg.* through 1 meter is called a kilogram-meter or meter-kilogram (*kgm*), and is regarded as the work-unit. If then there is a resistance of 10 *kgs.* to be overcome through the space of one meter, the work is 10 *kgms.*; but if this resistance is to be overcome over three meters, the work will be three times 10 kilogram-meters, that is, 30 *kgms.* We see from this that the amount of any work is calculated by multiplying the distance by the force. We are now enabled to include within our examinations the most easily comprehensible of Joule's experiments. A perpendicular axis of rotation, A A, (see figure,) provided with brass paddles F F,—having their planes F in an upright position, was placed in a weighed quantity of water, W; this shaft Joule caused to rotate by means of a weight, P, drawing a cord, S S, wound on the drum, A; the circulating current of the liquid W being prevented by rigidly fixed brass frames, *m m*. The friction of the water W against the planes F of the



paddles, the frames *m m* and its own parts caused a rise of temperature in the liquid, which was measured by means of excellent and very sensitive thermometers, T T. The multiplication of the amount of the fallen weight P by the distance it had travelled *n v* gave the measure of the mechanical labor used for the friction. If, then, the friction of all the movable parts outside the water-tank of the apparatus, and all other losses were taken into consideration, Joule was able to calculate how many work-units would have to be employed in the friction in order to produce one heat-unit.

Joule then modified this experiment in various ways by having the friction produced in other liquids and under different circumstances. He changed the size of the descending weight, and then the height to be traversed; the result was that in friction the same amount of work is always employed in the production of a heat-unit, the mean being 425 kilogram-meters. This important figure is called the work equivalent of the heat-unit, or the mechanical equivalent of heat.*

If 425 kilogram-meters are equal to one heat-unit, one kilogram-meter (that is, the work-unit) will amount to $\frac{1}{425}$ of the heat-unit. This numerical expression of $\frac{1}{425}$ of the heat-unit, which is the equivalent of the work-unit, is called the heat equivalent of the work-unit.

Joule has furthermore determined the mechanical equivalent of heat which shows itself in the compression of air. Hirn did similar work in relation to the heat produced by the collision of two bodies; other investigators at a later period ascertained the equivalent of other sources of heat. The results of all these experiments are in such accord that we may consider the above value of the mechanical equivalent of heat a settled question.

We have arrived at the knowledge that heat is a state of motion of the ultimate molecules. The system adopting this proposition is called the mechanical theory of heat (thermo-dynamics, thermo-mechanics).

Various opinions may be held in regard to the nature of this state of motion of molecules called heat: indeed, up to the present time, different views have been expressed in regard to this question. For the mathematical basis and treatment of the mechanical theory of heat the verification of the fact that heat is a state of motion is sufficient: while for the purpose of explaining and calculating the relation of gases in regard to heat, as well as to render the conception and comprehension of the corresponding mathematical deductions of the mechanical theory of heat, or thermo-dynamics, generally more easy, the leaders in this branch of science have attempted to set up a certain hypothesis relative to the inner structure of substances, as also to the manner of motion of their ultimate molecules.

Let us first turn our attention to the conception of the inner structure of matter. Even Leucippus, as early as 510 years B. C., and after him Democritus (470 B. C.) were of opinion that matter was composed of the minute indivisible particles which they called atoms (an indivisible thing). Their atomic theory was only developed further when physics commenced to be subjected to mathematical treatment, as material points or

* [Joule's unit of the mechanical equivalent of heat is more popularly expressed in Great Britain and in this country in *foot-pounds:* being 772 pounds lifted one foot,—the equivalent of one pound of water heated one degree Fahrenheit.—*Ed.*]

atoms adapted themselves easily to mathematical treatment. Dalton (in 1803) introduced his atomic hypothesis into modern physics, which since then has been subject to different views on the constitution of matter, and therefore has had to undergo various modifications. On the basis of certain physical and chemical manifestations, it is a generally accepted proposition that matter consists of unchangeable particles, or atoms separated by spaces, which, compared to their own size, are very considerable. We must assume as many kinds of atoms as there are of chemically indivisible substances. A group of similar or dissimilar atoms considered as connected by chemical affinity, according to certain laws, constitutes a molecule. Molecules are chemically divisible, mechanically, however, indivisible. Atoms then are the components of molecules; an atom is neither mechanically nor chemically divisible. Certain phenomena lead to the conclusion that an atom cannot exist in an isolated condition, so that even in the chemical elements at least two atoms are combined in a molecule. Chemical processes extend to the separation of the atoms constituting a molecule, and to the union of materially different atoms in the molecules of compound substances. In the chemical separation the stronger chemical elective attraction of one substance mostly takes from the molecules of the other the chemically affinitive atoms, whereby the molecules of the bodies in question are decomposed. Under favorable conditions the separated dissimilar atoms combine, by virtue of their chemical affinity for each other, to form molecules of a chemically new compound body.

While chemical affinity dominates in the atoms of molecules, physical forces of attraction (cohesion, adhesion) are in action between the molecules of bodies and of the earth, just as that force called the force of gravity or gravitation prevails between the celestial bodies.

Matter then consists of mechanically indivisible molecules; the latter again can only be divided into their own atoms. The comparatively large spaces intervening between the atoms we assume to be filled with an excessively fine and highly elastic substance, called æther, which surrounds atoms and molecules alike in the manner of an atmosphere. This æther exercises an attraction on the atoms and molecules of bodies, while it repels its own particles in such wise that the density of the æther surrounding each atom and molecule increases from without towards the interior. A further assumption is that this æther is not only distributed through the interstices or pores of bodies, but extends throughout the entire universe. From the oscillations of the atoms of this æther, transverse in direction to that of the propagation of the rays of heat and light, the diffusion of the waves of heat and light is deduced, and it has been proved by well-established experiments and irresistible conclusions that the rays of heat and light are identical, and that they only differ in the number of their oscillations and their effects.

We will now examine in what way the permeability of certain substances by heat rays is explained on the one side, and the increase of temperature of others in consequence of the absorption of heat rays, by the hypothesis of an oscillating æther and atoms, on the other.

If heat rays strike a body, a part of them penetrate into the substance and transfer the oscillatory motion of the heat waves of æther either to the atoms of the æther within the body or to the atoms of the body's substance. In the former case the body (for instance, rock salt) permits the greater part of the heat rays to pass through it, and its temperature is increased in a scarcely perceptible degree; in the latter case the body refuses almost entirely to let the heat rays pass, but its temperature is noticeably heightened. It is then said that the body has absorbed the heat rays. We conceive that in this absorption of the heat rays the oscillating atoms of the æther waves or the rays strike the atoms of the body, and in transmitting their own motion impart to them an oscillating motion about their center of equilibrium, or they intensify the existing vibration of the corporeal atoms.

If, on the contrary, the oscillating material atoms of a body transmit a part of their motion to the æther, we say that such a body radiates heat. As with the aid of the law of radiation and absorption in regard to radiating heat the propagation of heat by transmission may be reduced to a stratified radiation and absorption of heat, the increase of temperature of bodies by transmission is based finally on an increased motion of the particles of the warmer bodies.

In order to be able to speak more precisely of that molecular motion which is called heat, we must borrow from mathematical mechanics the following important proposition: When bodies or their particles are in motion, half the product of the mass so moved by the square of its velocity is called the kinetic (dynamic or actual) energy or half of the *vis viva*. This expression "living force" first used by Leibnitz (1686), grew into general use in mechanics and physics, while now it is more and more replaced by the term "kinetic energy." The word "energy" was applied in physics by Thomas Young (1807); but it was only recently that Rankine fixed the definite conception of this word in the sense indicated above. Energy is now understood to mean the capability of doing work or of overcoming a resistance; the kinetic energy is mathematically equal to half the *vis viva*. In theoretical mechanics it is mathematically demonstrated that work done by a body moved by a force is equal to the increase of the kinetic energy experienced by the body during the action of the force.

We will first apply this proposition relative to kinetic energy,—to heat as a molecular motion. It is conceived that the more kinetic energy increases by means of the increased velocity of the oscillating particles, the higher the temperature of the body will prove to be. In the development of heat by friction, the kinetic energy of the visible motion of the bodies is turned into that invisible kinetic energy of the molecular motion which manifests itself as a powerful increase of temperature of the bodies experiencing friction. In the increase of temperature of bodies by absorption of heat rays, the kinetic energy of the oscillating æther atoms is transformed into the kinetic energy of the oscillating particles: in the radiation of heat by bodies, it is an inverted exchange of their kinetic energies.

A body whose atoms should tend to perfect repose would manifest the absolute zero point of temperature. It has been calculated that the absolute zero point, if it existed in nature, would be 273° C. below zero of the thermometer. Although the absolute zero point of temperature does not exist in reality, it is of value in the theoretical examination of the heat theory. From the degrees of heat, calculated from the absolute zero point, the absolute temperature is deduced. No gas is so perfect that it could preserve its aeriform quality to near the absolute zero point, but the most permanent gases even, would finally take a solid form before the cooling process had reached 273° C. below zero of the thermometer, notwithstanding that any degree of cold observed until now in nature, or which could be produced artificially, lies very much above the absolute zero point of temperature.

As in reality there exists no absolute zero point of temperature, the particles of all bodies in the universe as well as those of the universal æther are constantly in a state of that peculiar motion called heat. In solid bodies the molecules oscillate about certain centers of equilibrium. If a solid body is heated, the oscillations of its molecules become more rapid and extended, whereby its temperature and volume are increased. The force of heat acts in opposition to the force of cohesion. By continuous heating the force of cohesion may be rendered so feeble that the molecules no longer oscillate about a certain point, but they move freely among each other; it is then said that a solid body has become fluid,—it has melted.

By still increased heating of a fluid its cohesion may be so overcome that the molecules with an accelerated motion scatter apart and disperse. Freed from cohesion the vaporous or gaseous condition of substances is attained. The gas molecules move always independently of each other in a rectilineal direction until they strike other gas molecules or a wall by which latter they are thrown back like elastic balls. The pressure of a gas upon the surrounding walls is caused by the great number of violently striking molecules. This theory of gases originated principally with Daniel Bernoulli (1738), and was only recently applied very successfully to the mechanical theory of heat by Krönig, Clausius, and Joule.

According to the preceding, the pressure of a gas if it be compressed (supposing the temperature to be constant) and hence the corresponding decrease of the volume of the same quantity of gas, must be proportional, as it is evident that the shocks of the gas molecules on the walls will become more frequent during each time-unit the more confined the space is becoming in which the same number of gas molecules are moving. (Boyle's Law 1660, or Mariotte's Law 1683.)

It will be easy to judge what process will take place in a body when heat is furnished to it from outside. In the first instance the velocity of the oscillating molecules will be increased, consequently the kinetic energy of the latter is intensified; this fact manifests itself by the rising of the temperature of the body. We will call the work employed in this, measured in work-units, (according to Zeuner,) the oscillation-work. There is besides a work process going on in the interior. This produces a change, as a rule the extension of the mean intervals, *i. e.*, the medium distances of the oscillating, corporeal atoms, whereby in the expansion of bodies by heat the particles of bodies recede from each other, or they even entirely *change their places*, as is the case in the processes of melting, boiling, and evaporating. There is, lastly, an exterior work connected with the expansion or aggregation change of bodies by heat in general, as usually the pressure of the atmosphere, or some other pressure on the surface of the body from without, has to be overcome. This exterior work produces the useful effect of caloric and steam engines.

The entire work done by a certain amount of heat is equal to the sum obtained by the addition of the exterior and interior amount of the oscillation work. In assuming an infinitely small change of the body by the increase or decrease of an infinitely small amount of heat we assume its changeableness, and so succeed in subjecting those quantities to mathematical calculation, and in deducing thereby those truths of the mechanical theory of heat which are of such high importance, theoretically and technically; in regard to this subject we would refer to the works of Clausius, Zeuner, and Hirn.

According to the mechanical theory of heat the true nature of specific heat will be easily understood. In specific heat, the variable assumes smaller values with reference to oscillation-work (temperature) for the addition of a certain amount of heat, as the specific heat of the body is greater; that is, if the body requires more heat both as to exterior and interior work, for the variable. In melting, boiling, and evaporating the further change of oscillation-work under uniform pressure from without is zero, that is, no increase in the thermometrical indication is obtained, because all the work employed is expended in the dispersion or segregation of the substance.

In regard to the latter point it is necessary to be more explicit in order to be understood. If a mercurial thermometer is placed in melting ice or snow the quicksilver of the thermometer will soon reach 0° C. (32° F.), where it will stand until all the ice is melted; it will be the same with other melting bodies. The melting temperature of every substance remains constant while it melts.

The same will be the case in boiling fluids. The temperature at which a fluid begins to boil, and continues to do so, is called its boiling temperature or its boiling point. This varies with the material quality of the fluid, and also has relation to a fixed pressure of the air. As long as a fluid boils with the pressure unchanged, its boiling point remains constant; no matter how much the fire is enlarged, there will only be roduced a more rapid evaporation of the fluid, but no increase of its emperature above the boiling point. What becomes of the great mount of heat which is supplied to the melting and boiling substances? Ve shall answer this question by a historical digression; this will guide s to the solution of the present problem.

A century and a half ago Réaumur and Celsius were acquainted with he fact of the constancy of the melting and boiling points of ice and rater. Obtrusively as these phenomena courted notice, they were yet nly used by the manufacturers of thermometers as very desirable for heir purpose, but were not further heeded. Black, whom we previously ulogized as the discoverer of specific heat, comprehended the imporance of this natural phenomenon, and endeavored to solve it (1759–'64). t was he who put forward the following proposition generally known o-day, and which he verified by many experiments. As often and as ong as any substance melts or boils (evaporates) so long all heat supplied to it disappears, for the latter then no longer acts on the thermoneters which may be immersed in these melting or boiling (evapoating) substances. As soon however as the vapors of any substance become again fluid, or as soon as a fluid substance congeals, the heat which, as Black proved, apparently disappeared during the boiling or melting of these substances reappears; it then acts again on the thermometers which are immersed in either of the substances which are transforming themselves from vapor into fluid or which are again congealing. This returning heat amounts, as shown by Black, to exactly as much as that which was apparently lost during the melting or boiling. What becomes of that heat concealed during the melting or boiling of a substance, up to that time, when by a reversion of the process it reappears?

We know that Black assumed a highly elastic caloric without weight, which penetrated a substance and heated it. For the melting and boiling (evaporating) of substances was required, according to Black, much more of the caloric which, by means of its elasticity, expands the molecules, and which, by virtue of a dominating attraction between the ponderable substances and the caloric, combines with the molecules of the ponderable matter. Black, for this reason, called the heat used in melting and boiling (evaporating), — "latent" heat. By reversing the process the previously "latent" heat became again sensible; the latter had the property of acting on the sense of feeling as well as on the thermometer.

The discovery by Black of "latent" heat (as well as of specific heat) is most wonderful, because something hidden was brought to light by ingenuity and genius, and the indestructibility of heat was actually proved; in consequence the way for our modern heat theory was prepared.* We know that Black's theory in relation to the material

* [This is not quite an accurate expression of the fact, and therefore deserves comment. Were there such a thing as "caloric," it would certainly be "indestructible," and it was precisely this fallacious conception which led the illustrious Black, in his

nature of heat was not correct. Even at that time his hypothesis only spoke of the concealing and reappearing of a caloric, but was unable to throw any light on the cause of this disappearing and returning of heat, and here the mechanical theory of heat shows itself in all its glory. If the latent and specific heat quantities are nothing else but the quantities of kinetic molecular energy applied to the disengaging of the molecules which mutually attract each other, then it is plain that, as long as heated bodies do not begin to melt or boil (which means evaporation inside), a part only of the supplied heat suffices for the loosening of the cohesion of the molecules (specific heat), and that in connection with it an increase of the oscillation-work, *i. e.* an increase of temperature, takes place. As soon however as all the newly supplied quantity of heat is used entirely and exclusively in the separation of the molecules during the process of melting and boiling (interior evaporation) then no increase of the oscillation-work of the molecules, *i. e.* no rising of temperature, can take place.

In conclusion let us review the acquisitions made by this lecture. We shall find that it resulted in the certain knowledge that heat is not a substance, but the internal motion of the molecules of bodies. The molecules of all bodies of the universe, as well as that of the universal æther, are constantly in that peculiar state of motion which is termed heat. Mechanical work is convertible into heat according to a definite equivalent. We shall endeavor to prove in the next lecture that under certain restrictions heat may, by a reversal of the process, be turned into mechanical work (thermo-dynamic machines); we shall moreover demonstrate that the kinetic energy of the molecules of bodies and the æther, termed heat, may be converted and again reduced to other energies, called light, electricity, magnetism, and chemical action, in such a manner that all these energies appear only as the transformations of one single indestructible energy. The doctrine of the indestructibility and increatibility of energy forms the basis of the modern fundamental principle in physics; it has transformed the latter as thoroughly and perspicuously as had been done in a similar manner in regard to chemistry toward the close of the last century, by the proposi-

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invaluable researches, to designate the heat which (by every available test) he observed to have disappeared—"latent caloric." The modern conception of the fact is however entirely different. Heat, as a very special "mode of motion," is just as destructible as any other special form of motion, and it is no more irrational to designate *sound* or *light* as indestructible than to so designate *heat* In the latter portion of the succeeding lecture the transformation of heat into work which is not heat, is substantially recognized. As Prof. J. Clerk Maxwell has correctly stated in his excellent Treatise on Heat,—"heat may be generated or destroyed by certain processes, and this shows that heat is not a substance." (*Theory of Heat*, chap. iii, p. 57.) And again: "The hypothesis of caloric, or the theory that heat is a kind of matter, is rendered untenable—first, by the proof given by Rumford, that heat can be *generated* at the expense of mechanical work; and secondly, by the measurements of Hirn, which show that when heat does work in an engine, a portion of the heat *disappears*." (Same work, chap. viii, p. 147.)—*Ed.*]

tion established at that time with reference to the indestructibility and increatibility of matter. These two great acquisitions, namely, the propositions relative to the permanence of matter and energy, give to modern physics a solid foundation.

Lecture II.

In the former lecture we have learned how, by transformation of mechanical work into heat, their equivalence has been demonstrated; we will now show how this equivalence has been ascertained by reversing the process, *i. e.* by turning heat into work. A transmutation of heat into work is observed in the expansion of bodies by heat, also in the melting and evaporation of substances, external as well as internal work being performed in these cases. However, it cannot be proved directly and plainly, with bodies expanded by heating, that in the transformation of heat into work a quantity of heat in proportion to the latter is used, because no decrease of temperature, but, on the contrary, an increase of it, takes place. We shall therefore be obliged to look for examples in which for the work performed by a body a corresponding quantity of the heat contained in it is consumed, and is thus diminished.

This was the case in the following experiments by Gay-Lussac, and at a later period by Joule. They introduced a current of compressed air within an exhausted chamber; no loss of heat was perceptible, because no work had been performed. There was however a loss of heat upon the compressed air flowing into a chamber filled with air, because now the pressure of the air had to be overcome; consequently labor had to be performed. Joule deduced from the amount of heat lost in this measured work the heat equivalent (1845).

In steam-engines the steam is the transmitter of the heat, which performs work indirectly. If the law of the mechanical equivalent of heat is to stand, it has to be proved that the quantity of heat produced in the steam of the boiler is greater than the amount of heat contained in the condenser after the work has been done. Hirn, in Colmar, has given this most difficult proof by highly ingenious experiments with a steam-engine (1855), and Clausius deduced the heat equivalent from these experiments (1855).

We have now learned the possibility of the transformation of heat into mechanical work; it can further be demonstrated that heat may be transformed and again reduced into other actual or possible forms of motion, which are called light, electricity, magnetism, or chemical action. For instance, by means of steam electric machines and thermopiles heat is transformed into electricity. By means of the heat in a steam-engine, magneto-electrical machines may be made to rotate, and to produce powerful electric currents; the latter again may produce mechanical, chemical, magnetic, thermal, and optical effects; electricity then no longer exists as such, but is transformed into mechanical or visible motion, chemical and magnetic power, as also into heat and light. The electric current of a galvanic element originates, as will be shown hereafter, in the slow oxidation of the dissolving zinc; that is, in the corresponding heat of combustion, which, by means of the transmutation into the form of the electric current, produces all the effects above referred to. These reciprocal changes and transformations of natural forces are treated in Grove's "Correlation of the Natural Forces."

As shown by the preceding examples, which might be multiplied at pleasure, it may be affirmed: All natural forces are closely connected; any one of these forces may be transformed into another, but none of them can be destroyed. This fundamental principle of modern physical research has its origin as regards the experimental part of it in the heat equivalent first demonstrated by J. R. Mayer and J. P. Joule; its substance is now generally termed the "conservation of energy." Until a few years ago this proposition was generally expressed by "conservation of force"; since however the conceptions of force, its work and energy, have become clearer, recently the former term has generally been used in preference to the latter. The proposition relative to the "conservation of energy" asserts that the sum total of active energies in the universe is unchangeable in whatever degree the constituents of this sum might change in their relation to each other. If, for instance, a stone is thrown up perpendicularly it possesses a certain kinetic energy in consequence of the velocity imparted at the start; as soon as it has reached a certain height this energy for an instant appears lost; at the turning point the velocity of the stone and its kinetic energy are zero. But at its arrival at the point from which it had been thrown up it again possesses the previously imparted velocity and consequently its original kinetic energy; a fact which can readily be mathematically demonstrated. We ask, then: Was the energy at the point of return really momentarily destroyed?

In order to answer this query let us suppose that the stone at the moment of turning rests on a flat roof; its kinetic energy as to motion is without a doubt zero; but it is not absolutely lost, it simply takes another form of energy. This will be plain to us if we remember that if afterward that stone falls to the ground, the original kinetic energy is again obtained. As long then as that stone remains lying up there the apparently lost energy is preserved in a different form for future use.

Let us take another example: If the spring of a bow is stretched a certain energy is imparted to it by the labor necessary for the stretching, which afterward in shooting off the arrow is returned in its entirety,—not considering the losses from the impediments to motion. Is the energy employed lost as long as the bow spring remains stretched? Or is it only laid up? It is plain that the latter is the case.

If, on throwing a body up perpendicularly, we call the energy with which it begins and on returning completes its motion—"kinetic energy" (also actual or dynamic energy); if furthermore we call the stored up or preserved energy of a lifted weight or of a stretched spring, &c., "potential energy" (also energy of position, statical or quiescent energy, or elasticity); we observe that in throwing up a stone, as also in the stretching of a spring, the original kinetic energy is by degrees transformed into potential energy, until finally the kinetic energy is equal to zero, while the potential energy has become a maximum quantity. In the return of the stone, or the resilience of the spring, the relation is the reverse; *i. e.* the potential energy is by degrees turned into kinetic energy, until finally the latter has attained its maximum, while the former on the other hand has become zero.

A swinging pendulum, at the moment when it reaches the middle point with the greatest velocity, possesses only kinetic energy; at the highest points of its excursion it possesses only potential energy. On all intermediate points the sum of its kinetic and potential energy is a constant quantity. In a similar way the kinetic and potential energy form in their sum a constant quantity in a stone that is thrown and falls back vertically.

This is the real import of the proposition of the "conservation of energy." Applied to the energy of the universe—as a whole, the proposition is: The sum total of the kinetic and potential energy in the universe remains ever constant, however much the values of the several items may change. It is consequently impossible to destroy either energy or work, or the forces producing them, but it is equally impossible to originate them. The mutual play of the natural forces consists then only in their transformation, in their absorption and reappearance, without the least loss of the effects, *i. e.* without any loss of energy or work, or without their re-creation.

Having grasped the meaning of the highly important theory of the "conservation of energy," we will test its sufficiency by a few examples. If a stone has had kinetic energy given it in being thrown upward, and at the turning point has passed through a state of potential energy, and on returning to the starting point possesses again its full, original kinetic energy, does it not lose it all the same when it is suddenly brought to rest on reaching the ground? Apparently it does! In reality it does not, for the kinetic energy regained through the fall of the stone has, by its striking the ground, been turned into oscillation energy, in internal and external work of the stone molecules; it has been transformed into heat and expansion by heat, as was demonstrated by Joule's experiment.

The descending water of the Rhine-fall, of mountain torrents, &c. in dashing against the foot of rocks, in reality does not lose any of its motive energy, but for the seeming loss in external motion the internal motion of the molecules becomes more intense than previously; *i. e.* it possesses at the foot of the height as much more of heat as it has lost in moving energy. The sudden heating of a moving body when arrested is fully explained by this.

Where did the moving energy originate which was imparted to the body when thrown upward? If we ourselves threw up the weight then the energy came from our muscular power, which again drew it from the vital power, that is, from a combination of physical and chemical forces; the latter were again taken from that great total of nature's energy which exists in unalterable quantity; this would be the case with any other force which had been instrumental in throwing up the stone. The masses of water of the cataract had at some previous time been carried aloft; this was done through the agency of the energy of heat, by which the water was raised in the form of vapor, and the latter by cooling off reached that spot in the form of rain, from which, after numerous transmigrations and changes of locality, it finally precipitates itself into the deep. These processes resemble very much the changes through which material substances pass in their innumerable physical and chemical actions. However great the differences, it is certain that no substance is ever lost in the universe: the transformation is simply like the building of a new edifice with old building stone; in this process the old energies also contribute, but in new forms.

The conservation of energy has its analogue, its precursory, necessary, and supplementary correlative in the conservation of matter. As matter without force and force without matter are inconceivable, the great discovery of Lavoisièr (1772–'86) of the indestructibility of matter in reality involved that of the indestructibility of force; nevertheless, half a century passed away before this was recognized. The conservation of energy, an acquisition of the present, and the permanence of matter, an acquisition of the last century, together form the fundamental law and the "center of gravity" of our modern natural science.

On reaching this point, it may be interesting to search in the annals of science whether in earlier times the truth of the persistence of matter and energy had not been discovered and lost again, or whether its high importance and bearings were not comprehended. Researches in this direction result in finding that indeed the ancient Greek philosophers (Leucippus, 510 B. C., Democritus, 470 B. C.; Aristotle, 350 B. C., and others), and more than two thousand years later, thinkers and investigators like Descartes, Newton, Huyghens, Bacon, and others, had an idea of the indestructibility of the atoms of matter, of the perpetual activity and motion of the same; that the former at times had a dim perception of the indestructibility of matter and energy, and the latter passed closely by this fundamental proposition; that however only within the last quarter of the last century has the theory of the indestructibility of matter, and within our own time the theory of the indestructibility of energy, been fully apprehended, and efforts made to prove the same by means of induction.

Against these proofs the objection has been raised that the constancy of matter and energy was not rigorously established by experiment, as the respective measurements could never attain perfect accuracy; that this theory, unconsciously impressed on us from the beginning, might therefore have been conjectured by the ancient philosophers without confirmation from experiment. We would, however, point out that the measurements relative to those propositions possess that degree of accuracy which is indispensable in the determination of a law in natural science; that in the latter, only laws thus proved are admissible, and that the theories of the persistence of matter and energy had never been definitely expressed with mathematical precision before the above named epochs. At any rate, the really scientific and highly fruitful application of these two fundamental laws falls in the last decades of the past century and in our time. It was only after the permanence of matter had been experimentally demonstrated with the aid of delicate precision-scales by Lavoisier (1772–'86), Wenzel (1772 to 1777), and Richter (1792), and on these grounds definite statements had been made, that chemistry really became truly scientific in form and character by reason of the development of the doctrine of definite proportions.

If on the one hand the theory of the persistence of matter created chemistry as a science proper, on the other the theory of the persistence of energy threw a full light on physics, chemistry, physiology, and in fact on the whole philosophy of the investigation of nature. The last step in the establishment of the theory of the conservation of energy was produced by the theory of heat. The premises of this theory existed however already in mechanics, it having been observed in the latter at an early date that by machines no power was ever gained, but that by the use of machines power could only be employed more easily and to better advantage.

The ancients knew that in the lever the greater weight moves just as many times more slowly as it exceeds the smaller weight in quantity. Galileo observed more generally (1592) that in lifting a weight by means of a simple machine as much is lost in space and consequently in time as is gained in power. Johann Bernoulli (1717) in an ingenious manner transformed this proposition as the "principle of virtual velocities" into the first principle of the theory of equilibrium, from which emanates the solution of every statical problem. Subsequently d'Alembert embodied this principle in its widest analytical form (1743). We find then that in simple and consequently in complicated machines (these being composed of the former) absolutely no power and therefore no energy can be gained. Machines cannot produce powers; they can only apply them more advantageously to a useful purpose.

Since by means of a machine the work performed by the first motor could at the utmost but reappear in undiminished quantity at the last, (and this could be only if there were no losses by impediments to motion from friction and resistance of the air,) it is evident that a *perpetuum* *mobile* is an impossibility. In such, the first portion of the machine, if once set in motion, is to move the second, this the third, &c. the last again the first, without ceasing. The action of the first part of the machine however arrives at the last part greatly diminished by resistances to motion, and from this returns again diminished to the first part, and so on; the machine, therefore, will soon stop. If then this kind of machine, which only performs its own continuous motion, is impossible, how could any mechanism be found which once moved, would in addition perform outside work without renewal of power? That is what the wise searchers for a "perpetual motion" are striving for! A machine in continuous motion itself would be too insignificant for them; it must be an apparatus that would work incessantly and gratuitously, which need be set in motion but once, when motion and work would continue forever.

As in the foregoing, it has been demonstrated from theoretical mechanics that a "perpetual motion" is impossible, and as this has also been confirmed by experience, Helmholtz, (1847—he was not then as yet acquainted with the pertinent works of Mayer and Colding, and only obtained knowledge of that of Joule towards the close of his researches)—deduced from this the theory of the "conservation of energy" by presenting the question: "If a *perpetuum mobile* is necessarily impossible, what are then the relations of the natural forces to one another?" Helmholtz points out that if the assumption of the impossibility of a *perpetuum mobile* is combined with the law set forth by Newton (1686), "In every action of a force a similar and opposite reaction is always present," the doctrine of the mechanical equivalence of heat results therefrom. Colding had previously (1843) expressed himself by reversing the above in this wise, that if the proposition maintained by him as to the indestructibility and convertibility of natural forces were false, a *perpetuum mobile* would be possible. Newton's proposition of the equality of action and reaction of a force has become so general that it includes Bernoulli's before-mentioned principle of virtual velocities. We may therefore conclude that Newton had *approached* the discovery of the theory of the conservation of energy even earlier, and from a more general standpoint than Bernoulli.

It has been observed that the term "conservation of force" has in the course of time been replaced by "conservation of energy." Why had the term "force" to give place to "energy"? The answer will follow if the meaning of the term "force" is precisely defined, and if the effect or the capability of action of a force—*i. e.* its "energy"—is not confounded with the "force" itself, which is considered as the cause of the effect or capability of action. Force is the appellation for every cause which overcomes the property of persistence or the inertness of a body, or endeavors to overcome it; that is, every cause which actually prevails upon a resting body to move, or upon a moving body to rest, or endeavors to do so. Every force which acts upon a body emanates from some other body. Force is never one-sided in its action, but in the same force with which the first body acts upon the second one this will react on the first. This is the previously mentioned principle of Newton on the equality of action and reaction; so, for instance, a stone and the earth attract each other with equal force; both fall towards each other; the stone being a small mass does so visibly; the earth being of great magnitude, (therefore moved in the most minute degree,) does so invisibly; that is, the motion of the earth toward the stone is not sensible, as it is of a non-measurable amount. The weight on a table exercises the same pressure from above as the table from below. A spring pressed by the hand exercises a counter-pressure in an equal degree, &c. Forces then are not self-existing, but they are confined to matter, and manifest themselves only by their actions.

As forces are never observed as such, but can only be measured by their actions, recently the question has repeatedly arisen whether the term "force" ought not to be entirely banished from natural science. By degrees an agreement has been arrived at in regard to this matter, so that the actions of forces, which manifest themselves either as pressure (tension) or as motion, are adequately termed potential or kinetic energy; the latter term is susceptible of a mathematical expression. What formerly was called pressure or elasticity is now termed potential energy, while the moving forces of old are now counted among the kinetic energies. The term "force" ought to be avoided in every case where its action (work, capability of action, energy) is referred to; it may however be used in all those cases (and preserving the former usage of language) where the cause of an effect, *e. g.* of a pressure or motion, is to be indicated.

On reviewing what has been said we find that although the older theoretical mechanics had certainly approached very near the proposition of the conservation of energy, only by the discovery of the heat equivalent and of the transformation of energy did it gain a precise definition, as also a highly important general significance and a universal application. At present, analytical mechanics has deduced this theorem mathematically and made its application general.

By the discovery of the heat equivalent, the theory of heat had to relinquish the hypothesis of a "caloric," transmitted by warmer bodies to colder ones, which the latter absorbed for the purpose of raising their temperature, and it had to turn to the hypothesis, according to which radiant heat had its cause in oscillating æther atoms, and absorbed heat in the effect of the oscillation of the molecules of bodies. The theories of heat and of optics thereby obtained a common basis, namely that of the oscillating æther atoms. In optics the theory of emission, according to which exceedingly fine elastic and imponderable light-atoms were radiated by luminous bodies with an enormous velocity, was discarded earlier than the theory of caloric emission in the case of heat; the cause of this was a series of phenomena which could no longer be explained by the emission hypothesis, but only by the transverse oscillations of that extremely rare and highly elastic medium which we have termed æther.

Let us examine in what manner the wave or undulatory theory explains the fundamental phenomena of the radiation of light and heat. The ultimate particles of an incandescent metal or the flame of a lamp or any similar source of heat and light execute extremely rapid oscillations, whose kinetic energy is imparted to the atoms of the surrounding æther in a similar manner to that effected by resounding bodies on the surrounding air. Just as the latter vibrates and transmits tones, so also does the oscillating æther transmit light. While however in the transmission of sound through the air the particles of the latter vibrate in the direction of the sound rays, it is most probable, in accordance with certain phenomena, that in the transmission of light the oscillations of the æther atoms take place in a direction perpendicular to the rays of light. The hypothesis is that the elasticity of the æther permits the displacement in a lateral direction to the rays much more easily than in their direction, or longitudinally.

Colorless light, as we know, may be reduced to the primary colors of the rainbow by means of a glass prism. These variously colored components of the colorless light are virtually the same in regard to it, that the different low and high tones are with reference to sound, and they are transmitted by the æther in a manner similar to that of the propagation of the several tones of sound by the air. Mathematical optics teaches that the difference in optical tones—*i. e.* the difference in the spectral tints—like the difference in acoustic tones, is owing to the unequal length of the oscillating æther waves, or to the unequal number of oscillations of the constituent atoms. In the different length of the waves of the various spectral colors we see why the variously colored component rays of the colorless light are, by refraction, diverted from each other and scattered in a spectrum in a fan-like shape.

The more rapidly the æther atoms oscillate, or the shorter the wave, the nearer to the violet-colored limit of the spectrum will the corresponding tint be located. The longest æther waves are on the red, the shortest on the violet-colored end of the spectrum; between the two occur the æther waves of medium length. The rays of the spectrum produce three kinds of effects, by means of their kinetic energy, accordingly as they fall on different bodies. In the region of the red rays and in the invisible space beyond them a heating of bodies placed there predominates; therefore an increase of the molecular energy takes place; the rays from red to violet (among them the yellow ones, particularly) act principally on the nerve ends of the retina of the eye and excite the optic sensibility; the blue ones—the violet ones, particularly, and the invisible rays beyond the violet—produce chemical changes as the shorter waves of the oscillating æther pass over to the æther between the atoms of a molecule, and thereby cause separations as well as a different grouping of the atoms into new molecules, dissimilar to those previously existing.*

* [The researches of the elder Draper tend to discredit entirely the generally received view here stated, that the calorific, optical, and actinic effects of the solar radiation occupy different positions in the spectrum, or have different refrangibilities.

Although the different rays of the spectrum, according to their position in the latter, produce predominantly thermal, optical, or chemical effects, it can be shown that the difference in the effects is not caused by an essential difference of the rays, but rather by the different material condition of the bodies on which the rays act. There is only one kind of radiation, which however according to the number of oscillations of the æther-atoms and the difference of the irradiated matter, manifests itself in various ways in the effect. Heat, light, and chemically acting rays are in essence identical, and they become only distinguishable when the kinetic energy of their æther oscillations is transmitted to the material particles of a suitably disposed body. For instance, every ray of light is also a ray of heat; but the so-called obscure rays of heat and rays of light differ only in the number of their oscillations; otherwise they are quite the same. The rays of light alone are able to excite the ends of the optical nerves to optical action, while the visible as well as the invisible (so-called obscure) heat rays cause an increase of temperature in those substances by which they are absorbed.

In order that rays may act upon a body which they strike, it is indispensable that they should be absorbed, The absorption of heat, light, or chemical rays is a transmission of kinetic energy from the oscillating æther atoms to the molecules, and, in chemical effects, to the atoms of matter. Although the equivalent of a given quantity of light has not yet been determined, it is certain that through the absorption of light rays, substances become heated, and the chemical action of the light rays augments precisely as the absorption of the latter; the law of the conservation of energy finds its application in this, though the quantitive proof is wanting as yet.

The wave, or undulatory theory of light, explains the phenomena in a very simple manner, as we demonstrated in the example of the spectrum; it reduces the radiation of light and heat to a common principle. The theory of the emission of luminous matter had to assume as many variously colored luminous atoms as the innumerable colored rays in

This eminent physicist has certainly proved that the accepted generalization is at least fallacious, and based on insufficient data. From the enormous distortion necessarily incident to every *refraction* spectrum, (as shown by reference to an arithmetical scale of wave-lengths, or by the simpler expedient of comparison with a *diffraction* spectrum,) Dr. Draper has pointed out that computing from the arithmetical center of the spectrum,—the point of maximum illumination in the yellow band—(near the sodium line *D*), the lower side of the scale is compressed into about half its just extent, while the upper side is expanded to about double its proper range. (*Am. Jour. Sci.* Sept. 1872, vol. iv, pp. 161–175.) And as this distortion goes on rapidly increasing from the mean portion, the extra optical rays are many times condensed beyond the red extremity, and many times dilated beyond the violet extremity. Accordingly the "heat-curve," familiarly exhibited by popular writers and lecturers, is simply an egregious "anamorphosis." Secondly, Dr. Draper has shown that the actinic or chemical energies of the solar ray are distributed throughout the spectrum (visible and invisible), provided that the observer's attention is not confined (as usual) to the decompositions of *silver* salts. (*Am. Jour. Sci.* Jan. and Feb., 1873, vol. v. pp. 25–38; and pp. 91–98.)—*Ed.*]

existence, which were believed to combine in the colorless ray to a colorless substance. Besides this, a peculiar caloric had to be assumed. The absorption of light could be considered only as a union of the caloric with substances by which the former lost its essential property, namely, its illuminating power. Thus many phenomena of light could not be explained by the theory of the emission of light, even with the assistance of new auxiliary hypotheses. How clearly does the undulatory theory explain, not only all the light phenomena, but also those of heat and chemically acting radiation! By the application of the proposition relative to the conservation of energy, the transformation of one kind of ray into another, as well as the absorption of rays, is easily comprehended.

By applying the undulatory theory to both heat and light, a common basis has been gained for them; the rays of heat and light are even identical. The undulatory theory of the æther being formed according to the demonstrated undulatory theory of acoustics, it shows by analogy, as indicated above, what the conception of the transmission of kinetic energy in acoustics is. First, in relation to the calling forth of tones, the mechanical work of bowing or striking the resounding instrument is changed into the kinetic energy of the vibrating motion of molecules. From the resounding body the kinetic energy passes over to the sound transmitter in form of progressing longitudinal waves, and from the sound transmitter by means of the vibratory parts of the ear to the extreme ends of the auditory nerves, whereby finally the perception of sound is produced. If the sound waves however strike accordant bodies, the latter get into resonance in consequence of the transmission of kinetic energy. In optics a similar calling forth of tones or colors in suitably constituted bodies by colored rays falling upon them is known; these phenomena are called fluorescence and phosphorescence.

We have observed that the theories of heat light and sound have been reduced to one of undulation. And since the latter is deduced from mathematical mechanics, these theories have theoretical mechanics as their basis, and, above all, the fundamental principle of the conservation of energy. The many relations existing between electrical, optical, and thermal phenomena, continually more and more discovered and displayed since the wider development of the mechanical theory of heat, are naturally calculated to arouse the efforts of natural philosophers to explain the fundamental phenomena of electricity also from some motion of material molecules or æther atoms, the many counter actions between the thermal, optical, and electrical phenomena having rendered untenable the hypothesis of electric fluids, or electric substances.

Up to the present time there have been two leading hypotheses by which the theory of electric phenomena was to be connected with the æther theory of optics and heat. One of these hypotheses maintains that there are opposite rotatory motions of the material molecules or æther atoms imparted to them in the production of the two kinds of electricity. The other assumes that the electric condition of a body is caused by a disturbed accumulation of freely acting æther. In accordance with the latter view every non-electric body would contain æther to a certain amount. By the exciting of electricity (through friction, for example), the equilibrium of the æther atoms and the ultimate particles of bodies would be disturbed, and by reason of this a flowing over of the disengaged æther from one body to another would take place; accordingly one body would have a *plus*, the other a corresponding *minus* of the disengaged æther; one body then shows positive, the other negative electricity. Endeavors have been made to explain the electric current on this ground. As yet neither the one nor the other representation has succeeded in explaining all the fundamental phenomena in electricity, although those observed up to the present time generally accord better with the latter than the former.

Although the hypotheses which aim at the ultimate attainment of a common basis for the theories of light, heat, and electricity have not satisfied the test in their detailed application, still the principle of the conservation of energy in its application to the theory of electricity has been found true. As every magnet may be considered the aggregate of all its molecules, surrounded by electric currents, if the general electric phenomena have been reduced to the theory of the conservation of energy, this reduction is, in principle, valid as to the primary magnetic phenomena.

As to frictional electricity an expenditure of work by friction is required in the separation of positive and negative electricity. The expended kinetic energy manifests itself on the rubbed bodies as the potential energy of the separated electricities in this wise, the two bodies which received the separated electricities strive to approach each other. If this approach really takes place in easily moved bodies, as for example in the motion of swinging electroscopes of opposite electricities, it finally reappears as kinetic energy as manifested in the visible approach of the easily moved electric carriers. The electric discharge in shape of a spark, as also of heat, to which the electricity has been changed, shows the passage and conversion from potential to kinetic energy.

By means of electric machines mechanical energy is transformed to the potential energies of positive and negative electricity. If the electrically charged positive and negative conductors of an electric machine are connected by a wire, the result is an electric current with which mechanical, thermal, magnetic, chemical, and physiological effects may be produced, with which therefore a transformation of energies may be effected.

The electric current also which emanates from galvanic batteries produces such transformations, in most cases to a higher degree than the frictional electric current. If a given quantity of zinc is dissolved in diluted sulphuric acid, which chemically is equivalent to its oxidation or slow combustion, a definite amount of heat is generated in the fluid by this combustion. But if an equal quantity of zinc is dissolved in the diluted sulphuric acid of a galvanic element, which is closed by an iron wire (which offers considerable resistance to electric conduction,) the amount of heat in the galvanic element decreases as compared to that of the same quantity of oxidized zinc, and is manifested instead in the resisting connecting wire, so that this thin wire appears as the bearer of a certain amount of heat or of the corresponding kinetic energy. The heat generated throughout the current conductor and augmented by the internal work is equal to that which disappears from the galvanic cell when the latter is closed with the resisting iron wire. If this experiment is modified so as to put the poles of the galvanic battery in metallic connection with *copper* wires (which latter offer a comparatively small conducting resistance), and if then the ends of these wires are united by a thin iron wire or charcoal points, a great part of the heat of oxidation produced in the battery may be conveyed to long distances in the form of the electric glow and light. In this process chemical energy is transformed into that of heat, electricity, and again of heat in accordance with the law of the correlation of energy.

If we analyze water by means of the electric current of a voltaic battery, the quantities of hydrogen and oxygen thereby obtained possess through their chemical attraction (chemical relation or affinity) that potential energy, which disappeared as the kinetic energy of heat from the battery and manifested itself in the closing wire as the kinetic energy of the electric current. Through the electrolysis of the water the electric current must be weakened by the amount required in the work performed in the separation of the atoms of the water molecules. If the mixture of inflammable gas obtained in the electrolysis of the water is set on fire, there arises from the explosion, light, heat, and sound; that is three kinds of kinetic energy. If all the losses in these processes could be taken into account, the total of all these energies would be equal to that heat energy which, during the electrolysis, was produced in the battery in the dissolution of the zinc.

In the generation of magnetism in an electro-magnet some of the kinetic energy of the electric current is expended, hence a periodical weakening of the current takes place at the moment of the magnetization; no energy is however required for the retention of the previously developed magnetism, because no work is required for the existing state of equilibrium in the electro-magnet, for where no mechanical work is performed no loss of the current can take place. In electro-magnetic motors, where the electro-magnet has to be constantly reproduced, there is then a constantly renewed expenditure of the energy of the electric current taking place. In this case there is an indirect transformation of the heat which is produced by the zinc consumed in the battery. This heat is transformed into the electric current, magnetism, and lastly into mechanical motion, which may be employed in the performing of mechanical work.

For every amount of work done by the electric current an equivalent of the energy of the current, or of the combustion heat of the oxidizing zinc in the battery, is consumed or rather transformed. We have seen that in the steam-engine a part of the heat of the steam is turned into mechanical work, and that after the work is accomplished this amount of heat is wanting in the steam that has been at work. In steam-engines, and in fact in all caloric or thermo-dynamic machines, a proportionate quantity of the heat, stored up in the form of vapors and gases, must seemingly disappear for every mechanical work done by such machine. Heat is only then turned into work if it passes from a warmer to a colder body; in this respect it resembles the flow of water (as Sadi Carnot ingeniously remarked as early as 1824), which only then can move mills and perform other work when it is able to descend from a higher to a lower level. This figurative conception, however, led Carnot to the false conclusion that in this sinking of heat from the higher to the lower tempered body no heat was lost. Ultimately Clausius corrected Carnot's proposition of the performance of work by the falling of temperature (1850), by changing the closing part of Carnot's proposition of the retention of heat to the exact opposite, that is, he concluded that there is an apparent loss of a proportionate amount of heat as such for every unit of work done, on account of its transformation into work. Clausius demonstrated furthermore, in agreement with Carnot that in any thermo-dynamic machine it was to be presumed that the work performed depended in each case on the amount of transmitted heat, and not on the material composition of the vehicle of heat, as for example, whether from steam or heated gas.

A steam or gas machine can only then perform work when the heat-bearing medium is cooled off on one side of the piston and a part of the heat is converted into work.*

In every thermo-dynamic machine a warmer body (the fire) transmits a certain amount of heat to the heat bearer (vapors or gases). The latter effects the transformation of the smaller portion of the received heat into mechanical work, while the supplementary, larger portion, is carried over to the colder body. Thermo-dynamic machines unavoidably, and

* [This passage correctly recognizes the well-established fact that heat is lost (or destroyed) in being transformed into "work." Whenever a permanent molecular change is effected either by heat or by impact, less heat remains than when no such work is effected. The falling stone (to use the lecturer's early illustration) is less heated by collision if broken than if not broken by the shock,—a portion of the kinetic energy in this case being expended in overcoming the tenacity of cohesion. Any hypothesis of the conservation of *motion* (as such) would necessarily lead us to the incongruity of conceiving the rolled iron or the crushed ore as having an extra amount of "latent" heat stored up within its molecules; or conversely of conceiving light as "latent" in the gas-holder, the oil-can, or the lucifer match; or sound as "latent" in the organ-bellows, the violinist's elbow, or the grain of gunpowder.—*Ed.*]

contrary to the design of their inventors, heat their surroundings, and it is only by making a virtue of necessity that this can be turned to the best advantage. The heat expended in this involuntary heating process, added to that expended in useful mechanical work, gives the total of heat which the medium (vapors or gases) had received from the higher temperature of the heat source. If the work performed be measured and a careful calculation of all the losses of heat made, it follows that the work done by the machine is the exact equivalent of the apparently [or rather actually] lost amount of heat.*

It is not only in thermo-dynamic machines, but in all conversion of heat into work (as both practice and theory teach us), that it may be said that but a small part of the "descending" heat, that is heat passing from the warmer to the colder body, can be transformed into useful work, for the greater portion of the heat passes directly as such to the colder body. Clausius has however demonstrated (1850) that heat can only pass over or "ascend" from a colder to a warmer body when for the raising of the temperature, work is *expended*. This proposition has the result that the last hope of the enthusiasts for a "perpetual motion" is entombed. Their hope was based on the possibility that the heat, which is produced in machines by impediments of motion—friction, shocks, resistance of the medium—might be reconverted into work, and at least a mechanism might be constructed which would be permanently automatic. In this, one thing was forgotten, that heat can never be entirely converted into work, but that on the contrary only the smaller portion of the higher temperature from the source of heat can be thus transformed, and that the greater part of it in passing to bodies of lower temperature must ever remain as heat. The *perpetuum mobile* therefore remains impossible.

By means of the theory of the conservation of energy the impossibility of a perpetual motion has been finally proved: for what is the result of that theory? Work can only be performed by an energy employed for the purpose; if the latter is exhausted or transformed it can perform no further work. It can no longer be assumed that perhaps by means of the thermal, electrical, or magnetic forces the construction

* Clausius has suggested the employment of the term *ergon* to express the numerical value of the work-unit when measured by the heat-unit. And he further proposes an adjective form of this word (*ergonized*) as a substitute for the manifestly inaccurate term "latent" when applied to heat. As he well remarks: "This name originated when it was thought that the heat which can no longer be detected by our senses (when a body fuses or evaporates) still exists in the body in a peculiar concealed condition. According to the mechanical theory of heat, this notion is no longer tenable. All heat actually present in a body is *sensible* heat: the heat which disappears during fusion or evaporation is converted into *work*, and consequently exists no longer as heat. I propose, therefore, in place of *latent heat* to substitute the term *ergonized heat*." (*The Mechanical Theory of Heat.* Edited by Prof. T. A. Hirst. 8vo. London. 1867. Sixth Memoir. Appendix A. pp. 253, 255.) This collection of memoirs, by Prof. R. Clausius, originally appeared in Poggendorff's *Annalen*, and they were translated from the German for the L. E. D. Philosophical Magazine, by Prof. J. Tyndall and others.

of a perpetual motion might be possible, because it is known that all energies, be their names what they may, can only be converted into work in equivalent amounts and that the reconversion of heat into work is only partially possible.

Through resistances to motion a portion of the kinetic energy is always transformed into heat; if such resistance should exist in free space the energy resulting from gravitation would in part be converted into heat. Laplace (1799–1825) assumed an absolutely void universe for the endless duration of the planetary system; according to the present condition of science, we are obliged to assume (on account of the radiation of light and heat) that the universe is filled with an imponderable, exceedingly rare, and extraordinarily elastic substance, termed æther.

The tenuity of this assumed æther is so great that as yet the result of its resistance as manifested in retardation has been perceptible only in the course of Encke's comet, but in no other celestial body. What would be the effects of a medium which would retard the motion of the celestial bodies? First, instead of the lost kinetic energy there would be heat; then, the attraction of the central body being supposed to be unimpaired, the tangential motion of the planetary bodies would be diminished through the resistance of the medium; the effect of the attractive force of the sun would be manifested in a greater degree, *i. e.*, these celestial bodies would disclose the existence of a resisting medium by their contracting orbits and an increased velocity. This seems to be really so in the case of Encke's comet, according to recent observations; and the final fate of this comet may be its precipitation into the sun.*

J. R. Mayer (1848) assumed such a precipitation of innumerable bodies (asteroids), in order to explain whence the sun obtained the supply of heat which it is constantly radiating. In such a precipitation of asteroids into the sun the energy of the mechanical motion would be transformed into the energy of heat of sufficient intensity to account for the unimpaired conservation of the sun's heat. Helmholtz explains the supply of the sun's radiation differently, in calculating that a continuous condensation of the sun, whose origin was a cosmic nebula, would preserve its heat for an incalculable period of time.

As with the heat of the sun, so the internal heat of the earth is explained by J. R. Mayer, by the precipitating of smaller bodies upon each other; by Helmholtz, by the condensation of the earth from an originally cosmic nebula, both basing their respective calculations upon the mechanical equivalent of heat. The result of such calculations teaches that on the basis of the above hypotheses incomparably higher degrees and greater amounts of heat come into action than from any known combustion or chemical combination, and that consequently in regard to the sun, on the assumption of the above hypotheses, the heat

* [That the observed acceleration of Encke's comet is really due to an *ætherial* resistance (as is so commonly assumed), appears to be extremely improbable.—*Ed.*]

and light phenomena must have a much more intense character than could be derived from any assumed combustions and chemical processes, so that the spectral phenomena of the sun are in nowise contradictory, but rather in accordance with the above suppositions.

Although the heat produced by combustion and chemical combinations is by no means sufficient to explain the retention of the sun's heat (at least not according to terrestrial data and knowledge), these sources are yet sufficiently striking and important to us, so that we are induced to search for their primary cause; and this all the more, as the heat from combustion is to us in many cases indispensable. If a body falls by reason of gravity, and its course downward is suddenly arrested, the visible kinetic energy is changed to molecular motion or heat; in a similar manner we suppose that the atoms of substances, acting upon each other in non-measurable proximity and under favorable conditions, precipitate themselves with violence upon each other, by virtue of their chemical attraction or relation, and so form the molecules of a new composition, wherein, by the violent shock, the suddenly arrested motion is converted into the molecular motion termed heat. Just as the lifting of a stone for the purpose of separating it from the ground requires work, which it returns in an equal measure in its downfall, and which finally turns into molecular motion or heat, so we require also energy, or in many cases even heat itself, in the dissolution of chemical combinations. Chemically separated substances may be compared to lifted weights or tightened springs; in short, they possess potential energy, which in the chemical combination is again converted into kinetic energy, mostly heat. This appears most strikingly in the chemical combination of substances with oxygen, from which result the phenomena of light and heat, and which is called combustion; and from the heat thereby generated heat was first measured. In all oxidations and, speaking more generally, in every chemical combination, whether produced directly or indirectly, at one time or at different periods, an equally large amount of heat is always produced for this combination. If, for instance, a weight-unit of coal were first converted into carbonic oxide and this into carbonic acid, just as much heat will have been developed in the end as if the coal had been converted into carbonic acid directly.

The oxidizable components of the blood in human and animal bodies suffer a slow and gradual oxidation, whereby the human and animal vital heat is produced. As the products of oxidation of the living animal body are thrown off by respiration (carbonic acid, water, and nitrogen), by perspiration (water, carbonic acid, and various combinations), and in other ways, a compensation for these oxidized substances becomes necessary. This compensation is secured by means of food, which is always taken from either the animal or vegetable kingdom, and must, on the whole, be oxidizable, because its components eventually are oxidized in the animal blood; that is, they combine chemically with the oxygen of the inhaled air. In animals a part of their heat is converted into mechanical work, as in the case of the steam-engine, and as demonstrated by calculations, to more advantage than in the latter, since the animal body provides in addition for its involuntary motions. According to the theory of the conservation of energy, a man, when working, must, under otherwise unchanged conditions, expend more heat than when resting, consequently a more considerable oxidation or a greater consumption of oxygen must ensue.

Through the continuous process of oxidation the products thereof, namely, carbonic acid and ammonia, would accumulate in a threatening manner if plants did not put them to use in their construction, partly directly and partly absorbed in water. The carbonic acid consumed by plants is decomposed under the influence of the sun's light, the carbon is retained as material in their construction, the oxygen is exhaled by the leaves and again consumed by the animal creation. Thus plants prepare for man and beast the oxygen required by them, and these in return give back their requisite carbonic acid. This circuit, which conditions the life of plants and animals, extends not only to oxygen, but is a general one, as first shown by Liebig (1840–'46), as plants supply to animals the required combustible matter, in the shape of food, while the animals contribute to plants the products of combustion. But as in this circular course the heat of animals passes off externally, and the mechanical work performed is not employed in the needful decomposition of those products of oxidation, we must seek the source of energy which again resolves them into their chemical components. We find this in the sun, which, by means of its rays, can, according to circumstances, either produce or dissolve chemical combinations. We have previously indicated that the sun's rays decompose the components of the carbonic acid consumed by plants, and in this wise produce oxygen for the inhalation of animals.

The energy of radiation emanating from the sun is in part laid up in the plants as potential, and partly it is changed to the kinetic energy required in meteorological events. The latter transformation serves again for the benefit of plants through the meteorological circulation of water. As plants serve animals and men for food (directly, or, in the subsistence on meat, indirectly), and the animal excretions are in due course made use of by vegetation, it is apparent that ultimately the sun is the preserving principle of the organic creation. On the existence of the sun depends the constant preservation of the circular course of the terrestrial organisms; and as the heat supply of the sun is assured for at least millions of years, the constant renewal of terrestrial organisms is guaranteed for a very long period.

The theory of heat has thus led us to the discovery of the mechanical equivalent of heat, and this again to the theory of the conservation of energy. Guided by this theory we have passed over several of the principal departments in physics; we have nowhere come upon a contradiction; everywhere previously isolated phenomena have been united in one. In the theorem of the conservation of matter we have an analogue to that of the conservation of energy; the similarity of the two theorems extends, however, only to the indestructibility and increatibility of matter and energy. In the following points some dissimilarities appear, to wit: The doctrine of the conservation of matter may in all cases be established with more ease and accuracy than that of the conservation of energy, by direct quantitive measurement; but as yet no transformation of a simple substance into another has become known, while the manifold transformations of energy have been learned. The possibility of the transformation of the latter permits the assumption that there exists but one single original energy, from which the individual energies (gravitation, affinity, radiation, electricity, and magnetism) are the particular manifestations. It has been supposed, nevertheless, that possibly one single, indivisible, elementary matter may exist, of which the known elements might be variations or allotropes, in the same manner as carbon, which appears as graphite and diamond; or as phosphorus, which exists in the ordinary and the red forms; or as sulphur, in the ordinary and the amorphous forms; but as yet success has not been had in the reduction of chemical elements to one single fundamental one of which the hypothetical æther might even be a variation.

In the same way as within the last quarter of the past century, the emphasizing of the indestructibility and increatibility of matter caused a complete revision and reform of the theories of chemistry, so in this century, since the discovery of the indestructibility, transformability, and increatibility of energy, a regeneration of the fundamental theories of physics and of the exposition of natural science in general has taken place; natural science thereby has regained its connection with philosophy. On a secure basis, the fundamental theories of natural science may now be deduced, and the bond of unity is now entwined around the formerly disjoined branches. Natural science gains thereby daily in simplicity and depth, and the theory of the conservation of matter and energy is the safely guiding compass on the sea of perplexing, individual phenomena. And though the apothegm "Into the inmost heart of nature enters no created mind" still remains true, the veil is at least lifted which envelops that inner part of it.

A UNIVERSAL METEOROGRAPH,

DESIGNED FOR DETACHED OBSERVATORIES.*

BY E. H. VON BAUMHAUER,
Permanent Secretary of the Society of Sciences of Holland, Haarlem.

[Translated from the French, by CLARENCE B. YOUNG.]

Among the prize questions proposed by the Netherland Society of Sciences in 1870 were the two following:

"The society offers its gold medal and an additional premium of 300 florins for a satisfactory plan of raising meteorological instruments to a considerable elevation in the atmosphere, by means of kites or captive balloons, and of maintaining them there for at least twenty-four hours.

"The society offers its gold medal for a self-registering meteorological instrument—thermometer, barometer, or hygrometer—capable of being attached to a kite or balloon, and of giving, for at least twenty four-hours, satisfactory records of the condition of the atmosphere at great elevations."

No reply having been made within the assigned limit of time to the questions as thus stated, they were repeated in 1872, modified in form and reduced to one, as follows:

"Devise a satisfactory plan of determining the temperature, humidity, and density of the atmosphere at a considerable elevation above the terrestrial surface; the method to allow of the automatic registration of observations, or at least their frequent repetition."

By these offers the Netherland Society showed how important they considered it to supply meteorological science with self-registering instruments—thermometers, barometers, and hygrometers—capable of indicating the temperature, pressure, and hygrometric condition of the atmosphere at considerable elevations above the surface of the earth, or at localities which are not at all times accessible.

The desired result might readily be obtained if in these places could be placed special meteorological observatories, which we shall designate detached observatories, containing instruments so constructed as only to require the occasional services of an attendant, and transmit constant records to a principal establishment situated in an inhabited locality.

* Translated and condensed for the Smithsonian Institution from a Memoir entitled *Sur un Météorographe universel destiné aux observatoires solitaires*, par E. H. von Baumhauer. Extrait des Archives Néerlandaises. T. IX. Harlem, 1874. [29 pp. 8vo.]

plains the fundamental phenomena of the radiation of light and heat. The ultimate particles of an incandescent metal or the flame of a lamp or any similar source of heat and light execute extremely rapid oscillations, whose kinetic energy is imparted to the atoms of the surrounding æther in a similar manner to that effected by resounding bodies on the surrounding air. Just as the latter vibrates and transmits tones, so also does the oscillating æther transmit light. While however in the transmission of sound through the air the particles of the latter vibrate in the direction of the sound rays, it is most probable, in accordance with certain phenomena, that in the transmission of light the oscillations of the æther atoms take place in a direction perpendicular to the rays of light. The hypothesis is that the elasticity of the æther permits the displacement in a lateral direction to the rays much more easily than in their direction, or longitudinally.

Colorless light, as we know, may be reduced to the primary colors of the rainbow by means of a glass prism. These variously colored components of the colorless light are virtually the same in regard to it, that the different low and high tones are with reference to sound, and they are transmitted by the æther in a manner similar to that of the propagation of the several tones of sound by the air. Mathematical optics teaches that the difference in optical tones—*i. e.* the difference in the spectral tints—like the difference in acoustic tones, is owing to the unequal length of the oscillating æther waves, or to the unequal number of oscillations of the constituent atoms. In the different length of the waves of the various spectral colors we see why the variously colored component rays of the colorless light are, by refraction, diverted from each other and scattered in a spectrum in a fan-like shape.

The more rapidly the æther atoms oscillate, or the shorter the wave, the nearer to the violet-colored limit of the spectrum will the corresponding tint be located. The longest æther waves are on the red, the shortest on the violet-colored end of the spectrum; between the two occur the æther waves of medium length. The rays of the spectrum produce three kinds of effects, by means of their kinetic energy, accordingly as they fall on different bodies. In the region of the red rays and in the invisible space beyond them a heating of bodies placed there predominates; therefore an increase of the molecular energy takes place; the rays from red to violet (among them the yellow ones, particularly) act principally on the nerve ends of the retina of the eye and excite the optic sensibility; the blue ones—the violet ones, particularly, and the invisible rays beyond the violet—produce chemical changes as the shorter waves of the oscillating æther pass over to the æther between the atoms of a molecule, and thereby cause separations as well as a different grouping of the atoms into new molecules, dissimilar to those previously existing.*

* [The researches of the elder Draper tend to discredit entirely the generally received view here stated, that the calorific, optical, and actinic effects of the solar radiation occupy different positions in the spectrum, or have different refrangibilities.

Although the different rays of the spectrum, according to their position in the latter, produce predominantly thermal, optical, or chemical effects, it can be shown that the difference in the effects is not caused by an essential difference of the rays, but rather by the different material condition of the bodies on which the rays act. There is only one kind of radiation, which however according to the number of oscillations of the æther-atoms and the difference of the irradiated matter, manifests itself in various ways in the effect. Heat, light, and chemically acting rays are in essence identical, and they become only distinguishable when the kinetic energy of their æther oscillations is transmitted to the material particles of a suitably disposed body. For instance, every ray of light is also a ray of heat; but the so-called obscure rays of heat and rays of light differ only in the number of their oscillations; otherwise they are quite the same. The rays of light alone are able to excite the ends of the optical nerves to optical action, while the visible as well as the invisible (so-called obscure) heat rays cause an increase of temperature in those substances by which they are absorbed.

In order that rays may act upon a body which they strike, it is indispensable that they should be absorbed, The absorption of heat, light, or chemical rays is a transmission of kinetic energy from the oscillating æther atoms to the molecules, and, in chemical effects, to the atoms of matter. Although the equivalent of a given quantity of light has not yet been determined, it is certain that through the absorption of light rays, substances become heated, and the chemical action of the light rays augments precisely as the absorption of the latter; the law of the conservation of energy finds its application in this, though the quantitive proof is wanting as yet.

The wave, or undulatory theory of light, explains the phenomena in a very simple manner, as we demonstrated in the example of the spectrum; it reduces the radiation of light and heat to a common principle. The theory of the emission of luminous matter had to assume as many variously colored luminous atoms as the innumerable colored rays in

This eminent physicist has certainly proved that the accepted generalization is at least fallacious, and based on insufficient data. From the enormous distortion necessarily incident to every *refraction* spectrum, (as shown by reference to an arithmetical scale of wave-lengths, or by the simpler expedient of comparison with a *diffraction* spectrum,) Dr. Draper has pointed out that computing from the arithmetical center of the spectrum,—the point of maximum illumination in the yellow band—(near the sodium line *D*), the lower side of the scale is compressed into about half its just extent, while the upper side is expanded to about double its proper range. (*Am. Jour. Sci.* Sept. 1872, vol. iv, pp. 161–175.) And as this distortion goes on rapidly increasing from the mean portion, the extra optical rays are many times condensed beyond the red extremity, and many times dilated beyond the violet extremity. Accordingly the "heat-curve," familiarly exhibited by popular writers and lecturers, is simply an egregious "anamorphosis." Secondly, Dr. Draper has shown that the actinic or chemical energies of the solar ray are distributed throughout the spectrum (visible and invisible), provided that the observer's attention is not confined (as usual) to the decompositions of *silver* salts. (*Am. Jour. Sci.* Jan. and Feb., 1873, vol. v. pp. 25–38; and pp. 91–98.)—*Ed.*]

existence, which were believed to combine in the colorless ray to a colorless substance. Besides this, a peculiar caloric had to be assumed. The absorption of light could be considered only as a union of the caloric with substances by which the former lost its essential property, namely, its illuminating power. Thus many phenomena of light could not be explained by the theory of the emission of light, even with the assistance of new auxiliary hypotheses. How clearly does the undulatory theory explain, not only all the light phenomena, but also those of heat and chemically acting radiation! By the application of the proposition relative to the conservation of energy, the transformation of one kind of ray into another, as well as the absorption of rays, is easily comprehended.

By applying the undulatory theory to both heat and light, a common basis has been gained for them; the rays of heat and light are even identical. The undulatory theory of the æther being formed according to the demonstrated undulatory theory of acoustics, it shows by analogy, as indicated above, what the conception of the transmission of kinetic energy in acoustics is. First, in relation to the calling forth of tones, the mechanical work of bowing or striking the resounding instrument is changed into the kinetic energy of the vibrating motion of molecules. From the resounding body the kinetic energy passes over to the sound transmitter in form of progressing longitudinal waves, and from the sound transmitter by means of the vibratory parts of the ear to the extreme ends of the auditory nerves, whereby finally the perception of sound is produced. If the sound waves however strike accordant bodies, the latter get into resonance in consequence of the transmission of kinetic energy. In optics a similar calling forth of tones or colors in suitably constituted bodies by colored rays falling upon them is known; these phenomena are called fluorescence and phosphorescence.

We have observed that the theories of heat light and sound have been reduced to one of undulation. And since the latter is deduced from mathematical mechanics, these theories have theoretical mechanics as their basis, and, above all, the fundamental principle of the conservation of energy. The many relations existing between electrical, optical, and thermal phenomena, continually more and more discovered and displayed since the wider development of the mechanical theory of heat, are naturally calculated to arouse the efforts of natural philosophers to explain the fundamental phenomena of electricity also from some motion of material molecules or æther atoms, the many counter actions between the thermal, optical, and electrical phenomena having rendered untenable the hypothesis of electric fluids, or electric substances.

Up to the present time there have been two leading hypotheses by which the theory of electric phenomena was to be connected with the æther *theory of optics* and heat. One of these hypotheses maintains that there *are opposite* rotatory motions of the material molecules or æther atoms imparted to them in the production of the two kinds of electricity. The other assumes that the electric condition of a body is caused by a disturbed accumulation of freely acting æther. In accordance with the latter view every non-electric body would contain æther to a certain amount. By the exciting of electricity (through friction, for example), the equilibrium of the æther atoms and the ultimate particles of bodies would be disturbed, and by reason of this a flowing over of the disengaged æther from one body to another would take place; accordingly one body would have a *plus*, the other a corresponding *minus* of the disengaged æther; one body then shows positive, the other negative electricity. Endeavors have been made to explain the electric current on this ground. As yet neither the one nor the other representation has succeeded in explaining all the fundamental phenomena in electricity, although those observed up to the present time generally accord better with the latter than the former.

Although the hypotheses which aim at the ultimate attainment of a common basis for the theories of light, heat, and electricity have not satisfied the test in their detailed application, still the principle of the conservation of energy in its application to the theory of electricity has been found true. As every magnet may be considered the aggregate of all its molecules, surrounded by electric currents, if the general electric phenomena have been reduced to the theory of the conservation of energy, this reduction is, in principle, valid as to the primary magnetic phenomena.

As to frictional electricity an expenditure of work by friction is required in the separation of positive and negative electricity. The expended kinetic energy manifests itself on the rubbed bodies as the potential energy of the separated electricities in this wise, the two bodies which received the separated electricities strive to approach each other. If this approach really takes place in easily moved bodies, as for example in the motion of swinging electroscopes of opposite electricities, it finally reappears as kinetic energy as manifested in the visible approach of the easily moved electric carriers. The electric discharge in shape of a spark, as also of heat, to which the electricity has been changed, shows the passage and conversion from potential to kinetic energy.

By means of electric machines mechanical energy is transformed to the potential energies of positive and negative electricity. If the electrically charged positive and negative conductors of an electric machine are connected by a wire, the result is an electric current with which mechanical, thermal, magnetic, chemical, and physiological effects may be produced, with which therefore a transformation of energies may be effected.

The electric current also which emanates from galvanic batteries produces such transformations, in most cases to a higher degree than the frictional electric current. If a given quantity of zinc is dissolved in diluted sulphuric acid, which chemically is equivalent to its oxidation or slow combustion, a definite amount of heat is generated in the fluid by this combustion. But if an equal quantity of zinc is dissolved in the diluted sulphuric acid of a galvanic element, which is closed by an iron wire (which offers considerable resistance to electric conduction,) the amount of heat in the galvanic element decreases as compared to that of the same quantity of oxidized zinc, and is manifested instead in the resisting connecting wire, so that this thin wire appears as the bearer of a certain amount of heat or of the corresponding kinetic energy. The heat generated throughout the current conductor and augmented by the internal work is equal to that which disappears from the galvanic cell when the latter is closed with the resisting iron wire. If this experiment is modified so as to put the poles of the galvanic battery in metallic connection with *copper* wires (which latter offer a comparatively small conducting resistance), and if then the ends of these wires are united by a thin iron wire or charcoal points, a great part of the heat of oxidation produced in the battery may be conveyed to long distances in the form of the electric glow and light. In this process chemical energy is transformed into that of heat, electricity, and again of heat in accordance with the law of the correlation of energy.

If we analyze water by means of the electric current of a voltaic battery, the quantities of hydrogen and oxygen thereby obtained possess through their chemical attraction (chemical relation or affinity) that potential energy, which disappeared as the kinetic energy of heat from the battery and manifested itself in the closing wire as the kinetic energy of the electric current. Through the electrolysis of the water the electric current must be weakened by the amount required in the work performed in the separation of the atoms of the water molecules. If the mixture of inflammable gas obtained in the electrolysis of the water is set on fire, there arises from the explosion, light, heat, and sound; that is three kinds of kinetic energy. If all the losses in these processes could be taken into account, the total of all these energies would be equal to that heat energy which, during the electrolysis, was produced in the battery in the dissolution of the zinc.

In the generation of magnetism in an electro-magnet some of the kinetic energy of the electric current is expended, hence a periodical weakening of the current takes place at the moment of the magnetization; no energy is however required for the retention of the previously developed magnetism, because no work is required for the existing state of equilibrium in the electro-magnet, for where no mechanical work is performed no loss of the current can take place. In electro-magnetic motors, where the electro-magnet has to be constantly reproduced, there is then a constantly renewed expenditure of the energy of the electric current taking place. In this case there is an indirect transformation of the heat which is produced by the zinc consumed in the battery. This heat is transformed into the electric current, magnetism, and lastly into mechanical motion, which may be employed in the performing of mechanical work.

For every amount of work done by the electric current an equivalent of the energy of the current, or of the combustion heat of the oxidizing zinc in the battery, is consumed or rather transformed. We have seen that in the steam-engine a part of the heat of the steam is turned into mechanical work, and that after the work is accomplished this amount of heat is wanting in the steam that has been at work. In steam-engines, and in fact in all caloric or thermo-dynamic machines, a proportionate quantity of the heat, stored up in the form of vapors and gases, must seemingly disappear for every mechanical work done by such machine. Heat is only then turned into work if it passes from a warmer to a colder body; in this respect it resembles the flow of water (as Sadi Carnot ingeniously remarked as early as 1824), which only then can move mills and perform other work when it is able to descend from a higher to a lower level. This figurative conception, however, led Carnot to the false conclusion that in this sinking of heat from the higher to the lower tempered body no heat was lost. Ultimately Clausius corrected Carnot's proposition of the performance of work by the falling of temperature (1850), by changing the closing part of Carnot's proposition of the retention of heat to the exact opposite, that is, he concluded that there is an apparent loss of a proportionate amount of heat as such for every unit of work done, on account of its transformation into work. Clausius demonstrated furthermore, in agreement with Carnot that in any thermo-dynamic machine it was to be presumed that the work performed depended in each case on the amount of transmitted heat, and not on the material composition of the vehicle of heat, as for example, whether from steam or heated gas.

A steam or gas machine can only then perform work when the heat-bearing medium is cooled off on one side of the piston and a part of the heat is converted into work.*

In every thermo-dynamic machine a warmer body (the fire) transmits a certain amount of heat to the heat bearer (vapors or gases). The latter effects the transformation of the smaller portion of the received heat into mechanical work, while the supplementary, larger portion, is carried over to the colder body. Thermo-dynamic machines unavoidably, and

*[This passage correctly recognizes the well-established fact that heat is lost (or destroyed) in being transformed into "work." Whenever a permanent molecular change is effected either by heat or by impact, less heat remains than when no such work is effected. The falling stone (to use the lecturer's early illustration) is less heated by collision if broken than if not broken by the shock,—a portion of the kinetic energy in this case being expended in overcoming the tenacity of cohesion. Any hypothesis of the conservation of *motion* (as such) would necessarily lead us to the incongruity of conceiving the rolled iron or the crushed ore as having an extra amount of "latent" heat stored up within its molecules; or conversely of conceiving light as "latent" in the gas-holder, the oil-can, or the lucifer match; or sound as "latent" in the organ-bellows, the violinist's elbow, or the grain of gunpowder.—ED.]

contrary to the design of their inventors, heat their surroundings, and it is only by making a virtue of necessity that this can be turned to the best advantage. The heat expended in this involuntary heating process, added to that expended in useful mechanical work, gives the total of heat which the medium (vapors or gases) had received from the higher temperature of the heat source. If the work performed be measured and a careful calculation of all the losses of heat made, it follows that the work done by the machine is the exact equivalent of the apparently [or rather actually] lost amount of heat.*

It is not only in thermo-dynamic machines, but in all conversion of heat into work (as both practice and theory teach us), that it may be said that but a small part of the "descending" heat, that is heat passing from the warmer to the colder body, can be transformed into useful work, for the greater portion of the heat passes directly as such to the colder body. Clausius has however demonstrated (1850) that heat can only pass over or "ascend" from a colder to a warmer body when for the raising of the temperature, work is *expended*. This proposition has the result that the last hope of the enthusiasts for a "perpetual motion" is entombed. Their hope was based on the possibility that the heat, which is produced in machines by impediments of motion—friction, shocks, resistance of the medium—might be reconverted into work, and at least a mechanism might be constructed which would be permanently automatic. In this, one thing was forgotten, that heat can never be entirely converted into work, but that on the contrary only the smaller portion of the higher temperature from the source of heat can be thus transformed, and that the greater part of it in passing to bodies of lower temperature must ever remain as heat. The *perpetuum mobile* therefore remains impossible.

By means of the theory of the conservation of energy the impossibility of a perpetual motion has been finally proved: for what is the result of that theory? Work can only be performed by an energy employed for the purpose; if the latter is exhausted or transformed it can perform no further work. It can no longer be assumed that perhaps by means of the thermal, electrical, or magnetic forces the construction

* Clausius has suggested the employment of the term *ergon* to express the numerical value of the work-unit when measured by the heat-unit. And he further proposes an adjective form of this word (*ergonized*) as a substitute for the manifestly inaccurate term "latent" when applied to heat. As he well remarks: "This name originated when it was thought that the heat which can no longer be detected by our senses (when a body fuses or evaporates) still exists in the body in a peculiar concealed condition. According to the mechanical theory of heat, this notion is no longer tenable. All heat actually present in a body is *sensible* heat: the heat which disappears during fusion or evaporation is converted into *work*, and consequently exists no longer as heat. I propose, therefore, in place of *latent heat* to substitute the term *ergonized heat*." (*The Mechanical Theory of Heat*. Edited by Prof. T. A. Hirst. 8vo. London. 1867. Sixth Memoir. Appendix A. pp. 253, 255.) This collection of memoirs, by Prof. R. Clausius, originally appeared in Poggendorff's *Annalen*, and they were translated from the German for the L. E. D. Philosophical Magazine, by Prof. J. Tyndall and others.

of a perpetual motion might be possible, because it is known that all energies, be their names what they may, can only be converted into work in equivalent amounts and that the reconversion of heat into work is only partially possible.

Through resistances to motion a portion of the kinetic energy is always transformed into heat; if such resistance should exist in free space the energy resulting from gravitation would in part be converted into heat. Laplace (1799–1825) assumed an absolutely void universe for the endless duration of the planetary system; according to the present condition of science, we are obliged to assume (on account of the radiation of light and heat) that the universe is filled with an imponderable, exceedingly rare, and extraordinarily elastic substance, termed æther.

The tenuity of this assumed æther is so great that as yet the result of its resistance as manifested in retardation has been perceptible only in the course of Encke's comet, but in no other celestial body. What would be the effects of a medium which would retard the motion of the celestial bodies? First, instead of the lost kinetic energy there would be heat; then, the attraction of the central body being supposed to be unimpaired, the tangential motion of the planetary bodies would be diminished through the resistance of the medium; the effect of the attractive force of the sun would be manifested in a greater degree, *i. e.*, these celestial bodies would disclose the existence of a resisting medium by their contracting orbits and an increased velocity. This seems to be really so in the case of Encke's comet, according to recent observations; and the final fate of this comet may be its precipitation into the sun.*

J. R. Mayer (1848) assumed such a precipitation of innumerable bodies (asteroids), in order to explain whence the sun obtained the supply of heat which it is constantly radiating. In such a precipitation of asteroids into the sun the energy of the mechanical motion would be transformed into the energy of heat of sufficient intensity to account for the unimpaired conservation of the sun's heat. Helmholtz explains the supply of the sun's radiation differently, in calculating that a continuous condensation of the sun, whose origin was a cosmic nebula, would preserve its heat for an incalculable period of time.

As with the heat of the sun, so the internal heat of the earth is explained by J. R. Mayer, by the precipitating of smaller bodies upon each other; by Helmholtz, by the condensation of the earth from an originally cosmic nebula, both basing their respective calculations upon the mechanical equivalent of heat. The result of such calculations teaches that on the basis of the above hypotheses incomparably higher degrees and greater amounts of heat come into action than from any known combustion or chemical combination, and that consequently in regard to the sun, on the assumption of the above hypotheses, the heat

* [That the observed acceleration of Encke's comet is really due to an ætherial resistance (as *is so commonly assumed*), appears to be extremely improbable.—Ed.]

and light phenomena must have a much more intense character than could be derived from any assumed combustions and chemical processes, so that the spectral phenomena of the sun are in nowise contradictory, but rather in accordance with the above suppositions.

Although the heat produced by combustion and chemical combinations is by no means sufficient to explain the retention of the sun's heat (at least not according to terrestrial data and knowledge), these sources are yet sufficiently striking and important to us, so that we are induced to search for their primary cause; and this all the more, as the heat from combustion is to us in many cases indispensable. If a body falls by reason of gravity, and its course downward is suddenly arrested, the visible kinetic energy is changed to molecular motion or heat; in a similar manner we suppose that the atoms of substances, acting upon each other in non-measurable proximity and under favorable conditions, precipitate themselves with violence upon each other, by virtue of their chemical attraction or relation, and so form the molecules of a new composition, wherein, by the violent shock, the suddenly arrested motion is converted into the molecular motion termed heat. Just as the lifting of a stone for the purpose of separating it from the ground requires work, which it returns in an equal measure in its downfall, and which finally turns into molecular motion or heat, so we require also energy, or in many cases even heat itself, in the dissolution of chemical combinations. Chemically separated substances may be compared to lifted weights or tightened springs; in short, they possess potential energy, which in the chemical combination is again converted into kinetic energy, mostly heat. This appears most strikingly in the chemical combination of substances with oxygen, from which result the phenomena of light and heat, and which is called combustion; and from the heat thereby generated heat was first measured. In all oxidations and, speaking more generally, in every chemical combination, whether produced directly or indirectly, at one time or at different periods, an equally large amount of heat is always produced for this combination. If, for instance, a weight-unit of coal were first converted into carbonic oxide and this into carbonic acid, just as much heat will have been developed in the end as if the coal had been converted into carbonic acid directly.

The oxidizable components of the blood in human and animal bodies suffer a slow and gradual oxidation, whereby the human and animal vital heat is produced. As the products of oxidation of the living animal body are thrown off by respiration (carbonic acid, water, and nitrogen), by perspiration (water, carbonic acid, and various combinations), and in other ways, a compensation for these oxidized substances becomes necessary. This compensation is secured by means of food, which is always taken from either the animal or vegetable kingdom, and must, on the whole, be oxidizable, because its components eventually are oxidized in the animal blood: that is, they combine chemically with *the oxygen of* the inhaled air. In animals a part of their heat is converted into mechanical work, as in the case of the steam-engine, and as demonstrated by calculations, to more advantage than in the latter, since the animal body provides in addition for its involuntary motions. According to the theory of the conservation of energy, a man, when working, must, under otherwise unchanged conditions, expend more heat than when resting, consequently a more considerable oxidation or a greater consumption of oxygen must ensue.

Through the continuous process of oxidation the products thereof, namely, carbonic acid and ammonia, would accumulate in a threatening manner if plants did not put them to use in their construction, partly directly and partly absorbed in water. The carbonic acid consumed by plants is decomposed under the influence of the sun's light, the carbon is retained as material in their construction, the oxygen is exhaled by the leaves and again consumed by the animal creation. Thus plants prepare for man and beast the oxygen required by them, and these in return give back their requisite carbonic acid. This circuit, which conditions the life of plants and animals, extends not only to oxygen, but is a general one, as first shown by Liebig (1840–'46), as plants supply to animals the required combustible matter, in the shape of food, while the animals contribute to plants the products of combustion. But as in this circular course the heat of animals passes off externally, and the mechanical work performed is not employed in the needful decomposition of those products of oxidation, we must seek the source of energy which again resolves them into their chemical components. We find this in the sun, which, by means of its rays, can, according to circumstances, either produce or dissolve chemical combinations. We have previously indicated that the sun's rays decompose the components of the carbonic acid consumed by plants, and in this wise produce oxygen for the inhalation of animals.

The energy of radiation emanating from the sun is in part laid up in the plants as potential, and partly it is changed to the kinetic energy required in meteorological events. The latter transformation serves again for the benefit of plants through the meteorological circulation of water. As plants serve animals and men for food (directly, or, in the subsistence on meat, indirectly), and the animal excretions are in due course made use of by vegetation, it is apparent that ultimately the sun is the preserving principle of the organic creation. On the existence of the sun depends the constant preservation of the circular course of the terrestrial organisms; and as the heat supply of the sun is assured for at least millions of years, the constant renewal of terrestrial organisms is guaranteed for a very long period.

The theory of heat has thus led us to the discovery of the mechanical equivalent of heat, and this again to the theory of the conservation of energy. Guided by this theory we have passed over several of the principal departments in physics; we have nowhere come upon a contradiction; everywhere previously isolated phenomena have been united in one. In the theorem of the conservation of matter we have an analogue to that of the conservation of energy; the similarity of the two theorems extends, however, only to the indestructibility and increatibility of matter and energy. In the following points some dissimilarities appear, to wit: The doctrine of the conservation of matter may in all cases be established with more ease and accuracy than that of the conservation of energy, by direct quantitive measurement; but as yet no transformation of a simple substance into another has become known, while the manifold transformations of energy have been learned. The possibility of the transformation of the latter permits the assumption that there exists but one single original energy, from which the individual energies (gravitation, affinity, radiation, electricity, and magnetism) are the particular manifestations. It has been supposed, nevertheless, that possibly one single, indivisible, elementary matter may exist, of which the known elements might be variations or allotropes, in the same manner as carbon, which appears as graphite and diamond; or as phosphorus, which exists in the ordinary and the red forms; or as sulphur, in the ordinary and the amorphous forms; but as yet success has not been had in the reduction of chemical elements to one single fundamental one of which the hypothetical æther might even be a variation.

In the same way as within the last quarter of the past century, the emphasizing of the indestructibility and increatibility of matter caused a complete revision and reform of the theories of chemistry, so in this century, since the discovery of the indestructibility, transformability, and increatibility of energy, a regeneration of the fundamental theories of physics and of the exposition of natural science in general has taken place; natural science thereby has regained its connection with philosophy. On a secure basis, the fundamental theories of natural science may now be deduced, and the bond of unity is now entwined around the formerly disjoined branches. Natural science gains thereby daily in simplicity and depth, and the theory of the conservation of matter and energy is the safely guiding compass on the sea of perplexing, individual phenomena. And though the apothegm "Into the inmost heart of nature enters no created mind" still remains true, the veil is at least lifted which envelops that inner part of it.

A UNIVERSAL METEOROGRAPH,

DESIGNED FOR DETACHED OBSERVATORIES.*

BY E. H. VON BAUMHAUER,
Permanent Secretary of the Society of Sciences of Holland, Haarlem.

[Translated from the French, by CLARENCE B. YOUNG.]

Among the prize questions proposed by the Netherland Society of Sciences in 1870 were the two following:

"The society offers its gold medal and an additional premium of 300 florins for a satisfactory plan of raising meteorological instruments to a considerable elevation in the atmosphere, by means of kites or captive balloons, and of maintaining them there for at least twenty-four hours.

"The society offers its gold medal for a self-registering meteorological instrument—thermometer, barometer, or hygrometer—capable of being attached to a kite or balloon, and of giving, for at least twenty four-hours, satisfactory records of the condition of the atmosphere at great elevations."

No reply having been made within the assigned limit of time to the questions as thus stated, they were repeated in 1872, modified in form and reduced to one, as follows:

"Devise a satisfactory plan of determining the temperature, humidity, and density of the atmosphere at a considerable elevation above the terrestrial surface; the method to allow of the automatic registration of observations, or at least their frequent repetition."

By these offers the Netherland Society showed how important they considered it to supply meteorological science with self-registering instruments—thermometers, barometers, and hygrometers—capable of indicating the temperature, pressure, and hygrometric condition of the atmosphere at considerable elevations above the surface of the earth, or at localities which are not at all times accessible.

The desired result might readily be obtained if in these places could be placed special meteorological observatories, which we shall designate detached observatories, containing instruments so constructed as only to require the occasional services of an attendant, and transmit constant records to a principal establishment situated in an inhabited locality.

* Translated and condensed for the Smithsonian Institution from a Memoir entitled *Sur un Météorographe universel destiné aux observatoires solitaires*, par E. H. von Baumhauer. *Extrait des Archives Néerlandaises.* T. IX. Harlem, 1874. [29 pp. 8vo.]

Such an observatory, if it occupied but little space and were sufficiently light, might easily be attached to a captive balloon, the cable of which would serve to maintain the required communication between the instruments and the ground.

The problem proposed by the society is a little vague in its terms, so that it is necessary to repeat it in a more definite form, specifying different conditions which would materially affect the solution.

1. A primary and very important point is whether by "considerable elevation" is meant a fixed accessible point, such as the summit of a mountain or a rock in the ocean, furnishing a solid base for the instruments, or an elevated point in the atmosphere to which the instruments are borne by means of a kite or a captive balloon. In the latter case, in fact, a mercurial barometer could not be used, even if hung on gimbals, since excessively great oscillations would be produced by the slightest breeze. Besides, barometrical observations will be of little value in determining variations of atmospheric pressure unless it be positively certain that the instrument has constantly remained at the same height above the level of the sea, or it be definitely known how many feet the balloon carrying it has ascended or descended.

It is true the height of a captive balloon may be deduced from the length of cable unrolled and the angle made by it with the vertical; but on account of possible oscillations, and of the curve which the cable assumes, this determination will always be very difficult and uncertain, and an error of ten or twenty feet in the height of the balloon will correspond to a difference of one one-hundredth of an inch in the height of the barometric column.

2. It is not a matter of indifference, either, in the solution of the problem, whether the observations are to be recorded where the instruments are placed, and therefore be known only at the end of a long series, or whether it be required that the instruments of the detached observatory should transmit their indications regularly to the main observatory for comparison with the observations made there. The latter system, which most meteorologists would doubtless prefer, will naturally require telegraphic communication, which the former could dispense with.

3. Finally, an essential point is to know for what time the automatic registry should be made without the necessity of visiting the detached observatory to wind the clock or make any other change. The difficulty would evidently not be the same if the apparatus be required to run twenty-four hours, a month, or a year.

In discussing the question proposed by the Netherland Society we will endeavor to keep in view the conditions we have just named, and we will consequently distinguish two different kinds of detached observatories, namely:

1. Those intended simply to collect observations for ten days at most, the records of which need not be known before the expiration of that period.

2. Those which, placed at a very elevated point, can only be visited occasionally, and which must transmit their observations immediately and regularly to the main observatory.

Finally, we will speak of observatories suspended to captive balloons, and which belong to one or the other of the preceding categories according to whether their observations require to be transmitted or not.

Whatever arrangement be adopted, in order that it render service to meteorology it should satisfy a great many strict conditions, the principal of which are the following:

1. The instruments should give exact indications. We do not speak here, however, of excessive refinement, for meteorologists are agreed in acknowledging that a difference of $\frac{1}{10}$ or $\frac{1}{5}$ of a degree Fahrenheit for thermometric observations, or of $\frac{1}{500}$ or $\frac{1}{2[illegible]}$ of an inch in the height of the barometric column, is not worth regarding. Readings to [illegible] degree Fahrenheit for thermometric observations, and $\frac{1}{100}$ or $\frac{1}{150}$ of an inch for barometric height, are sufficiently accurate, the essential point being that the records be always correct.

2. The instruments should be as simple as possible, in order that the chances of derangement be reduced to a minimum.

3. The first cost should not be too great.

4. It is important that human aid be dispensed with as much as possible; the instruments should work and the records be made without the assistance of the meteorologist.

5. The registering apparatus should be so arranged that all the observations be collected in one table and recorded in the form of curves, so that the movements of the instruments may be seen at a glance.

6. In the case of electrical connection between the detached and the main observatory the number of electric conductors should be as small as possible. This condition applies particularly in the case of a captive balloon, since it is necessary to avoid increasing too far the weight of the cable to be carried by the balloon.

7. When a galvanic current is employed, the instruments themselves should not form part of the circuit, because the working of the instruments would be affected thereby, especially under the influence of the sparks which pass at the instant of opening or closing the current; these sparks, too, passing between metallic surfaces, would produce oxidation, and consequently deterioration, of the instruments. For this reason the use of mercurial barometers and thermometers furnished with platinum wires hermetically sealed in the glass appears to me absolutely out of the question.

We do not need to decide on the form of barometer to be used, whether the siphon or the cistern barometer, the balanced barometer employed in Secchi's meteorograph, or an aneroid barometer. The method of recording observations which I have adopted allows of the use of all forms, since even in the siphon barometer motion may be communicated to a lever by means of a float, as in the dial barometer.

As regards temperature, any of the instruments may be used which depend upon the expansion of solid bodies, so as to afford the means of moving a lever. Such are Breguet's thermometer, Secchi's thermograph—founded on the linear expansion of a copper rod, and Dr. Krecke's metallic thermometer—founded on the different rates of expansion of zinc and glass.* The air thermometer may also be employed, the lever being actuated by a float on the surface of the mercury in the manometer. The ordinary mercurial thermometer alone is inadmissible here.†

* As, to my knowledge, Krecke's metallic thermometer has never been described, and as it deserves a more general use in meteorological observatories, on account of its simplicity, accuracy, and ready adaptation to automatic registry, I give here the principle of its construction.

Two glass tubes, *o o* (Fig. I), about 5 feet long and 1 inch in diameter, have their ends closed with two iron plates, A and B, the lower one, B, being fastened firmly to a wall, while the other is so attached to the wall as to permit a slight displacement. To the piece A is connected a zinc bar, C C′, and to the piece B a similar bar, D D′. These bars are otherwise entirely free throughout the rest of their length, but, in order to prevent them from bending, a ring is placed near the free end of each, so as to slip without sensible friction on the glass tubes *o o*. In order that the zinc bars may quickly assume the temperature of the air they must not be too thick, and yet they must have sufficient rigidity, which is secured by making them trough-shaped. At the free end of the bar D D′ a steel support, *p*, is fixed, against which rests the brass lever R M, somewhat like the arm of a balance. The arms D′ M and D′ R of this lever are unequal, and there is a movable counterpoise, R, on the shorter arm, the distance of which from D′ is so regulated that the weight of the arm D′ M is slightly in excess. In the lever there is also a screw, *s*, the point of which is turned upward and rests against the lower and free end of the zinc bar C C′. By means of this screw the position of the lever may be altered so as to raise or lower the pencil attached to its extremity M.

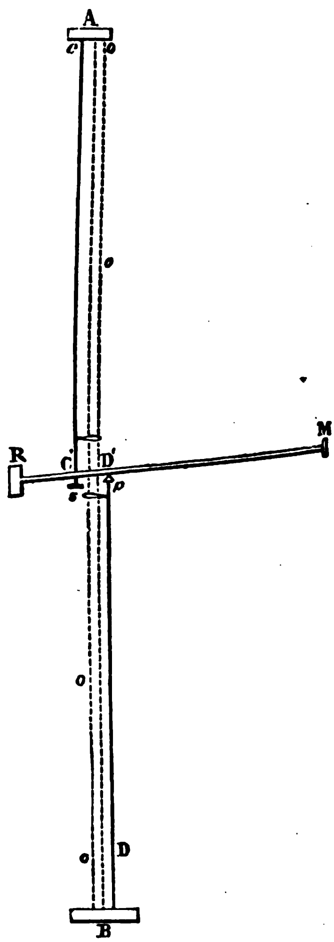


FIG. I.

The operation of this apparatus is easily understood. When the temperature rises the zinc bars lengthen about 4 times as much as the glass tubes, D′ rises while C′ falls, and the lever then turns around a point situated between C′ and D′ and the pencil M is moved upwards. When the temperature falls the opposite effect is produced.

† I have been informed that at the Brussels observatory a mercurial thermometer is employed, the horizontal tube of which is balanced on a knife-edge, so that the mercurial column, in expanding, causes the extremity of the tube to incline more and more, thus allowing the indications of the instrument to be registered as a dial instrument.

For the determination of the hygrometric condition of the air those instruments alone can be used which depend on the expansion and contraction of certain animal substances, and on the communication of these movements to an index. There will still remain to be provided for, the registration of the direction of the wind by means of the wind-vane, the velocity of the wind by means of Robinson's anemometer, and finally the amount of rainfall. All of these may be simultaneously recorded by the arrangement I am about to describe.

I.

DETACHED OBSERVATORIES WITHOUT TRANSMISSION OF RECORDS.

The slight interest which meteorologists feel in observations the results of which they do not see before the end of a certain period is, without doubt, the reason why observatories of this kind have not been long in use. Their erection would, in fact, present no difficulty, and they would have the advantage that a number could be kept up with a small force of assistants—at least if they were not too widely separated. Each would require to be visited but about once in every ten or fifteen days, in order to wind the clock, change the blanks, and inspect the instruments. They could be located anywhere, but, preferably, away from habitations; the first cost of erection would be very slight, and the only precautions necessary would be to protect the instruments from injury by rain and wind or malicious persons. The observations—automatically and continuously recorded according to an established system—would offer to the meteorologist a guarantee of accuracy which no human records possess, since to the latter may always be objected "*humanum est errare.*"

The following arrangement appears to me completely to satisfy the proposed conditions:

An aneroid barometer, a metallic thermometer, and a hair hygrometer are placed side by side on a board so that the pivots of their indexes are in a straight line. These indexes are of equal length and move in the same plane, but so that the greatest sweep of each will not describe an arc of over 120° at most. A little way above these indexes is placed a sheet of paper—kept in uniform motion by clockwork—on which there have been previously drawn lines marking out spaces corresponding to the arc described by the tip of each index. A pencil attached to this tip will trace a curve on the paper which will indicate at the same time the successive readings of the instruments and the corresponding time. But the friction of a pencil on the paper would be too great for such delicate instruments, and would necessarily falsify the indications. It would be infinitely better to have recourse to the method generally adopted at present in physical laboratories for the registration of delicate motions, which consists in the use of glazed white paper previously blackened above a resinous flame, on which a feather, attached to the tip of the index, rubs without sensible friction, tracing a white line upon it. These lines may subsequently be fixed by dipping the paper in gum water or thin varnish.

It would be better, instead of the blackened paper, to use a plate of glass blackened in the same way. When the observations are recorded, the plate may be laid on a piece of paper impregnated with silver-salt and both exposed to the light; the lines where the lampblack has been rubbed off will then print black on the paper. If scales, in degrees or hundredths of an inch, as well as time divisions, have been engraved on the plate by means of a diamond, we will readily obtain on the sensitive paper all the data required. The first exposure to light gives, as we have said, the reproduction in black lines of the curves traced by the feather points; then if, leaving the sensitive paper firmly fixed under the glass plate, we clean the latter with a cloth so as to remove all the lampblack, except what is left in the grooves made by the diamond, and the plate be again exposed a short time to the light, the whole surface of the paper will assume a gray tint, on which the curves previously obtained will stand out in black, while the diamond rulings will be in white. After being treated with hyposulphite of soda and washed in water this will give a permanent table of observations which may be reproduced by photography if, instead of sensitive paper, we use a collodion film, to be afterwards employed as a negative.

We will see presently that the direction and velocity of the wind and the amount of rain-fall may be recorded by straight lines, so that these indications may also be made on the blackened glass plate by means of a feather point.

There is, therefore, no difficulty in fitting up a detached observatory, which may be visited, for example, twice a month, and in which an ordinary clock, running 15 days without being rewound, registers observations which the meteorologist does not care to examine before the expiration of that period. The difficulty commences only when the meteorologist from his station at the principal observatory wishes to know at each instant the indications of the instruments at the more or less distant observatory, in order to compare the phenomena observed at the two stations.

II.

DETACHED OBSERVATORIES TRANSMITTING RECORDS.

Let us take an aneroid barometer having, as is usually the case, on the glass cover a second index for the purpose of comparing the state of the barometer at any given instant with that of a subsequent time. Remove the glass plate, maintaining the second index, however, in its position above the index of the barometer, and give to the latter a uniform motion of rotation around its axis. In other words, let us imagine an aneroid barometer without glass cover, and opposite to it a clock so placed that the arbor on which the minute hand turns is in the prolongation of the axis on which the index of the barometer turns. Now, designating the index by A and the minute hand by B, it is clear that B will at some point of each revolution be directly over A.

The planes in which the two hands move being supposed to lie a few hundreths of an inch apart, let us attach a "point"* to the extremity of B, which, passing over the extremity of A, will establish metallic connection between the two without however producing sufficient friction to move A out of its position. Let us also connect A by a conducting wire with the positive pole of a battery placed at the central station, and B with the negative pole of the battery; then, at each revolution of B there will be an instant when the circuit will be closed.

At some point on the positive wire, near the battery, let us place an apparatus consisting of a vertical metallic cylinder moved by clockwork, so as to make one revolution in the same time as the minute hand B, and also descend a little at each revolution. Let this metallic cylinder be covered with a sheet of dampened paper impregnated with some salt which will be changed in color under the action of a galvanic current (for instance, iodide of potassium and starch). If then a "point" connected with the negative pole rest on the dampened paper, it is evident that at each revolution of the cylinder a colored spot will be made on the paper at the instant when the two hands A and B come in contact. As the hand B and the cylinder have an isochronous movement, it will now only be necessary to have divisions on the paper corresponding to those on the aneroid barometer in order that the indications of the latter be recorded on the paper.

Since, however, the index of the aneroid barometer in its greatest oscillations describes at most an arc of but 120° it will be evident that this apparatus may serve to record more than barometric indications alone. For instance, let us place opposite the aneroid and at a short distance from it a circular metallic thermometer, the index of which C shall have the same length as that of the aneroid, and have its axis in the prolongation of the axis of the aneroid. Let this thermometer be so placed that the middle point on its graduated arc (60°) will be diametrically opposite to the middle position of the index A of the aneroid barometer (30 ins.). Let the clock be as before described, except that the minute hand B revolves between the planes of the two indexes A and C. Now, if an S-shaped "point" be attached to the extremity of the index B, instead of the single point before described, then, if the instruments are properly adjusted, at each revolution of B it will come once into contact with A and once with C. The latter being connected like A with the wire from the positive pole, two records will be produced on the sensitive paper at each revolution, which will never be confounded on account of their different positions.

*[This is the technical term for a metallic strip or spring, serving to make and break the electrical connection according as it rests on a conducting or an insulating substance.—*Tr.*]

Such was my first idea, and, in spite of the modifications which I have successively made, it still forms the basis of the mechanism which I am about to describe, and which seems to solve, in a simple way, the problem of a complete meteorograph for detached observatories.

In this description, as well as in the figures designed to make it more readily understood, I neglect entirely the meteorological instruments themselves, because, as I have already said, any instrument may be employed which is capable of transmitting its movements to a lever. The figures, then, show only the levers terminating in toothed segments which gear into the toothed wheels to which the indexes are attached.

In all these instruments the motions of the levers should be so regulated that the indexes in their widest excursions may only describe a determined arc, the number of degrees in which should depend on the number of instruments desired to be combined in the meteorograph. In the example which I have chosen the indexes need not be separated more than 90° in order to avoid coming in contact with each other, and in order that the indications of any instrument may never encroach on the zone of the cylinder intended for another. The system I have adopted depends, in fact, on the successive observation of the different instruments.

For records of wind and rain a different arrangement is required. The determination of the direction of the wind requires an entire revolution, and so also does the measurement of its velocity by Robinson's anemometer; in the case of the latter I have provided that the recording wheel shall make but one revolution while the current of air passes over a space of 20 kilometres (12 miles), which is seldom less than an hour.

For the rain-gauge I propose an arrangement which I have recommended for many years for the measurement of liquids in general and of granular solids or powders, which figure II will render intelligible without detailed explanation.

Let A be a reservoir of known sectional area, serving to collect the rain, the quantity of which is to be measured. The water falls through the tube *a* (at the bottom of which is a watering-pot rose, represented in M, in order that the fall of water may not produce a shock) into a bucket, *b b b*, which has the form of a sector of a cylinder and can oscillate on the axis *d*. As the figure shows, there are two buckets of equal size coupled together, one of which is always under the rain-tube while the other is discharging the water it has collected. The transverse section of the buckets is a scalene triangle, so that the vertical plane passing through the axis divides the bucket into two parts of unequal capacities. The excess of weight in the outer part tips the bucket, and, in order that the amount of water necessary to produce this motion (for example, a litre or a fraction of a litre) may be regulated with precision, the lips *m m* of the buckets fall on India rubber cushions *o o*, the position of which is regulated by the screws R R. The figure shows how the movement is afterwards transmitted to a wheel, every revolution of which corresponds to 100 litres (or determined parts of a litre) of water which has passed through the apparatus.

We have, then, three pieces of apparatus, the motions of which are

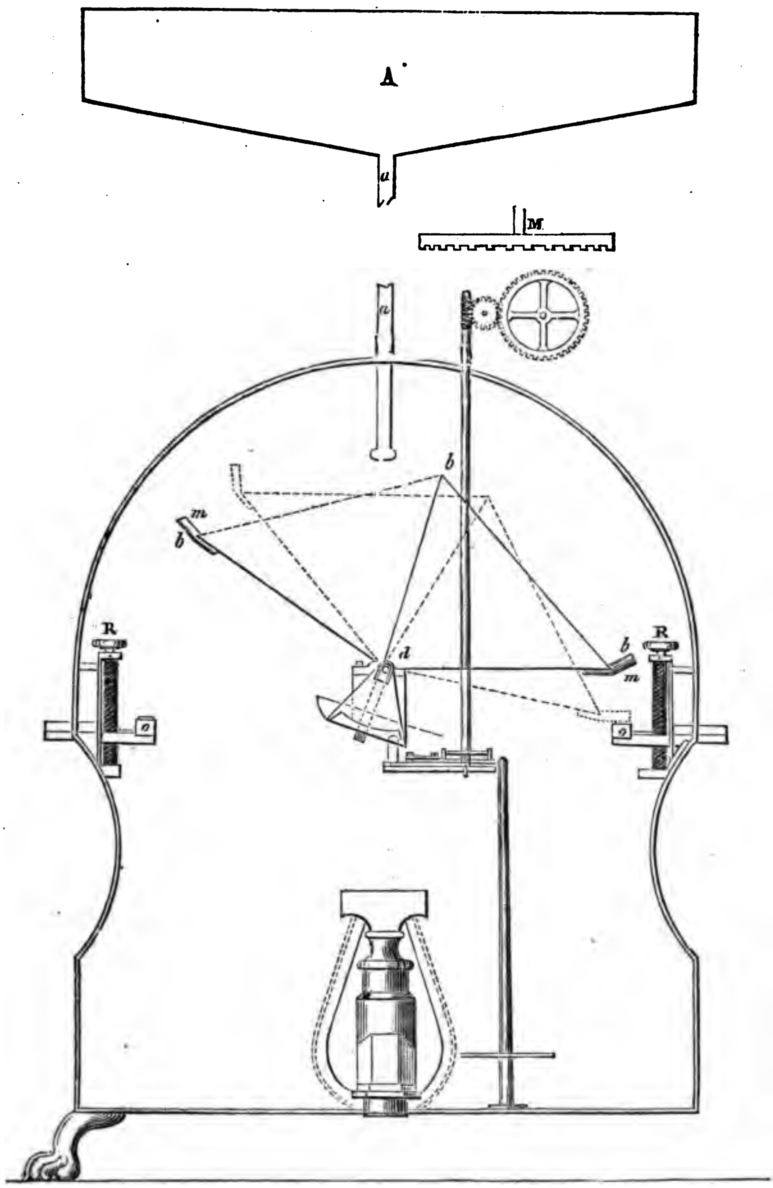


FIG. II.

finally resolved into one of rotation, which, for simplicity of registration, should be transformed into a rectilinear movement. The simplest means of making this transformation appears to me to be what I am about to describe. It should not be forgotten that the construction of my meteorograph rests on the hypothesis that the indications of each meteorological instrument be registered once an hour. The instruments for recording the velocity of the wind and the quantity of rain should therefore be so arranged that the wheel which makes the records shall never make more than one entire revolution in an hour; otherwise it would be doubtful whether the current of air had traversed, for instance, 2 or 22 kilometres during the hour elapsed, or whether the rain-gauge had discharged 5 or 105 litres of water.

Suppose two wheels, A and B (Fig. III), of the same diameter, lying in the same plane and placed so that the distance between their centers shall be exactly equal to the circumference of each. An endless band or chain, passing around the wheels, connects them together. To this chain are attached three pins, *b b b*, at equal distances and consequently the length of the circumference of the wheels apart. If, now, the wheel A is put in motion by one of the instruments, this motion will be transmitted to the endless chain and to the wheel B. At every stage of the movement one of the pins will be traversing the scale *p p*, placed underneath one of the straight portions of the chain; in a complete revolution of A the pin will travel the entire length of the scale, and when it leaves the scale near B the following pin will immediately replace it at A.

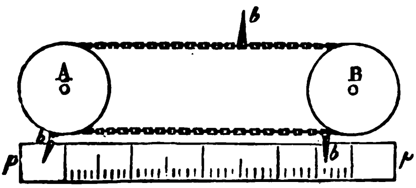


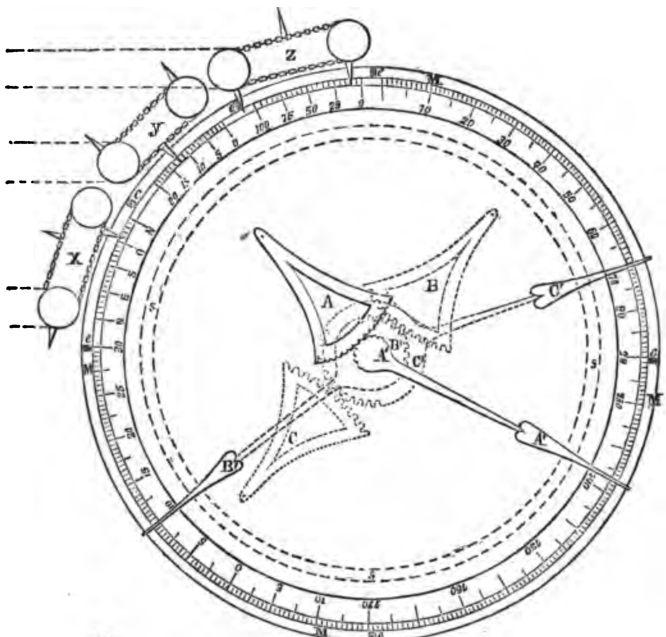
FIG. III.

We will now pass to the description of the registering apparatus, and take up, at first, that part which is placed in the detached observatory.

The lever A (Fig. IV) is put in motion by a barometer, B by a metallic thermometer, and C by a hygrometer. Each of these communicates its motions to a special wheel, A′ B′ C′, to which is attached the index of the instrument, as shown in the section Fig IV *b*. These levers and wheels are not situated in the same plane, but placed one above another, so that the wheels turn on a common axis, but perfectly independently of each other. The extremities of the indexes, however, should move in one and the same plane, very near to, but entirely clear of, the divided arc M M M M, and for this reason two of them are bent. The indexes themselves or at least their extremities, which terminate in a thin fine tip, are of ebonite—a substance which does not conduct electricity. Finally, each of these indexes, even in its widest excursions, moves over but a quarter of the circle, so as not to come into contact with the others. Three of the quadrants being allotted to the barometer, the thermometer, and the hygrometer, I use the fourth for the indications—transformed, as before mentioned—of the wind vane X, the anemometer Y, and the rain guage Z. The pins for registering these indications are also of ebonite, and may run with considerable friction over their scales, since there is in these instruments a superabundance of motive force.

In the case of the wind vane, which, by its sudden and extended oscillations, may often endanger the gold "point" of which we are about to

FIG. IV.



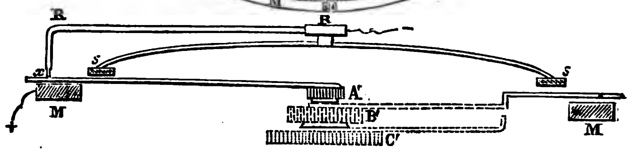


FIG. IV *b*.

speak, I propose to use a strained rubber band around the two wheels, instead of a chain or leather band, in order to lessen the intensity of the shocks.

The divided limb M M M M may be made of metal or any other material, but its outer edge should be of platinum or of brass, heavily gold-plated, because through it the galvanic current is made and broken, and consequently it is necessary to preserve it from oxidation. In front of the graduated limb is a clock, of which Fig IV *b* shows only the minute hand R R, the arbor of which is in the prolongation of the axis around which the several indexes turn. This minute hand is of metal, and carries at its extremity a metal "point" *x*, which glides over the platinum or gilt rim of the divided circle. The rim being connected by a conducting wire to the positive pole of a battery, the negative pole of which is connected in the same way with the minute hand, the current will then pass so long as the gold point rests in contact with the divided circle, but when the point meets one of the indexes the current will be interrupted for an instant by the interposition of the ebonite tip, but will be restored so soon as the point is freed from that obstacle.

When the minute hand has traversed the entire circle—that is to say, after an hour's time—the current will have been momentarily interrupted (in the example we have chosen) six times. These interruptions may now be made use of at the central observatory, which communicates by means of a telegraph wire with the outlying observatory, to record the indications of the instruments on a cylinder covered with a sheet of paper, rotated by clock work once an hour, the rotation of which is therefore isochronous with that of the minute hand at the outlying station.

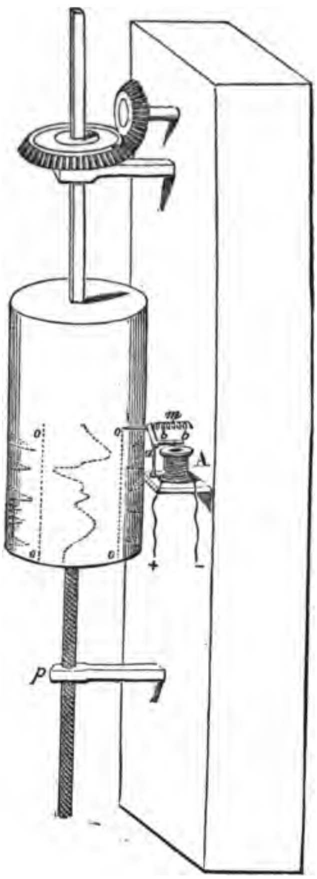


FIG. V.

The isochronism of the two movements is the condition on which the accuracy of the meteorograph depends; in order to judge if it is fulfilled, little ebonite plates *e e e* are fixed on the divided circle. We will see, later, how these plates give the desired in formation in regard to the working of the clock at the detached observatory.

On the spindle of the registering cylinder (Fig. V) is cut a screw-thread which runs in the nut *p*, so that at each revolution the cylinder descends a little—for example, a millimetre ($\frac{1}{26}$ inch.)

Beside the cylinder an electro-magnet, A, is placed, which attracts a piece of soft iron, *b b*, hinged at *d*, to which is attached a pencil, steel point, or diamond, pressed against the cylinder by a spring. While the current is closed the pencil is kept away from the cylinder, but at each interruption of the current in the detached observatory it is pressed against the surface of the cylinder and makes a dot or a line upon it. When the current is again closed, the pencil is again withdrawn by the action of the magnet.

A glance at Fig. V will suffice for the perfect understanding of this system. The straight lines *o o* which serve to regulate the isochronic movement of the two clocks, are formed by a number of points or dashes made by the interruption of the current by little ebonite plates in the divided arc of the apparatus at the detached observatory. If the clock at that station has a faster or slower rate than that at the principal station, these lines will not be parallel to the axis of the cylinder, but oblique, and in case of an irregular rate will even exhibit sinuosities. We are thus kept informed of the state of things, and, if it be impossible to go to the detached observatory, the main clock may be made to keep time with the defective inaccessible clock, taking note, of course, of the corrections which this alteration renders necessary. The construction of a clock to run a year without winding is declared by skillful clock-makers to present no difficulty, so that an observatory, the essential details of which I have briefly sketched, may then operate even on those steep peaks the ascension of which can only be made during two summer months. A telegraph wire connecting the isolated post with the main station is all that is necessary in order that the distant observations be regularly registered.

We have so far spoken of two independent clocks, but who that is familiar with the improvements in telegraphs and electric clocks cannot understand that the minute hand at the detached observatory may be kept in motion by the same clock that turns the cylinder at the principal station? For this purpose, however, a second telegraphic wire would be necessary, which would uselessly increase the expense of establishing the outlying station.

But, adopting another arrangement, I believe that the same wire may serve both to move the hand—which we will still call the minute hand, though it does not now deserve the name—and to transmit the indications of the instruments. We have before considered that the minute hand will make one revolution in an hour, so that, according to the state of the instruments, the record of the barometer is made, for example, at ten minutes past twelve, that of the thermometer at twenty-eight minutes past twelve, the hygrometer a quarter of an hour later, and those of the direction and velocity of the wind and the rain-fall in the fourth quarter of the hour. But such a difference would not satisfy meteorologists who prefer the simultaneous observation of all the instruments so as to have a complete view of the state of the atmosphere at any given moment. Consequently, instead of having the minute hand at the detached observatory and the cylinder at the central station make one revolution during the space of an hour, I propose to have them make the entire revolution in a very short space of time—a few minutes at most—the hand and the cylinder remaining at rest during the remainder of the hour. Once an hour the clock of the principal station would raise a catch at the other station, and the apparatus would then be set in motion by means of a weight or spring so regulated by a pendulum as to make a complete revolution in two or three minutes—the cylinder at at the main station being put at the same time into isochronous motion.

During this revolution the galvanic current is employed only in transmitting the indications of the instruments in the way before described; but, as soon as the revolution is finished, the minute hand is caught again and the current is made to set in motion a train of clockwork to raise the weight or wind up the spring, until the hour is ended and the minute hand begins another revolution.

In some preliminary trials with the apparatus I have encountered a difficulty which has obliged me to make a slight addition to it. The index of the aneroid barometer can overcome but a feeble resistance, even a slight touch being sufficient to move it from its position, and the same is the case with the hair hygrometer; the metallic thermometer, however, is much less sensitive in this respect, particularly that of Dr. Krecke. The indexes of these instruments, as has been said before, should not touch the surface of the divided arc, but should move freely a slight distance above it; since however on the other hand, the point attached to the minute hand should not be too fine if we wish to maintain electrical connection with the metallic rim for several months without cleaning the surfaces, it would be apt while passing over the tips of the barometer and hygrometer indexes to carry them with it and thus give a false record of the indications of these instruments. To avoid this source of trouble the same mechanism which produces the escape of the minute hand presses down a finely grooved ring, *s s s*, Figs. IV and IV *b*, so as to hold the indexes against the divided circle during the short period of the revolution of the hand that the gold point may run over their ebonite tips without risk of displacing them. While the minute hand is at rest the ring will be raised and the indexes again left free to move. The stoppage of the motion of the indexes for a minute or two would be of no consequence, since in so short a time the variations in the instruments would be extremely slight. In the case of the indexes which mark the direction of the wind and the amount of rainfall such an arrangement would be unnecessary, as the motive force is very great and the ebonite points, as said before, may press on the plate.

The problem of registering the indications of meteorological instruments placed at a considerable distance from the observer or at a great height above him is then completely solved. As regards, however, the hygrometric condition of the air I believe that while August's, Daniel's, and the hair or catgut hygrometers furnish close approximations to the truth, a determination of the weight of water contained in a known quantity of air is the only way to obtain exact results. My hygrometric areometer* will make this determination in a very simple way and also permit of automatic registry. There is nothing to prevent our obtaining the air from a distant point by means of an aspirator and a rubber tube and passing it through the areometer at the principal station. As the detached observatory is connected with this station by a telegraph wire the latter may be placed inside the rubber tube, which will then serve as

**Archives Néerlandaises* T VI, p. 419. *Poggendorff's Ann.* Bd. XCIII, p. 343.

an insulator. The observation would only be incorrect in case the air of the distant point has a higher temperature than that of some point in the course of the rubber tube, as in this case a part of the vapor would be condensed in the tube, and consequently would not reach the areometer. But, in general, this would not be likely to occur, because, since the temperature of the air usually decreases as we ascend, the existence of a warm and moist stratum above a colder one will be of but exceptional occurrence.

Before concluding, I must add a word in regard to the case where it is desired to make use of a captive balloon for carrying the observatory to the elevated regions of the atmosphere and supporting it there for a considerable time. The apparatus I propose is perfectly adapted to this purpose, and requires but two conducting wires in the cable which holds the balloon captive.

It will, of course, be objected that the balloon, losing gas rapidly, could not be kept up for more than two days; but this difficulty appears to me capable of being overcome in a very simple way. The two conducting wires in the cable should be insulated from each other, which might be simply done by inclosing each in an India-rubber tube. Now, one of these tubes may be made use of to carry a continuous current of gas into the balloon to supply its losses, while through the other the air of the elevated region may be drawn down by an aspirator to the hygrometric areometer. Thus supplied, the balloon would float in the air until the approach of a tempest—foretold by the observations—would render it necessary to draw it down again.

But there is still another objection, to which so far I can make no satisfactory answer, namely, the impossibility of maintaining the captive balloon at the same height, especially in a region where strong winds prevail. In such a case the record of the barometer is of no service except to give an approximate idea of the elevation of the instruments, and it will be impossible to tell whether the observed barometric variations are due to differences in the height of the balloon or to differences in the atmospheric pressure at the same height.

The use of captive balloons is always attended with a serious defect, namely, the limited height (3,000 feet at most) to which they can be raised, since, without mentioning other difficulties, the weight of the cable will soon become so great that the balloon must be very large to support it. But we can obtain meteorological observations from much greater elevations (from 15,000 to 30,000 feet, for example) by means of the detached observatory without transmission of records. By its relatively moderate price and its light weight this apparatus would, in fact, be well adapted to be suspended from a small balloon allowed to float freely in the atmosphere. Supposing that of ten balloons left to themselves one or two should fall into the sea or in uninhabited places and thus be totally lost, the expense of the experiment would still be much less than the ascension of a balloon large enough to carry the observers.

The registering barometer would then give the elevations corresponding to the several records of the temperature, moisture, &c., while an automatically registering compass would show the directions taken by the balloon in the different strata of the atmosphere traversed by it. In this case, the apparatus should, of course, be protected by an elastic covering capable of preventing shocks when the balloon strikes the earth. There should be placed on the apparatus a notice in several languages that it is not to be opened, but forwarded to a specified address; while by means of articles in the newspapers of even the most distant nations we should endeavor to inform every one of the nature and object of these aerial visitors. This double precaution would doubtless dispel the notion of the unpractical nature of the plan which might at first be entertained.

REPORTS OF AMERICAN OBSERVATORIES.

In the latter part of August, 1879, the following circular was sent to all known public and private observatories in America:

[CIRCULAR.]

SMITHSONIAN INSTITUTION,
Washington, D. C.

MY DEAR SIR: It is desired to present in the annual report of this institution a yearly summary of the state and progress of astronomy in the United States and elsewhere. To this end it is requested that the directors of observatories, public and private, will return this circular, with the blanks filled out and with such additional information as they may deem suitable for publication.

It is intended that one such circular shall reach every observatory, public or private, in the United States; if any have been omitted it has been by inadvertence, and notice of such ommissions is desired by the editor (Prof. EDWARD S. HOLDEN, U. S. Naval Observatory, Washington, D. C.).

It is proposed to continue the summaries in the future, and it is hoped that the directors of the various institutions will desire to furnish from year to year brief sketches of the activity of the observatories under their charge. In this way a record of current astronomical work will be kept up, which otherwise it is difficult to maintain in the absence of any American periodical specially devoted to astronomy.

Very truly yours,

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

To ——— ———.

Replies to this circular have been received as below up to September 15, 1879. They are here arranged in the alphabetic order by towns.

Location of observatory: (City) Allegheny; (County) Allegheny; (State) Pennsylvania.

Name of observatory: ALLEGHENY OBSERVATORY.

Longitude from Washington, $11^m\ 50^s.84$ W.
Latitude, $40°\ 37'\ 47''.6$ N.

I. PERSONNEL:

Director, S. P. LANGLEY; *Assistant*, F. W. VERY.

II. 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, and a number of subsidiary pieces for investigations in heat and light.

Electric appliances for the distribution of exact time, automatically and continuously to points outside the observatory.

III. OBSERVATIONS DURING THE PAST YEAR:

From September, 1878, to September, 1879.

(*b*) Nightly observations of from 3 to 6 stars for time determinations; observations to determine the longitude of Ebensburg, Pa.

(*c*) Daily map of solar surface, drawn by projection on a scale of 8 inches to diameter; enlarged drawings of any spots; measurements by thermopiles of heat of solar image; study of protuberances, and other work with attached spectroscopes.

(*d*) Studies of the lower end of the spectrum; mapping of lines in the extreme red, etc.

(*i*) Comparison of solar heat with that of the BESSEMER converter; the distribution of exact time to cities, railroads, corporations, or individuals.

IV. WORK PROPOSED FOR THE COMING YEAR, 1879–'80:

Systematic observation of sun as heretofore; continuance of researches now in progress, chiefly in solar physics; measurement of heat of diffraction spectrum by tasimeter, etc.; the continuance and extension of the "time-service."

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY DURING THE YEAR 1879:

1. S. P. LANGLEY, on certain remarkable groups in lower spectrum, in Proceedings of American Academy.

2. S. P. LANGLEY, on comparison of sun, in Proceedings of American Academy.

3. S. P. LANGLEY, on BESSEMER converter, in Proceedings of American Academy.

4. S. P. LANGLEY, on electric time service, in Journal of Electrical Society.

Location of observatory: (City) Annapolis; (County) Anne Arundel; (State) Maryland.

Name of observatory: U. S. NAVAL ACADEMY OBSERVATORY.

Longitude from Washington, E. $0^h\ 2^m\ 15^s.91$.
Latitude N. $38^\circ\ 58'\ 53''.5$

Authority for latitude and longitude: latitude, Professor CHAUVENET; longitude, United States Coast Survey.

I. PERSONNEL:

Lieutenant Commander ALLAN D. BROWN, U. S. N., head of Department Astronomy, Navigation, etc.

Assistants: 1. Lieutenant Commander CHAS. J. TRAIN, Instructor Astronomy, Navigation, etc.
2. Lieut. RAYMOND P. RODGERS, Instructor Astronomy, Navigation, etc.
3. Lieut. WM. J. BARNETTE, Instructor Astronomy, Navigation, etc.

II. INSTRUMENTS:

(*a*) *Meridian circles:* 1; maker, REPSOLD; *diameter of circles*, 28.7 inches; divided to 2′; read by four microscropes to 2″. *Aperture of objective*, 4 inches; for observations of the sun, aperture employed, 4 inches; magnifying power ordinarily employed, about 200 diameters.

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 7.75 inches; magnifying powers of eye-pieces, 40, 106, 553, 966; micrometer eye-pieces 89, 226, 673.

(*f*) *Chronographs:* One MORSE fillet; one Transit of Venus Commission.

(*g*) *Clocks:* One sidereal; makers, ARNOLD, CHAS. FRODSHAM, 84 Strand, London.

(*h*) *Chronometers:* Mean time; makers, NEGUS, Nos. 1030, 1088, 1260; DENT 2099; HATTON, 262. Sidereal; maker, NEGUS, Nos. 1520, 1527.

(*i*) *Miscellaneous:* One Talcott's zenith telescope (WURDEMANN); one Transit of Venus telescope (STACKPOLE); portable transit (WURDEMANN).

III. OBSERVATIONS DURING THE PAST YEAR:

From October 1, 1878, to October 1, 1879.

(*a*) Stars and sun (for time).

(*i*) STACKPOLE zenith telescope for latitude (for purposes of instruction); portable transit for time (for same purposes).

IV. WORK PROPOSED FOR THE COMING YEAR: (1879–'80).

Same as during past year.

Location of Observatory: (City) Battle Creek; (County) Calhoun; (State) Michigan.

Name of Observatory: HIGH SCHOOL OBSERVATORY.

Longitude from Washington not determined.

Latitude, not determined.

I. PERSONNEL:

ARTHUR K. BARTLETT (private observer).

II. INSTRUMENTS:

(*a*) Meridian circles, 1.

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. The two celestial eye-pieces belonging to the instrument disappeared mysteriously about three years ago, having been stolen from the case in which they were kept; and as they have not since been replaced, the telescope has remained in a crippled condition without them. But some new eye-pieces are to be ordered soon, with powers varying from 45 to 275, together with colored eye-screens for observing the sun, and a comet eye-piece, with large field and low power. A terrestrial eye-piece is at present being employed, with a power of about 75 diameters; but the telescope has been used to good advantage for observations of the moon, Jupiter's satellites, and star-clusters.

III. OBSERVATIONS DURING THE PAST YEAR:

A continual watch for meteors was made throughout the night of August 10, and a large number were observed between the hours of ten and eleven o'clock in the evening, but about midnight the moon made its appearance, and being near the "radiant" in Perseus, prevented any successful observations being made towards morning. More than one hundred shooting-stars were seen in the space of one hour before the moon interfered, and several bright meteors flashed across the sky, leaving luminous trains behind them, and presenting a fine appearance, notwithstanding the close proximity and brightness of the moon. Observations of the aurora were made on various occasions, although no extraordinary displays were seen; and on many successive evenings in March, the unusual and remarkable brightness of the zodiacal light was particularly noted.

The only systematic observations with the telescope since it was placed in the high-school building have been made by ARTHUR K. BARTLETT, of Battle Creek, who has used the instrument for practical purposes, and given private instructions to the students and others who are frequently entertained on pleasant evenings. This telescope has been used for various observations of the heavens. It was employed with success during the last transit of Mercury, on May 6, 1878, and the first external and internal contacts of the planet were well observed, but the last two were prevented by clouds. During the past year the instrument has been chiefly directed to observations of the various nebulæ, star-clusters, and the interesting phenomena of Jupiter's satellites. An occultation of the star Antares by the moon was observed, and several drawings of celestial scenery were made by the aid of the telescope.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

It is expected that the telescope will be provided with new eyepieces of high power some time this fall, and when they are secured the instrument will be in much better working order, so that it can be used in many other practical observations, for which it is not adapted at present. During the coming year I propose to study the sun at frequent intervals, when the weather is favorable, and shall employ the high powers mostly for observations of the planets, various nebulæ, and close double-stars. I shall also devote much time to literary work, and intend to lecture some during the winter. Meteoric astronomy, which has been a subject of special interest to me for some time past, will receive a good share of my attention in the future. The charming system of Jupiter will be studied with much pleasure, as in the past, and I also intend to continue my sketches and drawings of interesting objects in the heavens.

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY DURING THE YEAR:

My publications have consisted mostly of newspaper articles on various astronomical subjects, which have been prepared with the object of presenting to general readers the principles and wonders of the science, and also to keep them informed concerning many interesting phenomena of the heavens. Among the articles contribued by me to the press during the past five years, were the following: "Double Stars"; "The King of Suns"; "Shooting-Stars"; "The Zodiacal Light"; "A Look along the Zodiac"; "The Study of Astronomy"; "The Prince of Planets"; "The Ringed Planet"; "A Celestial Panorama"; "The Moons of Jupiter"; "The Harvest Moon"; "Venus in the Daytime"; "Prof. Richard A. Proctor"; "The Lunar Eclipse"; "Celestial Fireworks"; "Frost and Dew"; "The Planetary System"; "Motions of the Stars.' In 1877, I published a pamphlet of 36 pages, containing a lecture of mine on "The Science of Astronomy," embracing its sublimity, history' progress, wonders, and utility. The lecture was prepared for the purpose of popularizing astronomy and rendering it a subject of more general interest.

VI. ADDITIONAL INFORMATION:

There is no *regular* observatory in connection with the high school, but it consists of an apartment located on the third and upper floor of the building, in which the telescope is kept and the observations are usually conducted. Astronomy is taught only during the spring term, and but little interest is manifested in the study by the students, although they are permitted to use the telescope at any time. When the instrument is provided with higher powers it will be equal to any of its size in the State of Michigan and can be made to do some good service. I have already observed five new comets with it since 1873, two having been seen in one night--May 8, 1877. Among the comets observed were two discovered by Professor SWIFT, of Rochester, N. Y. The great work which I have had at heart has been to arouse an interest in the study of astronomy, as a means of culture, especially among the young, and to increase the small number of votaries in this science. To this end I intend to continue my lectures and articles in the press, and also to exhibit celestial objects of popular interest, on favorable occasions. I will doubtless be able to send you more valuable reports in the future.

Location of observatory: (City) Brooklyn; (County) Kings; (State) New York.

I. PERSONNEL:

Director, W. T. GREGG.

(c) *Equatorial instruments:* Maker, WILLIAM T. GREGG; aperture of objective, 6¼ inches; magnifying powers of eyepieces, 50 to 600.

VI. ADDITIONAL INFORMATION:

As I said last year, my observatory was built to facilitate corrections of objectives, primarily, but I have been prevented from using it at all thus far by reason of illness. I hope to be able to do something in the future worthy of reporting.

Location of observatory: (City) Brooklyn; (County) King's; (State) New York.

I. PERSONNEL:

Director, G. P. SERVISS.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* One telescope; maker, JOHN BYRNE, of New York; aperture of objective, 3⅜ inches; magnifying powers of eye-pieces, 50, 106, 160, 250, and 320.

(*i*) *Miscellaneous:* 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.

III. OBSERVATIONS DURING THE PAST YEAR:

From June, 1878, to September, 1879.

I have devoted most of the time spent with my telescope to viewing the moon and the planets, especially Jupiter and Saturn. I have made drawings of the surface of Jupiter at different times, noting every change in the belts and spots as accurately as possible. In August of this year (1879) and thus far in September I have made careful drawings of the disk of Jupiter and have colored them, seeking to give as near the exact tint as possible to the spots, belts, and shaded regions. The general result of my recent work shows that the northern dark belt is of a coppery hue, verging on a reddish-purple, while the southern belt is gray. The contrast in the color of these two belts has often appeared to me very strikingly. Their outlines are at times broken, and the copper belt is frequently seen split lengthwise. White and dark spots on the central light zone I have observed frequently.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

I intend to continue my observations and drawings of Jupiter and other planets. I am especially interested in watching a remarkable elongated spot of a light maroon color (with a trace of rose tint) that lies south of the gray belt, and is about one-fourth of the planet's diameter in length, one-eighth of its own length broad, and somewhat rounded at the ends. The gray belt opposite this spot seems to grow narrower and bend away from the spot toward the center of the disk. All of my drawings show light and dark markings on the central white zone about in the longitude of this great spot.

173 GATES AVENUE, BROOKLYN.

I have been trying in vain nearly a year to obtain the Harvard Vol. IX, to aid me in photometric work. Hope to get it soon. For that reason, and from other business, my observatory has remained idle this year and does not deserve a place in your notices. I hope to resume work next year; but my eyes need rest, and do not seem to improve in this long astronomical recess.

Yours, truly,

HENRY M. PARKHURST.

Location of observatory: (City) Buffalo; (County) Erie; (State) New York.

Longitude from Greenwich, 78° 53′ 26″.5.
Latitude, 42° 54′ 9″.5.

Authority for latitude and longitude: Regents of University of State of New York. Report for 1862.

I. PERSONNEL:

Director, HENRY MILLS.

II. INSTRUMENTS:

(*c*) Telescope not equatorial; maker, Bardon; aperture of objective, 3 inches; magnifying powers of eyepieces, 50 to 250.

III. OBSERVATIONS DURING THE PAST YEAR:

Observations on sun spots and such other celestial phenomena as come within range of my instrument.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

I propose to make systematic observations on sun spots and to record the same for future reference.

Location of observatory: (City) Cambridge; (County) Middlesex; (State) Massachusetts.

Name of observatory: The Astronomical Observatory of Harvard College.

Longitude from Washington, — $0^h\ 22^m\ 41^s.11$.
Latitude + 42° 22′ 48″.1.

Authority for latitude and longitude: American Ephemeris for 1881.

I. PERSONNEL:

Director, EDWARD C. PICKERING.

Assistants, WILLIAM A. ROGERS, A. M.; ARTHUR SEARLE, A. M.; LEONARD WALDO, S. D.; FRANK WALDO, S. B.; Miss R. G. SAUNDERS; WALTER HOXIE; J. F. MCCORMACK; WINSLOW UPTON, A. M.; OLIVER C. WENDELL. About half a dozen other persons are employed in computations.

II. 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:* Maker, 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:* Maker, MERZ; aperture of objective, 15 inches; magnifying powers of eyepieces, 100 to 2000.

(*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:* Mean time; maker, BOND, 394: sidereal; makers, FRODSHAM, 1327; BOND, 312.

(*h*) *Chronometers:* Sidereal; makers, FRODSHAM, 3451; BOND, 236; thermometric chronometer, FRODSHAM, 3424.

(*i*) *Miscellaneous;* Comet-seeker and other small telescopes and apparatus.

III. OBSERVATIONS DURING THE PAST YEAR:

From September 1, 1878, to September 1, 1879.

(*a*) Completion of observation of stars to the ninth magnitude, inclusive, in zone 50° to 55°; completion of observations of bright stars not recently well determined; commencement of observations of absolute places of important stars; observations for clock error, for use of time service (signals sent every two seconds to many points in and near Boston).

(*b*) Observations for clock error, as above.

(*b*′) Photometric comparisons of stars visible to the naked eye; the observing list includes about 4,000 stars.

(*c*) (*c*′) Photometric observations of satellites of superior planets; photometric observations of the eclipses of Jupiter's satellites; commencement of spectroscopic and photometric observations of selected nebulæ; observations of comets and asteroids.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

Continuation of observations now in progress.

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY DURING THE YEAR:

1. E. C. Pickering, annual report, 1878; published in 1879, vol. 1, page 14.

VI. ADDITIONAL INFORMATION:

Two volumes of the annals of the observatory are in course of publication.

The financial condition of the observatory has been greatly improved by the completion of a subscription to provide for its current expenses. This will be of important service in the reduction of a large accumulation of observations, the publication of which must otherwise have been long delayed.

A room has been fitted up for the purpose of making accurate measures of distance and comparisons of scales.

Location of observatory: (City) Chicago; (County) Cook; (State) Illinois.

Name of observatory: DEARBORN UNIVERSITY OBSERVATORY.

Longitude from Washington, + $0^h\ 42^m\ 14^s.26$.

Latitude, + $41^\circ\ 50'\ 01''.0$.

Authority for latitude and longitude: American Ephem. and Naut. Almanac.

I. PERSONNEL:

Director, G. W. HOUGH.

II. INSTRUMENTS:

(*a*) *Meridian circles:* 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 instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 18½ inches; magnifying powers of eyepieces, positive, 120, 190, 287, 385, 900; negative, 135, 225, 450, 900.

(*f*) *Chronographs:* G. W. HOUGH; cylinder recording.

(*g*) *Clocks:* Mean time; Makers, HOWARD & CO.; GRAHAM escapement, mercury pendulum. Sidereal; Makers, CHARLES GORTNER & CO., London; GRAHAM escapement, mercury pendulum,

(*h*) *Chronometers:* Sidereal; Makers, BOND & SON.

(*i*) *Miscellaneous:* Signal mean time clock for transmitting time signals.

III. OBSERVATIONS DURING THE PAST YEAR:

From May 18 to ———.

(*a*) The Dearborn Observatory is not at present in active operation for want of funds. Observations are, however, made by the director as far as his time will permit.

(c) (c′) *Equatorial:* Observations on Tempel's comet; observations on wift's comet; micrometrical measurements of the disk of Jupiter for gure now in progress. Mr. S. W. BURNHAM has the use of the equaorial for double-star work when it is not otherwise employed. Meridan circle used for time and the observation of stars for extra-meridian bservations.

Location of observatory: (Village) Clinton; (County) Oneida; (State) lew York.

Name of observatory: LITCHFIELD OBSERVATORY, of Hamilton Colege.

Longitude from Washington $0^h\ 6^m\ 34^s.65$ east.

Latitude $+ 43° 3' 16''.5$

Authority for latitude and longitude: reports to the regents of the niversity of the State of New York.

I. PERSONNEL:

Director, C. H. F. PETERS.

No assistants.

II. INSTRUMENTS:

(b) *Meridian transit instruments:* Maker, WÜRDEMANN; aperture 2½ nches.

(c) *Equatorial instruments:* Makers, SPENCER & EATON; aperture of bjective, 13½ inches; magnifying powers of eyepieces, 80 to 1,600.

(c′) Ditto, STEINHEIL, aperture 4 inches; altitude azimuth, SCHRODER, 5 inches aperture.

(f) *Chronographs:* WM. BOND & SON.

(g) *Clocks:* Mean time; makers, WM. BOND & SON.

(h) *Chronometers:* Sidereal; makers, WM. BOND & SON.

(i) *Miscellaneous:* For further details see catalogue of Hamilton College.

III. OBSERVATIONS DURING THE PAST YEAR:

(b) Time determination.

(c) (c′) Minor planets, comets, and zones of stars.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

Continuation of that of preceding year.

VI. ADDITIONAL INFORMATION:

[From January 1, 1879 to October 1, 1879, Dr. PETERS has discovered 7 asteroids, though he has omitted any notice of them from his report. This makes in all 38 asteroids discovered by him.—E. S. H.]

Location of observatory: (City) Columbia; (County) Boone; (State) Missouri.

Name of observatory: OBSERVATORY OF THE UNIVERSITY OF THE STATE OF MISSOURI.

Longitude from Washington, $1^h\ 1^m\ 6^s$ west.

Latitude 38° 56′ north.

Authority for latitude and longitude: JOSEPH FICKLIN and THOMAS J. LOWRY.

I. PERSONNEL:

Director, JOSEPH FICKLIN.
Assistant, THOMAS J. LOWRY.

II. INSTRUMENTS:

(*a*) *Meridian circles:* 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 instrument:* Maker, HENRY FITZ, of New York; aperture of objective, $4\frac{1}{16}$ inches; magnifying powers of eye-pieces, 30 to 240.

(*g*) *Clocks:* Mean time; maker, RIGGS, of Philadelphia; 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 microscope to 10 seconds. An altitude azimuth instrument, made by E. & G. W. BLUNT, of New York. It has an aperture of $2\frac{1}{2}$ 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.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*) Our observatory is used chiefly for instructional purposes. My time is so completely occupied by work in the class-room that I have very little time for original work.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

The ordinary work of instruction to classes in astronomy, and a redetermination of our latitude and longitude.

Location of observatory: (City) Columbus; (County) Franklin; (State) Ohio.

Name of observatory: OHIO STATE UNIVERSITY.

I. PERSONNEL:

Director, R. W. McFARLAND.

VI. ADDITIONAL INFORMATION:

I have no regular observatory yet, but have the private use of two telescopes, with which, in a small way, I am trying to get the authorities moved to do something worth reporting, which I cannot now do.

Location of observatory: (City) Elizabeth; (County) Union; (State) New Jersey.

Name of observatory: None.

Longitude from Washington, 2° 50′ 33″ east.
Latitude, 40° 40′ 19″ north.

Authority for latitude and longitude: United States Coast Survey.

I. PERSONNEL:

Director, CHARLES W. PLYER.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, JOHN BLISS & SONS, New York; aperture, 1 inch; magnifying power, 10 diameters.

(*c*) *Equatorial instruments:* Maker, HENRY G. FITZ; aperture of objective, 6¼ inches.

(*c′*) Nine eye-pieces, from 50 to 630.

III. OBSERVATIONS DURING THE PAST YEAR:

(*c*) (*c′*) None, owing to ill-health, except an occasional search for comets.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

Drawings of the surface of Mars, which will be a continuation of my work in 1877.

Location of observatory: (City) Fordham; (County) New York; (State) New York.

Private observatory.

Longitude from Washington, 0^h 12^m $40^s.47$ east.
Latitude, 40° 52′ 31″.3.

Latitude and longitude deduced from Coast Survey map of 1863 and American Ephemeris 1879, assuming the latitude and longitude of New York, given in the Ephemeris, to be the latitude and longitude of the City Hall.

I. PERSONNEL:

Director, WILLIAM MEIKLEHAM.

No assistants.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* 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*) *Spectroscopes:* One.

(*g*) *Clocks:* Mean time; Maker, SETH THOMAS, SONS & CO.

(*i*) *Miscellaneous:* Filar micrometer; divided on silver to measure $\frac{3}{10}$″ of arc in distance, and 6′ in position, with suitable eye-pieces and illuminating apparatus.

III. OBSERVATIONS DURING THE PAST YEAR:

From September 1, 1878, to September 1, 1879.

(c) Observations of the magnitudes and colors of double stars, lunar peaks and craters, solar spots and faculæ, belts of Jupiter, rings of Saturn. In solar observations I find it advantageous generally to reduce the aperature of my telescope to $3\frac{5}{10}$ inches, and use an eye-piece magnifying 80 diameters, with a right-angle prism instead of a colored glass screen.

(i) Measurements of position and distances of components of double stars; heights of lunar peaks by the lengths of their shadows; width of lunar craters; sizes of solar spots.

IV. WORK PROPOSED FOR THE COMING YEAR (1879-'80):

A continuation of the above.

Location of observatory: (City) near Fort Dodge; (County) Webster; (State) Iowa.

Longitude from Washington, $1^h. 8^m.5$ west.

Latitude, 42° 30′ north.

Authority for latitude and longitude, F. HESS.

I. PERSONNEL:

Director, F. HESS.

Assistant, Mrs. P. B. HESS.

II. INSTRUMENTS:

(a) Aperture of objective, $2\frac{5}{8}$ inches; for observations of the sun, aperture employed, $2\frac{5}{8}$ inches; magnifying power ordinarily employed, 50 diameters.

(b) *Meridian transit instruments:* Makers, J. BROWN & SON, New York; aperture, 1 inch; magnifying power, $10\frac{1}{2}$ diameters, with horizontal and vertical circle, each reading to 1.

(g) *Clocks:* Mean time; maker, G. M. WHEELER, Elgin, Ill.

(i) *Miscellaneous:* One TROUGHTON sextant and artificial horizon.

III. OBSERVATIONS DURING THE PAST YEAR:

From September 15, 1878, to September 15, 1879.

(a) Observations of sun-spots, occultations, eclipses of Jupiter's satellites, and searching for intra-Mercurial planets.

(b) (b′) Observing the variations of the magnetic needle, altitudes and azimuths, time, latitude and longitude, and approximately locating sun-spots.

(i) Observing altitudes, time, latitude and longitude of various places.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

Continuation of previous work and the establishment of an observatory on Mount Zapato, Colorado, located 5.9 miles S. $76\frac{1}{2}$ E. (M. B.) from

N. G. ADEE's house at Zapato, and rising to an altitude of 6,120 feet above said house, the approximate elevation of which above sea level is 8,099 feet, provided a valid title can be obtained by purchase or otherwise to sections 13 and 14, township 28 north, of range 73 west, of the sixth principal meridian, as yet unsurveyed and unoccupied public land comprising this mountain, the most accessible of the highest peaks of the Sierra Blanco.

V. ADDITIONAL INFORMATION:

April 25, 1879, I found BRORSEN's comet in the vicinity of a star supposed to be B. A. C. 1504, coming within the same field of view of instrument (*a*), in which the comet was seen with a magnifying power of 50. The comet was observed each following night until April ... a star, supposed to be B. A. C. 1849, was within the same field of ... with the comet. It was looked for again all night of May ... not be found again.

During a few hours in the nights of July 18 and August ... San Juan, below Pagosa Springs, Colorado, I saw many ... meteors. Monthly reports of sun-spots and other miscellaneous observations have been made to the Chief Signal Officer of the ...

Location of observatory: (City) Glasgow; (County, ... Missouri.

Name of observatory: MORRISON OBSERVATORY

Longitude from Washington, $1^h\ 3^m$ ...

Latitude, 39° 16′ 16″.75 N.

Authority for latitude and longitude: Longitude ... the Naval Observatory on five successive days; latitude ... observations on circumpolar stars made on ...

I. PERSONNEL:

Director, CARR W. PRITCHETT.

Assistant, C. W. PRITCHETT, JR.

II. INSTRUMENTS:

(*a*) *Meridian circles:* makers, TROUGHTON & ... eter of circles, 24 inches; divided to 5′; ... aperture of objective, 6 inches; for ... ployed, 4 inches; magnifying power ...

(*c*) *Equatorial instruments:* ... of objective, 12¼ inches; ...

(*f*) *Chronogra*...

(*g*) *Clock*...

(*h*) *Ch*...

No. 15...

(*i*) ...

thermo...

2

III. OBSERVATIONS DURING THE PAST YEAR:

(From September 1, 1878, to September 1, 1879.)

(*a*) Meridian circle has only been used for *time observations.*

1. Third series of observations on satellites of Saturn.

2. Observations of satellites of Jupiter.

3. Measures of position, angle, and distance of double and multiple stars.

4. In progress, an extensive series of observations on the Red Spot on Jupiter, first seen July 9, 1878. Transit of center, for redetermination of axial rotation.

5. A few occultations of stars by the Moon.

IV. WORK PROPOSED FOR THE COMING YEAR: (1880.)

(*a*) It is expected that the meridian circle will be put to systematic use during the ensuing year.

(*c*) The observations on the equatorial will be divided between the fixed stars and planets as the *relative* importance of the work, for the time being, may demand.

VI. ADDITIONAL INFORMATION:

We have no fund for defraying expenses of publications. A few papers have been published in the "Astronomische Nachrichten" and the "Observatory," London. There exists here quite a large number of observations which might be of use if published.

Location of observatory: (City) Hanover; (County) Grafton; (State) New Hampshire.

Name of observatory: SHATTUCK OBSERVATORY.

Longitude from Washington, $19^m\ 3^s.56$ east.

Latitude, 43° 42′ 15″.2 north.

Authority for latitude and longitude: Prof. C. A. Young.

I. PERSONNEL:

Director, CHARLES F. EMERSON.

Assistants: 1. CHARLES D. LAMB, } Room in the observatory, and
2. DAVID R. REED, } have charge of the meterological observations.
3. GEORGE O. MITCHELL.

II. INSTRUMENTS:

(*a*) *Meridian circles:* 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*) *Equctorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 9.25 inches; magnifying powers of eyepieces, 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*) *Chronographs:* BOND'S Spring Governor.

(*g*) *Clocks:* Mean time; makers, UTZSCHNEIDER & FRAUENHOFER, connected with chronograph; 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.

III. OBSERVATIONS DURING THE PAST YEAR.

(*a*) For time and latitude.

(*d*) Class illustration on reversal of lines, and for prominences.

(*i*) Meteorological observations 3 times per day; sun spot observations since September 1, 1879.

IV. WORK PROPOSED FOR THE COMING YEAR: (1880.)

Similar work, with special attention to sun spots, prominence, &c., and spectroscopic observations.

Location of observatory: Hastings; (County) Westchester; (State) New York.

Name of observatory: Henry Draper's Observatory,
Longitude from Greenwich, 73° 52′ 25″ west.
Latitude, 40° 59′ 25″.

Authority for latitude and longitude: United States Coast Survey.

I. PERSONNEL:

Director, Dr. H. DRAPER.
Assistant, Mrs. DRAPER.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, STACKPOLE BROS.; aperture, 2 inches; magnifying power, 25 diameters.

(*c*) *Equatorial instruments:* 28-inch silvered glass reflector by H. DRAPER; 12-inch achromatic by ALVAN CLARK.

(*d*) *Spectroscopes:* Grating spectroscope for solar work by ALVAN CLARK; stellar spectroscope by BROWNING; stellar photographic spectroscope by H. DRAPER; large spectroscope for research on oxygen in the Sun.

(*f*) *Chronograph:* by H. DRAPER.

(*h*) *Chronometers:* Mean time, makers, NEGUS BROTHERS; sidereal, makers, NEGUS BROTHERS, break circuit.

(*i*) *Miscellaneous:* Silvered glass altazimuth 15½ inches aperture;

petroleum engine; gramme machine; 17-inch induction coil; photographic apparatus.

III. Observations during the past year:

(*a*) The main work has been photography of the spectra of stars and the planets especially, and α Lyræ, Arcturus, Jupiter, and the Moon. The research on the presence of oxygen in the Sun has been continued.

IV. Work proposed for the coming year: (1879–'80.)

Continuation of the above.

VI. Additional information:

The results of the researches in this observatory have been printed in the American Journal of Science, in the monthly notices of the Royal Astronomical Society, the Comptes Rendus of the French Academy of Science, and the Journal of the Italian Spectroscopists.

Location of observatory: (City) Haverford; (County) Montgomery; (State) Pennsylvania.

Name of observatory: Haverford College.

Longitude from Washington, ——.
Latitude, 40° 0′ 36″.5.

I. Personnel:

Director, Isaac Sharpless.
Assistants: 1. William F. Perry,
2. Josiah P. Edwards.

II. Instruments:

(*a*) *Meridian circles:* 2; diameter of circles, 26 inches; divided to —′; read by 4 microscopes to 2″; aperture of objective, 4 inches.

(*b*) *Meridian transit instruments:* Aperture, 1½ inches.

(*c*) *Equatorial instruments:* Maker, Fitz; aperture of objective, 8¼ inches; magnifying powers of eyepieces, 60 to 900.

(*f*) *Chronographs:* Bond's magnetic.

(*g*) *Clocks:* Mean time; maker, William E. Harper, Philadelphia; 1 sidereal; makers, no name.

Prof. Samuel Alsop, the previous director of the observatory, has been absent from duty during the past year on account of ill health.

Location of observatory: (City) Iowa City; (County) Johnson; (State) Iowa.

Name of observatory: C. W. Irish's Private Observatory.

Longitude from Washington, 57^m 52^s.
Latitude. 41° 39′$\frac{8}{10}$.

Authority for latitude aud longitude: Observations by self during the past eleven years.

I. PERSONNEL:

Director, C. W. IRISH.
Assistants: 1. Mrs. C. W. IRISH,
2. Miss LIZZIE IRISH,
3. Miss RUTH IRISH,
4. Dr. C. M. HOBBY.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments*: Makers, made by self; aperture, 1 inch; magnifying power, 11 diameters.

(*c*) *Equatorial instruments*: Makers, CHEVALIER, Paris; aperture of objective, 4 inches; magnifying powers of eyepieces, 25 to 300.

(*f*) *Chronographs*: A Morse register.

(*g*) *Clocks*: Mean time; makers, German make, beats $\frac{3}{4}$ seconds.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*) Have done nothing since the transit of Mercury, May, 1878.

(*Former*) *location of observatory*: (City) Jackson; (County) Jackson; (State) Michigan.

Longitude from Washington, west $29^m\ 29^s.74$.
Latitude, $42^\circ\ 14'\ 25''.21$.

Authority for latitude and longitude: Monument set by Lake Survey.

I. PERSONNEL:

Director, O. MULVEY.

II. INSTRUMENTS:

(*c*) *Equatorial instruments*: Makers, S. & B. SOLOMONS, London; aperture of objective, 3 inches; magnifying powers of eyepieces, 30 to 205.

(*h*) *Chronometers*: Mean time; makers, FINER & NOWLAND, London.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*.) Telescope dismounted for past year. Will remount at Wichita, Kans.

VI. ADDITIONAL INFORMATION:

Having removed to Wichita, Kans., please address me at this place in future.

Location of observatory: (City) Lawrence; (County) Douglas; (State) Kansas.

Name of observatory: Connected with Kansas State University.

Longitude from Washington, $1^h\ 12^m\ 47^s.9$.
Latitude $38^\circ\ 57'\ 15''$.

Authority for latitude and longitude: FRED. W. BARDWELL, late Professor of Astronomy, K. S. U.

I. PERSONNEL:

Director, H. S. S. SMITH.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, STACKPOLE BROS.; aperture, 2¼ inches;

(*g*) *Clocks:* Mean time; makers, E. HOWARD & Co., Boston (medium); Sidereal; makers, BROCKBANKS, London (old).

(*h*) *Chronometers:* Sidereal; makers, T. S. & J. D. NEGUS, New York (good).

(*i*) *Miscellaneous:* Sextant, GAMBEY.

III. OBSERVATIONS DURING THE PAST YEAR:

(*b*) (*b'*) Time.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

Not settled.

VI. ADDITIONAL INFORMATION:

Observatory torn down in April. Small temporary observatory in process of construction.

Location of observatory: (City) Madison; (County) Jefferson; (State) Indiana.

Name of observatory: FAIRMOUNT OBSERVATORY.

Longitude from Washington, $0^h\ 33^m\ 34^s$ +.

I. PERSONNEL:

Director, ISRAEL FOWLER.

Assistant, My son.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* Maker, I. FOWLER; aperture of objective, 6 inches; magnifying powers of eyepieces, 90, 120, 300.

(*g*) *Clocks:* Mean time; maker, I. FOWLER.

(*i*) *Miscellaneous:* My yard is my observatory; location, Fairmount, near the City of Madison, Jefferson County, State of Indiana. I and my son are the observers. Instruments: 1. A 6-inch metal reflector, focal length 90 inches, mounted equatorially with hour and declination circles, also tangent screw for slow motion. 2. A portable silvered glass reflector 50 inches focal length, with eyepieces varying from 40 to 300 diameters. 3. A mean-time clock beats seconds, used as a regulator in my watch shop, all made by myself. I commenced my observations in 1869; scarcely a favorable night has passed without finding me at the telescope, but I have kept no record, so it can be of no service to science.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

I propose the coming year to keep a record of all observations made; so if I should awkwardly stumble upon something of interest I will communicate the same. My observations will be confined to sun spots, a search for Vulcan, and observing Jupiter and Saturn.

Location of observatory: Mount Lookout; (County) Hamilton; (State) Ohio.

Name of observatory: CINCINNATI OBSERVATORY.

Longitude from Washington, 29^m 29.42^s W.

Latitude, 39° 8′ 35″.5.

Authority for latitude and longitude: American Ephemeris for 1880.

I. PERSONNEL:

Director, ORMOND STONE.

Assistant, HERBERT A. HOWE.

Student, H. V. EGBERT.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, BUFF and BERGER; aperture, 3 inches; magnifying power, 100 diameters.

(*c*) *Equatorial instruments;* Makers, UTZSCHNEIDER and FRAUENHOFER; finished by MERZ & MAHLER; object-glass refigured by ALVAN CLARK & SONS; aperture of objective, 11¼ inches; magnifying powers of eyepieces, 90 to 1,400.

(*c′*) ALVAN CLARK & SONS; aperture, 4 inches; magnifying powers, 15 to 250.

(*f*) *Chronographs:* BOND.

(*g*) *Clocks:* 2 mean time; makers, ROBERT MOLYNEUX, JAS. RITCHIE & SON.

(*h*) *Chronometers*, Sidereal, 1; makers, WM. BOND & SON.

(*i*) *Miscellaneous:* Magnetic theodolite; maker, GAMBEY. Sextant; makers, STACKPOLE & BROTHER. Inclinometer, time-ball, telegraphic apparatus, etc.

III. OBSERVATIONS DURING THE PAST YEAR:

From September 1, 1878, to September 1, 1879.

(*b*) Determination of time and latitude.

(*c*) 2033 sets of double-star measurements.

(*c* and *c′*) Examination of surface of Sun on 180 days. Spots seen on 40. (*c′*) was used with one inch aperture until the middle of February, 1879. Since that (*c*) most of the time with an aperture of 5 inches.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–80):

Continuation of observations of double stars and observations of sun spots with (*c*); Durchmusterung south of 23° south declination with (*c*); determination of time with (*b*).

VI. ADDITIONAL INFORMATION:

Telegraphic time signals are sent to the city and a ball dropped from a staff at the observatory each day at noon.

Location of observatory: (City) Nashville; (County) Davidson; (State) Tennessee.

Longitude from Washington, 38^m, 56^s.

Latitude, + 36° 10′ 01″.

Authority for latitude and longitude: Mr. GEORGE DEAN, United States Coast Survey.

I. *Director*, E. E. BARNARD.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* Maker, JOHN BYRNE, New York; aperture of objective, 5 inches; magnifying powers of eyepieces, 52, 78, 85, 104, 173, 260, 330, 520. This instrument has simple equatorial mounting moved by hasp joint and handle (on tripod stand).

(*i*) *Miscellaneous:* Have also a small achromatic telescope with objective 2½ inches in diameter, simple vertical and horizontal mounting. I use a good silver watch and get my time from Western Union Telegraph office by noon signal from Washington.

(*c*) (*c′*) Jupiter, changes in belts, etc.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

I propose to use what time I can spare observing further the changes on Jupiter; and particularly the lunar crater Plato. Also other objects which come under my notice and time.

VI. ADDITIONAL INFORMATION:

The spare time from my work has been very little, and most of that has been occupied in the study of mathematics. What little time I have had for observing has been employed in the observation of the lunar crater Plato and the changes on the surface of the planet Jupiter; making drawings of his belts, etc. Since last season a large oblong *red* spot or short belt, rather, has appeared. I have been watching this to detect any changes that may occur in it. I have made drawings at every favorable opportunity of this remarkable spot, but I have so far been unable to detect any positive change in it, but there seems to be change going on in some of the belts, especially in the belt immediately above the *red* spot and nearer the equator of the planet. This seems to be changing in form and color. When I first noticed this belt it was of a dusky grayish tint; then, afterwards, of a beautiful bluish color; this bluish tint was quite marked. The northern of the equatorial belts is very ruddy, but heretofore has been not near so red as the large red spot, but on the night of the 14th of September it seemed to be fully as ruddy as the spot. My lack of proper instrumental equipment has kept me from making any very accurate observations. I would further state in regard to the changes of Jupiter that on the above-mentioned night, at $9^h 30^m$, there were one or two little round spots on the disc near the South Pole; they appeared about the size of one of the satellites (the 3rd) which had come on the disc half hour or so before; they were faint and not seen readily. I had not noticed these spots before.

Location of observatory: (City) New Haven; (County) New Haven; (State) Connecticut.

Name of observatory: The SHEFFIELD SCIENTIFIC SCHOOL OF YALE COLLEGE.

Of equatorial { Longitude from Washington, $0^h\ 16^m\ 30^s.0$ E.
Latitude, 41° 18′ 36″.5 N.

Authority for latitude and longitude: Latitude from observations with zenith telescope by C. S. L. Longitude, Coast Survey. The Coast Survey latitude is 41° 18′ 40″.67.

I. PERSONNEL:

Director, C. S. LYMAN.

Assistant, WILLIAM BEEBE.

II. INSTRUMENTS:

(*a*) *Meridian circles:* Makers, ERTEL & SONS, 1845. Altered by WM. 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:* Makers, one by C. S. L., 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.

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 9 inches; magnifying powers of eyepieces, 40, 80, 140, 200, 280, 450, 620.

(*c′*) Portable 4⅝-inch refractor by Messrs. CLARK & SONS.

(*d*) *Spectroscopes:* By A. CLARK & SONS, of 7 prisms twice traversed.

(*f*) *Chronographs:* One just finished by A. CLARK & SONS.

(*g*) *Clocks:* Sidereal; makers, 1 by APPLETON, London, and 1 by E. HOWARD & SONS, Boston.

(*h*) *Chronometers:* Sidereal; maker, POOLE, improved by NEGUS.

(*i*) *Miscellaneous:* 1 bi-filar position micrometer by DOLLOND; 1 multiple ring micrometer (8 rings); 1 patent sextant by PISTOR & MARTINS; 1 patent reflecting circle by PISTOR & MARTINS. Yale College has also a 10-foot refractor of 5-inch aperture by DOLLOND, and a 5-foot transit instrument of 4-inch aperture by TROUGHTON & SIMMS. The former is in charge of Professor LOOMIS, the latter not mounted.

III. OBSERVATIONS DURING THE PAST YEAR (from September, 1878, to September, 1879):

(*b*) (*b′*) Time observations for city and chronometers of the port. Practice of students for time, latitude, longitude, etc.

(*c*) (*c′*) Observations of BRORSEN'S and SWIFT'S comets, etc.

IV. WORK PROPOSED FOR THE COMING YEAR (September, 1879, to September, 1880):

Of Mars at opposition for parallax, comets, and occultations, &c.; meridian circle, for redetermination of latitude, &c.; the work of instruction leaves but limited opportunity for other work.

Location of observatory: (City) Newington; (County) Hartford; (State) Connecticut.

Name of observatory: PRIVATE OBSERVATORY of D. W. EDGECOMB.

Longitude from Washington, 5° 21′ 30″ E.

Latitude, 41° 44′ 0″.

Authority for latitude and longitude: Difference from Hartford State-house, Coast Survey.

I. PERSONNEL:

Director, D. W. Edgecomb.

Assistants, None.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* Makers, A. CLARK & SONS; aperture of objective, 9.4 inches; magnifying powers of eyepieces, various up to 2,000. (See general description.)

(*g*) *Clocks:* Mean time; Swiss regulator, seconds.

VI. ADDITIONAL INFORMATION:

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. The latter rests upon a granite pedestal, weighing about 1,500 pounds. The mounting is by YOUNG, of Philadelphia, and is of the best workmanship. The declination circle is 13 inches in diameter, reading by verniers to 10 seconds of arc. The hour circle is 10 inches diameter, reading by verniers to 4 seconds of time. The graduations are upon silver. The object-glass, tube, and finder are by A. CLARK & SONS. The aperture of the object-glass is 9.4 inches, with a focal length of 121 inches, and is without doubt the finest specimen of the skill of Mr. ALVAN CLARK. Under the most rigid tests, its figure is found to approach very closely to absolute perfection. It is shown also by the vision it gives of the closest double stars and the faintest companions to bright stars hitherto discovered. Among the former, γ^2 Andromedæ, λ Cassiopeæ, and η Coronæ in its present position (September, 1879) may be mentioned, and of the latter class, the companions to γ Lyræ, ζ Aquillæ, ϵ and ρ Hydræ, the star closely following the attendant to Regulus, and under very favorable circumstances the 2″ companion to ϵ Coronæ. The instrument has been used for general observations of the stars, moon, and planets, other occupations preventing the owner from carrying on at present any more regular work.

Location of observatory: (City) New York; (County) New York; (State) New York.

Name of observatory: Mr. RUTHERFURD'S PRIVATE OBSERVATORY.

Longitude from Washington, east 3° 3′ 52″.05.

Latitude north, 40° 43′ 48″.53 ± 31.

Authority for latitude and longitude: United States coast surveying party (1859), with zenith telescope upon 24 pairs of stars, and telegraphic communication with Washington and Cambridge.

I. PERSONNEL:

Director, L. M. RUTHERFURD.

Assistant, D. C. CHAPMAN.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Maker, STACKPOLE; aperture, 3 inches.

Only used for time.

(*c*) *Equatorial instruments:* Makers, Messrs. RUTHERFURD & FITZ, aperture of objective, 13 inches.

(*c′*) The telescope has been employed mostly in photographing the sun, moon, and groups of stars.

(*f*) *Chronographs:* MORSE.

(*g*) *Clocks:* Sidereal; Maker, DENT.

Location of observatory: (City) Northfield; (County) Rice; (State) Minnesota.

Name of observatory: OBSERVATORY of CARLETON COLLEGE.

Longitude from Washington, 93° 9′ 14″ approximately.

Latitude 44° 27′ 41″ approximately.

Longitude: Occultation of Jupiter's satellites. We hope soon to be determined telegraphically.

Authority for latitude and longitude: Observations with telescope taking a great number of measures of pairs of stars with micrometer according to Coast Survey practice.

I. PERSONNEL:

Acting Director, WILLIAM W. PAYNE.

Assistants: 1. A. C. WILSON.
2. W. T. BILL.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, FAUTH & Co., Washington; aperture, 3 inches; magnifying power, 60, 70, and 80 diameters.

(*c*) *Equatorial instruments:* Makers, A. CLARK & SONS, Cambridgeport, Mass.; aperture of objective, 8¼ inches; magnifying powers of eyepieces, 50, 100, 200, 400, 800, besides a series of micrometer powers.

(*c′*) Portable equatorial: Makers, JOHN BYRNE, New York; objective, 4.3 inches clear aperture.

(*f*) *Chronograph:* An electro-magnetic instrument by A. CLARK & SONS.

(*g*) *Clocks:* 1 mean time; makers, E. HOWARD & CO., Boston; 1 sidereal; makers, E. HOWARD & CO., Boston.

(*h*) *Chronometers:* 1 sidereal; makers, W. BOND & SON, Boston.

(*i*) *Miscellaneous:* A partial outfit of metereological instruments.

III. OBSERVATIONS FOR THE PAST YEAR:

Instruments just received. No regular work in observatory yet undertaken, except the completion of a trial orbit for comet I of 1879.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

1. A series of double-star measures, to determine personal equation.
2. Observations on comets II and III, for 1879.
3. Observations of the planet Jupiter, respecting the color of disc.
4. Miscellaneous work, to aid State Astronomical Society; there being no other instrument equal to our equatorial in the State.

VI. ADDITIONAL INFORMATION:

One year ago our clocks were set and regulated; since that time we have had control of the time in this entire State, and parts also of Iowa, Nebraska, Kansas, Dakota, and Missouri. When full connections are made, our noonday signal is directly distributed over 1,285 miles of wire, thereby supplying each telegraphic station in all this wide area with the daily time of our meridian. All the railroads (I believe) and the principal cities adopt our time.

[Extracts from previously-published information.]

"CARLETON COLLEGE.—PLAN OF INSTRUCTION AND ORIGINAL WORK

The main building of the new observatory is now completed, and is 20 feet square and 32 feet high. There are two wings, each 12 by 15 feet and 9 feet high, with flat roof. The east wing is for the astronomical library and the observer's study. The west wing is used for the transit room only. On the first floor of the main building is the instrument case, table for chronograph, pier for astronomical clocks, and circular stairway leading to the equatorial room in the dome.

The central equatorial pier starts 9½ feet below the ground, has a footing of large flat stone, is built circular, with a diameter 8 feet, and is laid of solid masonry in cement to a height of 5 feet above the ground. From the footing it is curbed with dry stone way to the surface of the ground, that it may stand independent. Above it is built of brick in circular form to the upper surface of the second floor, and capped with a stone 3½ feet in diameter and 8 inches thick. The entire height of the pier is 26 feet. The pier for the transit instrument is made in a similar manner, except that it is rectangular in shape.

The second story of the building is devoted to the equatorial room, which is circular, and 16 feet in diameter inside. It is also a little more than 16 feet from the floor to the highest point of the dome. The dome is a hemisphere, and rests on twelve sheaved rollers, and is revolved by machinery at the pleasure of the observer.

The transit is already received. It was made by Messrs. Fauth & Co., of Washington, at a catalogue price of $900. Its telescope has 3 inches clear aperture and 3½ feet focal length. It has a striding level reading to seconds of arc, a 6-inch setting circle with level alidade on axis divided on silver and reading to thirty seconds, glass micrometer instead of spider lines, illumination on the new plan through the axis with side reflector, so as not to interfere with the object rays. The clamp is of the improved Davidson form. One of the Y's can be moved in azimuth and the other in altitude. The transit is also provided with a neat and convenient reviewing apparatus that will add much to facility in work. Before the instrument was shipped from Washington it was tested by Professor Hilgard, one of the leading officers of the Coast Survey, who acted as chairman of the committee of judges on astronomical instruments at the late Centennial Exposition. He pronounces the transit excellent in design and finish.

The observatory will be provided with two clocks, a sidereal and a mean time, costing about $500 each. The former is already in place and nearly regulated. The latter is expected daily.

A 4-inch equatorial portable instrument has been ordered, at a cost of about $400. Correspondence is now being had respecting the purchase and making of a large 8½-inch equatorial instrument. It is to be mounted in the best style, and to be provided with a driving clock. It cannot be completed in less than six months, and therefore may not be received until late this fall. It is, however, hoped that it may be secured and set ready for use this coming winter. Its cost will not vary much from $3,000.

CARLETON COLLEGE TIME SIGNALS.

Few of those who have visited the observatory of Carleton College, in our city, have definite knowledge of the system of daily time signals which are given from it. Very little has been written or published respecting the details of regulating the time by astronomical observations, or of the noon-day distribution of it over the vast area of portions of six different contiguous States.

It is not our purpose now to describe either branch of this practical or useful work to which the instruments of the observatory have been mainly devoted for the five months since it was erected, but rather to mention a few facts respecting the time signals that have been noticed by friends of the institution who have asked for a brief statement of them for publication.

The observatory is connected with the main line of the Northwestern Telegraph Company, and hence may use, at pleasure, either the commercial or the railroad line for communication with any distant points. By courtesy of the officers of the telegraph company our branch line was erected and a complete set of instruments supplied for the observatory office.

The mean-time regulator of the observatory, by great care, is kept accurately in true time. To be assured of this frequent time star-observations are taken by which the error and rate of the sidereal regulator are known. The mean-time is deduced from this, and any needed correction of the mean-time clock is made by an ingenious magnetic attachment which is controlled by an electric current at the pleasure of the person in charge.

Daily, at three minutes before noon, the mean-time clock, which is provided with an electrical attachment, is connected with the telegraph lines of the Chicago, Milwaukee and Saint Paul Railroad, and from this line to the Saint Paul and Sioux City Railroad, and nearly all others in the State and some out of it. The clock is so constructed that it will give its own signal so as to be understood at the most distant points where line-connections are made. As an example of the facility and extent of the daily time signals which the observatory regulator furishes, we will quote from a letter recently received from our friend, W. H. Drake, of Saint Paul, train-dispatcher of the Saint Paul and Sioux Railroad:

Monday, 17th, your clock beat time for 1,285 miles of line wire through (near as I can count it) 157 instruments. Where the Milwaukee and Saint Paul line via Mason City crosses our line at Sheldon, Iowa, our instruments are on the same table. The stroke of the clock comes to each of them alike. Monday, Kansas City was the terminus. The stroke sounded in Minnesota, Iowa, Dakota, Nebraska, Kansas, and Missouri. When I can arrange with the Union Pacific for some fair day we will try to compare time with the Pacific coast. They have been ready twice, but did not give sufficient time to arrange with you.

This single incident will serve to show the wide sphere of usefulness and of influence which the college has and may hold if it can carry out plans of work already well begun."—(*Rice County Journal.*)

Location of observatory: (Near) Oxford; (County) Lafayette; (State) Mississippi.

Name of observatory: UNIVERSITY OF MISSISSIPPI.

Longitude from Washington, W. 0^h 49^m $55^s.03$.

Latitude N. 34° 22′ 12″.64.

Authority for latitude and longitude: R. B. FULTON.

I. PERSONNEL:

Director, R. B. FULTON.

II. 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 instruments:* Makers, B. PIKE & SONS; aperture, 2¼ inches.

(*c*) *Equatorial instruments:* Maker, MERZ, of Munich; aperture of objective, 4½ inches; magnifying powers of eye-pieces, 96 to 312 diameters.

(*d*) *Spectroscopes:* 1 KIRCHHOFF'S 4-prism table spectroscope.

(*g*) *Clocks:* 1 mean time; makers, RITCHIE & SONS, Boston.

(*h*) *Chronometers:* 1 sidereal; makers, WM. BOND & SON, Boston.

III. OBSERVATIONS DURING THE PAST YEAR:

From January 1, 1878 to July 1, 1879.

(*a*) Determination of latitude.

(*b*) Determination of local time.

(*c*) Transit of Mercury, May, 1878.

(*h*) Local time and transit of Mercury.

VI. ADDITIONAL INFORMATION:

Transit of Mercury duly observed and report transmitted to Naval Observatory and published in Appendix II to Washington Observations for 1876.

Location of observatory: (City) Phelps; (County) Ontario; (State) New York.

Name of observatory: RED HOUSE OBSERVATORY. (Private.)

Longitude from Washington: Recent surveys make it very close to the Washington meridian.

Latitude, 42° 58′.

I. PERSONNEL:

Director, WM. ROBT. BROOKS.

Assistant, Mrs. MARY E. BROOKS.

II. INSTRUMENTS:

(*i*) *Miscellaneous:* Instruments used are a 2-inch refractor, 36 inches focal length, mounted as altitude-azimuth; magnifying powers 30, 45, 100 diameters; objective imported; mounted by the observer. A 5-inch aperture silver-on-glass Newtonian reflector, 50 inches focal length, altitude-azimuth mounting; magnifying powers, 40, 60, 140 diameters; made by the observer.

III. OBSERVATIONS DURING THE PAST YEAR:

From September 1, 1878, to September 1, 1879.

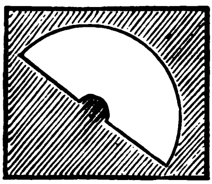
My observations have been mainly of sun-spots, planetary phenomena, and comet-seeking, using both instruments, but chiefly the reflector for sun-spots and comet-seeking. Have made several observations of SWIFT'S comet (No. 1 of 1879); PALISA'S (No. 2); and HARTWIG'S (No. 3) has been seen by glimpses.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–80):

A continuation of the work of the past year is intended for the coming year, especially that of sun-spots with the 5-inch reflector, and watching for the transits of inter-mercurial planets, and also comet-seeking and locating new nebulae. To the better fitting of myself for comet-seeking I propose to construct, the coming winter, a new reflector of 10 or 12 inches aperture and short focal length.

VI. ADDITIONAL INFORMATION:

Several descriptive articles of the new comets of SWIFT and PALISA, planetary phenomena, and sun-spots, in the daily press (principally Rochester, N. Y., Democrat and Chronicle), the Phelps Citizen (weekly), and the Scientific American.



Last September, while observing Mercury one morning at the time of its conjunction with Venus, I observed a dark semicircular notch out of the illuminated portion of Mercury, near the middle of the terminator, report of which was sent to the Naval Observatory. It occurred to me as having a connection with the *bright* spot seen on Mercury at the time of its last transit (seen independently by myself as well as many others), and as confirming PROCTOR'S notion of a hole through Mercury.

Location of observatory: (City) Providence; (County) Providence; (State) Rhode Island.

Name of observatory: SEAGRAVE OBSERVATORY.

Longitude from Washington, E. $0^h\ 22^m\ 34^s.51$.

Latitude, $41^\circ\ 49'\ 46''.4$.

Authority for latitude and longitude: United States Coast Survey and ourselves.

I. OBSERVERS:

F. E. SEAGRAVE and LEONARD WALDO.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS; aperture of objective, 8 inches; magnifying powers of eyepieces, 1, 122; 2, 245; 3, 367; 4, 489; 5, 611.

(*d*) *Spectroscopes:* 1 spectroscope having a system of four whole and two half prisms of 60° flint glass, which gives a dispersive power of ten prisms, by reflection.

(*g*) *Clocks:* 1 sidereal.

(*h*) *Chronometers:* 1 sidereal; maker, VICTOR KULLBERG, London.

III. OBSERVATIONS DURING THE PAST YEAR:

From August 1, 1878, to August 1, 1879.

(*a*) Observations of *0* Cassiopeæ to investigate its large proper motion, and if possible to determine its parallax.

(*e*) (*c'*) Observations of the satellites of Saturn.

(*d*) Observations of a few double stars discovered by S. W. BURNHAM, Esq., of Chicago.

Location of observatory: (City) Rochester; (County) Monroe; (State) New York.

Name of observatory: "WARNER OBSERVATORY."

Longitude from Greenwich, 77° 51′.

Latitude, 43° 8′ 17″.

Authority for latitude and longitude: Signal Service officer.

I. PERSONNEL:

Director, LEWIS SWIFT.

II. INSTRUMENTS:

(*c*) *Equatorial instruments:* Makers, ALVAN CLARK & SONS (constructing) aperture of objective, 16 inches; magnifying powers of eyepieces, from 45 to 2,000.

(*c′*) Altitude azimuth 4½ inches, by FITZ; powers from 25 to 432.

III. OBSERVATIONS DURING THE PAST YEAR:

(*c′*) Almost exclusively in charting nebulæ and searching for comets. Comets I (SWIFT'S), II (PALISA'S), and III (HARTWIG'S) were severally observed. Several nebulæ heretofore overlooked have been found and recorded. The "brick-red" spot on Jupiter and changes in the color of his belts have been observed.

IV. WORK PROPOSED FOR THE COMING YEAR (1880):

With 16-inch equatorial, when mounted (about July 1), discovering, observing, and cataloguing nebulæ on moonless nights, and on double-star work when moon interferes with nebular work. The solar disk will receive a share of my attention with a view to detect the transits of intra-mercurial planets. With 4½-inch, comet-seeking as heretofore.

VI. ADDITIONAL INFORMATION:

During the year I have discovered one new comet (Comet I, 1879), viz: on the morning of June 17, civil time, with elements unlike any heretofore recorded. At the time of discovery I suspected its cometary character, but soon clouding up I was unable to decide it until the morning of the 21st. Immediate notification was given to Professor BAIRD, who caused its discovery and its position to be cabled to Europe. The customary notifications were also given to astronomers in this country. It was a faint comet during the whole period of its visibility. I several times lost and recovered it, and by determined effort was able to observe it as late as September 17–18, after which I was unable to follow it.

Location of observatory: (City) Saint Louis; (County) Saint Louis; (State) Missouri.

Name of observatory: WASHINGTON UNIVERSITY OBSERVATORY.
Longitude from Washington, W. 0^h 52^m $37^s.02$.
Latitude, N. 38° 38′ 3″.64.

Authority for latitude and longitude: A pier about 150 feet away from the observatory pier was located by HARKNESS and EIMBECK (1870). A survey was made by me from that pier to the new one.

I. PERSONNEL:

Director, J. K. REES.
Assistant, E. A. ENGLER.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Maker, WÜRDEMANN; aperture, 2.65 inches; magnifying power, 90 diameters, with micrometer attachment.

(*c*) *Equatorial instruments:* Maker, H. FITZ, of New York City; aperture of objective, 6¼ inches; magnifying powers of eyepieces, 76, 125, 190, 305, and 456 diameters.

(*c′*) *Finder:* $2\frac{8}{100}$ inches aperture; magnifying power, 23 diameters.

(*d*) *Spectroscopes:* One single prism BROWNING spectroscope.

(*e*) *Photometers and other subsidiary apparatus:* Filar position, micrometer attached; clock work for moving telescope.

(*g*) *Clocks:* Mean time; common tower clock.

(*h*) *Chronometers:* Mean time; makers, (1) DENT No. 2749, (2) BLACKIE No. 789.

(*i*) *Miscellaneous:* Sextant, by BLUNT, of New York City.

III. OBSERVATIONS DURING THE PAST YEAR:

(*b*) Observations of time stars. We furnish the time to 30 different points in the city. These points are connected by wire with our tower clock. Senior class study appearance of planets, Sun, and Moon. Some double stars measured.

(*i*) Used in class instruction and when the transit cannot be employed.

IV. WORK PROPOSED FOR THE COMING YEAR (1879-80):

(1) To continue the time service and to extend it.

(2) Measurements of double stars.

VI. ADDITIONAL INFORMATION:

The only papers which we have published are:

(1) Outlines of work done by the Fort Worth solar eclipse party. (Proceedings A. A. A. S., 1879.)

(2) Report of personal work at Fort Worth in vol. "Report of the observations of the total solar eclipse July 29, 1878, made at Fort Worth, Texas, 1879."

Location of observatory: (City) San Francisco; (County) San Francisco; (State) California.

Name of observatory: LICK ASTRONOMICAL DEPARTMENT OF THE UNIVERSITY OF CALIFORNIA.

VI. ADDITIONAL INFORMATION:

The "additional information" comprises the whole of what I am able to report concerning the "Lick Astronomical Observatory."

During this summer temporary accommodations have been erected at Mount Hamilton (observatory site), Santa Clara County, California, including a snug little house with revolving dome and masonry pier, upon which Prof. S. W. BURNHAM has a 6-inch equatorial mounted and at work with clock, micrometer, etc.

Professor BURNHAM is making various experiments to test the capabilities of the position as a place of observation, and his report will no doubt be received with eager interest.

The preliminary steps above indicated comprise the work of practical advancement so far as accomplished during the past year, being, it is hoped, a commencement of more effective progress.

Location of observatory: (City) South Bethlehem; (County) Northampton; (State) Pennsylvania.

Name of observatory: SAYRE OBSERVATORY.

Longitude from Washington, 6^{m} $40^{s}.19$ east.

Latitude, $40°$ $36'$ $23''.89 \pm .036$.

Authority for latitude and longitude: For longitude, Appendix I, Washington Observations 1875. Latitude, Ast. Nach., No. 2260.

I. PERSONNEL:

Director, C. L. DOOLITTLE.

II. INSTRUMENTS:

(*a*) *Meridian circles:* None.

(*c*) *Equatorial instruments:* Makers, CLARK & SONS; aperture of objective, 6 inches; magnifying powers of eyepieces, 12 to 225.

(*g*) *Clocks:* Sidereal; makers, BOND & SON.

(*i*) *Miscellaneous:* A portable transit instrument by STACKPOLE, a zenith telescope by BLUNT, and a prismatic sextant by PISTOR & MARTIN.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*) The field instruments are designed for the use of students in astronomy of the university, and have been employed to good purpose by them

(*c*) (*c'*) With the equatorial a series of measurements of Jupiter's satellites has been made; also a considerable number of eclipses and other phenomena of those satellites. A few observations of BRORSON'S comet were also made.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

The observations of Jupiter will be continued, and such attention given to comets, eclipses, or other special appearances as circumstances will permit.

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY DURING THE YEAR 1879:

1. C. L. DOOLITTLE, Observations of Jupiter's Satellites, published in Ast. Nach.

2. C. L. DOOLITTLE, Mean declinations and proper motions of 58 stars, and the latitude of the Sayre Observatory, in Ast. Nach., vol. 95, page 49.

Location: Tarrytown, Westchester County, New York.

Position: Latitude, 41° 04′ 21″ north; longitude, 73° 51′ 14″ west, Greenwich.

Authority: United States Coast Survey.

The instrumental outfit under my control is so meager and unimportant as not to warrant an entry under the headings given above.

The principal work done during the past year has been in connection with the observations taken at Central City, Colo., at the time of the solar eclipse of 28th July, 1878. As a member of the party in charge of Prof. E. S. HOLDEN, I determined the residuals between the times of observed contact and the instants obtained by computation from the lunar tables.

CHAS. H. ROCKWELL.

Location of observatory: (City) Poughkeepsie; (County) Dutchess; (State) New York.

Name of observatory: VASSAR COLLEGE.

Longitude from Washington, 12^m, $38^s.5$.
Latitude 41° 41′ 18″.

I. PERSONNEL:

Director, MARIA MITCHELL.

II. INSTRUMENTS:

(*a*) *Meridian circles:* 1; maker, YOUNG, of Philadelphia; aperture of objective, 3¾ inches.

(*c*) *Equatorial instruments:* Makers, object glass by CLARK; aperture of objective, 12¼ inches; magnifying powers of eyepieces, 200 to 600+.

(*f*) *Chronographs:* One.

(*g*) *Clocks:* One clock sidereal; makers, Bond & Son.

(*h*) *One chronometer:* Mean time; makers, Bliss & Creighton.

(*i*) *Miscellaneous:* Small telescopes; one by CLARK & SONS; aperture, 3 inches.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*) Observations for time.

(*c′*) Observations on planets, especially Saturn.

(*i*) Observations on Sun spots.

IV. WORK PROPOSED FOR THE COMING YEAR (18—):

The work proposed for the coming year is the same as given above.

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY DURING THE YEAR :

1. Maria Mitchell: Observations on the Satellites of Saturn; published in American Journal of Arts and Sciences, vol. xvii, June, 1879.

Location of Observatory: (City) Troy; (County) Rensselaer; (State) New York.

Name of Observatory: WILLIAMS PROUDFIT OBSERVATORY.

Longitude from Washington $13^m\ 27^s.5$ east (nearly).

Latitude 42° 43′ 52″.

Authority for latitude and longitude: Latitude determined by observations with the zenith telescope; longitude by signals from United States Naval Observatory.

I. PERSONNEL:

Director, Professor DASCOM GREENE.

Assistant, PALMER C. RICKETTS.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Makers, E. KÜBEL, Washington; aperture, 2.5 inches; magnifying power, 60 diameters.

(*b′*) Makers, PHELPS & GURLEY, Troy; aperture, 2 inches; magnifying power, 30 diameters.

(*c*) *Equatorial instruments:* Maker, HENRY FITZ, New York; aperture of objective, 3.5 inches; magnifying powers of eyepieces, 45 to 200 diameters.

(*g*) *Clocks:* Mean time; maker, STOKELL, New York; Howard, Boston.

(*h*) *Chronometers:* Sidereal; maker, J. FLETCHER, London.

(*i*) *Miscellaneous:* Sextant; TROUGHTON & SIMMS, London.

III. OBSERVATIONS DURING THE PAST YEAR:

From September, 1878, to September, 1879.

(*a*) Besides regular transit observations for time, by the director and assistant, the instruments have been used by the senior class of the Rensselaer Polytechnic Institute, for practice in astronomical observation.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80).

This is expected to be similar to the work of the past year.

Location of observatory: (City) Washington, District of Columbia.

Name of observatory: UNITED STATES NAVAL OBSERVATORY.

Longitude from Greenwich $5^h\ 8^m\ 12^s.09$.

Latitude +38° 53′ 38.8″.

I. PERSONNEL:

Director: Rear-Admiral JOHN RODGERS, U. S. N.

Assistants:
1. Prof. A. HALL.
2. Prof. W. HARKNESS,
3. Prof. J. R. EASTMAN,
4. Prof. E. S. HOLDEN,
5. Prof. E. FRISBY,

} *Professors U. S. Navy.*

6. Mr. A. R. SKINNER,
7. Mr. H. W. PAUL,
8. Mr. H. S. PRITCHETT,

} *Permanent Assistant Astronomers.*

9. Mr. J. A. ROGERS,
Temporarily employed in photographic experiments.
10. Mr. W. F. GARDNER,
Instrument-maker.

II. 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 eyepieces, 126 to 1600.

(*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.

III. OBSERVATIONS DURING THE PAST YEAR:

(*a*) American ephemeris and miscellaneous stars; south stars of the B. A. C., many asteroids, and the Sun, Moon, and planets.

(*b*) The transit and mural and prime vertical transit are now out of use.

(*c*) Double stars, satellites of Mars, Saturn, Neptune, and Uranus, and nebulæ.

(*c′*) Occultations; and the finding of asteroids preparatory to their observation by the transit circle.

(*i*) A series of daily photographs of the sun and photographic experiments looking to eclipse-photography.

IV. WORK PROPOSED FOR THE COMING YEAR (1879–'80):

The same as in former years.

V. PRINCIPAL PUBLICATIONS OF THE OBSERVATORY:

Report on the Transit of Mercury, 1878.
EASTMAN, Meteorological Observations, 1876.
EASTMAN, Meteorological Observations, 1877.

VI. ADDITIONAL INFORMATION:

[The following is a short abstract of the annual report of the Superintendent of the Observatory to the Chief of the Bureau of Navigation, and in it will be found details additional to the information presented above.—E. S. H.]

UNITED STATES NAVAL OBSERVATORY,
Washington, October 20, 1879.

* * * * * * *

"I strongly recommend the removal of the institution to a better site. The present grounds are malarious, the river fogs obscure the vision, rendering it less clear than in a position more removed from the water. When the contemplated improvements are made on the river front, which seem only the question of a short time, when the marsh, partly encircling the observatory, is filled in, and the hill on which the buildings rest is used as a top-dressing to the land thus acquired, this part of the city will be the center of its water commerce, and its value to the government will be greater than the cost of a new situation for the observatory. It thus seems that when the hill is cut down the selection of a new site will be imperative. It will be better to select this new site now, for the cost will be greater in the future."*

THE 26-INCH EQUATORIAL.

The observers on this instrument have been the same as in the preceding year, namely, Prof. ASAPH HALL, in charge, and Prof. EDWARD S. HOLDEN, assistant. This instrument is now in good order, and is in constant use. The principal work done with it by the astronomers during the year is as follows:

The satellites of Saturn were observed until December 24, 1878. We have now accumulated a large number of observations of the three outer satellites of Saturn; and these observations ought to be completely reduced and discussed for the purpose of determining more accurately the orbits of these satellites and the mass of the planet.

The principal series of observations with this instrument are the observations of double stars by Professor HALL. The thirty stars selected by STRUVE for the comparison of micrometrical measurements by various observers have each been observed eight nights on an average. This work may now be considered as finished.

*NOTE.—An appropriation of $75,000 has been made to purchase a new site.

In August last the Naval Observatory was honored by a visit from the distinguished director of the Pulkowa Observatory, Mr. OTTO VON STRUVE, and his son Mr. HERMANN STRUVE, who came for the purpose of examining our large telescope, with the view of purchasing a still larger one for the Imperial Observatory at Pulkowa. I am happy to say that the performance of our telescope was found satisfactory by so competent and experienced a judge, and that Mr. STRUVE has ordered a 30-inch objective from Messrs. ALVAN CLARK & SONS, the makers of our instrument.

THE TRANSIT CIRCLE.

This instrument, under the direction of Prof. J. R. EASTMAN, assisted by Prof. EDGAR FRISBY, and assistant astronomers A. N. SKINNER, H. M. PAUL, and H. S. PRITCHETT, has been employed in observations of—

(1.) Stars of the American ephemeris, for clock and instrumental corrections.

(2.) Sun, moon, major and minor planets.

(3.) Stars whose occultations were observed in connection with observations of the Transit of Venus in 1874.

(4.) Standard stars for a catalogue of zone observations.

(5.) Stars of the British Association Catalogue between 120° 0′ and 131° 10′ N. P. D.

(6.) Stars used in observations of comets with the 26-inch and 9.6-inch equatorials.

(7.) Stars used in the determination of latitude by the United States Coast and Geodetic Survey, the Lake Survey, Capt. G. M. WHEELER'S survey, and by Lieut. Commander F. M. GREEN in surveys in the West Indies.

(8.) Stars used by Mr. DAVID GILL, of the Royal Astronomical Society of London, in determining the solar parallax from observations of Mars with the heliometer.

The whole number of observations made with the transit circle since the last annual report is 4,100. Of these observations, 81 were of the sun; 61 of the moon; 130 of the major planets, and 146 of the minor planets.

The meteorological department is under the direction of Professor EASTMAN, and the usual observations, at intervals of *three hours*, have been made throughout the year.

The Observatory is responsible for the control, by means of the motor clock, of clocks in the State, War, Navy, and Treasury Departments; for furnishing accurate time-signals to the Western Union Telegraph Company, and for dropping the time-ball on the Western Union Telegraph Office in New York.

The facilities for controlling the clocks in the departments are now wholly inadequate; and a complete change will soon be made, which, it is hoped, will insure thorough and continuous control.

A change also in the method of transmitting time-signals and of dropping the Washington and New York time-balls is nearly completed, and will probably be in operation by the end of October.

PHOTO-HELIOGRAPHIC AND MISCELLANEOUS WORK.

Prof. WILLIAM HARKNESS reports as follows:

The photographs of the late Transit of Mercury were examined, and out of the whole number it was found that twenty-five of the Cambridge pictures, twenty-three of the Washington pictures, and sixty-four of the Ann Arbor pictures were sufficiently well defined for measurement. Accordingly, these one hundred and twelve plates have been read off, all but twelve being done in duplicate; and the computations, also in duplicate, have been nearly completed. About three months' work is yet required to determine from the photographs the final corrections to the right ascension and declination of Mercury.

The drawings of Mars, made by Professor HARKNESS during the opposition of 1877, have been transformed from the orthographic to Mercator's projection, and a map of the planet has been constructed. General tables have also been computed, which give directly the areographic latitude and longitude of the center of the disc of Mars, and the position angle of its axis as seen from the earth; the arguments being the geocentric right-ascension and north polar distance of the planet.

Mr. JOS. A. ROGERS has been employed under a special appropriation for experiments in astronomical photography, and has spent most of his time in endeavoring to overcome the uncertainties of the emulsion process. Here it may be well to remark that our success in photographing the total eclipse of the Sun of July, 1878, was largely due to the excellence of the emulsion which he furnished; and the future of astronomical photography seems to a great extent dependent upon the emulsion process. Hence the importance of the experiments in which Mr. ROGERS is engaged. He has also photographed the Sun on every clear day, and has made numerous copies of the negatives of the corona taken during the eclipse mentioned above.

THE LIBRARY.

The library is in charge of Prof. EDWARD S. HOLDEN, in addition to his other duties. It is now in a satisfactory condition.

A card catalogue has been begun, and over 9,000 cards made. Part I of the catalogue of the Library "Astronomical Bibliography" will be printed in 1879.

A complete index to the publications of the observatory, from 1845 to 1875, has been made. It will be printed as Appendix I to the Observations for 1876. At intervals of ten years similar indexes should be made.

The usual annual appropriation of $1,000 for the purchase and care of astronomical works should be continued.

In this connection it may be said that our library is now the best astronomical library in the United States, and is constantly appealed to by persons not connected with the observatory. It is highly desirable that it should be still further increased, and that this valuable collection, which, if destroyed, could hardly be replaced, should be safely lodged in a fire-proof room.

CHRONOMETERS.

There are at the present time in the chronometer room one hundred and ten (110) mean-time chronometers.

A time-ball on the tower of the Western Union Telegraph Company's main building in New York City is dropped daily at New York, noon (except Sunday), from the chronometer-room. During the year this ball has failed to drop eight times; three, because wires were out of order at New York; once, on account of the wire insulation here having been destroyed by lightning; three times, here, because of the mean-time clock having stopped, and the changing of wires while putting in instruments and telephones; and once, for which no cause could be found.

At Washington, noon, a time-ball is dropped from the staff on the dome of the observatory, and time-signals are transmitted to all parts of the United States.

The following paper by Prof. SIMON NEWCOMB, secretary of the Transit of Venus Commission, and charged with the preparation of the report, is herewith appended.

"The reductions of the Transit of Venus work are in the following state:

"Part I, containing a general discussion of the observations so far as to deduce equations of condition from them, is ready for the press.

"Part II, containing the reports of the observers and the observations made at the several stations, is also nearly ready.

"Part III, containing the discussion of the longitudes of the stations, from occultations, and other sources, is still incomplete and requires some examination from me, which I shall be unable to give it for two or three months to come.

"Part IV, which should contain the photographic plate-measures, is in the hands of Professor HARKNESS."

Location of observatory: Whitestone; (County) Queens; (State) New York.

Name of observatory: WILLETS POINT FIELD OBSERVATORY.

Longitude from Washington, east $13^m\ 04^s.57 \pm 0.14$.

Latitude, north $40^\circ\ 47'\ 20''$.

Authority for latitude and longitude: Observations with zenith telescope; telegraphic time signals from Washington.

I. PERSONNEL:

Director, General H. L. ABBOT, Corps of Engineers.

Assistants: Capt. A. M. MILLER, Corps of Engineers, and officers on duty with the battalion of engineers.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Maker, TROUGHTON; focal length, 30 inches; aperture, 2 inches; Russian transit, STACKPOLE & BRO.; focal length, 31 inches; aperture, 2½ inches; combined transit, and zenith teloscope, WURDEMANN; focal length, 30 inches; aperture, 2½ inches.

(*c*) *Equatorial instruments:* Maker, TULLEY; portable; focal length, 65 inches; aperture of objective, 3.8 inches; magnifying powers of eyepieces, 50 to 200; mounted on tripod with SMEATON'S block.

(*d*) *Spectroscopes:* 1; Chemical.

(*f*) *Chronographs:* Field pattern, made by NEGUS.

(*h*) *Chronometers:* Mean time; makers, ARNOLD & DENT (1). Sidereal; makers, BOND & SON (2); both with NEGUS break-circuit arrangement.

(*i*) *Miscellaneous:* 1. Zenith telescope, made by WÜRDEMANN, of latest pattern; magnifying power, 80 diameters; 2 STACKPOLE & BRO. sextants; 1 portable field transit, by STACKPOLE & BRO.; focal length, 24 inches; aperture, 2 inches.

III. OBSERVATIONS DURING THE PAST YEAR:

The object of the observatory is the instruction of junior officers of engineers on duty at the engineer school of application in practical fie'd astronomy, such as they may be called upon to practice on boundary geodetic surveys. The work has been directed accordingly.

IV. WORK PROPOSED FOR THE COMING YEAR:

As above.

Location of observatory: (City) Ypsilanti; (County) Washtenaw; (State) Michigan.

Name of observatory: Michigan State Normal School.

Longitude from Washington, 6° 32′ 30″ west.

Latitude 42° 13′.

Authority for latitude and longitude: J. C. WATSON.

I. PERSONNEL:

Director, LEWIS MCLOUTH, M. A.

II. INSTRUMENTS:

(*b*) *Meridian transit instruments:* Maker, GURLEY, Albany; aperture, 1½ inches; magnifying power, 30 diameters.

(*c*) *Equatorial instruments;* Maker, A. CLARK, Cambridgeport, Mass; aperture of objective, 4 inches; magnifying powers of eyepieces, 45, 90, 144, 210.

(*d*) *Spectroscopes:* BROWNING, London, 2 prism.

(*h*) *Chronometers:* 1 Sidereal; maker, NEGUS.

(*i*) *Miscellaneous:* Our observatory building will be completed this fall. No systematic work has been done. Our building is small, and its equipment is for instruction rather than investigation. I expect, however, to have a larger and better outfit in the course of this school year. As my time is largely taken up with the work of instruction in physics and in chemistry as well as in astronomy, I cannot expect at present to do much. I hope within the year to get a much better transit instrument. My equatorial is quite good—the one with which Professor WATSON made his observations on the supposed planet Vulcan.

ABSTRACTS OF REPORTS OF EUROPEAN OBSERVATORIES.

[Translated and condensed from the Vierteljahrsschrift of the German Astronomical Society by GEO. H. BOEHMER, Smithsonian Institution.]

BASEL.

(ED. HAGENBACH, Director of the Physical Institute.)

The principal instruments are: The equatorial, made by the "Société Genevoise pour la construction d'instruments de physique" mounted on an isolated pillar, under a movable dome of 5 metres diameter. The instrument is provided with a centrifugal regulator, constructed according to Prof. M. Thury's directions, with position micrometer, spectroscope, and camera obscura.

The meridian circle, constructed by the Société Genevoise, with 2½ objective, by C. A. Steinheil.

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.

BERLIN.

(Prof. H. FOERSTER, Director of the Observatory; Dr. TIETJEN, Director of the Computing Bureau.

The small meridian circle was used by Dr. Steinbrink, a volunteer observer, in comparison star determinations for planetary observations.

The large meridian circle was used to continue the observations of the 521 fundamental stars of the V. J. S. Catalogue and those of Mayer's catalogue. In connection with this a series of observations were made which served partly to determine star positions for the examination of the heliometers of the German transit of Venus and Mr. Gill's expeditions, and partly to examine certain systematic errors in observing.

For time determinations and position of instrument 858 stars were observed on 108 nights.

Observations were made for examination of the influence of the position of the head (north or south) in observations of stars near the zenith. For the same purpose 155 observations of right ascension were made at the request of Mr. Gill on 12 stars designated by him.

The spare time was principally employed in determining the definite position of the (521) Bradley stars, and their mean positions turned over to Professor Auwers. The catalogue containing the (2,100) observations is to be published by the observatory.

Dr. Knorre observed with the 9-inch equatorial on determination of positions.

The new micrometer for the measurement and registration of differences of declination, described by Dr. Knorre in vol. 93 (p. 363) of the Astronomische Nachrichten, was brought into service in determination of 572 stars.

The time-service has been continued. The results of the service carried on jointly by the Berlin, Königsberg, and Hamburg observatories will probably be published shortly.

The principal work of the computing bureau has been, as in former years, the publication of the Astronomisches Jahrbuch.

Of the ephemerides of the 529 stars of the Astronomical Society the volume for 1879 was published; 22 circulars (83–104) were issued, and in them will be found 43 computations of new elements and 62 ephemerides. Of the former 33, and of the latter 47, were computed in Berlin. Of the "Correspondenzen über Planetenbeobachtungen," Nos. 46–68 were issued.

UNIVERSITY OBSERVATORY, BONN.

(Professor E. SCHÖNFELD, Director.)

The progress of the work has been greatly retarded by the unfavorable state of the weather and by a change in the personnel. Dr. Seeliger resigned, and his place was occupied by Dr. Deichmüller, who again was succeeded by Mr. Emil Kaiser.

The meridian circle was used in observing 53 zones and adding some important fragments, containing 380 stars of comparison and 1,707 zone stars. Six hundred and twenty-seven zones have been observed.

The southern review with the Schröder telescope, Mr. Kerper assisting, resulted in the determination of 44,204 star positions, which were partly reduced to 1855.

One hundred and two special catalogues were commenced and 46 completed.

A catalogue of doubtful observations has been commenced, containing now 780 numbers.

State of work December 31, 1878.

1. Zones: 395, 6 hours, containing 189,606 star observations.
2. Computation of reduction tables: no arrears.
3. Computed star positions: 3,000 in arrears.
4. Special catalogues of 1^h and 1° extension: Commenced, 439; arrears, 65; mostly finished, 100; complete, 160; without any doubt, 22.
5. Distribution of the observations.

Quadrant.	I.	II.	III.	IV.	Total.
	Hours.	*Hours.*	*Hours.*	*Hours.*	*Hours.*
Northern third	37.9	41.8	46.7	47.9	174.3
Middle	19.2	11.8	24.0	26.1	81.1
Southern third	27.5	29.7	38.0	45.0	140.2
Total	84.6	83.3	108.7	119.0	395.6

Observations on the light of variable stars were made, and the transit of Mercury observed on the 6th of May.

UNIVERSITY OBSERVATORY, BRESLAU.

(J. G. GALLE, Director.)

Owing to a number of circumstances which prevented the purchase of new and improved instruments, the activity of the observatory, in an astronomical point of view, has been mainly confined to the instruction of the students of mathematics.

Regular observations, however, were made in meteorology, embracing a series of eighty-eight years (since 1791), to which were added, nine years ago, the daily records of the variation in the magnetic declination.

The works in progress are: A compilation and reduction of all the meteorological observations made at the observatory since 1791. This work also contains a compilation of geographical constants, topographical communications, and determinations of heights, and notes respecting the progress in astronomy in Silesia and elsewhere.

ROYAL OBSERVATORY, BRUSSELS.

(J. C. HOUZEAU, Director.)

The death of Mr. Ernest Quetelet has materially changed the programme of work of the observatory. Mr. Quetelet had, at the time of his death, commenced the last series of his work on stars with proper motion, an account of which work, commenced in 1848, was given by himself. Of the unfinished portion of the work the observations for 1876 are in the hands of the printer; the calculations of those for 1877 are well advanced, and the computation of those for 1878 will soon commence.

Meridian instruments were employed as follows: The mural circle to observe α and δ Ursæ minoris for the purpose of determining the latitude; the Gambey meridian transit to observe fundamental stars for time. Moon-culminating stars were observed for the determination of geographic longitudes. Telegraphic comparisons are being made with Greenwich.

The solar spectrum has been observed, and micrometric measurements made of certain double stars. The satellites of Jupiter were observed whenever the state of the sky permitted.

All the observations were made as accurate as the old instruments of the observatory permit, but it would be desirable to have them replaced by the new and improved ones now in course of construction.

PUBLICATIONS.—The "Annales de l'Observatoire" have been divided into 2 sections, the "Annales Astronomiques" and the "Annales Météorologiques." The first volume of "Annales Astronomiques" contains "Uranométrie Générale" and a compilation under the title, "Repertoire des Constants de l'Astronomie." The second volume contains the observations with the meridian instrument and with the mural circle, during the years 1873, 1874, 1875; physical observations of Mars during the opposition of 1877, accompanied by chromo-lithographed plates.

The first volume of the "Annales Météorologiques," about to appear, contains meteorological and magnetic observations made in 1876 and 1877.

"L'Annuaire" for 1879, and the catalogue of astronomical and meteorological books in the principal libraries of Belgium, have been published.

A law was passed on the 29th of March, 1877, directing the publication of a magnetic chart of the country. Observations for this purpose were taken on inclination, declination, and intensity, and the computations of the same are now in a well-advanced state.

DÜSSELDORF OBSERVATORY.

(DR. ROBERT LUTHER, Director.)

The isolation and strength of the old brick pillar carrying the 7[illegible] instrument, weighing 975 pounds, having become doubtful, a new [illegible] of basalt lava, resting on a foundation of brick, laid in cement, [illegible] erected. A satisfactory proof of the stability of this new pillar has [illegible] offered in the recent severe shocks of earthquake, which did not c[illegible] its isolation.

The fruitless searching for (118) Peitho and other not much ob[illegible] planets, and the alarming increase (now about 38) in the num[illegible] minor planets observed in only one opposition, induces me to ma[illegible] request that the observers may be assisted in future to overco[illegible] difficulties of finding them again by more exact opposition-ephe[illegible] and by the publication of several hundred special charts on the [illegible] the Paris charts.

In addition to the observations made for correction of instrum[illegible] time, 41 observations were made on 23 planets. Since 1847, 897 o[illegible]tions were made on 112 planets.

PRIVATE OBSERVATORY OF DR. EPSTEIN, FRANKFORT-ON-TH[illegible]

The work of continuing Herschel's sweeps, undertaken in Se[illegible] 1877, and reported upon last year, has been continued. In a[illegible] the 219 fields, 264 fields were swept and 5,831 stars counted. [illegible]ent state of the work is 483 fields and 13,500 stars. Observa[illegible] ouble stars and red stars. Saturn's satellites were observed ıts from the 30th of August.

GOTHA OBSERVATORY.

(Dr. A. Krüger, Director.)

e last report the observations of the zone stars between 55° and ·lination have been continued. Mr. A. Donner resigned his ; assistant, and was succeeded by Dr. L. de Ball. The num- ›s has been increased to 643, and the observations now number 'ne or two nights will be sufficient to close the series. The on of the observations was continued. The deduction of the ıd of the apparent declinations is nearly completed, as also ·eductions to the mean positions for 1875. A copy was made ıtion of the original observations. The original observations blished at the earliest possible moment.

HAMBURG OBSERVATORY.

(Dr. Georg Ruemker, Director.)

o prevailing unfavorable weather—only 181 nights during the r could be utilized, and in most cases only in part, for observ- work of cataloguing stars and nebulæ progressed but very e meridian circle was employed in observations on time and as of fixed stars and planets. Positions of nebulæ were de- with the equatorial.

fulness of the IV Division of the "Seewarte" (chronometer- stitute), which was placed under the observatory, has satisfac- eased. On occasion of the second competitive chronometer uted by the imperial navy department, 51 chronometers were by 12 German manufacturers, 7 of whom reside in Hamburg-

e signals had to be discontinued for some time on account of ;e done to the apparatus during the severe storm of March 8.)all stations at Cuxhaven and Bremerhaven have worked very ily.

Koch resigned his position, and was succeeded by Dr. Karl of O'Gyalla, Hungary.

KREMSMÜNSTER OBSERVATORY.

(G. Strasser, Director.)

idian circle was furnished with new microscope and new hor- rel.

ıtions on the Moon and moon-culminating stars were continued. ry observations were made partly with the meridian instru- partly with the refractor.

Uranus, Jupiter, and Neptune, were observed with the meridian circle.

Observations were made on 12 minor planets.

Fifty comparison stars of planets were determined with the meridian circle, for which purpose 160 positions had to be taken. A large number of positions of fixed stars were observed, but have not yet been reduced.

The transit of Mercury was invisible on account of clouds, and the same occurred on occasion of the eclipse of the Pleiades.

UNIVERSITY OBSERVATORY, LEIPZIG.

(Prof. C. BRUHNS, Director.)

No change has taken place in the personnel. The following gentlemen are volunteer observers: Messrs. Gautier, Dr. Hilfiker, von Dankelman, Keiser, Meier, Regler, Schneider, and Schnauder.

The following instruments were procured: A Meyerstein universal instrument, used by Dr. Börger in his expedition to East Greenland; a new registering apparatus by Fuess, including a polarizing relay. Telephonic connection has been established.

Mr. Weinek, who is still engaged in the discussion of the photographic views of Venus, observed with the meridian circle, and Dr. Peter, with the equatorial: 23 stars in RA and Decl. were observed, and 12 stars in RA for a discussion by Mr. Gill. Minor planets were observed with the meridian circle.

Preparations and experiments were made for zone-observations. Mr. Weinek observed the transit of Mercury with the 6-foot refractor, and took 44 photographic views of the planet by means of the photoheliograph, which was used, in 1874, in Kerguelen Island.

Dr. Peter, with the equatorial, made in 99 nights, 181 observations on 51 minor planets and 12 observations on comparison stars.

Tempel's comet was invisible, and observations on Swift's comet failed on account of an error in the dispatch announcing the discovery.

The first contact in the transit of Mercury, an eclipse of the Moon, and eclipses of the satellites of Jupiter, were observed.

The changes supposed by Dr. Klein to have taken place in Hyginus in the Moon, failed to be detected in drawings made by Dr. Peter for the purpose.

Mr. Leppig, with a small Frauenhofer refractor, observed on sun-spots; he also observed the transit of Mercury, the eclipse of the Moon, etc.

Mr. Schneider practiced with the 6-foot refractor and made drawings of nebulæ. Mr. Dietrich examined the photometer, but did not complete a series of observations.

The first volume of the "Leipzig Beobachtungen" will be published shortly.

METEOROLOGICAL WORK.—The greater part of the observations with self-registering instruments were reduced by Mr. Leppig. The results of the tri-daily observations were published in the annual report of the Leipzig Geographical Society. The volume containing the tri-daily observations of all stations will be published shortly. Telegraphic observations were sent to General Myer, in Washington. Mr. von Dankelman is in charge of the Bureau for Weather Prognostics.

MISCELLANEOUS.—Mr. Weinek, assisted by Mr. Regler, and Dr. Hilfiker, has continued the reductions of the transit of Venus.

Mr. Harzer's time and geographical determinations of the Venus expedition, were revised by Mr. Schneider, and are nearly ready for publication.

UNIVERSITY OBSERVATORY, LUND.

(Professor AXEL MÖLLER, Director.)

The refractor was used by Dr. Dunér on making observations on double stars; U. Geminorum and V. Coronæ were observed by him systematically and over 1,500 spectroscopic observations made.

Dr. Lindstedt determined comparison stars for the refractor observations.

Observations for the zone + 35° to + 40° were commenced and continued during the second half of the year. The programme contains 11,200 stars, of which, owing to unfavorable weather, only 1,183 could be observed.

UNIVERSITY OBSERVATORY, MANNHEIM.

(Dr. W. VALENTINER, Director.)

The observations on the cluster G. C. 4410, of which the densest portion had been previously observed, were extended farther to the north. Seventy-one stars were determined by observation of the differences of 3168 right-ascensions and of 1507 declinations. The second group G. C. 1166 contains 36 stars with observations of differences for 1570 right-ascensions and 594 declinations. The results of the observations on the above groups are in the hands of the printer, and expected soon to be ready for distribution.

Of group G. C. 1454, only a few measurements were obtained. Of this group 2 stars were noted as double stars (A. O.″ 5645 and—10^s,—1′.7).

Measurements in G. C. 1119 will be commenced shortly.

The reduction of the meridian observations of Barry has been printed in the "Jahresbericht des Mannheimer Vereins für Naturkunde" and distributed.

Money has been appropriated for the purchase of a transit instrument. The Reichenbach Repeating Circle is to be changed into a meridian circle.

UNIVERSITY OBSERVATORY, MILAN.

(Prof. M. SCHIAPARELLI, Director.)

During the year ill-health prevented the usual activity in the use of the refractor, and only 102 double stars were measured. No comet was observed. Advantage was taken of this inactivity to examine the periodic errors in the micrometer screw, which was done twice; the micrometer, meanwhile, being taken apart and cleaned. The errors discovered were very small, less than 0″.04.

The northern hemisphere of Mars being somewhat free of snow during first four months of 1878, I was able, in some measure to complete the topographical map of that planet made during the previous year. During the same period we observed the aspects of Venus, and made many sketches before and after the inferior conjunction. The results were not satisfactory, but we will continue observations for two other inferior conjunctions to have the aspect under all geocentric longitudes.

Professor Celoria has reduced the meridian circle observations made during 1871–'2. In the first six months of 1878 he made with this instrument 1,200 observations on stars of rapid movement and on the principal ones of the new doubles of Mr. Burnham. In the last six months the construction of the adjoining tower of the registering anemograph has prevented observations with the circle. In the mean time Professor Celoria devoted himself to preparing for publication his calculations of longitudes made in 1875, and continued his studies of ancient eclipses.

The determination of time for the use of the observatory and the city has been made by Dr. Frisiani—who also has charge of the meteorological observations—and assistant, Dr. Rajna.

A new equatorial refractor of 18 French inches aperture is being made for the observatory by A. Repsold, of Hamburg.

UNIVERSITY OBSERVATORY, MOSCOW.

(Dr. TH. BREDICHIN, Director.)

Professor Bredichin continued his spectroscopic observations of the Sun, observed on Jupiter, and made microscopic measurements of the star Algol and of some star-groups.

The tails of the following comets were computed by him: 1577, 1618 (3), 1665, 1807, 1811, 1823, 1835, 1843 (1), 1845 (3), 1853 (2), 1853 (3), 1853 (4), 1854 (2), 1854 (3), 1857 (3), 1858, 1860 (3), 1862 (2), 1863 (4), 1877 (2), and a memoir published on comets.

Mr. Ceraski continued his photometric observations of stars.

Messrs. Belopolski and Socoloft observed the August meteors, and made a series of meridian observations of stars with independent motion, and examined the errors of the microscope and of the meridian circle.

Mr. Belopolski continued his photographic observations of the Sun.

ASTRO-PHYSICAL INSTITUTE, POTSDAM.

The buildings are progressing and some of them are being occupied, temporarily, by the laboratory and the library. A temporary structure was erected in 1874, for heliographic experiments.

The erection of the large refractor has to be delayed until next spring. The optical parts of the heliograph were purchased. Of smaller instruments were purchased:

A telescope by Schroeder $0^m.078$ aperture and $0^m.84$ focal distance; a comet-seeker of $0^m.076$ aperture; a 12-inch universal instrument by Repsold; a 5-inch reflector by Pistor and Martins; a $\frac{3}{4}^s$ clock by Tiede; a small star-spectroscope and an astatic mirror-galvanometer by Siemens and Halske.

For time-determinations a small transit was borrowed of the Berlin-Observatory.

Dr. P. Kempf, of Berlin, has been employed as assistant.

The observations on sun-spots and protuberances were continued by Professor Spörer, assisted by Dr. Kempf. No spots were visible in 173 days out of 245 days of observation.

The mean heliographic latitude of the spots amounted to $\pm 7°$ in the first four months, $\pm 9°$ in the second, and in the last four months they were visible only in the northern hemisphere. Only a small number of the days were favorable for protuberance observations. Professor Spörer completed the arrangement of the sun-spot observations for 1871–1873, and, assisted by Dr. Kempf, computed those measured in the years 1874–1878.

Dr. Vogel and Dr. Müller continued the examination of the solar spectrum.

Spectroscopic observations of fixed stars and nebulæ were made by Dr. Vogel. With the instruments employed could be seen those nebulæ mentioned by Herschel as "pretty bright," and under favorable conditions the observer could determine the character of the spectrum of the nebulæ termed "faint." Only 54 nebulæ spectra were examined.

The examination of the surfaces of planets was continued by Dr. Lohse with the 7½-inch telescope; 38 drawings were made of Jupiter and observations made on Saturn.

Dr. Lohse took photographic views of the Sun, a large number of which were made with a photographic telescope of $0^m.057$ aperture and $1^m.5$ focal distance. He also experimented in the laboratory on the new and, in astro-photography, important process of employing gelatine in place of collodion.

Dr. Müller made determinations of refraction in various kinds of glass intended for use in astronomical instruments. He also continued his photometric researches.

Observations were made on 63 days on Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, and Vesta, the comparison of which was made either direct or with Capella, and on fixed stars.

The time-determinations were made by Dr. Kempf with the refractor and by meridian observations with Ertel's transit.

The transit of Mercury was observed and the meteorological observations continued in the usual manner.

Publications of the Observatory.

1. Notices on observations of the new star in the Swan, by Dr. Vogel.
2. Report on the Transit of Mercury.
3. Observations on the sun-spots from October, 1871, to December, 1873, by Professor Spörer.
4. Observations and researches on the physical condition of Jupiter, and observations on Mars, by Dr. Lohse.
5. On the origin of protuberances by chemical processes, by Professor Spōrer.
6. Dr. Vogel's report on the observations of the solar spectrum is in press.
7. The star-group χ Persei, observed in the years 1867–1870 with the 8-inch refractor of the Leipzig Observatory, by Dr. Vogel.

UNIVERSITY OBSERVATORY, STOCKHOLM.

(Dr. Hugo Gyldén, Director.)

The work of the observatory has quite unexpectedly been interrupted by the sickness of the director and by the resignation of the assistants. At present the personnel is again complete, Mr. C. A. Lindhagen being first and Mr. H. Branting second assistant, with Mr. Rankin, of Helsingfors, assisting temporarily.

Examination was made of the error in the division of the meridian circle, mainly performed by Mr. Jäderin, and to be described by him in a special report.

The observations commenced in 1877, with the view of determining relative parallaxes by registration of differences of right ascension of stars close together, has to be delayed on account of the sickness of the director. The observations made thus far refer to the following stars:

α Cassiopeiæ.	ζ Herculis.
μ Cassiopeiæ.	β Lyræ.
β Andromedæ.	ν Lyræ.
ϑ Persei.	ε Cygni.
ι Persei.	61 Cygni.
α Persei.	ζ Cygni.
α Aurigæ.	τ Cygni.
No. 61 of Argelander's Catalogue.	No. 240 of Argelander's Catalogue.
β Aurigæ.	ι Andromedæ.

UNIVERSITY OBSERVATORY, STRASSBURG.

(Prof. A. Winnecke, Director.)

One hundred and seventy-eight observations on 118 nebulæ were made in 41 nights. A very considerable periodic variability of brightness was recognized in the nebula h 882 = H I. 20, and is very probable in nebula h 1061 = H IV, 56.

Sixteen observations were made of Nova Cygni. Not much progress was made in the comparative observations of double stars. The attendant of α Scorpii was observed on the 18th of July.

A series of observations was commenced on the double star Σ 1516.

The environs of Kepler's and Tycho's Nova were observed several times.

Of variable stars minima were observed by Dr. Winnecke of S Cancri, Algol, λ Tauri, U Coronæ, and the maximum of Mira Cetti.

Swift's comet could not be found; Tempel's periodic comet was seen on several occasions.

The conjuction of Mercury and Venus was observed on September 30.

Dr. Schür observed for time with Cauchoix's transit; 34 culminations of the first and 29 of the second limb of the moon were observed, and the opposition and quadratures of Jupiter, Saturn, Uranus, and Neptune.

Seventy-one comparison-stars were determined. Dr. Schur and Mr. Hartwig continue with the heliometer the series of measurements of the solar diameter; 54 measurements were obtained by Dr. Schur. The minimum of Algol was observed twice, that of λ Tauri once.

A series of observations with the large spectroscope was commenced on the refraction of the two kinds of glass employed by Merz in the construction of the 18-inch objective.

Mr. Hartwig obtained measurements with the heliometer of the polar-diameter of the sun on 103 days, and of the equatorial diameter on 106 days. The same instrument was employed by him to locate the moon's craters: Mösting A; Hypatia B; Lapeyrouse.

The diameter of Mars and Venus were measured 2 and 7 times, respectively; the distances of η, 17, and η, 27 Tauri observed in 7 nights, and the 5 star-distances in Cygnus 5 times each.

The heliometer was improved (by Messrs. Repsold) by a new position-circle.

The large comet-seeker was employed, Mr. Hartwig obtaining 2 maxima of R Vulpeculæ and T Herculis, maximum of V Cancri, S Coronæ, R Orionis, S and T Ursæ Majoris, R Aquilæ, R and S Herculis, R Draconis, S Geminorum, R Camelopardi; 2 minima of S Ursæ Majoris, and the minimum of R Draconis and minima of Algol.

Observations were made on transit of Mercury on the partial eclipse of the moon and the eclipses of the satellites of Jupiter.

The following instruments were purchased: A prism-circle by Steinheil, one Merz telescope of 101^{mm} aperture, one Plössl of 76^{mm} aperture, and a Paris theodolite which has been changed to a spectrometer. A 2-foot Leibherr repetition-circle was presented by Director Merz.

The buildings for the new observatory are well under way, and it is hoped that they will soon be ready for occupation.

IMPERIAL OBSERVATORY, VIENNA.

(Dr. E. WEISS, Director.)

Owing to financial complications less progress was made in the construction of the new observatory than was anticipated. The most important part of the work consisted in the erection of the large dome. The interior of the building is in a sufficiently advanced state to permit the occupation.

But little hope is entertained that the new meridian circle and the large refractor can be obtained this year. As a consequence the instruments of the old observatory, with the addition of a 11¾-inch Clark refractor and a 6-inch comet-seeker, will have to be used.

The activity in the old observatory was very limited. Dr. Holetschek determined with the meridian circle the position of those stars which were selected as fundamental points for the Vienna zones between $+15^\circ$ and $+18^\circ$ declination. He also observed a few asteriods.

Mr. A. Palisa continued the observations with the 6-inch refractor of the asteroids until August, when Mr. E. Glaser took his place. Comparatively small results were obtained.

Volume 27 of the Annales of the Observatory, published last summer, contains, besides a necrology of C. v. Littrow, the paths of 2,685 meteors and those of 1,175 meteors observed in Vienna between the years 1840–1845, not reduced and published before; and finally the meteorological observations of 1877.

Volume 28 of the Annales, just in press, will be devoted mainly to zone observations.

ASTRO-PHYSICAL OBSERVATORY, WILHELMSHAVEN.

(Dr. C. BÖRGEN, Director.)

The buildings were completed in July, 1878, and occupied in August.

The principal instrument is a meridian circle by Repsold of 120^{mm} aperture, 1.5^{m} focal distance, 2 circles of 0.5 diameter, and is furnished with level, 2 collimators of 67^{mm} aperture, and an artificial horizon.

The standard clock is one of Tiede's pendulums. A second clock of inferior quality is located in the chronometer room, and is used both for comparison of chronometers and as clock for the registering apparatus in the meridian room.

A Steinheil refractor of 3½″ aperture is used for astronomical observations, and some astro-nautical instruments for practice.

The observatory possesses meteorological instruments and a self-recording apparatus for tidal observations, a collection of such magnetic instruments as are used on shipboard, and a model for the study of the deviation of the magnetic needle produced by the iron of a ship.

The activity of the observation is fourfold:

1. Astronomical, including time-service.

2. Meteorological; the observations are being published monthly in the "Annalen der Hydrographie."

3. Physical, the registering of magnetic and tidal observations; and

4. Nautical, comprising the examination of chronometers and barometers, and the determination of the compass deviation on shipboard.

Tides have been observed at various places and the observations discussed. Only one series, the one of Wilhelmshaven, has been printed in the Annales; but as a result of the observations tidal tables for the Baltic Sea have been published by the hydrographic bureau of the imperial navy.

Time signals were received from the Berlin Observatory during the earlier stages of its time-ball service.

Observations with the meridian circle were made on the Moon and such objects as are connected with it, including Uranus and Neptune.

The meteorological observations have been continued uninterruptedly.

Observations are being made on declination, inclination, and intensity of the terrestrial magnetism.

The *personnel* of the institute has been increased by the appointment, as assistant, of Dr. Andries.

UNIVERSITY OBSERVATORY, ZURICH.

(Dr. RUDOLF WOLF, Director.

Observations on frequency of sun-spots were made whenever practicable, and the notes on sun-spot literature continued in the "Astronomische Mittheilungen." For determination of position of the spots, observations could be taken only on sixteen days, and were conducted by Mr. Alfred Wolfer.

Comparisons of Mairet's clock (standard) for sidereal time were made by Mr. Wolfer, who also recorded a number of observations with the equatorial and micrometric measurements, made 2 drawings of Venus, 52 of Jupiter, 18 of Saturn, and observed the transit of Mercury.

LIST OF ILLUSTRATIONS.

INDEX.