FOR·THE·INCREASE·AND·DIFFVSION·OF·KNOWLEDGE·AMONG·MEN·
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·SMITHSONIAN·INSTITVTION·
·WASHINGTON·1846·

ANNUAL REPORT

OF THE

BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION,

SHOWING

THE OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION

FOR THE

YEAR ENDING JUNE 30, 1900.

REPORT

OF THE

U. S. NATIONAL MUSEUM.

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Approved January 12, 1895.

"Of the Report of the Smithsonian Institution, ten thousand copies; one thousand copies for the Senate, two thousand for the House, five thousand for distribution by the Smithsonian Institution, and two thousand for distribution by the National Museum."

REPORT

OF THE

U. S. NATIONAL MUSEUM,

UNDER THE DIRECTION OF

THE SMITHSONIAN INSTITUTION,

FOR THE

YEAR ENDING JUNE 30, 1900.

REPORT OF THE U. S. NATIONAL MUSEUM FOR THE YEAR ENDING JUNE 30, 1900.

SUBJECTS.

I. Report of the Assistant Secretary of the Smithsonian Institution, with Appendices.

II. Papers describing and illustrating Collections in the U. S. National Museum.

UNITED STATES NATIONAL MUSEUM,
UNDER DIRECTION OF THE SMITHSONIAN INSTITUTION,
Washington, October 1, 1900.

SIR: I have the honor to submit herewith a report upon the present condition of the United States National Museum, and upon the work accomplished in its various departments during the fiscal year ending June 30, 1900.

Very respectfully,

RICHARD RATHBUN,
Assistant Secretary.

MR. S. P. LANGLEY,
Secretary, Smithsonian Institution.

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PART I.

REPORT

UPON THE

CONDITION AND PROGRESS OF THE U. S. NATIONAL MUSEUM DURING THE YEAR ENDING JUNE 30, 1900.

BY

RICHARD RATHBUN,

ASSISTANT SECRETARY OF THE SMITHSONIAN INSTITUTION.

REPORT

UPON

THE CONDITION AND PROGRESS OF THE U. S. NATIONAL MUSEUM DURING THE YEAR ENDING JUNE 30, 1900.

BY

RICHARD RATHBUN,
Assistant Secretary of the Smithsonian Institution.

GENERAL CONSIDERATIONS.

The act of Congress of 1846 establishing the Smithsonian Institution made it the legal place of deposit for all "objects of art and of foreign and curious research, and all objects of natural history, plants, and geological and mineralogical specimens belonging to the United States," and thereby created, in fact if not in name, a national museum. With extraordinary foresight the same act provided for additions to the national collections by exchange, donation, or other means, and for the arrangement and classification of the specimens in a manner best to facilitate their examination and study, all in such broad and comprehensive terms as to cover the full activities of a great establishment of this kind.

The Smithson fund at that time amounted to about half a million dollars, a sum then considered ample to meet the needs of the multifarious operations upon which it was proposed that the Smithsonian Institution should enter. In 1846 probably not more than one or two universities or learned establishments in America had so large an endowment, and it was apparently the idea of Congress that the fund was sufficient both for the erection of a building and for the care of the collections which would be turned over to it or acquired by the national surveys and in other ways. The Museum thus began as an integral part of the Institution, coordinate with its library, and was required by law to provide for the Government collections which had previously accumulated, a duty which the Institution did not see its way clear to fulfill until 1858, when Congress began to make small yearly appropriations for the purpose. So inadequate, however, were the sums voted, that for many years the slender income of the Institution was heavily drawn upon to insure the maintenance of what was then called the Smithsonian Museum, and justly enough, since the building was paid for out of the Smithson fund, a considerable portion of the collections were and still are the actual property of the Institution, through exploration, gift, and purchase, and at least a number of the officials in charge of the collections were employed at its expense.

The title "National Museum," first recognized by Congress in 1875, came into general use through the display of the Government collections at the Centennial Exhibition at Philadelphia in 1876. This was the first exposition in this country in which the Government participated, and the first to make known to vast numbers of the people of the United States the existence of national collections at Washington, as well as new methods of installing and exhibiting museum materials, differing radically from the older cabinets of college or local museums which prevailed up to that time. After its close the material brought back belonging to the Government, together with the extensive gifts made to the United States by private persons and foreign governments, forced the erection of a separate building, which brought the name "National Museum" into greater prominence. Since that time Congress has in the main provided for the maintenance of the Museum, but its management remains, by the fundamental act, under the authority of the Regents of the Smithsonian Institution, administered through their Secretary, who is ex officio the keeper—a form of government insuring a consistent and uniform policy and a nonpartisan administration of its affairs. The greater part of the Smithsonian building is still used for museum purposes, and the Institution, as well as all the scientific bureaus at Washington, cooperate, both through men and material, in enlarging and caring for the national collections.

With the primary object of preserving the collections in anthropology, biology, and geology obtained by the Government surveys, and of arranging them in a manner convenient for study, every effort is made to complete the representation in all departments of science and the arts capable of being illustrated in a material way. Extensive series of specimens, selected with reference to their educational value and the popular interest they may excite, and bearing appropriate labels, are exposed to view in the public halls. The duplicate specimens are made up into sets for exchange and for distribution to schools and colleges throughout the country. Papers descriptive of the collections, both technical and popular, are published for gratuitous circulation to the extent of three or more volumes yearly; and, finally, the Museum has come to be regarded as a sort of bureau of information, being constantly called upon to answer questions relating to every subject with which it might, in the remotest degree, be concerned.

The first scientific collection to come into the possession of the Institution—and, in fact, it accompanied the bequest—was the small but valuable mineralogical cabinet of James Smithson, the founder, who was himself a chemist and mineralogist of repute, and a Fellow of the Royal Society of London. Some six years before the Institution had been formally established, however, a society was organized in Washington under the name of the National Institution, afterwards changed to the National Institute, which had for its avowed purpose the direction of the Smithson bequest and the pursuit of objects in consonance with the terms of that foundation. One of these objects was the gathering of historical and natural-history specimens, from both official and private sources, prominent among the former having been the United States Exploring Expedition of 1838–1842. Rooms in the Patent Office building were secured for the museum of the society, which was virtually recognized as the appropriate place of deposit for all Government collections held in Washington, and here was actually accumulated the nucleus of the National Museum. Another important service rendered by the society was, as Doctor Goode has said, in the direction of educating public opinion "to consider the establishment of such an institution worthy of the attention of the Government of the United States." Failing, however, to secure the public recognition at which it aimed, the National Institute became inactive in 1846, though it continued in existence until 1861. The Government collections in its possession, which were practically in the care of the Commissioner of Patents, were turned over to the Smithsonian Institution in 1858. Other material directly under the control of the National Institute remained at the Patent Office until 1862, and a portion of the historical objects were retained there until 1883.

The discussion of plans for the organization of the Smithsonian Institution, which devolved upon its first Board of Regents, led in January, 1847, to the unanimous adoption of the following resolution expressing approval of the museum feature as one of its important functions:

Resolved, That it is the intention of the act of Congress, and in accordance with the design of Mr. Smithson, as expressed in his will, that one of the principal modes of executing the act and the trust is the accumulation of collections of specimens and objects of natural history and of elegant art, and the gradual formation of a library of valuable works pertaining to all departments of human knowledge, to the end that a copious storehouse of materials of science, literature, and art may be provided, which shall excite and diffuse the love of learning among men, and shall assist the original investigations and efforts of those who may devote themselves to the pursuit of any branch of knowledge.[1]

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[1] Report of committee on organization, p. 20.

The transfer of Government collections to the Institution was, in accordance with the Congressional act of 1846, to be effected "whenever suitable arrangements can be made from time to time for their reception." In the absence of any stated limitations as to the time or character of arrangements, the date for accepting the obligation rested with the Regents, who, while confronted with the mandatory language of the law, were still forced to recognize the inadequacy of the Smithsonian fund for the support of so large an undertaking. The cost of the large and elaborate building, designed mainly for the accommodation of the museum and library, would have drawn heavily upon the principal of the fund had not a policy of delay prevailed, and thus nine years were allowed to elapse between the laying of the corner stone, in 1846, and the completion of the structure. This delay gave opportunity for influencing a change in sentiment, so that when, in 1857, the necessary arrangements became possible, Congress was prepared to vote means for building cases, for transferring the specimens from the Patent Office, and to a certain extent for the care and preservation of the collections. The appropriations continued very small, however, for many years, during which the Institution was obliged to make up the deficit.

The vast amount of material secured for the Government at the close of the Centennial Exhibition of 1876, which impelled the erection of a second building, for the exclusive use of the Museum, resulted in a larger and more systematic organization. Twenty-five more years have now elapsed, noteworthy for extensive explorations and surveys both at home and abroad. Material has been pouring in from these in a never-ceasing flow, first filling far beyond their ordinary capacity the halls and storerooms of the two large buildings, and then requiring to a greater and greater extent each year the use of outside quarters for their mere shelter. The main buildings are essentially fireproof, but not so the others, containing collections valued at hundreds of thousands of dollars, which, through accident or maliciousness, might at any time be destroyed.

While the collections in the custody of the National Institute remained at the Patent Office until 1858, material for a museum was, in the meantime, being accumulated at the Smithsonian Institution. Reference has been made to the cabinet of minerals which had belonged to Smithson, unhappily destroyed by fire in 1865. The personal bent of Professor Baird, who became the Assistant Secretary of the Institution in 1850, was toward the collection of natural-history specimens for the purposes of study. With the approval of Secretary Henry, he put into operation plans for the accomplishment of this object, which, fostered and encouraged, were soon yielding regular and abundant returns. Professor Baird's own vacations were spent in field researches. Officers of the Army and Navy and of other branches of the Government service, fishermen, fur traders, private explorers, and such powerful organizations as the Hudson Bay Company and the Western Union Telegraph Company were enlisted in the cause and rendered valuable assistance. The influence exerted by these beginnings has been lasting and widespread, as shown in the extensive natural history operations of subsequent national and State surveys, the organization of the United States Fish Commission, and the support given to scientific collecting by many other bureaus of the Government.

Having as its first purpose the promotion of scientific research, next accepting the custody of the Government and other collections, and finally developing broadly along educational lines, the history of the National Museum may, as the late Doctor Goode has pointed out, be divided into three epochs, which he describes as follows:

> First, the period from the foundation of the Smithsonian Institution to 1857, during which time specimens were collected solely to serve as materials for research. No special effort was made to exhibit them to the public or to utilize them, except as a foundation for scientific description and theory.
>
> Second, the period from 1857, when the institution assumed the custody of the "National Cabinet of Curiosities," to 1876. During this period the Museum became a place of deposit for scientific collections which had already been studied, these collections, so far as convenient, being exhibited to the public and, so far as practicable, made to serve an educational purpose.
>
> Third, the present period (beginning in the year 1876), in which the Museum has undertaken more fully the additional task of gathering collections and exhibiting them on account of their value from an educational standpoint.
>
> During the first period the main object of the Museum was scientific research; in the second, the establishment became a museum of record as well as of research; while in the third period has been added the idea of public education. The three ideas—record, research, and education—cooperative and mutually helpful as they are, are essential to the development of every great museum. The National Museum endeavors to promote them all.
>
> It is *a museum of record*, in which are preserved the material foundations of an enormous amount of scientific knowledge—the types of numerous past investigations. This is especially the case with those materials that have served as a foundation for the reports upon the resources of the United States.
>
> It is *a museum of research*, which aims to make its contents serve in the highest degree as a stimulus to inquiry and a foundation for scientific investigation. Research is necessary in order to identify and group the objects in the most philosophical and instructive relations, and its officers are therefore selected for their ability as investigators, as well as for their trustworthiness as custodians.
>
> It is *an educational museum*, through its policy of illustrating by specimens every kind of natural object and every manifestation of human thought and activity, of displaying descriptive labels adapted to the popular mind, and of distributing its publications and its named series of duplicates.

In these words the objects of the Museum are so clearly defined and the plan laid down is so broad that those who come after have but to perfect the details while preserving that unity of interests which is requisite if the structure as a whole shall forever prove worthy of its founders and of this great nation.

AS A MUSEUM OF RECORD.

In its capacity of a museum of record, the growth of the National Museum has been unprecedented, due mainly to the rapid exploration and development of a rich and extensive country, under the liberal and progressive policy of the Government, whose inquiries into new regions and into new fields have been pushed without stint. Scientific institutions everywhere, foreign governments and individuals have likewise contributed abundant stores of great value, and a small fund in recent years has permitted of some purchases to supply desiderata. The richness of the collections has also been much increased through the exchange of duplicate specimens with other similar establishments.

The principal sources of the collections may be briefly summarized as follows:

1. The explorations carried on more or less directly under the auspices of the Smithsonian Institution, or by the Institution in connection with educational institutions or commercial establishments, and the efforts, since 1850, of its officers and correspondents toward the accumulation of natural history and anthropological material.

2. The United States Exploring Expedition around the world from 1838 to 1842, the North Pacific or Perry Exploring Expedition from 1853 to 1856, and many subsequent naval expeditions down to and including the recent operations in West Indian and Philippine waters.

3. The activities of members of the United States diplomatic and consular service abroad.

4. The Government surveys at home, such as the Pacific Railroad survey, the Mexican and Canadian boundary surveys, and the surveys carried on by the Engineer Corps of the United States Army; and the activities of officers of the Signal Corps, and other branches of the Army stationed in remote regions.

5. The explorations of the United States Geological Survey, the United States Fish Commission, the Department of Agriculture, the Bureau of American Ethnology of the Smithsonian Institution, and other scientific branches of the Government.

6. Donations and purchases in connection with the several expositions at home and abroad in which the Museum or Fish Commission have participated, among these having been the Centennial Exhibition at Philadelphia in 1876, the international fisheries exhibitions at Berlin in 1880 and at London in 1883, the New Orleans Cotton Centennial Exposition in 1884 and 1885, the Cincinnati Exposition of 1888, the World's Columbian Exposition at Chicago in 1893, and the expositions at Atlanta in 1895, at Nashville in 1897, and at Omaha in 1898. The returns from the Philadelphia Exhibition

were of greatest extent, comprising, besides the collections displayed by the United States in illustration of the animal and mineral resources, the fisheries and the ethnology of the native races of the country, valuable gifts from the thirty foreign governments which participated, as well as the industrial collections of numerous manufacturing and commercial houses of Europe and America.

7. Exchanges with foreign and domestic museums.

Immediately preceding the Centennial Exhibition of 1876, when the collections were entirely provided for in the Smithsonian building, the number of entries of specimens in the Museum record books was about 235,000. In 1884, when the additional room afforded by the new building gave opportunity for taking a provisional census of the large accessions received from Philadelphia, and from other sources, the number had grown to 1,471,000. It has gone on steadily increasing every year, and now, at the close of 1900, the number of specimens is in excess of 4,800,000.

While these figures convey no impression of the bulk of the collections, when it is considered that in 1883 all of the space in both buildings was completely filled, and in fact was so overcrowded that a third building was already being asked of Congress, some conception may be had of the conditions now existing. The storerooms are packed to their utmost capacity, making it difficult to gain access to the specimens or to provide adequately for their safety. For many years most of the objects received have had to be stored in outside and unsafe structures where they are mainly piled up in the original packing boxes, and where has already accumulated much more than enough material of great intrinsic and scientific value to fill a larger building than that now occupied by the main collections.

AS A MUSEUM OF RESEARCH.

In order to permit of their examination and study, as provided in the act of establishment, the collections of the Museum are, to the extent of its accommodations, arranged systematically and in a manner convenient for reference. Access to the reserve or study series, as they are called, consisting of the main body of the collections and as complete in all the groups as the accessions have made possible, is given to all properly qualified persons engaged in original research. Advantage of the opportunity thus afforded is widely availed of, the Museum being visited every year by many investigators, some of world-wide distinction, coming from the scientific centers of European and other foreign countries as well as from all parts of the United States. Material is occasionally sent out to representatives of other museums or laboratories having the means of providing for its safe-keeping, this being done more particularly when they are engaged to work up special subjects or when they desire to use the material for comparison in connection with their own collections.

Being charged primarily with the custodianship of its collections, the members of the scientific staff of the National Museum have comparatively little time during office hours for advancing knowledge, though they are mostly well qualified for such work, being selected with special reference to their ability to identify and classify the specimens under their care in accordance with the most advanced researches. The fact, however, that many papers descriptive of the collections are produced each year is indicative of the industry which prevails among the staff and of the extent to which the hours of work are prolonged.

Among the honorary officers having their laboratories at the Museum are a number of assistants employed by other scientific bureaus to conduct investigations on material kept here in their charge, and in whose results the Museum shares.

Many collections have, from time to time, been transferred by the Geological Survey, the Fish Commission, the Department of Agriculture, and other branches of the Government to the custody of the Museum in advance of their final working up, in order to provide for their safe storage and to secure the better facilities for study here afforded. Under this arrangement the amount of research work carried on in the Museum building has been greatly increased.

Though having little means to expend for field work, members of the Museum staff are occasionally given opportunities to participate in the explorations of other Government bureaus or of private expeditions, in connection with which special researches may be carried on, though the chief advantage results from the acquisition of new and valuable material and a knowledge of the conditions under which it occurred.

AS AN EDUCATIONAL MUSEUM.

The educational side of the Museum consists in the main of an exhibition of all the classes of objects which it represents, so labeled that the public may be instructed as by an encyclopedia cut apart and spread out, except that its illustrations are real and material things. Conceding all the space required, the principal difficulty incident to the proper installation of such a collection is in the selection of its parts so that while visitors may have placed before them all that is genuinely essential, they shall not be overburdened or confused with details. With the advance in museum methods, moreover, the objects on display are being grouped to a greater and greater extent, to show relationships, with, whenever possible, some added notion of their natural environment, so that at a glance the visitor may better comprehend their true character and significance. In this direction the National Museum has been making conspicuous progress, and probably now takes the lead.

No museum administrator had a better understanding of the public needs than the late Doctor Goode, and none labored more earnestly and conscientiously than he to make this a museum for, as well as of, the people. His assistants were relied upon to arrange and maintain the study series in a manner acceptable to the specialist, but the interests of the public were retained in his own immediate charge. His mind was ever occupied in devising ways for so presenting the features of nature and the thoughts and activities of mankind that the visitor, by the very force of his surroundings, was bound to receive and carry with him some definite impression, some new bit of knowledge.

Doctor Goode's labors in this field ranged from the planning of the general scheme to the most minute details of case architecture and fittings. His official connection with nearly all the important expositions of the past quarter of a century and his exhaustive studies of all the principal museums of Europe and the United States gave him exceptional opportunities for observation and experiment. Though a young man when he died, none other had acquired so ripe an experience and none is more worthy of being followed.

In this, as in every other activity of a live organization, change and improvement are constant. The receipt of new material will, it is to be expected, continue unceasingly, and every year something must arrive in which the public has a right to share. During the past five years the progress made in the installation of the exhibition series has been especially noteworthy, and now for the first time every hall designed for public use is permanently opened, though not one is above addition or improvement, and in some the arrangement is entirely provisional.

An incidental, though very popular, educational feature of the Museum, having for its purpose the promotion of scientific teaching throughout the country, has been the distribution to schools and colleges of its duplicate specimens, properly identified and labeled, and put up in carefully selected sets. Inadequate means have prevented this measure from being carried out on the scale which the resources of the Museum would admit of, as it requires the working over of entire collections before the reserve and duplicate series can be separated, and the labeling and packing take much time. Many hundreds of these sets have been given away, but none have been prepared recently, and the few remaining on hand at the beginning of the year have now been disposed of.

Scarcely a year passes that some exposition, either at home or abroad, is not occupying the attention of the Museum, and through this means its existence and aims are being brought constantly and prominently before the public. These expositions have of late followed one another so closely and have required so extensive preparation as to interfere greatly with the legitimate work of the Museum, but the practice of introducing new and varied features, of showing a fresh series of objects or improved groupings in connection with each one, insures a substantial gain, as the collections are returned to Washington, besides fulfilling the important function of making museum methods known to the people of the United States and stimulating the growth of museums in many quarters.

The publications of the Museum may be classed, at least in a general way, as belonging to its educational side, though they are mainly technical, and in that respect most useful to the investigator. They spread the work of the Museum abroad and make known the nature and extent of its collections. The Annual Report was first printed as a separate volume of the Smithsonian Report in 1884, and has just reached its seventeenth volume. Besides the administrative part, it has consisted mainly of semipopular papers on interesting portions of the collection. Of the Proceedings, made up of technical papers of small to moderate size, twenty-one volumes have been issued and another is in press. The Bulletins, reserved chiefly for the larger and more exhaustive scientific papers, number forty-nine, of which the last one printed (Bulletin 47), a monograph of the fishes of North and Middle America, is in four parts, completed near the close of the year.

PRESSING NEEDS OF THE MUSEUM.

By 1883, only two years after possession had been taken of the present Museum building, its capacity was found to be wholly insufficient, and an estimate for a second structure of even larger size was at once submitted to Congress. In his report for 1884, Doctor Goode explained that it was a serious problem where to store the incoming collections, leaving entirely out of consideration the question of their display. The needs in this direction, always increasing, have been urged in every subsequent report, but so far without effective result. The Senate voted $500,000 for a new building in 1888, and again in 1890, 1892, and 1896, but all these measures failed of action in the House.

The Museum has now reached a crisis in its history which must be frankly met. It can no longer comply with the mandates of Congress imposed upon it by the act of 1846 establishing the Smithsonian Institution. The two buildings which it occupies are overcrowded to the extent that the collections they contain can only in part be arranged and classified so as to permit of their examination as required by law, and many of the collections are so inaccessible as to endanger their very safety. Many hundreds of boxes, to a large extent turned over by the Government surveys and filled with material valued at hundreds of thousands of dollars, are stacked up in frame and cheaply constructed brick buildings, liable at any time to destruction by fire. There is no place where this material, composing fully one-half of the Museum's possessions, can be unpacked and spread out for study or reference, while the portion suitable for exhibition would alone more than fill another structure as large as the present Museum building.

For the existence of this condition neither the National Museum nor the Smithsonian Institution can be held responsible. The Institution was made the custodian of all collections belonging to the Government in the Congressional act providing for and thus preceding its organization. It has fulfilled the obligation conscientiously and in accordance with the spirit of the law, even when its own funds have had to be drawn upon. It has shown that the trust was not misplaced, and in the face of obstacles which have at times seemed insurmountable has given its museum feature a standing not excelled in any country in the world, though in accommodations and display its position is decidedly inferior to many.

A national museum is not of the nature of a project which may await the pleasure of summary action. Its material accumulates with the exploration and development of the country—in the case of the United States mainly through Congressional direction—and if the material collected by this means be destroyed or otherwise disposed of, the most of it can only be replaced, if at all, at greatly increased cost. For many years this country has been supporting extensive investigations under authority of Congress. Prominent among the bureaus whose work requires the collecting of specimens and their transfer to Washington for purposes of study are the Geological Survey, the Fish Commission, the Biological Survey and the divisions of Entomology and Botany of the Department of Agriculture, and the Bureau of American Ethnology. A large amount of material has reached Washington in the past, and will certainly continue to do so, from other Government sources, such as Army and Navy expeditions, representatives abroad of the Department of State, the Revenue-Marine Service, and the Coast and Geodetic Survey. These bureaus depend by law upon the National Museum for the care of their collections. Having for the most part very inadequate accommodations in their own buildings, much of their material is turned over as soon as received in Washington, and thus the Museum is called upon, very appropriately, to make greater provision for the handling and storing of specimens than is generally supposed. This unworked material has, in one sense, even greater value than that which has been determined and described, as its study is expected to develop facts yet undiscovered, and the responsibility for its safe-keeping is increased accordingly.

The demand for additional space and for new cases, always incessant, has reached a stage where the helplessness of the authorities to meet it is pathetic. Galleries have been built in some of the Museum halls. Their capacity has not sufficed to keep pace with the current demands of the years in which they were constructed, and collection after collection has been carted away to one of the outside buildings. These now are all practically filled, and next year a new one must be leased, or accessions turned away, or the exhibition halls transformed into storehouses.

On its educational side there is equal cause for complaint. The public demands to see more than is now placed before it, and what is already on display is so closely crowded as to be difficult of inspection. As previously explained, there is much material in storage which should be put on exhibition. In fact, a very large share of the collections can be best looked after and protected in the exposed cases of the open halls. With its great resources, exceeding those of any State, municipal, or private establishment, the Government is under a moral obligation to foster and promote the educational feature of the Museum to the fullest extent possible. Congress has acknowledged this obligation from the very start, and has, perhaps, done more in support of this object than of any other. It is the one, moreover, which requires the most space and most expensive furnishings—the largest item in the construction of a new building.

Laboratories of much larger size than the existing ones are required in all the departments. This is not alone in the interest of the work carried on by employees of the Museum. Better accommodations are needed for the assistants from other scientific bureaus who are called here to consult the collections, and who could to some extent carry on their investigations much more advantageously at the Museum than in their own buildings were proper facilities afforded them. The wants of scientific men from other parts of the country and from abroad, who turn to the national collections for materials for their study, and many of whom visit Washington every year, have also to be considered and provided for.

And finally, the shops where cases are made, where paint is stored and mixed, where the taxidermy, modeling, and coarser preparatory work is done, now distributed among as many outside buildings, require to be brought together in the interest of economy and of better administration.

As a result of its extraordinary growth under the very inadequate provisions made for its maintenance, the National Museum has been obliged to adapt itself to circumstances, to scatter its belongings and its work, so that to-day its form and its administration are conditioned by the restrictions under which it labors and not in accordance with the best ideals, in the realization of many of which it was originally a pioneer. The first and most urgent need is a new building, large, dignified, and accessible, with extensive halls and ample accommodations for its collections and activities. Such a house provided, it may take its proper place among the great museums of the world. The interests of the Government and of research will be promoted, the public will secure its proper measure of advantages, educational establishments throughout the country will be benefited, and a museum worthy of the generous people all over the United States who have lavished gifts upon it, of the patient toil of the many scientific men who have given it the best years of their lives, often without hope of reward, and of this great, prosperous, and enlightened nation will grace the national capital.

IMPORTANT ACCESSIONS AND WORK OF THE YEAR.

The additions to the collections in the various departments aggregated considerably over 200,000 objects. The most important accession was the so-called Marsh collection of fossil vertebrates received from the United States Geological Survey. Its contents can not as yet be fully determined, as the matrix still hides many of the specimens, but the latter range from small teeth to more or less perfect skeletons weighing from 500 to 2,000 pounds apiece. The total weight of the collection is over 80 tons, and its value, at a rough estimate, has been placed at not less than $150,000. Another noteworthy acquisition by the Department of Geology was the collection of minerals belonging to the late Prof. C. U. Shepard, consisting of over 5,000 specimens, among which are many rareties and much of historical value, including a large number of Professor Shepard's types. The meteorite collection, which has been increased to 742 specimens, now ranks among the largest in the world, while in the field of paleobotany the National Museum has become the center of systematic work.

Dr. William L. Abbott, in continuation of many past favors, has contributed nearly 1,200 specimens of mammals, birds, and batrachians, besides a large quantity of material in other groups, the results of his explorations among the islands of the China Sea, and in Trong, Lower Siam, and Singapore. Other large and valuable additions have been the birds, mollusks, insects, and plants of the E. H. Harriman Alaskan Expedition; the unique collection of spiders belonging to the late Dr. George Marx; many birds from Hawaii and Colombia; large numbers of bats from the West Indian region; and fishes from both sides of the Pacific Ocean.

The additions to the herbarium numbered over 27,000 specimens, mainly from the Southern and Western States, Alaska, Mexico, and Europe.

In anthropology over 33,716 objects were received, among them many of great scientific and historical value. A large number of these were obtained through the instrumentality of the Bureau of American Ethnology.

Following are some of the more important changes in connection with the exhibition series: The gallery in the northeast court has been newly furnished with ebonized cases of elegant design, in which the collection of ceramics, together with other works in glass, lacquer, and metal, has been installed with very effective results. The Indian basketry collection, one of the finest now in existence, has been arranged, with the ethnological exhibits from Latin America, in the corresponding gallery of the northwest court. The display in the hall containing the Catlin paintings and the Indian groups has been as nearly completed as the material on hand permits, while the medical exhibit has been entirely revised, and many additions and readjustments have been made in the Hall of History.

The south or Mammal Hall has been partly refitted with large cases, and its contents rearranged, the American species being retained on the floor, while those from other countries have been transferred to the new gallery above. In this hall are displayed, in several groups, some of the finest examples of taxidermic work ever produced. The floor space of the south east range has been entirely given over to the exhibition of fishes, reptiles, and batrachians, and the reorganization of the bird collection in the Smithsonian building, chiefly through a reduction in the number of specimens displayed, has been nearly finished. The lighting by electricity of the cases in the central quadrangle of the latter hall, containing bright-plumaged birds, has resulted satisfactorily, bringing into use what has practically been a large waste space.

The systematic exhibition series in practical geology, occupying the gallery of the southwest court, has been essentially completed. Important changes have been made in the collections illustrating the building stones and mineral resources of the United States, and good progress is to be noted in the installation of invertebrate fossils. Several striking special exhibits of geological structure and phenomena have also been added.

The total number of persons who visited the exhibition halls during the year was 225,440 for the Museum building and 133,147 for the Smithsonian building, an average daily attendance of 720 at the former and of 425 at the latter.

The principal researches completed, or in which marked progress was made during the year by assistants of the Museum, have related to mammals, birds, insects, mollusks, crustaceans, plants, and certain branches of ethnology and geology. Reference should especially be made to a monograph by Mr. Robert Ridgway on the Birds of North and Middle America, on which he has been engaged for several years. The first volume is nearly ready for printing, and several additional volumes will be required to complete the work. Specimens in greater or less number have been sent for study to the representatives of over twenty prominent museums and universities in different parts of the United States.

More of the Museum staff than usual were in the field, the duration of their absence from Washington varying from two or three weeks to as many months. Mr. William H. Dall, Mr. Robert Ridgway, Dr. C. Hart Merriam, and Mr. F. V. Coville accompanied the Harriman Alaskan Expedition. Mr. Leonhard Stejneger, Dr. Charles W. Richmond, Mr. William Palmer, and Mr. J. H. Riley visited Cuba and Porto Rico in the interest of the Pan-American Exposition. The whale fishery of Newfoundland was investigated by Dr. Frederick W. True, and the anthropology of Cuba and Jamaica by Mr. William H. Holmes. Collections of plants were made in Mexico by Dr. J. N. Rose and Dr. Walter Hough; of vertebrates in Venezuela by Mr. Marcus W. Lyon, jr.; of fishes in the Vineyard Sound region of Massachusetts by Mr. Barton A. Bean, and of fossils in Wyoming by Mr. Charles Schuchert and Dr. Lester F. Ward.

From the appropriation of $300,000 made by Congress for the Government exhibit at the Pan-American Exposition of 1901 $50,000 have been allotted to the use of the Smithsonian Institution and its bureaus. Before the close of the year the plans for the display by the Museum had been practically settled, and considerable progress had been made in bringing the necessary collections together and in starting the work of preparing them.

REPORTS OF HEAD CURATORS.

REPORT ON THE DEPARTMENT OF ANTHROPOLOGY FOR THE YEAR 1899-1900.

By William H. Holmes,
Head Curator.

ORGANIZATION AND PERSONNEL.

The organization of the department has remained practically unchanged during the year.

Owing to the lack of space in the exhibition halls, the Division of Somatology and several sections are not represented in the exhibition series, and numerous other branches are but meagerly shown.

The only change made in the personnel of the anthropological staff was the assignment of Mr. Paul Beckwith, of the clerical force, to the duties of aid in the Division of History and Biography. Mr. Beckwith's services are also utilized in the Section of Coins and Medals.

The death of Mr. A. Zeno Shindler, a preparator in the department, occurred during the year. Mr. Shindler had been attached to the Smithsonian Institution and Museum for twenty-five years or more, doing excellent service as a painter of ethnological portraits and in coloring casts in the Department of Biology as well as that of Anthropology.

DEPARTMENT OFFICES.

During previous years the offices occupied by members of the staff of the department were much scattered and, in the main, not conveniently situated with respect to the exhibition halls. Recently, however, the roomy west portal of the Museum building has been remodeled as an office for the head curator, while the adjoining rooms on the north and south have been fitted up as department laboratories and utilized largely for receiving and distributing collections. The office of the curator of the Division of Ethnology connects with this suite on the south, and the department recorder occupies a room on the north. On the floor above are five small rooms, occupied by assistant curators, aids, and preparators. Rooms requiring it have been connected by means of speaking tubes, and a telephone has been introduced into one of the laboratories, greatly facilitating the transaction of business. All of these rooms have been renovated and repaired during the year. The several honorary members of the staff occupy, of necessity, offices at points convenient to the work in which they are primarily engaged. A sectional library has been established in the office of the head curator, which is intended to be supplied with such general reference works as may not be available for the several divisions and sections.

EXHIBITION CASES.

Little progress was made during the year in the direction of increased or improved facilities for installation. The handsome ebonized wall case, 64 feet in length and 9 feet in height, built in the gallery of the northeast court during the previous year, has been fitted up with shelving, and the ceramic collections, together with numerous works in glass, lacquer, and metal, have been installed in it. This case, built by the Museum mechanics, is probably not surpassed anywhere for beauty, convenience, and mechanical perfection. Much attention has been given to the reassemblage and fitting up of cases already in use, and the furniture of the department presents a much more creditable appearance than at any previous period.

ACCESSIONS.

Accessions to the collections of the department have been of average number and importance. The following statistical statement gives the accessions by divisions and sections:

	Permanent accessions.		Temporary accessions.	
	Number.	Number of specimens.	Number.	Number of specimens.
1. Division of Ethnology	81	2,337	5	50
2. Division of Technology	24	121	8	35
3. Division of Prehistoric Archæology	67	1,513	10	28,426
4. Division of American History	53	323	31	430
5. Division of Religions	1	1	2	13
6. Division of Somatology	4	7		
7. Section of Graphic Arts	1	2	2	23
8. Section of Ceramics	4	19	4	99
9. Section of Photography	1	10		
10. Section of Music	5	10		

The manner of acquirement is indicated in the following table:

	Number of accessions.	Number of specimens.
By gift	175	2,089
By collection	4	375
By purchase	40	1,361
By manufacture	9	21
By Smithsonian and governmental deposits	9	147
By temporary deposit	59	29,285
By exchange	15	438

IMPORTANT ACCESSIONS.

A considerable number of collections acquired during the year are worthy of special mention, as follows:

By gift.—1. Ethnological material from the Malay Archipelago, donated by Dr. William L. Abbott; 67 specimens.

2. Two ancient stone chairs from Ecuador, presented by Hon. Perry M. de Leon, United States consul-general at Guayaquil. These valuable specimens were discovered about thirty years ago as the result of a freshet. The waters uncovered what appeared to be an ancient council chamber in which had been placed a large stone table surrounded by numerous chairs.

3. A mummy from the valley of Cuzco, Peru, presented by Dr. C. H. Russell, surgeon U. S. S. *Newark*.

4. The Ramage printing press, presented by Barnhart Bros. & Spindler, of Chicago, Ill. This press marks the change in the hand press from wood construction to iron. It is said to have been made in 1775.

5. A series of 32 insulated electrical conductors, presented by the American Electrical Works, of Providence, R. I.

6. Two typewriting machines, presented by the Hammond Typewriter Company, New York. One of these machines is of the model first made by the company, in 1884, and the other is of the latest style, made in 1900.

7. Collection of weapons of Australian aborigines; 33 specimens; presented by Hon. F. W. Goding, United States consul at Newcastle, New South Wales.

8. Two antique bronze cannon from Manila, presented by Admiral George Dewey, United States Navy.

9. United States regulation sword used by Gen. J. B. McPherson throughout the civil war, presented by Mr. D. W. Wood.

10. Wedding dress of Mrs. Joseph Little, of Hagerstown, Md., June 17, 1784; presented by Mrs. S. H. Young.

11. Collection of postage stamps used in the Philippine Islands at the time of American occupation, presented by Mr. Charles Doran.

By collection.—1. Archæological and historical relics from Cuba and Jamaica, by Mr. W. H. Holmes; 200 specimens.

2. Ethnological and archæological objects from Mexico and Arizona, by Dr. Walter Hough; 153 specimens.

3. Ethnological collections from the Pacific Islands, by Mr. C. H. Townsend and Mr. H. F. Moore of the *Albatross* expedition of 1899–1900; 243 specimens (partial returns).

4. Collection of Indian skulls and ethnological materials from Tierra del Fuego and Patagonia, by Prof. J. B. Hatcher; 37 specimens.

By purchase.—1. Collection of ethnological specimens from the Kongo Valley, Africa, from the Rev. S. P. Verner; 275 specimens.

2. Copper implements from an ancient interment in Houghton County, Mich., through the Bureau of Ethnology, from Mr. Isaac Otis, Westburg, N. Y.: 4 specimens.

3. Ancient stone implements from the West Indian Islands; 274 specimens; through the Bureau of Ethnology; from Mr. Louis Guesde, of Pointe a Pitre, Guadeloupe Island.

4. Three antique printing presses, from Mr. John A. Lant, Tarrytown, N. Y.

5. Collection of small arms, from Col. W. C. Dodge, Washington City; 57 specimens.

6. Collection of implements, etc., from an Illinois mound, through the Bureau of Ethnology, from Mr. C. E. Clifton, Washington City; 140 specimens.

7. Collection of Washoe Indian baskets; 47 specimens, through the Bureau of Ethnology, from Mr. Eugene Mead, Grand Rapids, Mich.

8. Ethnological specimens from the tribes of Angola, Africa; 59 specimens; from Rev. W. P. Dodson, Brooklyn, N. Y.

Permanent deposit.—1. Historical collections relating to the Spanish-American war, cannon, small arms, uniforms, etc.; 66 specimens, from the United States Navy Department.

2. Historical flags; 33 specimens, from the Smithsonian Institution. (Gift of Library of Congress.)

3. Personal relics of Gen. Thomas Swords; 48 specimens, from the Smithsonian Institution. (Gift of Miss E. H. Cotheal.)

Loans from private sources.—1. Collection of vases, by Grueby Faience Company, Boston, Mass.; 12 specimens.

2. Collection of important objects, historical and personal, by Admiral George Dewey, United States Navy; 80 specimens.

3. Historical collections by the societies of Colonial Dames (53 specimens) and Daughters of the American Revolution (18 specimens).

4. Collection of books and bindings, by Miss E. R. Scidmore; 23 specimens.

5. Collection of stone implements from Georgia, by Dr. Roland Steiner; 18,907 specimens.

6. Autograph letters of persons prominent in the civil war; 103 specimens; by Mrs. L. O. Mason.

7. Military and personal relics of the Ord family; 28 specimens; by Lieut. James T. Ord.

CARE OF COLLECTIONS.

During the past year, and during the two preceding years as well, there was a constant shifting and reshifting of the collections, resulting from reclassification and the demand of additional material for installation. Instructive and valuable specimens have been selected and placed on exhibition and less important material has been placed in storage. The effort has been to constantly improve the condition and enhance the usefulness of the collections. The task of destroying moths and other injurious insects has been faithfully performed by Mr. Joseph Palmer, preparator, who is able to report the rare occurrence of these pests among the collections of the department. The work of poisoning is begun at once upon the arrival of specimens and is generally completed before assignment is made to the divisions and sections. The extensive basketry collection has been thoroughly cleaned and treated with preservatives, and other articles requiring it have been treated in like manner. Poisoned specimens are specially tagged or marked, and a card catalogue recording dates and kind of treatment is kept.

STORAGE.

A great body of material belonging to the collection is in storage in the Smithsonian Institution, in the Museum, and in three outbuildings. During the year the head curator undertook the task of examining all of this storage material, the object being to determine its nature and availability for exhibition. He was made chairman of a committee by the executive curator and was instructed to investigate the entire storage material of the Museum. A force of from six to ten men was employed for six weeks in this work. The storage material has been accumulating for twenty-five years without full separation of the various classes of collections and with but meager records. The multitude of crates, boxes, and uncased objects was gotten out and classified. The anthropological property was segregated by divisions and sections, and a card catalogue was made enumerating briefly the contents of each package. The same information was placed upon the packages which are so arranged that the labels are visible and so they can be removed with a minimum of labor. Up to date the catalogue contains 711 cards. In addition, there is a large body of collections mounted in glass covered unit boxes for exposition use. This material is now stacked in the storage buildings.

CATALOGUING.

The routine for the reception, distribution, and cataloguing of collections is given in last year's report. The work of the head curator's office and of each division and section has been conducted according to the plan laid down in that report, and the results seem to be entirely satisfactory. In writing the present report the head curator has assembled on his desk the following data: The department's books recording accessions, permanent and temporary, for the year; the card catalogue of accessions; the card catalogue of collections for the year from all the divisions and sections; the card catalogue of storage; the card catalogue of exchanges; the card catalogue of articles poisoned or otherwise treated, and a card catalogue of articles, such as models and casts, made for the Museum by preparators or other persons employed by the Museum. At the same time a detailed report of the operations of each division and section for the year is in the hands of the head curator, who is able, through these various sources of information, to understand and summarize the work of the year with much ease and satisfaction.

INSTALLATION.

The year has witnessed very decided progress in the work of installation, the divisions of Ethnology, Technology, History, and Medicine, and the sections of Graphic Arts and Ceramics having made most gratifying headway. Prof. O. T. Mason reports, for the Division of Ethnology, that the cases in the west north range are so fully installed and labeled that this room may be considered to fall little short of completion. During the year the force of the division has been partly engaged in installing collections in the gallery of the northwest court. On the east side of this gallery there are cases containing typical exhibits of basketry from all parts of the world. On the north side the series of rail cases shows the types of California basketry, while in the wall cases a series of baskets is shown representing various tribes from British Columbia to Mexico. On the south and west sides of this gallery are exhibits of ethnological materials of Latin America, beginning with Sonora on the north and ending with Tierra del Fuego on the south.

The honorary curator of the Division of Mechanical Technology, Dr. J. E. Watkins, reports that important improvements in the installation of the Section of Land Transportation have been made. The base and iron rail of the locomotive "John Bull" have been completed. The ox cart from New Mexico and the Red River cart have been placed on a new mahogany base and installed with other wheeled vehicles. The large wooden models of the locomotives "Tom Thumb" and "Arabian" have been removed to storage, and small models are being made to take their place in the exhibit. The original driving wheels of the locomotives "John Bull" and "De Witt Clinton" and several other antique car wheels have been permanently installed on the piers within the hall. The boiler of the locomotive "Stourbridge Lion" has been fitted with wooden axles and mounted on its wheels. It is hoped that additional parts of this locomotive may be secured, so that it may, in time, be restored to approximately its original condition.

The curator of the Division of Prehistoric Archæology, Dr. Thomas Wilson, mentions in his report the very obvious fact that the exhibition cases of the division are overcrowded. With every accession of importance he is compelled to condense the exhibits in order to make room. During the year the work of segregating various exhibition units has been continued, but it is not deemed advisable to begin the radical change of installation so manifestly called for until extensive improvements are made in the hall.

Mr. A. H. Clark, honorary custodian of the Section of American History, states that very satisfactory progress has been made in the care of the collections of that section. Additional cases have been introduced into the north hall and the rotunda, and various rearrangements of cases and exhibits have been made. The contents of many cases have been reclassified and installation has been perfected. The superb collection of personal relics of Admiral George Dewey, deposited during the year, has been installed in cases near the Museum entrance. During the year it has been necessary to send numerous exhibits to storage. Increased exhibition room for this section is very much needed.

A complete reinstallation of the exhibits included in the Division of Medicine has been made during the year by the honorary curator, Medical Director J. M. Flint, United States Navy. The cases have been arranged in alcove style, thus giving a passageway of proper width along the gallery. Included with the collections of this division are two cases containing exhibits designed to illustrate the composition of the human body.

Noteworthy improvements have been made in the installation of the Section of Graphic Arts. Mr. Paul Brockett has conducted this work under the immediate supervision of the head curator. Two cases have been added, one containing series of exhibits illustrating the history of the book, and the other, examples of modern binding; the latter exhibit is lent by Miss E. R. Scidmore.

The Section of Ceramics has been assigned to the northeast court gallery, which has been fitted up with excellent cases. Early in the year the collections of ceramics, glass, lacquer, bronze, etc., were installed here by the head curator, the arrangement being primarily by countries and secondarily by varieties or factories.

LABELING.

The important work of labeling the collections of the department is progressing satisfactorily. The system of case labeling adopted during the preceding year, and described in the report for that year, has been successfully applied, and many labels are already in place. The printing of labels for several halls is now going forward, and minor labels have been prepared in large numbers by the various curators. As soon as the work of labeling is reasonably complete and the installation satisfactory, it is planned to prepare a key or guide to the collections of the department.

FIELD WORK.

The department has not been able to carry on extensive field work during the year. The explorations of Dr. Walter Hough, made in connection with an expedition conducted by Dr. J. N. Rose, of the Division of Botany, were mentioned in the report of last year, although not completed until August of the present year. The collections made are of very considerable scientific value, including, as they do, many plants used in the native arts, ancient and modern, besides numerous specimens of native handiwork. During the year Mr. C. H. Townsend returned from his voyage on the *Albatross*, bringing a large collection of ethnological specimens from the Pacific islands, and Dr. W. H. Abbott, continuing his explorations in the Malay Archipelago, has forwarded many objects of interest. Col. H. H. Hilder, of the Bureau of American Ethnology, has visited the Philippines, collecting for the Pan-American Exposition, and reports the shipment of much material that will finally enrich the Museum. Maj. J. W. Powell and Mr. W. H. Holmes spent three months in Cuba and Jamaica, securing valuable collections of relics illustrating the ancient peoples of these islands.

RESEARCHES.

The curators of the department have found time, aside from their duties as custodians of the collections, to engage in important researches based largely, as usual, on the national collections. The head curator has continued his studies relating to aboriginal pottery, to the evidences of auriferous gravel man in California, and to antiquities of Mexico. The curator of ethnology has made progress toward completing his monograph on American aboriginal zootechny, and has made a careful study of the recently received Hudson collection of California basketry. The assistant curator of ethnology has continued his studies in heating and illumination, and has prepared a manuscript on the primitive stages of illumination, covering the use of the torch and the candle. He has also pointed out the connection between Mexico and the Philippines with relation to the introduction of plants and industries from Mexico to the Philippines and from the Philippines to Mexico.

The curator of prehistoric archæology has made further progress in his studies relating to primitive trepannation, working experimentally with primitive utensils upon various specimens of human crania. He has also been interested in the discovery of the truth with respect to allegations that prehistoric man was ambidextrous, studying the statistics furnished by our Indian schools and the rich collections of his division.

The curator of the Division of Religions has completed an illustrated catalogue of the Benguiat collection of Jewish ceremonial objects.

The curator of the Division of Mechanical Technology has been prosecuting researches in various sections of this division, and Mr. G. C. Maynard, aid, continues his studies with respect to the electrical collections.

The extensive collections of the department naturally form the basis of study in many branches of research. Students are made welcome at all times, and not a few have availed themselves of the facilities offered. Mr. Foster Jennings, Rev. Dr. W. E. Griffis, Mr. W. H. Patton, Mr. J. D. McGuire, and Mr. E. Quesada have pursued investigations in the Divisions of Ethnology and Somatology. Mr. Frank Calvert, Prof. F. B. Tarbell, and Mr. Willard Nye, jr., have consulted the collections in prehistoric archæology, and Mr. Franklin W. Smith and the Association for the Study of Comparative Religions have pursued investigations in the Division of Religions. Scientific and numerous nonscientific writers engaged in the preparation of matter for periodicals and newspapers have found the department a profitable field.

LOANS.

It is not usual to lend collections to students desiring to study them outside of the Museum, save in cases where loss or injury is not imminent. In several instances, however, articles have been turned over to the Bureau of American Ethnology, and a few loans have been made to museums. A collection of Shoshone and Ute crania was forwarded to the American Museum of Natural History at the request of Prof. F. W. Putnam. These were studied by Dr. A. Hrdlicka, and returned in good order. A number of games have also been loaned to the museum of the University of Pennsylvania for the use of Mr. Stewart Culin. Numerous models belonging to the Section of Transportation were loaned to the Carnegie Museum, Pittsburg, Pa., in order that copies of them might be made for that institution. A collection of electrical apparatus numbering 56 specimens was loaned to the American Commissioner-General for the Paris Exposition.

REPORT ON THE DEPARTMENT OF BIOLOGY FOR THE YEAR 1899–1900.

By Frederick W. True,

Head Curator.

The past year has been one of unusual activity in several of the divisions, and a number of important advances have been made. It has been marked also by the beginning of preparations for the Pan-American Exposition, which opens at Buffalo, N. Y., in May, 1901.

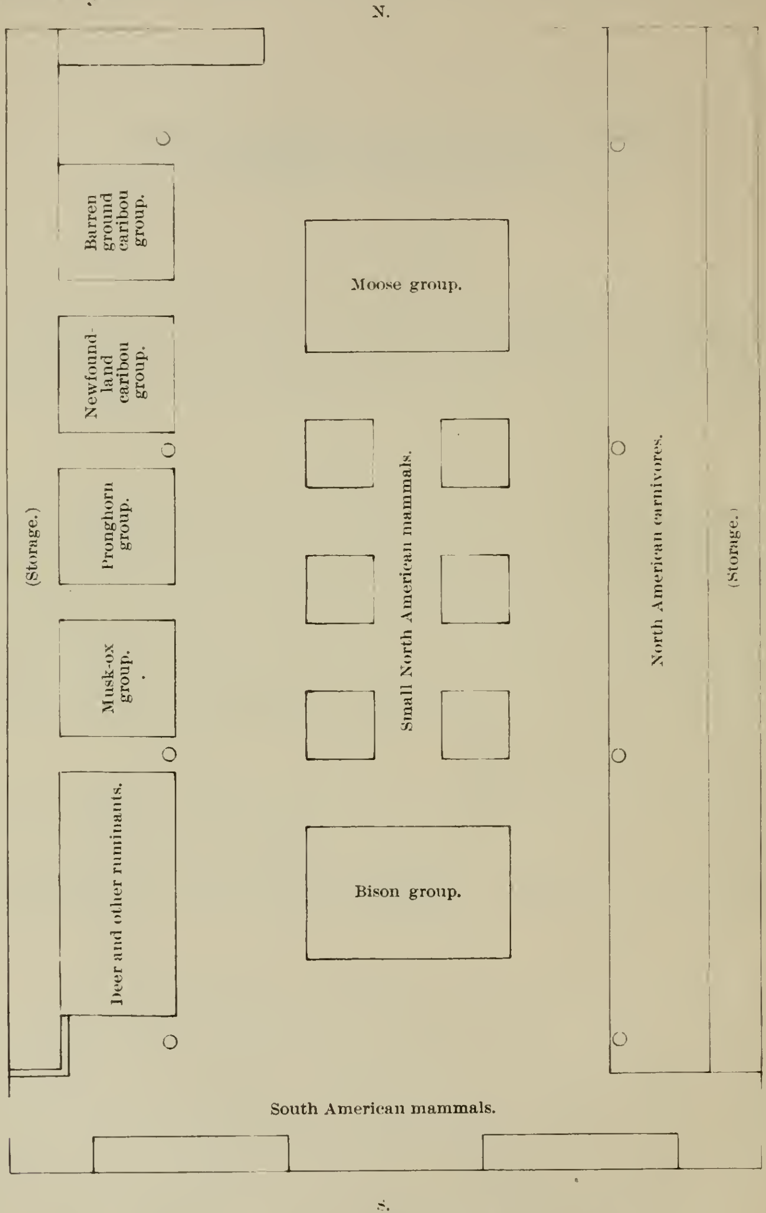
IMPROVEMENT OF EXHIBITION HALLS.

In the Division of Mammals a plan for improving the housing of the exhibition series, worked out last year, was carried into effect. A large case, 91 feet long and 9 feet deep, was built along the east wall of the south hall, and in it were placed all the North American carnivores. This allowed the removal of the unsightly temporary case containing the seals from the center of the hall, and the placing of the groups of bison and moose, the finest zoological groups the Museum possesses, in a better light. The present arrangement of cases is shown on the following page.

The large cast and skeleton of a humpback whale, which was for many years suspended from the roof in this hall, was removed to the adjoining osteological hall, replacing a skeleton of the same species formerly exhibited there. This change has improved the lighting in the south hall, as the cast formerly obstructed the light from the main south window.

An important change was, after full consideration, made in the south east range, occupied last year jointly by the exhibits of reptiles and of fishes and a part of the mammal collections of the Biological Survey of the Department of Agriculture. The range was completely floored over at the level of the gallery, dividing the hall into an upper and lower story. The mammal collections referred to were transferred to the upper story, leaving the ground floor entirely free for exhibition purposes, a decided advantage both as to increase of space and improvement of appearance.

As the old wooden floor could not be replaced at once by a stone pavement, it was thought best not to attempt a rearrangement and extension of the exhibition series of reptiles, batrachians, and fishes until next year.



U. S. NATIONAL MUSEUM, SOUTH HALL—AMERICAN MAMMALS.

No important change has taken place in the Hall of Comparative Anatomy, but the introduction of skylights in the roof of this hall has increased the amount of light.

The flooring over of the south east range, already mentioned, made it possible to extend the laboratory of the Division of Plants. New dust-tight cases were built for the herbarium and placed in the second story of the range, which they occupy jointly with the mammal collections of the Department of Agriculture. A row of skylights in the roof over these cases gives abundance of light.

The work of reorganizing the exhibition series of birds in the main hall of the Smithsonian building, which was begun last year, has been completed, except in so far as regards labeling. The old wooden floor in this hall was replaced by one of stone and cement (terrazzo) at the beginning of the year and a plan was adopted for lighting the center of the hall, formerly almost totally dark, by artificial means. New cases with large glass were provided for the four spaces about the entrance, styled "the quadrangle," and in them have been placed special exhibits of birds of more than ordinary interest, such as the birds of paradise, parrots, hornbills, etc. The cases are lighted by incandescent electric lamps, provided with hoods and reflectors. The result of these changes is that this section of the hall, formerly unfit for exhibition purposes, is now one of the most attractive points in the building. The reduction in the number of birds exhibited has relieved the congested condition of the cases, and makes it possible to view each specimen satisfactorily. The cases themselves are old and not as free from dust as could be wished, but otherwise the improvement effected may be considered to have amply repaid the labor involved. A considerable amount of relabeling remains to be done, and better provision made for the bird groups and the collections of eggs and nests.

A series of enlarged illustrations of Rotifers was added to the new exhibition series of lower invertebrates during the year. In the North American series the groups remaining to be represented are the parasitic and nonparasitic worms and the polyzoa and certain of the crustacea.

No opportunity was found during the year to reorganize the exhibits of insects and of plants, and no important changes were made in the exhibition series of mollusks. The osteological exhibit, as stated in a previous report, is as full as can be accommodated in the present quarters.

EXPLORATIONS.

The extensive collecting operations of Dr. W. L. Abbott, who generously donates the fruit of his labors to the Museum, continued during the year.

The activities of the scientific bureaus of the Government, involving the acquisition of natural history specimens, vary from year to year. During the past year, as in many years preceding, the operations of the United States Fish Commission resulted in large additions to the Museum.

A new source of increment has been found in the willingness of observers of the Weather Bureau, especially those in the West Indies, to collect material desired by the Museum.

Purchases were more frequent during the past year than formerly, and the success in filling important gaps in various series was most gratifying. Indeed, the zoological collections have reached the stage where means to supply definite deficiencies by expenditure of money is a matter of the greatest importance. Not less important, and promoting the same end, is the employment of trained collectors to visit localities selected for specific reasons. During the past year several such opportunities were taken advantage of with most beneficial results.

While the Museum has never been in a position financially to maintain extensive field operations, members of the scientific staff have nearly every year made collections of more or less magnitude. Several such enterprises were entered into last year. In addition, opportunities occur, from time to time, to accompany field parties under private auspices. Several members of the scientific staff joined the Harriman Alaska Expedition by invitation of Mr. Edw. H. Harriman. At the close of the year, Mr. M. W. Lyon, jr., was detailed to accompany Lieut. Wirt Robinson, U. S. A., to Venezuela.

During the summer of 1899 Messrs. J. N. Rose and Walter Hough were engaged for three months in a botanical expedition in central and southern Mexico. They visited numerous places where collections had been made previously, and obtained many plants from type localities, not a few of which were not represented in the herbarium, besides numerous undescribed species.

Mr. B. A. Bean pursued ichthyological investigations for the Museum in Edgartown Harbor, Massachusetts, and obtained an excellent series of fishes for the collection.

The head curator spent some weeks, by the favor of the Cabot Steam Whaling Company, at their station in Newfoundland, where he had admirable opportunities to study fresh examples of finback and humpback whales.

ACCESSIONS.

The accessions of the year compare favorably in scientific importance with those of preceding years, but were somewhat less numerous than in 1898–99.

Accessions to the collections are received from a great variety of sources, among which the donations of numerous friends and correspondents of the Smithsonian Institution are conspicuous.

Dr. W. L. Abbott, whose name is associated in these reports with so many valuable donations, presented large zoological collections during the year from the islands of the China Sea, from Trong, Lower Siam, and Singapore. These collections comprised no less than 257 mammals, 763 birds, and 125 batrachians, together with insects and other invertebrates. They are of great interest to the Museum, since they contain many species new to science, as well as a variety of others previously unrepresented here. Their value for scientific purposes is much enhanced by the accurate and thorough manner in which they are labeled by Dr. Abbott.

While with the Harriman Alaska expedition Mr. Ridgway obtained over 300 birds and Mr. Dall collected a considerable number of interesting mollusks. The collection of insects presented by Mr. Harriman numbers over 4,000 specimens, and is probably the largest and most complete collection of Alaska insects ever brought together. It contains many new forms and a large series of species from boreal America not previously represented in the Museum. The collecting was done by Mr. Trevor Kincaid, of the University of Washington.

Sir Charles Eliot, British Samoan commissioner, presented to the Museum an excellent series of shells and naked mollusks, and a large number of other invertebrates, which he collected in Samoa.

The zoological collectors sent out by the Institution in the interest of the Pan-American Exposition to Cuba and Porto Rico obtained a large amount of interesting material. Doctors Stejneger and Richmond collected 250 birds, 549 reptiles and batrachians, 126 bats, and a quantity of insects, crustaceans, earthworms, and other specimens. Messrs. J. H. Riley and William Palmer in Cuba, at the close of the year, had collected 509 bats, 298 birds, 209 reptiles and batrachians, a large number of fishes, more than 1,700 insects, besides other invertebrates, and plants and specimens of other kinds.

The most important purchase of the year was the Goodfellow collection of humming birds, comprising about 1,200 specimens. Many species are represented by series of from 10 to 20 skins. The skins are admirably prepared and very fully labeled. A large number of the species was previously unrepresented in the collection.

Another purchase of importance was the Marx collection of spiders, containing several thousand specimens, chiefly North American, and including numerous types and co-types of described species.

An especially noteworthy specimen obtained this year was the skeleton of the recently-discovered Marsupial Mole, *Notoryctes*, which was received in exchange from the University College, Dundee.

Endeavors to add to the Museum collection of bats have been very successful. Mr. Ernest T. Giers presented 88 specimens from the island of Trinidad. Lieut. J. W. Daniel, jr., presented 46 specimens from Cuba; 196 specimens from Curaçao were purchased from Mr. Leon J. Guthrie. Mr. P. McDonough presented 29 specimens from the Barbados, and Mr. L. M. McCormick presented 17 specimens from the Philippine Islands. In addition, the collectors for the Pan-American Exposition (as above stated) obtained 126 specimens in Porto Rico and 509 in Cuba. Altogether, therefore, over 1,000 specimens of bats have been added during the year.

Two collections of European mammals, comprising 185 specimens, were purchased. The proprietors of Forepaugh and Sells Brothers' shows presented an African rhinoceros which died in their menagerie.

Skeletons of the aye-aye, potto, and a porpoise (*Neomeris*) were purchased, and skeletons of a guanaco and a spotted hyena were obtained from the National Zoological Park.

Among birds a very interesting addition was the skeleton of Harris's cormorant, received in exchange from Leland Stanford Junior University. It is at present the only known skeleton of this rare species. A valuable collection of Hawaiian birds, containing about 500 specimens, was purchased from Mr. H. W. Henshaw. Mr. Outram Bangs presented a collection of about 300 Colombian and Panama birds. From Maj. W. A. Glassford, U. S. A., was received a specimen of the Cuban Macaw (*Ara tricolor*), which is now believed to be extinct. Dr. E. A. Mearns, U. S. A., presented a number of reptiles which he collected in Texas.

An excellent collection of Japanese fishes, including the types of 14 new forms, was presented by the Leland Stanford Junior University, through Dr. David S. Jordan. These were supplemented by collections from the same region transmitted by the Fish Commission, together with Alaskan, Hawaiian, and Californian fishes. A collection of fishes of the Red Sea, in an especially fine state of preservation, and also fishes of the Mediterranean, were obtained from the Museo Civico, Milan, Italy. New Zealand fishes were obtained from the Public Museum at Wanganui.

Mr. Barton A. Bean made a collection of fishes in the vicinity of Woods Hole, Mass., in which were included the young of a number of southern forms not previously found so far north.

Among mollusks the most interesting addition was a fine collection of some 800 specimens of South Australian shells received in exchange from Walter D. Reed, esq., of Adelaide. A small series of rare shells was received from the Bishop Memorial Museum, Honolulu, and Mr. Dall also presented specimens collected by himself in the Hawaiian Islands.

A valuable series of land shells from the Galapagos Islands was received from the Leland Stanford Junior University, and the Museum series is now probably unsurpassed. Rare land shells from the Hawaiian Islands were presented by Mrs. Henrietta D. Walcott, of Dedham, Mass. Mr. B. H. Wright, of Penn Yan, N. Y., continued his generous donations of type specimens of river mussels (Naiades) from the South and West.

Many fine shells have been added to the Pacific coast series by correspondents in California, among whom should be mentioned Mrs. T. S. Oldroyd, Prof. F. W. Kelsey, and Hon. Delos Arnold.

The additions to the collections of insects and arachnida and myriapoda were very extensive, numbering no less than 85,000 specimens. Mention has already been made of the Marx collection of spiders and of Dr. Abbott's donations. Mr. Hugo Soltau presented a large collection of coleoptera. Mr. E. A. Schwarz continued to make important additions to the Hubbard and Schwarz collection. Large numbers of insects were received from the New Mexico Agricultural College, through Prof. T. D. A. Cockerell, including many types and co-types of species described by Professor Cockerell. Prof. John B. Smith presented types of various species of Noctuidæ described by him. Collections of Mexican hymenoptera and South American lepidoptera were purchased. Co-types of species described by Doctor Horn were received from the California Academy of Sciences.

The Department of Agriculture transmitted a collection of insects from Porto Rico collected by Mr. August Busck.

A large collection of crustaceans from the coast of Brazil, obtained by the Branner-Agassiz Expedition of 1899, was presented by Dr. J. C. Branner. Dr. C. H. Eigenmann presented cotypes of an Isopod crustacean from Izel's Cave, Texas. Dr. C. A. Kofoid presented co-types of a new genus of Volvocidæ, and Rev. George W. Taylor co-types of two species of British Columbia sponges. Mr. H. W. Henshaw presented a number of crustaceans from the Hawaiian Islands. Crustaceans collected in Texas and Mexico were received from the biological survey of the Department of Agriculture. Corals and crustaceans collected in Porto Rico were received from the United States Fish Commission.

The additions to the herbarium were very extensive, exceeding 27,000 specimens. Two large donations deserve special mention. Dr. Charles Mohr, of Mobile, Ala., an enthusiastic botanist and collector, presented to the Institution his herbarium of more than 3,000 specimens, chiefly from the southern United States. As the national herbarium was previously deficient in plants from the South, Dr. Mohr's contribution was especially acceptable. Of similar importance was the donation of the De Chalmot collection of 3,000 plants, from the United States and Europe, by Mrs. Marie De Chalmot, of Holcombs Rock, Va. In the same connection should be mentioned the gift of about 1,100 plants, chiefly from the United States, by Mr. A. H. Curtiss, of Jacksonville, Fla.

Extensive series from Porto Rico, Mexico, the District of Columbia, the Yellowstone National Park, the Pribilof Islands, Canada, Jamaica, and the New England States were purchased, and collections from Montana, Central America, and the Philippine Islands were obtained by exchange.

Dr. J. N. Rose, while pursuing botanical investigations in Mexico, collected some 1,200 specimens for the Museum.

The Department of Agriculture transmitted 2,500 Alaskan plants collected by Mr. F. V. Coville and Mr. T. H. Kearney, 2,300 specimens from Virginia and North Carolina collected by Mr. Kearney, and 807 specimens from the State of Washington collected by Mr. Kirk Whited. The United States Geological Survey transmitted 413 plants from Oregon.

STUDY COLLECTIONS.

In the Division of Mammals satisfactory progress was made in re-arranging the study collections of rodents, insectivores, and bats, comprising several thousand specimens, and the work of remodeling skins for study purposes was continued for about five months. The majority of these small skins are now in excellent condition. The collection of skins of large mammals is still in confusion owing to lack of proper case room.

The curator of the Division of Birds having been detailed for work on the manuscript of his Manual of the Birds of North and Middle America, and the assistant curator having been in the West Indies for some months, little was accomplished in this division beyond the re-arrangement of the exhibition series, already referred to, and the performance of routine work. The great study collection of birds is, however, in a very satisfactory condition except that portion which is still in old-style cases. Before this can be put in order some eighteen half-unit cases must be provided, for which funds have not been available thus far.

The curator of the Division of Comparative Anatomy and assistant were occupied very largely with work on vertebrate fossils, especially with the transfer of the Marsh collections from New Haven. This, and the necessity of re-arranging the exhibition hall, left little time for other than routine work. The condition of the osteological collections is satisfactory.

Mr. Dall, honorary curator of the Division of Mollusks, reports as follows:

> Progress in the revision of the study series is naturally slow but constant. All the reserve material is accessible and in order. Anything in the collection can be found in a few minutes and the genera are catalogued on cards which refer to their location in the cases. The whole duplicate collection is in first-class order and catalogued on cards. The unadministered alcoholics are catalogued by genera on cards and located so that any jar can be found at once.

In the Division of Marine Invertebrates the study collection of dry specimens of sea urchins was overhauled and arranged systematically for more convenient reference. The collection of worms was transferred to a room in the north tower of the Smithsonian building.

Regarding the study collection of insects, Doctor Howard, honorary curator, reports as follows:

The collections are in excellent condition, and totally free from museum pests. During April and May all the cabinets and boxes were examined for museum pests, and not a specimen was found infested. It is the first year in the history of the division that such a state of affairs has existed, and this is due principally to the fact that a large percentage of the insects is now permanently arranged in the new standard insect drawers.

The identification of species and the frequent rearrangement of the different orders still continues. Most of the orders are now arranged more or less satisfactorily, except the exotic material. The exotic material, particularly in the orders Rhynchota, Orthoptera, Coleoptera and Lepidoptera, is only partially arranged and identified, and it will take many months, if not two or three years, before all can be satisfactorily arranged and identified.

Doctor Dyar has done much work on the Lepidoptera, Mr. Schwarz on the Coleoptera, Mr. Coquillett on the Diptera, Mr. Ashmead on the Hymenoptera, Mr. Banks on the Arachnida, Mr. Currie on some of the Neuropteroid insects, particularly on the Odonata and Myrmeleonidæ, and Mr. Heidemann on some families in the Rhynchota.

The order Orthoptera, especially the exotic material, is almost entirely unarranged.

Reference has already been made to the improvements in the botanical laboratory. The following statement by Mr. F. V. Coville, honorary curator of the Division of Plants, explains more fully the character and extent of these changes, as well as the progress of routine work during the year:

During the past year the gallery of the south east range has been extended over the center court and about 1,200 square feet have been added to our floor space. This has enabled us to transfer the cases which were temporarily placed on the exhibition gallery to permanent quarters as well as to make room for some new cases. After considerable experimenting a very satisfactory case was planned and eighty new cases have been made and put in place. Each case contains four rows of six pigeonholes, each of the standard size. In addition to the usual doors which fit against felt strips, a second set of doors can be added. These are only to be used during the process of fumigating.

The new cases are stacked in nine double rows, the alternate double rows being two cases high, while the other are one case high. These low cases furnish an abundance of table room either for the distribution of specimens into the cases or as a convenient place for the critical examination of plants. Above these table cases five skylights have just been added, which furnish an abundance of light and suitable ventilation.

During the year the entire collection has been transferred to zinc-lined cases and poisoned with carbon bisulphide. While this work has been done as carefully as possible, yet it requires a great deal of time and is more or less injurious to the plants. In spite of this care, I regret to say, after the specimens are returned to their proper places in the herbarium, the ravages of the insects are still considerable.

Three preparators have been engaged in mounting and labeling specimens during the year. The total number of specimens mounted is 24,049 against 22,559 last year. Nearly all of these have been stamped and incorporated into the general herbarium.

The marking of all accessions with a uniform stamp was begun in 1895, and 76,030 sheets had been stamped at the close of the year covered by this report.

RESEARCHES AND PUBLICATIONS.

The present year saw the completion of Jordan and Evermann's elaborate manual of the Fishes of North and Middle America, which constitutes Bulletin 47 of the National Museum. The companion work on birds by Mr. Robert Ridgway progressed favorably and the manuscript of the first volume was very nearly ready for the printer at the close of the year. The first installment of completed manuscript, about 250 pages, was submitted. A paper on the birds of Trong, Lower Siam, collected by Dr. W. L. Abbott, was begun by Dr. Charles Richmond.

Mr. B. A. Bean engaged in the study of the fishes of New York, Woods Hole, Mass., and the District of Columbia, and also determined the fishes collected by Mr. J. B. Hatcher in Patagonia.

A revision of the two great groups of bivalve mollusks, the Tellinidæ and Cardiidæ, including their classification and a review of the American species, recent and Tertiary, was completed during the year by Mr. William H. Dall. Over 100 new forms, recent and fossil, were detected and described.

Mr. Simpson completed his revision of the Naiades, or river mussels, a work which represents many years of arduous study, and may be considered the most important contribution to the subject since the appearance of Doctor Lea's last synopsis. Mr. Paul Bartsch has undertaken and partially completed a revision of the Pyramidellidæ of the Pacific coast, a puzzling group of shells requiring much microscopical investigation.

Mr. Richard Rathbun reports as follows regarding the scientific work of the Division of Marine Invertebrates:

The extensive collection of Decapod crustaceans obtained by the United States Fish Commission steamer *Fish Hawk* in Porto Rico in the early part of 1899, were transferred to this division for study. The report on the Anomura has been completed by Doctor Benedict, and that on the Macrura by Miss Rathbun, who has also the portion on the Brachyura well under way. These reports will be published by the Fish Commission.

Doctor Benedict has nearly completed a monograph of the Galatheidæ, to be published in the Proceedings.

Some of the Crustacea collected on the Branner-Agassiz expedition to Brazil in 1899, by Dr. J. C. Branner and Mr. A. W. Greeley, have been worked up in this division, the Decapoda and Stomatopoda by Miss Rathbun, the Isopoda by Miss Richardson. Reports on the same are now in press and will appear in the Proceedings of the Washington Academy of Sciences. The Annelida of the same expedition will be studied by Doctor Benedict.

A beginning has been made toward a report on the Decapoda collected from Puget Sound northward to Bering Sea by the Harriman Alaskan expedition, summer of 1899.

Miss Rathbun has completed a report on the Decapod Crustacea of West Africa, which has been published in the Proceedings, and has also made a series of keys to North American crabs, two of which have already been published in the American Naturalist.

The Decapoda and Isopoda collected on an expedition to the Galapagos Islands in 1898-99, sent out by Stanford University, have been received for study. The Isopoda have been written up by Miss Richardson, and the Brachyura and Macrura have been determined by Miss Rathbun.

During last summer Miss Rathbun made a study of a certain portion of the fresh-water crabs belonging to the Museum of Natural History, Paris.

Miss Richardson has prepared a key to North American Isopoda, which has appeared in two numbers of the American Naturalist; she has also nearly completed an account of the Isopoda of the Atlantic coast of North America, with descriptions of many new species.

Mr. F. A. Lucas, in connection with work on fossil vertebrates, has engaged in studies of the gallinaceous birds and of the cormorants, and also of certain Cyprinodont fishes.

The treatise on the reptiles of Japan, prepared by Doctor Stejneger, was delayed for want of satisfactory illustrations, but toward the close of the year means were found to obtain desirable results, and it is expected that the work can soon be published. Doctor Stejneger has been engaged also on a monograph of the reptiles and batrachians of Porto Rico, and, since his return from a visit to that island, has extended the scope of his work to include a general survey of the Antilles.

Activity in mammalogy has been due almost exclusively to Mr. G. S. Miller, jr., who has studied and published upon numerous lots of material in the Division of Mammals. He published fourteen contributions during the year, including a series of directions for preparing specimens of small mammals. His work on the free-tailed American bats has been held back awaiting the accumulation of additional material. An extended report on the mammals collected by Doctor Abbott in the islands of the South China Sea, by Mr. Miller, was completed during the year, and also a report on the mammals collected by Mr. Currie in Liberia.

Mr. Ashmead continued work on his monograph of the North American Braconidæ and on his reports on Japanese hymenoptera, on the hymenoptera collected by Doctor Abbott in Africa and Siam, and on the parasitic hymenoptera of the Hawaiian Islands. He completed reports on the aculeate hymenoptera of St. Vincent and Grenada received from the British Museum in 1897, and on the Australia hymenoptera collected by Albert Koebele, and others bred by Mr. W. W. Froggatt in New Zealand. Mr. Coquillett prepared monographs of the flies of the families Ephydridæ and Drosophilidæ and began a report on the Diptera of the Harriman Expedition. A monograph of the antlions of North America was begun by Mr. R. P. Currie.

Dr. J. N. Rose, besides determining the plants collected by him in Mexico, completed, conjointly with Dr. J. M. Coulter, a revision of the Umbelliferæ of the United States, containing notices of about 50 species new to science. The Museum collection in this order is very rich and contains fully 9,000 sheets.

Mr. Pollard continued his investigations of the North American violets to which reference was made last year. In this work Professor Greene, of the Catholic University of America, has largely coöperated. One set of duplicate specimens was distributed last year, as mentioned in my previous report.

The head curator continued his investigations of the whalebone whales of the North Atlantic, in connection with which he located and as far as possible examined and photographed the types of the various species hitherto described.

USE OF THE COLLECTIONS.

The staff of the Biological Survey of the Department of Agriculture has, as in past years, made extensive use of the zoological collections, especially those of mammals and birds. Mr. Outram Bangs, of Boston, Mass., made comparisons of birds recently collected for him in Panama and Colombia with those from this region in the Museum. The collections of Alaskan birds were examined by Dr. Louis B. Bishop, of New Haven, Conn., in connection with his determinations of birds collected by him in the Yukon region. Dr. A. W. Grabau, who is making a special study of the mollusks of the family Fusidæ, spent some time in examining the Museum collections. Numerous persons brought shells to the Museum to be compared and named.

Many workers have been engaged upon the collections of the Division of Marine Invertebrates during the year. Miss H. Richardson continued work on the Isopods, Mr. T. Wayland Vaughan on West Indian corals, and Mr. W. P. Hay on crayfishes. The Museum has had the benefit of the services of these experts on several occasions. Dr. Albert Mann spent several weeks in examining the deep-sea deposits for diatoms. Several months were spent by Mrs. F. B. Arnold in general studies of invertebrates in connection with a popular work on marine life which she is about to publish.

The collection of fishes have been made use of, as in preceding years, by various officers of the United States Fish Commission, particularly by Doctors Evermann, Kendall, and Smith, and Mr. M. C. Marsh.

The herbarium was extensively consulted during the year, both by the members of the scientific staff of the Department of Agriculture engaged in botanical work, and other botanists.

LOAN OF SPECIMENS.

As in previous years, the use of the collections for scientific purposes is not confined to examination of material in the Museum laboratories. Large numbers of specimens are sent out for study every year to naturalists throughout the United States and in other countries.

During the past year this has obtained to a large extent as regards plants, birds, mammals, and marine invertebrates, and special mention should be made of some of the more important loans.

The collection of crustaceans of the family Alpheidæ, which was to have been worked up by Prof. F. H. Herrick, having been returned by him with the statement that circumstances prevented his carrying out the undertaking, it was transmitted to Dr. H. Coutière, Museum of Natural History, Paris, who has been many years engaged in the study of the group.

Applications having been received simultaneously from Professor Edwards, of the University of Cincinnati (now of Trinity College), and Dr. Hubert L. Clark, of Olivet College, Michigan, for the use of the collections of Holothurians for monographic purposes, it was decided to divide the collections, sending the Apoda to Dr. Clark, and the remainder of the specimens to Professor Edwards. Mr. Robert W. Hall, New Haven, Conn., obtained the use of the large collection of *Palæmonetes* for special study of that genus. Samples of ocean bottom were sent to Dr. Albert Mann, who desired to search them for diatoms.

Dr. J. Percy Moore, who has been engaged for some time in working up the collections of leeches, received an additional consignment of specimens during the year.

The Museum collection of meadow larks (35 skins) was sent to Mr. F. M. Chapman, of the American Museum of Natural History, New York, for use in a revision of the genus *Sturnella*.

The collection of lemmings (124 skins) was lent to Mr. Witmer Stone, of the Academy of Natural Sciences, Philadelphia, who was engaged in a study of the species of this group of rodents.

At the request of Dr. D. S. Jordan the collections of Japanese and Corean fishes made by Messrs. Jouy, Morse, Hitchcock, and Bernadou were sent to the Leland Stanford Junior University, to aid in his work on the fish faunas of these countries.

A collection of insects of the family Saldidæ (Rhynchota) was sent for the purpose of study to Prof. H. E. Summers, of the Iowa Agricultural College, who is engaged in monographing the family. Specimens of Tipulidæ and Ortalidæ (Diptera) were lent to Prof. R. W. Doane, for monographic purposes.

A collection of Hymenoptera was sent to Prof. T. D. A. Cockerell, of Mesilla Park, N. Mex., for study in connection with his investigations of the mouth parts of these insects. Several other loans of insects were made during the year.

The extensive use of the herbarium by experts outside of Washington is shown by the fact that 3,232 herbarium sheets were sent out for study during the year.

DISTRIBUTION OF DUPLICATES.

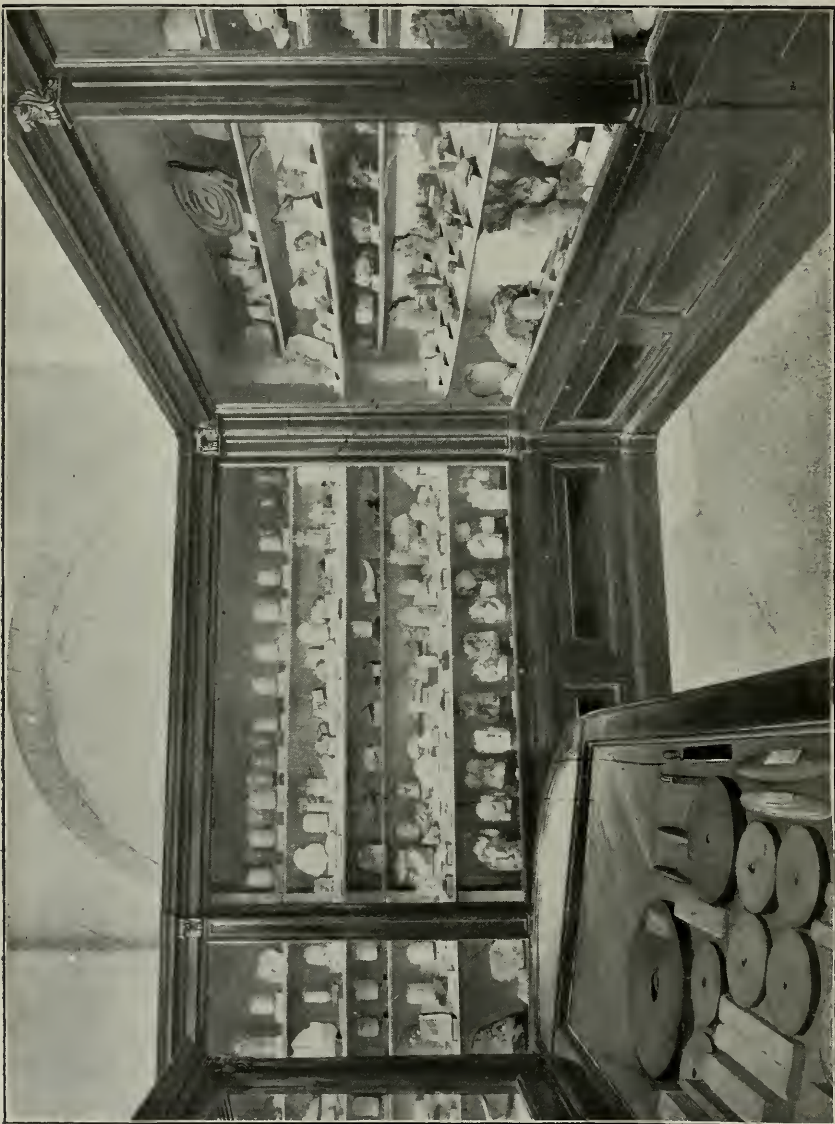
The demand for zoölogical material by educational institutions showed no abatement during the year. Nearly all the sets of duplicate specimens prepared some years ago have now been distributed, and it will be necessary to form additional series at no distant date. Eighteen of the educational sets of marine invertebrates and eleven special sets were distributed.

PREPARATIONS FOR THE PAN-AMERICAN EXPOSITION.

The head curator of the department was appointed representative of the Smithsonian Institution and National Museum for the Pan-American Exposition, to be held at Buffalo, in 1901. A plan for the exhibition of an outline series representing the vertebrate fauna of America was formed at an early date, and in February, 1900, Doctors Stejneger and Richmond were detailed to make collections in Porto Rico and other islands of the Antilles, and Messrs. William Palmer and J. H. Riley in Cuba. As already mentioned, a large amount of valuable zoölogical and botanical material was obtained. Taxidermic work for the exposition has been carried on during the year.

PERSONNEL.

On July 10, 1899, Mr. W. R. Maxon received temporary appointment as aid in the Division of Plants, and on November 16, 1899, he was regularly added to the staff and was assigned to the section of Cryptogamic collections. Mr. Sidney I. Wilson, of St. Joseph, Mo., spent several months in the Division of Birds as a volunteer assistant, with the purpose of increasing his knowledge of ornithology. The Museum has profited by the coöperation of Mr. H. C. Oberholser, who determined several collections of birds during the year. Professor Greene contributed valuable expert services in the preparation of sets of herbarium specimens of the various species of violets.



VIEW SHOWING WALL AND RAIL CASES AND INSTALLATION OF NONMETALLIC MINERALS ON GALLERY OF SOUTHWEST COURT OF UNITED STATES NATIONAL MUSEUM, LOOKING WEST.

VIEW SHOWING RAIL CASE AND INSTALLATION OF NONMETALLIC MINERALS ON GALLERY OF SOUTHWEST COURT OF UNITED STATES NATIONAL MUSEUM, LOOKING NORTH.

FOR DESCRIPTION SEE PAGE 47.

REPORT ON THE DEPARTMENT OF GEOLOGY FOR THE YEAR 1899-1900.

By George P. Merrill,
Head Curator.

The fiscal year just closed has been one of steady progress in the department, and so far as the Section of Vertebrate Paleontology is concerned, has been notable for the marked increase in the size and value of the collections. Indeed, it is not too much to say that, so far as acquisition of material is concerned, the progress made in this section is without parallel in the history of the Museum.

ACCESSIONS.

The total number of accessions received by the various divisions is tabulated below, the totals for 1898–99 being also given for the sake of comparison:

Divisions.	Regular.	Temporary.	Total.	
			1899–1900.	1898–99.
Geology	108	189	297	279
Mineralogy	37	120	157	116
Vertebrate Paleontology	30	....	30	....
Invertebrate Paleontology	72	....	72	99
Paleobotany	21	....	21	39

It is, however, impossible to gain from these figures any tangible idea of the value or amount of material received, since accessions vary almost indefinitely, not only in number of specimens, but in the value of the individual objects comprising them.

In the Division of Geology the more important materials received were as follows: A series of orbicular granites from Finland, Sweden, and Rhode Island; a series of nearly 400 specimens of volcanic materials from the Hawaiian Islands; some 2,000 specimens of rocks representing areas surveyed by the United States Geological Survey, and turned into the Museum for preservation, with a view to future reference in accordance with the usual custom. These comprise rocks from the Little Belt Mountains, the Uvalde, the Anthracite and Crested Butte, and the Big Trees quadrangles; and the Silver Cliff and Rosita districts of Colorado, besides much miscellaneous material.

In the Division of Minerals the most important accession has been the private collection of Prof. Charles U. Shepard, comprising some 5,000 specimens, many of which are very choice and rare, as noted below. The meteorite collection has increased more than during any similar period in its history since the receipt of the Shepard collection of meteorites in July, 1886. This great increase is due in part to the purchase of the Allegan stone (some 64 pounds) which fell at Allegan, Michigan, on July 10, 1899. In addition to this the following specimens have been obtained:

Aërolites.—Jerome, Gove County, Kansas; Schönenberg, Bavaria; Bishopville, Sumter County, South Carolina; Indarka, Russia; Lissa, Bohemia.

Aërosiderites.—Augustinowka, Russia, and Bischtube, Russia.

The gem collection has been increased by three fine opals, and three cut Japanese beryls.

The principal accession of the year in the Section of Vertebrate Fossils has been the Marsh collection, which was formally transferred to the Museum in December, 1899. This I will refer to in detail later. In addition to this, the section has received: Through exchange with the Glen Island Museum a fine specimen of fossil gar, *Lepidosteus simplex;* a very perfect skull and a large part of the body of the fossil gar, *Lepidosteus atrox*, the gift of Mr. Charles Schuchert; types of new Jurassic fishes, described by Dr. C. R. Eastmann and transferred to the Museum by the Geological Survey; a number of specimens of a new *Leuciscus*, also received from the Geological Survey; a fine skull and cranium of an *Elotherium* and a *Diceratherium*, purchased from Mr. Frank Stillwell.

The most important collections received in the Section of Invertebrate Paleontology are: The Cragin collection (1,322 specimens) of Texas Jurassic fossils; the John M. Clarke collection (617 specimens) of New York Lower Helderberg fossils; the Townsend collection (864 specimens) of Guelph (Upper Silurian) fossils; a collection of some 1,002 Mesozoic fossils, collected in Wyoming by Mr. Schuchert; a series of specimens showing the twenty stages through which the Cambrian trilobite *Sao hirsuta* passes during its development, received in exchange from Dr. Anton Fritsch, of the Bohemian Museum; a series of corals illustrating Mr. Vaughan's forthcoming work on American corals; a life-size model of the crustacean *Stylonurus* as restored by Dr. C. E. Beecher; a specimen of the rare echinoid *Oligonoporus nobilis*, the gift of Mr. W. L. Woods; and from the Geological Survey a series of labeled Cambrian brachiopods (366 specimens) and Rocky Mountain, Ordovician, Silurian, and Devonian fossils (740 specimens).

Additions of value in the Section of Paleobotany have come almost wholly through the United States Geological Survey, and comprise: A series of plants associated with the lavas of the Cascade Range, as described and figured by Dr. F. H. Knowlton in the Twentieth Annual Report of the United States Geological Survey; plants from the Montana formations, described by the same author in Bulletin 163 of the Survey; plants of the Payette formation described by Dr. Knowlton in the Eighteenth Annual Report of the United States Geological Survey; plants from the Cascades of the Columbia; plants from Esmeralda County, Nevada; a fine series of cycads from the Freezeout Hills north of the Medicine Bow River, Carbon County, Wyoming, collected by Mr. Charles Schuchert and Dr. Lester F. Ward.

PROGRESS IN INSTALLATION.

The progress in caring for the collections has been eminently satisfactory. The confusion incidental to the erection of the new galleries has been practically overcome, and it is not too much to say that the collections as a whole are in better condition now than ever before.

The installation of the systematic series in the Section of Applied Geology on the gallery in the southwest court (Plates 1 and 2) has been practically completed and some 2,500 new labels have been supplied. The reserve collection of ores has been arranged in the storage drawers beneath the rail cases and a complete card catalogue of the same prepared. Great changes have been made incidentally on the ground floor of the court, which is now given up to the building-stone collection; the collection illustrating the mineral resources of the United States, and various special collections, as the Tenth Census collection of iron ores; rocks and ores illustrating the geology of Leadville; and collections illustrating the metallurgy of gold, silver, lead, copper, zinc, and iron.

Progress in the Section of Vertebrate Paleontology has been slow, since the energies of the division have been occupied almost entirely in making a temporary place for the Marsh collection. One hundred and thirteen boxes of this collection have been opened and their contents distributed and catalogued. Fifteen skulls of *Titanotherium*, and the limb bones of a large dinosaur have been mounted for exhibition.

In the Section of Invertebrate Paleontology Mr. Schuchert reports the mounting of 2,850 specimens of Triassic, Jurassic, Cretaceous, Ordovician, Silurian, Lower Helderberg, and Lower Carboniferous fossils. In addition, the I. H. Harris collection of Cincinnati fossils, comprising 75 boxes, has been unpacked, assorted, and prepared for installation. A large amount of material has been also added to the duplicate collections.

In the Section of Paleobotany the work of installing the Lacoe collection has been practically completed. Many of the older Museum collections which have never been satisfactorily cared for have been overhauled and catalogued and numbers painted upon the specimens in a way, it is hoped, to avoid possible confusion in the future.

The work of building storage racks on galleries of the east south and west south ranges has been completed and satisfactory progress made in installing in the drawer space thus afforded material belonging to the sections of Vertebrate Paleontology and Paleobotany.

The duplicate series designed to show the origin of soils through rock weathering and for distribution to schools and colleges, to which reference was made in my last report, has been practically completed, so far as gathering the materials is concerned; the work of labeling, wrapping, and properly describing remains yet to be done. In addition to this, some 2,000 duplicates have been weeded out from the collections of the Division of Geology alone, wrapped and labeled, and sent to the storage sheds, according to our usual custom. Mr. Schuchert reports that he has now in storage unassorted duplicate materials aggregating many thousands of specimens.

With the reorganization of 1897, the plans for a Division of Technology were sufficiently formulated to enable me to turn over a large amount of manufactured material and special exhibits, which had long been recognized as not belonging properly to the Department of Geology, but which were allowed to remain there simply that they might be cared for. The space thus gained in storage and exhibition rooms has been of material value to the department.

The constant intrusion of new materials in our exhibition series, together with the shifting of collections made possible by the acquisition of new cases on the galleries, has brought prominently forward the question of labels, with particular reference to color, board, and character of type. It need scarcely be said that the first necessity of a label is legibility. Brevity and conciseness of statement are also important considerations. The head curator's experience has led him to doubt the advisability of long explanatory labels for individual specimens, excepting, it may be, in the case of large and striking objects. The name of the object in type sufficiently large and clear to catch the eye, and a few explanatory lines in smaller type, regarding source, etc., are considered the chief essentials. After many trials the form given here, printed on a gray board, which experience has shown to be little affected by exposure, has been adopted in the sections of Geology, Invertebrate Paleontology, and Paleobotany:—

DIAMONDS.—Cape Bort.

KIMBERLY MINES, SOUTH AFRICA. 53,671.

Diamonds of this size and quality are used in making engravers' points and burnishing tools for watch and pencil case makers. Four pieces; weight, three-eighths karats each.

GALENA.—Sulphide of lead. A cluster of crystals showing both cubic and octahedral faces.

JOPLIN MINE, JOPLIN, MISSOURI. 17,590.

Gift of Davis and Murphy.

BASALTIC COLUMNS.

Bennau, near Asbach, Prussia.

FOR DESCRIPTION SEE PAGE 49.

VOLCANIC BOMBS.

FOR DESCRIPTION SEE PAGE 49.

In the Section of Vertebrate Paleontology, where larger materials permit the use of larger type, an herbarium board is used. The drawback to the herbarium board in the small label, it should be stated, lies in the difficulty of getting solid black impressions sufficient to give the desired contrast and easy legibility.

In this connection copy for some 5,000 specimen labels has been prepared and sent to the Government Printing Office during the year, mainly from the sections of Geology and Invertebrate Paleontology. Up to the close of the year some 3,500 of these had been printed. Eleven large, explanatory labels, in black and gold, for the exhibition halls, have also been prepared and are awaiting framing preparatory to being put in place.

Some time has been occupied in revising and bringing up to date the manuscript of a guide to a study of the collections in the Section of Applied Geology. This is now completed, and at the date of writing is at the Government Printing Office.

PRESENT CONDITION OF COLLECTIONS.

The present condition of the exhibition and study series of the department can be in part surmised from what has already been said.

The crowded condition of the exhibition halls has led to the withdrawal of some of the minor and less conspicuous exhibits to give place to larger and more striking forms. Among the recent additions of this class reference may be made to the cluster of basaltic columns from Bennau, near Asbach, Prussia, shown in Plate 3. These occupy the same relative position to one another as when formed, and convey to the public a much better idea of columnar structure and its cause than do the isolated columns. The materials were obtained and set up for the Museum under the direction of Mr. F. W. Crosby, of this city.

The large silicified tree trunks (*Araucarioxylon arizonicum*) from the so-called Fossil Forest or Chalcedony Park, near Holbrook, Arizona, which were exhibited by the department at the Omaha Exposition in 1898, have been returned to the Museum and installed in the east end of the west south range, there being no room for them with the Paleobotanical exhibit on the gallery. Unfortunately, the long trunk was broken in three pieces in process of trans-shipment, but as the fractures are sharp and unabraded, the trunk-like nature of the specimen is still apparent. The exhibit comprises this trunk, 7½ feet long by 20 inches in diameter, with two cross sections each 33 inches in diameter.

The special series illustrating volcanic phenomena, faults, folds, and concretionary structures are now in a very satisfactory condition. Plate 4 shows some of the more striking forms of volcanic bombs from various localities comprised in the first-named exhibit.

From the series of jointed sandstones from the Black Hills collected by Mr. N. H. Darton, of the United States Geological Survey, and mentioned in my last annual report, have been selected for exhibition the typical series shown in Plate 5. The sharpness and clear-cut nature of the faulting, together with the comparatively small amount of displacement, render such blocks almost ideal for the purpose of exhibition. Advantage has been taken of opportunities for procuring examples of the peculiar concretionary forms of granitic rocks known to the Germans as "kugel" granites and otherwise as orbicular or concretionary granites. Such have been studied and described by Krutschoff, who regards them as contact phenomena and as due to the crystallizing of the granitic material about preexisting fragments of other rocks. One of the more striking forms from Sweden is shown in Plate 6.

The meteorite collection, to which reference has already been made, comprises 742 specimens, representing 349 falls. This places it among the large collections of the world, being only excelled, so far as we have knowledge, by those of Paris, London, Vienna, and the private collections of Prof. H. A. Ward and Mr. C. S. Bement.

The collections in the Division of Mineralogy are practically all labeled, and a case at the south end of the hall has been prepared for the reception of the Shepard collection of minerals already noted. The text for a catalogue of the gem collection is well under way.

The question of getting a maximum number of specimens into a case with a minimum amount of interference or shadow has been quite satisfactorily solved, so far as the Section of Vertebrate Paleontology is concerned, by the means shown in Plate 7. As will be noted, shelving is quite done away with, with the exception of that afforded by the bottom of the case and two narrow shelves at the top for large and heavy materials which are often "out of classification" as compared with the rest of the exhibit. The fossils are cemented to encaustic tiles which are of standard sizes, in units of 4-inch width, and which are prevented from falling forward through some sudden jar by an overlapping edge of wood at the top. By actual trial it has been found that, though an apparently wasteful method of installation, so far as space is concerned, more material can be actually put into a case than when the ordinary horizontal or sloping shelf is used, and, moreover, the view of one specimen is never obscured by one in front or shadowed from above. The possibly objectionable features thus far discovered are that it limits the size and weight of the specimen exhibited and necessitates the cementing of the samples to the tiles. The first-mentioned objection has proved thus far mainly theoretical, space for the larger specimens being readily found on the bottom or on the narrow shelves, while the second is avoided by not including in the series materials that would be injured or whose value would be in any way impaired by the cementing process.

FAULTED SANDSTONES.

Black Hills, South Dakota.

FOR DESCRIPTION SEE PAGE 50.

CONCRETIONARY GRANITE.

Slattemösse, Småland Sweden.

FOR DESCRIPTION SEE PAGE 50.

VIEW SHOWING WALL CASE AND INSTALLATION OF INVERTEBRATE FOSSILS ON GALLERY OF SOUTHEAST COURT.

FOR DESCRIPTION SEE PAGE 50.

The view here given (Plate 8) of the gallery in the west south range shows better than words the facilities for storage afforded by the new galleries. The Section of Paleobotany has here some 1,900 drawers, giving 10,000 square feet, and the Division of Geology 180 drawers, giving some 800 square feet of storage space. The table cases around the outer edges of the gallery serve as convenient tables for laying out material for study, while giving at the same time additional storage space beneath.

The paleobotanical series is now fairly well systematized and its value is becoming recognized, as is shown by the following quotation from a recent number of the American Geologist:

> The United States National Museum has already become the great depository of the coal-plant material in this country, and, with its great number of American types, will doubtless remain a center of systematic work in this field.

For the first time in the history of the Museum all the halls devoted to exhibition purposes in geology are open to the public. Much, of course, remains to be done, but the confused and unsightly condition of affairs which has existed for nearly three years has subsided. It should be stated, however, that the work on the exhibition series of the Section of Vertebrate Paleontology has been scarcely begun, and it will require years of labor to bring this up to the standard of those which have been longer in existence.

Tons of material from the Marsh collection are stored in a rented building used as a work and store room of the department, where they must remain until they can be unpacked, sorted, and cleaned, a task which, with the present force, will occupy several years at best.

RESEARCH.

For several years past so large a proportion of the energies of the curators has been consumed in the work of installation, that very little in the way of investigation could be carried on, and almost no work of a systematic and far-reaching nature.

The head curator has devoted considerable time to the meteorite collection, and has published a preliminary paper on the stone which fell at Allegan, Michigan, in July, 1899. He has also devoted some time to the study of the collection of volcanic rocks made by Prof. C. H. Hitchcock in the island of Oahu.

Mr. Tassin has devoted some attention to the subject of hydrolosis of the metallic sulphates, especially those of iron, with particular reference to the origin of the red colors in sedimentary deposits. His work is as yet incomplete. He is also engaged in preparing a handbook on the collection of gems and meteorites.

Mr. Lucas has studied the dentition and general structure of Zeuglodon, and has prepared a paper on the pelvic girdle of the same. He has also described a new fossil from the Miocene of California, and studied the Miocene Rhinoceros and Titanotherium, and a new Stegosaur from the Lower Cretaceous. He has also devoted some time to the study of the skull of Lepidosteus.

Mr. Schuchert has prepared a preliminary catalogue of Cephalopod genera and has devoted considerable attention to the subject of the Lower Devonian aspect of the Lower Helderberg and Oriskany formations. On this subject he is still engaged. He has also continued his work on a monograph of the American fossil starfishes.

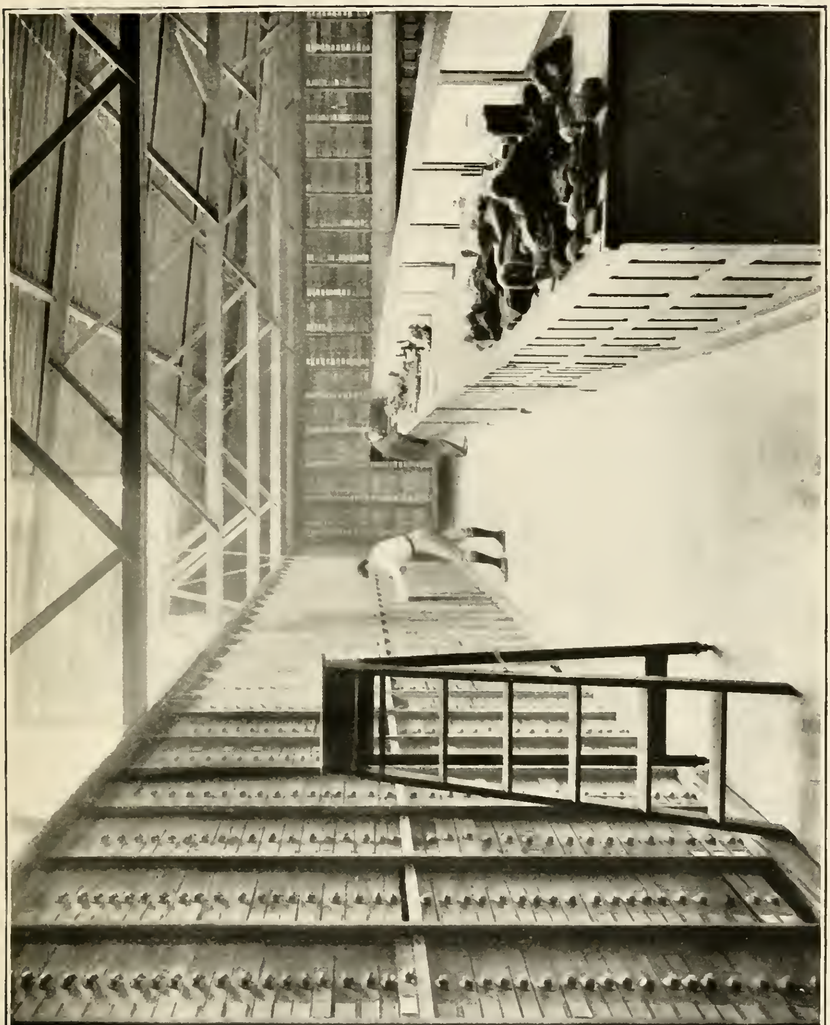
SOURCES OF NEW MATERIAL.

The principal source of material for the Division of Geology, as in years past, has been the United States Geological Survey. In addition, mention should be made of the continued interest shown by Mr. F. W. Crosby, and of the cooperation of Prof. C. H. Hitchcock, in the Hawaiian Islands.

It will be remembered that in 1887 Dr. C. U. Shepard, jr., deposited in the Museum his meteorite collection, numbering at the time 101 specimens. During the past year he has again manifested his interest in the National Museum by depositing the entire series of books, pamphlets, and manuscripts on meteorites, left by his father, the late Prof. C. U. Shepard, and, in addition, his private collection of minerals, consisting of upward of 5,000 carefully selected specimens, many of which are quite rare. The collection is particularly noteworthy for the superb series of Graves Mountain rutiles and lazulites, and also the series of southern phosphates and their associations. The collection, as a whole, forms a most important addition to our crystallographic series, and is of further interest from an historical standpoint, containing many of Prof. Shepard's types and illustrating the classification prevalent during his day. The acquisition of these old collections is a matter of the highest importance, since such often contain materials from localities now exhausted, or which served as types in the original descriptions. Further than this, they serve to keep alive the memory of one who was a pioneer in his line of work, Prof. Shepard's Treatise on Mineralogy, 1832, being the third work on this subject to appear in America from the hands of an American author.

It will be remembered that Prof. O. C. Marsh, of Yale College, served as vertebrate paleontologist to the United States Geological Survey from 1882 to 1892, inclusive. During these ten years of actual service his department received such allotments as enabled him to employ continuously from seven to ten persons in the capacities of collectors, preparators, clerks, etc., and to accumulate a quantity of exceedingly valuable material, a large proportion of which was still at New Haven at the time of his death.

After the death of Professor Marsh it was decided by the Director of the Survey, Dr. C. D. Walcott, to transfer the entire collection to



VIEW SHOWING STORAGE CASES IN SECTION OF PALEOBOTANY ON GALLERY OF WEST SOUTH RANGE.

FOR DESCRIPTION SEE PAGE 51.

the custody of the National Museum, subject only to the usual restrictions. The work of packing and shipping, which fell to the lot of this department, under the immediate supervision of Mr. F. A. Lucas, was begun in April, 1899, as stated in my last report, and completed the following November, the final transfer being made December 8, as will be observed from an abstract of the correspondence here inserted.

Department of the Interior,
United States Geological Survey,
December 8, 1899.

Prof. S. P. Langley,
Secretary, Smithsonian Institution, Washington, D. C.

Dear Sir: I have the honor to state that all the vertebrate collections of the late Prof. O. C. Marsh, belonging to the Government, have been shipped from New Haven, Conn., and are now transferred to the custody of the United States National Museum, subject only to the use of such material as may be necessary for study and illustration in the completion of the monographs that were in course of preparation by Professor Marsh at the time of his death.

From a statement submitted by Mr. F. A. Lucas, who had charge of the packing of the collections, it appears that there were 1,200 trays (20 by 26 inches) of specimens, 200 unopened boxes as received from the field, 30 blocks, and 90 prepared specimens. To ship this material required 592 boxes, forming 5 carloads, having an aggregate weight of 160,000 pounds. To this there should be added 2 carloads, containing 211 boxes, received from Professor Marsh on deposit in 1891 and 1898.

The actual number of specimens represented in this collection can not be stated. They range in size from minute teeth of fossil mammals to individual specimens weighing from 500 to 2,000 pounds each. The collections are rich in large Dinosauria, especially in examples of *Triceratops* and *Stegosaurus*, while the series of *Titanotherium* skulls is one of the best, if not the best, in existence. It contains fifty or more complete examples cleaned, and a number in the rough, besides many hundred bones.

Among the specimens transferred are the types of forty or more species, including Dinosaurs, and Jurassic, Cretaceous, and Tertiary mammals. Among the types are the following:

Dinosaurs.

Diplodocus longus.
Labrosaurus ferox.
Camptosaurus nanus.
Triceratops sulcatus.
Triceratops californis.
Triceratops obtusa.
Pleorocœlus nanus.
Ceratosaurus nasicornis.
Ceratops montanus.
Ceratops alticornis.

Crocodiles.

Rhytidodon rostratus.

Snakes.

Coniophis precedens.

Jurassic mammals.

Paurodon valens.
Manacodon rarus.
Enneodon crassus.
Enneodon affinis.
Laodon venustus.

Cretaceous mammals.

Priconodon crassus.
Cimolodon agilis.
Telacodon præstans.
Oracodon cenulus.
Allacodon pumilis.
Batodon tenuis.
Allacodon fortis.

It is to be recalled that these collections were made by Professor Marsh during his connection with the Geological Survey, from 1882 to 1892, inclusive; that prior to his connection with the Survey he made large collections, including the toothed birds, the *Dinocerata*, *Brontosaurus*, many Dinosaurs, and the best *Titanotherium* yet discovered. He also purchased numerous collections after the stopping of allotments for his work in 1892. These collections were transferred to Yale University some time prior to his death.

As there has been considerable comment in relation to this matter, I send you a copy of a report on the examination of the collections under Professor Marsh's charge, made by me to the Director of the Geological Survey, in 1892.

I twice visited New Haven while the collections were being packed, and am fully convinced that all material belonging to the Government has been transferred to Washington. Mr. Lucas reports that the trustees of the Peabody Museum in New Haven gave him every facility for packing the collections, and that the records were so complete that no difficulties arose in determining those specimens which belonged to the Government and those which were the property of the Peabody Museum.

The transfer of these great collections to Washington without the loss of any material, either through imperfect recording or through misunderstanding as to the ownership of specimens, reflects the greatest credit on the business-like methods and the integrity of Professor Marsh. The addition of the material to the National Museum places it in the front rank among museums in its collection of vertebrate fossils. It is necessary that some gaps in the collections be filled, and I sincerely trust it will be possible for the Museum to do this at an early date.

Yours respectfully,

Chas. D. Walcott, *Director.*

Smithsonian Institution, *December 22, 1899.*

Dear Sir: I take great pleasure in acknowledging the receipt of your letter of the 8th instant, advising me that you have transferred to the National Museum all the vertebrate fossils collected by the late Prof. O. C. Marsh belonging to the United States Government, subject only to the condition that such material as is required may be used for study and illustration in completing the monographs which were in preparation by Professor Marsh at the time of his death.

The addition of this immense collection of most important American fossil remains to the treasures already assembled in the National Museum will, I am sure, afford the greatest satisfaction to all workers in the field of paleontology both at home and abroad, and you will permit me to add a personal word in appreciation of your untiring efforts to facilitate in every way possible the great task connected with the removal of the collection from New Haven to Washington.

During the coming year I expect to have two preparators engaged in working out of the matrix specimens still uncleaned, and confidently hope that it may be possible in a few years to have the entire collection made available for study and a selected series for public exhibition. From this latter series the public will be able to form a correct idea as to the number, variety, and great size of these wonderful extinct creatures of the western country, and will undoubtedly be impressed with the extent and importance of the work of the paleontological divisions of the Geological Survey and the marvelous industry and intelligence displayed by Professor Marsh in bringing together this great collection.

Yours respectfully, S. P. Langley, *Secretary.*

Hon. Charles D. Walcott,

Director United States Geological Survey, Washington, D. C.

As may readily be imagined, the receipt of these enormous collections, many of which were still uncleaned and in the matrix, single specimens in some instances weighing several thousand pounds, taxed the resources of the Department greatly. Fortunately the gallery in the east south range was completed, and, when fitted with standard

SKULL OF LEPIDOSTEUS ATROX.
Fossil, Wyoming.

FOR DESCRIPTION SEE PAGE 55.

storage racks and drawers, furnished room for such of the material as was already cleaned. A very large share of the material could not however, be brought into the Museum building without blocking the exhibition halls, and was, therefore, stored as fast as received, without unpacking, in a rented building, as already noted.

In June, 1899, the Union Pacific Railroad Company extended to the Smithsonian Institution an invitation to send a representative of the Museum to participate in a collecting and exploring tour through the fossil fields of Wyoming. This invitation was accepted, and Mr. Charles Schuchert, assistant curator in the Division of Invertebrate Fossils, was detailed to make the trip. Mr. Schuchert left Washington early in July and returned the last week in September.

During this time, aside from many valuable observations, he collected upward of 1,000 Jurassic invertebrates, and a very complete femur of a large Dinosaur, and purchased and donated to the Museum the particularly fine gar, *Lepidosteus atrox*, shown in Plate 9. He also obtained numerous lithological and mineralogical specimens.

Inasmuch as there is much popular misapprehension regarding the occurrence and mode of procedure in collecting these vertebrate remains, or rather since the public at large has no adequate conception of the skill and expense involved in collecting and so restoring such remains that they may be of value for exhibition and study, I have introduced the following extract from an article published by Mr. Schuchert in Science for November 17, 1899:

> In the very beginning, alarming setbacks are encountered when climbing the hills in any direction for a "bone lead." Having the good fortune to discover one, the real work then begins in the digging, only to find that every bone is cracked into innumerable pieces. These must be bandaged and set in plaster, and when all is hard the bones can be turned to undergo more bandaging. This means that one must have patience, be expert with pick and shovel, with gunny sacking and plaster, and with saw and hammer. However, with all these difficulties to overcome, no less than 6 carloads of bones were shipped this summer from Medicine Bow, a little village on the Union Pacific Railroad in Wyoming, by specially organized parties from the universities of Wyoming and Kansas, and the Field, Carnegie, and American museums of natural history.
>
> In no one place are complete Dinosaur skeletons found. Sometimes a "quarry" will yield a lot of vertebræ, or a number of either hind or fore limbs, or there is a general mixture of parts of animals of different genera. To make an adequate collection of Jurassic Dinosaurs, therefore, requires several successful field seasons. The cost is still further enhanced since in the laboratory the bones must be cleaned, hardened, and restored before they are ready for study and exhibition. On account of these conditions and the further one that Dinosaur skeletons are very large, the work is extremely expensive. We can, therefore, believe that the best skeleton of *Brontosaurus* in Professor Marsh's collection, an imperfect one, cost him $10,000.

No systematic explorations with a view to enriching the collections in paleobotany, mineralogy, or geology were undertaken, though a very considerable amount of material was obtained by exchange.

ASSISTANCE AFFORDED STUDENTS AND INVESTIGATORS.

During the year there have been sent out from the Division of Geology some 18 lots of material, comprising 284 specimens for study and by exchange.

Specimens from the duplicate collection in the Division of Mineralogy have been furnished Dr. F. W. Clarke for use in his work on the composition of the various silicates, noted in the bibliography, and also to other members of the Geological Survey as occasion required. Mention should here be made of a lot of carnotite furnished to Dr. Hillebrand for his investigations, the results of which are not yet published.

The fine specimen of *Lepidosteus simplex* from the Section of Vertebrate Paleontology was lent to Dr. C. R. Eastman, of Cambridge, Massachusetts, and has been returned. The type specimen of *Equus excelsus* and other bones belonging to this genus have been lent to Mr. J. W. Gidley, of the American Museum of Natural History at New York, where they still remain.

From the Section of Invertebrate Paleontology collections were lent for purposes of study to Dr. Anton Fritsch, of Prague; Dr. E. Schellwein, of Königsberg, and Dr. G. Hambach, of St. Louis, Missouri.

In accordance with the usual practice, facilities for study have been afforded to students not officially connected with the institution, when such could be done without too much interference with Museum work. Dr. E. C. E. Lord, as in the year previous, has passed some time in the laboratory of the department engaged in the study of eruptive rocks from the coast of Maine. Mr. M. W. Twitchell, a graduate student of the Columbian University, has utilized the goniometer and other facilities in the Division of Mineralogy in the work of preparing his thesis for an advanced degree. Dr. O. P. Hay has spent some time in the study of the paleozoic fishes, and Dr. C. R. Eastman has utilized Museum material in the preparation of a paper on the fossil gar. Dr. A. S. Woodward, of the British Museum, made a brief examination of the types of various fossil fishes in our collections. Mr. R. B. Rowe, of the Maryland Geological Survey, Prof. John M. Nichols, of Cincinnati, and Mr. E. H. Sellards, of the University of Kansas, have also had access to Museum materials in connection with their own work.

FUTURE WORK.

No radical changes in the plans for the work in any of the divisions of the department are contemplated. There remains yet a large amount of work to be done in the exhibition series in vertebrate paleontology and paleobotany, which will doubtless consume the greater portion of the time of those in charge of these divisions for an indefinite period.

Prior to the reorganization of the Museum in 1897, the catalogues of the various divisions had been kept quite independently of and without sufficient regard to each other, and in many cases the work was very imperfectly done, owing to lack of sufficient assistance. Under the present administration an attempt is being made to centralize and harmonize the work of cataloguing. This will, however, involve the rewriting of probably 200,000 entries as well as much careful overhauling of the records, and is a work which we can not hope to accomplish within several years. It is the intention of the head curator to give particular attention to this work during the coming year.

The department has now arrived at that stage in the building up of its collections where a proportionately small amount of material of value is received in the form of donations. If, therefore, the collections are to be systematic and well balanced, a considerable amount of money must be available for purposes of purchase. This is a matter which has been repeatedly urged and needs no further mention.

SUMMARY OF THE OPERATIONS OF THE YEAR.

THE MUSEUM STAFF.

The executive curator, Dr. Frederick W. True, continued in direct charge of the administration of the Museum during the year, the Assistant Secretary exercising only a general supervision over its affairs.

There have been but few changes in connection with the scientific staff. In the death of Mr. Frank Hamilton Cushing on April 10, 1900, the Museum, as well as the Bureau of Ethnology, lost one of its most active and distinguished workers during nearly a quarter of a century. Medical Director James M. Flint, U. S. N., under whose supervision the Division of Materia Medica was established in 1881, and who has been its honorary curator, under detail by the Secretary of the Navy, for three separate periods, aggregating about thirteen years, was placed on the retired list of the Navy in February, 1900. Proposing to continue his residence in Washington, however, Doctor Flint has volunteered his further services in the same capacity and they have been gladly accepted.

Mr. W. R. Maxon was appointed an aid in the Division of Plants in November, 1899.

A list of the members of the scientific and administrative staffs will be found in Appendix 1.

APPROPRIATIONS AND EXPENDITURES.

The total amount appropriated by Congress for the maintenance of the Museum during the year ending June 30, 1900, was $238,540, as against $257,000 for the previous year. The only changes in the several items, as compared with 1899, were an increase of $5,000 under preservation of collections and of $2,000 under building repairs, and a decrease of $10,000 under furniture and fixtures and of $460 under rent of workshops. The sundry civil act for 1899 also contained two special items, one of $10,000 for the construction of galleries and one of $5,000 for the purchase of the scientific library of the late Dr. G. Brown Goode, which are mainly accountable for the larger appropriation in that year.

The expenditures actually made from the appropriations for 1900 up to the end of that fiscal year aggregated $224,912.42, leaving a balance of $13,627.58 to meet outstanding liabilities. During the same year $12,284.88 were disbursed from the balance ($12,629.63) of the appropriation for 1899 remaining on July 1, 1899.

The following tables show the expenditures during 1899–1900 from the appropriations for the past two years and the balances on hand on June 30, 1900:

Appropriations and expenditures for the fiscal year ending June 30, 1900.

Object.	Appropriations.	Expenditures.	Balance on hand June 30, 1900.
Preservation of collections	$170,000	$160,866.18	$9,133.82
Furniture and fixtures (including $10,000 for furnishing new galleries)	25,000	24,424.76	575.24
Heating, lighting, and electrical service	14,000	13,438.04	561.96
Books	2,000	1,121.28	878.72
Postage	500	500.00	....
Building repairs	6,000	5,748.93	251.07
Rent of workshops	4,040	4,039.92	.08
Printing and binding	17,000	14,773.31	2,226.69
Total	238,540	224,912.42	13,627.58

Disbursements from unexpended balances of appropriations for the fiscal year ending June 30, 1899.

Object.	Balance June 30, 1899.	Expenditures.	Balance June 30, 1900.
Preservation of collections	$4,661.94	$4,660.41	$1.53
Furniture and fixtures	995.28	993.93	1.35
Heating and lighting	1,780.02	1,780.01	.01
Books	699.57	674.49	25.08
Building repairs	81.08	80.17	.91
Galleries	4,301.66	4,095.87	205.79
Rent of workshops	110.08	....	110.08
Total	12,629.63	12,284.88	344.75

Disbursements to the extent of $88 were also made on account of preservation of collections for 1897–98, leaving a balance under that item on June 30, 1900, of $9.28. Other balances remaining from the appropriations for the same year, all of which now revert to the surplus fund of the Treasury, are as follows: Furniture and fixtures, $1.23; heating and lighting, $5.49; building repairs, $4.53; galleries, $8.87; rebuilding sheds, $0.78.

The appropriations for the year ending June 30, 1901, are as follows:

Preservation of collections	$180,000
Furniture and fixtures (including $2,500 for furnishing a new lecture hall)	17,500
Heating, lighting, and electrical service (including $3,500 for electrical installation)	17,500
Postage	500

Books, pamphlets, and periodicals	$2,000
Repairs to buildings, shops, and sheds	15,000
Rent of workshops and temporary storage quarters	4,040
Printing and binding	17,000
Purchase of specimens	10,000
Total	263,540

BUILDINGS.

Skylights have been placed in the roof of the Museum building above the four courts and above the west south, east south, and south east ranges, in all of which the lighting has been poor, especially since the construction of galleries in them. The galleries in the east, west, and south halls and the stairways leading to the galleries from the rotunda have been furnished with iron railings, and the gallery in the south east range has been extended so as to form a complete second story, adding much needed room for laboratory and storage purposes.

The old wooden floor in the main hall of the Smithsonian building, occupied by the exhibition collections of birds and mollusks, has been replaced by a terrazzo pavement, a change long contemplated, which greatly improves the comfort and appearance of the hall.

ACCESSIONS AND REGISTRATION.

The additions to the collections during the year were embraced in 1,467 accessions and numbered 206,617 specimens, which increases the total number of specimens in the Museum to 4,819,836. The following table gives the additions and totals under the Museum classification:

Number of specimens received in 1899–1900, and total number in the several divisions on June 30, 1900.

Division.	Received in 1899-1900.	Total.
Anthropology:		
Ethnology	2,387	456,295
Historic archæology	13	1,989
Prehistoric archæology	29,939	307,957
Technology	156	30,784
Graphic arts	28	7,383
Medicine		6,800
Religions	1	2,367
History and biography	903	38,086
Somatology	7	2,316
Ceramics	118	4,127
Photography	10	1,781
Music	10	1,425
Biology:		
Mammals	4,811	[1] 31,830
Birds	4,988	[1] 120,047
Birds' eggs	159	64,820
Reptiles and batrachians	1,263	40,240

[1] Including material recently added to the Department of Agriculture series.

Number of specimens received in 1899–1900, and total number in the several divisions on June 30, 1900—Continued.

Division.	Received in 1899–1900.	Total.
Biology—Continued.		
Fishes	1,200	152,501
Mollusks	8,854	748,871
Insects	85,000	[1] 1,333,370
Marine invertebrates	3,917	[2] 507,366
Helminthological collections	8	4,953
Comparative anatomy	48	15,633
Plants	45,221	436,462
Forestry	....	749
Geology:		
Physical and chemical geology	2,830	80,693
Mineralogy	5,623	35,150
Invertebrate paleontology	7,477	385,841
Vertebrate paleontology	243	
Paleobotany	1,400	
Total	206,617	4,819,836

[1] Including Department of Agriculture material.
[2] The apparent decrease since June 30, 1899, is explained by the assignment of a very large number of specimens to purposes of distribution.

The number of entries made in the catalogues of the several divisions was 22,622. In Appendix II will be found a complete list of the accessions for the year.

The number of accessions received annually since 1880 has been as follows:

Year.	Accession numbers (inclusive).	Number of accessions during the year.
1881	9890–11000	1,111
1882	11001–12500	1,500
1883	12501–13900	1,400
1884	13901–15550	1,650
1885 (January to June)	15551–16208	658
1886	16209–17704	1,496
1887	17705–19350	1,646
1888	19351–20831	1,481
1889	20832–22178	1,347
1890	22179–23340	1,162
1891	23341–24527	1,187
1892	24528–25884	1,357
1893	25885–27150	1,266
1894	27151–28311	1,161
1895	28312–29534	1,223
1896	29535–30833	1,299
1897	30834–32300	1,467
1898	32301–33741	1,441
1899	33742–35238	1,497
1900	35239–36705	1,467

Seventeen thousand nine hundred and seventy packages have been received by the registrar, besides 20,824 volumes of publications. One thousand one hundred and sixty-three packages contained material for the Museum collections, and 1,236 supplies of various kinds. Three thousand six hundred and fourteen packages were sent out.

DISTRIBUTION AND EXCHANGE.

Twenty-six thousand and four specimens have been sent out as gifts or in exchange, and 12,177 specimens have been lent for study. The gifts have consisted chiefly of rocks, minerals, marine invertebrates, and casts of prehistoric implements, presented, in accordance with a long-established practice, to educational institutions in all parts of the United States. The distributions of all kinds are given in detail in Appendix III. The following table shows the number of "lots" of specimens sent to each State and foreign country:

Alabama	4
Arizona	1
California	13
Colorado	9
Connecticut	10
Delaware	2
District of Columbia	18
Florida	1
Georgia	1
Illinois	24
Indiana	2
Iowa	8
Kansas	6
Maine	2
Maryland	2
Massachusetts	32
Michigan	5
Minnesota	5
Missouri	11
Nebraska	1
New Hampshire	3
New Jersey	6
New Mexico	6
Nevada	1
New York	46
North Carolina	4
Ohio	5
Oregon	2
Pennsylvania	19
Rhode Island	2
South Carolina	1
Tennessee	1
Texas	3
Utah	2
Vermont	4
Virginia	3
Washington	3
West Virginia	2
Wisconsin	4
Wyoming	2
Foreign countries:	
Argentina	1
Australia	2
Austria	7
Belgium	1
Brazil	1
Canada	5
Denmark	1
England	24
France	9
Germany	11
Holland	1
India	1
Italy	7
New Zealand	2
Norway	1
Russia	4
Scotland	2
South Africa	1
Sweden	3
Switzerland	3

Among the more important exchanges received from establishments and individuals abroad were the following: Co-types of *Nectomys garleppi* from the British Museum of Natural History, London, England; a collection of fishes, crustaceans, and echinoderms from

Mr. H. W. Parritt, London, England; a collection of amulets in Bohemian glass, representing teeth of various animals, from Mr. Edward Lovett, Croydon, England; collections of insects and crustaceans from the Museum of Natural History, Paris, France; fishes from the Italian coast and the Red Sea, from the Museum of Natural History, Milan, Italy; invertebrate fossils from Mr. D. Socoloff, Orenburg, Russia; many ethnological objects from islands in the South Seas, and a collection of Moa bones, from Canterbury Museum, Christchurch, New Zealand; natural history and archæological specimems from the Public Museum, Wanganui, New Zealand; specimens of Eocene and Oligocene fossils from Mr. F. K. McK. Grant, Melbourne, Victoria; collections of plants from the Natal Botanic Gardens, Durban, South Africa; specimens of fossil brachiopods from the Museu Paulista, São Paulo, Brazil.

Material, for which return had not been made at the close of the year, was sent abroad, as follows: Specimens of crabs to the Zoological Museum, Turin, Italy; 100 skins and skulls of North American mammals, and several Indian baskets, to the Royal Zoological Museum, Dresden, Germany; 128 specimens of Lower Cretaceous fossils, representing 30 species, to the Geological-Paleontological Institute, Munich, Germany; 900 plants to the Freie Vereinigung Tiroler Botaniker, Dellach in Oberdrauthale, Carinthia, Austria; 97 specimens of Lepidoptera, representing 36 species from North America, Asia, and Africa, to Mr. G. Ruscherveyh, Buenos Ayres, Argentina.

VISITORS.

The number of persons who visited the Museum building was 225,440, and the Smithsonian building 133,147. The following tables show, respectively, the attendance during each month of the past year, and during each year since 1880:

Number of visitors during the fiscal year 1899–1900.

Year and month.	Museum building.	Smithsonian building.
1899.		
July	12,563	5,960
August	17,492	9,364
September	32,374	14,951
October	20,735	12,099
November	12,668	8,021
December	16,223	10,440
1900.		
January	8,988	7,892
February	16,180	8,767
March	15,992	11,472
April	27,385	17,028
May	26,301	14,650
June	18,539	12,503
Total	225,440	133,147
Approximate daily average on a basis of 313 days in the year	720	425

Number of visitors to the Museum and Smithsonian buildings since the opening of the former in 1881.

Year.	Museum building.	Smithsonian building.
1881	150,000	100,000
1882	167,455	152,744
1883	202,188	104,823
1884 (half year)	97,661	45,565
1884–85[1]	205,026	105,993
1885–86	174,225	88,960
1886–87	216,562	98,552
1887–88	249,665	102,863
1888–89[1]	374,843	149,618
1889–90	274,324	120,894
1890–91	286,426	111,669
1891–92	269,825	114,817
1892–93[1]	319,930	174,188
1893–94	195,748	103,910
1894–95	201,744	105,658
1895–96	180,505	103,650
1896–97[1]	229,606	115,709
1897–98	177,254	99,273
1898–99	192,471	116,912
1899–1900	225,440	133,147
Total	4,390,898	2,248,945

[1] Years of Presidential inaugurations.

RESEARCHES.

An account of the researches carried on by members of the Museum staff will be found in the reports of the head curators. A great deal of the work of identifying and monographing the collections is, however, performed by persons not connected with the Museum, but for the most part having relations with other establishments of learning either in this country or abroad. Such services are, with rare exceptions, rendered gratuitously, even though they be directly solicited on the part of the Museum. In very many cases, the use of specimens is given to aid in the preparation of reports undertaken in the interest of the expert himself or in behalf of the institution to which he belongs, the Museum benefiting indirectly. It is arranged, wherever possible, to have these investigations conducted in Washington, and specimens are only sent away for study when their safety can be definitely assured. Considerable progress has been made during the year, under this practice, in the working up of collections.

From the Department of Anthropology, a series of Shoshone and Ute crania was lent to Dr. A. Hrdlicka, of the American Museum of Natural History, New York, and a part of the collection of primitive games to Mr. Stewart Culin, director of the museum of the University of Pennsylvania. It may also be mentioned here that a number of the models of vehicles from the collections illustrating land transportation were sent for copying to the Carnegie Museum at Pittsburg, and many models from the historical series of electrical apparatus were turned over to the United States Commissioner-General for exhibition at the Paris Exposition.

In zoology, the collections of mammals and birds have been utilized by the Biological Survey of the Department of Agriculture, and those of fishes by the Fish Commission. Studies have been conducted at the Museum by Mr. Outram Bangs, of Boston, Mass., on the birds recently received from the region about Panama; by Dr. Louis B. Bishop, of New Haven, Conn., on Alaskan birds in connection with those collected by him in the Yukon region, and by Dr. A. W. Graham, on the Fusidæ, a family of mollusks. Miss Harriet Richardson has continued her work on the Isopod crustaceans; Mr. T. Wayland Vaughan, of the Geological Survey, his studies of West Indian and other recent corals, and Prof. W. P. Hay, of Howard University, his investigations on crayfishes.

Arrangements for monographing the extensive collection of Holothurians were made with Prof. Hubert Lyman Clark, of Olivet College, Michigan, and Prof. C. L. Edwards, of Trinity College, Hartford, Conn., and the specimens have been sent to them. The Pedata were assigned to Professor Edwards and the Apoda to Professor Clark. Additional specimens of leeches were forwarded to Prof. J. Percy Moore, of the University of Pennsylvania, who has for some time been engaged in working up the Museum's material in this group.

The principal loans of zoological material have been as follows: The collection of lemmings to Mr. Witmer Stone, of the Philadelphia Academy of Natural Sciences; the collection of meadow larks to Mr. F. M. Chapman, of the American Museum of Natural History, who is engaged upon a revision of the genus *Sturnella;* the collection of Japanese and Korean fishes to President David S. Jordan, of Leland Stanford Junior University; the crustaceans of the family Alpheidæ to Dr. H. Coutière, of the Museum of Natural History, Paris, France, and of the genus *Palæmonetes* to Mr. Robert W. Hall, of New Haven, Conn.; a collection of Diptera to Prof. R. W. Doane, of the Museum of Comparative Zoology; a collection of Hymenoptera to Prof. T. D. A. Cockerell, of Mesilla Park, N. Mex., and specimens of the family Saldidæ to Prof. H. E. Summers, of the Iowa Agricultural College. Entomological specimens have also been supplied to Dr. Samuel H. Scudder, of Cambridge, Mass.; Prof. John B. Smith, of Rutgers College, New Brunswick, N. J.; Prof. C. H. Fernald, of the Massachusetts Agricultural College; Rev. George B. Hulst, of Brooklyn, N. Y.; Dr. Herman Strecker, of Reading, Pa., and Mr. William Beutenmüller, of the American Museum of Natural History.

Specimens of plants were lent to a large number of persons, the principal sendings having been to the Gray Herbarium, at Cambridge, Mass.; Dr. N. L. Britton, of the New York Botanical Gardens; Prof. L. M. Underwood, of Columbia University; Dr. William Trelease, of the Missouri Botanical Garden; Mr. W. W. Ashe, of the North Carolina Geological Survey; Mr. L. F. Henderson, Boston, Mass.; Mr. Alvah A. Eaton, Seabrook, N. H.; Mr. Williard N. Clute, Binghamton, N. Y.; Dr. B. W. Evermann and Theodor Holm, Washington, D. C., and Mr. Anton Heimel, Vienna, Austria.

The facilities afforded by the Department of Geology have been availed of by several persons, including assistants of the United States Geological Survey. The eruptive rocks from the coast of Maine were studied by Dr. E. C. E. Lord. The types of certain fossil fishes were examined by Dr. A. S. Woodward, of the British Museum. The paleozoic fishes were studied by Dr. O. P. Hay, of the American Museum of Natural History, and the fossil gars by Dr. C. R. Eastman, of the Museum of Comparative Zoology. Among others who had access to the collections were Mr. R. B. Rowe, of the Maryland Geological Survey; Mr. E. H. Sellards, of the University of Kansas, and Prof. John M. Nichols, of Cincinnati, Ohio.

Collections of invertebrate fossils were lent to Dr. Anton Fritsch, of Prague, Bohemia; Dr. E. Schellwein, of Königsberg, Prussia, and Dr. G. Hambach, of St. Louis, Mo.; and a number of specimens of fossil horse remains were sent to Mr. J. W. Gidley, of the American Museum of Natural History.

COOPERATION OF THE EXECUTIVE DEPARTMENTS OF THE GOVERNMENT.

The relations of the Museum with the Executive Departments have been greatly extended during the last few years, especially as regards the War and Navy Departments in connection with their operations across the seas, through the cordial assistance rendered by officers of these two services. The historical and ethnological collections were the first to be benefited, but latterly more attention has been given to the natural features of the new possessions, and many interesting contributions in zoology and botany are now being received. It is hoped that the interest thus stimulated will lead to important results in this direction. In European countries the military branches of the governments have done much toward enriching the collections of their national museums, and it would be exceedingly unfortunate were the exceptional opportunities now presented to our own country and our own National Museum to be neglected.

The State Department, through its diplomatic and consular officers, has also been instrumental in securing much valuable material. The receipts from the Fish Commission, consisting mainly of zoological collections obtained on the Porto Rican expedition of the steamer *Fish Hawk*, have been of great interest. The United States Geological Survey has transmitted material from many sources, but of most importance, and constituting perhaps the largest single accession ever received, was the well-known collection of vertebrate fossils assembled under the direction of the late Prof. O. C. Marsh, of Yale University. The scientific branches of the Department of Agriculture which engage in field collecting, the Biological Survey, the Division of Entomology, and the Division of Botany, have, as in past years, deposited in the Museum the main parts of the material resulting from the year's work. The collections received from the Bureau of American Ethnology have been extensive and noteworthy.

Acknowledgment is due to several of the Departments for courtesies in connection with administrative matters, especially deserving of mention being the facilities afforded for the transportation of collections and assistants by the Quartermaster's Department of the Army.

EXPLORATIONS.

Although having very limited means for field investigations, at least a few members of the Museum staff spend a month or more during every year in adding to the collections, making their trips independently or in connection with expeditions sent out by other Government bureaus or under private auspices. Much important material is obtained in this way.

Dr. F. W. True spent several weeks of the summer of 1899 at the station of the Cabot Steam Whaling Company, in Newfoundland, studying the finback and humpback whales, which are taken along that coast in large numbers.

Anthropological researches were carried on in Cuba and Jamaica during the spring of 1900 by Maj. J. W. Powell, Director of the Bureau of American Ethnology, and Mr. William H. Holmes, head curator of anthropology, who collected many objects illustrating the ancient peoples of those islands.

Extensive zoological and botanical collections were made in Cuba and Porto Rico for the Pan-American Exposition of 1901 by Dr. Leonhard Stejneger, Dr. Charles W. Richmond, Mr. William Palmer, and Mr. J. H. Riley, of the Museum staff. The groups of animals chiefly represented were birds, reptiles and batrachians, fishes, bats, insects, crustaceans and annelids. The Philippine Islands were visited in behalf of the same exposition by Col. H. H. Hilder, of the Bureau of American Ethnology, who secured a large amount of interesting material bearing upon the native tribes and the history of the islands.

The expedition to central and southern Mexico by Dr. J. N. Rose and Dr. Walter Hough, which started in the spring of 1899, as noted in the last report, continued during a part of the summer and was very successful. Its object was the collecting of botanical and ethnobotanical specimens, the latter including plants used in the arts, both ancient and modern, and examples of native handiwork. At the close of the year Mr. Marcus W. Lyon, jr., was in Venezuela with Lieut. Wirt Robinson, U. S. A., having been detailed to make collections of the higher vertebrates. Mr. Barton A. Bean was in the Vineyard Sound region of Massachusetts during part of the summer of 1899 in the interest of the Division of Fishes.

During the summer of 1899 Mr. Charles Schuchert accompanied an expedition under the auspices of the Union Pacific Railroad Company to the fossil beds of Wyoming, where he obtained many Jurassic invertebrate fossils, the femur of a large Dinosaur, and a large number of lithological and mineralogical specimens. In company with Prof. Lester F. Ward, he also collected an interesting series of fossil cycads in the same State.

On the expedition to Alaska during June and July, 1899, so elaborately equipped and carried out at the expense of Mr. E. H. Harriman, of New York, the National Museum was represented by Mr. William H. Dall, Mr. Robert Ridgway, Dr. C. Hart Merriam, and Mr. F. V. Coville. The birds, insects, mollusks, and plants obtained have been transferred to the Museum, the plants coming through the Department of Agriculture, while the insects, collected by Mr. Trevor Kincaid, of Seattle, Wash., were presented by Mr. Harriman. Before returning to Washington Mr. Dall visited the Hawaiian Islands, where he made an important collection of mollusks.

The Government explorations which contribute most constantly and extensively to the Museum are those conducted by the Geological Survey, the Fish Commission, and the scientific bureaus of the Department of Agriculture, in all of which there was much activity during the past year. The cruise of the Fish Commission steamer *Albatross* to the South Pacific Ocean offered an opportunity for securing ethnological objects from many interesting islands, and through the courtesy of the Commissioner of Fisheries two of the naturalists attached to the expedition, Mr. C. H. Townsend and Mr. H. F. Moore, were authorized to collect in this field. They were successful in obtaining much valuable material. Explorations under the Department of Agriculture have been illustrated by extensive collections of plants made in Alaska by Mr. F. V. Coville and Mr. T. H. Kearney, and in Virginia and North Carolina by Mr. Kearney, and by an interesting collection of insects gathered in Porto Rico by Mr. August Busck, and of crustaceans obtained in Texas and Mexico by Messrs. Vernon Bailey, E. W. Nelson, and E. A. Goldman. Several important accessions have also been received as the result of the field work of the Geological Survey. Interest in the needs of the Museum has been aroused among officers of the Army and Navy and observers of the Weather Bureau stationed in the West Indies and the South Pacific Ocean, and it is expected that valuable contributions will soon be received through these channels. A collection of reptiles, which he made in Texas, has been presented by Dr. E. A. Mearns, U. S. A.

Of private expeditions there have been several which benefited the Museum. As a result of his explorations in the Malay Archipelago and other eastern localities, including Trong, Lower Siam, and Singapore, Dr. William L. Abbott has contributed a large and important collection of zoological and ethnological material, the former comprising 257 mammals, 763 birds, and 125 batrachians, besides many insects and other forms of invertebrates. Among the specimens are many species new to science and numerous others not heretofore represented in the Museum. This is only one of several expeditions through which the Museum has been placed under great indebtedness to Doctor Abbott.

While at the Samoan Islands as the British representative on the joint commission, Sir Charles Eliot found time to bring together an excellent collection of the mollusks and other marine invertebrates, which he has kindly turned over to the National Museum.

Other acquisitions, the results of private explorations, have been as follows: A series of Japanese fishes from the Leland Stanford Junior University; a collection of crustaceans made on the Brazilian coast by Dr. John C. Branner during the Branner-Agassiz expedition; a collection of Hawaiian crustaceans from Mr. H. W. Henshaw; about 300 Colombian birds from Mr. Outram Bangs; over 800 plants of the State of Washington from Mr. Kirk Whited; a valuable series of volcanic rocks and other geological material from the Hawaiian Islands, from Prof. C. H. Hitchcock.

Collecting outfits.—Outfits have been furnished to the following persons who have offered to collect material for the Museum: Prof. Dean C. Worcester, United States commissioner to the Philippine Islands; Capt. H. C. Benson, Manila; Dr. Azel Ames and Mr. L. M. McCormick, San Juan, P. R.; Mr. B. S. Bowdish, Aguadilla, P. R.; Maj. J. H. Hysell, Santiago, Cuba; Capt. O. S. Durfee, Ciego de Ovila, Cuba; Mr. F. G. Gosling, Hamilton, Bermuda; Mr. Charles B. Taylor, Kingston, Jamaica; Mr. Fred Driver, Montserrat, West Indies; Mr. F. C. Holman, United States of Colombia; Rev. Samuel P. Craver, Montevideo, Uruguay; Mr. Paul Narbel, Cour, Lausanne, Switzerland; Dr. E. A. Mearns, U. S. A., Newport, R. I.; Mr. Dane Coolidge, Leland Stanford Junior University, California; Dr. J. Hornung and Mr. M. L. Robb, San Francisco, Cal.; Mr. Robert T. Young, Waring, Tex.; Mr. R. T. Young, Boern, Tex.; Mr. Howard S. Reed, New Orleans, La.; Dr. Adolph Tucheband and Mr. W. A. Schantz, New York City; Mr. Robert Stein, Washington, D. C., leader of an expedition to the North Polar regions; Miss Thora Stejneger, Washington, D. C.; Lieut. John W. Daniel, jr., Lynchburg, Va.; Mr. George C. Lewis, Fort Myer, Va.

INFORMATION FURNISHED.

The Museum long ago came to be regarded by the public at large as a place where information might be sought on many scientific topics. Specimens are sent for identification and analysis, and inquiries are received bearing upon every subject within its scope, as well as upon many with which it has no relation. Every communication is answered, and so far as possible the writer's wishes are complied with, though requests for chemical analyses can not be met, as the Museum is not equipped for work of that kind.

During the past year the demands in this direction were much greater than ever before. Over seven hundred lots of objects were received for examination, while of letters asking information there was an average of not less than one hundred weekly. As will be realized, the time of both the scientific and the clerical staff was heavily drawn upon in preparing the necessary replies. Very few of the specimens which come in this way are of any value to the Museum, while those that might be profitably added to the collections have generally to be returned to the owners, so that the Museum derives little benefit from these sendings.

PUBLICATIONS.

Volume 1 of the Annual Report for 1897 was received from the Government Printing Office in December. The several papers composing it have also been issued in separate pamphlet form and distributed in the usual manner. The second volume of this report, still in course of printing, will contain a biographical account of Dr. George Brown Goode, the late assistant secretary of the Smithsonian Institution in charge of the National Museum, and reprints of several of his most important papers on museums and on the history of scientific progress in the United States. It is expected that the Annual Report for 1898 will be ready for distribution early in the next fiscal year. The appendix to this report will consist of only one paper—a monographic treatise on the "Crocodilians, Lizards, and Snakes of North America," by the late Prof. Edward Drinker Cope.

Volume 21 of the Proceedings was issued in August, 1899, and 24 papers of volume 22 were printed and distributed during the year.

Part 4 of Bulletin No. 47, entitled "The Fishes of North and Middle America," by Dr. David Starr Jordan and Dr. Barton Warren Evermann, was printed just before the close of the year. This volume, consisting of some additions to the text, 392 plates with their explanations, and a general table of contents, completes one of the most important works thus far published by the Museum. Parts M, N, and O have also been added to Bulletin No. 39. They are entitled, respectively, "The methods employed at the Naples Zoological Station for the preservation of marine animals," by Dr. Salvatore Lo Bianco; "Directions for preparing study specimens of small mammals," by Gerrit S. Miller, jr.; and "Directions for collecting and rearing dragon flies, stone flies, and may flies," by Dr. James G. Needham.

A list of the publications of the Museum and of the members of its staff, issued during the year, is presented in Appendix IV. The number of authors represented is 66 and the total number of papers cited 276. The following table classifies these papers in accordance with the subjects treated:

Subject.	Papers by Museum officers.	Papers by other investigators.	Total.
Administration	1	....	1
Archæology	3	....	3
Birds	27	19	46
Botany	13	....	13
Ethnology	4	2	6
Exploration	1	....	1
Fishes	....	3	3
Fossils	12	6	18
General natural history	2	....	2
Geology	7	2	9
Helminthology	....	1	1
Insects	70	29	99
Mammals	22	....	22
Marine invertebrates	6	10	16
Minerals	5	....	5
Mollusks	22	....	22
Religions	1	....	1
Reptiles and batrachians	2	2	4
Technology	1	....	1
Miscellaneous	3	....	3
Total	202	74	276

Twenty-three papers by members of the staff, based upon Museum material, have, with the approval of the Secretary of the Smithsonian Institution, been printed during the year in publications other than those of the Museum. Their titles will be found in the bibliography. The names of the authors are as follows: Dr. George P. Merrill, Mr. Gerrit S. Miller, jr., Dr. J. N. Rose, Mr. William R. Maxon, Mr. Charles Louis Pollard, Dr. C. W. Richmond, Mr. Charles Schuchert. and Mr. Charles T. Simpson.

LIBRARY.

The Museum library now contains over 15,000 bound volumes and 27,000 unbound papers. The additions during the year consisted of 337 books, 728 pamphlets, and 4,298 parts of periodicals. There were catalogued 1,005 books, 2,699 pamphlets, and 4,924 parts of periodicals. The number of books, pamphlets, and periodicals borrowed from the central library amounted to 18,500, including 7,000 withdrawn for assignment to the sectional libraries, of which there are now 27, as follows:

Administration.	Marine invertebrates.
Anthropology.	Materia medica.
Biology.	Mesozoic fossils.
Birds.	Mineralogy.
Botany.	Mollusks.
Children's room.	Oriental archæology.
Comparative anatomy.	Paleobotany.
Editor.	Parasites.
Ethnology.	Photography.
Fishes.	Prehistoric anthropology.
Geology.	Reptiles.
History.	Stratigraphic paleontology.
Insects.	Technology.
Mammals.	

TAXIDERMY AND OSTEOLOGY.

Owing to the absence in Cuba, during several months, of Mr. William Palmer, chief taxidermist, and the detail of his assistant during the last half of the year to the Division of Mammals, the amount of taxidermic work accomplished has been less than usual. Sixty-five specimens in the flesh, including 31 mammals, 23 birds, and 11 reptiles, and also 116 skins of mammals, were received. Many of the fresh specimens came from the National Zoological Park. Twenty-five skins were mounted for the exhibition cases and 93 were prepared for the study series. Many specimens were renovated or remounted for display purposes.

The taxidermists of the Division of Birds have remade a number of old skins, besides preparing and mounting several specimens received in the flesh. They have also reduced some of the mounted specimens to skins and have overhauled a large portion of the extensive exhibition series.

The amount of osteological work has also been smaller than usual, because of the necessity of transferring one of the assistants temporarily to the Department of Geology. One thousand skulls of mammals and the skeletons of several mammals and birds received in the flesh have, however, been cleaned. The large skeleton of the humpback whale which has been displayed in the Osteological Hall was removed, and in its place has been substituted the specimen formerly suspended in the south hall, showing both the skeleton and the exterior.

PHOTOGRAPHY.

Mr. T. W. Smillie, the photographer, reports having made for the Museum during the year 435 negatives, 644 platinum prints, 175 silver prints, 1,841 blue prints, and 67 transparencies. In a museum of the scope and character of this one a great diversity of photographic work is called for, and it is quite essential that the highest standard of the art be attained. In this respect the National Museum has been very fortunate from the beginning, and the results accomplished have been all that could be desired, as testified by the many illustrations scattered through its publications which have been produced through this means. Mr. Smillie's time is also partly shared with other branches of the Institution; and on the Smithsonian eclipse expedition to Wadesboro, N. C., in May, 1900, he was in immediate charge of the photographic branch.

EXPOSITIONS.

Pan-American Exposition, Buffalo.—By act of Congress approved March 3, 1899, the sum of $300,000 was appropriated for a Government exhibit at the Pan-American Exposition to be held at Buffalo, N. Y., in 1901, besides an additional sum of $200,000 for the erection of a building. Dr. Frederick W. True, executive curator, has been designated as the representative of the Smithsonian Institution and its bureaus on the Government board of management, and Mr. W. V. Cox as chief special agent. By the close of the past year the plans for the display on the part of the Museum had been essentially completed, and the work of bringing together and preparing the necessary collections was being rapidly pushed.

A series of models and original pieces of electrical apparatus belonging to the Henry, Morse, and Farmer collections was sent to the Paris Exposition of 1900, and several series of exhibits from the Division of Graphic Arts to the Printing Exposition held in New York City during the month of May, 1900.

NECROLOGY.

Frank Hamilton Cushing, one of the collaborators in the Division of Ethnology in the National Museum, died April 10, 1900. He was born in the village of Northeast, Erie County, Pa., July 22, 1857. He took a deep interest in the study of ethnology and archæology, and began making collections when but a boy. At the age of 18 he went to Cornell University for the purpose of pursuing a special course in anthropology. In 1876 he was given charge of a portion of the exhibit of the Smithsonian Institution at the Centennial Exposition in Philadelphia, and in 1879 he entered the service of the Smithsonian Bureau of Ethnology. Mr. Cushing lived for many years among the Indians of the Southwest, during which time he acquired a thorough knowledge of their customs, arts, language, religion, and tribal history. In 1887 he organized and conducted important archæological explorations in the Salado and Gila valleys of Arizona under the auspices of the Hemenway Southwestern Archæological Expedition. In 1896 he was placed in charge of an expedition sent out by the Bureau of Ethnology, in conjunction with the University of Pennsylvania, to explore the antiquities of the west coast of Florida. This work resulted in most important discoveries, partially reported upon in the Proceedings of the American Philosophical Society, Philadelphia, for 1896. Among the works bearing on his explorations in Arizona that entitled "Outlines of Zuñi Creation Myths," published in the Thirteenth Annual Report of the Bureau of Ethnology, is one of the most important. In the second annual report an interesting paper on "Zuñi Fetiches" appeared. Many of the articles on various phases of his explorations were published in periodicals from time to time, but it is a matter of regret that his early death precludes the possibility of publishing a large amount of material which he had brought together.

Mr. A. Zeno Shindler, who died August 18, 1899, was connected with the National Museum for many years as an artist. He was engaged largely upon ethnological work and produced a number of portrait studies of the peoples of the world, but his most notable service was in painting casts of fishes, reptiles, and other natural history specimens.

APPENDIX I.

The Museum Staff.

[June 30, 1900.]

S. P. Langley, Secretary of the Smithsonian Institution, Keeper Ex-Officio.
Richard Rathbun, Assistant Secretary.
Frederick W. True, Executive Curator.

SCIENTIFIC STAFF.

Department of Anthropology:

W. H. Holmes, Head Curator.

(*a*) *Division of Ethnology:* O. T. Mason, Curator; Walter Hough, Assistant Curator; J. W. Fewkes, Collaborator.

(*b*) *Division of Historic Archæology:* Paul Haupt, Honorary Curator; Cyrus Adler, Honorary Assistant Curator; I. M. Casanowicz, Aid.

(*c*) *Division of Prehistoric Archæology:* Thomas Wilson, Curator.

(*d*) *Division of Technology* (*Mechanical phases*): J. E. Watkins, Curator; George C. Maynard, Aid.

Section of Electricity: G. C. Maynard, Custodian.

(*e*) *Division of Graphic Arts:* S. R. Koehler, Honorary Curator.

Section of Photography: T. W. Smillie, Custodian.

(*f*) *Division of Medicine:* J. M. Flint, U. S. N. (Retired), Honorary Curator.

(*g*) *Division of Religions:*

Section of Historic Religious Ceremonials; Cyrus Adler, Custodian.

(*h*) *Division of History and Biography:*

Section of American History, A. H. Clark, Custodian; Paul Beckwith, Aid.

Department of Biology:

Frederick W. True, Head Curator.

(*a*) *Division of Mammals:* Frederick W. True, Acting Curator; G. S. Miller, jr., Assistant Curator; Marcus W. Lyon, jr., Aid.

(*b*) *Division of Birds:* Robert Ridgway, Curator; Charles W. Richmond, Assistant Curator; J. H. Riley, Aid.

Section of Birds' Eggs: William L. Ralph, Custodian.

(*c*) *Division of Reptiles and Batrachians:* Leonhard Stejneger, Curator.

(*d*) *Division of Fishes:* Tarleton H. Bean, Honorary Curator; Barton A. Bean, Assistant Curator.

(*e*) *Division of Mollusks:* William H. Dall, Honorary Curator; C. T. Simpson, Aid; Paul Bartsch, Aid.

(*f*) *Division of Insects:* L. O. Howard, Honorary Curator; W. H. Ashmead, Assistant Curator; R. P. Currie, Aid.

Section of Hymenoptera: W. H. Ashmead, in charge.
Section of Myriapoda: O. F. Cook, Custodian.
Section of Diptera: D. W. Coquillett, Custodian.
Section of Coleoptera: E. A. Schwarz, Custodian.
Section of Lepidoptera: Harrison G. Dyar, Custodian.
Section of Arachnida: Nathan Banks, Custodian.

Department of Biology—Continued.

(*g*) *Division of Marine Invertebrates:* Richard Rathbun, Honorary Curator; J. E. Benedict, First Assistant Curator; Miss M. J. Rathbun, Second Assistant Curator.

Section of Helminthological Collections: C. W. Stiles, Custodian.

(*h*) *Division of Comparative Anatomy:* Frederic A. Lucas, Curator.

(*i*) *Division of Plants (National Herbarium):* Frederick V. Coville, Honorary Curator; J. N. Rose, Assistant Curator; C. L. Pollard, Assistant Curator; W. R. Maxon, Aid.

Section of Forestry: B. E. Fernow, Honorary Curator.

Section of Cryptogamic Collections: O. F. Cook, Honorary Assistant Curator.

Section of Algæ: W. T. Swingle, Custodian.

Section of Lower Fungi: D. G. Fairchild, Custodian.

Associates in Zoology (Honorary): Theodore N. Gill, C. Hart Merriam, R. E. C. Stearns.

Department of Geology:

George P. Merrill, Head Curator.

(*a*) *Division of Physical and Chemical Geology (Systematic and Applied):* George P. Merrill, Curator; W. H. Newhall, Aid.

(*b*) *Division of Mineralogy:* F. W. Clarke, Honorary Curator; Wirt Tassin, Assistant Curator; L. T. Chamberlain, Honorary Custodian of Gems and Precious Stones.

(*c*) *Division of Stratigraphic Paleontology:* Charles D. Walcott, Honorary Curator; Charles Schuchert, Assistant Curator.

Section of Vertebrate Fossils: F. A. Lucas, Acting Assistant Curator.

Section of Invertebrate Fossils: Paleozoic, Charles Schuchert, Custodian; Carboniferous, George H. Girty, Custodian; Mesozoic, T. W. Stanton, Custodian; Cenozoic, W. H. Dall, Associate Curator.

Section of Paleobotany: Lester F. Ward, Associate Curator; A. C. Peale, Aid; F. H. Knowlton, Custodian of Mesozoic Plants; David White, Custodian of Paleozoic Plants.

Associate in Paleontology (Honorary): Charles A. White.

ADMINISTRATIVE STAFF.

Chief Clerk, W. V. Cox.

Chief of Buildings and Superintendence, J. E. Watkins.

Chief of Correspondence and Documents, R. I. Geare.

Photographer, T. W. Smillie.

Registrar, S. C. Brown.

Disbursing Clerk, W. W. Karr.

Property Clerk, W. A. Knowles (Acting).

Librarian, Cyrus Adler.

Assistant Librarian, N. P. Scudder.

Editor, Marcus Benjamin.

APPENDIX II.

List of Accessions.

Abbott, Master George, Soldier, Idaho: Two specimens of Cecropia moths. 35269.

Abbott, Miss Nellie, Vineland, N. J.: Plant. 35256.

Abbott, Dr. W. L., Singapore, Straits Settlements: A large and valuable collection of natural-history specimens, including mammal skins, birds' skins and eggs, reptiles and batrachians, mollusks, insects, skeletons of birds, mammals, and a reptile, also ethnological objects, from Trong, Lower Siam (35322); 80 birds' skins, mammal skins, insects, and ethnological objects from Selitar, Singapore Island (35505); mammals, birds' skins, reptiles, shells, insects, fishes, marine invertebrates, mammal skeletons, ethnological objects, and a canoe obtained from islands in the China Sea (36053).

Abel, J. C., Lancaster, Pa.: Stone implements from the Conestoga Hills, near Lancaster (35323); arrow-points, scrapers, and flint chips (35552); stone implements (35735); rude chipped implements and arrow-points of white quartz (35840); rude pieces of white quartz, etc. (35955); arrow-points and spear-heads and two unfinished banner stones (36219); 81 archaeological objects from the Conestoga Hills and a copper implement from an island in the Susquehanna River, near Blue Rock (36369).

Adams, C. F., Kansas City, Mo.: Insects (35367, 35750, 36009).

Admiral Dewey Reception Committee. Received through W. H. Moses, chairman: Bronze badge made from metal captured at Manila and struck in honor of the Admiral's return to Washington, October 2, 1899, and a complete set of buttons worn by members of the committee. 35878.

Agriculture, Department of. Hon. James Wilson, Secretary: Collection of insects from Texas (35708); 6 specimens of rare dragonflies from Cory, Maine, collected by Mr. F. L. Harvey (35826); large collection of Odonata from Maine obtained by Mr. Harvey (35828); large collection of insects obtained by August Busck in Porto Rico (36240); 2 crabs from Texas collected by Vernon Bailey (36504); land and fresh-water shells obtained by E. W. Nelson in Mexico (36531); 2 specimens of crabs (*Pseudothelphusa*) collected in Mexico by Messrs. Nelson and Goldman (36547); about 5,000 insects collected in Porto Rico by August Busck (36620).

Material deposited in the National Herbarium: Forty-six plants (35315); specimen of *Sarcobatus baileyi* Coville, collected by H. W. Turner (35440); 2,300 plants collected by T. H. Kearney in Virginia and North Carolina (35441); 100 plants collected by F. V. Coville and T. H. Kearney (35442); 107 plants obtained by Professor Flahault (35758); 2 plants collected by Mrs. E. P. McGowan (35776); 2,500 plants of the Harriman Alaska expedition, collected chiefly by Messrs. Coville and Kearney (36866); 132 plants obtained by Aven Nelson (35934); received through Prof. F. Lamson-Scribner, 25 forage plants (36104); 19 plants from Kansas collected by F. V. Coville (36257); 153 plants from North Carolina and Virginia collected by F. V. Coville (36258); 60 plants from Maryland collected by Mr. Coville (36259); 123 plants from the District of Columbia collected by Mr. Coville (36260); 3 plants from Connecticut collected by

AGRICULTURE, DEPARTMENT OF—Cont'd. *Material deposited in the National Herbarium*—Continued.

C. G. Bissell (36263); 88 plants collected by David Griffiths, T. A. Williams, and P. A. Rydberg (36328); 34 plants collected by Kirk Whited in Washington (36397); 3 specimens of grasses from Florida (36427); received through L. H. Dewey, specimen of *Grewia* from South Australia (36444); received through Lieut. B. H. Dutcher, Fort Grant, Ariz., 19 plants from Arizona (36445); 817 plants from Washington collected by Kirk Whited (36472); specimen of *Arctoseaphylos canescens* from California (36543); 1,126 plants collected in Oregon by E. P. Sheldon (36665).

(See under Anderson, A. P.; Austin, S. W.; Bailey, Vernon; Bissell, C. G.; Boardman, C. A.; Brown, Herbert; Busck, August; California Academy of Sciences; Campbell, A. J.; Coville, F. V.; Cusick, W. C.; Dewey, L. H.; Dutcher, B. H.; Eby, Mrs. A. F.; Engman, E. J.; Fay, John; Flahault, Prof.; Fitzgerald, Margaret P.; Flett, J. B.; Fyles, T. W.; Godbug, T. K.; Goldman, E. A.; Graham, G. A.; Griffiths, David; Harvey, F. L.; Hitchcock, A. S.; Kearney, T. H.; Lamson-Scribner, F.; McGowan, Mrs. E. P.; Miller, F. J. X.; Nelson, Aven; Nelson, E. W.; Noble, S. W.; Oakman, Miss; Olds, H. W.; Piper, C. V.; Plitt, C. C.; Rydberg, P. A.; Sheldon, E. P.; Spencer, Mr.; Steele, W. C.; Tracy, S. M.; Turner, H. W.; Waghorne, A.; Way, P. N.; Werckle, C.; Wheeler, Maj. Gen. Joseph; Whited, Kirk; Williams, T. A.; Wilson, J. M.)

ALASKA COMMERCIAL COMPANY, San Francisco, Cal.: Specimen of *Ursus middendorffi*, from Kadiak Island, Alaska. Purchase. 35884.

ALDRICH, Prof. J. M., Moscow, Idaho: Sixty-seven specimens of Coleoptera, including the rare Cerambycid genus *Piodes*, new to the Museum collection. 35424.

ALEXANDER, W. H., Bassoterre, St. Kitts, West Indies: Collection of natural history specimens. 35370.

ALLEN, A. J. (See under Cambridge Botanical Supply Company.)

ALLEN, GLOVER M., Intervale, N. H.: Three snakes (*Thamnophis sirtalis pallidula*), topotypes, from Bartlett, N. H. 35587.

ALLEN, Mrs. L. P., Dunedin, Fla.: Four starfishes. 35654.

AMERICAN ELECTRICAL WORKS, Providence, R. I.: Thirty-two electrical conductors. 35807.

ANDERSON, A. P., Clemson College, S. C. Received through Department of Agriculture: Ninety-four plants. Exchange. 35401.

ANDERSON, R. T., West Aylmer, Ontario, Canada: Specimen of *Callimorpha clymene* Brown. 36129.

ANDRUS, F. H., Elkton, Oreg.: Thirteen specimens of *Vertigo andrusiana* Pilsbry (35331); land and marine shells (36391).

ANGEL, Miss LILLIE, Orange, N. J.: Three specimens of violets. Exchange. 36514.

ANTHONY, A. W., Portland, Oreg.: Shrew (*Sorex* (*Atophyrax*) *bendirei*), from Taylorsville, Cal. 36669.

APPLEGATE, E. I., Klamath Falls, Oreg.: Specimen of *Scirpus*, from Oregon. 36108.

ARNHEIM, J. S., San Francisco, Cal.: Shell and specimen of *Eunaticina*, from California. 35701.

ARNOLD, Hon. DELOS, San Pedro, Cal.: Type specimen of *Caryophyllia arnoldi* Vaughan. 36621.

ARNOLD, EDWARD, Battlecreek, Mich.: Two skins of *Falco richardsonii*. 36200.

ASBESTOS AND ASBESTIC COMPANY, Danville, Quebec, Canada: Specimens of asbestos and asbestic material. 35557.

ASH, CHARLES E., Newport, R. I. Received through Dr. E. A. Mearns: Lobster weighing 27 pounds. 36684.

ASH, C. J., National Home, Va.: Primitive rat trap. 36596.

ASHE, W. W., Raleigh, N. C.: Three specimens of *Viola* (gift). (36261); 50 specimens of violets (exchange) (36568); 50 specimens of violets (exchange) (36634).

Atkinson, G. E., Portage La Prairie, Manitoba, Canada: Four skulls of moose (*Alces americanus*); skull of elk (*Cervus canadensis*). 36629.

Atkinson, Richiel, Atkinson, Ala.: Cricket (*Gryllotalpa borealis* Burm). 36355.

Attwater, H. P., San Antonio, Tex.: Seventeen birds' eggs and 2 nests from Texas. 36064.

Auringer, Rev. O. C., Troy, N. Y.: Fourteen rude stone implements. Exchange. 36338.

Austin, S. W., Independence, Cal. Received through Department of Agriculture: Plant collected by W. L. Hunter (35794); received through Department of Agriculture: 6 plants from California (36512).

Bachline, John, Washington, D. C.: Marine shells and echinoderms from Cuba. 35251.

Bailey, Gen. G. W., Atchison, Kans. Received through Smithsonian Institution, Bureau of Ethnology: Four pieces of pottery from mounds near Charleston, Mo.: medicine bag obtained from the Sioux Indians, Rosebud, S. Dak.; necklace from the Apaches of Arizona; wolf-skin headdress from the Sioux Indians, and a skin scraper from an Indian tribe located near Perry, Iowa. 35415.

Bailey, Vernon, Washington, D. C. Received through Department of Agriculture: Specimen of *Tillandsia* from Texas. 36536.

Baker, Carl, Washington, D. C.: Sixteen specimens of Umbelliferæ from Colorado. 36082.

Baldwin, D. R., Ravenden Springs, Ark.: Specimen of *Tabanus mexicanus* Linnæus. 35248.

Bangs, Outram, Boston, Mass.: Ninety-two birds' skins from Colombia, South America (35458); 102 birds' skins from the Santa Marta region of Colombia not previously represented in the Museum collection (35655, 35859); 2 skins and skulls of mammals (36171); 100 birds' skins from Loma del Leon, Panama (36579).

Banks, Nathan, Department of Agriculture: One hundred and seventy-eight specimens of Odonata from North America. 35818.

Barber, A. W., Washington, D. C.: Two pieces of broken pottery, 4 pieces of human bones, and part of a flint arrow-point (36270); seed of Coönti plant from a cocoanut grove at Biscatai Bay, Florida (36299). (See under Mrs. H. D. Brainard, and Smithsonian Institution, Bureau of Ethnology.)

Barber, Mrs. A. W., Washington, D. C.: Two skins of snakes. 36011.

Barber, C. M. (See under Wooten, E. O.)

Barber, Herbert, U. S. National Museum: Thirty specimens of Odonata from Washington, D. C., and vicinity. 35821.

Barbour, W. C., Sayre, Pa.: One hundred and twenty specimens of violets. Exchange. 36703.

Bark, James E., Phoenix, Ariz.: Twenty-six small arrow-points found on the Superstition Mountains (36218); pieces of charred yarn found in a ruin on the Verde River (36388).

Barnes, George D., Chattanooga, Tenn.: Three hundred and thirty-five specimens of Lower Carboniferous fossils from Oak Mountain, James County, Tenn. Purchase. 35382.

Barnes, Dr. W., Decatur, Ill.: Twenty-two specimens of rare Lepidoptera, including 4 types of species described by the donor. 35923.

Barnhart Brothers & Spindler, Chicago, Ill. Received through F. J. V. Skiff, director of Field Columbian Museum, and G. A. Dorsey, curator of anthropology: The old Ramage printing press. 35949.

Barrett, O. W., Museo de Comision, Tacubaya, D. F., Mexico: Forty specimens of Coleoptera. 35239.

Barrott, A. F. (See under A. B. Johnson.)

Bartholomew, Elam, Rockport, Kans.: Specimen of Lupinus. 35953.

Bartlett, Mrs. C. H., Kittery, Me.: Thirteen specimens of *Telamona ampelopsides* Harris. 35360.

Bartsch, Paul, U. S. National Museum: Three specimens of Odonata from Washington, D. C. 35832.

Bass, W. L., Brooklyn, N. Y.: Nest of hummingbird (*Mellisuga minima*), from Jamaica. 36650.

Bateson, N. Maine, Norfolk, Va.: Piece of Fiji tapa cloth. 35969.

Bather, F. A. (See under London, England, British Museum of Natural History.)

Batty, J. H., Jersey City, N. J.: Seventeen skins of Trogons from South America (purchase) (35326); 2 skins of Trogons (gift) (35327).

Beach, Jay, Oakland, Cal.: Two photographs of a mammoth tusk. 36233.

Bean, B. A., U. S. National Museum: Fishes collected at Woods Hole, Mass. 35607.

Beaulieu, G. H. (See under Smithsonian Institution, Bureau of Ethnology.)

Becker, Dr. F. L. S., Grahamstown, South Africa: Specimen of *Voluta africana* Reeve, with a photograph showing the specimen in three positions. 36056.

Beckwith, Paul, U. S. National Museum: United States silver 10-cent piece dated 1831 (35333); currency (5 cents) issued by the mayor and common council of Jersey City, November 15, 1862 (35693); silver reals (9) of Ferdinand VII, King of Spain, dated 1802; 2 machetes obtained during the Cuban campaign (purchase) (35835); 3 silver coins (35856); money belt from Ponce, Porto Rico (35948); 2 coins of the Ottoman Empire (35967).

Beecher, Dr. C. E. (See under Peabody Museum; Yale University Museum.)

Bell, George, Denver, Colo.: Piece of gold-bearing breccia from Sheba Mine, Johannesburg, Africa. 35502.

Bellotti, Dr. C. (See under Milan, Italy, Museum of Natural History.)

Benedict, J. E., U. S. National Museum: Collection of dragonflies (35355); dragonflies and other insects (35405); marine invertebrates and mollusks (35463); 1900 microscopic slides illustrating annelids (purchase) (35738).

Benedict, J. E., Jr., Woodside, Md.: Collection of dragonflies from Provincetown, Mass. 35453.

Benjamin, Mrs. Marcus, Washington, D. C.: Badge and ribbon commemorating the forty-eighth meeting at Columbus, Ohio, of the American Association for the Advancement of Science (gift) (35562); ribbon badge of the American Chemical Society, December, 1897 (gift) (35582); 2 baskets made by Klamath Indians (exchange) (35912).

Bennett, Rev. William, S. J., St. John's College, Belize, British Honduras: Collection of reptiles and insects from Honduras. 35768.

Bennetts, W. J., Milwaukee, Wis.: Three plants. 35621.

Berea, Durban, Natal, Africa, Natal Botanic Gardens. Received through J. Medley Wood: One hundred and sixteen plants (36256); 100 plants (35680). Exchange.

Bessey, Prof. C. E., Lincoln, Nebr.: Plant from Black Hills, South Dakota. 36425.

Bethel, E., Denver, Colo.: Forty specimens of violets. (35400, 35524.)

Biascoechea, Henry, Aguadilla, P. R.: Collection of shells from Porto Rico. 36500.

Biederman, C. R., Gold Hill, Oreg.: Moths, butterflies, and other insects. (35619, 35501.)

Bien, W. H., Los Angeles, Cal.: Two species of land shells from California. 35879.

Bigelow, E. F., Stamford, Conn.: Coccinellid larvæ. 36577.

Billups, A. C., Concord, N. C.: Unios. 35632.

Bishop Memorial Museum. (See under Honolulu, H. I.)

Bissell, C. G. (See under Agriculture, Department of.)

Blackburn, Joseph, Hickman, Tenn.: Dobson fly, *Corydalus cornutus* Linnaeus. 35283.

Blackford, Dr. C. M., Jr., East Orland, Me.: Pupa of *Acronycta americana*. 35980.

Blaisdell, Dr. F. E., Mokelumne Hill, Cal.: Two skins and skeletons of gophers (*Thomomys*). 36179.

Blake, O. P. (See under Evens & Howard Fire Brick Company.)

Blanchard, Walter, Boulder, Colo.: Fourteen birds' eggs from Colorado. 35358.

Blasdale, W. C. (See under J. B. Davy.)

Blood, C. H., Los Angeles, Cal.: Two specimens of *Amphissa*, from White Point, Los Angeles County. 36217.

Boardman, C. A., Rimouski, Quebec. Received through the Department of Agriculture: Specimen of *Castalia tetragona*. Exchange. 35398.

Boepple, J. F., Muscatine, Iowa. Received through U. S. Fish Commission: Valves of colored and distorted Unionidæ. 36679.

Boettcher, F. L., Washington, D. C.: Plant. 35573.

Bogue, Prof. E. E., Stillwater, Okla.: Five galls and 2 specimens of *Aulax glectomæ* Linnaeus. 35683.

Bohm, J., Berlin, Germany: Thirty-eight species of fossil corals from Italy and Egypt. Exchange. 35546.

Booth, John, Coalville, Utah: Agates. 35686.

Bosworth, J. S., Sedalia, Mo.: Glass snake, *Opheosaurus centralis*, from Missouri. 35462.

Botanical Garden, Washington, D. C.: Two specimens of *Polypodium*, from the greenhouse. 36406.

Bousch, M., Buffalo City, N. C.: Ash beetle, *Dynastes tityus* Linnæus. 35321.

Boutwell, J. M., Montpelier, Vt.: Dark barre granite from Dark Barre Granite Quarries, Montpelier. 35388.

Bowdish, B. S., San Juan, P. R.: Bird skin (*Seiurus motacilla*) from Vieques, P. R. (36202); 10 birds' skins from Porto Rico (36488); specimen of *Dendroica adelaidæ*, from Porto Rico (36578).

Bowers, Stephen, Los Angeles, Cal.: Thirty-three specimens of Post-pliocene fossils, from Borax Lake, San Bernardino County, Cal. (36125); distorted salt crystals (36197); 2 specimens of cinnabar and hydrocarbon compound (36364).

Boynton, A. G., Biltmore, N. C.: Stone implement found near Asheville. 36449.

Boynton, Miss Laura E., Biltmore, N. C.: Forty specimens of violets. Exchange. 36633.

Brainard, Mrs. H. D., Wulfert, Fla. Received through A. W. Barber: Shell hatchet and a shell ornament from Buck Key near Sanibel Island, Florida. 36269.

Branch, H. Selwyn, Antrim Valley, Dominica, West Indies: Six skins of Imperial Parrot, *Amazona imperialis*. Purchase. 36483.

Branner, Dr. J. C., Stanford University, Cal.: Crustaceans collected in Brazil by the Agassiz Expedition in 1899. 36636.

Brannerman, Francis, New York City, N. Y.: Piece of cable from the U. S. battle ship *Maine*. 35261.

Bray, Prof. W. L., University of Texas, Austin, Tex.: Four hundred and forty-eight plants. Exchange. 35451.

Briggs, Dr. A. A., East Andover, N. H.: Specimen of sedge (*Carex conoidea*) (35297); plant (35674); 2 plants (36581);

Brigham, Dr. W. T. (See under Honolulu, H. I.: Bishop Memorial Museum).

Brill, J. A., Philadelphia, Pa.: Indian pipe made of soapstone and polished. 36024.

Brimley, H. H. and C. S., Raleigh, N. C.: Fifteen snakes (35616); reptiles and batrachians from Mexico (36058). Purchase.

Brisbin, Edward, Boise, Idaho.: Diatomaceous earth. 35634.

Britton, Dr. N. L., New York City, N. Y.: Specimen of *Sedum mexicanum* Britton (35645); 9 plants from Yukon Territory (35898). Exchange. (See under New York Botanical Garden).

Britts, Dr. J. H., Clinton, Mo.: Specimens of fresh-water mussels from Missouri. 35756.

Brodie, Dr. William, Toronto, Canada. Received through Dr. L. O. Howard: Collection of insects. 36522.

Brodnax, Dr. B. H., Brodnax, La.: Two stone celts. 36595.

Brooks, A. H., U. S. Geological Survey: Fossil shells and corals from Russell Springs, Flint River, Georgia. 36505.

Brooks, Louis, Santiago, Cuba: Ancient Arawack bowl from a cave near Santiago, collected by Mr. W. H. Holmes. 36682.

Brown, C. F., Hot Springs, Ark.: Two quartz crystals. 36591.

Brown, E. J., Lemon City, Fla.: Mammal skins, insects, and reptiles from Florida (35452); butterfly (36615).

Brown, Herbert, Yuma, Ariz. Received through Department of Agriculture: Two specimens of snakes (*Contia episcopa* and *Rena humilis*). 35383.

Brown, Mrs. J. Crosby, New York City, N. Y.: Four musical instruments (purchase) (35344); military serpent (gift) (35721).

Brown, Mrs. N. M., Ashtabula, Ohio: One hundred and sixty-three plants, collected by E. A. Goldman in Mexico (purchase) (35713); 965 plants, collected by E. W. Nelson in Mexico (35759); 470 plants, collected in Mexico by Mr. Nelson (35842, 35841).

Brown, Philip F., Blue Ridge Springs, Va.: Specimen of maple-tree aphids. 36610.

Brown, W. L., San Francisco, Cal.: Five specimens of minerals (36309); received through B. L. Hasseltine, 5 specimens of minerals (36490).

Brown, W. P., Washington, D. C.: Copy of Welsh crwth. Purchase. 36525.

Brown, W. Q., Riddles, Oreg. Received through Mr. J. S. Diller: Nickel ore. 35723.

Bruce, R. E., Stanford University, Cal. Received through Dr. T. W. Stanton: Twenty-five specimens of Miocene fossils from Los Angeles County, Cal. 36020.

Bryant, F. W., Winchester, Cal.: Specimens of *Epiphragmophora indioensis*, from California (36132); 2 species of shells from California (35611).

Buckland Mineral Water Company, Washington, D. C.: Forty bottles of mineral waters. Purchase. 36613.

Buffalo Botanical Garden, Seneca, N. Y.: One hundred specimens of violets. Exchange. 35375.

Burnham, S. H., Vaughns, N. Y.: One hundred and twenty specimens of violets (35581); specimen of *Viola emarginata* (35963); 59 plants (36304).

Burns, Frank. (See under J. H. Early.)

Burnside, J. M., Hyattsville, Md.: Salamander (*Ambystoma opacum*) from Maryland. 35848.

Burrelle, F. A., New York City: Reduced reproduction of title page of the album presented to Admiral Dewey by the shipping merchants. 36502.

Busck, August. (See under Agriculture, Department of.)

Bush, B. F., Courtney, Mo.: One hundred and thirty-five plants (purchase) (36300); 121 specimens of mosses from the United States (exchange) (36186); 200 plants from Texas and Missouri (purchase) (36226).

Bush, Palmer, Craig, Colo.: Two plants. 36352.

Butler, Dr. C. M., Morenci, Mich.: Skin of Northern Phalarope, *Phalaropus lobatus*, from Michigan. 35550.

Button, F. L., Oakland, Cal.: Four specimens of land shells from California and Lower California (36144); 2 specimens of *Polygyra hindsii*, from Mexico (36220); 4 specimens of land shells from California (36532); marine and land shells (36607).

Butts, E., Kansas City, Mo.: Specimens of *Peripristis semicircularis* and *Philipsia major*. 35929.

Cadle, Col. Cornelius, Cincinnati, Ohio: Four photographs of a stone pipe. 36147.

Cahill, E. J., Boonton, N. J.: Four fossil fishes. 36374.

Calcutta, India, Indian Museum. Received through Frank Finn, deputy superintendent: Four birds' skins. Exchange. 35395.

Calcutta, India, Royal Botanical Garden: One hundred and nine plants. Exchange. 35915.

California Academy of Sciences, San Francisco, Cal. Received through Department of Agriculture: Forty-four species of Coleoptera from Baja, Cal., including many cotypes described by Dr. Horn. 36310.

Cambridge Botanical Supply Company, Boston, Mass.: One hundred and forty-seven specimens of mosses from the Cascade Mountains collected by A. J. Allen. Purchase. 36704.

Camp, J. H., Lima, Ohio: Specimens of miscellaneous insects (36478); beetle (*Calosoma scrutator* Fabr.). (36658).

Campbell, A. J., Luray, Va. Received through Department of Agriculture: Plant. 35572.

Candlin, H., Greeley, Colo.: Four snakes from Texas. 35806.

Canterbury Museum. (See under Christchurch, New Zealand.)

Carpenter, Miss Anna, Jersey Shore, Pa.: Specimens of Thripsidæ. 35845.

Carrico, E. T., Stithton, Ky. Received through Smithsonian Institution, Bureau of Ethnology: Five arrowpoints. 36440.

Carroll, Patrick, Hospital Corps, Dumaguete, Isle of Negros, Philippine Islands: Large beetle. 35977.

Cary, Merritt, Neligh, Nebr.: Birds' skins. Exchange. 36509.

Case School of Applied Science, Cleveland, Ohio. Received through F. W. Comstock: Five hundred and eighteen plants from Ohio. Exchange. 36585.

Casey, T. L., Vicksburg, Miss.: Fossil land shells. 36451.

Casper, A. B., Lowell, Mich.: Two specimens of parasitic flies (*Olfersia americana* Leach). 35425.

Cendoya, Julian, Santiago, Cuba: Torpedo shell from the Spanish war ship *Oquendo*, collected by Mr. W. H. Holmes. 36672.

Chamberlain, Dr. L. T. (See under Smithsonian Institution.)

Chamberlain, Mrs. M. A., Washington, D. C.: Five-dollar gold piece dated 1809. 36627.

Chapin, S. B., Tallahassee, Fla.: Specimen of Tachinid fly, *Jurinia metallica* Desv. 35601.

Chapman, Mrs. C. B., Macon, Ga. Received through U. S. Fish Commission: Specimens of recent and fossil shells. 35594.

Chapman, Frank M. (See under F. W. Urich.)

Chesser, John, Anthony, Tex.: Stone hatchet. 36450.

Chester, A. H., New Brunswick, N. J.: Specimen of hydrozincite from Bethlehem, Pa. 36281.

Chicago Colortype Company, Chicago, Ill.: Large assortment of sheets of flowers, animals, etc., printed in colortype. 35475.

Chickering, Prof. J. W., Kendall Green, Washington, D. C.: Three plants. Exchange. 35641.

Christchurch, New Zealand, Canterbury Museum. Received through F. W. Hutton, curator: Ethnological objects from the South Sea Islands, and a collection of Moa bones. 36389. Exchange.

Christensen, Hans, Conway, Wash.: Five specimens of lichens. 35351.

Clark, J. H., Paterson, N. J.: Nest and 2 eggs of Blue-throated Hummingbird, *Cœligena clemenciæ*, from Las Minas, Vera Cruz, Mexico. 36393.

Clark, Prof. William B. (See under Maryland Geological Survey.)

Clarke, Prof. F. W. (See under William Glenn.)

Clarkson, Frederick, New York City, N. Y.: Willow gall (*Cecidomyia ænigma* Welch) and parasites (*Cirrospelus flavicinctus* Riley). 35430.

Clearfield Coal Company, Tyler, Pa. Received through David White: Coke made from supposed Dugus coal in beehive ovens. 35801.

Clements, Mrs. J. C., Pewee Valley, Ky.: Snout-beetle (*Balaninus caryatrypes* Boh.). 35420.

Clough, L., East Concord, N. H.: Graphite from Deering, N. H. Exchange. 35962.

Clute, Willard N., Binghamton, N. Y.: Two hundred and ninety-three plants from Jamaica. Purchase. 36566.

Cobb, J. L., Lincolnton, N. C. Specimen of woolly aphids. 36603.

Cochrane, M. H., Madison, Ind.: Beetle (*Dynastes tityus* L.). 36115.

Cockerell, Prof. T. D. A. (See under New Mexico Agricultural Experiment Station.)

Cohn, A., Carson City, Nev.: Three photographs of Washoe Indian basketry. 36120.

Colburn, A. E., Washington, D. C.: Skeleton of an otter. 35731.

Cole, Mary A., Washington, D. C.: Specimen of Triton (*Spelerpes ruber*). 35855.

Coleman, Richard. (See under Smithsonian Institution.)

Coles, Mrs. C. S., Washington, D. C.: Sandal from San Juan River, Nicaragua. (35481); Turkey "call." (36368.)

Collett, Prof. Robert, Zoological Museum, Christiania, Norway: Fifteen microtine rodents from Norway. 35816.

Collins, F. S., Malden, Mass.: Seventy-five plants. Purchase. (35598, 36110, 36422.)

Collins, G. N., Department of Agriculture: Collection of Odonata, from the District of Columbia and vicinity (35822); 8 specimens of Odonata from the same vicinity (35823); 245 specimens of miscellaneous insects from Miami County, Fla. (35262); plant (35267); 60 specimens of *Viola tenella*, from Maryland (36402); specimen of Alamanda (36570.)

Collins, H. F., Barroteran, Coah, Mexico: Larvæ of 2 beetles. 36550.

Collins, J. F., Brown University, Providence, R. I.: Thirty specimens of violets. Exchange. 35796.

Colquitt, G. D., Washington, D. C.: Specimen of Cowkiller (*Mutilla occidentalis* Linnæus). 35397.

Colvill, W., Point Bleue, Lake St. John, Canada. Received through Dr. D. W. Prentiss: Skin of an albino muskrat (*Fiber zibethicus*). 35667.

Comstock, F. W. (See under Case School of Applied Science, Cleveland, Ohio.)

Congress, Library of. Received through Hon. Herbert Putnam, librarian: Thirty-three fragments of flags captured during the war of the Revolution and the war of 1812. Loan. 35989.

Connell, G. W., Ponce, P. R.: Specimen of Spider wasp, *Pepsis speciosa*. 36421.

Conzatti, C., Oaxaca, Mexico: Plant. 36379.

Cook, J. B., Los Angeles, Cal.: Quartz containing sulphides of copper and molybdenum. 36653.

Cook, Prof. O. F., U. S. National Museum: Three plants from Porto Rico (gift) (35930); 400 specimens of cryptogams from the vicinity of the District of Columbia (gift) (36015); basket made of "Poma rosa," *Eugenis jambos*, from Porto Rico (exchange) (36349); 5 cryptogams from Maryland and the District of Columbia (gift) (36628).

Copeland, E. B., Morgantown, W. Va.: Sixty-three plants from California, Colorado, and other localities. 36101.

Copper Queen Consolidated Mining Company, New York City. Received through George Notman, secretary: Stalactites from the Copper Queen mines at Bisbee, Ariz. 36470.

Coquillett, D. W., Department of Agriculture: Four hundred specimens of Diptera, including 46 species, types of 3 new genera and 29 new species (36042); 610 specimens of dipterous insects belonging to the family Anthomyidæ (36551).

Cory, Ernest, Takoma Park, D. C.: Two specimens of a species of *Mitromyces*. 36380.

Cotheal, Miss E. H. (See under Smithsonian Institution.)

Coubeaux, Eugene, Prince Albert, Saskatchewan, Canada: Four birds' skins (35535); 9 birds' skins (36394). Exchange.

Coville, F. V. (See under Agriculture, Department of.)

Cox, Emery, Brightwood, D. C.: Two specimens of Star-nosed Mole, *Condylura cristata*. 36387.

Cragin, F. W. (See under Charles Schuchert.)

Cranmer, Dr. C. C., New York City: Seed of an euphorbiaceous plant known as the Mexican "Jumping Bean," *Carpocarpa saltitans* Westro. 35503.

Craver, Rev. Samuel P. (See under William T. Foster.)

Crawford, Dr. Joseph, Philadelphia, Pa.: Specimens of *Carex umbellata* (exchange) (35340); specimen of *Isœtes dodgei* (exchange) (35868); specimen of *Viola* (exchange) (35464); 50 specimens of violets (exchange) (36513); 15 specimens of *Viola brittoniana* from Pennsylvania (gift) (36542).

Crevecœur, F. F., Onaga, Kans.: Bones, fossil plants, and mollusks from Kansas. 36546.

Crockett, Dr. J. G., Pulaski, Va.: Royal Horned Caterpillar, *Citheronia regalis* Fabr. 35403.

Crosby, F. W., Washington, D. C. Received through C. Droop: Specimens of pitchstone and kapper quartz from Saxony (purchase) (35511); 3 pieces of orbicular granite from Quonochontaug, R. I. (purchase) (35626, 35959); 2 specimens of sphalerite in chert (gift) (36135); galenite in stalactitic form (purchase) (36432); specimen of sphalerite in gangue (gift) (36696).

Crosby, F. W. (See under James Roach.)

Crosby, W. O., Massachusetts Institute of Technology, Boston, Mass.: Specimens of corundum from North Carolina and Georgia. Exchange. 35338.

Cross, F. J., Keystone, S. Dak.: Specimen of gold ore from the Cross mine (35614); geological specimen from the Silver Queen lode claim (35783).

Cross, Whitman, U. S. Geological Survey: Fifty-eight specimens of rocks from Saxony. 35336. (See under Interior Department, U. S. Geological Survey.)

Culin, Stewart, University of Pennsylvania, Philadelphia, Pa.: Plaster cast of a stone object. 35549.

Currie, R. P., U. S. National Museum: One hundred and twenty-six specimens of Odonata, from the District of Columbia and vicinity (35825); 16 species of Odonata, from Essex County, Va. (35826).

Curtis, W. E., Ladner, British Columbia: Two stone hammers and two stone mortars obtained from the Kit Kahtla Indians. 35737.

Curtiss, A. H., Jacksonville, Fla.: Two hundred and twenty plants from the Southern States (purchase) (36160); 205 plants (exchange) (36165). (See under estate of Mrs. Floretta A. Curtiss.)

Curtiss, Estate of Mrs. Floretta A. Received through A. H. Curtiss, Jacksonville, Fla.: One thousand one hundred and sixty plants, consisting of *Algæ curtissianæ* 35364. Bequeathed to the National Museum.

Cushing, E. M. (See under Smithsonian Institution, Bureau of Ethnology.)

Cusick, W. C., Union, Oreg. Received through the Department of Agriculture: Three hundred and forty-four plants (purchase) (35978); 7 specimens of Umbelliferæ (gift) (36062); 244 plants from Oregon (purchase) (36423).

Cutler, J. E., Denver, Colo.: Specimens of Phyllopoda. Exchange. 36416.

Daggett, Hon. John, Blackbear, Cal.: Unfinished Klamath basket, with specimens of all the materials used in making it; photographs of finished examples and descriptions of the work. 36156.

Dall, W. H., U. S. Geological Survey: Tertiary fossils (35518); collection of Tertiary fossils from various localities in Alaska, collected during the Harriman Expedition (35740); mollusks collected during the Harriman Expedition at Shoshone and Blue Lake, near Shoshone Falls, Idaho, Lowe Inlet, British Columbia, Biorka Island, Sitka Sound, English Bay, Kadiak, Dutch Harbor, Unalaska and St. Matthews Island, Bering Sea (35771); fossils of bowlder clay (Pleistocene) from Douglas Island, Alaska, from 75 to 200 feet above tide, on the line of the water pipe by which the village is supplied (35772); insects from Glacier Bay, Alaska, and from the moraine in front of the Grewingk Glacier, Kachekmak Bay, Cook's Inlet, Alaska, collected during the Harriman Expedition; also beetle and spiders from Biorka Island, Sitka Sound, Alaska (35773); wooden spoon carved by Chilkat Indians of Alaska (35982); 200 land shells, principally from Alaska and California (36077).

Daniel, Lieut. J. W., U. S. A., Lynchburg, Va.: Mammal skins from Matanzas, Cuba (35747); hummingbird (*Sporadinus riccordi*) from Cuba (35894); collection of birds from Cuba (36038); skin of a passenger pigeon, *Ectopistes migratorius* (36039).

Daniels, L. E., Brookston, Ind.: Unionidæ (35760, 35810, 36063); crayfishes (36637).

Darton, N. H. (See under Interior Department, U. S. Geological Survey.)

Davenport, H. C., East Orange, N. J.: Vulturine Guinea fowl (36164); Pheasant, *Thaumalea obscura* (36230.)

DAVIDSON, Dr. ANSTRUTHER, Clifton, Ariz.: Collection of insects. 36065.

DAVIS, C. G., Punta Gorda, Fla.: Larvæ of flannel moths (*Megalopyge opercularis*), and puparia of dipteron. 35921.

DAVIS, T. C., Marion, S. C.: An ear of corn of abnormal growth. 35570.

DAVIS, W. T., New Brighton, N. Y.: Forty specimens of violets (35313); 100 specimens of *Viola* and one specimen of *Rudbeckia* (35413). Exchange.

DAVISON, Mrs. L. P., Fort Myer, Va.: Decoration from the cap of a Spanish officer, Porto Rico. 35508.

DAVY, J. B., Berkeley, Cal.: One hundred and ten plants collected in California by Messrs. Davy and W. C. Blasdale. Purchase. 36376.

DAWSON, Mrs. CAROLINE, Washington, D. C.: Specimen of *Stagmomentis carolina* L. 35620.

DEAN, S. B., Arlington, Mass.: Five specimens of European heating and illuminating apparatus. Purchase. 36437.

DEANE, WALTER, Cambridge, Mass.: Seventy-eight plants. Exchange. 35867.

DEISHER, H. K., Kutztown, Pa. Received through Smithsonian Institution, Bureau of Ethnology: Thirteen arrowheads. 36170.

DE NYSE, W. I., Gravesend Beach, Brooklyn, N. Y.: Specimen of *Chloroscombrus chrysurus*. 35688.

DEVLIN, E., jr., U. S. National Museum: Common mole (*Scalops aquaticus*). 36465.

DEWEESE, DALL, Canon City, Colo.: Skin, skull, and leg bones of a calf moose, *Alces gigas*. 35627.

DEWEY, L. H., Department of Agriculture: Specimen of *Shortia*. 36446. (See under Agriculture, Department of.)

DEWHURST, Miss BESSIE L., Worcester, Mass.: Chrysomelid beetles. 36576.

DICKERSON, F. B., Detroit, Mich.: Dog-day Locust (*Cicada canicularis* Harris). 35467.

DICKIE, W. W., Richmond, Va.: Wheel bug (*Prionidus cristatus* Linnæus). 35711.

DICKINSON, JOHN, Estate of, New York City: Carbon, diamond dust, etc. Purchase. 36614.

DIETZ, Dr. W. G., Hazelton, Pa.: Six specimens of Microlepidoptera. 36420.

DILLER, J. S. (See under Brown, W. Q., and Interior Department, U. S. Geological Survey.)

DINGUS, H. H., Nasbie, Va.: Fossil plants. 36370.

DOANE, Prof. R. W., Pullman, Wash.: Eighty-three specimens of Diptera. 36199. (See under Washington Agricultural College, Pullman, Wash.)

DODGE, B. E., Richfield, Mich.: Walking-stick, *Diapheromera femorata* Say. 35404.

DODGE, G. M., Louisiana, Mo.: Four specimens of *Catocales*, including one type specimen (36212); 30 specimens of Microlepidoptera and living larvæ of a Catocala (36535).

DODGE, Mrs. KATHERINE T., Washington, D. C.: Collection of photographs of American Indians. Purchase. 35966.

DODSON, Dr. W. P., Flatbush, N. Y.: Seventy ethnological objects from Africa. 36436.

DOLAN, J. J., U. S. National Museum: Brown Bat (*Vespertilio fuscus*). 36347.

DONOVAN, STEVE, Glenns Ferry, Idaho: Neck vertebra of a camel found in a sandstone concretion. 35671.

DORAN, CHARLES, Washington, D. C.: Collection of Spanish stamps made during the Spanish-American war. 36273.

DORSEY, G. A. (See under Barnhart Bros. & Spindler.)

DRAKE, C. M., Gorda, Cal.: Marine shells and a starfish. 35466.

DREW, S. H. (See under Wanganui, New Zealand, Public Museum.)

DROOP, C. (See under F. W. Crosby.)

DRUERY, C. T., London, England: Three specimens of ferns. Exchange. 35477.

DU BOSE, G. M., Lisbon, Ga.: Unio shells (exchange) (35469); fossils from Iowa (gift) (35513); land shells (gift) (35720); 4 species of fresh-water mussels and a shell of a box turtle from Georgia (36533).

DU BOSE, J. H., Huguenot, Ga.: Fragments of pottery, arrow-heads, and other archæological objects. 35353.

DU BUISSON, G. H., New York City: Seven specimens of Silver fish moths (*Lepisma saccharina* Linnæus). 35473.

Duckworth, C. L., Arden, W. Va.: Perforated stone tablet. 36080.

Dudley, J. H., Tacoma, Wash.: Specimens of *Platarctia caja* Linnæus. 35484.

Duerden, J. E. (See under Kingston, Jamaica, Institute of Jamaica.)

Dugès, Prof. A., Guanajuato, Mexico. Six birds' skins, specimens of *Sphæroma dugesi* Dollfus, and dipterous larvæ (35285); 2 plants (35574); Coppery-tailed Trogon, *Trogon ambiguus;* specimens of lichens and a moth from the galls of *Tecoma mollis* (35714); 37 plants (35916); large oak gall (35944); nest and larvæ of *Eucheira socialis* Westw., and 2 specimens of lichens (36010); 4 plants from Mexico (36054); 3 birds' skins (36342).

Dutcher, Lieut. B. H. (See under Agriculture, Department of.)

Dyar, Dr. H. G., Department of Agriculture: Small collection of Hymenoptera from Maryland (35538); miscellaneous collection of insects from Southern Florida (36237).

Dysart, Miss Annie E., H. Matamoras, Mexico: Six plants from Mexico (36471); 2 water lilies (*Nymphæa elegans*) (36526).

Eames, Dr. E. H., Bridgeport, Conn.: One hundred and sixty specimens of violets. Exchange. 35414.

Earle, F. S., Agricultural Experiment Station, Auburn, Ala.: Three hundred and twenty-seven plants (exchange) (35380); 112 plants from New Mexico (purchase) (35517); 19 plants (exchange) (36301).

Early, J. H., Darlington, S. C. Received through Frank Burns: Bird-shaped ornament of brown slate from South Carolina. 36476.

Easterbrook, William, Camden, N. J.: Countersigned pass dated March 6, 1862; piece of a Confederate flag supposed to have been carried by General Morgan in Kentucky. 35449.

Eastwood, Miss Alice, San Francisco, Cal.: One hundred and seventy plants (35374); 96 plants (35399). Exchange.

Eaton, A. A., Seabrook, N. H.: Two ferns (35624); 160 specimens of violets (35712); 18 plants (35775); 6 plants, principally type specimens of the genus *Isætes* (36130). Exchange.

Eaton, J. M. C., Irvington, N. J.: Six eggs of a snapping turtle. 35324.

Eaton, Misses, Boston, Mass.: Five photographs of baskets. 35981.

Eby, Mrs. A. F., Lancaster, Pa. Received through Department of Agriculture: Eight plants from Pennsylvania. 36075.

Edison, T. A., Orange, N. J.: Model of "Spectacle type" phonograph, the first pattern used after the tin-foil record machines. 35337.

Eggleston, W. W., Rutland, Vt.: Four hundred and twenty-two plants (36255); 20 plants from Vermont (35873). Exchange.

Ehrhorn, E. M., Mountain View, Cal. Received through Dr. L. O. Howard: Small collection of Myriapods, etc. 35728.

Ehrmann, G. A., Pittsburg, Pa.: Seventeen specimens of Diptera. Exchange. 35769.

Eigenmann, Dr. C. H., Bloomington, Ind.: Type specimens of *Brackenridgia cavernarum*, from Yzel's Cave, San Marcos, Tex. (35984); land shells from Beaver Cave, near San Marcos, Tex. (35925).

Eliot, Sir Charles, British Embassy, Washington, D. C.: Collection of marine invertebrates from Samoa (35615); insects from Samoa (36292). (See under H. Suter.)

Elliott, J. D., Dale, Idaho: Specimen of alum. 35478.

Elrod, Dr. M. N., Columbus, Ind.: Twenty-five specimens of *Seminula cozona* from the St. Louis and Kaskaskia formations of Indiana. 36241.

Emmons, Lieut. G. T., U. S. N., Princeton, N. J.: Collection of ethnological objects from Alaska. Exchange. 36189.

Emmons, S. F., U. S. Geological Survey: Specimens of Peruvian copper-bearing rocks. 36188.

English, G. L. & Co., New York City: Fifteen specimens of minerals. Purchase. 35529.

Engman, E. J. Received through Department of Agriculture: Two plants from Louisiana. 35951.

Enos, H. C., Porters Station, Del.: Specimen of neuropteroid insect. 35310.

Evans, Glen W., Olivet, Mich.: Effigy pipe. Purchase. 36469.

Evans, J. M., Maitland, Ala.: Ethnological objects. Purchase. 36148.

Evens and Howard Fire Brick Company, St. Louis, Mo. Received through O. P. Blake: Terra-cotta model of the battle ship *Maine*. 35258.

Evermann, B. W. (See under Fish Commission, U. S.)

Faile, M., Washington, D. C.: Plants (35266, 36185, 36262).

Fant, A. L., U. S. National Museum: Copper coin of Russia (35902); 2 specimens of State script (parish of Concordia, La., April 15, 1862, and county of Fluvanna, Va., February 23, 1863) (36059).

Farrington, Prof. O. C. (See under Field Columbian Museum, Chicago, Ill.)

Faville, G. C., Norfolk, Va.: Specimen of silica from Chalk Creek, Wayne County, Tenn. 35559.

Faxon, Dr. Walter. (See under Museum of Comparative Zoology, Cambridge, Mass.)

Fay, H. W., De Kalb, Ill.: Four photographs illustrating archæological objects. 36390.

Fay, John, Mineral Point, Kans. Received through Department of Agriculture: Plant from Kansas. 36583.

Fearn, Dr. J. B., Yazoo, Miss.: Six Japanese coins. 35468.

Featherstonhaugh, Thomas, Washington, D. C.: Five watch movements. 35514.

Ferriss, James H., Joliet, Ill.: Three unios from Arkansas. 35913.

Fewkes, J. Walter, U. S. National Museum: Loom (35265); feathers used in the Soyaluna ceremony in 1899 among the Moki Indians of Arizona (36098). (See under Smithsonian Institution, Bureau of Ethnology.)

Field Columbian Museum, Chicago, Ill.: Received through Prof. O. C. Farrington: Specimen of Bjelokrynitschie meteorite and a specimen of Schönenberg meteorite. 35892.

Finn, Frank. (See under Calcutta, India, Indian Museum.)

Finn, John, Washington, D. C.: Kissing-bug, *Melanolestes picipes* H. Schp. 35329.

Fischer, V. G., & Co., Washington, D. C.: Five pieces of Delft ware. Purchase. 36023.

Fish Commission, U. S., Hon. G. M. Bowers, Commissioner: Marine shells and insects in alcohol collected in Porto Rico during the cruise of the steamer *Fish Hawk* in 1898–99 (35421); 51 plants collected by Dr. W. C. Kendall at Sebago Lake, Cobbosseecontee Lake, Rattlesnake Pond, and Panther Pond, Maine, in 1899 (35576); received through Dr. H. M. Smith, 2 species of unios from Georgia (35670); received through Prof. B. W. Evermann, 7 specimens of Odonata from Indiana (35820); plants from the Wabash Basin (35852); 2 specimens of Atlantic salmon, *Salmo salar*, from the Penobscot River, Maine (35857); 2 specimens of land-locked salmon, *Salmo salar sebago*, from Grand Lake, Maine (35910); specimen of *Callinectes sapidus* with a white claw, from Hampton Bar, obtained by N. Raynor and transferred to the Museum by Dr. H. M. Smith (35957); specimen of *Lysiosquilla scabricauda*, from the Gulf of Mexico (36308); 16 specimens of coral from Porto Rico (36448); crayfishes from Cape Henry, Virginia, collected by Dr. H. M. Smith (36553); 7 specimens of Porto Rico corals (36618); specimens of Japanese, Alaskan, Hawaiian, and Californian fishes collected by the steamer *Albatross* (36693). (See under Boepple, J. F.; Mrs. C. B. Chapman.)

Fisher, H. L., Califon, N. J.: Specimen of *Callimorpha clymene* Brown. 35349.

Fisher, W. H., Baltimore, Md.: Six photographs of snakes. 35648.

Fiske, W. F., Durham, N. H.: Sixteen specimens of Lepidoptera. Exchange. 35952.

Fitzgerald, Margaret P., Kneeland, Cal. Received through Department of Agriculture: Specimen of *Viola hallii*, from California. 36405.

Flahault, Professor. (See under Agriculture, Department of.)

Fleming, J. H., Toronto, Ontario, Canada: Two skulls of moose (*Alces americanus*). 36392.

Fletcher, James, Ottawa, Canada. Received through Dr. L. O. Howard: Collection of Diptera and other insects from Mount Cheam, British Columbia, and Canada. 35707.

Flett, J. B., Tacoma, Wash. Received through Department of Agriculture: One hundred and thirty-two plants (35961); 6 plants (36072); 10 specimens of ferns (36479). (See under Maxon, W. R.)

Foote, Dr. A. E., Philadelphia, Pa.: Ninety-three specimens of minerals. Purchase (35533, 36287).

Forepaugh, Adam, and Sells Brothers Circus: Rhinoceros (*Rhinoceros bicornis*), in the flesh. 36410.

Forney, A. H., U. S. National Museum: Specimen of *Diadophis punctatus*, from Virginia. 35491.

Foster, W. T., Sapucay, Paraguay. Received through Rev. S. P. Craver: Collection of moths, butterflies, beetles, and a frog from Paraguay (35692, 35813).

Fowler, Prof. James, Kingston, Ontario, Canada: Twenty-four specimens of Canadian violets. Exchange. 35888.

Fox, Dr. B. F., New Smyrna, Fla.: Three-tailed snake, *Eumeces fasciatus*. 35465.

Foxlee, E. W., Acton, London, England: Ten photo-enamels, Latinde Carmarsaes process, 1864. Purchase. 36375.

Frazar, Everett M., Yokohama, Japan. Received through George B. Frazar: Specimens of sulphur from Moyoro, Island of Etorfu, Kurile Islands. 36187.

Frazar, G. B. (See under E. W. Frazar.)

French, Capt. F. H., U. S. A., Manila, P. I.: Six amulets of stamped paper used by the Filipinos as a protection against American bullets, and taken from a Filipino prisoner at Logod, Cebu. 36429.

Frierson, L. S., Frierson, La.: Three specimens of flies (*Oscinis trigramma* Low) (35296); crayfish (*Cambarus diogenes ludovicianus* Faxon) (35288); specimens of *Unio amphichænus* (35596); 5 species of unios (35664); unios from Alabama (35809); crayfish (*Cambarus argillicola* Faxon) (36435); 2 crayfishes

Frierson, L. S.—Continued.
(36554); 10 specimens of crayfishes (*Cambarus diogenes* and *Cambarus blandingii acutus*) (36592); specimen of *Cornus planorbis*, from Zanzibar (36675).

Frishmuth, Mrs. S. E., Philadelphia, Pa.: French bagpipe. Purchase. 35877.

Fritsch, Dr. Anton. (See under Prague, Bohemia; K. K. Böhmische, Karl-Ferdinand-Universität; Prague, Bohemia, Museum des Konigreichs Bohmen.)

Fritz, C. D., Sellersville, Pa.: Five plants. 35876.

Frobenius, L., Leipzig, Germany: Collection of spears and stone implements from islands in the Indo-Pacific Ocean and from Western Africa. Exchange. 35240.

Froggatt, Prof. Walter W., Department of Agriculture, Sydney, New South Wales: Collection of parasitic Hymenoptera from New Zealand. 36673.

Fuller, C. V., Lansing, Mich.: Casts of bird amulet and banner stone. 35988.

Fuller, J. J., Weiser, Idaho: Fossil leaf impression from the foothills of Bitter Root range, southwestern portion of Washington County, Idaho. 35497.

Fyles, Rev. T. W., Levis, Quebec, Canada. Received through Department of Agriculture: Miscellaneous collection of insects from Quebec. 36236. (See under Agriculture, Department of.)

Gadsden, J. B. (See under Treasury Department, Light-House Board.)

Gann, T., Corozal, Colombia, South America: Plaster cast of a flint implement. 36611.

Gates, Dr. W. A., Rockland, Mich.: Three pieces of native copper used by American Indians. 35479.

Gestro, Dr. R., Museo Civico di Storia Naturale, Genoa, Italy: Three Burmese rats. Exchange. 36052.

Giers, F. T., Port of Spain, Trinidad, West Indies: Twenty-eight bats from Trinidad; (35330) 61 bats from Trinidad (36322.)

Gies, A. J., chief inspector streets and drainage, Manila, P. I.: Ethnological, historical, and technological objects, and four horns of mammals. Purchase. 36555.

Gilbert, Hon. B. D., Clayville, N. Y.: Two specimens of ferns (35860); 9 specimens of *Asplenium* (36048). Exchange.

Gilbert, Prof. C. H. (See under Leland Stanford Junior University.)

Gill, Dr. Theodore, Smithsonian Institution: Specimens of *Mus musculus* (35941, 36323.)

Gillian, Rev. J. D., Pocatello, Idaho: Lumbar vertebra of a camel. 35275.

Glassford, Maj. William, U. S. A., Chief Signal Officer, San Juan, P. R.: Three birds' skins. Deposit. 36489.

Glatfelter, Dr. N. M., St. Louis, Mo.: Seventy plants (35376); 25 specimens of violets (35494). Exchange.

Glen Island Museum, New Rochelle, N. Y.: Fossil Gar Pike. Exchange. 36126.

Glenn, Capt. E. F., U. S. A., Vancouver Barracks, Wash.: Rocky Mountain goat. 36090.

Glenn, William, Baltimore, Md. Received through Prof. F. W. Clarke: Sand chrome and chrome salt. 35743.

Godbug, T. K., Waldo, Fla. Received through Department of Agriculture: Specimen of *Rhineura floridana*, from Waldo. 35286.

Goding, Hon. F. W., U. S. Consul, Newcastle, New South Wales: Collection of aboriginal weapons and utensils. 35704.

Goldman, E. A. (See under Agriculture, Department of, and Mrs. N. M. Brown.)

Goll, G. P., Washington, D. C.: Plants from Porto Rico. (36018, 36055.) Purchase.

Gordon, R. H., Cumberland, Md.: Nine specimens of Lower Helderberg fossils. 35725.

Goward, Gustavus, Washington, D. C.: Collection of Korean pottery (36044); intaglio drawing on ivory; carved bamboo brush holder; hot-iron etching on paper; fan umbrella; lacquer twine holder; Korean measure; 2 Korean key holders; pocket looking-glass; twine winder; pipe bowl inlaid with silver (36499); 2 Etruscan vases, 3 Chinese vases, Korean vase, 2 Japanese vases, and a Chinese teapot (36350). Purchase.

Graenicher, Dr. Sigmund, Milwaukee, Wis.: Twelve specimens of Diptera (two species new to the collection). 35926.

Graham, G. A., Graham, Tex. Received through Department of Agriculture: Specimen of *Daucus pusillus*, from Texas. 36661.

Grant, F. H. McK., Melbourne, Victoria, Australia: Three hundred and eighty-nine specimens of Eocene and Oligocene fossils from Hamilton, Victoria, Australia. Exchange. 36095.

Graves, J. A., Susquehanna, Pa.: Two plants. Exchange. 36175.

Gray Herbarium, Boston, Mass.: Plants. (35933, 36401, 36138.) Exchange.

Gray, R. P., East Orland, Me.: Specimen of parasitic copepod. 36073.

Grebnitski, N. A., St. Petersburg, Russia: Four skins of fur seals (*Callotaria ursina*). 35901.

Greene, Prof. E. L., Catholic University, Washington, D. C.: Specimen of *Solidago monticola* (gift) (35972); specimen of *Ribes menziesii*, from California (exchange). 36443.

Greene, W. Maxwell, U. S. Consul, Hamilton, Bermudas: Specimens of hard, fine-grained limestone found near Shelly Bay, Bermuda. 36501.

Greene, Hon. W. Maxwell. (See under J. Brooks Hunt.)

Gresley, W. S., Erie, Pa. Received through F. H. Knowlton: Fossil plants. 36314.

Greyson, T. B., Waghorn, Alberta, Northwest Territory: Nine specimens of *Erebia discordalis*. 35537.

Grice, Frank, San Antonio, Tex.: Four fossil teeth of the Southern Mammoth, *Elephas colombi*. 36455.

Griffin, W., Somerset, Ky.: Fossil crinoid. 35564.

Griffith, H. K., Washington, D. C.: Old-style bicycle. 35291.

Griffiths, David. (See under Agriculture, Department of.)

Grinnell, Joseph, Pasadena, Cal.: Eight birds' skins from Alaska (35986, 36438).

Gross, J. Mason. (See under Rhode Island Graphite Company.)

Grout, A. J., Plymouth, N. H.: Thirty-six specimens of mosses. Exchange. 35373.

Gunn, Calvin, St. Louis, Mo.: Stone club head found on an ancient Indian camp site near Mississinawa River, Wabash County, Ind. 36078.

Guthrie, Leon J., Willemstad, Curaçao, West Indies: Bats from the West Indies (36111, 36524). Purchase.

Haley, C. B., Oklahoma City, Okla. T.: Specimen of Wheel bug, *Prionidus cristatus* Linnæus. 35754.

Hall, R. J., Fort Plain, N. Y.: Fragments of pottery from an Indian burial site, Minden, N. Y. 36548.

Hallock, Charles, Washington, D. C.: Fourteen specimens of fossils from various localities. 35774.

Hamilton, J. A., Chambersburg, Pa.: Larva of *Photinus pyralis* Linnæus. 35245.

Hammell, P. J., Bellevue, Iowa: Five arrow-points. 36128.

Hammond, J. B. (See under Smithsonian Institution.)

Hampson, Sir George. (See under London, England; British Museum.)

Handwerk, J. H., Joliet, Ill.: Three specimens of *Pisidium handwerki* Sterki, from a type lot obtained in Joliet. 36067.

Hansard, A. C., Luguillo, P. R.: Nests of trapdoor ants from Porto Rico. 35318.

Hard, W. M., Colon, Colombia, South America: Twenty specimens of Lepidoptera. Purchase. 36639.

Haring, A. B., Frenchtown, N. J.: Two insects. 35553.

Harper, M. L., & Co., Washington, D. C.: Specimens of mineral waters. Purchase. 36574.

Harr, Miss Alice, Forest Glen, Md.: Specimens of *Diemyctylus miniatus*, from Maryland. 36655.

Harriman, A. S., Bucksport, Me.; Two collections of insects. (35281, 35455.)

Harriman, Edward H., Harriman Expedition. Received through Dr. C. Hart Merriam: Large collection of Alaskan insects and arachnids. 36670.

Harris, Graham H., Chicago, Ill.: Trout (*Salvelinus marstoni*), from Lake Tourilli, Quebec. 35656.

Harrison, Benjamin, Jacksonville, Fla.: Jaws of a tiger shark from Nassau Sound. 35871.

Harrison, Miss Carrie, Department of Agriculture: Five plants. 35660.

Harrison, W. H., Petersburg, Va.: Hawk-moth. 36477.

Hart, C. A., Urbana, Ill.: Two specimens of Sawflies (*Schizocerus zabriskei* Ashm.). 35943.

Harvey, F. L. (See under Agriculture, Department of.)

Harward, Miss Winnie, Albuquerque, N. Mex.: Two plants. 36537.

Harwood, Dr. George, Johnson City, Tex.; Larva of Texas Screw-worm, *Chrysomyia* (*Lucilis*) *macellaria* Fabr. 36144.

Hasbrouck, Dr. E. M., Washington, D. C.: Skin of Brown Pelican, *Pelecanus fuscus*, from Florida (exchange) (36040); 2 Crossbills (*Loxia curvirsotris minor*) (gift) (36167).

Hassall, Dr. Albert, Department of Agriculture: Plant from the District of Columbia (35571); bat (*Vespertilio fuscus*) (35927).

Hasseltine, B. L. (See under Brown, W. L.)

Hatcher, J. B., Princeton, N. J.: Collection of reptiles, batrachians, and fishes from South America. 35802.

Hause, H. D., Syracuse, N. Y.: Fifteen plants (35516); specimen of *Pyrola secunda* (35450); 2 violets (36539); 35 specimens of *Viola selkirki* (36527); 5 violets from central New York (36625). Exchange.

Havens, Capt. J. G. W., U. S. Life-Saving Service, Point Pleasant, N. J.: Cutlass-fish (*Trichiurus lepturus*). 35798.

Hawks, A. McL., Tacoma, Wash.: Marine shells from Washington. 35528.

Hay, Prof. W. P., Washington, D. C.: Triton (*Spelerpes ruber*), from the District of Columbia. 35706. (See under Williamson, E. B.)

Haymond, Mrs. Dorcas, Morgantown, W. Va.: Six pieces of pottery. 36307.

Hazzard, David, Milton, Del.: Samples of iron ore. 36152.

Heath, Harold, Pacific Crove, Cal.: Two specimens of Anomuran crabs (35299); Isopods from Monterey Bay (35332).

Heidemann, O., Department of Agriculture: Ten specimens representing two species of Hemiptera, new to the col-

Heidemann, O.—Continued.
lection (35563); specimen of *Euphorbia adenoptera* Bertol (35599); 4 specimens of *Aradus niger* Stal (35628); cotypes of *Aphrophora irrorata* Ball, and a specimen of *Aphrophora annulata* Ball, from Utah and Nebraska (35964).

Heller, A. A., Lancaster, Pa.: Plants from Porto Rico. Purchase. (36354, 36473.)

Hemphill, Henry, San Diego, Cal.: Specimen of selenites from San Diego (35427); land-shells (35456).

Henderson, L. F., Gray Herbarium, Cambridge, Mass.: Type specimen of plants (*Downingia*) (gift) (36103); 4 plants from Idaho (exchange) (36377, 36400); plant from Idaho (exchange) (36586).

Henshaw, H. W., Hilo, Hawaii: Bat (*Lasiurus semota*) (gift) (35316); 469 birds' skins from Hawaii (purchase) (35325); crustaceans (gift) (35464, 35540); crab (*Calappa gallus*) (gift) (35694); shrimp (gift) (36235); 3 specimens of shrimps (*Atyoida*), from Kaiwiki, Hawaii (36528).

Herrera, Prof. A. L., Museo Nacional, Mexico: Memorandum concerning the imitation of protoplasm by oleates, with preparations illustrating the same. 36037.

Hess, L. L., Marathon, Tex.: Received through R. T. Hill: Specimen of cinnabar from Terlinga, Brewster County, Tex. 35560.

Hesseltine, T. B. (See under Wilfred L. Brown.)

Hill, Hon. David J. (See under State Department.)

Hill, R. T., U. S. Geological Survey: Flint chips from Peña, Colorado Springs, Tex. 35646. (See under L. L. Hess.)

Hill, Mrs. W. E., Fort Bliss Station, El Paso, Tex.: Kissing bug (*Melanolestes abdominalis* H. Schaff). 35365.

Hillebrand, Dr. W. F., U. S. Geological Survey: Vanadium and carnotite-bearing sands from San Miguel River, Placerville, near Telluride, Colo. 35359.

Hilliard, G. B., Urbana, Ohio: Kissing-bug (*Melanolestes picipes* H. Schf). 35418.

Hills, R. C., Denver, Colo.: Eocene fossils. 35586.

Hinds, J. E., Brooklyn, N. Y.: Electrical apparatus. 36642.

Hine, Prof. J. S., Ohio State University, Columbus, Ohio: Forty specimens of dragonflies (35423); 2 specimens of dragonflies (*Lepthemis gravida* Calvert) (35817).

Hitchcock, Prof. A. S., Manhattan, Kans. Received through Department of Agriculture: Plant (gift) (35777); 90 violets (exchange) (35886).

Hitchcock, C. H., Hanover, N. H.: Geological material from the Hawaiian Islands (35600, 36124). Purchase.

Holland, Dr. J., Pahala Kau, H. I.: Cranium, celt, and a piece of lava from a lava cave, Hawaii. 36146.

Holman, F. C., Cali, Colombia, South America: Two specimens of Torrent Ducks (*Merganetta columbiana*). 36025.

Holmes, J. H., Dunedin, Fla.: Marine shells from Florida (35253, 35566).

Holmes, W. H., U. S. National Museum. (See under Brooks, Louis; Cendoya, Julian, and Martine, Dr. José.)

Holzinger, J. M., Winona, Minn.: Fifty-six specimens of mosses (exchange) (35377); specimen of *Talinum rugospermum* (gift) (35973); 5 plants (exchange) (36051); specimen of moss (exchange) (36358).

Honolulu, Hawaiian Islands; Bishop Memorial Museum. Received through Dr. W. T. Brigham, director: Land-shells from the Hawaiian and other islands in the Pacific Ocean. 35767.

Hopkins, Rev. A. C., Charlestown, W. Va.: Luna moth (*Actias luna* Linnæus). 35368.

Horan, Joseph, U. S. National Museum: Three Remington and Spencer cartridges, said to have been used during the Cuban campaign. 35319.

Horgan, E. J., U. S. National Museum: Two skins and skull of *Mus decumanus*. 35854.

Horniman Museum. (See under London, England.)

Hough, Mrs. Myrtle Zuck, Washington, D. C.: One hundred and seventy-four plants from Arizona. Purchase. 35579.

Hough, Dr. Walter, U. S. National Museum: A hat worn by a member of Ringo's artillery company, one of the early military organizations of Washington, D. C. (35485); land-shells from Mexico (35932). (See under Smithsonian Institution, Bureau of Ethnology.)

Houtz, Mrs. E. T. (See under Smithsonian Institution, Bureau of Ethnology.)

Howard, Dr. L. O. (See under Agriculture, Department of; Ehrhorn, E. M.; Fletcher, James; Brodie, Dr. William.)

Howe, C. F., Bridgetown, Barbados, West Indies: Reptiles and batrachians (36045); large specimen of Manjak from Chalky Mountain Mine, Barbados, received through Mr. P. McDonough (36113).

Howell, A. H., Washington, D. C.: Plants from Vermont (35272); plant (35661); 2 plants from Duke, Va. (36569).

Howell, E. E., Washington, D. C.: Specimen of sulphur crystals; specimen of fluorite crystals; 2 specimens of agates; specimen of lodestone; models of the Great Mogul diamond and a fossil fish (purchase) (36647); specimen of lodestone (presented to the Smithsonian Institution) (36648).

Hubbard, H. G., and Schwarz, E. A., Department of Agriculture. Received through E. A. Schwarz: Three thousand specimens of North American insects. 35819. (See under E. A. Schwarz.)

Hudson, Dr. J. W. (See under Smithsonian Institution, Bureau of Ethnology.)

Hunt, J. Brooks, Hamilton, Bermuda. Received through Hon. W. Maxwell Greene: Geological material. 36134.

Hunter, William, Washington, D. C.: Five plants (35575); specimen of *Lasiurus borealis* (35657).

Hunter, W. L. (See under Austin, S. W.)

Huse, T. W., Fort Benton, Mont.: Two specimens of Sphinx-moth. 35356.

Hutchens, J. F. (See under Robert Scott.)

Hutchinson, Dr. W. T., Winchester, Va.: Spotted skunk (*Spilogale*) (35716); 7 eggs (one set) of *Rallus virginianus*, from Virginia (35719).

Hutton, F. W. (See under Christchurch, New Zealand, Canterbury Museum.)

Ihering von, Dr. H. (See under Sao Paulo, Brazil, Museu Paulista.)

India Museum. (See under Calcutta, India.)

Interior Department, *United States Geological Survey:* Five hundred and ninety boxes and crates containing a collection of fossil vertebrates and trays transferred from New Haven, Conn.; stone implement (35249); igneous and sedimentary rocks and ores from Little Belt Mountains, Montana, obtained by Walter H. Weed (35263); fossil fishes and fossil leaves, collected by H. W. Turner from the Big Smoky formation, California (35264); 5 stone implements from Umatilla, Oreg., and a pair of seal-skin boots from Port Clarence, Alaska (35672); 366 specimens of Lower Cambrian brachiopods from Troy, N. Y. (35734); kaolin from the line of the Georgia Railroad near Augusta, Ga. (35800); coals and clays from Pennsylvania (35907); 740 specimens of Ordovician, Silurian, and Devonian fossils (35935); series of drawings of fossil vertebrates for comparison with the fossils constituting accession 35249 (35956); geological specimens from Big Tree quadrangle, California, collected by H. W. Turner (36003); geological specimens from Uvalde quadrangle, Texas, collected by T. Wayland Vaughan (36030); 28 specimens of Middle Devonian fossil plants from Mapleton, Aroostook County, Me., collected by Prof. H. S. Williams (36060); series of Dinosaur bones, collected in the Black Hills by N. H. Darton (36114); 750 specimens of rocks, collected in the Anthracite and Crested Butte quadrangles of Colorado by Whitman Cross (36181); series of fossil fishes from the Jurassic of Colorado (36183); received through David White, 5 specimens of Paleozoic insects, collected by Mr. White (36210); 388 specimens of rocks from Silver Cliff, Rosita district,

INTERIOR DEPARTMENT—Continued.
Colorado (36274); 11 specimens of minerals principally tellurides from Calaveras County, Cal. (36288); 413 plants collected by J. B. Leiberg in Oregon (36317); 10 specimens of blue hornblende schist from Oregon, collected under the direction of J. S. Diller (36456); gold quartz vein from Swank mining district, Kittitas County, Wash. (36475), 2 specimens of *Cancer proavitus* Pack (type) from the Miocene green sand of Gayhead, Mass. (36588); well-core from a deep drilling at Hubbard City, Tex. (36608); 3 fossils plants from Michigan consisting of one specimen of *Stigmaria verrucosa* (Mort) Mill, from Owasso, and 2 specimens of *Neuropteris* n. sp., from the Standard Mine, near East Saginaw (36589); fossil plants associated with the lavas of the Cascade Range; fossil plants of the Montana formation; fossil plants of the Payette formation; plants from the Cascades of Columbia River, made by F. H. Knowlton, G. K. Gilbert, and others, fossil plants from Esmeralda County, Nev., made by H. W. Turner (36534); specimen of orbicular amphibole-gabbro from Yosemite Valley, obtained by H. W. Turner (36685). (See also under Lucas, T. and Socoloff, D.)

D'INVILLIERS, EDWARD V., Philadelphia, Pa.: Specimens of sulphur from Mexico. 35700.

IRELAND, W. J., Arapahoe, Nebr.: Specimen of beetle (*Harpalus*). 35665.

IVY, JESSE W., Mount Pleasant, Miss.: Beetle, *Calosoma scrutator* Fabr. 36549.

JACKSON, Miss VICTORIA, Bowling Green, Ky.: Fresh-water shells from Kentucky. (35651, 35814.)

JAMAICA, INSTITUTE OF. (See under Kingston, Jamaica.)

JASCENSKI, Prof. LEONARD V., St. Petersburg, Russia. Received through Mr. G. F. Kunz, New York City: Three specimens of nephrite from Siberia. 35554.

JENNINGS, FOSTER H., Washington, D. C.: Fourteen Korean hats. Exchange. 35448.

JERMEY, W. P., St. Louis, Mo. Four plants from the Great Bend region of the Rio Grande in Texas. 36378.

JOHNSON, A. B., Linnæus, Oreg. Received through A. F. Barrott: Archæological objects from Oregon. (35999, 36241.) See under Treasury Department, Light-House Board.)

JOHNSON, C. F., Freeport, Ill.: Fifty-three plants, principally from Illinois. Exchange. 36139.

JOHNSON, Prof. C. W., Wagner Free Institute of Science, Philadelphia, Pa.: Collection of fossil corals from the Pliocene of the Caloosahatchie River, Florida. Purchase. 35585.

JOHNSON, H. W., Habana, Cuba: Specimen of carbonate of lime. 35488.

JOHNSON, W. R., Rossland, British Columbia: Collection of butterflies and moths. 35350.

JOHNSTON, J. W., Midlothian, Va.: Pupa case of a fossorial wasp. 36598.

JONDEZ, A., San José, Costa Rica, Central America: One hundred plants from Costa Rica. Purchase. 35623.

JONES, C. W. Battersea, S. W., London, England: Small clay pipe (36094); 2 clay pipes (36646).

JONES, MCDUFFEE, AND STRATTON COMPANY, Boston, Mass.: Twenty-five pottery plates depicting Americal historical scenes. 36697.

JONES, MARCUS E., Salt Lake City, Utah: Thirty specimens of violets and specimens of Umbelliferæ (36033); type specimen of plant (36381). Exchange.

JORDAN, R. B., Carrollton, Va.: Bald eagle. 36247.

JUDD, S. D., Department of Agriculture: Five specimens of bats (*Vespertilio fuscus*), from Georgetown, D. C. 35343.

JUDGE, JAMES, Columbus, Ohio: Specimen of Hair seal (*Phoca*). 35669.

JUDSON, Mrs. ISABELLA FIELD, Ardsley on Hudson, N. Y.: Pennant from the U. S. frigate *Niagara* used during 1857 and 1858, and also on the steamer *Great Eastern* in 1865 and 1866, while engaged in laying telegraph cables across the Atlantic Ocean. 35547.

JUETT, J. S., Orlando, Fla.: Crab spider. 35790.

KARIGER, CURTIS, Kendallville, Ind.: Specimen of *Chalchophora campestris* Say. 36008.

KATZENBERGER, G. A., Greenville, Ohio: Photograph of a collection of archæological objects. 36313.

KEARNEY, T. H., Washington, D. C.: Twenty plants from Maryland and the District of Columbia. 36587. (See under Agriculture, Department of.)

KELSEY, F. W., San Diego, Cal.: Specimens of Diplodonta in alcohol from San Diego (35992); mollusk (36047); 60 specimens of marine shells from California, representing 19 species (36068); 3 specimens of Myoforceps (36166).

KENDALL, W. C. (See under Fish Commission, U. S.)

KENNEDY, Dr. HARRIS, Roxbury, Mass.: Seventeen specimens of bats (*Phyllonycteris planifrons*). 36321.

KEPLER, FRANK, Clifton, Ariz.: Obsidian pebbles. 35470.

KESEL, JOSEPH, Sabra, Mont.: Cocoon of a Cecropia moth. 36333.

KEW, LONDON, ROYAL BOTANIC GARDENS: Seven hundred and twenty-three plants from the Philippine Islands. Exchange. 35273.

KIEFFER, Prof. J. J., Bitche, Deutsch-Lothringer, Germany: Specimens of parasitic Hymenoptera from Europe and Africa. 36604.

KIMBALL, Miss LAURA F., National City, Cal.: Six specimens of *Asplenium blepharodes* (36149); 15 specimens of ferns (36204). Exchange.

KINCAID, T., University of Washington, Seattle, Wash.: Seventeen specimens of crustaceans. 36594.

KINGSBURY, GEORGE, care Gerrit S. Miller, U. S. National Museum: Batfish (*Cephalacanthus volitans*), from St. Kitts, West Indies. 35294.

KINGSTON, JAMAICA, Institute of Jamaica. Received through J. E. Duerden: Eight specimens of crustaceans representing 4 species. 35447.

KIRKLAND, Dr. R. J., Grand Rapids, Mich.: Ten specimens of *Pisidium medianum* Sterki, and 6 specimens of *Pisidium kirklandi* Sterki, from type lots collected in Michigan. 36066.

K. K. BÖHMISCHE Karl-Ferdinand Universität. (See under Prague, Bohemia.)

K. K. NATURHISTORISCHEN HOFMUSEUM. (See under Vienna, Austria.)

KLEIN, E., Mace, Ind.: Volcanic dust (35595); nest of a hornet (*Vespa*) 35732.

KNIGHT, Prof. W. C., University of Wyoming, Laramie, Wyo.: Forty specimens of fossil leaves from Rock Creek, near Harpers Station, Union Pacific Railroad, Albany County, Wyo. (35905); specimen of *Microtus mordax* (36283).

KNOWLES, F. E., San Francisco, Cal.: Granite from Raymond Quarries, Madera County, Cal. 35335.

KNOWLES, W. A., U. S. National Museum: Four specimens of dragonflies from Havre de Grace, Md. 35827.

KNOWLTON, F. H., U. S. Geological Survey: Fifteen plants (35849); Star-nosed mole (*Condylura cristata*), from Laurel, Md. (36486). (See also under Gresley, W. S.; Interior Department, U. S. Geological Survey.)

KOENIG, Dr. ADOLPH, Pittsburg, Pa.: Twenty-seven plants from Pennsylvania (gift) (36177); 80 plants (exchange) (36624) 8 photographs of violets (gift) (36690); 50 specimens of violets (gift) (36705).

KOFOID, Dr. C. A., Urbana, Ill.: Type specimens of *Platydorina caudata*, a new genus and species of Volvocidæ. 36026.

KRANTZ, F., Bonn, Germany: Specimen of Bischtube meteorite. Exchange. 36494.

KREITE, R., Kansas City, Mo.: Twenty-five specimens of Upper coal measure fossils from Kansas City. Exchange. 35652.

KRUEGER, P. W., Cleveland, Ohio: Seven specimens of insects. 36088.

KUNZ, G. F., New York City: Nephrite from Russia, China, and Silesia. Exchange. 35786. (See under Jascenski, Prof. Leonard V.)

LACOE, R. D., Pittston, Pa.: Twenty-two specimens of Upper Carboniferous fossils (36231); 47 specimens of *Naiadites estheria*, from the Upper Carboniferous of Pennsylvania (36462).

LADBURY, Miss EMMA, Gallatin, N. Dak.: Moth (*Attacus cecropia*). 36671.

LAMBERT, W. M., Tampa, Fla. Received through H. S. Ray: Portions of the carapace of a large tortoise. 35689.

Lamson-Scribner, Prof. F. (See under Agriculture, Department of.)

Langley, Hon. S. P., Smithsonian Institution: Model of a wave-propelled boat invented by Mr. Herm. Linden, Naples, Italy. Deposit. 36282.

Latto, A. P., Southampton, N. Y.: Specimen of Bonito (*Sarda sarda*). 35691.

Lauer, R. C., Milwaukee, Wis.: Small porcelain doll with an oyster attached, found on the beach at Bedloe Island, New York. 36222.

Leasure, W. A., Ludlow, via Bagdad, Cal.: Solphugid (*Datames formidabilis* Simon). 36657.

Lee, Mrs. Elizabeth Lloyd, Alexandria, Va. Received through Charles Schafer: Lock of hair said to have been taken from the head of George Washington. 36022.

Leiberg, J. B., Athol, Idaho: Seeds of a new Umbellifer from Crater Lake, Oregon. 35788. (See under Interior Department, U. S. Geological Survey.)

Lejeune, Dr. Adolf, Galveston, Tex.: Ninety-five specimens of Devonian fossils representing 35 species; 65 specimens of Cretaceous fossils (19 species), and 70 specimens of Tertiary fossils (32 species), from Europe. Exchange. 35965.

Leland Stanford Junior University, Stanford University, Cal. Received through Prof. C. H. Gilbert: Skeleton of Harris' Cormorant (exchange) (36069); land-shells from Cocos and the Galapagos islands (gift) (36158); Japanese fishes, including types of 14 species obtained principally by K. Otaki (36692).

Levering, T. J., Lafayette, Ind.: Proof from steel plate entitled "Abolishing Slavery," engraved by Walter Shirlaw. 35752.

Lewis, Corp. George C., U. S. A., Fort Myer, Va.: Skin and skull of bat (*Lasiurus borealis*) (35392); collection of mammals, insects, and reptiles from the Philippine Islands (35896).

Lewis, J. B., Petaluma, Cal.: Eleven ceremonial objects of stone and 2 specimens of chalcedony geode in lava. Exchange. 36561.

Limbach & Welch, Victor, Colo.: Ten crystals of calaverite. Purchase. 35504.

Linthicum, Dr. T. W., Savage, Md. Received through J. D. McGuire: Two flaked spear-points found on a farm near the Patuxent River. 36498.

Liston, H. F., U. S. Indian service, Covelo, Cal.: Pitt River Indian basket (Po-num-chaw). 36336.

Locker, H. C., Lafayette, Ky.: Fungus growth from the bladder of a hog. 35942.

London, England, British Museum. Received through Sir George Hampson: Collection of Hymenoptera including about 1,000 specimens from St. Vincent and Granada (35715). Received through Mr. Oldfield Thomas: Two topotypes of *Nectomys garleppii* (35843); 2 squirrels, *Sciurus*, specimens of *Mus messorius*, a cricetine rodent belonging to the genus *Rhipidomys*, and a hedgehog (35844). Received through F. A. Bather: twenty-three wax and paraffin casts of British fossil starfishes (36294).

London (Forest Hill), England, Horniman Museum. Received through Richard Quick, curator: Two old-style pig-scrapers made of bullock's hoofs with a piece of iron for a scraper, from St. Neot's, Hunts. Exchange. 35279.

Lorenz, Master R. M., Piscataway, Md.: Nest of *Vespa maculata* Fabr. 36057.

Loring, J. Alden, New York City. Eight mammal skins and skulls. Exchange. 36327.

Lounsbury, C. P., Natal, South Africa: Vial containing alcoholic larva (*Lophostethus*). 36214.

Lovett, Edward, Croydon, England: Collection of amulets in Bohemian glass representing teeth of animals, etc. Exchange. 36162.

Lowe, H. N., Long Beach, Cal.: Crustaceans, jellyfishes, etc. Exchange. 35378.

Lowe, Prof. V. H., Geneva, N. Y.: Eleven specimens of chalcids. 35568.

Lucas, T., Passaic, N. J.: Received through Interior Department, U. S. Geological Survey: Four fossils and a photograph of the locality where they were found. 35381.

LUDLOW, S., & Co., Spring Lake, N. J.: Specimen of Leather-jacket, *Oligoplites occidentalis*. 35391.

LUGENBEEL, H. G., U. S. National Museum: Specimens of *Mus musculus*. (35604, 36441.)

LUTHER, Dr. R. M., South Orange, N. J.: Two Burmese dahs, 2 Zulu spears with native handles, and 2 Naga spears. 35729.

LYON, M. W., jr., U. S. National Museum: Specimen of Cassis (35445); 3 skins and skulls of *Mus musculus* (35612); 4 fox squirrels (*Sciurus niger*) (purchase) (36325).

MCALLISTER, J. T., Hot Springs, Va.: Tooth of a mastodon. 36407.

MCCLATCHIE, Prof. A. J., Phoenix, Ariz.: Specimen of *Asplenium vespertinum* Maxon, from California. 36538.

MCCLURE, S. S., New York, N. Y.: Colored sketch of Mammoth restored. 35985.

MACCLURE, WILLIAM. (See under L. V. Pirsson.)

MACCORMICK, R. C. (See under Smithsonian Institution, Bureau of Ethnology.)

MCCORMICK, L. M., Glen Island Museum, New Rochelle, N. Y.: Small collection of bats from the Philippine Islands. (36001); bats and a crab from Porto Rico, West Indies (36663).

MCDONOUGH, P., Bridgetown, Barbados, West Indies: Bats from the vicinity of Bridgetown (purchase) (35998); reptiles and batrachians (gift) (36045). (See under C. F. Howe.)

MCGEE, Dr. ANITA NEWCOMB, Washington, D. C. Received through Smithsonian Institution, Bureau of Ethnology: Sun-dried brick from a shell mound near Hampton, Va. 35548.

MCGEE, W J, Bureau of Ethnology, Washington, D. C.: Musquaki loom. Exchange. 36385.

MCGINNIS, W. H., Youngstown, Ohio: Thirteen specimens of selenite crystals. 35834.

MCGOWAN, Mrs. E. P., Washington, D. C. Received through Department of Agriculture: Plant from California. 36582. (See under Agriculture, Department of.)

MCGREGOR, R. C., Palo Alto, Cal.: Ten birds' skins from California (deposit) (35490); 2 birds' skins (*Tringa minutilla*) (gift) (35605); 75 birds' skins from California (exchange) (35869); crustaceans and mollusks from the Hawaiian Islands (gift) (36562).

MCGREW, MORRIS, Plainville, Ohio: Fine siliceous mud from Florida. 35590.

MCGUIRE, J. D. (See under Linthicum, Dr. T. W.)

MCINTOSH, W., St. John's, New Brunswick, Canada: Six specimens of Lepidoptera. 36419.

MCINTYRE, FRANK, Bohemia, Oreg.; Crystals from Oregon (35993); specimens of cerussite, from Musick Mine, Bohemia Peak, Calipooha Range. (36173); specimens of cerussite (36221.)

MCKINNEY, M. B., Estatoe, N. C.: Soapstone carving from Mitchell County. 35947.

MACMILLAN, Prof. CONWAY, University of Minnesota, Minneapolis, Minn.: Ninety-six specimens of violets. Exchange. 36085.

MCMILLAN, P. A., Banyan, Fla.: Water-bug, *Belostoma uhleri* Montandon. 35797.

MCNALLY, MAJOR V. (See under War Department.)

MCNULTY, Dr. L., Laurel, Md.: Skin and skull of a fox. Exchange. 36339.

MACALESTER, C., Wytheville, Va.: Mounted albino Summer Duck (*Aix sponsa*), from New Jersey. 35872.

MACOUN, Prof. JOHN, Geological Survey, Ottawa, Canada: Six hundred and forty-one specimens of mosses from St. Paul Island, Bering Sea (purchase) (36029); 586 plants (purchase) (36356); 100 specimens of violets from Canada (exchange) (36515).

MADSEN, Serg. O. J., U. S. A., Puerto Principe, Cuba: Sphinx-moth. 35954.

MAGRETTI, Dr. PAOLA, Milan, Italy: Four hundred and ninety-four specimens of Hymenoptera. Exchange. 36372.

MAHLER, Miss A. L., Chelan, Wash.: Cricket (*Stenopelmatus talpa* Burm.). 35718.

MAIER, JACOB, Philadelphia, Pa.: Homopterous insect (*Telamona ampelopsidis* Harris). 35246.

Manning, Mrs. E. G., Washington, D. C.: Crab-spider, *Acrosoma spinea* Hentz. 35472.

Marbury, Miss E. M., U. S. National Museum: Two music boxes of French manufacture. 36046.

Markley, E. M., Bainbridge, Pa.: Grooved axe. 36654.

Markley, R. C., Hatboro, Pa.: Beetle and larvæ. 36699.

Marshall, Ernest. (See under George Marshall, Henry Marshall, and Henry Marshall, jr.)

Marshall, George, U. S. National Museum: Skull of a Red Fox, *Vulpes fulvus;* skin and skull of a common mole, *Scalops aquaticus*, and skin and skull of a Shrew mole, *Blarina brevicauda* (35919); 3 snakes from Maryland (36205); 4 bats (*Lasiurus borealis*) (36324); skull of Red Fox *Vulpes fulvus* (36341); Short-Tailed Shrew *Blarina brevicauda* (36466; leeches and crayfishes collected in Laurel by Henry and Ernest Marshall (36497). (See under Ernest and Henry Marshall.)

Marshall, Henry, U. S. National Museum: Gray squirrel, *Sciurus carolinensis*, from Laurel, Md. 36417.

Marshall, Henry and Ernest, Laurel, Md.: Three bull-frogs (35506); Red squirrel, *Sciurus hudsonicus loquax* (36485); fishes, including *Lepomis auritus; Lepomis gibbosus; Micropterus salmoides; Aphredoderus sayanys*, and *Notropis megalops* (35289); 2 flying squirrels (*Sciuropterus volucella*) and a bat (*Vespertilio fuscus*) (35366); mole, *Scalops aquaticus*, from Laurel (36454).

Marshall, Henry, jr., and Ernest, Laurel, Md. Received through George Marshall: Collection of fishes from Patuxent River. 36360.

Marshall, J. Rush. (See under Settle, Dr. Thomas L.)

Martin, Charles, Atlanta, Ga.: Specimen of Wheel-bug, *Prionidus cristatus*, Linné. 35346.

Martin, D. S., Presbyterian College for Women, Columbia, S. C.: Fragments of pottery. 36606.

Martine, Dr. Louis, Santiago, Cuba: Ancient Arawak bowl from Santo Domingo, collected by Mr. W. H. Holmes. 36683.

Marx, Mrs. M. D., Washington, D. C.: Collection of Arachnida and Acarina belonging to the late Dr. George Marx. Purchase. 35293.

Maryland Geological Survey, Baltimore, Md. Received through Prof. William B. Clark: Five specimens of *Terebratula harlani*, from the Eocene of Maryland. 36140.

Mason, Prof. O. T., U. S. National Museum: Baskets of the Abenaki Indians, collected by Professor Mason. 35583.

Mason, V. L., War Department, Washington, D. C.: Stirrups used by General Torral, commanding the Spanish troops at Santiago. 35357.

Mason, W. M., Washington, D. C.: Hair-comb worn by native women of the Philippine Islands. 36092.

Massachusetts Commission, New Orleans Exposition, New Orleans, La.: Collection of Gay Head Indian pottery unbaked. 35486.

Matthews, J. T., Armour, S. Dak.: Upper and lower tooth of an elk. 36316.

Maxon, Mrs. S. A., Oneida, N. Y.: Plants and fruits (gift and exchange) (35307, 35390, 35412, 35531); 100 specimens of violets (exchange) (36563).

Maxon, W. R., U. S. National Museum: Two hundred plants from West Virginia and Virginia (35580); 9 birds' skins from New York (35591) (exchange); 120 plants from New York and the District of Columbia (35643); collection of Odonata, from the District of Columbia and vicinity (35822); 44 specimens of Odonata, from Lowell, West Virginia, and Mountain Lake, Virginia (35824); 55 specimens of mosses from Washington State, collected by J. B. Flett (35887); 400 plants from the vicinity of the District of Columbia (36015); 21 plants from Washington, D. C. (36118); 30 plants from Maryland (36119); 60 specimens of *Viola tenella*, from Maryland (36402); 50 specimens of *Viola cuculata*, from the District of Columbia (36403); 45 specimens of *Viola sagittata* (36447); snake from the District of Columbia (36460); 2 birds (36521); 30 plants from Virginia (36571); 20 plants from Maryland and the District of Columbia (36587); 35 specimens of Odonata, etc. (36662).

Mauck, C. H., Memphis, Tenn.: Cranium found near West Memphis. 36652.

Mayer, Sergt. Maj. Casper, Fort Meade, S. Dak.: Larva of a golden-eyed insect (*Chrysopa*). 35482.

Mead, C. H., Ponce, P. R.: Fossils from the southern side of Porto Rico. 36503.

Mead, Eugene. (See under Smithsonian Institution, Bureau of Ethnology.)

Mearns, Dr. E. A., U. S. A., Fort Adams, Newport, R. I.: Collection of mammal skins and skulls, skeleton of a dolphin, fish-bones, bird's head, crabs, sponges, and birds' skins (gift) (36089); specimens of rocks showing weathering (purchase) (36508); collection of mammals, crabs, dry fish and fish-bones and a porpoise skeleton (gift) (36645). (See under Ash, C. E.)

Mearns, Master Louis di Zerega, Newport, R. I.: Two mammal skins and 4 birds' skins. Deposit. 36091.

Meehan, J. V., U. S. National Museum: Copy of the New York Herald of April 15, 1865, containing an illustrated notice of the death of President Lincoln. 36238.

Melnikof, M., Musée d' Institut des Mines, St. Petersburg, Russia: Specimens of meteorites (Indarka and Augustinowka). Exchange. 36296.

Melville, J. C., Prestwick, West Manchester, England: Two abyssal shells. 35584.

Melville, W. P., Sault Ste. Marie, Mich.: Reptiles, insects, a mammal, and a bird from Angola, West Africa. 35784.

Merriam, Dr. C. H. (See under Harriman, E. H.)

Merriam, J. C., University of California, Berkeley, Cal.: Two specimens of *Trochocyathus californianus* Vaughan (35805); 12 specimens of fossil corals from California (36632).

Merrihew, Mrs. E. L., Long Beach, Cal.: Shells. 35697.

Merrill, Dr. George P., U. S. National Museum: Slate and associated rocks from Brownville, Me. (35341); geological material from Maine, New Hampshire, and Vermont (35342); fresh-water mollusks from Penobscot County, Me. (35428); slates from Granville, Washington County, N. Y. (35510); meteoric stone from Duruma, East Africa (35815); minerals and associations from Mitchell County, N. C. (35880); skin of a lynx from Mitchell County, N. C. (35918); fresh and weathered rocks from Chatham, Va. (35983); specimen of turquoise from New Mexico (purchase) (36006); 10 photographs of quarries fossil vertebrates from Freezeout Hills, Wyoming (purchase) (36007); fragments of Veramin meteorite (36028).

Merrill, L. B., Paris, Me.: Geological material. Purchase. 35558.

Metz & Schloerb, Oshkosh, Wis. Received through C. A. Woodruff: Two pairs of snowshoes and two pairs of moccasins. 36275.

Mexico, Mexico, National Museum. Received through Dr. Manuel Urbina, director: Type specimen of *Cornus urbinai*, from Mexico. Exchange. 36540.

Miguel, Jean, Barrubio, Hérault, France: Collection of Cretaceous and Tertiary fossils, vertebrate fossils, and 36 prehistoric implements. Exchange. 36097.

Milan, Italy, Museum of Natural History. Received through Dr. C. Bellotti: Collection of fishes from the Red Sea and Italy. Exchange. 36396.

Miller, B. D., Peterboro, N. Y.: Two shrews. 36267.

Miller, Mrs. E. P., Atlantic City, N. J.: Specimen of Hippa and one of Libinia (36346); fiddler-crabs and Hippas from Atlantic City (36492).

Miller, F. J. X., Washington, D. C. Received through Department of Agriculture: Plant. 35675.

Miller, Gerrit S., Jr., U. S. National Museum: Specimen (topotype) of *Lepus bachmani ubericolor* (35317); tree-frog from New York (35320); type specimen of *Hyla evittata*, from Four Mile Run, Virginia (35436); mammals from Prince George County, Md. (35748); snake from Maryland (35780); bat, *Pipistrellus subflavus*, from Forest Glen, Md. (35928); frog (*Hyla versicolor*), from Massachusetts (35994); Fox Sparrow, *Passerella iliaca* (36265); collection of fishes made in the tributaries of Red Creek (36359); parasitic fungus from Virginia (36544).

Miller, Dr. M. G., Philadelphia, Pa.: Lizard-fish, *Synodus fœtens*, from Pine Island Sound, Florida. 36412.

Milligan, Dr. John D., U. S. Fish Commission: Skin of a Merganser. 35903.

Milner, A. N., Webb City, Mo.: Crystals of sphalerite and marcasite on chert. 36433.

Minnesota, University of, Minneapolis, Minn.: Fifty-seven plants from various localities. Exchange. 36357.

Minor, Lucian, Galveston, Tex.: Specimen of fulgurite found in the white sand hills in Ward County, N. Dak. 35498.

Missouri Botanical Garden, St. Louis, Mo.: One hundred and seventy-five specimens of violets collected by J. B. S. Norton (35577); specimen of *Viola viarum* (36519). Exchange.

Mitchell, Hon. J. D., Victoria, Tex.: Deformed carapace and claw of a crab (*Callinectes sapidus*) (35749); 4 specimens of *Dentalium disparile* from Texas (35779).

Mock, M. G., Muncie, Ind.: Sixteen spearheads, stone hatchets, drilled tablets, etc., from near Muncie. 35551.

Moe, Rev. P., Coon Valley, Wis.: Two fossil teeth of mammals. 35653.

Mooney, James. (See under Smithsonian Institution, Bureau of Ethnology.)

Moore, Clarence B., Philadelphia, Pa., and Pine Key, Fla.: Four shell hammers (36163); shell hatchet found on the surface of Mound Island, or Johnsons Key, Estew Bay, Lee County, Fla. (36250); shell implement from Goodland Point, Marco Island, Lee County, Fla. (36320); 27 perforated shell implements from the Ten Thousand Islands on the southeastern coast of Florida (36590).

Morris, E. L., Washington, D. C.: Six plants. Exchange. 35678.

Moses, W. H. (See under Admiral Dewey Reception Committee.)

Motter, Dr. Murray Galt, Washington, D. C.: Insects from Mountain Lake, Maryland. 35567.

Münch, Prof. Herman, San Cristobal, Mexico: Two species of ferns from San Cristobal (35384); fern from Mexico (35753).

Murphy, Rev. J. W., Washington, D. C.: Nest of Yellow-throated Vireo (*Vireo flavifrons*). 35471.

Musée d'Histoire Naturelle (Laboratoire d'Entomologie), Paris, France. (See under Paris, France.)

Museo Civico di Storia Naturale. (See under Milan, Italy.)

Museo Nacional. (See under San José, Costa Rica.)

Museu Paulista. (See under São Paulo, Brazil.)

Museum des Konigreichs Böhmen. (See under Prague, Bohemia.)

Museum of Comparative Zoology, Cambridge, Mass. Received through Dr. Walter Faxon: Six specimen of crabs representing 3 species. Exchange. 35906.

Musser, F. P., Millheim, Pa.: Crab-spider (*Gasteracantha cancer* Hentz). 35426.

Myer, S. N., Washington, D. C.: Peace Jubilee medal struck in Washington, D. C., May 23, 1899 (35864); forah pointer or "yad" made of olive wood (35881); bronze medal conferred by the city of Brooklyn on her citizen soldiers who participated in the war with Spain; badge of white metal of Company B, Thirteenth Infantry, Fifth Army Corps, who participated in the Spanish-American war (35960); plaque given to participants in the war with Spain, belonging to members of the First Brigade, Pennsylvania Volunteers (36000).

Mytinger, C., Navy Department, Washington, D. C.: Minerals, botanical specimens, fossil plants, fossils, tooth of a shark, and a sturgeon plate. 36609.

Narbel, Paul, Cour, Lausanne, Switzerland: Four skulls of mammals. Purchase. 36031.

Natal Botanic Garden. (See under Berea, Durban, Natal, Africa.)

National Museum of Mexico. (See under Mexico, Mexico.)

Navy Department, Washington, D. C., Hon. John D. Long, Secretary. Received from the Norfolk Navy-Yard, Norfolk, Va.: Collection of relics of the Spanish-American war (35459); collection of Spanish-American relics and a lens from a porthole of the U. S. S.

NAVY DEPARTMENT—Continued.
Cumberland in use during the civil war, 1861–1865 (35460); four 24-inch search lights and mounts captured from the Spanish fleet at Manila (35509); ribbons used with the floral decorations of the graves of the *Maine* dead in Habana, February, 1899 (35968). Deposit.

NEBRASKA, UNIVERSITY OF, Lincoln, Nebr.: Six specimens of invertebrate fossils from the Upper Cretaceous (Dakota formation), near Glasco, Kans., and Jackson, Nebr. 36266.

NELSON, AVEN, Laramie, Wyo.: Two hundred and eighty plants (exchange) (35515); 87 plants from the western section of the United States (exchange) (35874); 40 specimens of violets (exchange) (36034); 840 plants from the Yellowstone National Park (purchase) (36520). (See under Agriculture, Department of.)

NELSON, E. W. (See under Agriculture, Department of; Brown, Mrs. N. M.)

NEVE, MISS A. M., Tampa, Fla.: Larva of a beetle (*Coptocycla aurichalcea* Fabr.). 35705.

NEWCOMB, W., Tenafly, N. J.: Specimen of butterfly mosaic work. 36363.

NEWCOMBE, DR. C. F., Victoria, British Columbia: Starfish (*Pteraster*). 36386.

NEWMAN, REV. S. M., Washington, D. C.: Two specimens of *Dryopteris* from New York. 36463.

NEW MEXICO AGRICULTURAL EXPERIMENT STATION, Mesilla Park, N. Mex. Received through Prof. T. D. A. Cockerell: Collection of insects (35242); blind snake (*Leptotyphlops dulcis*) (35257); topotype of *Eremopedes scudderi*, variety *bicolor* Cockerell (35446); 2 plants from Arizona and New Mexico (36013); specimen of *Eutanypus borealis* Coquillett (36121); 7 specimens of bees (36176); 6 specimens of Diptera (36198); 11 plants principally from New Mexico (exchange) (36398); land isopods from New Mexico and Arizona (36208); 22 specimens of Hymenoptera, including several type specimens; 3 plants and 5 species of land shells (36312); 35 specimens of insects containing types and cotypes (36523); 23 plants from New Mexico (exchange) (36541); insects,

NEW MEXICO AGRICULTURAL EXPERIMENT STATION—Continued.
including Coleoptera, Diptera, Hymenoptera, etc. (36602).

NEW YORK AQUARIUM, New York City: Specimens of *Angelichthys ciliaris* and Trunk-fish, *Lectophrys triqueter*, from Bermuda, 35588.

NEW YORK BOTANICAL GARDEN, New York City. Received through Dr. N. L. Britton: One thousand and seventy-one plants from Montana. Exchange. 36150.

NICKEL, C. L., Cleveland, Ohio: Fossil plants and a concretion. 36691.

NIMS, CHARLES S. (See under United States Marble Company.)

NIXON, S. D., Baltimore, Md.: Three eggs of Chipping Sparrow, *Spizella socialis*, with abnormal coloration (36530); nest of Chipping Sparrow (36449).

NOBLE, S. W., Wilmington, N. C. Received through Department of Agriculture: Two plants representing the species *Stuartia malachodendron* L. 36565.

NORFOLK NAVY-YARD. (See under Navy Department.)

NORTHRUP, MRS. A. R., Yonkers, N. Y.: Specimen of Cassia from the Bahamas (36116); plant from the Bahamas (36223).

NORTHRUP, C. H., San José, Cal.: Specimen of Vivipara shell from California (35625); 3 specimens of Japanese Vivipara from San José (36249).

NORTON, DR. C. A. Q., Hartford, Conn.: Eight lamps. Exchange. 36182.

NORTON, J. B. S. (See under Missouri Botanical Garden.)

NOTMAN, GEORGE. (See under Copper Queen Consolidated Mining Company.)

NOWLAN, MRS. O. F., Janesville, Wis.: Specimens of minerals. Exchange. 36190.

NOYES, MISS C. E., U. S. National Museum: Proclamation issued from Headquarters Department of the Pacific, August 4, 1899; proclamation, military governor, Philippine Islands, Manila, January 4, 1899; proclamation, Philippine Commission, April 4, 1899. 35726.

NYE, WILLARD, jr., New Bedford, Mass.: Indian skull exhumed from the western bank of Acushnet River, New

Nye, Willard, jr.—Continued. Bedford (36272); 2 balls of bristles from the stomach of an alligator (36351).

O'Neill, Mrs. S. C., Day, Mo.: Larva of a Lampyrid (*Phengodes*). 35495.

Oakman, Miss, Edenton, N. C. Received through Department of Agriculture: Three specimens of violets from North Carolina. 36330.

Odell, W. S., Ottawa, Canada: Two salamanders (*Spelerpes bilineatus*). 35990.

Oglesby, W. J., Krebs, Ind.: Cases of common caseworms (*Thyridopteryx ephemeræformis*). 35311.

Ohlen, Emanuel. (See under Smithsonian Institution, Société de Numismatique et d'Archéologie de Montréal.)

Oldroyd, Mrs. T. S., Los Angeles, Cal.: Marine shells from San Pedro, Cal. 35924.

Olds, H. W., Department of Agriculture. Received through the Department: Thirty plants (35659); specimen of *Nitromyces lutescens* (35889); 5 plants from Maryland (36117).

Oöhner, Teodor, Zoological Institute, University, Upsala, Sweden: Four specimens of helminths. 35858.

Osborn, Prof. H. F., American Museum of Natural History, New York City: Two restorations of extinct reptiles (*Agathaumas* and *Nanosaurus*). 36207.

Osborne and Marsellis Company, Upper Montclair, N. J.: Trap rock used for macadam and street paving. 36043.

Osterhout, G. E., New Windsor, Colo.: Forty specimens of violets (exchange) (33312); 56 plants (exchange) (35389); plant (gift) (36353).

Otaki, K. (See under Leland Stanford Junior University.)

Otis, Isaac. (See under Smithsonian Institution, Bureau of Ethnology.)

Owen, Mrs. Narcissa, Washington, D. C.: Relics of Gen. George Washington. 36137.

Palestine Exploration Fund, Cambridge, Mass. Received through Rev. T. F. Wright: Cast of Lachish tablet; cast of seal of Haggai; cast of Wright bead; cast of Chaplin weight. Purchase. 35833.

Palmer, Edward, Washington, D. C.: Two hundred and fifteen plants from Kentucky (35255); 112 plants (35569); 225 plants from Durango and Saltillo, Mexico (purchase) (36459); 40 photographs of plants, etc. (36584).

Palmer, Grover, Barrow, Suffolk, England: Collection of British Lepidoptera. 35727.

Palmer, H. D., Olivet, Pa.: Beetle (*Alaus oculatus L.*) 36529.

Palmer, William, U. S. National Museum: Specimen of Queen snake, *Natrix leberis*, from Great Falls, Md. (35260); type specimen of *Dryopteris goldieana celsa* (35476); 65 plants (35658); Garter snake from Virginia (35882); Virginia deer, *Odocoileus americanus* (35920); muskrat (*Fiber zibethicus*), from Little River, Va. (35939); 35 birds' skins and 3 birds' eggs (36264, 36302); collection of insects and 48 birds' skins from Cuba (36415); reptiles and batrachians (36457); natural history specimens and geological material from western Cuba (36484); 5 specimens of fossil corals from Cuba (36491); 35 specimens of Odonata (36662); large collections of plants from Cuba (36253, 36254, 36271, 36289, 36297, 36298, 36318 36319, 36329, 36337, 36382, 36424, 36487, 36573, 36641, 36660, 36701).

Paris, France, Musée D'Histoire Naturelle (Laboratoire d'Etomologie): Six vials containing insects. Exchange. 35971.

Parish, S. B., San Bernardino, Cal.: Six plants from California and Arizona. 36225.

Parke, G. H., Williamsport, Pa.: Specimen of Carabid beetle, *Calosoma scrutator* Fabr. 36552.

Parker, A. T., Jersey Shore, Pa.: Specimen of *Epeira domiciliana* Hentz. 35673.

Parker, C. Le Roy. (See under Phelps, Dr. Albert.)

Parlin, J. C. (no address given): Plant from Maine. 36081.

Parmelee, H. P., Charlevoix, Mich.: Type specimen of *Pecten parmeleii* Dall, from the Pliocene of California. 36076.

Parritt, H. W., London, England: Echinoderms, crustaceans and 2 specimens of fishes. Exchange. 35695.

Parsons, Dr. W. B., Missoula, Mont.: Specimen of fungus (*Mycelium*) from Montana. 36191.

Patcanof, S. (See under Smithsonian Institution.)

Patten, Col. W. S., U. S. A. (See under War Department, Quartermaster-General's Office.)

Paxton, Rev. J. W., Danville, Va.: Two pieces of Chinese money. 36246.

Payne, E. J., Olympia, Wash.: Volcanic dust from near Mount Ranier, Thurston County, Wash. (35396); specimen of copper ore from Washington (35685); specimen of gold-bearing quartz (35761); 2 specimens of marble from Alaska (36384).

Peabody Museum, New Haven, Conn. Received through Dr. C. E. Beecher: Specimen of Iceland spar. Exchange. 35555.

Pearse, A. S., Lincoln, Nebr.: Batrachians and a hair worm from Montana. 36667.

Peck, Prof. C. H., Albany, N. Y.: Specimen of *Viola communis.* 35900.

Petersen, H. P., Washington, D. C.: Forty-six Mexican opals and an onyx paper knife. 36277.

Peterson, D., Lima, Mont.: Two specimens of impure graphite and a specimen of clay colored by graphite. 35987.

Phelps, Dr. Albert, Glens Falls, N. Y. Received through C. Le Roy Parker: Tooth of a fossil shark with perforations. 36133.

Phelps, G. B., Chicago, Ill.: U. S. Army belt buckle, found in one of the public buildings, Habana, Cuba. 36141.

Philadelphia Academy of Sciences, Philadelphia, Pa.: Two bats (*Phyllonycteris*). Exchange. 36326.

Philadelphia Museums, Philadelphia, Pa.: Fifty-four specimens of violets. Exchange. 36084.

Pierson, Mrs. D. L., East Northfield, Mass.: Katydid, *Scudderia curvicauda* Serv.; tree-crickets, *Œcanthus niveus* De Geer, and the Alder woolly aphid, *Pemphigus tesselata* Fitch. 35520.

Pike, G. H., Glens Falls, N. Y.: Eight fragments of pottery. 35304.

Pillsbury, D. S., New York, N. Y.: Elbow melodeon. Purchase. 36196.

Piper, C. V., Cambridge, Mass.: Received through Department of Agriculture: Plant from Washington, D. C. (36507); plants (36689, 36702). Exchange.

Pirsson, Prof. L. V., Yale University, New Haven, Conn.: Collection of rocks made in central France, around Clermont-Ferrand, obtained by William MacClure. 36004.

Pittier, Henri R., San José, Costa Rica: One hundred plants from Costa Rica (35597); 152 plants from Costa Rica (36564). Purchase.

Plitt, C. C., Baltimore, Md. Received through Department of Agriculture: Three plants. Exchange. 35642.

Pollard, C. L., U. S. National Museum: Two hundred and forty-five specimens of insects from Miami County, Fla. (35262); bat (*Vespertilio fuscus*) (35363); 200 plants from West Virginia and Virginia (35580); 8 specimens of Odonata from Washington, D. C., and vicinity (35823); 44 specimens (10 species of Odonata), from Lowell, W. Va., and Mountain Lake, Va. (35824); 20 specimens of *Lygodium palmatum* (35850); 15 cryptogams from the District of Columbia (36016); 30 plants from Maryland (36119); 3 plants from Maryland (36481); 200 plants (35644); 30 plants from Virginia (36571); specimen of *Arabis* from Maryland (36572); 35 specimens of Odonata, etc. (36662);

Pou, José, Ponce, P. R.: Specimen of coffee from Porto Rico. 35354.

Powell, W. F. (See under State, Department of.)

Prague, Bohemia, K. K. Böhmische Karl-Ferdinand Universität. Received through Dr. Anton Fritsch: Twenty specimens illustrating the development of *Sao hirsuta;* 3 trilobites; 12 species of cystidæ; hammer used by Barrande in geological work (35609); 9 specimens of Cambrian brachiopods from Bohemia (35690). Exchange.

Prague, Bohemia, Museum des Konigreichs Böhmen. Received through Dr. Anton Fritsch, director: Collection of fresh-water sponges from Germany. Exchange. 35543.

Pratt, F. C., Department of Agriculture: Ten specimens of insects. 35803.

Pratt, H. A., Washington, D. C.: Rain cloak, hat, brushes, and model of a Filipino hut. 36556.

Preble, E. A., Department of Agriculture: Five frogs from the District of Columbia (36431); 2 frogs from Maryland (36495).

Prentiss, Dr. D. W. (See under W. Colvill.)

Preston, H. L., Rochester, N. Y.: Meteoric stone from Bohemia, and a specimen of meteoric stone from France. Purchase. 36676.

Price, Miss S. F., Bowling Green, Ky.: Plants and fresh-water shells (35526, 35698, 36102, 36404).

Price, W. W., Nordhoff, Cal.: Five skins and skulls of mammals. 35997.

Pringle, C. G., Charlotte, Vt.: Four hundred plants from Mexico (35271, 35897). Purchase.

Proudfit, Robert, Washington, D. C.: Collection of stone implements from an Indian village site near Chain Bridge. 36340.

Public Museum. (See under Wanganui, New Zealand.)

Puffer, R., Dorchester, Mass.: Two specimens of native copper from Central Mine, Keweenaw County, Mich. 35474.

Purcell, N. J., Hillsboro, Va.: Roseate Spoonbill from Southern Florida. 35290.

Putnam, Hon. Herbert. (See under Congress, Library of.)

Putnam, Mrs. J. D., Davenport, Iowa: Basket from Aleutian Island. Exchange. 36136.

Quick, Richard. (See under London, England, Horniman Museum.)

Ralph, Dr. W. L., U. S. National Museum: Sixteen mammals from New York. 35853.

Ramsdell, Dr. F. R., Lampasas, Tex.: Cell of an Odynerid wasp. 35280.

Randall, C. W., Austinburg, Ohio: (Elaterid) (*Asaphes memnonius* Hbst.) and several specimens of insects (*Psocids*) (*Psocus venosus* Burm.). 35379.

Randolph, N. & Son, Houston, Tex.: Case-bug worms (*Thyridopteryx ephemeræformis* Haworth). 35431.

Randolph, P. B., Seattle, Wash.: Seven fragments of pottery from Kitchen Middens, near the junction of Nauvaranok River and Yukon, Alaska. 35521.

Raymond, W. H., East Orange, N. J.: Copalite containing insects. 35846.

Raynor, N. (See under Fish Commission, U. S.)

Ray, H. S. (See under Lambert, W. M.)

Reading, H. G., Franklin, Pa.: Worm case (35541); alcoholic specimens of *Bipalium kewense* (35739).

Reed, Walter D., Adelaide, South Australia. Shells from South Australia. Exchange. 35492.

Reeder, J. T., Calumet, Mich.: Specimen of domeykite in quartz (35282); 2 specimens of mohawkite (36345).

Reverchon, J., Dallas, Tex.: Twelve plants (gift) (36224); 100 specimens of Umbelliferæ from Texas (purchase) (36442).

Reynolds, Dr. E. R., Pension Office, Washington, D. C.: Three ferns (35622); specimen of *Viola brittoniana*, from Maryland (36518).

Rhode Island Graphite Company, Providence, R. I. Received through J. M. Gross, vice-president: Graphite from Cranston, R. I. 36036.

Richardson, C. H., Hanover, N. H.: Two specimens of rhodonite from Waits River, Vermont. 35556.

Richardson, James, Alamogordo, N. Mex.: Specimen of iron ore found in the San Adreas Mountains. 36413.

Richardson, W. W., Cooman, Manitoba, Canada: Luna moth, *Actias luna* Linnæus. 36599.

Richmond, Dr. C. W., U. S. National Museum: Eleven species of land shells from Porto Rico (36192); 7 birds' skins, a mouse, and a small collection of shells from San Juan, P. R. (36201); insects, shells, crustaceans from Porto Rico (36232); collection of mammals, birds, reptiles, insects, crustaceans, worms, and mollusks from Cuba and Porto Rico (36467); natural-history specimens from Porto Rico (36559).

Ridgway, Robert, U. S. National Museum: Three hundred and nineteen birds' skins from Alaska. 35457.

Riley, J. H., U. S. National Museum: Thirteen mammals from Franklin, W. Va. (35259); 30 mammal skins from the same place (35309); snake and 8 salamanders from West Virginia (35328); 14 mammal skins from Franklin, W. Va. (35362); land and fresh-water shells from West Virginia (35429); 11 birds' skins (35995); 3 eggs of *Ampelis cedrorum*, from West Virginia (36027); 6 mammals (36086); Pine Mouse (*Microtus pinetorum*) (36093); 35 birds' skins and 3 bird's eggs (36264, 36302); collection of insects and 48 birds' skins from Cuba (36415); reptiles and batrachians from Cuba (36457); collection of natural-history specimens and geological material from western Cuba (36484); 5 specimens of fossil corals (36491); large collections of plants from Cuba (36253, 36254, 36271, 36289, 36297, 36298, 36318, 36319, 36329, 36337, 36382, 36424, 36487, 36573, 36641, 36660, 36701).

Roach, James, Joplin, Mo. Received through F. W. Crosby: Calcite crystals. 36434.

Robbins, Dr. H. A., Washington, D. C.: Shells (*Physas*) from Burkartsville, Md. 35277.

Rockhill, Hon. W. W., Bureau of American Republics, Washington, D. C.: Greek musical instrument. 35565.

Roe, W. C., Colony, Okla. T.: Arapaho dance outfit. Purchase. 35699.

Rose, J. N., U. S. National Museum: Collection of Mexican plants (35950); land shells from Mexico (36019); 216 plants from Mexico (36157).

Rosenberg, W. F. H., London, England: Seven hundred and fifty specimens of Lepidoptera from Colombia and Ecuador. Purchase. 35633.

Ross, C., Howard, Kans.: One hundred and twenty specimens of Upper Carboniferous fossils from Kansas (35243); 195 specimens of fossils from the Upper Coal Measures of Elk County, Kans. (35649).

Rostel, C. B., Medford, Oreg.: Specimen of coleopterous larvæ. 36575.

Rowles, Prof. W. W., Cornell University, Ithaca, N. Y.: Eighteen plants from New York and North Carolina. Exchange. 35875.

Royal Botanic Garden. (See under Calcutta, India.)

Royal Botanic Gardens. (See under Kew, England.)

Rubin, C. A., Soldiers' Home, Washington, D. C.: Three moths. 36677.

Russell, Prof. I. C., Ann Arbor, Mich.: Calcareous marl used in making cement. 36017.

Rust, Dr. R. C., Hudson, Ohio: Shells. 35991.

Ruth, A., Knoxville, Tenn.: One hundred and thirty-three plants. Purchase. 35270.

Rydberg, P. A., Bronx Park, N. Y.: Plant from Big Horn Mountains, Montana. 36362. (See under Agriculture, Department of.)

Sabin, J. F., New York City: Oil portrait of an Indian. Purchase. 35241.

Samaha, M., Washington, D. C.: Twenty-four pieces of Bedouin jewelry. Purchase. 36211.

Samson, H. W., Washington, D. C.: Engraved portrait of General and Mrs. Washington, by Stuart. 36383.

San José, Costa Rica, Museo Nacional. Received through José C. Zeledon: Sixteen birds' skins from Costa Rica. Gift. 36665.

Santos, Mrs. T. Alejandro, Shorthills, N. J. Received through Julio R. Santos: Stone figure from Ecuador. 36286.

Santos, Julio R. (See under Mrs. Alejandro Santos.)

Sao Paulo, Brazil, Museu Paulista. Received through Dr. H. von Ihering, director: Twenty-seven specimens of South American brachiopods. Exchange. 35911.

Saunders, D. A., Brookings, S. Dak.: Ninety plants. Purchase. 35865.

Schafer, Charles. (See under Mrs. Elizabeth Lloyd Lee.)

Scheol, J. C., San Juan, P. R.: Mole cricket. 35789.

Schiller, Miss Bertha, La Salle, Ill.: Beetle (*Coptocycla aurichalcea* Fabr.). 35618.

Schuchert, Charles, U. S. National Museum: Pair of summer kamicks used by natives of Niakomat, Noursoak Peninsula, North Greenland (35303); 34 specimens of fossils from Baffin Land

Schuchert, Charles—Continued. and 868 specimens of fossils from Guelph (purchase) (35702); collection of fossils (35778); 50 specimens of Triassic and Jurassic and 225 specimens of Cretaceous invertebrate fossils and 200 lithological specimens from Wyoming (35863); plants from Wyoming (35870); 2 specimens of fossil wood from Bates Hole, Wyo.; a specimen of *Equisetum*, from Freezeout Mountain, Wyoming, and a specimen of *Halymenites major*, from Cooper County, Wyo. (35917); 1,322 specimens of Jurassic fossils, representing 76 species, collected near Malone, Tex., by F. W. Cragin (purchase) (36601); 2 fossil corals and an echinoid spine from the Eocene of Marlboro, Md. (36622).

Schwarz, E. A., Department of Agriculture: Reptiles from Arizona and California, obtained by H. G. Hubbard (35782); snake (*Tantilla nigriceps*) from Arizona (35838).

Schwarz, E. A., and H. G. Hubbard. Received through Mr. Schwarz: 3,000 specimens of North American insects. 35819.

Scisco, L. D., Baldwinsville, N. Y.: Bowl-shaped stone. 36688.

Scott, J. R., Petros, Tenn.: Night-flying Moth, *Triptogon modesta* Harris. 35433.

Scott, Robert, Pioneer, Mo. Received through J. F. Hutchens: Tooth of a bison. 36229.

Seal, W. P., Delair, N. J.: Specimen of *Ophibolus doliatus triangulus* and a young turtle (35284); fishes from North Carolina (36361).

Seegear, G. A., U. S. National Museum: Specimen of *Spelerpes ruber*, from Maryland. 36496.

Sehon, E., Huntington, W. Va.: Tooth of a mammoth. 36409.

Sells Brothers Circus. (See under Adam Forepaugh.)

Settle, Dr. T. L., Paris, Va. Received through J. Rush Marshall: Coiled taper and stand known as "Confederate Candle." 35958.

Seward, Miss Risley, Washington, D. C.: English hunting knife. 35407.

Sharp, Dr. David, Cambridge University, Cambridge, England: Six cotypes of Hawaiian Hymenoptera. 36619.

Shaw, C. P., Alberene, Va.: Wheel-bug, *Prionidus cristatus* Linnæus. 35755.

Shaw, R. E., Alberene, Va.: Ground snake, or Worm snake *Carphophiops amoenus*. 36227.

Sheahan, Thomas, Herring, N. Y. (home address, Geneva, Ill.): Fossil found in Lewis County, N. Y. 36593.

Shear, C. L., Department of Agriculture: Collection of insects (35710); 8 plants from Oregon (36291).

Sheldon, E. P. (See under Agriculture, Department of.)

Sheley, O. C., Independence, Mo.: Skin of Loggerhead Shrike, *Larius ludovicianus*, from Missouri. 35393.

Shepard, Dr. C. U., Summerville, S. C.: Shepard collection of minerals; meteoric papers; paper trays; bound catalogue of mineral collection; autograph of Adams's "Classification of Minerals" (loan) (35914); specimen of Bishopville meteorite (exchange) (36278).

Shepherd, R. S., Kensington, Md.: Specimen of Brunnich's Murre, *Uria lomvia* 35883.

Shindler, A. Z. (estate of): Collection of stone implements, arrow-points, etc., principally from the District of Columbia and vicinity. 35617.

Shufeldt, Miss Katherine, Washington, D. C.: Beetle (*Purpuricenus humeralis* Fabr.). 36638.

Shufeldt, Percy W., Washington, D. C.: Natural-history specimens from Smiths Island, Virginia, and Maryland (35696); 2 lizards from Chesapeake Beach, Maryland (36510).

Simpson, W. W., Manchester, N. H.: Five birds' skins from Tibet. Purchase. 36474.

Singley, J. A., Giddings, Tex.: Five specimens of Eocene corals, including types of *Oculina singleyi* Vaughan, and a figured specimen of *Turbinolia pharetra* Lea. Exchange. 36630.

Sisson, D. C., Port Angeles, Wash.: Elk (*Cervus canadensis*). Purchase. 36344.

Skiff, F. J. V. (See under Barnhart Brothers & Spindler.)

Skinner, F. B., Greene, N. Y.: Egg of a Pekin duck. 36411.

Skinner, Dr. Henry, Academy of Natural Sciences, Philadelphia, Pa.: Two Noctuid moths from Point Barrow, Alaska. 36306.

Slack, Rev. W. S., Musson, La.: Walking-stick, *Diapheromera denticus* Stäl. 35519.

Sloan, C. G., Washington, D. C.: Burmah drum and a fetish god from Africa. Purchase. 36348.

Slocum, Capt. Joshua, Larchmont, N. Y.: Gorgonian from near the island of Rodriquez, section of limb of *Psiadia rotendifolia*, and a stone ax from New Guinea. 36605.

Slosson, Mrs. A. T., New York City: Eleven specimens of Hymenoptera (new to the collection) (35687); 6 specimens of Diptera (36293); 58 specimens of Diptera (36418).

Smart, Dr. E. N., Madison, Nebr.: Right humerus of a Trumpeter Swan. *Olor buccinator*. 36070.

Smith, D. Wilmot, Breckenridge, Minn.: Indian drinking cup made of birch bark, from Leach Lake, Cass County, Minn. 36276.

Smith, Dr. H. M., U. S. Fish Commission: Land and fresh-water shells from Lake Erie. 35416. (See under Fish Commission, U. S.)

Smith, Prof. J. B., New Brunswick, N. J.: Seven type species of Noctuidæ (35348); pupa, larva, and imago of an Ant-lion, *Myrmeleon immaculatus* De Geer (36234); 45 specimens of Noctuid moths of which 43 are type specimens (36311); 301 types and cotypes of Noctuid moths (36511).

Smith, Capt. John Donnell, Baltimore, Md.: Plants from Central America. 35904.

Smith, Mrs. Rosa Wright, Washington, D. C.: A copy of "Freedom," May 25, 1899, a newspaper printed at Manila. 35394.

Smithsonian Institution, Mr. S. P. Langley, Secretary.

Collection of Japanese theatrical masks from Japan. Received from Prof. Alexander Graham Bell. 35254.

Collection of volcanic formations from the Canary Islands and Spanish possession of Rio del Oro, on the western coast of Africa; sample of cake or bread found in an ancient tomb; ear bones of a whale. 36695. Received from Mr. Solomon Berliner, U. S. Consul, Teneriffe, Canary Islands.

Two cut sapphires from Yogo Gulch, Montana, and a cut opal from Mexico. Received from Dr. L. T. Chamberlin. 35244.

Moro dagger of native manufacture from Mindanao. Received from Mr. Richard Coleman, Manila, P. I. 36558.

Articles belong to the late General Swords, consisting of a coat, U. S. A. (1838); pompon; 4 epauletts; complete set of aiguilettes; regulation sword (1838); yellow silk sash; patent leather sword belt; chapeau and plume; blue feathers (1838); regulation chapeau of 1860; forage cap (1860); dispatch belt with pocket; military saddle valise; photograph of General Swords; plan of West Point Military Academy, drawn by Cadet Swords; commissions from 1829–1865; 3 newspaper clippings and a map; 4 insignia (3 eagles and a star). Received from Miss E. H. Cotheal. 36367.

Collection of plants belonging to the late Dr. G. De Chalmot. Received from Mrs. De Chalmot. 36032.

Stone chair (complete); stone chair (broken); stone pillar from the summit of "Cerro de Hojas," Province of Manibi, Republic of Ecuador. Received from Hon. Perry M. de Leon, Consul-general of the United States, Guayaquil, Ecuador. 36285.

One of the earliest forms and one of the latest improved Hammond typewriters. Received from the Hammond Typewriter Company, through Mr. J. B. Hammond, president. 36557.

Bronze medal of the Diamond Jubilee of Queen Victoria, 1897, struck by the order of the corporation of the city of London. Received from the corporation of the city of London. 35970.

Three thousand two hundred and eighty-eight cryptogams. Received from Dr. Charles Mohr. 36105.

SMITHSONIAN INSTITUTION—Continued.

Bronze medal in commemoration of the civic library inaugurated by H. J. Tiffic, in 1896. Received from the Société de Numismatique et d'Archæologie de Montreal, through Emanuel Oblen, corresponding secretary ot the society. 35287.

Collection of casts of seals. Received from Mr. S. Patcanof, St. Petersburg, Russia. 36461.

A set of eggs of Stephen's Whippoorwill, *Antrostomus macromyctax*, and a set of eggs of the Western Nighthawk, *Chordeilis virginianus henryi*. Received from Dr. William L. Ralph. 36123.

Mummy from Cuzco, Peru. Received from Dr. A. H. C. Russell, U. S. N. 36836.

Transmitted from the Bureau of Ethnology, Maj. J. W. Powell, director:

Collection of Indian baskets from California, obtained through Dr. J. W. Hudson, Ukiak, Cal. (35435); collection of Carib implements from the West Indies, obtained through M. Louis Guesde, Pointe à Pitre, Guadeloupe, West Indies (35724); 4 ancient copper implements, received through Isaac Otis (35787); collection of ethnological objects from the Wasco and other tribes of the Warm Spring Indians, obtained through Mrs. E. T. Houtz (35837); collection of ethnological objects from Terra del Fuego, obtained by J. B. Hatcher (35895); collection of Indian ethnological objects, obtained through James Mooney (36021); Kutenai canoe and 2 pairs of Kutenai snowshoes, received through A. W. Barber, General Land Office (36096); collection of ethnological objects from Mexico, New Mexico, and Arizona, obtained by Dr. Walter Hough (36143); Zuñi and Navajo blankets, received through E. M. Cushing (36174); collection of Washoe baskets, etc., received through Eugene Mead (36244); collection of Ojibwa ethnological objects, received through G. H. Beaulieu (36315); 3 pottery bowls, pottery cup, from Black Falls ruins, Wukoki, 40 miles northeast of Flagstaff, Ariz.; turquoise mosaic earring, from the same location, received through Dr. J. Walter Fewkes (36468); collection of stone implements and other objects from Jamaica, West Indies, received through R. C. MacCormick (36678); collection of ethnological, archæological, and historical objects, collected by W. H. Holmes. 36681. (See under Bailey, G. W.; Deisher, H. K.; McGee, Dr. Anita Newcomb; Hudson, J. W.; Carrico, E. T.).

Transmitted from the National Zoological Park, Dr. Frank Baker, superintendent:

Specimen of *Auchenia huanacos* (35352); cormorant and anhinga (35409) Lemur (*Lemur mongoz*) (35410); specimen of *Lagothrix humboldti* and 2 specimens of Coati-mundi (*Nasua rufa*) (35487); 2 specimens of iguana from Mexico and Honduras (35496); cockatoo in flesh (35522); specimen of *Ctenosaura teres*, from Mexico (35592); 2 birds in the flesh (35606); black bear (*Ursus americanus*) and a lion (*Felis leo*) (35608); snake (*Pituophis melanoleucus*), from Florida (35663), 2 flamingoes and a spotted hyena (35730); specimen of *Ctenosaura teres*, from Mexico (35745); flamingo and a Cuban parrot (35861); puma (*Felis concolor*) (35940); kangaroo (36049); puma (*Felis concolor*), Mexican Coati, *Nasua narica* (36127); snake (36142); gray parrot (*Psittacus erithacus*) (36155); swan (*Cygnus olor*) (36155); green monkey (*Cercopithecus cynosurus*) and a zebu (*Bos indicus*) (36184); American buffalo (*Bison americanus*) (36193); iguana from Honduras (36194); snake from Florida (36195); flamingo, chachalaca and wild turkey (36284); snake (*Crotalus horridus*), from West Virginia (36335); monkey (*Macacus*) (36366); bear (*Ursus*) (36303); Squirrel-Monkey, *Chrysothrix sciurus* (36545); 2 gray wolves (*Canis lupus griseoalbus*), black bear (*Ursus americanus*) (36560); snake (*Ophisaurus ventralis*), from Georgia (36666).

SNOWDON, R. P., Bordentown, N. J.: Two pieces of the original rail over which the engine "John Bull" was run. 35630.

SNYDER, Prof. A. J., Belvidere, Ill.: Thirty-three specimens of Lepidoptera (36213); 48 specimens of Lepidoptera containing species new to the collection (36012).

SOCOLOFF, D., Taschla, Government of Orenburg, Russia: Twenty-three specimens of Jurassic invertebrate fossils (5 species and 4 varieties) of *Aucella* from Russia. Received through the U. S. Geological Survey. Exchange. 36002.

SOLTAU, HUGO, estate of. Received through Otto Soltau, New York City: Collection of Coleoptera obtained in the southern and western sections of the United States. Bequest. 35536.

SOLTAU, OTTO. (See under Soltau, estate of Hugo.)

SORRELL, S. N., Farmers, Ky.: Ash beetle, *Dynastes tityus* Linnæus. 35308.

SORRELS, C. M., U. S. National Museum: Old-style English weight, found in Prince George County, Md. 35408.

SOULE, Mrs. C. G., Brandon, Vt.: Two rose galls (*Rhodites*). 35298.

SPAINHOUR, Dr. J. M., Lenoir, N. C.: Moth (*Ecpantheria scribonia* Stoll). 35361.

SPENCER, Mr. Received through Department of Agriculture: Photograph and a seed from Central America. 35936.

SPIER, G. W., Washington, D. C.: English watch movement. 35808.

STAHL, Dr. A., Bayamon, P. R.: Freshwater crabs from Porto Rico. 36643.

STANGL, PAUL L., acting hospital steward, brigade hospital, Bacoor, P. I.: Collection of insects from Bacoor (36087); geological specimens (36516); collection of insects (36430).

STANTON, T. W. (See under Bruce, Robert E.)

STANTON, Rev. W. A., S. J., Belize, British Honduras. Received through Dr. L. O. Howard: Insects. 36151.

STAPLER, R. L., Jasper, Fla.: Moth (*Chærocampa tersa* Linnæus). 35709.

STAPLES, C. H., Nashville Tenn.: Pupa case of an Ephemerid. 36597.

STATE, DEPARTMENT OF: Specimen of cinnabar obtained through Hon. W. F. Powell (35247). Received through Assistant Secretary David J. Hill: Chinese flag used upon the occasion of the appearance of the first American embassy in Chinese waters (35766).

STEARNS, Dr. R. E. C., Los Angeles, Cal.: Thirty-seven specimens of *Tivela crassatelloides* from California (35252); 6 species of shells introduced into the Californian fauna and apparently acclimated (35785); 3 specimens of *Epiphragmophora* (36268).

STEELE, E. S., Washington, D. C.: One thousand three hundred plants (35443); 3 plants (36242); plant (36331); plant from Maryland (36506).

STEELE, W. C., Switzerland, Fla. Received through Department of Agriculture: Four plants (35851); 4 bulbs (35945); 20 bulbs of *Amaryllis treatea* (35974).

STEJNEGER, Dr. L., U. S. National Museum: Collection of natural history specimens from Cuba and Porto Rico (36467); natural history specimens from Porto Rico (36559).

STEPHENS, J. H., Jacksonville, Fla.: Decomposed chert. 35387.

STEPHENS, Hon. J. H., M. C., House of Representatives: Volcanic ash from Wilbarger County, Tex. (35996, 36616).

STEPP, F. E., Warrenton, Va.: Luna Moth, *Actias luna* Linnæus. 35347.

STERN, H., & Co., Allegan, Mich. Meteorite. Purchase. 35742.

STEWART, Capt. JOHN, Washington, D. C.: Piece of cloth from the Lincoln catafalque. 35909.

STICKNEY, R. H., jr., Anniston, Ala.: Moth (*Attacus polyphemus*). 35432.

STILWELL, L. W., Deadwood, S. Dak.: Skull and jaw of a fossil rhinoceros (*Diceratherium*) (purchase) (36159); skull of a fossil pig representing the genus *Elotherium* (36295).

STONE, A. J., New York City: Skin, skull, and leg bones of a Caribou. Purchase. 36107.

STRANAHAN, J. W., Everglade, Fla.: Suit of Seminole Indian. Purchase. 36168.

STRAUSS, Hon. OSCAR S. (See under Turkey, Sultan of.)

Strecker, Dr. H., Reading, Pa.: Seven specimens of Lepidoptera. 36228.

Strickland, F. P., Kansas City, Kans.: Twenty coins (foreign and domestic); 2 Confederate notes and fragments of notes (35305); arrow-head or spear-head from Wyandotte County (35438); foreign coin (35530).

Stringer, C. A., Munnsville, N. Y.: Larva of *Thyreus abbottii* Swainson. 36700.

Strong, Mrs. W. W., Kenosha, Wis.: Species of fungus (*Mitromyces*) from Virginia. 36408.

Strother, W. L., Vicksburg, Miss.: Moth (*Attacus polyphemus*) (35300); specimens of *Actias luna* Linnæus. (36305).

Sumpter, J. W., Elliston, Va.: Two eggs of a Hog-nose Snake (*Heterodon platirhinus*). 35434.

Suter, H., Christchurch, New Zealand. Received through Sir Charles Eliot: Unios from New Zealand. 35650.

Swain, C. O., Roslyn, Wash.: Six specimens of fossil leaves. 35406.

Swain, Thomas, Paradox, Colo.: Specimen of uranium ore and associations of clay and sandstone. 35334.

Sweetser, A. R., Forest Grove, Oreg.: Twenty-four plants. Exchange. 36623.

Swift, F. W., Alden, N. Y.: Nine specimens of *Meloe angusticollis* Say. 35527.

Switzer, Mrs. M., Vesuvius, Va.: Larvæ of a moth (*Hemilenca maia* Drury). 36600.

Tait, J. S., Phoenix, Ariz.: Collection of beetles. 35717.

Talbott, Henry (no address given): Specimen of Brunnich's Murre, *Uria lomvia* from Four Mile Run Bay, Virginia. 35862.

Talmage, Dr. J. E., Deseret Museum, Salt Lake City, Utah: Specimens of crude and refined salt from Great Salt Lake. Exchange. 35339.

Tanner, S. R., Brightwood, Va.: Specimen of *Dynastes tityus* Linnæus, and a specimen of *Orthosoma brunneum* Forster. 35419.

Tarbox, Mrs. J. H., Westport, Me.: Sphinx moth. 35269.

Tarleton, J. B., Seattle, Wash.: One hundred and seventy-one plants from Yukon, Alaska. Purchase. 36079.

Tassin, Wirt, U. S. National Museum: Canvas canoe. 35461.

Taylor, C. B., Kingston, Jamaica: Collection of insects from Jamaica (36239); 2 bats from Jamaica (*Nyctinomus*) (36698).

Taylor, Rev. G. W., Nanaimo, British Columbia: Two specimens of sponges (new species). 36145.

Taylor, Capt. J. R. M., U. S. A., Manila, P. I.: Set of stamped paper used by the insurgent government for deeds, transfers, petitions, and documents of record. 36439.

Taylor, Mrs. W. L., Welch, W. Va.: Crab spider (*Acrosoma rugosa* Hentz). 35483.

Thomas, Oldfield, British Museum, Cromwell road, London, England: Forty-six skins and skulls of mammals. 36216. (See under London, England, British Museum.)

Thompson, D'Arcy W., University College, Dundee, Scotland: Specimen of *Notoryctes typhlops*. Exchange. 35931.

Thompson, J. W., Philadelphia, Pa.: Plaster cast of rattlesnake from Texas. Purchase. 35733.

Thorn, Maj. Walter, Brooklyn, N. Y.: Medal of the Society of War Veterans and Sons. 35302.

Thorne, Mrs. S. C., Buffalo, N. Y.: Four hundred and sixty-six birds' skins collected by the late Capt. P. M. Thorne. Purchased. 36517.

Tiffany & Co., New York City: Twenty-one watches. Purchase. 35489.

Tilden, Miss Josephine, Minneapolis, Minn.: One hundred specimens of Algæ of North America. Purchase. 36290.

Tilden, Dr. W. C., Washington, D. C.: Snake (*Ophibolus doliatus*). 35561.

Todd, Commander C. C., U. S. N., Rio Janeiro, Brazil: Specimen of fossil wood from Brazil. 35306.

Topping, D. L., Washington, D. C.: Plant. Exchange. 35578.

Townes, William, Cuscowilla, Va.: Snake (*Ophibolus doliatus syspilus*). 35278.

Townsend, C. H., U. S. Fish Commission: Collection of objects from Tokelan, Solomon Island, New Britain, Samoa,

TOWNSEND, C. H.—Continued.
and New Guinea (36122); ethnological objects from Easter, Solomon, Tonga, and Fiji Islands (36365); 6 skins of Birds of Paradise (36651). Purchase. (See under Wooton, E. O.)

TOWNSEND, Prof. C. H. TYLER, Las Cruces, N. Mex.: Eight hundred and seventy-five specimens of Mexican Hymenoptera. Purchase. 35681.

TRACY, Prof. S. M., Biloxi, Miss.: One hundred and six plants (35679, 35757, 36109); received through the Department of Agriculture, 91 plants (36480), 3 specimens of *Hydrocotyle* and *Chamæcrista* from Florida (36567); plants (36640).

TRAPHAGEN, Prof. F. W., Bozeman, Mont.: Corundum in crystals and in gangue from Gallatin County, Mont. 36245.

TRAVERS, S. H., Richmond, Va.: Two specimens of Digger-wasp, *Sphecius speciosus* Drury. 35542.

TREASURY DEPARTMENT, LIGHT-HOUSE BOARD. Received through A. B. Johnson: Specimen of bryozoan from the bottom of light-vessel No. 53, Charleston, S. C., in 1894, by John B. Gadsden. 35762.

TRUE, Dr. F. W., U. S. National Museum: Specimens of *Mallotus villosus* taken from the stomach of a whale (*Balænoptera physylus*) from Snooks Arm, Newfoundland; marine invertebrates, specimens of sulphur and copper ores, and the pelvic bones of whales, from Newfoundland. 36050.

TSKAMOTO, YASUSI, Imperial University, Tokyo, Japan: Japanese copper coin, Temps-tzuho issued in 1840. 35682.

TURKEY, Sultan of. Received through Hon. Oscar S. Strauss: Two vases and a hand-painted box containing porcelain products of the Imperial Ottoman potteries. 36373.

TURNER, A. P., Roswell, N. Mex.: Caterpillar. 35454.

TURNER, H. W., Fish Lake Valley, Nevada. Received through Department of Agriculture: Plant (*Sarcobatus baileyi* Coville). 36332. (See under Agriculture, Department of; Interior Department, U. S. Geological Survey.)

TWIST, E. M., Norfolk, Va.: Fragments of pottery from Columbus Island, Republic of Colombia. 36280.

TYLER, A. A., Easton, Pa.: Forty specimens of violets. Exchange. 35314.

ULMER, I. M., Butler, Ala.: Eleven arrowpoints. 36686.

UMBACH, L. M., Naperville, Ill.: Two hundred and fifty-four plants. Exchange. 35532.

UNDERWOOD, C. F., Museo Nacional, San José, Costa Rica. Received through José C. Zeledon: Hummingbird, *Microchera parvirostris* from Costa Rica. Gift. 36664.

UNDERWOOD, L. M., Columbia University, New York City: Twenty plants. Purchase. 35946.

UNITED STATES MARBLE COMPANY, Spokane, Wash. Received through Charles S. Nims, president: Five specimens of marble from Stevens County, Wash. 35741.

UNITED STATES NATIONAL MUSEUM. The following models were made in the Anthropological Laboratory: Five plaster casts of stone relics (35371); model of an Indian village (35386); game board and dice from Korea; lamp stand (model natural size) from Korea (35493); small model of locomotive "Stourbridge Lion" (35602); model of a primitive log raft (35635); model of a primitive dugout (35636); model of an open dugout made to illustrate early experiments with paddle wheels by Roosevelt (35637); model of the U. S. gunboat *Monitor*, single turret (35638); model of Rumsey's steamboat (35639); model of John Fitch's steamboat (35640); cast of a copper celt lent to the Museum by Arthur Bibbins, of the Woman's College of Baltimore (35908); model of the locomotive "Tom Thumb" (36074); cast of a Seneca Indian pipe (36172); model of a Japanese Jinrikshaw (36206); 5 models of musical instruments (36482); 2 plaster casts of "Patu Patu" from New Zealand (36659).

URBA, Dr. K., Prague, Bohemia, Austria: Specimen of Lissa meteorite. Exchange. 36493.

URBAN, I., Botanical Museum, Berlin, Germany: Nine hundred and ninety-three plants from Porto Rico. Purchase. 36131.

URBINA, Dr. MANUEL. (See under Mexico, Mexico, National Museum.)

URICH, F. W., Port-of-Spain, Trinidad. Received through F. M. Chapman: Eleven birds' skins from Venezuela. 36071.

VAN DEUSEN, R. F., Mahopac, N. Y.: Moth (*Attacus promethea* Dr.). 35385.

VAN HORNE, C. F., Glen, N. Y.: Specimen of *Xylaria polymorpha*. 35345.

VANETTA, E. G., Academy of Natural Sciences, Philadelphia, Pa.: Specimens of *Zonitoides nummus* from Texas. 36203.

VAUGHAN, T. WAYLAND, U. S. Geological Survey: Land snails and shells from Eglon, W. Va. (35544); 6 specimens of *Balanophyllia* (?) *cornu* Socoloff, from Jekaterinoslaw, Russia (Oligocene fossil corals); topotypes and a part of the original type material received from Dr. Socoloff. (36631.) (See under Interior Department, U. S. Geological Survey.)

VELIE, J. W., St. Joseph, Mich.: Crustaceans from the western coast of Florida (35610); cast of a pin made from the column of "*Fulgur perversa.*" (35703.)

VERNER, Rev. SAMUEL P., Washington, D. C.: Collection of objects illustrating the arts of the people of the Upper Kassai River region in South Africa; also natural history specimens from the same locality. Purchase. 35839.

VERNON, Dr. J. B., New Boston, Ill.: Pathologic mussel shells and pearls from the Mississippi River (gift) (36248); 3 specimens of opals (purchase) (36279).

VERNON, J. B., Batesville, Ark.: Specimen of black marble from near Batesville. 36668.

VIENNA, AUSTRIA, K. K. NATURHISTORISCHEN HOFMUSEUM: One hundred cryptogams. Exchange. 35422.

VOLKMAR, Lieut. W. S., U. S. A., Fort McHenry, Baltimore, Md.: Mole Cricket, *Gryllotalpa borealis* Burm. 35647.

VRIERE, Baron RAOUL DE, Chateau du Baes-Veld, Phem, Zedelghem, Belgium; Collection of Belgian beetles. Exchange. 35792.

WADMOND, S. C., Racine, Wis.: Eighty specimens of violets from Wisconsin. Exchange. 36061.

WAGHORNE, ARTHUR, Bay of Islands, Newfoundland. Received through the Department of Agriculture: Seven plants. 35677.

WAGNER PALACE CAR COMPANY, New York City. Received through W. S. Webb, president: Models of sleeping cars. 35751.

WALCOTT, CHARLES D., jr., Washington, D. C.: Spotted salamander, *Ambystoma punctatum*, from Quebec, Canada. 35603.

WALKER, Maj. E. P., Washington, D. C.: Beetle (*Harpalus ruficornis*). 35268.

WALKER, H. P., Washington, D. C.: Specimen of *Pogonia pendula*, from New Hampshire. 36014.

WANGANUI, NEW ZEALAND, PUBLIC MUSEUM. Received through S. H. Drew: Fishes in alcohol, large lizard, crustaceans, and cuttlefish, 2 birds' skins and obsidian flakes. 35437.

WAR DEPARTMENT, Army Medical Museum: Collection of human bones made during the Hemenway Expedition (35301); transmitted by Maj. V. McNally, Ordnance Department: Two U. S. magazine rifles and two U. S. magazine carbines (35500). Received through Col. William S. Patten, Quartermaster-General's Office: Book of uniforms of the U. S. Army from 1774 to 1889 (36099).

WARD'S NATURAL SCIENCE ESTABLISHMENT, Rochester, N. Y.: Specimen of orbicular granite from Finland (purchase) (35512); specimen of heulandite (purchase) (35534); skeleton of porpoise (purchase) (35770); jaw of a small shark (purchase) (35799); specimen of Missouri meteorite and a specimen of Magdalena meteorite (exchange) (35890); cast of a human-headed winged lion and a cast of a human-headed winged bull (purchase) (35893); mounted skeleton of an Aye-Aye and 2 lemurs (purchase) (35938); 7 squir-

WARD'S NATURAL SCIENCE ESTABLISHMENT—Continued. rels and 2 bats (purchase) (36112); 6 mammals from Como River, Africa (purchase) (36153); 13 mammal skins (purchase) (36458); 90 bats (purchase) (36687).

WARD, F. A., Rochester, N. Y.: Eleven birds' skins. Purchase. 36674.

WARD, Prof. L. F., U. S. Geological Survey: One hundred and twenty-two plants from Oregon (35631); 25 plants from the Grand Canyon of Colorado River (35847).

WASHINGTON AGRICULTURAL COLLEGE, Pullman, Wash. Received through R. W. Doane: Snake and a salamander. 36453.

WAUGH, F. W., Toronto, Canada: Ojibway sugar camp outfit. Purchase. 35744.

WAY, P. N., Tallapoosa, Ga. Received through Department of Agriculture: Two plants (35676); 38 plants (36680).

WEAST, H. H., East Ashford, N. Y.: Sphinx moth, *Protoparce carolina* Linnæus. 35746.

WEBB, J. G., Osprey, Fla.: Moth (*Ecpantheria scribonia* Stoll). 36106.

WEBB, W. S. (See under Wagner Palace Car Company.)

WEBBER, H. J., Washington, D. C.: Ten specimens of palm (*Serenoa*) from Florida. 36395.

WEED, W. H. (See under Interior Department, U. S. Geological Survey.)

WEEDEN, Mrs. THOMAS, Florence, Ariz.: Two specimens of Kissing bug (*Conorhinus sanguisugus* Lex.). 35439.

WEEDEN, W. C., U. S. National Museum: Turtle (35411); brown bat, *Vespertilio fuscus* (36180).

WEEKS, A. G., Jr., Boston, Mass.: Sixty specimens of Lepidoptera representing 33 species. Exchange. 36041.

WEHRLE, R. W., Indiana, Pa.: Beetle (*Coptocycla purpurata* Boheman). 35539.

WEINHEIMER, Lieut. CHARLES, U. S. A., Manila, P. I.: A species of *Capsicum* from the Philippine Islands. 36161.

WELLS, J. G., Carriacou, Grenada, West Indies: Pair of Cowbirds (*Molothrus*). 35402.

WERCKLE, C., San José, Costa Rica. Received through Department of Agriculture: Five plants. 35795.

WHEELER, J. A., Milford, N. H.: Seven specimens of violets from New Hampshire. Exchange. 35899.

WHEELER, Gen. JOSEPH, U. S. A., Paniqua, Luzon, P. I. Received through Department of Agriculture: Specimen of *Ceiba casearia* Medic from the Philippine Islands. 36083.

WHITE, DAVID, U. S. Geological Survey: Plant (*Camptosorus*) (35545). (See under Clearfield Charcoal Company; Interior Department, U. S. Geological Survey; Wood, James.)

WHITE, JAMES, Norfolk, Va.: Forty caliber revolver from the wreck of the *Reina Mercedes* and cartridges for the same (purchase) (35369); 1-pound cartridge and a china platter recovered from the wreck of the *Cristobal Colon;* also specimens of smokeless powder (35372).

WHITE, Dr. LEONARD, Washington, D. C.: Gun made by the Joslyn Erie Fire Arms Company, Stonington, Conn. 35722.

WHITED, KIRK. (See under Agriculture, Department of.)

WHITEHEAD, B., Jackson, Mont.: Ball of cast copper. 36343.

WICKHAM, G. M., Chicago, Ill.: Water bug (*Belostoma americanum*). 35292.

WIDRIG, R. G., Gerry, N. Y.: Specimen of Upper Devonian glass sponge. Exchange. 36100.

WILDER, B. G., Ithaca, N. Y.: Seventeen bats. 35922.

WILLIAMS, A. B., Greenville, S. C.: Carabid beetle, *Harpalus pennsylvanicus* De Geer. 35507.

WILLIAMS, Prof. H. S. (See under Interior Department, U. S. Geological Survey.)

WILLIAMS, J. O., Catoosa, Ind. T.: Chrysalis of a diurnal butterfly (*Danais archippus* Fabr.). 35295.

WILLIAMS, T. A., Takoma, D. C.: Dragon fly (*Aeschna*) (35589); 2 specimens of *Amanita strobiliformis* (35613); 10 specimens of *Myxomycetes* from South Dakota (exchange) (36426). (See under Agriculture, Department of.)

WILLIAMSON, C. P., Philadelphia, Pa.: Specimen of *Limosella* (35417); specimen of *Viola pedata* (35525).

WILLIAMSON, E. B., Salem, Ohio. Received through W. P. Hay: Crayfish (*Cambarus argillicola*) from Bluffton, Ind. 36452.

WILLIS, Mrs. IDA G., Luray, Va.: Bat (*Myotis subulatus*) (36371); Jumping-mouse (*Zapus*) from Page County, Va. (36428.)

WILLIS, Capt. M. A., Riverton, Va.: Two specimens of Roach or Golden Shiner, *Notemigonous chrysoleucus*. 36694.

WILLSON, J. M., Kissimmee, Fla. Received through Department of Agriculture: Plant. 35274.

WILSON, J. H., Yonkers, N. Y.: Specimen of *Terebratella hemphillii*, from California. 36005.

WILSON, W. W., Sumner, Wash.: Specimens of aluminous silicate. 35763.

WINCHELL, N. H., University of Minnesota, Minneapolis, Minn.: Six hundred and seventeen specimens of New York Helderberg fossils. Exchange. 35736.

WING, F. B., Norfolk, Va.: Beetle. 36252.

WINLOCK, W. C. (deceased), Smithsonian Institution: Metal model of the orbit of the comet of 1682. 36169.

WINSTON, ISAAC, Washington, D. C.: Concretions from Colorado. 35885.

WOLCOTT, Mrs. H. L., Dedham, Mass.: Land and fresh-water shells from Hawaii (35979); specimens of the seed of *Cæsalpinia* (36035); fossils from the Silurian, Devonian, and Carboniferous systems (36334).

WOLDRICH, Dr. J. N., K. K. Bohemian National University, Prague, Bohemia: Eight pieces of moldavite. Exchange. 36215.

WOOD, D. W., Washington, D. C.: Regulation sword carried by Gen. James B. McPherson, U. S. A., during the civil war, 1861–1865. 35765.

WOOD, JAMES, Anita, Pa. Received through David White: Fossil plant and fossil wood. 35791.

WOOD, J. MEDLEY. (See under Berea, Durban, Natal, Africa.)

WOOD, N. R., U. S. National Museum: Specimen of *Geothlypis trichas* in unusual plumage from the District of Columbia, and a blue mountain duck from New Zealand (35793); 147 specimens of Odonata from Clyde, N. Y. (35830); 379 specimens of Odonata from the District of Columbia and vicinity (35831).

WOODRUFF, C. A. (See under Metz and Schloerb.)

WOODS, W. L., Washington, D. C.: Fossil. 35480.

WOOLSON, G. A., Pittsford Mills, Vt.: Specimen of *Phyllachora pteridis*. 35444.

WOOTON, E. O., Mesilla Park, N. Mex.: Eighteen plants from Mexico (gift) (36243); 250 plants collected by C. H. Townsend and C. M. Barber in Chihuahua, Mexico (purchase) (36644).

WORTHEN, C. R., Warsaw, Ill.: Tortoise from the Galapagos Islands. Purchase. 36626.

WRIGHT, B. H., Penn Yan, N. Y.: Type specimen of *Unio danielsi* B. H. W. and 4 specimens of *Unio polymorphus* B. H. W. (from type lot), Georgia (35276); type specimens of *Unio dispalans* (35499); types of 2 species of southern unios (35666); 2 species of unios (35684); shell, type of *Unio conjugans* (35781); Unionidæ from the Southern States (35937); shells (35975); Unionidæ (36178).

WRIGHT, Rev. T. F. (See under Palestine Exploration Fund.)

YALE UNIVERSITY, New Haven, Conn. Received through Dr. C. E. Beecher: Model of *Stylonurus* restored to life size (gift) (35811); collection of Utica shale from Rome, N.Y., containing *Triarthrus* preserving limbs (exchange) (35812); Jerome meteorite (exchange) (35891); specimen of *Dalmanites limulurus*, 12 specimens of *Caryocrinus ornatus* and 2 specimens of *Ptychoparia kingi* (protaspis stage) (exchange) (36399).

YATES, J. W., Jr., Markham, Va.: Three specimens of limonite pseudomorph after pyrite from near Lexington, Va. 36580.

YOUNG, C. G., Berbice, Sea Roads, Bexhill-on-Sea, England: Thirteen bats from Berbice, British Guiana (35662); 2 specimens of crab (*Dilocarinus dentatus*), from Guiana (35764).

YOUNG, R. T., Boerne, Tex.: One hundred and three mammals from Europe (purchase) (35668); reptiles and batrachians (gift) (36617); reptiles, batrachians, and an insect from Texas (36656).

YOUNG, Mrs. SUSANNAH HOLT, Washington, D. C.: Complete wedding dress of colonial times worn in 1784. 36612.

ZEHNDER, G. N., Arcata, Cal. (present address, Washington, D. C.): Basket hat from the Klamath Indians; 2 model cradles or baskets for carrying children and a small box of beads found in an Indian grave near Arcata. 35804.

ZELEDON, JOSÉ C. (See under San José, Costa Rica, Museo Nacional; Underwood, C. F.)

ZOLLIKOFER, E. H., St. Gallen, Switzerland: One hundred and eighty-two bats, shrews, and mice from Italy, Sardinia, and Switzerland. Purchase. 35250.

APPENDIX III.

Distribution of Specimens.

AFRICA.

Albany Museum, Grahamstown, South Africa: Fur seals (2 specimens). Exchange. (D. 13345.)

AMERICA.

North America.

CANADA.

Ontario.

Fowler, James, Kingston: Plants (10 specimens). Exchange. (D. 13085.)

Geological Survey of Canada, Ottawa: Fossil medusæ (15 specimens). Gift. (D. 13448.)

Lambe, Lawrence M., Ottawa: Fossil coral (1 specimen). Exchange. (D. 13385.)

Macoun, J. M., Ottawa: Plants (204 specimens). Exchange. (D. 12860, 13091.)

UNITED STATES.

Alabama.

Earle, F. S., Auburn: Plants (381 specimens). Exchange. Plant (1 specimen). Lent for study. (D. 12853, 13083, 13227.)

University of Alabama, Tuscaloosa: Fossil medusæ (13 specimens). Gift. (D. 13455.)

Arizona.

Blake, W. P., Tucson: Rocks (3 specimens and 1 thin section). Exchange. (D. 13383.)

California.

Brown, H. E., Santa Rosa: Plants (11 specimens). Lent for study. (D. 13208.)

California Academy of Sciences, San Francisco: Plants (10 specimens); bird skins (7 specimens). Exchange. (D. 13079, 13318.)

California—Continued.

Eastwood, Miss Alice, San Francisco: Plants (109 specimens). Exchange. (D. 12873.)

Gilbert, C. H., Stanford University: Lizards (2 specimens). Lent for study. (D. 13286.)

Grinnell, Joseph, Pasadena: Bird skins (104 specimens). Lent for study. (D. 13203, 13302.)

Hemphill, Henry, Oakland: Shells (10 specimens). Exchange. (D. 13027.)

Leland Stanford Junior University, Stanford University: Skeleton of great auk. Exchange. Fossil medusæ (15 specimens). Gift. Japanese fishes (3 boxes). Lent for study. (D. 13330, 13452, 13590.)

Parish, S. B., San Bernardino: Plants (45 specimens). Lent for study. (D. 13207.)

University of California, Berkeley: Plant (1 specimen). Exchange. (D. 13540.)

Colorado.

Bethel, E., Denver: Plants (81 specimens.) Exchange. (D. 12880, 13063.)

Cutler, J. E., Denver: *Apus equalis* (1 specimen). Exchange. (D. 13610.)

Hills, R. C., Denver: Meteorites (2 specimens). Exchange. (D. 13601.)

Osterhout, George E., New Windsor: Plants (10 specimens). Exchange. (D. 13113.)

Public School, Denver: Minerals (57 specimens, set 199). Gift. (D. 13642.)

State Historical and Natural History Society, Denver: Marine invertebrates (288 specimens, Series VI, set 93); insects (2,122 specimens); fishes (82 specimens); casts of pre-

Colorado—Continued.
historic implements (98 specimens); bird skins (67 specimens). Gift. (D. 13232, 13351, 13352.)

Connecticut.

Dana, E. S., New Haven: Portion of the Allegan meteorite. Exchange. (D. 13170.)

Eames, E. H., Bridgeport: Plants (10 specimens). Exchange. (D. 13080.)

Hall, Robert W., New Haven: *Palæmonetes* (980 specimens). Lent for study. (D. 13075, 13659.)

Norton, C. A. Q., Hartford: Lamps (9 specimens). Exchange. (D. 13526.)

Peabody Museum, New Haven: Fossil medusæ (26 specimens). Gift. (D. 13450.)

State Normal School, New Haven: Marine invertebrates (288 specimens, Series VI, set 92). Gift. (D. 13164.)

Wortman, J. L., New Haven: Skull of fur seal (1 specimen). Lent for study. (D. 13411.)

Yale University Museum, New Haven: Fossils (710 specimens). Exchange. (D. 13653.)

Delaware.

Canby, W. M., Wilmington: Plants (21 specimens). Exchange. (D. 13359, 13068.)

District of Columbia.

Ashe, W. W., Washington: Plates illustrating turpentine industry. Lent for study. (D. 13197.)

Benjamin, Mrs. Marcus, Washington: Pomo Indian baskets (2 specimens). Exchange. (D. 13042.)

Buffington, A. R., Washington: Arkansas novaculite (1 specimen). Lent for study. (D. 13643.)

Columbian University, Washington: Marine invertebrates (291 specimens, Series VI, set 90). Gift. (D. 13088.)

Greene, E. L., Washington: Plants (133 specimens). Exchange. Plants (30 specimens). Lent for study. (D. 12862, 13109, 13502, 13604.)

Hasbrouck, Dr. E. M., Washington: Peacock (1 specimen). Exchange. (D. 13312.)

Jennings, Foster H., Washington: Navajo basket (1 specimen); Indian

District of Columbia—Continued.
pipe (1 specimen). Exchange. (D. 12901.)

Maxon, W. R., Washington: Bird skins (2 specimens). Exchange. (D. 12951.)

Morris, E. L., Washington: Plants (151 specimens). Exchange. (D. 12874, 13138.)

Pollard, Edward, Washington: Arrows (6 specimens). Exchange. (D. 12792.)

Ridgway, Robert, Brookland: Bird skins (430 specimens). Lent for study. (D. 13634, 13712.)

U. S. Fish Commission, Washington: Shells (8 specimens). Gift. (D. 13436.)

Wood, N. R., Washington: Bird skins (4 specimens). Exchange. (D. 13272.)

Florida.

Curtiss, A. H., Jacksonville: Fossil medusæ (385 specimens). Exchange. (D. 13481.)

Georgia.

Gilbert, B. D., Thomasville: Plants (10 specimens). Exchange. (D. 13501.)

Illinois.

Barnes, C. R., Chicago: Plants (157 specimens). Exchange. (D. 12865.)

Coulter, J. M., Chicago: Plants (3 specimens). Exchange. (D. 13611.)

Dorsey, George A., Chicago: Skull from Calaveras County, Cal. (1 specimen). Lent for study. (D. 13086.)

Elliot, D. G., Chicago: Skulls of seals (2 specimens); skulls of mammals (2 specimens); skulls of bats (2 specimens). Lent for study. (D. 13487, 13548, 13714, 13555.)

Field Columbian Museum, Chicago: Portion of meteorite. Exchange. Fossil medusæ (13 specimens). Gift. Alcoholic fishes (3 specimens). Lent for study. (D. 13180, 13454, 13530.)

Herbarium of Chicago University, Chicago: Plant (1 specimen). Gift. (D. 13288.)

High School, Muncie: Marine invertebrates (288 specimens, Series VI, set 91). Gift. (D. 13163.)

Iddings, J. F., Chicago: Rocks (3 specimens). Exchange. (D. 12834.)

Johnson, Charles F., Freeport: Plants

Illinois—Continued.

(82 specimens). Exchange. (D. 13368.)

Jones, C. H., Springfield: Rocks (30 specimens). For examination. (D. 13016.)

Millspaugh, C. F., Chicago: Plants (291 specimens). Exchange. Plants (49 specimens). Lent for study. (D. 12882, 13137, 13693.)

Smallwood, Miss Mabel E., Chicago: Marine invertebrates (10 specimens). For study. (D. 13557.)

St. Francis Solanus College, Quincy: Minerals (57 specimens, set 197). Gift. (D. 13381.)

Umbach, L. M., Naperville: Plants (632 specimens). Exchange. (D. 12852, 13105.)

University of Chicago, Chicago: Fossil medusæ (14 specimens). Gift. (D. 13451.)

Ward, H. A., Chicago: Section of meteoric iron. Exchange. (D. 13124.)

Indiana.

Ethington, Ernest L., Terre Haute: Geological material (11 specimens). For examination. (D. 13228.)

Public schools, Jonesboro: Marine invertebrates (291 specimens, Series VI, set 89). Gift. (D. 13074.)

Iowa.

Ellsworth College, Iowa Falls: Minerals (57 specimens, set 196); marine invertebrates (288 specimens, Series VI, set 96). Gift. (D. 13363.)

Historical Department of Iowa, Des Moines: Baskets and models (21 specimens). Gift. (D. 13165.)

Pammell, L. H., Ames: Plants (204 specimens). Exchange. (D. 12871.)

Public school, Odebolt: Casts of stone implements (98 specimens, set 69). Gift. (D. 13261.)

Putnam, Mrs. Charles E., Davenport: Ethnological material (4 specimens); Strike-a-light candlestick. Exchange. (D. 13697, 13534.)

Simpson College, Indianola: Marine invertebrates (10 specimens). Gift. (D. 13593.)

Summer, H. E., Ames: Hemiptera (131 specimens). Lent for study. (D. 12809.)

Kansas.

City Schools, Burlington: Marine invertebrates (294 specimens, Series VI, set 86); marine invertebrates (Series VI, set 88). Gift. (D. 12974, 13051.)

Fairmount College, Wichita: Marine invertebrates (320 specimens, Series V, set 100). Gift. (D. 13598.)

Hitchcock, A. S., Manhattan: Plants (627 specimens). Exchange. (D. 12856, 13090.)

Strickland, Frank P., Kansas City: Birds' eggs (7 specimens). Exchange. (D. 12934.)

Maine.

Cushing, Frank H., Haven: Plaster casts of stone pipes and carvings (6 specimens). Lent for study. (D. 12830.)

Good Will Home for Boys, East Fairfield: Marine invertebrates (300 specimens, Series VI, set 84). Gift. (D. 12828.)

Maryland.

McNulty, D. L., Laurel: Wolf skin (1 specimen). Exchange. (D. 13535.)

Woman's College, Baltimore: Mounted specimen of young polar bear and seal; casts of stone implements (98 specimens, set 68). Gift. Mounted mammals (23 specimens). Exchange. (D. 13556, 12804, 13335.)

Massachusetts.

Atwater, W. O., Boston: Materials showing the composition of the human body. Lent for study. (D. 13026.)

Bangs, Outram, Boston: Bird skins (62 specimens). Lent for study. (D. 13245, 13246, 13595.)

Bigelow School, Marlboro: Geological material (5 specimens). Gift. (D. 13060.)

Cummings, Miss Clara E., Wellesley: Plants (31 specimens). Exchange. (D. 13343.)

Deane, Walter, Cambridge: Plants (82 specimens). Exchange. (D. 12857, 13064, 13630.)

Doane, R. W., Cambridge: Insects (324 specimens). Lent for study and exchange. (D. 12922.)

Eastman, C. R., Cambridge: Fossil (1 specimen); negative of Gar skull. Lent for study. (D. 13482, 13532.)

Massachusetts—Continued.

Fernald, C. H., Amherst: Moths (25 specimens). Lent for study. (D. 13529.)

Fernald, M. L., Cambridge: Plants (10 specimens). Exchange. Plants (55 specimens). Lent for study. (D. 13081, 13539.)

Frazer, George B., West Medford: Magnetic sand. Exchange. (D. 13434.)

Gray, G. M., Woods Hole: Crinoids. Exchange. (D. 13315.)

Gray Herbarium, Cambridge: Plants (1,097 specimens). Exchange. Plants (788 specimens). Lent for study. (D. 13216, 13344, 13408, 13605, 13692, 13698.)

Greenman, J. M., Cambridge: Plants (5 specimens). Lent for study. (D. 12825.)

Henderson, L. F., Boston: Plants (12 specimens). Lent for study. (D. 13299, 13682.)

High School, Brookline: Casts of stone implements (set 71). Gift. (D. 13446.)

Howe, Reginald H., jr., Cambridge: Bird skins (29 specimens). Lent for study. (D. 13006, 13597.)

Hyatt, Alpheus, Boston: Shells (1,005 specimens). Lent for study. (D. 13491.)

Massachusetts Institute of Technology, Boston: Ores (43 specimens). Exchange. (D. 13134.)

Museum of Comparative Zoology, Cambridge: Crabs (6 specimens). Exchange. (D. 13049.)

Robinson, B. L., Cambridge: Plants (68 specimens). Exchange. Plants (9 specimens). Lent for study. (D. 12867, 13136, 13558.)

Vaughan, A. K., Boston: Infusorial earth (11 samples). For examination. (D. 13476.)

Weeks, A. G., jr., Boston: Lepidoptera (32 specimens). Exchange. (D. 13499.)

Michigan.

Clark, Hubert Lyman, Olivet: Marine invertebrates (3 specimens); Holothurians (609 specimens). Lent for study. (D. 13001, 13517.)

Michigan—Continued.

Holmes, S. J., Ann Arbor: Crabs (3 specimens). Lent for study. (D. 12975.)

Reeder, John T., Calumet: Minerals (11 specimens). Exchange. (D. 12816.)

Wheeler, C. F., Agricultural College: Plants (52 specimens). Exchange. (D. 12851.)

Minnesota.

Heatwole, J. P., Northfield: Pottery (60 specimens); Indian basketry (7 specimens). Exchange. (D. 13723.)

Holzinger, J. M., Winona: Mosses (146 specimens). Exchange. (D. 12888.)

MacMillan, Conway, Minneapolis: Plants (75 specimens). Exchange. (D. 12883, 13110.)

University of Minnesota, Minneapolis: Fossils (758 specimens). Exchange. (D. 12171.)

Missouri.

Bush, B. F., Courtney: Plants (87 specimens). Exchange. (D. 12876.)

Glatfelter, N. M., St. Louis: Plants (10 specimens). Exchange. (D. 13082.)

Hambach, G., St. Louis: Blastoids (1,138 specimens). Lent for study. (D. 13009.)

Kreite, R., Kansas City: Fossils (126 specimens). Exchange. (D. 13010.)

Missouri Botanical Garden, St. Louis: Living plant. Gift. Seeds (57 packets); three photographs; plants (3 specimens). Exchange. (D. 13166, 13641.)

Trelease, William, St. Louis: Plants (236 specimens). Exchange. Plants (125 specimens). Lent for study. (D. 12866, 13111, 13429, 13640.)

Nebraska.

Bessey, C. E., Lincoln: Plants (59 specimens). Exchange. (D. 12877.)

Nevada.

Grout, A. J., Plymouth: Mosses (183 specimens). Exchange. (D. 12887.)

New Hampshire.

Clough, L., East Concord: Rocks (11 specimens). Exchange. (D. 13371.)

Hitchcock, C. H., Hanover: Ores and rocks (51 specimens). Exchange. (D. 13293.)

New Hampshire—Continued.

Richardson, C. H., Hanover: Blow pipe material (30 pounds). Exchange. (D. 13057.)

New Jersey.

Emmons, Lieut. G. T., Princeton: Ethnological material (6 specimens). Exchange. (D. 13235.)

Mann, Albert, Belmar: Diatomaceous deposits. Lent for study. (D. 13464.)

Princeton University, Princeton: Fossil medusæ (13 specimens). Gift. Skull of tapir, teeth of mastodon and rhinoceros. Exchange. (D. 13453, 13521.)

Scott, W. B., Princeton: Bird skins (40 specimens). Lent for study. (D. 13387.)

Rusby, H. H., Newark: Plants (16 specimens). Lent for study. (D. 12785.)

New Mexico.

Cockerell, Theodore D. A., Mesilla Park: Plants (3 specimens). Exchange. (D. 13238.)

New York.

American Museum of Natural History, New York: Crania of Utah, Navajo, and Apache Indians (45 specimens). Lent for study. (D. 13215.)

Allen, J. A., New York: *Glossophaga elongata* (2 specimens). Exchange. Bird skins (10 specimens). Lent for study. (D. 13632, 13702.)

Arnold, Mrs. Francis B., New York: Foraminifera (5 lots). Lent for study. (D. 13579.)

Bicknell, E. P., Riverdale-on-Hudson: Plants (10 specimens). Exchange. (D. 13107.)

Britton, Mrs. E. G., New York: Plants (47 specimens). Exchange. (D. 12861, 12912.)

Britton, N. L., Bronx Park: Plants (17 specimens.) Exchange. Plants (271 specimens). Lent for study. (D. 13067, 13472, 13512.)

Burnham, Stewart H., Vaughns: Plants (10 specimens). Exchange. (D. 13069.)

Chapman, Frank M., New York: Bird skins (320 specimens). Lent for study. (D. 12906, 13267.)

New York—Continued.

Clute, Willard N., Bronx Park: Plants (126 specimens). Lent for study. (D. 13115.)

Cowell, John F., Buffalo: Plants (10 specimens). Exchange. (D. 13065.)

Dwight, Jonathan, jr., New York: Birds (7 specimens). Lent for study. (D. 13614.)

Eaton, A. A., Seabrook: Plants (134 specimens). Exchange. Plants (191 specimens). Lent for study. (D. 12879, 12948, 13084, 13264, 13304, 13406, 13463.)

Ethical Culture Schools, New York: Marine invertebrates (300 specimens, Series VI, set 55). Gift. (D. 13724.)

George Junior Republic, Freeville: Ethnological material (235 specimens); marine invertebrates (51 specimens). Gift. (I. 13054.)

Glen Island Museum, New Rochelle: Casts of fossils (2 specimens). Exchange. (D. 13364.)

Hay, O. P., New York: Scale of fossil fish. Lent for study. (D. 13382.)

Heller, A. A., New York: Plants (10 specimens). Exchange. (D. 13135.)

Hulst, Rev. George D., Brooklyn: Moths (220 specimens). Lent for study. (D. 13527, 13633.)

Kunz, George F., New York: Ores (56 specimens). Exchange. (D. 12999.)

Manual Training High School, Brooklyn: Marine invertebrates (291 specimens, Series VI, set 98); casts of stone implements (98 specimens, set 73). Gift. (D. 13573.)

New York Botanical Garden, Bronx Park: Plants (2 specimens); plants from Philippine Islands (92 specimens). Exchange. Plants (29 specimens). Lent for study. (D. 13152, 13369, 13580.)

Osborn, H. F., New York: Teeth of fossil horse (27 specimens). Lent for study. (D. 13639.)

Public School No. 3, Yonkers: Marine invertebrates (288 specimens, Series VI, set 97). Gift. (D. 13433.)

Rowlee, W. W., Ithaca: Plants (116 specimens). Exchange. (D. 12859, 13106.)

New York—Continued.

Small, John K., New York: Plants (589 specimens). Exchange. Plants (2 specimens). Lent for study. (D. 12870, 13305.)

Rydberg, P. A., Bronx Park: Plants (2 specimens). Lent for study. (D. 12979.)

Underwood, L. M., New York: Plants (671 specimens). Lent for study. (D. 12813, 12994, 13117, 13409.)

Widrig, Robert G., Gerry: Fossils (9 specimens). Exchange. (D. 13339.)

North Carolina.

Ashe, W. W., Raleigh: Plants (130 specimens). Lent for study. (D. 13503.)

Beadle, C. D., Biltmore: Plants (927 specimens). Exchange. (D. 12869, 13070.)

Ohio.

Comstock, F. M., Cleveland: Plants (121 specimens). Exchange. (D. 12881, 13108.)

Edwards, Charles L., Cincinnati: Holothurians (1,672 specimens). Lent for study. (D. 13563.)

Matlack, Mr., Columbus: One transparency. Exchange. (D. 13717.)

Public schools, Tiffin: Marine invertebrates (316 specimens, Series V, set 99); casts of stone implements (96 specimens, set 72). Gift. (D. 13566.)

Oregon.

Cusick, William C., Union: Plant (1 specimen). Exchange. (D. 13362.)

Sweetzer, Albert R., Forest Grove: Plants (11 specimens). Exchange. (D. 12970.)

Pennsylvania.

Carnegie Institute, Pittsburg: One model each of Conestoga wagon, American stage coach, American colonial chaise, John Bull locomotive and one car, Japanese jinrikisha, Mexican cart and Korean chair. Lent for examination. (D. 12932, 12942, 12992, 13181, 13600, 13670.)

Crawford, Joseph D., Philadelphia: Plants (46 specimens). Exchange. (D. 13139.)

Culin, Stewart, Philadelphia: Collection of Indian games. Lent for study. (D. 13416.)

Pennsylvania—Continued.

Ehrmann, George A., Pittsburg: Beetles and diptera (17 specimens). Exchange. (D. 13101.)

High School, Bradford: Geological and paleontological material (28 specimens). Gift. (D. 13420.)

MacElwee, Ellis, Philadelphia: Plants (10 specimens). Exchange. (D. 13112.)

Moore, J. Percy, Philadelphia: Leeches (55 specimens). Lent for study. (D. 13358.)

Philadelphia Academy of Sciences, Philadelphia: Plants (22 specimens). Exchange. (D. 13493.)

Stone, Witmer, Philadelphia: Bird skins (8 specimens); mammals (124 specimens). Lent for study. Bats (2 specimens). Exchange. (D. 12930, 12950, 13609, 13234, 13095.)

University of Pennsylvania, Philadelphia: Plant (1 specimen). Gift. (D. 13291.)

Rhode Island.

Collin, J. Franklin, Providence: Plants (10 specimens). Exchange. (D. 13066.)

Museum of Natural History, Providence: Marine invertebrates (288 specimens, Series VI, set 94). Gift. (D. 13334.)

South Carolina.

Anderson, Alexander P., Clemson College: Plants (66 specimens). Exchange. (D. 12875.)

Tennessee.

University of Tennessee, Knoxville: Fossil medusæ (15 specimens). Gift. (D. 13439.)

Texas.

Bray, W. L., Austin: Plants (70 specimens). Exchange. (D. 12858.)

Marble Falls Academy, Marble Falls: Minerals (57 specimens, set 198). Gift. (D. 13488.)

Price, R. H., College Station: Plants (14 specimens). Exchange. (D. 12872.)

Utah.

Jones, Marcus E., Salt Lake City: Plants (11 specimens). Exchange. (D. 13092, 13386.)

Vermont.

Hitchcock Library and Museum, Westfield: Marine invertebrates (297 specimens, Series VI, set 87). Gift. (D. 13032.)

Jones, L. R., Burlington: Plants (34 specimens). Exchange. (D. 12878.)

Pringle, C. G., Charlotte: Plants (2 specimens). Exchange. (D. 13116.)

Waugh, F. A., Burlington: Plants (25 specimens). Lent for study. (D. 12955.)

Virginia.

Daniel, Joseph W., jr., Lynchburg: Birds' eggs (43 specimens). Exchange. (D. 13204.)

Riley, J. H., Falls Church. Bird skins (6 specimens). Exchange. (D. 12928.)

University of Virginia, Charlottesville: Pottery (32 specimens). Exchange. (D. 12943.)

Washington.

Allen, O. D., Ashford: Plant (1 specimen). Exchange. (D. 13361.)

Flett, J. B., Tacoma: Plant (1 specimen). Exchange. (D. 13360.)

University of Washington, Seattle: Fish (1 specimen). Gift. (D. 13157.)

West Virginia.

Pollock, W. M., Buckhannon: Plants (95 specimens). Exchange. (D. 12868.)

State Normal School, Shepherdstown: Marine invertebrates (291 specimens, Series VI, set 95). Gift. (D. 13346.)

Wisconsin.

La Crosse High School, La Crosse: Marine invertebrates (303 specimens, Series VI, set 83). Gift. (D. 12817.)

Nowlan, Mrs. Oscar F., Jaynesville: Minerals (30 specimens). Exchange. (D. 13474.)

Public School, Eau Claire: Marine invertebrates (297 specimens, Series VI, set 85). Gift. (D. 12908.)

University of Wisconsin, Madison: Plant (1 specimen). Gift. (D. 13289.)

Wyoming.

Nelson, Aven, Laramie: Plants (10 specimens). Exchange. (D. 13089.)

University of Wyoming, Laramie: Plant (1 specimen). Gift. (D. 13290.)

South America.

ARGENTINA.

Ruscherveyh, G., Buenos Ayres: Lepidoptera (97 specimens). Exchange. (D. 12794.)

BRAZIL.

Museu Paulista, São Paulo: Fossils (172 specimens). Exchange. (D. 13438.)

ASIA.

INDIA.

Prain, David, Bengal: Plants (406 specimens). Exchange. (D. 12896.)

EUROPE.

AUSTRIA.

Beck, G. von, Vienna: Plants (115 specimens). Exchange. (D. 12895.)

Heimerl, Anton, Vienna: Plants (518 specimens). Lent for study. (D. 13314.)

Imperial Royal Geological Establishment, Vienna: Fossil medusæ (18 specimens). Gift. (D. 13471.)

Royal Bohemian Museum, Prague: Fossils (266 specimens); rocks (4 specimens). Exchange. (D. 13182.)

Simmer, Hans, Carinthia: Plants (960 specimens). Exchange. (D. 12864.)

Vrba, K., Prague: Meteorites (2 specimens). Exchange. (D. 13538.)

Woldrich, J. N., Prague: Geological material (6 specimens). Exchange. (D. 13509.)

BELGIUM.

Royal Museum of Natural History, Brussels: Fossil medusæ (13 specimens). Gift. (D. 13462.)

DENMARK.

Warming, Eug., Copenhagen: Plants (159 specimens). Exchange. (D. 12863.)

FRANCE.

André, Ernest, Haute-Saône: Insects (140 specimens). Exchange. (D. 13591.)

Coutiere, H., Paris: Alpheidæ (1,263 specimens). Lent for study. (D. 13524.)

Edwards, Prof. A. Milne, Paris: Cave insects (11 specimens). Exchange. (D. 13048.)

Gandoger, Michel, Villefranche: Plants (135 specimens). Exchange. (D. 12892.)

Mecernier, Stanislaus, Paris: Meteorite (1 specimen). Exchange. (D. 13574.)

Miguel, Jean, Barrubio, Hérault: Fossils (681 specimens); stone implements, shell beans and fragments of pottery (59 specimens). Exchange. (D. 13528.)

Sayeux, L., Paris: Geological material (5 specimens). Lent for study. (D. 13034.)

GERMANY.

Engler, A., Berlin: Plants (152 specimens). Exchange. (D. 12891.)

Geological and Paleontological Institute, Munich: Fossils (128 specimens). Exchange. (D. 13470.)

Haeckel, Ernst, Jena: Fossil medusæ (20 specimens). For study. (D. 13458.)

Huene, F. von, Tubingen: Fossils (28 specimens). Exchange. (D. 13423.)

Kleinschmidt, Otto, Nierstein-on-Rhine: Bird skins (2 specimens). Exchange. (D. 13055.)

Krantz, F., Bonn: Meteorites (4 specimens). Exchange. (D. 13627.)

Lejeune, Adolf, Frankfort: Fossils (226 specimens). Exchange. (D. 13417.)

Rosenbusch, H., Heidelberg: Rocks (3 specimens). Exchange. (D. 13313.)

Royal Zoological Museum, Dresden: Skins and skulls of North American animals (100 specimens); Indian baskets (8 specimens). Exchange. (D. 13374, 13720.)

Schellwein, Ernst, Königsberg: Fossils (709 specimens). Lent for study. (D. 13419.)

GREAT BRITAIN.

England.

Baker, E. G., London: Plants (24 specimens). Lent for study. (D. 13425.)

Barrrett-Hamilton, G. E. H., London: Co-types *Mus arianus griseus* (2 specimens). Lent for study. (D. 13375.)

England—Continued.

British Museum (Natural History), London: Plants (344 specimens). Exchange. Fossil medusæ (16 specimens). Gift. Plants (26 specimens); moth (1 specimen). Lent for study. (D. 12894, 13644, 13456, 13645, 13686.)

Cambridge University, Cambridge: Fossil medusæ (16 specimens). Gift. (D. 13461.)

Doyle, W. E., Manchester: Octopus (1 specimen). Lent for study. (D. 13596.)

Druery, Charles T., London: Plant (1 specimen). Exchange. (D. 12788.)

Horniman Museum, London: Plaster casts of stone pipes (9 specimens). Exchange. (D. 12855.)

Lankester, Prof. E. Ray, London: Star-nosed mole (1 specimen). For study. (D. 13087.)

Lovett, Edward, Croydon: Pottery (12 specimens). Exchange. (D. 12803.)

Manchester Museum, Manchester: Casts (3 specimens); fossils (6 specimens). Gift. (D. 13422.)

Mason, G. E., London: Shells (6 specimens). Exchange. (D. 13205.)

Parritt, H. W., London: Echinoderms and crustacea (38 specimens). Exchange. (D. 13114.)

Royal Gardens, Kew: Plants (32 specimens). Lent for study. Three photographs; plants (7 specimens); seeds (55 packets). Exchange. (D. 13143, 13646, 12836, 13647.)

Sharpe, R. Bowdler, London: Bird skins (48 specimens). Lent for study. (D. 12940.)

Thomas, Oldfield, London: Red-backed mice (30 specimens); mammal (1 specimen). Lent for study. Skin and skull of opossum. Exchange. (D. 12964, 13002, 13148.)

Scotland.

Balfour, Isaac Bayley, Edinburgh: Plants (149 specimens). Exchange. (D. 12893.)

University College, Dundee: Alcoholic fishes (26 specimens). Exchange. (D. 13377.)

HOLLAND.

Jentink, F. A., Leyden: Bats (4 specimens). Exchange. Bat (1 specimen). Lent for study. (D. 13196.)

ITALY.

Civic Museum of Natural History, Milan: Fishes (40 specimens). Exchange. (D. 12799.)

Gestro, R., Genoa: *Zapus* (4 specimens). Exchange. (D. 13149.)

Magretti, Paolo, Milan: Hymenoptera (518 specimens). Exchange. (D. 13581.)

Mayer, P., Naples: Caprellidæ (14 specimens.) Lent for study. (D. 13511.)

Zoological Museum, Turin: Crabs (3 specimens); crustacea (86 specimens). Exchange. (D. 13295, 13522.)

NORWAY.

Zoological Museum, Christiana: Small mammals (15 specimens). Exchange. (D. 13154.)

RUSSIA.

Imperial Academy of Sciences, St. Petersburg: Fossil medusæ (16 specimens). Gift. (D. 13460.)

Klinge, J., St. Petersburg: Plants (43 specimens). Lent for study. (D. 13281.)

Museum of the Academy of Sciences, St. Petersburg: Meadow mice (10 specimens). Exchange. (D. 13297.)

Socoloff, D., Taschla: Cretaceous fossils (19 specimens). Exchange. (D. 13276.)

SWEDEN.

Botanical Garden, Upsala: Plants (10 specimens). Exchange. (D. 12824.)

Cohner, Teodor, Upsala: Alcoholic worms (3 specimens); one slide. Lent for study. (D. 13186.)

Royal Natural History Museum, Stockholm: Fossil medusæ (17 specimens). Gift. (D. 13457.)

SWITZERLAND.

Kathariner, L., Freiburg: Snake (1 specimen). For study. (D. 13301.)

Narbel, Paul, Cour, Lausanne: Mammals (4 specimens); mammal skins and skulls (12 specimens). Exchange. (D. 13287, 13687.)

OCEANICA.

Australasia.

AUSTRALIA.

Reed, Walter D., Adelaide, South Australia: Shells (907 specimens). Exchange. (D. 13132.)

Grant, F. H. McK., Melbourne, Victoria: Stone implements (9 specimens). Exchange. (D. 13569.)

NEW ZEALAND.

Canterbury Museum, Christchurch: Ethnological material (68 specimens). Exchange. (D. 13721.)

Public Museum, Wanganui: Mounted mammals (18 specimens). Exchange. (D. 13046.)

APPENDIX IV.

Bibliography.

PUBLICATIONS OF THE MUSEUM.[1]

ANNUAL REPORT.

Annual Report | of the | Board of Regents | of the | Smithsonian Institution, | showing | the Operations, Expenditures, and Condition | of the Institution | for the | Year ending June 30, 1897. | — | Report | of the | U. S. National Museum. | Part 1. | — | Washington: | Government Printing Office. | 1899. |

8vo, pp. I–XXVII, 1–1021, pls. 150.

PROCEEDINGS.

Smithsonian Institution. | United States National Museum. | — | Proceedings | of the | United States National Museum. | — | Volume XXI. | — | Published under the direction of the Smithsonian Institution. | — | Washington: | Government Printing Office. | 1899. |

8vo pp. I–XIII, 1–933, pls. 1–89.

BULLETIN.

Smithsonian Institution. | United States National Museum. | — | Bulletin | of the | United States National Museum.—No. 47. | — | The Fishes | of | North and Middle America: | A descriptive catalogue of the species of fish-like vertebrates found in | the waters of North America, north of the Isthmus of Panama. | By | David Starr Jordan, Ph. D., | President of the Leland Stanford Junior University and of the | California Academy of Sciences, | and | Barton Warren Evermann, Ph. D., | Ichthyologist of the United States Fish Commission. | Part IV. | Washington: | Government Printing Office. | 1900. |

8vo, pp. I–CI, 3137–3313, pls. 1–392.

Smithsonian Institution. | United States National Museum. | — | The Methods Employed at the Naples | Zoological Station for the Pres- | ervation of Marine Animals. | By | Dr. Salvatore Lo Bianco. | Translated from the original Italian | by | Edmund Otis Hovey. | — | Part M of Bulletin of the United States National Museum, No. 39. | — | Washington: | Government Printing Office. | 1899. |

8vo, pp. [1]–[42], 1 plate.

Smithsonian Institution. | United States National Museum. | — | Directions for Preparing Study | Specimens of Small | Mammals. | By | Gerrit S. Miller, Jr., | Assistant Curator, Division of Mammals. | — | Part N of Bulletin of the United States National Museum, No. 39. | — | Washington: | Government Printing Office. | 1899.

8vo, pp. [1]–[10], 1 fig.

Smithsonian Institution. | United States National Museum. | — | Directions for Collecting and Rearing | Dragon Flies, Stone Flies, and | May Flies. | By | James G. Needham, Ph. D., | Lake Forest College, Lake Forest, Illinois. | — | Part O of Bulletin of the United States National Museum, No. 39. | — | Washington: | Government Printing Office. | 1899.

8vo, pp. [1]–[9], figs. 1–4.

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[1] The titles of the papers from the Report and Proceedings which were published in separate form during the year are given in Appendix V.

PAPERS BY OFFICERS OF THE NATIONAL MUSEUM AND OTHERS, BASED UPON MUSEUM MATERIAL.

ADLER, CYRUS. The Hebrew collection in the National Museum.

Jewish Comment (Baltimore), X, No. 13, Jan. 12, 1900, p. 1.

ASHMEAD, WILLIAM H. Description of the type of *Polyodontoscelis* Ashmead.

Psyche, VIII, No. 279, July, 1899, pp. 387, 388.

Described *Polyodontoscelis cinctifrons*, from Florida.

——— Classification of the Entomophilous Wasps, or the superfamily Sphegoidea. (Paper No. 2.)

Canadian Entomologist, XXXI, No. 7, July, 1899, pp. 161–174.

Treats of the family Oxybelidæ and part of the Crabronidæ. Twenty-two genera are tabulated, of which 7 are new. The family Crabronidæ is divided into 5 subfamilies. A list of the North American species, arranged under their respective genera, as proposed in this paper, is also given.

——— Classification of the Entomophilous Wasps, or the superfamily Sphegoidea. (Paper No. 3.)

Canadian Entomologist, XXXI, No. 8, Aug., 1899, pp. 212–225.

Treats of the remaining subfamilies and genera of the Crabronidæ and of the family Pemphredonidæ. Thirty-two genera are tabulated, of which 7 are new. The Pemphredonidæ are divided into 2 subfamilies, the Pemphredoninæ and the Pseninæ.

——— Classification of the Entomophilous Wasps, or the superfamily Sphegoidea. (Paper No. 4.)

Canadian Entomologist, XXXI, No. 9, Sept., 1899, pp. 238–251.

Treats of the families Bembicidæ and Larridæ. In the former 5 genera are tabulated, while in the latter 4 subfamilies and 38 genera are tabulated. *Pseudohelioyetes*, new genus, is described from Africa. All the North American species falling in these families are listed.

——— Classification of the Entomophilous Wasps, or the superfamily Sphegoidea. (Paper No. 5.)

Canadian Entomologist, XXXI, No, 10, Oct., 1899, pp. 291–300.

Treats of the families Philanthidæ, Trypoxylidæ, and Mellinidæ. The Philanthidæ are divided into two subfamilies, the Cercerinæ and the Philanthinæ. In the former 5 genera are recognized; in the latter 9, of which 2 are new, *Epiphilanthus* and *Pseudanthophilus*. In the Trypoxylidæ only 2 genera are noted. The family Mellinidæ, as here defined, contains 8 genera, 4 being new, viz, *Harpactostigma*, *Hypomellinus*, *Mellinogastra*, and *Hapalomellinus*. The paper terminates with a list of the North American species.

ASHMEAD, WILLIAM H. Classification of the Entomophilous Wasps, or the superfamily Sphegoidæ. (Paper No. 6.)

Canadian Entomologist, XXXI, No. 11, Nov., 1899, pp. 322–330.

Treats of the family Nyssonidæ, which is divided into 4 subfamilies, Gorytinæ, Alysoninæ, Nyssoninæ, and Astatinæ. In all, 26 genera are tabulated, of which 3 are new, viz, *Pseudoplisus*, *Argogorytes*, and *Metanysson*. All the North American species are listed.

——— Classification of the Entomophilous Wasps, or the superfamily Sphegoidæ. (Paper No. 7, conclusion.)

Canadian Entomologist, XXXI, No. 12, Dec., 1899, pp. 345–357.

Treats of the families Stizidæ, Sphegidæ, and Ampulicidæ. In the Sphegidæ 4 subfamilies have been recognized, while in the Ampulicidæ but 2 subfamilies are defined. In all, 38 genera are tabulated. A list of all the North American species is also given.

——— The largest Oak-gall in the world and its parasites.

Entomological News, X, No. 7, Sept., 1899, pp. 193–196.

Describes the gall and gall-maker, *Andricus* (*Cynips*) *championi* Cameron, from Mexico, its inquiline, *Synergus dugesii*, new species, and a parasite, *Torymus mexicanus*, new species.

——— On the genera of the chalcid-flies belonging to the subfamily Encyrtinæ.

Proc. U. S. Nat. Mus., XXII, No. 1202, June 5, 1900, pp. 323–412.

Defines the family Encyrtidæ and divides it into 3 subfamilies, Eupelminæ, Encyrtinæ, and Signiphorinæ. After a brief historical sketch of the genera of the Encyrtinæ, which are divided into 4 tribes, viz, Ectromini, Encyrtini, Mirini, and Arrhenophagini, the author gives tables for recognizing the genera, 90 of which are tabulated, 24 being new. The paper terminates with a bibliographical and synonymical catalogue of 292 species, 38 of which are new and are described here for the first time.

——— Classification of the fossorial, predaceous, and parasitic wasps, or the superfamily Vespoidea. (Paper No. 1.)

Canadian Entomologist, XXXII, No. 5, May, 1900, pp. 145–155.

In this great complex, the author recognizes and tabulates 15 distinct families. The first of these, the family Pompilidæ, is then taken up, and after a brief historical sketch of the genera, he gives his view in regard to its classification and divides it into 6 subfamilies, viz, the Pepsinæ, Ageniinæ, Pompilinæ, Planicepinæ Notocyphinæ, and Ceropalinæ.

ASHMEAD, WILLIAM H. Classification of the fossorial, predaceous, and parasitic wasps, or the superfamily Vespoidea. (Paper No. 2.)

Canadian Entomologist, XXXII, No. 6, June, 1900, pp. 185–188.

In this paper the genera of the subfamily Pepsinæ are tabulated. Fifteen genera have been recognized, 3 being new, viz, *Tetraodontonyx*, *Calopompilus*, and *Ferrcolomorpha*.

ASHMEAD, WILLIAM H., and SMITH, JOHN B. Order Hymenoptera.

Smith's Insects of New Jersey, 8vo, Trenton, N. J., 1900, pp. 501–613.

The paper contains a list of 1,718 species of these insects found in the State of New Jersey: the arrangement of the superfamilies, families, and tribes being in accordance with Mr. Ashmead's views on the classification of these insects.

BANGS, OUTRAM. On some new or rare birds from the Sierra Nevada de Santa Marta, Colombia.

Proc. Biol. Soc. Wash., XIII, Nov. 11, 1890, pp. 91–108.

An annotated list of 68 species, of which the following are new: *Pharomachrus festatus*, p. 92; *Metallura districta*, p. 94; *Ochthodiæta pernix*, p. 95; *Hapalocercus paulus*, p. 96; *Myiopatis montensis*, p. 97; *Piprcola aureipectus decora*, p. 98; *Sclerurus albigularis propinquus*, p. 99; *Conopophaga browni*, p. 100; *Scytalopus latebricola*, p. 101; *Haplospiza nivaria*, p. 102; *Cinclus rivularis*, p. 105; *Troglodytes monticola*, p. 106, and *Merula albiventris fusa*, p. 107.

——— The Gray-breasted Wood Wrens of the Sierra Nevada de Santa Marta.

Proc. N. E. Zool. Club, I, Dec. 27, 1899, pp. 83, 84.

Two species are here compared, *Henicorhina leucophrys* (Tsch.) and *H. anachoreta*, a new form.

——— On a small collection of birds from San Sebastian, Colombia.

Proc. N. E. Zool. Club, I, Dec. 27, 1899, pp. 75–80.

A list of 29 species, with notes. *Acestrura astreans*, p. 76, is new.

——— A review of the Three-toed Woodpeckers of North America.

Auk, XVII, No. 2, Apr., 1900, pp. 126–142.

A synopsis of the North American species of *Picoides*. Six forms are recognized, of which 3 are new, viz, *Picoides arcticus tenuirostris*, p. 131; *P. americanus bacatus*, p. 136, and *P. a. labradorius*, p. 138.

——— Description of a new Rice Grackle.

Proc. N. E. Zool. Club, II, June 30. 1900, pp. 11, 12.

Cassidix oryzivora violea is described as new.

BANKS, NATHAN. The Smynthuridæ of Long Island, N. Y.

Journ. N. Y. Ent. Soc., VII, No. 3, Sept., 1899, pp. 193–197.

A synopsis of 13 species occurring on Long Island, of which 6 are new.

——— The Psocids from an old snake fence.

Entomological News, X, No. 9, Nov., 1899, pp. 260, 261.

Notes on 4 species.

——— On two genera of Mites.

Canadian Entomologist, XXXII, No. 2, Feb., 1900, pp. 30–33.

Notes on *Rhagidia* and *Lucasiella*.

——— A new genus of Atropidæ.

Entomological News, XI, No. 4, Apr., 1900, pp. 431, 432, 1 fig.

Description of *Psocinella stossonæ*.

——— Some new North American spiders.

Canadian Entomologist, XXXII, No. 4, Apr., 1900, pp. 431, 432, 1 fig.

Description of 12 new species.

——— The Scorpions, Solpugids, and Pedipalpi. Synopses of North American invertebrates. IX.

Am. Naturalist, XXXIV, No. 401, May, 1900, pp. 421–427, 4 figs.

Tables for the species occurring in the United States.

——— The red spiders of the United States (*Tetranychus* and *Stigmæus*).

Bull. Div. Ent., U. S. Dept. Agric. (Technical Series) No. 8, June, 1900, pp. 65–77, 16 figs.

A revision of the group.

——— New genera and species of Nearctic neuropteroid insects.

Trans. Am. Ent. Soc., XXVI, June, 1900, pp. 239–259.

Descriptions of 6 new genera and 44 new species.

BARTSCH, PAUL. *Ammodromus nelsoni* in Iowa.

Auk, XVI, July, 1899, pp. 276, 277.

Recording Nelson's Sparrow for the first time for the State of Iowa, the specimen having been collected by the writer.

——— An ambitious Hummer.

Osprey, IV, No. 1, Sept., 1899, p. 14.

This is the first record of the Ruby-throated Humming bird laying three eggs. The nest was found in the District of Columbia by the writer.

BARTSCH, PAUL. [Review of] Butler's Birds of Indiana.

Osprey, IV, No. 1, Sept., 1899, p. 16.

——— The first record of *Turdus swainsoni* in Russia.

Osprey, IV, No. 5, Jan., 1900, p. 79.

A translation from the German of N. von Ssomaw.

——— [Review of] On the Birds' Highway. By R. Weber Howe.

Osprey, IV, No. 5, Jan., 1900, p. 80.

——— A note on birds observed on women's hats in a street car.

Osprey, IV, No. 7, Mar., 1900, p. 111.

——— [Review of] Birds Afield. By Keeler.

Osprey, IV, No. 7, Mar., 1900, p. 112.

——— [Review of] Bird Studies with a Camera. By F. M. Chapman.

Osprey, IV, No. 10, June, 1900, p. 157.

——— Birds of the road.

Osprey, IV, No. 5, Jan., 1900, pp. 65–67, 2 figs.; No. 6, Feb., 1900, pp. 81–83, 2 figs.; No. 7, Mar., 1900, pp. 99–101, 2 figs.; No. 8, Apr., 1900, pp. 114–118, 4 figs.; No. 9, May, 1900, pp. 131–134, 3 figs.; No. 10, June, 1900, pp. 145–149, 7 figs.

This series of popular articles discusses the birds of Washington and its vicinity. Figures of the common forms and photographs of nests with eggs and young accompany the articles.

BEAN, BARTON A. (See under H. M. SMITH.)

BISHOP, LOUIS B. Descriptions of three new birds from Alaska.

Auk, XVII, No. 2, Apr., 1900, pp. 113–120.

Canachites canadensis osgoodi, p. 114; *Sayornis saya yukonensis*, p. 115, and *Contopus richardsonii saturatus*, p. 116, are described as new. Critical notes on *Parus hudsonicus evura* and *Hylocichla ustulatus almæ* are added.

CAUDELL, ANDREW N. A new species of *Sinea*.

Canadian Entomologist, XXXII, No. 3, Mar., 1900, pp. 67, 68.

Describes *Sinea complexa*, from California.

CHITTENDEN, FRANK H. Insect enemies of the white pine.

Bull. Div. Forestry, U. S. Dept. Agric., No. 22; reprint, Sept. 23, 1899, pp. 55–61, figs. 5–15.

A short general account of the more important insects affecting *Pinus strobus*, including a list of others known to attack this tree. Two of the illustrations are original.

CHITTENDEN, FRANK H. The Bronze Apple-tree Weevil (*Magdalis ænescens* Lec.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 37–44, figs. 25, 26.

General account in connection with recent injury to trees in Washington State, including approximate life history with biologic notes by C. V. Piper, and the relation of attack to that of *Macrophoma curvispora*, the conclusion being that the fungus is probably the primary cause of injury. Two original illustrations.

——— Insects and the weather: Observations during the season of 1899.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 51–64.

A consideration of the effects of weather upon the increase and decrease of injurious insects, with particular reference to results following the cold winter of 1898–99. The paper includes a consideration of the life zones about the District of Columbia; a list of species, indicating the southern character of its insect fauna; lists of southern species which were appreciably lessened as a consequence of cold snaps, and of the corresponding increase of northern species in the same latitude; observations on species common to both North and South which were, as a rule, not materially affected; comparisons with results of the cold on insects in other States, and speculations as to the probable increase or decrease of certain of these insects during following seasons, etc.

——— Food plants and injury of North American species of *Agrilus*.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 64–68.

Special mention of *Agrilus anxius*, *A. otiosus*, and *A. bilineatus*, with list of 22 species, with food plants and references.

——— On the recent spread of the Mediterranean Flour Moth (*Ephestia kuehniella*).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 97, 98.

A brief review of reported invasion of flour mills by *Ephestia kuehniella* in North America, with account of outbreak at St. Paul, Minn.

——— Note on two species of Lightning Hoppers.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 98, 99.

Biological observations on *Ormenis* (*Pœciloptera*) *pruinosa* and *Chlorochroa* (*Flata*) *conica*, with mention of new food plants for both species.

CHITTENDEN, FRANK H. Biologic observations on *Harpalus pennsylvanicus* De G.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 100–104.

——— A note on the Cocklebur Bill-bug.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 104, 105.

A review of food plants of *Rhodobænus 13-punctatus* Ill., with additions and biologic notes.

——— A new vine borer of lima beans (*Monoptilota nubilella* Hulst).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 9–17, fig. 1.

A general account of this species, with technical descriptions of the genus and species (after Hulst) and of the earlier stages by the writer. One original illustration.

——— The Smaller Corn-stalk Borer (*Elasmopalpus lignosellus* Zell.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 17–22, figs. 2–4.

A general account, including mention of new food plants, new localities, and one original and two adapted illustrations.

——— The Pale-striped Flea-beetle (*Systena blanda* Mels.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 22–29, figs. 5, 6.

A full, general account of this species, with original records, other observations, and two original illustrations.

——— Observations of the Bean Leaf-beetle (*Ceratoma trifurcata* Forst.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 30, 31.

Additional notes on injuries, etc.

——— Notes on the Imbricated Snout-beetle (*Epicærus imbricatus* Say).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 31, 32, fig. 7.

Supplementary observations to a former paper, with an original illustration of a fungus-infected beetle.

——— A new Tingitid on bean (*Gargaphia angulata* Heid.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 32, 33, fig. 8.

A short account, with one original illustration.

CHITTENDEN, FRANK H. The destructive Green-pea Louse (*Nectarophora destructor* Johns.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 33–37, fig. 9.

A general account, with particular reference to reported injuries supplementary to those reported by Johnson in Bulletin No. 20, pp. 94–99. One original illustration.

——— A note on the Mexican Bean Weevil (*Spermophagus pectoralis* Sharp).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 37, 38, fig. 10.

Notes supplementary to two former papers, with a quotation from a publication of 1858, showing the probability of this species being synonymous with *S. semifasciatus*.

——— The Cabbage Curculio (*Ceutorhynchus rapæ* Gyll.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 39–50, figs. 11, 12.

A general economic article, including a practically complete account of the insect's life history, with two original illustrations. The species is identified as the European *C. rapæ*.

——— Remarks on the food habits of species of *Ceutorhynchus*.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 50–53.

Biologic notes on 5 European and 5 native or introduced American species of the genus.

——— Additional notes on the Imported Cabbage Web-worm (*Hellula undalis* Fab.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 53–61, fig. 13.

Includes a consideration of new localities and additional literature, with other observations looking toward a more complete account of this species.

——— The Common Rhubarb Curculio (*Lixus concavus* Say).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 61–69, figs. 14–16.

A rather full general economic account, with three original figures.

——— The Strawberry Flea-beetle (*Haltica ignita* Ill.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 70–78, figs. 17, 18.

A general economic account of this species with two original illustrations.

CHITTENDEN, FRANK H. The Fall Army worm in 1899 (*Laphygma frugiperda* S. and A.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 78–85, fig. 19.

A preliminary account with particular reference to reported injuries during 1899. One original illustration.

——— The Strawberry Crown Moth (*Sesia rutilans* Hy. Edw.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 85–90, fig. 20.

A general account, with one original figure.

——— The Black Gooseberry Borer (*Xylocrius agassizii* Lec.).

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 23, May 7, 1900, pp. 90–92, figs. 21–23.

A short general account based on notes received through Dr. James Fletcher, and an account published by him in his report for the year 1898 (pp. 207–210).

CLARKE, FRANK W., and STEIGER, GEORGE. Experiments relative to the constitution of pectolite, pyrophyllite, calamine, and analcite.

Am. Journ. Sci., VIII, 1899, p. 245.

——— The action of ammonium chloride upon analcite and leucite.

Am. Journ. Sci., IX, 1900, p. 117.

——— The action of ammonium chloride upon natrolite, scolecite, prehnite, and pectolite.

Am. Journ. Sci., IX, 1900, p. 345.

CLARKE, JOHN M. The Paleozoic faunas of Para, Brazil. 1. The Silurian fauna of the Rio Trombetas. 2. The Devonian Mollusca of the State of Para.

Archivos de Museu Nacional de Rio de Janeiro, X, 1899. Author's English edition, Albany, N. Y., 1900, pp. 1–127, pls. 1–8.

The Silurian fauna, Dr. Clarke writes, "is a middle Silurian one, though a quite different association of species from that described from the island of Anticosti as middle Silurian by M. Billings."

The second part treats of the Devonian mollusca of the State of Para and completes the description of the Para fauna by Messrs. Ch. Fred Hartt and Richard Rathbun. Some of the illustrated material is in the U. S. National Museum.

CLARKE, JOHN M., and SCHUCHERT, CHARLES. The nomenclature of the New York series of geological formations.

Science (new series), X, Dec. 15, 1899, pp. 874–878.

The American standard Paleozoic section is here redefined and brought up to date.

COOKE, GEORGE H. Te Pito Te Henua, known as Rapa Nui; commonly called Easter Island, South Pacific Ocean.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 689–723.

COQUILLETT, DANIEL W. New genera and species of Nycteribidæ and Hippoboscidæ.

Canadian Entomologist, XXXI, No. 11, Nov., 1899, pp. 333–336.

Describes 2 new genera and 3 new species of Nycteribidæ, gives a synoptic table of the 6 North American genera of the fully winged Hippoboscidæ, 2 of which are new, and describes 1 new species.

——— Notes and descriptions of Trypetidæ.

Journ. N. Y. Ent. Soc., VII, No. 4, Dec., 1899, pp. 259–268.

Describes 1 new genus and 17 new species, gives synonymical notes and generic references of several other species, and concludes with a synoptic table of the 23 genera which occur in the United States.

——— Two new Cecidomyians destructive to the buds of roses.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 44–48.

Gives the habits, distribution, and description of 2 new species, and figures 1 of them, for which a new genus is erected.

——— A new violet pest.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 48–51.

Gives the habits, together with a description and figure, of a new species of *Diplosis*.

——— New genera and species of Ephydridæ.

Canadian Entomologist, XXXII, No. 2, Feb., 1900, pp. 33–36.

Describes 2 new genera and 7 new species.

——— Notes and descriptions of Ortalidæ.

Journ. N. Y. Ent. Soc., VIII, No. 1, March, 1900, pp. 21–25.

Describes 1 new genus and 10 new species, with synonymical notes and generic references of several other species.

COQUILLETT, DANIEL W. Two new genera of Diptera.

Entomological News, XI, No. 4, April, 1900, pp. 429, 430.

Describes 2 new genera and 2 new species, with a figure of the head and wing of one of them.

——— Report on a collection of dipterous insects from Porto Rico.

Proc. U. S. Nat. Mus., XXII, No. 1198, May 12, 1900, pp. 249–270.

Gives a list, with localities, dates of capture, and general distribution, of 117 species of Diptera collected by Mr. August Busck, of the U. S. Department of Agriculture. Three of the genera and 16 of the species are described as new.

——— New Scenopinidæ from the United States.

Entomological News, XI, No. 6, June, 1900, p. 500.

Gives a synoptic table of the 3 genera, 1 of which is new, and describes 2 new species.

——— Description of a new parasitic tachinid fly from Ceylon.

Indian Museum Notes, IV, 1899, p. 279.

Describes and figures a new species of *Exorista*.

COULTER, JOHN M. (See under J. N. ROSE.)

CURRIE, ROLLA PATTESON. New species of North American Myrmeleonidæ V.

Canadian Entomologist, XXXI, No. 12, Dec., 1899, pp. 361–365.

Describes for the first time the male of *Brachynemurus tuberculatus* Banks, and gives descriptions of 2 new species of the same genus, *B. papago* and *B. pusillus*.

DALL, W. H. Synopsis of the Solenidæ of North America and the Antilles.

Proc. U. S. Nat. Mus., XXII, No. 1185, Oct. 9, 1899, pp. 107–112.

This synopsis shows the species of the region referred to and the groups to which they belong, with synonyms.

Ensis minor, *E. californicus*, and *Solen mexicanus* are described as new; *Ensis directus* Conrad is substituted for *Ensatella americana* Beck, a later name in common use, and *Psammosolen* Risso, not Hupé, for the later *Macha* of Oken. Some supplementary notes to the author's Synopsis of the Psammobiidæ, 1898, are added, in which the genus *Novaculina* Benson is redefined, a new section, *Clunaculum* Dall, proposed, and a new species, *Tagelus poeyi* Dall, from Cuba is described.

DALL, W. H Synopsis of the American species of the family Diplodontidæ.

Journ. Conchology, IX, No. 8, Oct., 1899, pp. 244–246.

This synopsis exhibits the groups into which this family is divided, the genera already described and their synonyms. Section *Felaniella* Dall, based on *Felania usta* Gould, and section *Phlyctiderma* Dall, based on *Diplodonta semiaspera* Philippi, are described as new. *Diplodonia verrillii* Dall is proposed as a new name for *D. turgida* Verrill and Smith, not Conrad; *D. semirugosa* Dall is proposed as a new name for *D. semiaspera* Carpenter, not of Philippi. *Diplodonla platensis*, from Argentina, is described as new.

——— The mollusk fauna of the Pribilof Islands.

The Fur Seals and Fur Seal Islands of the North Pacific Ocean, Part III, 1899 (Nov.), pp. 539–546, and map.

This paper discusses the distribution of mollusks in Bering Sea and vicinity and its causes, the characteristics of the littoral fauna, and those of the very distinct plateau fauna of the offshore shallows of Bering Sea. Lists of the species known to inhabit the Pribilof and Commander islands are given, followed by an enumeration of the fossil mollusks of St. Paul Island. The map shows the summer and winter southern limits of pack ice, and the direction of currents of the sea bearing upon the distribution of animal life in this region.

——— Note on *Sigaretus oldroydii*.

Nautilus, XIII, No. 8, Dec., 1899, p. 85.

Notes the discovery of the adult form of this species, and describes its characters from specimens dredged at Drakes Bay, California, by J. S. Arnheim.

——— Origin of the mutations of *Ostrea*.

Nautilus, XIII, No. 8, Dec., 1899, pp. 91–93.

Reprint of a discussion of this subject in *Transactions of the Wagner Free Institute of Science*, III, part IV, 1898.

——— A new species of *Capulus* from California.

Nautilus, XIII, No. 9, Jan., 1900, p. 100.

Describes *Capulus californicus* as new, from a specimen dredged in 20 fathoms off San Pedro. In a note attention is called to the nepionic shell of *Petricola*.

——— Note on *Petricola denticulata* Sowerby.

Nautilus, XIII, No. 11, Mar., 1900, pp. 121, 122.

Shows that the nepionic shell of *P. denticulata* is identical with Carpenter's *Psephis tellimyalis*, and after growth has taken place and the shell is adult, the dark colors of the larval shell fade out entirely.

DALL, W. H. Notes on the Tertiary geology of Oahu.

Bull. Geol. Soc. Amer., XI, Mar., 1900, pp. 57-60.

Records observations on the raised reefs and terraces of Oahu, and concludes that, with the exception of certain beds very near the sea level, the formations referred to are of Tertiary age.

——— A new species of *Lima*.

Nautilus, XIV, No. 2, June, 1900, pp. 15, 16.

A new species of the type of *Lima excavata*, from clays pierced by the city tunnels of Los Angeles, Cal., is described under the name of *Lima hamlini*. It is probably Pliocene.

——— Alaskan notes.

Nation, LXIX, No. 1781, Aug. 17, 1899, pp. 127, 128.

A summary account of the apparent changes in conditions on the Alaskan coast since 1895.

——— Impressions of Honolulu.

Nation, LXIX, No. 1792, Nov. 2, 1899, pp. 331, 332.

An account of the conditions existing in Oahu during the summer of 1899, and the changes indicated since earlier days, especially in the flora and fauna.

——— Alaska and the Klondike.

Science (new series), No. 260, Dec. 22, 1899, pp. 929, 930.

Review of Heilprin's work of the name cited.

——— [Review of] Preliminary report on the geology of Louisiana.

Science (new series), XI, No. 280, May 11, 1900, pp. 745, 746.

Review of Prof. G. D. Harris's report of the above name.

——— Note on a new abyssal limpet.

Science (new series), XI, No. 284, June 8, 1900, p. 914.

Account of a peculiar deep-sea limpet, *Bathysciadium conicum* D. and F., and its anatomy.

——— Additions to the insular land shell faunas of the Pacific coast, especially of the Galapagos and Cocos islands.

Proc. Acad. Nat. Sci. Phila., 1900, pp. 88-106.

This paper may be regarded as supplementing one on the same subject in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1896, pp. 395-497. It enumerates the species collected by the Stanford expedition to the Galapagos and Cocos islands and by others at various localities along the shore from Panama northward.

Bulimulus snodgrassi, *Bulimulus approximatus*, *Bulimulus hoodensis*, *Vitrea actinophora*, and *Endodonta helleri* (from the Galapagos), are described as new, and a species previously described and figured but not named is now named *Bulimulus indefatigabilis*.

Trochomorpha bauri is changed to *Guppya bauri* and *Leptinaria chathamensis* to *Tornatellina chathamensis*. From Cocos Island *Guppya hopkinsi*, *Leptinaria martensi*, and *Vertigo cocosensis* are described as new. Other new forms are *Epiphragmophora leucanthea* from Cerros Island, *E. crassula* from Natividad Island, *E. guadalupensis* from Guadalupe Island, *Epiphragmophora catalinæ* from Catalina Island, *E. clementina* from San Clemente Island, and *E. orcutti* from Lower California. The new forms are figured on Plate VIII.

DYAR, HARRISON G. Life history of *Notodonta georgica*.

Entomological News, X, No. 7, Sept., 1899, pp. 202-204.

——— A new genus of Cochlidiidæ from Virginia.

Journ. N. Y. Ent. Soc., VII, No. 3, Sept., 1899, pp. 208, 209.

Describes the genus *Isochætes*.

——— Life history of a European slug caterpillar, *Cochlidion avellana*.

Journ. N. Y. Ent. Soc., VII, No. 3, Sept., 1899, pp. 202-208, pl. V, figs. 1-13.

——— A new *Plagodis* (*P. approximaria*).

Canadian Entomologist, XXXI, No. 9, Sept., 1899, p. 266.

——— Description of the larva of *Hadena miseloides*.

Canadian Entomologist, XXXI, No. 10, Oct., 1899, p. 286.

——— Life histories of New York slug caterpillars.

Journ. N. Y. Ent. Soc., VII, No. 4, Dec., 1899, pp. 234-253, pls. VI-VIII.

Concluding remarks on the New York Cochlidiidæ.

——— Description of the mature larva of *Acronycta connecta*.

Journ. N. Y. Ent. Soc., VII, No. 4, Dec., 1899, p. 253.

——— A note on African Limacodidæ.

Ent. Tidsk., XX, No. 4, 1899, pp. 231, 232.

——— *Bombyx cunea* Dru.

Canadian Entomologist, XXXII, No. 1, Jan., 1900, p. 16.

Short note in a discussion on this species, started by Rev. Dr. Fyles.

DYAR, HARRISON G. A new cochlidian of the palæarctic group.
Entomological News, XI, No. 1, Jan., 1900, pp. 333, 334.
Describes *Tortricidia fiskeana*.

——— Notes on some North American Yponomeutidæ.
Canadian Entomologist, XXXII, No. 2, Feb., 1900, pp. 37–41; No. 3, Mar., 1900, pp. 84–86.
Synoptic tables and bibliography of North American species.

——— On the larvæ of *Atomacera* and some other sawflies.
Journ. N. Y. Ent. Soc., VIII, No. 1, Mar., 1900, pp. 26–31.

——— A new zygænid from Arizona.
Journ. N. Y. Ent. Soc., VIII, No. 1, Mar., 1900, p. 32.
Describes *Gingla latercula*.

——— Preliminary notes on the larvæ of the genus *Arctia*.
Journ. N. Y. Ent. Soc., VIII, No. 1, Mar., 1900, pp. 34–47.

——— Life history of *Margarodes flegia*.
Canadian Entomologist, XXXII, No. 4, Apr., 1900, p. 117.

——— The larva of *Eustrixia pupula*.
Canadian Entomologist, XXXII, No. 5, May, 1900, p. 155.

——— Larvæ from Hawaii.
Canadian Entomologist, XXXII, No. 5, May, 1900, p. 156.
Notes on 5 larvæ from the Hawaiian Islands.

——— Life histories of North American Geometridæ, II–XII.
Psyche, VIII, No. 279, July, 1899, pp. 386, 387; No. 280, Aug., 1899, pp. 395, 396; No. 281, Sept., 1899, pp. 407, 408; No. 282, Oct., 1899, pp. 415, 416; No. 283, Nov., 1899, p. 429; No. 284, Dec., 1899, p. 438; IX, No. 285, Jan., 1900, pp. 9, 10; No. 285, Jan., 1900, pp. 10, 11; No. 286, Feb., 1900, pp. 21, 22; No. 289, May, 1900, pp. 59, 60; No. 290, June, 1900, pp. 69, 70.

EVERMANN, BARTON WARREN, and MARSH, MILLARD CALEB. Descriptions of new genera and species of fishes from Porto Rico.
Rep. U. S. Fish Com., 1899, pp. 351–362.
In this paper the authors describe as new 3 genera and 20 species of fishes which were obtained in January and February, 1899, by the steamer *Fish Hawk*.
The types are deposited in the National Museum.

FLINT, JAMES M. Recent Foraminifera. A descriptive catalogue of specimens dredged by the U. S. Fish Commission steamer *Albatross*.
Rep. Smithsonian Inst. (*U. S. Nat. Mus.*), 1897 (1899), pp. 249–349, pls. 1–80.
The material here catalogued is chiefly from the North Atlantic Ocean and the Gulf of Mexico. The figures are from photographs of mounted specimens enlarged about fifteen diameters. An analytical key to families and genera is given; also descriptions of families, genera, and species.

GANE, HENRY STEWART. Some Neocene corals of the United States.
Proc. U. S. Nat. Mus., XXII, No. 1193, Apr. 20, 1900, pp. 179–198, pl. XV.

GIRTY, GEORGE H. Devonian and Carboniferous fossils of the Yellowstone National Park.
Monogr. U. S. Geol. Surv., XXXII, Sept., 1899, pp. 479–599, pls. 66–71.
Describes the Devonian and Carboniferous fossils occurring in the Yellowstone National Park. All of the material is in the National Museum.

——— Preliminary report on Paleozoic invertebrate fossils from the region of the McAlester Coal Field, Indian Territory.
19th Ann. Rep. U. S. Geol. Surv., 1899, pp. 539–600, pls. 70–72.
Describes the Lower Helderberg and Carboniferous material and lists the Ordovician species of the McAlester-Lehigh Coal Field, Indian Territory. All of the material is in the National Museum.

HAY, O. P. Descriptions of two new species of tortoises from the Tertiary of the United States.
Proc. U. S. Nat. Mus., XXII, No. 1181, Oct. 7, 1899, pp. 21–24, pls. IV–VI.

——— Description of some vertebrates of the carboniferous age.
Proc. Am. Philosoph. Soc., XXXIX, 1900, No. 161, pp. 96–123, pl. 7.

HAY, W. P. Synopses of North American invertebrates. VI.—The Astacidæ of North America.
Am. Naturalist, XXXIII, No. 396, Dec., 1899 (1900), pp. 957–966, 1 text fig.
The species found on the whole continent of North America are included. Two lists are given, one in which the species are arranged in natural groups with their geographical distribution indicated, and the other an artificial key for the ready determination of species.

HAY, W. P. Description of two new species of crayfish.

Proc. U. S. Nat. Mus., XXII, No. 1187, Oct. 11, 1899, pp. 121-123, 2 text figs.

Two new species of crayfish (*Cambarus pilosus* and *C. clypeatus*) from Kansas and Mississippi, respectively, are described and figured.

HOLMES, WILLIAM H. A preliminary revision of the evidence relating to auriferous gravel man in California.

Am. Anthropologist (new series), I, Part I, Jan., 1899, pp. 107-120; Part II, Oct., 1899, pp. 614-645.

HOUGH, WALTER. Oriental influences in Mexico.

Am. Anthropologist (new series), II, No. 1, Jan.-Mar., 1900, pp. 66-74.

This paper points out the great influx of oriental arts and products into Mexico subsequent to the discovery of the Philippines.

HOWARD, LELAND O. Spider bites and "Kissing bugs."

Appleton's Popular Science Monthly, Nov., 1899, LVI, No. 1, pp. 31-42, 7 figs.

Gives an account of the newspaper scare of the summer of 1899 in regard to the insects popularly known as kissing bugs; describes the habits of 7 species of heteropterous insects concerned in the comparatively small number of bites which gave rise to the scare.

——— A remedy for gadflies; Porchinski's recent discoveries in Russia, with some American observations.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 20, Nov., 1899, pp. 24-28.

Showing how Porchinski has discovered that gadflies (Tabanidæ) frequent pools of water for drinking purposes and are captured and destroyed by a kerosene film on the surface of the water; showing also how the writer had discovered this same drinking habit and mentioned it in his original account of an experiment against mosquitoes, in *Insect Life*, vol. v, p. 13.

——— The present status of the Caprifig experiments in California.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 20, Nov., 1899, pp 28-35. Reprinted in *Scientific American* Supplement, Feb. 3, 1900, pp. 20144, 20145.

An account of the introduction and establishment of *Blastophaga grossorum* at Fresno, Cal., under the auspices of the U. S. Department of Agriculture, together with a brief review of the habits of the insect and the fertilization of the figs in oriental regions.

HOWARD, LELAND O. Report of the entomologist for 1899.

Rep. Secy. Agric., 1899, pp. 43-52 (Dec., 1899).

An account of the work of the Division of Entomology for the fiscal year ending June 30, 1899, with recommendations concerning future work.

——— An interesting case of the use of insects as food.

Scientific American, Feb. 3, 1900, p. 71.

An account of the use of the "Bugong Moth" (*Agrotis infusa* Boisduval) by the natives of Australia.

——— The two most abundant Pulvinarias on maple.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 7-23, 17 figs.

Full biology of *Pulvinaria innumerabilis* Rathvon and *P. acericola* Walsh and Riley.

——— The insects to which the name "Kissing bug" was applied during the summer of 1899.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 24-30, 7 figs.

——— General notes and notes from correspondence.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 22, Feb. 20, 1900, pp. 93-109.

A number of unsigned notes.

——— Progress in economic entomology in the United States.

Yearbook U. S. Dept. Agric., 1899, June 1, 1900, pp. 135-156, 1 pl.

Account of the development of economic entomology during the present century.

——— A new genus of Aphelininæ from Chile.

Canadian Entomologist, XXXII, June, 1900, pp. 167, 168.

Description of *Aphytis* n. g., *chilensis*, n. sp.

HOWARD, LELAND O., and MARLATT, C. L. The original home of the San Jose scale.

Bull. Div. Ent., U. S. Dept. Agric. (new series), No. 20, Nov., 1899, pp. 36-38.

Discusses the different theories as to the original home of the San Jose scale, and concludes that nothing more definite can be said with certainty than had already been said in Bulletin No. 3 (new series), Division of Entomology, U. S. Department of Agriculture, by the authors.

HOWE, Reginald Heber, Jr. Ranges of *Hylocichla fuscescens*, and *Hylocichla fuscescens salicicola* in North America.

Auk, xvii, No. 1, Jan., 1900, pp. 18–25.

A revision of the geographical distribution of these forms in North America.

——— North American Wood Frogs.

Proc. Boston Soc. Nat. Hist., xxviii, No. 14, pp. 369–374.

A critical review of the group, based in part upon material belonging to the National Museum.

KELLOGG, Vernon L. A list of the Biting Lice (Mallophaga) taken from birds and mammals of North America.

Proc. U. S. Nat. Mus., xxii, No. 1183, Oct. 9, 1899, pp. 39–100.

KISHINOUYE, K. Contributions to the natural history of the Commander Islands. No. xiii.—A new species of Stalked Medusæ, *Haliclystus stejnegeri*.

Proc. U. S. Nat. Mus., xxii, No. 1188, Dec. 23, 1899, pp. 125–129, 3 text figs.

Based on specimens collected at Nikolski, Bering Island, by Dr. Leonhard Stejneger in 1897.

KNOWLTON, Frank Hall. Report on some fossil wood from the Richmond basin, Virginia.

19th Ann. Rep. U. S. Geol. Surv., 1899, Part ii, pp. 516–519, pl. lii.

The specimens examined comprised three forms from the Triassic; one was too much changed for identification; one was identified as *Araucarioxylon (?) virginicum;* and the third was a new species, viz, *Araucarioxylon woodworthi*, named for the collector of the specimens.

——— Fossil plants associated with the lavas of the Cascade Range.

20th Ann. Rep. U. S. Geol. Surv., Part iii, 1900, pp. 37–64, pls. i–iii.

The specimens described in this paper are in the Museum collection. They were collected by Mr. J. S. Diller and Mr. Elmer I. Applegate from six different localities in Oregon, and include 28 forms, 10 of which are regarded as new to science. The characters of the plants indicate the Miocene age of the beds from which they were obtained.

——— Fossil flora of the Yellowstone National Park.

Monogr. U.S. Geol. Surv., xxxii, 1899, Chap. xiv, pp. 651–882, pls. lxxvii–cxxi.

The specimens upon which this paper is based are in the Museum collection. The paper describes 150 species, 76 of which are new. They are distributed among 33 families, of which 19 are not represented in the present flora of the park. A comparison of the Tertiary and living flora renders apparent the great climatic changes that have taken place since the close of the Miocene period.

LO BIANCO, Salvatore. The methods employed at the Naples Zoological Station for the preservation of marine animals.

Bull. U. S. Nat. Mus., No. 39, Part M, Oct. 2, 1899, pp. [1]–[42], 1 plate.

Translated from the original Italian by Edmund Otis Hovey.

LÜTKEN, C. F., and MORTENSEN, Th. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer *Albatross*, during 1891; Lieut. Commander Z. L. Tanner, U. S. N., commanding. xxv.—The Ophiuridæ.

Mem. Mus. Comp. Zool. (Harvard College), xxiii, No. 2, Nov., 1899, pp. 97–208, 22 plates and a chart.

Sixty-six species were collected by the *Albatross;* 1 genus and 53 species are new. These are fully described and figured. A list of papers on Ophiurids, published subsequently to Lyman's Monograph, is given, and also a list of the new genera and species contained therein.

McGUIRE, Joseph D. Pipes and smoking customs of the American aborigines, based on material in the U. S. National Museum.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 351–645, pls. 1–4, figs. 1–239.

MARLATT, C. L.
(See under L. O. Howard.)

MARSH, Millard Caleb. (See under B. W. Evermann.)

MASON, Otis Tufton. The man's knife among the North American Indians. A study in the collections of the U. S. National Museum.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 725–745, figs. 1–17.

——— Ethnology and archæology of Mexico.

Handbook of Mexico (Bureau of American Republics), Washington, 1900, Chap. iii, pp. 21–43.

A bibliography from 1876 to date is included.

MAXON, William R. A new *Asplenium*, hitherto referred to *A. trichomanes* var. *incisum* Moore.

Bull. Torrey Botan. Club, xxvii, Apr., 1900, pp. 197–199.

MAXON, William R. Notes on American ferns. I.

Fern Bulletin, VIII, Apr., 1900, pp. 29–31.

MAYNARD, George C. The electrical collections in the National Museum.

Electrical Review, New York, XXXVI, Jan. 3, 1900, pp. 10, 11; Mar. 14, pp. 266, 267, and May 16, pp. 507–509.

MERRILL, George P. A discussion of the terms rockweathering, serpentinization, and hydrometamorphism.

Geol. Mag. (Decade IV), VI, Aug., 1899, p. 422.

Reprinted in *American Geologist*, Oct., 1899.

——— Preliminary note on new meteorites from Allegan, Mich., and Mart, Tex.

Science (new series), XX, Nov. 24, 1899, pp. 770, 771.

——— Nepheline melilite basalt from Oahu, Hawaiian Islands.

Am. Geologist, XXV, May, 1900, pp. 312, 313.

——— Sandstone disintegration through the formation of interstitial gypsum.

Science (new series), XI, June 1, 1900, pp. 850, 851.

MILLER, Gerrit S., Jr. Directions for preparing study specimens of small mammals.

Bull. U. S. Nat. Mus., No. 39, Part N, Aug. 26, 1899, pp. [1]-[10], 1 fig.

——— Jamaica bats. A new genus and species.

Journ. Inst. Jamaica, II, Aug. 31, 1899, pp. 625–627, figs. 2–5.

Reithronycteris aphylla gen. et sp. nov. An abstract of a paper in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1898, pp. 326–337.

——— Descriptions of two new Gray Foxes.

Proc. Acad. Nat. Sci. Phila., 1899 (August), pp. 276–280.

Urocyon parvidens and *U. guatemalæ* are described.

——— The voles collected by Dr. W. L. Abbott in central Asia.

Proc. Acad. Nat. Sci. Phila., 1899 (August), pp. 281–298, pls. XII, XIII.

Ten species are described, of which the following are new: *Microtus ravidulus*, *M. pamirensis*, *M. brachelix*, *M. cricetulus*, and *M. acrophilus*

MILLER, Gerrit S., Jr. A new Tree Frog from the District of Columbia.

Proc. Biol. Soc. Wash., XIII, Sept. 28, 1899, pp. 75–78.

Hyla evittata sp. nov.

——— The Dogbanes of the District of Columbia.

Proc. Biol. Soc. Wash., XIII, Sept. 28, 1899, pp. 79–90, pl. II.

Apocynum speciosum sp. nov., *A. urceolifer* sp. nov., and *A. nemorale* sp. nov.

——— Descriptions of six new American rabbits.

Proc. Acad. Nat. Sci. Phila., 1899 (Oct. 8, 1899), pp. 380–390.

Lepus asellus sp. nov., *L. bachmani ubericolor* subsp. nov., *L. floridanus yucatanicus* subsp. nov., *L. floridanus subcinctus* subsp. nov., *L. floridanus caniclunis* subsp. nov., and *L. floridanus sanctidiegi* subsp. nov.

——— Descriptions of three new free-tailed bats.

Bull. Am. Mus. Nat. Hist., XII, Oct. 20, 1899, pp. 173–181.

Nyctinomus minutus, *Saccopteryx perspicillifer* and *Peropteryx trinitatis*.

——— Preliminary list of the mammals of New York.

Bull. N. Y. State Museum, VI, Oct., 1899 (Nov. 18, 1899), pp. 273–390.

——— History and characters of the family Natalidæ.

Bull. Am. Mus. Nat. Hist., XII, Dec. 23, 1899, pp. 245–253.

——— The bats of the genus *Monophyllus*.

Proc. Wash. Acad. Sci., II, Mar. 30, 1900, pp. 31–38.

Monophyllus portoricensis sp. nov., *M. plethodon* sp. nov., and *M. clinedaphus* sp. nov.

——— A new shrew from Eastern Turkestan.

Proc. Wash. Acad. Sci., II, Mar. 30, 1900, pp. 39, 40.

Crocidura lignicolor sp. nov.

——— Three new bats from the island of Curaçao.

Proc. Biol. Soc. Wash., XIII, Apr. 6, 1900, pp. 123–127.

Myotis nesopotus sp. nov., *Leptonycteris curasoæ* sp. nov., and *Glossophaga elongata* sp. nov.

MILLER, Gerrit S., Jr. Seven new rats collected by Dr. W. L. Abbott in Siam.

Proc. Biol. Soc. Wash., XIII, Apr. 21, 1900, pp. 137–150, pls. III–V.

Mus vociferans sp. nov., *M. ferreocanus* sp. nov., *M. validus* sp. nov., *M. cremoriventer* sp. nov., *M. asper* sp. nov., *M. pellax* sp. nov., and *M. surifer* sp. nov.

——— The *Vespertilio concinnus* of Harrison Allen.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 154.

Identical with *Myotis nigricans*.

——— The generic name *Evotomys* not invalidated by *Anaptogonia*.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 154.

——— Note on *Micronycteris brachyotis* Dobson and *M. microtis* Miller.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, pp. 154, 155.

——— The systematic name of the Cuban Red Bat.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 155.

Lasiurus blossevillei.

——— Note on the *Vespertilio blythii* of Tomes.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 155.

A valid species which should stand as *Myotis blythii* (Tomes).

——— The *Scotophilus pachyomus* of Tomes a valid species.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, pp. 155, 156.

The proper name for the animal is *Vespertilio pachyomus*.

——— A bat of the genus *Lichonycteris* in South America.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 156.

——— The systematic name of the large Noctule Bat of Europe.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 156.

Pterygistes maximus (Fatio).

——— A new subgenus for *Lepus idahoensis*.

Proc. Biol. Soc. Wash., XIII, June 13, 1900, p. 157.

Brachylagus subgen. nov.

MILLER, Gerrit S., Jr. *Antennaria solitaria* near the District of Columbia.

Proc. Biol. Soc. Wash., XII, June 13, 1900, p. 157.

MORTENSEN, Th. (See under C. F. Lütken.)

NEEDHAM, James G. Directions for collecting and rearing dragon flies, stone flies, and may flies.

Bull. U. S. Nat. Mus., No. 39, Part O, Nov. 29, 1899, pp. [1]–[9], figs. 1–4.

NELSON, E. W. Description of a new subspecies of *Meleagris gallopavo* and proposed changes in the nomenclature of certain North American birds.

Auk, XVII, No. 2, Apr., 1900, pp, 120–126.

A new turkey, *Meleagris gallopavo merriami*, is described (p. 120), and nomenclatural changes affecting four species of North American birds are proposed,

NYE, Willard, Jr. A Bahaman bird apparently extinct.

Auk, XVI, No. 3, July, 1899, p. 273.

Note on the capture of a single specimen of *Centurus nyeanus*, now in the U. S. National Museum.

OBERHOLSER, Harry C. Description of a new *Geothlypis*.

Auk, XVI, No. 3, July, 1899, pp. 256–258.

Geothlypis trichas arizela is described as new.

——— Notes on birds from the Cameroons district, West Africa.

Proc. U. S. Nat. Mus., XXII, No. 1180, Oct. 7, 1899, pp. 11–19.

Critical notes on 32 species, involving several changes of nomenclature. *Eurillas* (p. 15) is a new genus belonging to the family Pycnonotidæ.

——— A list of the birds collected by Mr. R. P. Currie in Liberia.

Proc. U. S. Nat. Mus., XXII, No. 1182, Oct. 9, 1899, pp. 25–37, pl. VII.

A list of 39 species, with critical remarks and notes on nomenclature. The following new genera and species are named: *Horizocerus*, p. 28; *Dendromus caroli arizelus*, p. 29; *Stelgidillas*, p. 30; *Anthreptes idius*, p. 33; *Dicrurus modestus atactus*, p. 35, and *Fraseria prosphora*, p. 37.

——— A synopsis of the genus *Contopus* and its allies.

Auk, XVI, No. 4, Oct., 1899, pp. 330–337.

A synopsis of the genera *Nuttallornis*, *Contopus*, and *Blacicus*. *Contopus*, being preoccupied, is renamed *Horizopus*.

OBERHOLSER, HARRY C. Flammulated Screech Owls, *Megascops flammeolus* (Kaup) and *Megascops flammeolus idahoensis* Merriam.

Ornis, x, No. 1, Dec., 1899.

An account of these two forms, with synonymy, geographical distribution, etc.

——— A new wren from Alaska.

Auk, xviii, No. 1, Jan., 1900, pp. 25, 26.

Anorthura meligera is described as a new species from the Aleutian Islands.

——— Notes on birds collected by Dr. W. L. Abbott in central Asia.

Proc. U. S. Nat. Mus., xxii, No. 1195, Apr. 23, 1900, pp. 205–228.

Notes on 62 species from Ladak and Kashmir. *Totanus totanus eurhinus* (p. 207) is a new subspecies; *Saxicola oreophila* is a new name for *S. montana* Gould (preoccupied), and *Perissospiza* is proposed in place of *Pycnorhamphus* (preoccupied).

——— Notes on some birds from Santa Barbara Islands, California.

Proc. U. S. Nat. Mus., xxii, No. 1196, Apr. 23, 1900, pp. 229–234.

A list, with notes, of 26 species recorded from these islands.

——— Catalogue of a collection of birds from Madagascar.

Proc. U. S. Nat. Mus., xxii, No. 1197, Apr. 24, 1900, pp. 235–248.

A list, with critical notes, on 57 species of birds collected in Madagascar by Rev. James Wills.

PALMER, WILLIAM. The avifauna of the Pribilof Islands.

Fur Seals and Fur Seal Islands of the North Pacific Ocean, Part iii, 1899, pp. 355–431, pls. xxxviii–xli.

A general account of the birds recorded from the Pribilof Islands. *Arenaria morinella* is treated as distinct from the Old-World Turnstone, and *Hirundo erythrogastra unalaschkensis* (Gmel.) is recognized as the Alaskan representative of the Barn Swallow.

PERGANDE, THEO. A new species of plant-louse injurious to violets.

Canadian Entomologist, xxxii, Feb., 1900, pp. 29, 30. Describes *Rhopalosiphum violæ*, new species.

POLLARD, CHARLES LOUIS. The genus *Achillea* in North America.

Bull. Torrey Botan. Club, 26, July, 1899, pp. 365–372.

A revision of the North American species with notes on their geographical range. *A. californica*, *A. gigantea*, and *A. Pecten-Veneris* are described as new.

POLLARD, CHARLES LOUIS. The families of flowering plants.

Plant World Supplement, Jan. 1, 1900, iii, pp. 1–43.

A popular illustrated account of the plant families, based in part on the observation of material in the U. S. National Herbarium.

——— Eight new species of North American plants.

Proc. Biol. Soc. Wash., xiii, Apr. 6, 1900, pp. 129–132.

New species described in *Gentiana*, *Lupinus*, *Viola*, *Chrysopsis*, and *Solidago*.

——— Treatment of the genera *Cassia* and *Chamæcrista* in Millspaugh's Plantæ Utowanæ.

Bull. Field Columbian Mus., Botanical series, ii, 1900, pp. 46–48.

RATHBUN, MARY J. Jamaica crustacea.

Journ. Inst. Jamaica, ii, No. 6, Aug. 31, 1899, pp. 628, 629.

Consists of lists of crustacea collected by Dr. J. E. Duerden at Port Royal Cays, Kingston Harbor, and Port Antonio, and determined by Miss Rathbun. Several species are added to the Jamaican fauna, and the name *Chloridella* Miers is substituted for the preoccupied name *Squilla* Fabricius, the well-known genus of Stomatopoda.

A portion of the material belongs to the Museum.

——— List of crustacea known to occur on or near the Pribilof Islands.

The Fur Seals and Fur Seal Islands of the North Pacific Ocean, Part iii, 1899, pp. 555–558.

The material upon which this list is based consists mainly of specimens dredged by the U. S. Fish Commission steamer *Albatross*, and also of shore specimens collected by Dr. F. W. True and Messrs. F. A. Lucas, William Palmer, and Henry W. Elliott. Four new species of shrimps are described.

——— Synopses of North American invertebrates. vii.—The Cyclometopous or Cancroid crabs of North America.

Am. Naturalist, xxxiv, No. 398, Feb., 1900, pp. 131–143, 5 text figs.

A key to the genera and species of American Cyclometopa occurring north of the southern boundary of the United States, the peninsula of Florida excluded, and from the shore to a depth of 100 fathoms. Four new species are noticed.

RATHBUN, Mary J. The Decapod crustaceans of West Africa.

Proc. U. S. Nat. Mus., xxii, No. 1199, May 12, 1900, pp. 271–316, 2 text figs.

A report prepared at the request of Prof. O. F. Cook for the New York State Colonization Society. The region covered extends from Senegal to the southern boundary of Portuguese West Africa, and not only the coast but the fresh waters tributary to it. The arrangement includes keys to families, genera, and species, a synonymical list of species, their West African habitat, and general distribution. A new species of hermit crab, *Clibanarius cooki*, is described and figured.

——— Synopses of North American invertebrates. x.—The Oxyrhynchous and Oxystomatous crabs of North America.

Am. Naturalist, xxxiv, No. 402, June, 1900, pp. 503–520, 15 text figs.

A key similar to No. vii of the same series. A new species of *Cyclodorippe*, *C. plana*, is described from southern California.

RICHARDSON, Harriet. Description of a new species of *Idotea* from Hakodate Bay, Japan.

Proc. U. S. Nat. Mus., xxii, No. 1189, Feb. 2, 1900, pp. 131–134, 6 text figs.

The new species, *Idotea japonica*, is compared with *I. ochotensis* and *I. rectilineata*, to which it is nearly related.

——— Synopses of North American invertebrates. viii.—The Isopoda. Part i. Chelifera, Flabellifera, Valvifera.

Am. Naturalist, xxxiv, No. 399, Mar., 1900, pp. 207–230, 11 text figs.

Includes terrestrial, fresh-water, and marine forms from the shore to the deep sea. Several species are diagnosed here for the first time.

——— Synopses of North American invertebrates. viii.—The Isopoda. Part ii. Asellota, Oniscoidea, Epicaridea.

Am. Naturalist, xxxiv, No. 400, Apr., 1900, pp. 295–309, 16 text figs.

A continuation of the preceding paper.

RICHMOND, Charles W. Overlooked descriptions of five humming birds.

Auk, xvi, No. 4, Oct., 1899, pp. 323–325.

Original descriptions of *Trochilus cohuatl*, *T. xicotencal*, *T. tzacatl*, *T. papantzin*, and *T. topiltzin* are here reprinted.

——— On the date of Lacépède's "Tableaux."

Auk, xvi, No. 4, Oct., 1899, pp. 325–329.

Notes on the date of publication of Lacépède's "Tableaux," with a list of the livraisons and dates of publication of the "Didot" edition of Buffon's "Histoire naturelle."

RICHMOND, Charles W. Note on the name *Drymophila*.

Auk, xvi, No. 4, Oct., 1899, pp. 353, 354.

Note on the proper use of the name *Drymophila*.

——— Further notes on Lacépède's "Tableaux."

Auk, xvii, No. 2, Apr., 1900, pp. 166, 167.

Additional data regarding this subject, with a list of genera of birds dating from Lacépède's "Tableaux," 1799.

——— The earliest name for the Roadrunner.

Auk, xvii, No. 2, Apr., 1900, pp. 173, 174.

Note regarding the date of Swainson's specific name, *longicauda*, for the Roadrunner.

——— Some necessary changes in nomenclature.

Auk, xvii, No. 2, Apr., 1900, pp. 178, 179.

Notes on some proposed changes in nomenclature. *Semnornis* is a new generic and *Geothlypis nelsoni* a new specific name.

——— Description of a new bird of the genus *Dendrornis*.

Proc. U. S. Nat. Mus., xxii, No. 1200, May 12, 1900, pp. 317, 318.

Dendrornis striatigularis is described as a new species from Mexico.

——— Description of three new birds from Lower Siam.

Proc. U. S. Nat. Mus., xxii, No. 1201, May 12, 1900, pp. 319–321.

Æthopyga anomala, p. 319, *Criniger sordidus*, p. 320, and *Turdinulus granti*, p. 320, are described as new.

RIDGWAY, Robert. Descriptions of supposed new genera, species, and subspecies of American birds. iv.—Fringillidæ (concluded); Corvidæ (part).

Auk, xvi, No. 3, July, 1899, pp. 254–256.

The following new species are described: *Pipilo maculatus atratus*, p. 254; *Pipilo fuscus potosinus*, p. 254; *Aimophila rufescens sinaloa*, p. 254; *Cyanocorax affinis zeledoni*, p. 255; *Perisoreus obscurus griseus*, p. 255; *Cyanocitta stelleri azteca*, p. 256. *Cyanolyca mitrata* is a new name (p. 255) for *C. ornata*, preoccupied.

——— Descriptions of supposed new genera, species, and subspecies of American birds. v.—Corvidæ. (Concluded.)

Auk, xvii, No. 1, Jan., 1900, pp. 27–29.

The following species are described as new: *Xanthoura yncas galeata*, p. 27; *X. luxuosa glaucescens*, p. 28; *X. l. virida*, p. 28.

RIDGWAY, ROBERT. Descriptions of supposed new genera, species, and subspecies of American birds. VI.—Fringillidæ. (Supplement.)

Auk, XVII, No. 1, Jan., 1900, pp. 29, 30.

Melospiza melodia kenaiensis, p. 29; *Passerella iliaca insularis*, p. 30, and *P. i. annectens*, p. 30, are described as new.

ROSE, JOSEPH NELSON. Studies of Mexican and Central American plants.

Contrib. U. S. Nat. Herbarium, V, No. 4, Oct., 1899, pp. 145–200.

——— Three new species of *Tradescantia* from the United States.

Contrib. U. S. Nat. Herbarium, V, No. 4, Oct., 1899, pp. 204–206.

——— *Treleasea*, a new genus of Commelinaceæ.

Contrib. U. S. Nat. Herbarium, V, No. 4, Oct., 1899, pp. 207, 208.

——— Notes on useful plants of Mexico.

Contrib. U. S. Nat. Herbarium, V, No. 4, Oct., 1899, pp. 209–259.

ROSE, JOSEPH NELSON, and COULTER, JOHN M. A synopsis of the Mexican and Central American Umbelliferæ.

Proc. Wash. Acad. Sci., I, Jan. 8, 1900, pp. 111–115, pls. 3–13.

SCHUCHERT, CHARLES. The Fossil Field's Expedition to Wyoming.

Science (new series), X, Nov. 17, 1899, pp. 725–728.

Mr. Schuchert accompanied this expedition as the representative of the National Museum. An account of his trip is given in this paper.

——— On the Lower Silurian (Trenton) fauna of Baffin Land.

Proc. U. S. Nat. Mus., XXII, No. 1192, April 7, 1900, pp. 143–177, pls. XII–XIV, figs. 1, 2.

Descriptions of fossils gathered at the head of Frobisher Bay, southern Baffin Land. This locality was first noticed by Hall and the place named "Silliman's Fossil Mount." Seventy-two species, constituting the most extensive Paleozoic local collection from Arctic American regions, are listed or described.

——— Lower Devonic aspect of the Lower Helderberg and Oriskany formations.

Bull. Geol. Soc. Am., XI, May, 1900, pp. 241–332.

This paper gives reasons for referring these formations to the Devonic system instead of to the Siluric as formerly. The work is largely based on previous literature; the material used belongs to the National Museum.

(See also under JOHN M. CLARKE.)

SIMPSON, CHARLES TORREY. The pearly freshwater mussels of the United States, their habits, enemies, and diseases, with suggestions for their protection.

Bull. U. S. Fish Com., 1898, pp. 279–288, 8 figs.

This paper gives an account of the more obvious shell characters and anatomy of our pearly freshwater mussels, with some account of their embryology, habits, and enemies. Suggestions are offered for their protection and propagation.

——— Protective mimicry of mollusks.

Popular Science, July, 1899, pp. 154, 155, 4 figs.

A brief popular sketch of the way in which certain mollusks are protected from their enemies by resembling their environment or other animals.

——— New and unfamiliar Unionidæ.

Proc. Acad. Nat. Sci. Phila., 1900, pp. 74–86, pls. I–V.

This paper contains descriptions of new species of Unionidæ that have come to light during the preparation of a paper on the "Synopsis of the Naiades." Several new genera are described, and others are established under old names and redefined. Most of the unfigured species of Unionidæ of Messrs. S. H. and B. H. Wright, the types of which are in the National Museum, are figured.

SMITH, HUGH M., and BEAN, BARTON A. List of fishes known to inhabit the waters of the District of Columbia and vicinity.

Bull. U. S. Fish Com., 1898 (1899), pp. 179–187.

This list records 81 species of fishes found in the vicinity of Washington (within a radius of 20 miles). It is based largely upon the collections of the National Museum and U. S. Fish Commission. Both scientific and common names are given, with brief notes on the life histories of the more important species.

SMITH, JOHN B. New species of nocturnal moths of the genus *Campometra*, and notes.

Proc. U. S. Nat. Mus., XXII, No. 1181, Oct. 9, 1899, pp. 101–105.

(See also under W. H. ASHMEAD.)

STANTON, TIMOTHY W. Mesozoic fossils [of the Yellowstone Park].

Monogr. U. S. Geol. Surv., XXXII, Pt. II, Sept., 1899, pp. 600–650, pls. 72–76.

Describes the Triassic, Jurassic, and Cretaceous fossils occurring in the Yellowstone National Park. Based partly on Museum material.

STARKS, Edwin Chapin. The osteological characters of the fishes of the suborder Percesoces.

Proc. U. S. Nat. Mus., XXII, No. 1179, Oct. 7, 1899, pp. 1–10, pls. I–III.

In this paper the author gives the results of a study of the skeletons of several representatives of the families Atherinidæ, Mugilidæ, and Sphyrænidæ.

This study leads him to conclude that these families are not so closely allied to each other as their external similarity would lead one to suppose.

——— The osteology and relationship of the Percoidean fish, *Dinolestes lewini*.

Proc. U. S. Nat. Mus., XXII, No. 1186, Oct. 11, 1899, pp. 113–120, pls. VIII–XI.

This paper is a comparative study of *Dinolestes* and the Sphyrænidæ and Cheilodipteridæ. The author finds the affinity of *Dinolestes* to be with the Cheilodipteridæ rather than with the Sphyrænidæ.

STEARNS, Robert E. C. *Urosalpinx cinereus* in San Francisco Bay.

Nautilus, XII, No. 10, Feb., 1899, p. 112.

Relates to the appearance of the Atlantic coast species in parts of the bay where it had not previously been noted.

——— *Crepidula convexa* Say var. *glauca* Say.

Nautilus, XIII, No. 1, May, 1899, p. 8.

Notes the occurrence of this Atlantic coast form on the shore of Alameda County, California.

——— Natural history of the Tres Marias islands, Mexico.

Nautilus, XIII, No. 2, June, 1899, pp. 19, 20; *Science* (new series), X, No. 239, July 28, 1899.

Attention is called to the omission by the author of *North American Fauna*, No. 14, U. S. Department of Agriculture, of any mention of the Fisher collection of shells made in 1876. The list of species included in Fisher's collection forms the substance of the paper entitled "The shells of the Tres Marias and other localities along the shores of Lower California and the Gulf of California," in vol. XVII, 1894, *Proc. U. S. Nat. Mus.*, No. 996, pp. 139–204.

——— *Donax stultorum* Mawe=Conrad's species *Cytherea crassatelloides*.

Nautilus, XIII, No. 7, Nov., 1899, pp. 73–75.

In pursuance of a previous paper (*Proc. U. S. Nat. Mus.* XXI, pp. 371–378), the literary history of the species is given.

STEARNS, Robert E. C. Abalone fishery in California. Protective regulation.

Nautilus, XIII, No. 7, Nov., 1899, pp. 81, 82.

Mentions the action of the authorities of Monterey County, Cal., in restricting the persistent and excessive collecting of these mollusks by Japanese and Chinese fishermen.

——— *Modiola plicatula* Lamarck in San Francisco bay.

Nautilus, XIII, No. 8, Dec., 1899, p. 86.

The author mentions the occurrence of this well-known Atlantic coast species in Californian waters as incidentally introduced through the operations of the oyster industry.

——— List of shells collected by Vernon Bailey in Heron and Eagle lakes, Minnesota, with notes.

Proc. U. S. Nat. Mus., XXII, No. 1190, Apr. 7, 1900, pp. 135–138.

Describes variations in form of *Linnæa emarginata* as exhibited in a collection received by the National Museum from the U. S. Department of Agriculture.

——— Description of a new variety of *Haliotis* from California, with faunal and geographic notes.

Proc. U. S. Nat. Mus., XXII, No. 1191, Apr. 7, 1900, pp. 139–142.

H. fulgens Philippi variety *walallensis* is described from Guallala, Mendocino County, and the physiographic features of the coast in that vicinity are indicated. A preliminary description of the foregoing species was published in *Nautilus*, XII, No. 9, Jan., 1899.

——— Exotic mollusca in California.

Science (new series), XI, No. 278, Apr. 27, 1900, pp. 655–659.

The circumstances of the introduction of several foreign forms, either intentionally or otherwise, are herein given. *Helix aspersa* Mull., *Amalia hewstoni* Cp., *Zonites* (*Vitrea*) *cellaria* Mull., *Zonites* (*Vitrea*) *draparnaldi* Beck, *Bulimus ventrosus* Fer., *Helicodiscus lineatus* Say, *Cochlicopa lubrica* Mull., among the terrestrial forms, and *Ostrea virginica* Gmelin, *Mya arenaria* Linn., *Modiola plicatula* Lamarck, *Urosalpinx cinereus* Say, and *Crepidula convexa* var. *glauca* Say, marine species, are cited.

——— Notes on the distribution of and certain characteristics in the Saxidomi of the west coast.

Nautilus, XIV, No. 1, May, 1900, pp. 1–3.

Attention is called to the hinge characters, and the exceeding development of the adductor muscles, as compared with other forms of same size in the Veneridæ.

STEIGER, George. (See under F. W. Clarke.)

STEJNEGER, Leonhard. A new name for the great crested *Anolis* of Jamaica.

Am. Naturalist, XXXIII, July, 1899, pp. 601, 602.

Shows that the name *Anolis edwardsii* has been erroneously attributed to the great crested *Anolis* of Jamaica, and proposes that it be called *A. garmani.*

——— The proper name of the Polar Bear.

Science (new series), X, Sept. 15, 1899, pp. 377, 378.

Contends for *Thalarctos maritimus* (Phipps), 1774, correcting J. A. Rehn, who in a previous number of *Science* states that it is *Thalarctos marinus* (Pallas), 1776.

——— The birds of the Hawaiian Islands.

Osprey, IV, Jan., 1900, pp. 71–73.

A review of Scott Wilson and Evans's *Aves Hawaiienses*, with a discussion of the relationship of the Hawaiian avifauna.

——— The relations of Norway and Sweden.

Conservative Review, II, Part I, Nov., 1899, pp. 317–346; III, Part II, Mar., 1900, pp. 114–141.

An historical review of the political relations from the earliest times to the present.

STONE, Witmer. On a collection of birds from the vicinity of Bogota, with a review of the South American species of *Speotyto* and *Troglodytes*.

Proc. Acad. Nat. Sci. Phila., 1899, pp. 302–313.

An annotated list of 76 species, of which *Speotyto cunicularia tolimæ* is new.

TASSIN, Wirt. Catalogue of the series illustrating the properties of minerals.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 647–688.

——— Classification of the mineral collections in the U. S. National Museum.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 747–810.

VAUGHAN, T. Wayland. Geologic notes on the Wichita Mountains, Oklahoma, and the Arbuckle Hills, Indian Territory.

Am. Geologist, XXIV, July, 1899, pp. 44, 55.

VAUGHAN, T. Wayland. Some Cretaceous and Eocene corals from Jamaica.

Bull. Mus. Comp. Zool. (Harvard College), XXXIV, No. 1, Sept., 1899, pp. 227–250, pls. XXXVI–XLI.

——— A new fossil species of *Caryophyllia* from California, and a new genus and species of Turbinolid coral from Japan.

Proc. U. S. Nat. Mus., XXII, No. 1194, Apr. 20, 1900, pp. 199–203, pl. XVI.

The fossil species of *Caryophyllia* (*C. arnoldi*) was sent to the National Museum by Mr. Ralph Arnold, of Stanford University. The Turbinolid is a recent species contributed by Rev. H. Loomis, and named by its describer *Levipalifer orientalis.*

——— Reconnaissance in the Rio Grande coal fields of Texas.

Bull. U. S. Geol. Surv., No. 164, 1900, pp. 1–100, pls, I–XI, 9 text figs.

VERRILL, A. E. Revision of certain genera and species of starfishes, with description of new forms.

Trans. Conn. Acad. Arts and Sci., X, Aug., 1899, pp. 145–234, pls. XXIV–XXX.

Includes a revision of the classification of the orders Valvata and Paxillosa of Perrier, and descriptions of many genera and species. Three families, 3 subfamilies, 9 genera, 14 species, and 1 variety are described as new.

The material studied is contained in the U. S. National Museum, the Museum of Comparative Zoology of Harvard University, the Yale University Museum, and the Museum of the University of Iowa.

——— North American Ophiuroidea. Part I. Revision of certain families and genera of West Indian Ophiurans. Part II. A faunal catalogue of the known species of West Indian Ophiurans.

Trans. Conn. Acad. Arts and Sci., X, Part 2, Oct., 1899, pp. 301–386, pls. XLII, XLIII.

This revision and list are based on collections in the Museum of Yale University, the Museum of Comparative Zoology, the Museum of the University of Iowa, and the U. S. National Museum.

Analytical tables are given of many of the genera and species. Three families, 4 subfamilies, 6 genera, 3 species, and 1 variety are described as new.

WALCOTT, Charles D. Report upon the condition and progress of the U. S. National Museum during the year ending June 30, 1897.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 1–245.

WARD, Lester F. The Cretaceous formation of the Black Hills as indicated by the fossil plants.

19th Ann. Rep. U. S. Geol. Surv., Part II, 1899, pp. 521–946, pls. LVII–CLXXII.

This paper was prepared in collaboration with Walter P. Jenney, William M. Fontaine, and F. H. Knowlton.

The specimens described are in the Museum collection. They include 86 species, and are from the lower part of the Cretaceous formation, from the beds that extend down from the Dakota group to the upper part of the Jurassic. One new genus and 36 new species are described.

——— Description of a new genus and 20 new species of fossil cycadean trunks from the Jurassic of Wyoming.

Proc. Wash. Acad. Sci., I, 1900, pp. 253–300, pls. XIV–XXI.

This paper is based partly upon Museum material. The locality of the specimens described is given as the Freezeout Hills, north of Medicine Bow, in Carbon County, Wyo. The new genus to which the 20 species are referred is *Cycadella*.

WHITE, David. Report on fossil plants from the McAlester coal field, Indian Territory, collected by Messrs. Taff and Richardson in 1897.

19th Ann. Rep. U. S. Geol. Surv., Part III, 1899, pp. 457–538, pls. LXVII, LXVIII.

The collections, which include about 75 species, were made at thirteen localities. They have been arranged in three groups; First, that from the horizon of the McAlester coal; second, a group from about 2,000 feet above the McAlester coal: and third, a group of localities from which a flora was collected belonging to a coal horizon about 1,500 feet below the McAlester coal. Comparing these with the Carboniferous divisions of the Old World, the McAlester flora is said to be clearly Stephanian and comparable to the flora of the Upper Coal Measures of Great Britain. The upper group belongs to a horizon some distance below the Permian, while the lower flora is plainly Westphalian, having close relations with the Middle or Lower Coal Measures of Great Britain. The fossil floras indicate a very great expansion of the coal measures in Indian Territory.

WHITE, David. Fossil flora of the Lower coal measures of Missouri.

Monogr. U. S. Geol. Surv., XXXVII, 1899, I–XI, 1–467, pls. I–XXXIII.

The greater portion of the specimens described in this paper were derived from two horizons about 45 feet apart. The plants described are concluded to be contemporaneous with the flora of the uppermost zone of the Westphalian of the Franco-Belgian Basin, and other coal fields of Europe.

WILSON, Thomas. History of the beginnings of the science of prehistoric anthropology. Vice presidential address, Section H, American Association for the Advancement of Science.

Proc. Am. Assoc. Adv. Sci., Columbus Meeting, XLVIII, 1899, pp. 310–353; *Science* (new series), X, No. 252, Oct. 27, pp. 585–601, and No. 253, Nov. 3, 1899, pp. 637–648.

A summary of scientific investigations in Europe and America concerning prehistoric anthropology, beginning in Denmark early in the present century.

——— Arrowpoints, spearheads, and knives of prehistoric times.

Rep. Smithsonian Inst. (U. S. Nat. Mus.), 1897 (1899), pp. 811–988, pls. 1–65, figs. 1–201.

——— The Arkansas Traveler.

Ohio Archæolog. and Hist. Soc. Pubs., VIII, 1900, p. 296.

Early wagon transportation in eastern Ohio.

WOODWORTH, W. McM. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer *Albatross*, during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding. XXVII.—Preliminary account of *Planktonemertes agassizii*, a new pelagic Nemertean.

Bull. Mus. Comp. Zool. (Harvard College), XXXV, No. 1, July, 1899, pp. 1–4, 1 pl.

A new genus and species of Nemertean collected in deep water in the western part of the Pacific Ocean near the Equator. Five specimens were taken, four of which are figured.

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APPENDIX V.

Papers Published in Separate Form.

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Pipes and smoking customs of the American aborigines, based on material in the U. S. National Museum. By Joseph D. McGuire. pp. 351–645, pls. 1–4, figs. 1–239.

Catalogue of the series illustrating the properties of minerals. By Wirt Tassin. pp. 647–688.

Te Pito Te Henua, known as Rapa Nui; commonly called Easter Island, South Pacific Ocean. By George H. Cooke, U. S. N. pp. 689–723.

The man's knife among the North American Indians. A study in the collections of the U. S. National Museum. By Otis Tufton Mason. pp. 725–745, figs. 1–17.

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No. 1184. New species of nocturnal moths of the genus *Campometra*, and notes. By John B. Smith. pp. 101–105.

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No. 1187. Description of two new species of crayfish. By W. P. Hay. pp. 121–123, figs. 1, 2.

No. 1188. Contributions to the natural history of the Commander Islands. No. XIII. A new species of stalked medusæ, *Haliclystus stejnegeri*. By K. Kishinouye. pp. 125–129, figs. 1–3.

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No. 1190. List of shells collected by Vernon Bailey in Heron and Eagle lakes, Minnesota, with notes. By Robert E. C. Stearns. pp. 135–138.

No. 1191. Description of a new variety of *Haliotis* from California, with faunal and geographical notes. By Robert E. C. Stearns. pp. 139–142.

No. 1192. On the Lower Silurian (Trenton) fauna of Baffin Land. By Charles Schuchert. pp. 143–177, pls. XII–XIV, figs. 1, 2.

No. 1193. Some Neocene corals of the United States. By Henry Stewart Gane. pp. 179–198, pl. XV.

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No. 1196. Notes on some birds from Santa Barbara Islands, California. By Harry C. Oberholser. pp. 229–234.

No. 1197. Catalogue of a collection of birds from Madagascar. By Harry C. Oberholser. pp. 235–248.

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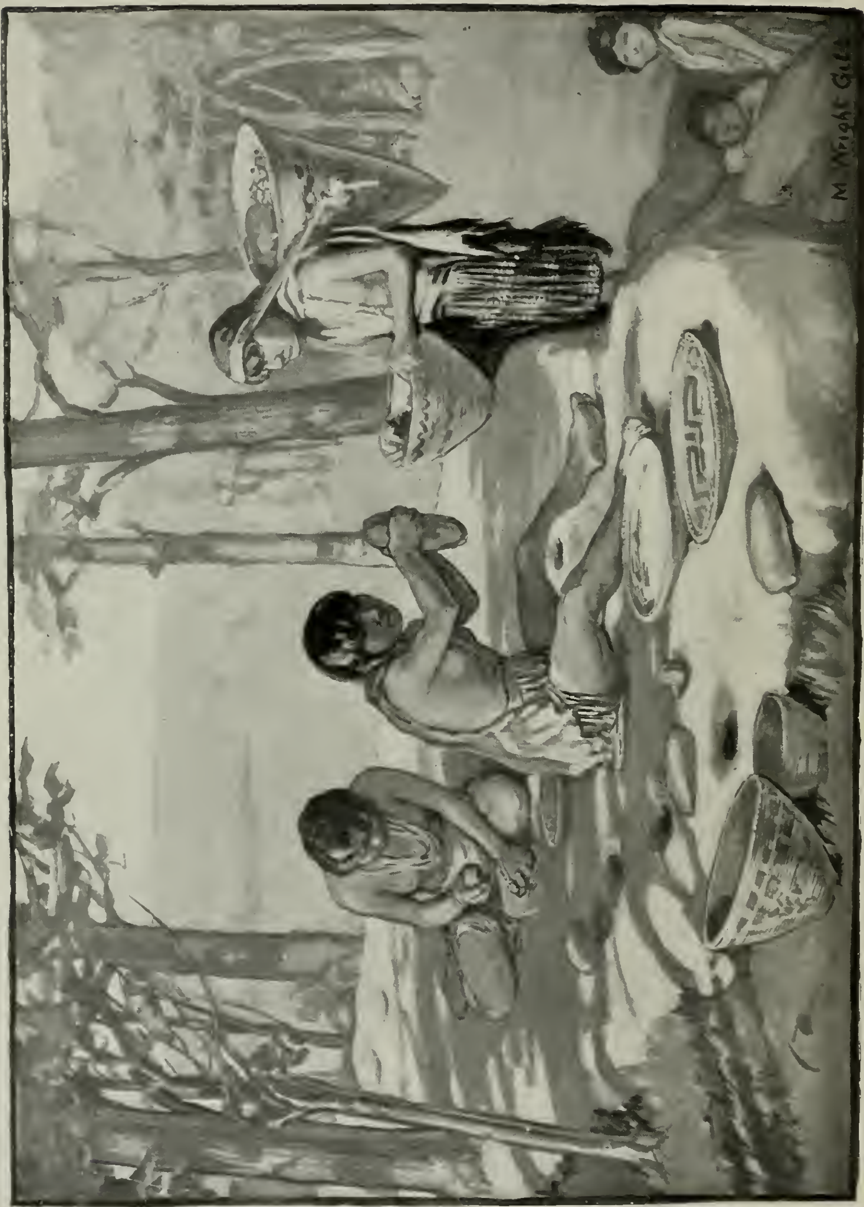
PART II.

PAPERS DESCRIBING AND ILLUSTRATING COLLECTIONS IN THE U. S. NATIONAL MUSEUM.



MILLING PLACE OF THE CALIFORNIA INDIANS. PRIMITIVE COSTUMES.

ANTHROPOLOGICAL STUDIES IN CALIFORNIA.

BY

WILLIAM HENRY HOLMES,
Head Curator, Department of Anthropology.

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ANTHROPOLOGICAL STUDIES IN CALIFORNIA.

By William Henry Holmes,
Head Curator, Department of Anthropology.

INTRODUCTION.

It is not intended in the present paper to enter into a systematic discussion of Californian archæology and ethnology, but rather to present such materials as it has been my good fortune to acquire during a brief period of exploration, mainly in the central portions of the State.[1] In order that these observations may have, in a measure, the proper setting, a few introductory remarks in explanation of general anthropological conditions on the Pacific coast are presented.

In considering the archæology of a great region like California, it is proper that the present aborigines and their culture should be studied, and the knowledge thus acquired utilized in discussing the prehistoric monuments and artifacts of the region. To-day there are remnants of many tribes in California, at least twenty separate linguistic stocks being represented, a really marvelous diversity in a province which, howsoever extensive (some 300 by 800 miles in extent), is not separated into very well-defined areas by orographic or other barriers. As laid down in colors on the map, the remarkable multiplicity of stocks along the Pacific coast is especially noticeable, and it seems as if the varied ethnic elements of a vast region must have been attracted, one after another, to these lowland and coastal valleys by some powerful magnet, such, for example, as that furnished by an unfailing food supply; and so formidable are the barriers of mountain ranges on the east and

[1] The observations recorded in these pages were made during a brief trip to California in the summer of 1898. The work was conducted under the auspices of the Bureau of American Ethnology, and the writer was accompanied during the major part of the journey by Dr. W J McGee, ethnologist in charge of the Bureau. One of the principal objects of the journey was to look into the evidence relating to the antiquity of man in the Auriferous Gravel region of the Sierra Nevada. This subject has already received attention in a paper published in the American Anthropologist for January and October, 1899, and reprinted with additions in the Smithsonian Report for 1900, and will not be presented at length in this connection.

so forbidding the deserts on the south, that few communities once settled along the coast would ever take the trouble to seek homes elsewhere. It would seem that the nations were caught as fish in a trap. The way in was easy, but the way out was hard. By some such process California acquired its varied peoples. The remarkable diversity in language is thus probably largely due to the arrival of tribes already speaking diversified tongues rather than to differentiation within present habitats.

Notwithstanding the great multiplicity of languages there is marked uniformity in the physical characters of the people, and culture in general is diversified only in details. We conclude that although the peoples had a common origin, no doubt in the far north, scattering and isolated occupation of vast areas of country led to multiplication of tongues, while all those elements of culture dependent upon immediate environment and readily modified by it have been remodeled into a homogeneous whole. It is probable that conditions nearly identical with those of historic times have prevailed for a long period on the Pacific coast. Archæology seems to have no strong light to throw upon the history of the region. We seek in vain for the presence of distinct peoples or indications of different conditions. We can neither trace any of the present peoples back along the course of their history to more primitive conditions, nor follow them in their migrations far outward into regions from which they may have come. There is nothing in the past of culture that is not comprised in the present. There may have been simpler peoples, less advanced peoples, in the near or far past, but there is no trace of former higher development or the coming of strangers bearing with them germs of strange cultures from foreign lands, northern or southern, Asiatic, European, or Polynesian.

We observe, also, that in its ensemble Californian culture is sharply marked off even from that of most of the neighboring peoples—as, for example, the Pueblos, the Mound-Builders, and the Mexicans. Art in stone, upon which archæology must largely depend, is practically uniform at all points in the California province, differences being due largely to variations in local resources. The absence of certain forms of implements and utensils common elsewhere is especially noteworthy. There are no grooved axes[1] and no celts, past or present. Sculpture of life forms is almost wholly absent, and building in stone was and is unknown. At the same time many of the classes of artifacts found in California are peculiar to the region. The mortar and the pestle are most notable features of the domestic outfit of the coast, and though, in one form or another, present in many sections of America, are nowhere so prevalent and so varied in shape. The grinding plate and

[1] An exception is found in the grooved implement, illustrated in the seventh volume of the Surveys West of the One Hundredth Meridian, p. 203.

muller are almost equally numerous, and it is probably to the acorn that the region owes the remarkable development of these utensils; and the wide distribution of the oak tree over the slope in a measure regulates the distribution of the tribes, tending to foster a very general but rather scattering occupation by small communities. It is thus that the tribes have always been but slightly associated and wholly without the ability to unite in concerted action.

Simultaneously with the development of the mortar and grinding plate there grew up the art of olla or stone vessel making, and the discovery of extensive deposits of soapstone on the far-away island of Santa Catalina led to a new and distinctive group of artifacts confined to the channel islands and the neighboring coastal districts.

A most notable peculiarity of the art of the region is the rarity of earthenware, which for some undiscovered reason was never utilized, save in the making of rude balls of baked clay for use in slings and in sporadic efforts at vessel making. The rude earthen vases found in the Tulare region and elsewhere are probably mainly of recent origin, and the practice of the art by the mission tribes of the South is no doubt a late Shoshonean transfer from the Colorado Valley. Utensils of stone and wood occupied the field covered by pottery in other sections, and basketry grew into unexampled importance, displaying remarkably varied phases of form, technique, and embellishment.

Sea shells, which abound along the entire coast, and especially the haliotis and the clam, have furnished material for personal ornaments and helped to determine their character, and the great deposits of obsidian toward the north have probably given an impetus to flaked stone art among all the tribes.

We might expect at first glance to find dividing lines, more or less distinct, between the peoples of the south and those of the north, and between those of the Sierra belt on the east, the chain of valleys traversing the middle of the State from north to south, and the coastal zone, but the differences are not of great importance, as no barrier exists to prevent free intercourse between neighboring sections. The north has evidently been affected by the farther north, but the south has hardly felt the influence of the more advanced tribes of the Colorado Valley.

That the peoples are of Asiatic origin I see no reason to doubt, but to speak of them as Chinese, Malay, or Tartar in origin, without very considerable qualification, is a great mistake. Although all may have arrived, more or less directly, from the north, and primarily from the shores of Bering Sea and beyond, it is not likely that any particular Asiatic strain ever passed the north Pacific arch, ran the gauntlet of interfering and opposing nations, and reached far-away California in even approximate purity. That any particular language of the many existing in temperate Asia should be preserved throughout the centuries of migration and struggle and appear in California so unchanged as to be identified with a given Asiatic tongue to-day is not to be expected, and it is manifest folly to continue the search for traces of Asiatic arts and industries other than those that may have been transferred in recent times by means of modern ships. Every art, save the most elementary, would be lost or transformed in passing the frigid gateway. Religion, social institutions, government, industries, all would change with changing conditions and be remodeled in each of the numerous distinctive environments encountered between Tartary and California. Agriculture, pastoral arts, metallurgy, ceramics, and all forms of domestic art would be obliterated, and other activities, such as weaving, stone-shaping, house-building, hunting, and fishing, would be so completely modified that no knowledge of original practices would remain in the mind of any individual or be preserved in any tradition. What is now found, old or new, in the culture of California, is America's own, if not, indeed, fully and absolutely Californian. The incoming populations of the coast had to discover the metals, and could not have developed the arts of using them until ages after reaching the temperate zone. Clay existed everywhere in plenty, but tribes arriving from the far north would be slow to discover its use in the arts and cast aside inherited arctic forms of utensils. It has not yet in any part of the coast usurped the place of skin, bark, and wood in vessel making, although neighboring provinces on the east and south have been potters for many centuries. Before soapstone came into use it had to be found in far out of the way places; and the group of milling arts, now so important a feature in the economy of the people, had no prototypes in the frigid zone, where the diet was exclusively animal. It would be useless even to guess at the time required for the development of the group of arts and industries characterizing the aboriginal culture of California.

Study of analogies in blood and culture, with the view of establishing more than the most general relationships between American and transoceanic nations, has been and no doubt will be quite in vain. The question of a possible very ancient autochthonic people is sometimes raised, but as yet there is apparently no sufficient basis upon which to discuss the proposition. If there were such people in America they must now be merged fully into the Asiatic populations of the present period. The same would be true also of the culture. We may well pursue the study of Californian archæology with practical certainty that, whatever the origin of the people, we are, in the main, elucidating local and sublocal culture. With language it is different. Although changing rapidly with altered conditions, speech has little tendency toward uniformity among distinct nations. Twenty peoples coming from different regions to California, bringing as many distinct languages, might still speak twenty different languages after the other activities had been modified and remodeled as in a common mold by the local environment.

VICINITY OF NEVADA CITY, NEVADA COUNTY.

The first stop of our party in California was at Nevada City, Nevada County. Here archæological investigations were made and collections of basketry and stone implements were secured from some families of "Hi-eet" Indians (Pujunan stock), whose village is on the table-land about a mile west of the city. A recent fire had deprived these poor people of their wooden houses, and they were lodging in improvised shelters, brooding over their misfortunes. There are hardly more than a dozen individuals, all told. They are not, however, ill favored and debased in appearance, and compare very well with other tribes of corresponding condition and habits. The men work in the mines or at other occupations when opportunity offers, and the women gather acorns—still a large factor in their domestic life—grind them in the stone mills, and prepare the food; they also continue to make baskets in the usual style of the Sierra tribes. It is not pleasant for the ethnologist to note, however, that the gunnysack is taking the place of the strongly woven carrying basket, that the iron pestle and muller are superseding those of stone, and that cooking on iron stoves and in tin utensils is being substituted for the old-time stone-boiling in tightly woven baskets.

Several milling places were found near the dwellings, where convenient masses of granite happened to be exposed. A dozen conical depressions, some shallow and some deep, were scattered over the rock surfaces, and all about were the mealing stones, some nearly round, others oval, flattish, or cylindrical, a few well shaped, the others rude. Some were suited for grinding by abrasion, others by pounding, the shape being accommodated to the contour of the depression in which they were to be used. These milling places are usually covered by a rude pole and brush shelter, which serves to protect from sun and rain the women (Plate 1), who spend much of their time at the mills. Besides the fixed mortars, there were seen about the dwellings both round and flattish mortars and mealing stones, with accompanying pestles and mullers used in the minor pulverizing work of the household. Illustrations of typical forms from neighboring districts are given farther on. The archæological features of the vicinity are referred to in the paper, already mentioned, devoted to evidences of auriferous gravel man. It was observed that in particular the modern villagers dwelt above the brinks of the great mines, and that stray artifacts necessarily found their way into the excavations. Search was made for the mine from which one of the specimens, a mortar, referred to by Josiah D. Whitney in his work on the Auriferous Gravels of

California, is said to have come, and it was ascertained that this mine was confined to a small gulch, at the head of which stands an oak grove suited in every way for occupation by the acorn-using natives of the district.

Nevada City is picturesquely situated on the banks of a mountain torrent known as Deer Creek, and evidences of former mining activity are visible on all hands. The gravels occur in extensive deposits, and though rich in gold are not yet nearly worked out, the enactment of laws limiting the use of water for hydraulic operations having greatly retarded the work.

VICINITY OF FOREST HILL, PLACER COUNTY.

From Nevada City it is a day's journey to Forest Hill, the county seat of Placer County—a great mining center in former days. The trip was made by rail to Colfax, on the Central Pacific R. R., and thence by stage coach across the magnificent canyon of the North Fork of American River. These Sierra valleys are all of absorbing interest to the student of human history, for it is held by many that man inhabited this region long before the vast gorges began to be excavated, and the grand ranges culminating in the snow-capped Sierra began to be carved out. As our coach crept wearily up the eastern rim of the valley, and, long after nightfall, passed out over the crest through the mining town of Yankee Jim, 2,000 feet above the river behind us, we for the first time realized the full significance and magnitude of the proposition advocated by Whitney, namely, that human bones and relics of advanced culture occur in large numbers in the original formations of these mountain crests—formations laid down in the stream beds of a river system already obliterated in Tertiary times, and long before the erosion of the present valleys began. The particular object of our visit to this district was to learn something of the possible origin of the objects of art reported by Whitney as coming from the mines, and at the same time to collect from the native villages scattered over the district such objects of interest for the ethnologist as the people possessed.

The village of Yankee Jim is located on the brink or rim of the great valley of the North Fork of the American, and Forest Hill, 2 miles farther on across the plateau-like crest, overlooks the superb valley of Middle Fork. Professor Whitney says,[1] on the authority of Mr. C. D. Voy, that stone implements were found in 1864, about a mile south of the town of Forest Hill, at a depth in the gold-bearing gravels of about 10 feet. One of the most interesting of these was a flat dish, or platter, worked out of hard granite, and about 18 inches in diameter. We at once sought out those residents of the locality

[1] J. D. Whitney, Auriferous Gravels, p. 272.

best qualified to inform us regarding the mines and their history, and were so fortunate as to meet Mr. Richard Clark, a well-known citizen and extensive mine owner, who had been in the district from the very beginning. It was soon learned that the great Dardanelles mine, owned and worked by Mr. Clark, was about 1 mile south of the village, and in his company the site was at once visited. The mine occurs several hundred feet down the slope descending into the canyon of the Middle Fork, and on a narrow bench called Oro Flat. Here the outcropping margin of the gravel deposits of a Tertiary river channel are exposed in a heavy deposit 200 to 400 feet thick. The mining operations destroyed a large part of the flat, leaving at the upper margin, when active work ceased ten years ago, an irregular gravel cliff half a mile long, exposing the full thickness of the gravels now considerably weathered down and gullied by erosion. Approaching from above, we descended to the flat and halted upon a rounded portion of the surface overlooking the brink of the mine. Here was a small farm, and a field immediately above the deepest part of the mine was quite bare, although it had not been cultivated apparently for some years. It was soon discovered that the spot had been extensively occupied by the native peoples, and in the course of the forenoon a dozen mealing stones and mortars (Plate 2), thirty hand stones and pestles (Plate 3), and many minor relics—mainly arrow and spear points—were collected. It was noticed that the outer margin of the site had been encroached upon by the mine and perhaps a third or half of it had been destroyed. It was further seen that the site slopes toward the vertical brink of the mine, and that many gullies are cut, growing deeper toward the cliff, and that near the margin they are so deep and precipitous that it was unsafe to enter them. The relics were found all over the field, but more abundantly in the gullies where they had rolled and lodged; but all were surely on their way to the mine. Naturally, only the smaller, flatter objects remained, the round pestles and the globular mortars had long since found their way into the mine below, where they became intermingled with the great mass of loose gravels and bowlders. Some specimens were found far down the sides of the mine lodged on ledges and in heaps of débris, and the fact was impressed upon our minds that finds of stone relics in the mine, unless made by expert observers, could have no value as an index of age. On the brink of the mine were found also conical mortar basins werked in the surface of large bowlders and outcropping rocks. Mr. Clark assured us that this site had not been occupied by the natives since the opening of the mine in 1852, and it is clear that as the mining work went on all along the lower margin of this site the stone implements rolled in, and it is no wonder that collectors were able to secure from it the flat dish or platter of granite referred to by Whitney, for a dozen of these objects were still scattered along the brink above ready to fall in as the work of the miner advanced. Plates 2 and 3 illustrate part of the finds made on this spot. It is observed that these relics do not correspond fully with those of the modern Indian sites, that the mullers are smaller and rounder and more neatly shaped, and that the smaller stone objects are of varieties not now in use. This, however, does not necessarily indicate different peoples, but probably results from changes in habits due to contact with the whites and the degeneracy of aboriginal work in general.

At Yankee Jim, at one time a very lively camp, but now a small village, we visited a mine being opened by Mr. Robert Clark, and spent an hour at an Indian dwelling on the hill slope near the mine. The photograph of a dismantled mill shown in Plate 4 *a*, was secured at this place. The shallow mortars, similar to those shown in Plate 2, were sunk in the ground so that they can just be distinguished in the picture. The hand stones consisted of several rather rudely shaped ovoid and cylindrical stones (Plate 4 *b*), a small, oblong, flattish grinding stone pecked away at one end to make it available as a pestle, and three or four iron wagon-axle pestles. Some of these hand stones evidently served both for pounding and rubbing, while one or two are slightly concave on one side, indicating their use also for cracking acorns upon or as mortars for pulverizing in a small way. The fact that some of the mortars and grinding plates of California are well rounded and finished on the margins and base while others are rude and unfinished has been noted by several writers, but I do not recall mention of the fact that the unfinished ones are intended for planting in the ground, leaving only the concave grinding surface exposed, while the finished ones, at least those of smaller size, are portable household utensils. What ethnical significance there may be in this is not determined. The differences in form may be due to the presence of distinct peoples on the site, or to diversity in the practices of a single people at the same or at different times.

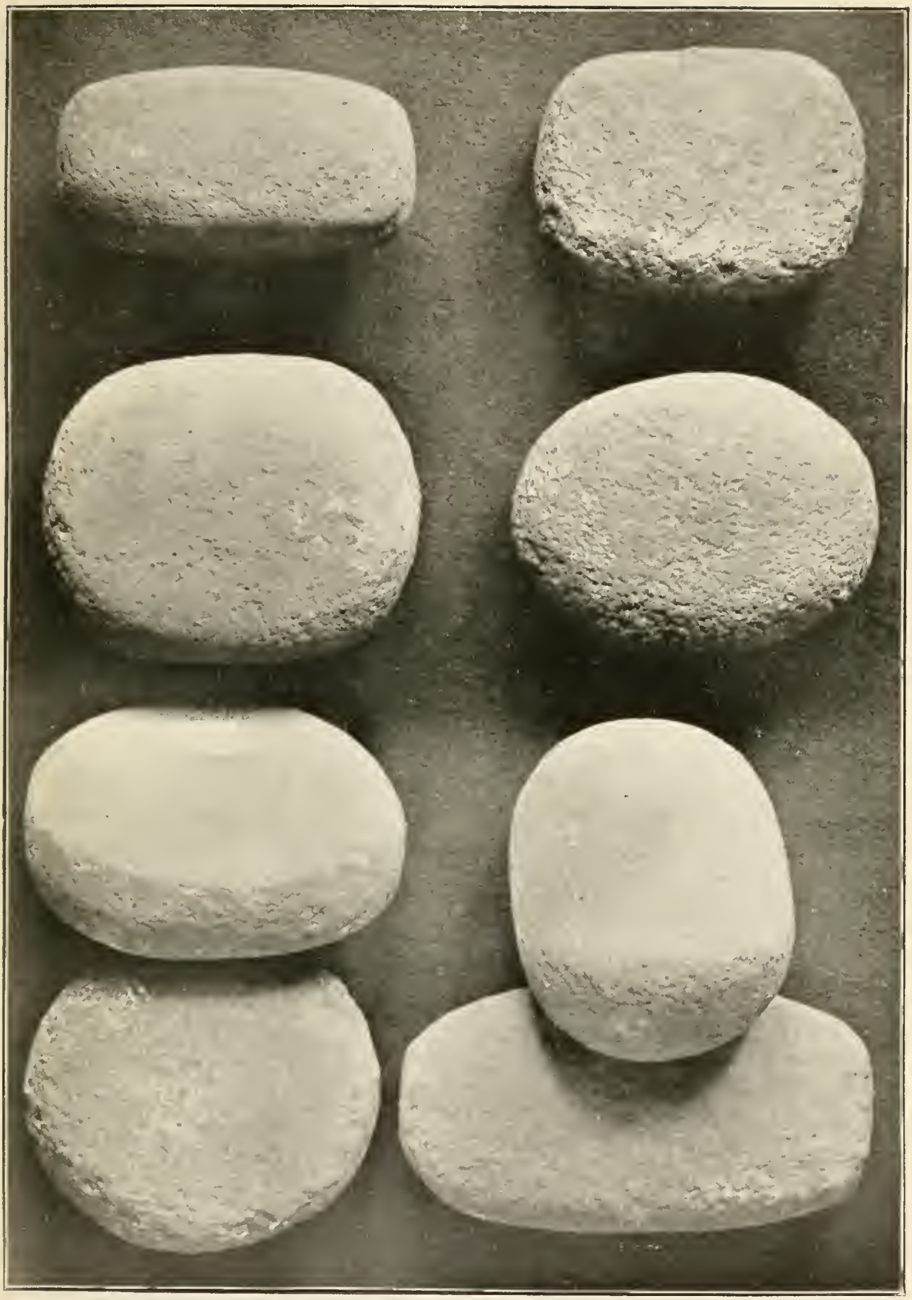
Learning of an Indian settlement in Todd's Valley, 4 miles south of Forest Hill, we drove down and spent a day in the vicinity. Here also we found extensive gravel mines, similarly situated to those at Oro Flat, and native settlements in intimate association with them. The residence of an Indian family stands on the very brink of the mine, and doubtless the site has been long occupied.

While Dr. McGee was engaged in his usual occupation of securing vocabularies and hints of the customs and history of the people, I looked into their milling places and learned what I could of their arts. The principal dwelling is a frame house of two or three rooms and a porch, while about are the mill house and other simple shelters. An elderly woman, Susan by name (her native name could not be learned from any source), having tattoo marks on her chin, had near at hand a very snug little shelter made of sticks, bark, and foliage, in which

Diameter $15\frac{3}{4}$ inches.

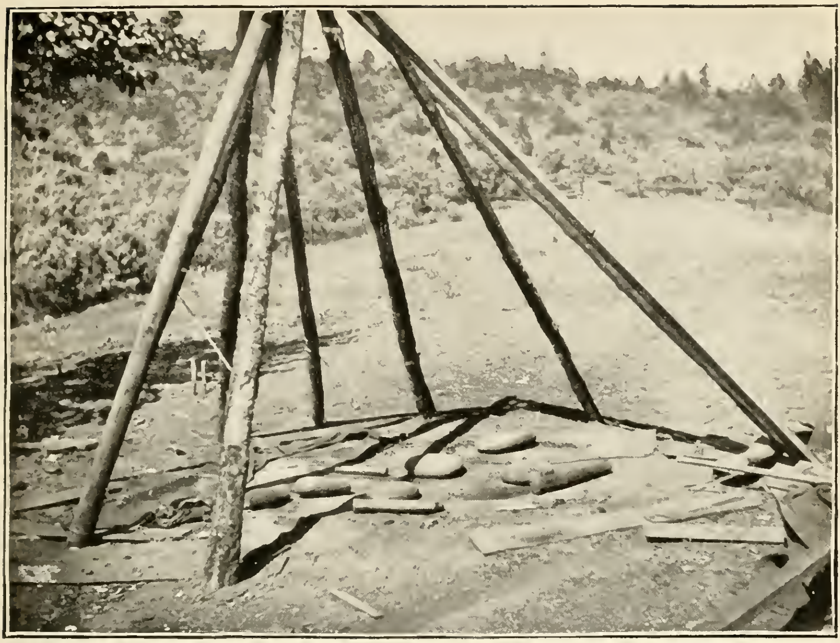
Diameter $7\frac{1}{2}$ inches. Diameter $7\frac{1}{4}$ inches.

STONE MEALING PLATES, ORO FLAT.

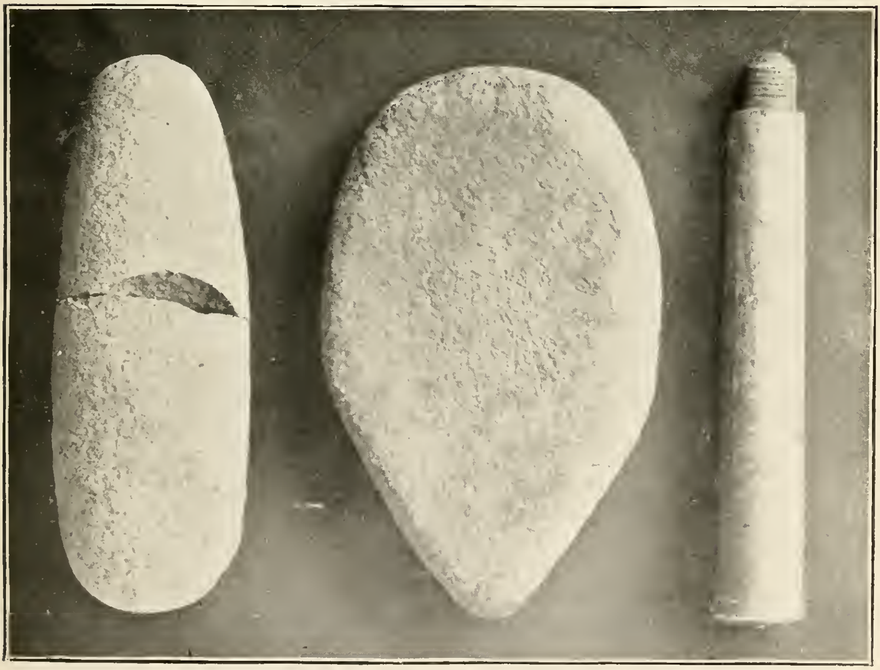


STONES FOR RUBBING AND POUNDING, ORO FLAT.

About one-half actual size.

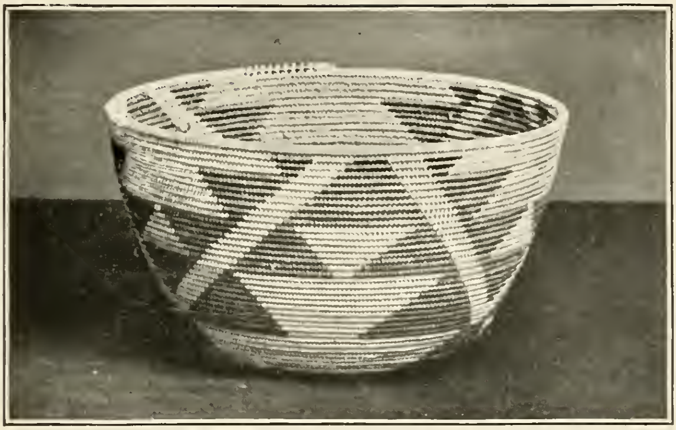


A. DISMANTLED MILLING PLACE, YANKEE JIM.



B. STONE PESTLE, POUNDING-GRINDING STONE, AND WAGON-AXLE PESTLE, YANKEE JIM.

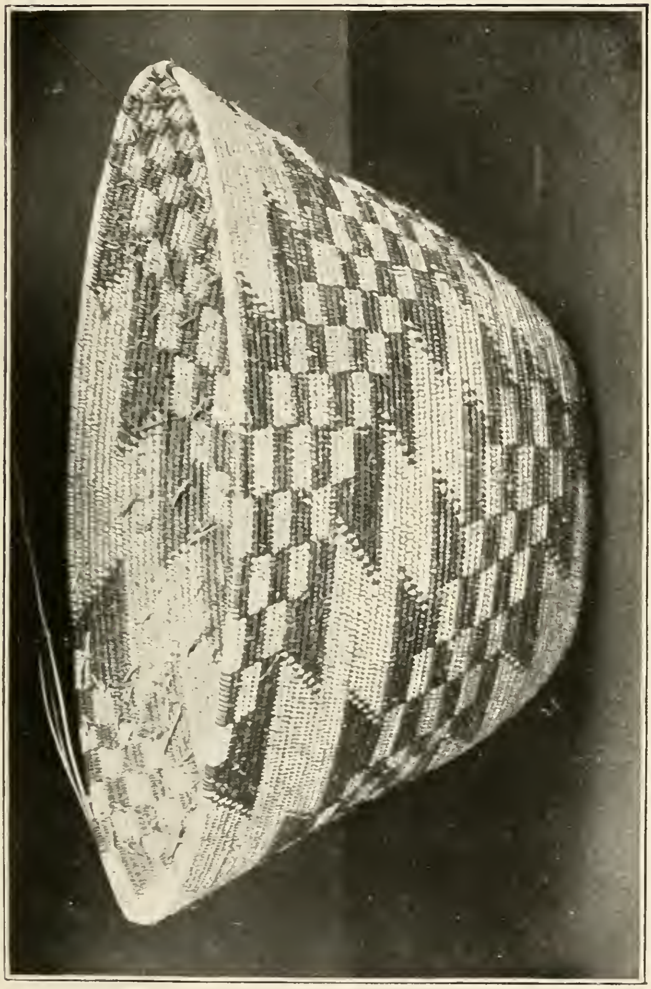
Length about 12 inches.



Diameter $9\frac{1}{2}$ inches.

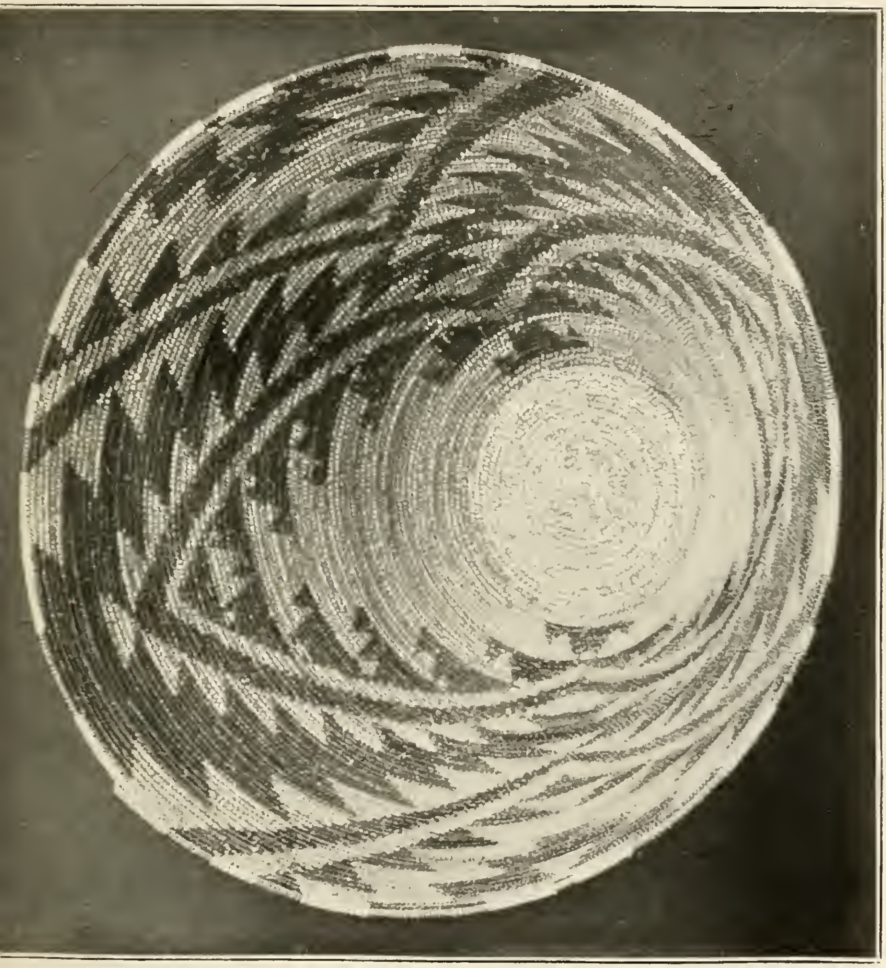
Diameter $11\frac{1}{2}$ inches.

BASKETS, TODDS VALLEY INDIANS.



UNFINISHED BASKET, TODDS VALLEY INDIANS.

Diameter 17 inches.



BASKET, TODDS VALLEY INDIANS.

Diameter $18\frac{1}{8}$ inches.

she lived and carried on her share of the family drudgery. She ground acorns on a flat stone disk set in the ground near the middle of her shelter, and by the side of this was a slight depression in the hard earth used as a hearth. She boiled the porridge outside by heating small stones in an open fire and lifting them into the cooking baskets with a pair of neatly trimmed and pointed pine sticks about 5 feet in length. When the water was boiled the stones were removed with other sticks, and when the porridge became somewhat firm it was dipped out with a cup into another basket and was ready for use. This food was not at all unpalatable, as it had been deprived of the bitter taste of the acorn by leaching. This process consists in scooping out a depression in a bed of sand, into which the meal is poured and soaked with water until the bitterness is absorbed by the sand. The gruel is then taken up and is ready for cooking. The baskets used were of excellent make and tastefully ornamented. By dint of long bargaining and insisting we were able to secure half a dozen examples of the good woman's handiwork. Some of these are shown in Plates 5, 6, and 7. They are typical specimens of the basketry of this portion of California, and seem to combine some of the characteristics of the basket work of the surrounding tribes. They are new, and we were quite unable to buy the baskets in present use. We were shown one feather-decorated piece, said to have been made by an aunt of the young woman of the household at some distant point. It was valued very highly, having been a gift, and we could not secure it. It was stated that the use of feathers was not common among the American River tribes. Some of their carrying baskets and the gleaning paddles and meal-fanning trays, they informed us, were of Paiute make.

A very interesting mealing outfit was encountered on the hillside above the dwelling and near the margin of the mine. It had been deserted for some time, but the poles of the shelter were still in place. There were four or five shallow mortars worked on the surface of a rock even with the surrounding ground, and sixteen hand stones, comprising numerous shapes ranging from a flat ovoid rubbing stone to a well-formed and symmetric pestle. We were also shown an acorn-cracking outfit, consisting of a small round stone with a shallow pit on the upper surface for resting the acorn and a globular stone for striking. The acorn is set on end to receive the blow. Stones of various shapes are used, according to the supply on hand, and in the absence of suitable stones the cracking is done with the teeth. Details of the grinding and other operations are given a little farther on.

On the bottom of the mine, 200 feet beneath the spot occupied by the mealing place just described, we found a large stone having a deep conical mortar on one side. It had evidently fallen in from above, and had probably escaped the attention of seekers after evidence of Tertiary man.

The dwelling of Porter, the headman of the small group of native families in this vicinity, is a short distance below the mine. It is of rude construction, and is distinguished from the ordinary dwellings by its circular shape and radiating clapboard roof. Similar houses were encountered in Calaveras County, and an illustration is given in Plate 8. They are probably the communal or council houses, or survivals of these.

TUOLUMNE TABLE MOUNTAIN REGION.

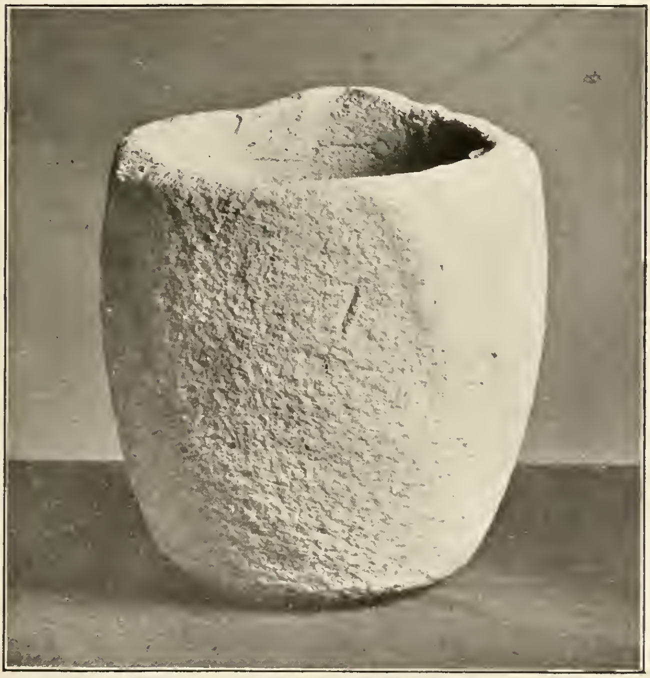
From Forest Hill we returned to Colfax, and were soon in San Francisco. From this place visits were made to other points of interest. Another excursion to the auriferous gravel region was made, by way of Stockton, Oakdale, and Jamestown. At Jamestown we were within easy reach of many interesting points ethnologically and archæologically. This district includes Tuolumne Table Mountain and the mining towns of Sonora, Murphys, and Angels, and has furnished much of the testimony upon which the theory of an auriferous gravel man has been supported. In recent centuries it has been occupied by a numerous population of the Sierra tribes. The finds in the auriferous gravels are fully discussed in a paper already referred to, and I need here mention them but casually, giving chief attention to the remnants of native population scattered here and there in small bands over the hills and along the valleys. Half a mile south of Jamestown we encountered a small aboriginal community occupying half a dozen houses, built in the main of sawed lumber and fairly comfortable. The people were carrying on the usual acorn industry, using utensils of native make and grinding and preparing the meal in the native way, but otherwise showing many indications of contact with the whites.

A second community of like character and proportions was located a mile to the west, on the slopes of Table Mountain. These people showed indications of thrift, and their simple arts were carried on under the shade of their own vine and fig tree. One man, exhibiting traces of negro blood, and having a wife quite half white, was engaged in rounding the ends of the shingles to be used in giving an ornamental effect to the walls of his house. It is said that in this district, when the mines were being extensively worked and a large white population filled the country, there were also large numbers of Indians gathered on the outskirts of the towns, ten or a hundred times more than are found in the vicinity at the present time.

Ancient village sites are numerous, and old native burial places are common. At Springfield, 10 miles north of Jamestown, an old miner named John Cannon had two well-shaped globular mortars in his back yard. These were so highly valued by Mrs. Cannon as receptacles for watering the chickens that we had difficulty in securing one

NATIVE VILLAGE AT MURPHYS.

SHELTER FOR SUMMER USE, NEAR MURPHYS.



STONE MORTARS FROM STANISLAUS AND MOKELUMNE VALLEYS.

Diameter of each $10\frac{1}{2}$ inches.

of them (Plate 9*a*). Mr. Cannon stated that he found them several years ago in a mine on Mormon Creek near by. They were embedded in auriferous gravels 5 or 6 feet deep, and at the same place, but a little deeper, he uncovered a number of skeletons, accompanied by various relics—implements of stone and ornaments of shell. That the burials were comparatively recent is indicated by the fact that the hair of the scalps was well preserved. From Patrick Shine, a little farther on, I secured a flattish, plate-like mortar, some 8 inches in diameter and of usual type, that he declared had been obtained from a mine on his place at a depth of 80 feet.

Old village sites were found at Saw Mill Flat, 8 miles northeast of Jamestown, on the brink of a deserted mine, and at the entrance to the tunnel of Montezuma mine, on Table Mountain, 3 miles southwest of Jamestown. Near Columbia, which was a great mining center in the early days, there is a large granite outcrop, exhibiting a considerable group of mortars of the usual form, sunk in the surface.

The journey from Jamestown to Murphys and Angels gave us the opportunity of crossing the valley of the Stanislaus at two points—Robinson and Parrott ferries—and the impression made on our minds by the gorge of the American Fork was strengthened by the experience. The proposition necessarily entertained by believers in auriferous gravel man that these vast valleys with their lofty and wide-spreading walls have been eroded within the human period seems too preposterous to be entertained. The descents are made by well-kept roads, but the way is long and often precipitous, and the scenery is exceedingly impressive.

On the plateau beyond the canyon the limestone belt begins, and as a result canyons, caverns, and natural bridges are common. Near Murphys a visit was made to Mercer's cave, which is entered by a contracted irregular opening descending almost vertically and expanding into a series of irregular crevice-like chambers, the result of the solution of a particular limestone stratum by underground waters. Through the appreciative courtesy of Mr. W. J. Mercer we were able to examine the cavern and to dig for human remains in the débris directly beneath the opening. A few fragments only were found, but Mr. Mercer had previously secured some skulls and other portions of skeletons. They were not old and were not coated with calcareous matter, having been buried but a short time in the loose earth which had fallen in from the opening. One of these skulls was presented to the U. S. National Museum by Mr. Mercer, and the result of an examination by Dr. George A. Dorsey shows that it resembles very closely the so-called Calaveras skull of Whitney.[1]

At a considerable depth, and not directly beneath the opening, we were shown portions of a skeleton of some large animal. Some frag-

[1]Smithsonian Report, 1899, p. 465.

ments were secured and examined by Mr. F. A. Lucas, of the U. S. National Museum, who found them to belong to a gigantic sloth, one of the Tertiary Mylodons. Mr. Mercer says that about 2 miles beyond the cavern there is a burial pit from which he previously obtained human bones and obsidian implements.

On the partially wooded ridge overlooking Murphys on the north and within half a mile of the cave, we came upon an Indian village, comprising half a dozen dwelling houses and the usual accompaniment of summer shelters and milling places. Two of the houses are shown in Plate 8. They are round and upward of 25 feet in diameter. The walls are formed of planks and the roof is covered with clapboards radiating from a conical, shingled chimney. The framework is of poles and the construction does not differ essentially from that of the aboriginal round-house of many tribes. The men and women all appeared to be busy with domestic affairs, the work being conducted in a large roofed structure, open at the sides; and in a little conical shelter made of sticks and brush, on the slope below the village, we found two old women pounding acorns.

In one of the houses was quite a store of basketry, some of the pieces evidently homemade, but others the work of the Paiute and other neighboring tribes. Within the group of houses was an interesting granary—a tall wattlework receptacle resting upon a stem of wood and further supported by four marginal poles. Its purpose was no doubt to place the crop of acorns, corn, or other food material beyond the reach of rats and pigs.

A single family, the remnant of a larger community, is located on the Adams place, a little to the eastward of the village of Murphys, and a small village was encountered on the road from Vallecito to Angels, a few miles south of Murphys. Here I procured some photographs of a rather comely Indian woman engaged in the arduous task of grinding acorns, her interesting family of three children entering prominently into the pictures (Plates 12 and 13). Plates 10 and 11 serve to illustrate two of the first steps in the acorn industry, the carrying and hulling of the acorns, and the use of the mealing plate in grinding. The upper view in Plate 12 shows the miller as she sits over the crater-like cone of pulverized acorns with the heavy pestle raised in front of her face. As the pestle descends into the center of the heap, spreading it out over the margin of the mortar, one hand or the other is freed and deftly rakes the meal toward the center of the stone again and joins the other hand to raise the stone, the whole movement being so rapid that there is no pause in the operation of pounding. The shallow mortar, formed of a flattish stone, is planted in the ground even with the surface, and the meal spreads out on the firmly-impacted soil. The basket receptacle for the meal, covered with the fanning basket tray, is at her right hand, and the children, engaged in play,

CARRYING AND HULLING ACORNS.

GRINDING ACORN MEAL ON STONE PLATE.

A. POUNDING ACORNS IN MORTAR.

B. SIFTING THE MEAL—SEPARATING THE COARSE PARTICLES BY SHAKING.

A. REMOVING COARSE PARTICLES FROM EDGE OF BASKET.

B. RESTING FROM THE WORK.

A. CLEANING THE MEAL BY SHAKING AND BLOWING.

B. POURING MEAL INTO SAND BED FOR LEACHING.

A. LIFTING HOT STONES INTO BASKET OF WATER.

B. REMOVING STONES FROM BASKET OF WATER.

are on her left. Two mealing stones are seen in the foreground, which combine the functions and shape of both muller and pestle. The ends are used as a pestle for pulverizing (Plate 12 *a*), and the slightly flattish sides are fashioned for rubbing (Plate 11). In the lower picture (Plate 12 *b*), the woman is engaged in tossing the meal in the fanning basket, separating the husks and brushing them off at one side. The partially filled basket of meal is seen on her right. In the upper picture (Plate 13) the meal has been nearly all cleaned up and the basket receptacle is well filled with the fine flour. In the lower picture (Plate 13) a curious change has come over the scene. By some misadventure the woman became conscious of the fact that the visitors were taking her picture and ceased to work, appearing frightened, for they all seem to know what the little black kodak box means and seriously object to being photographed. As a rule it was unsafe to show the camera among these people, for in a moment there would be a general disappearance and a necessary cessation of friendly communication and trade. Behind the miller in the last picture two stone mortars may be seen set in the ground. Formerly there was a considerable group of milling stones here, but at the time of our visit the shelter had been removed and the mill had apparently been for some time neglected.

I introduce here four other pictures, illustrating successive steps in the work of preparing the acorns for food. The upper view, Plate 14*a*, shows the process of clearing the meal of chaff by tossing and blowing. Plate 14*b* is intended to illustrate the process of leaching the meal in a bed of sand. The boiling in baskets is shown in Plate 15, *a* and *b*.

The houses in this rancheria, three or four in number, are built, as usual, of slab walls and clapboard roofs. The lower view, Plate 8, shows one of the brush shelters or summer houses under which the family sits and most of the domestic work is carried on. Here, as elsewhere, there is a distressing admixture of tinware, ovens, etc., with the native utensils. The only man seen in the place was a strong, swarthy individual, who took no notice whatever of the visitors, being absorbed in the task of filing a crosscut saw.

COLLECTIONS IN SAN FRANCISCO AND VICINITY.

There are many collections of archæological and ethnological objects in California, but altogether they inadequately represent the rich field so conveniently at hand. There has been little systematic collection, and a splendid opportunity has been lost. The vast accumulations of wealth for which the coast is noted have accrued to those who had no appreciation of the native history of the coast or who lacked the public spirit to endow museums. The future Californian will realize this more fully and regretfully than the Californian of to-day.[1]

[1] Fortunately the statement here made is no longer true. Subsequent to the stereotyping of this paper it is announced that Mrs. Phoebe Hearst has provided liberally for anthropological researches, to be under the direction of the University of California.

In San Francisco the Golden Gate Museum has acquired considerable material, portions of which are well identified and of value to science, but Curator Wilcomb has not been able to give any considerable time or funds to collection. The Academy of Sciences also has a large collection, but so heterogeneous in character and so deficient in associated data as to be of no great anthropological value. Private collectors have done good work in limited fields, and I refer with pleasure to the very valuable collection of baskets brought together by Mr. and Mrs. C. F. Briggs.

The State University at Berkeley has not attempted to acquire collections, but has had placed in its care a large number of stone implements and utensils brought together by Mr. C. D. Voy and attributed in the main to the auriferous gravels of the central districts of the State.[1] The Stanford University has made a very creditable effort to gather and preserve the precious relics of native art, but so far has not been able to enlist the services of curators competent to give the collections standing as scientific material.[2] Such collections as I was able to examine in other parts of the State are referred to in connection with notes relating to the localities to which they pertain.

POMO RESERVATION, MENDOCINO COUNTY.

From San Francisco a run was made north to Ukiah, in Mendocino County, the chief object being to pay a visit to Dr. J. W. Hudson and have a look at his collection of basketry, reputed to be one of the finest in the West. While at Ukiah we had the opportunity of visiting two villages of the Pomo Indians (Kulanapan linguistic family), who are among the most interesting tribes of the region. Their dwellings are roughly constructed of frame and weatherboarding, and must be comparatively comfortable, save in severe winter weather. Little trace is seen of aboriginal construction or modes of life. The ruin of a large earth lodge, used formerly for ceremonial purposes, is found in one of the villages. It is illustrated in Plates 16 and 17.

The people have not entirely lost their nomadic habits, and at certain seasons wander in small bands along the rivers and over the mountains, hunting, fishing, and gathering fruits and seeds, carrying their possessions on their backs, and putting up simple brush shelters for protection against the weather.

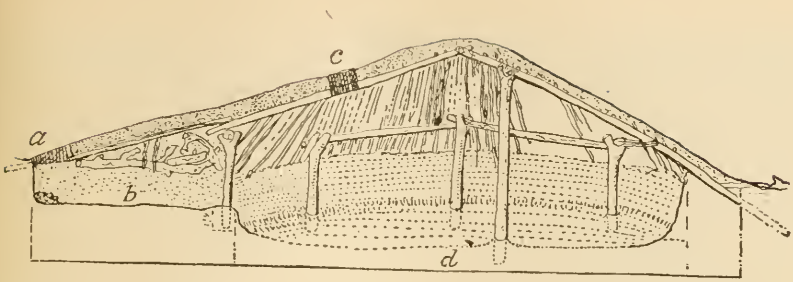
These Indians are past masters in basket making, and Doctor Hudson, in his twenty years of practice in the vicinity and his frequent visits to the villages, has had exceptional opportunities for making

[1] I have to acknowledge the kind assistance of Professor J. C. Merriam, curator of the State University collections, in my study of these relics.

[2] To Prof. John C. Branner, of this institution, I am greatly indebted for data relating to the auriferous gravel finds.

UNDERGROUND COUNCIL CHAMBER, POMO VILLAGE.

From photograph by Dr. J. W. Hudson.



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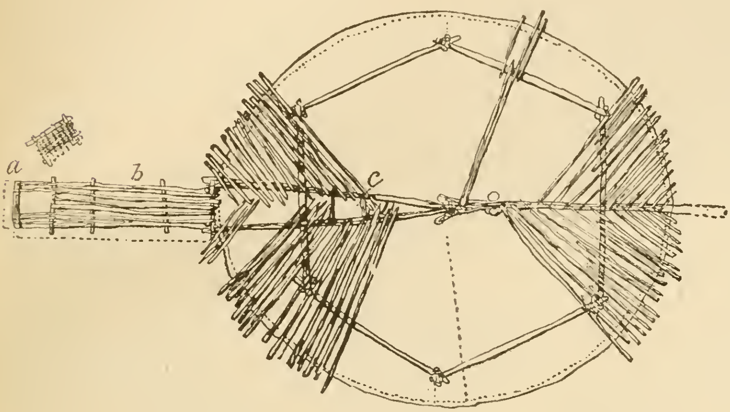

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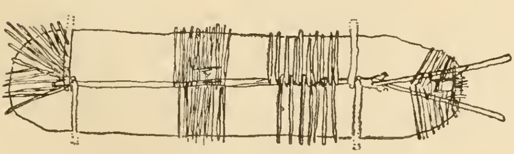

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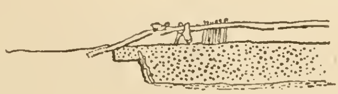


4

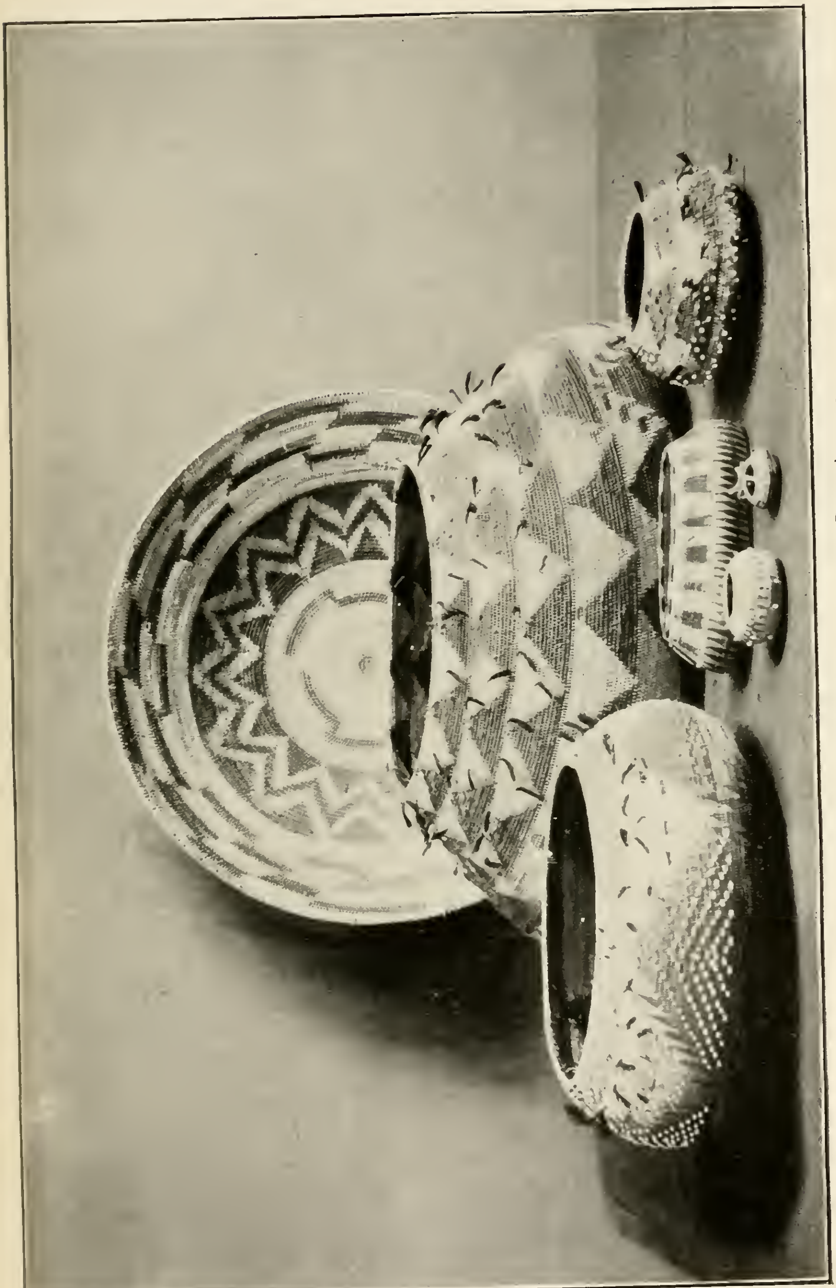
CONSTRUCTION OF POMO BUILDINGS.

1, Section of ceremonial chamber, length 40 feet; 2, horizontal projection of ceremonial chamber; 3, construction of hiberna for women, length 24 feet; 4, 5, sections of 3.

Drawn by Dr. J. W. Hudson.

CARRYING BASKETS OF THE POMO INDIANS.

Diameter of near basket 23 inches.



FEATHER-DECORATED BASKETS OF THE POMO INDIANS.

Diameter of back basket 18⅓ inches.

FEATHER-DECORATED BASKETS OF THE POMO INDIANS.

Diameter of hanging basket 13½ inches.

A. POMO WOMAN MAKING A BASKET. PRIMITIVE COSTUME.

B. POMO MEN MAKING SHELL BEADS—GRINDING AND DRILLING. PRIMITIVE COSTUME.

A. POMO WOMAN WITH CARRYING BASKET.

B. POMO WOMAN POUNDING ACORNS IN MORTAR WITH BASKET HOPPER. PRIMITIVE COSTUME.

collections. He has gathered only choice pieces, and among these are many feather-decorated specimens of exceptional beauty. Arrangements were made for securing this collection for the Smithsonian Institution, and before the end of the year it was forwarded to Washington. I will not attempt to describe it, leaving that pleasant task to Professor Mason, who has made minute studies of that branch of native art, and, with the help of the carefully prepared notes of Doctor Hudson, a valuable contribution may be expected. In Plates 18, 19, and 20 a few notable specimens are shown. They serve for comparison with the Sierra Indian and Tulare work, illustrated in other portions of this paper.

I was interested in watching the women making baskets, Plate 21 *a*, and the men grinding and drilling clam-shell wampun, Plate 21 *b*. These people rely very largely on the acorn for their food, and the carrying basket, Plate 22 *a*, and the mortar and pestle, Plate 22 *b*, are constantly in evidence. The drawings represent the people in their native costumes, which have, however, been superseded in recent years by trousers and calico gowns.

The following interesting notes, furnished Professor Mason by Doctor Hudson, relate to Pomo bread making, dress, and forms of the drill:

Indian corn, or maize, is not indigenous west of the Sierra Mountains, and is not and never was used by our "Diggers." Acorns, buckeyes, and weed seed (about twenty-five varieties), notably the tar weed (*Madaria sp.*), also berries of a number of plants, especially manzanita (*Arctostaphylos tomentosa*), madrona, wild rose, and mountain laurel, are their staples, important in the order mentioned. Teuni bread is made of any of the eight varieties of acorns—Xuci, from *Quercus agrifolia*, and Tsupa, from *Quercus densiflora*, being valued as the sweetest. The nuts are sun dried, then hulled, then reduced to flour by the stone pestle and basket mortar, and cleaned by frequent siftings. A shallow pit is made in fine sand and pressed smooth with the hands; the meal is poured in and covered with leaves of iris (*Iris macrosiphon*). Fresh water is then poured on in quantities and the meal is stirred until it is thoroughly leached. Within an hour it can be gently lifted out in large pieces. Another pit is prepared for the oven, in which a fierce fire is started; stones the size of a smoothing iron are thrown in and, when very hot, half of them are taken out. The remainder form a griddle in the coals and are covered with wet leaves, oak and iris, on which the dough, which is the acorn meal mixed with 5 per cent of Masil, or red earth in solution; also sometimes the same amount of tar weed meal, Mako, is evenly spread. Wet leaves are placed over this; then the hot stones; then about 6 inches of earth. In six or eight hours the oven is opened, disclosing a large, flat cake incrusted in leaves, and smelling somewhat like bread. The Masil, or red ceremonial yeast, has given a dark-red cast, while the Mako turns it almost black. The taste is not unpleasant. It is flavored with an impure salt gathered either on the coast or at a spring on Eel River.

Buckeye Disa: The nuts are roasted in hot rocks, hulled and peeled with a deer-rib knife, then mashed in a basket with a heavy billet, like a giant potato masher, Disapawohai, then leached as above, and in the form of paste eaten hot or cold.

Pinole (Spanish) or To-o is a mush of acorn meal, leached of course, mixed with a percentage of other seed meals, boiled in a Tee or Bamtoosh basket by dropping hot round stones into it until the contents are cooked. It has the consistency of mush, and is quite insipid. Wheat is now often substituted. It is toasted in a plaque with live coals, then mortared out into flour and cooked as above.

Other cakes are Mako, Malalkato, Bimu, named from constituents and methods of preparing. Yuhu is a coarse, unpalatable cake made from acorns (*Quercus wislizeni*).

All of the above except the wheaten cakes are of ancient origin.

The ordinary aboriginal dress of a man was a skirt, Kauxi, of the bark of a willow (*Salix nigra*), or of bulrush stems shredded. A mantle of skin, panther preferred, is tied over the shoulders and belted at the waist. A thick chaplet of mountain laurel covers the head. The woman has a deerskin mantle or chemise above and the Kauxi below; the head is usually bare. She sits generally on a tule mat at her work; the man kneels when drilling wampum, or at like labor.

The pump drill was introduced into Ukiah Valley by a Spaniard in the early seventies, and was carried into Potter Valley about the year 1876 by old blind George, now living. The aboriginal tool was called Dawihai (da win, to bore, hai, a stick), and was a straight shaft of wood, 2 feet long and half an inch in diameter at the middle [twirled between the palms of the hands]. The drill point was of jasper or flint, and fastened to the shaft by a lashing of hemp (*Apocynum cannabinum*), and coated with pitch. Its origin is beyond tradition.

STOCKTON DISTRICT.

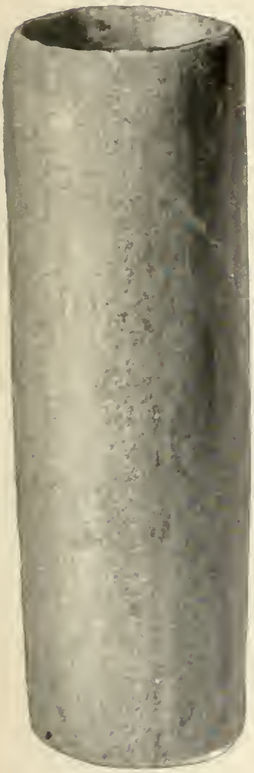
Early reports on the antiquities of California somewhat casually mention the occurrence of mounds in various parts of the State. Later investigations have furnished definite knowledge of the shell mounds and kitchen-middens along the coast, and of the earthworks in the interior valleys. Quite recently a new chapter has been added to the history of aboriginal California as a result of researches among the mounds of the great inland basins, including the valleys of the Sacramento and San Joaquin rivers and the basins of Tulare Lake and Kern River. These earthworks were erected by a much simpler and less ambitious people than the mound-builders of the Mississippi Valley. They are scattered over the low lands, mainly in the tule flats, where annual inundations are or were common. They are not arranged in any systematic order and show none of the specialization of form characterizing the mounds of the east or of Mexico and Central America on the south. They are roundish in outline and rarely more than 10 or 12 feet in height, although a few are reported to reach 20 feet; the profiles are gently rounded as a result of the crumbling nature of the earth of which they are composed (Plate 23 *a*). and the area covered is often quite extensive. It appears that in the main they were erected primarily for domiciliary purposes and as places of retreat in time of overflow. They were also used as burial places, though probably not originally erected for this purpose, and a few are literally filled with human remains (Plate 23 *b*).

The exceptional environment furnished by these interior valleys has evidently given rise to a somewhat peculiar phase of local culture,

A. MOUND NEAR STOCKTON.

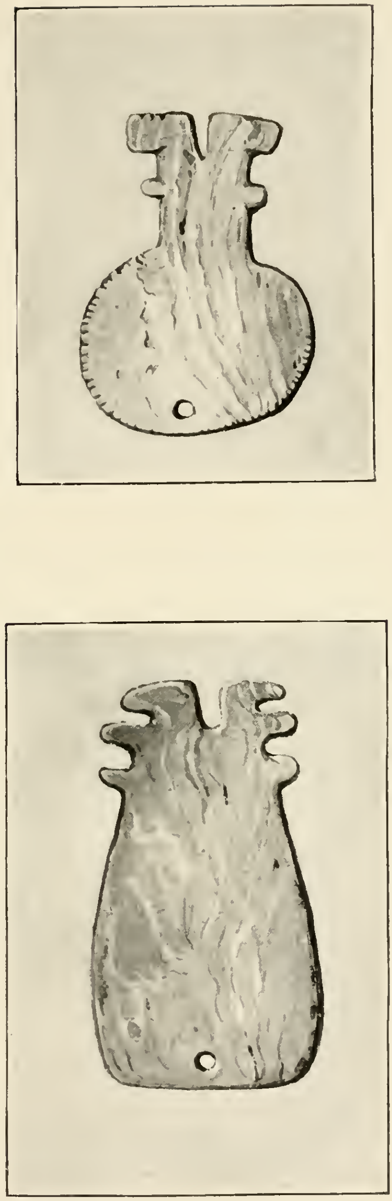
B. EXPOSURE OF SKELETONS IN MOUND, STOCKTON.

From photographs by Mr. H. C. Meredith.



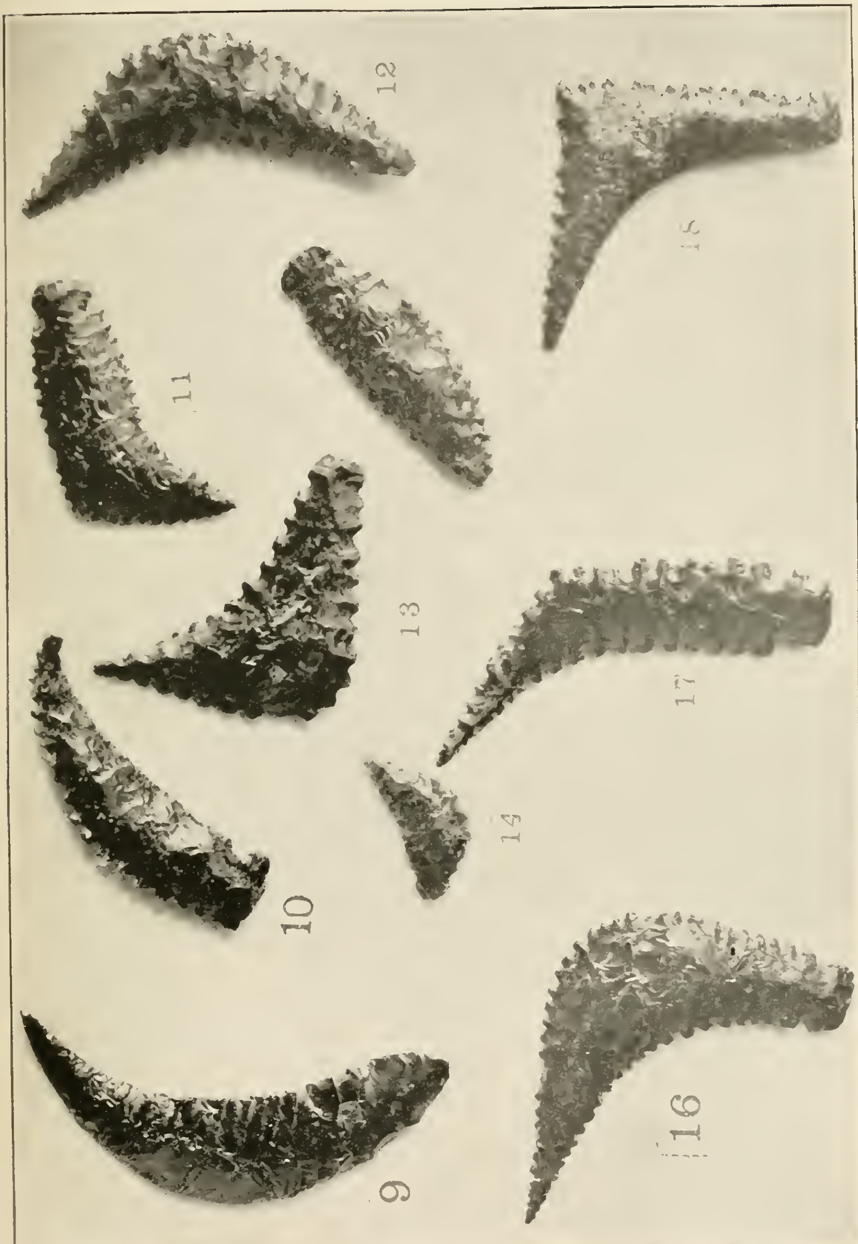
A. Cylindrical Steatite Vessel, from Stockton Mounds.

Barr collection.



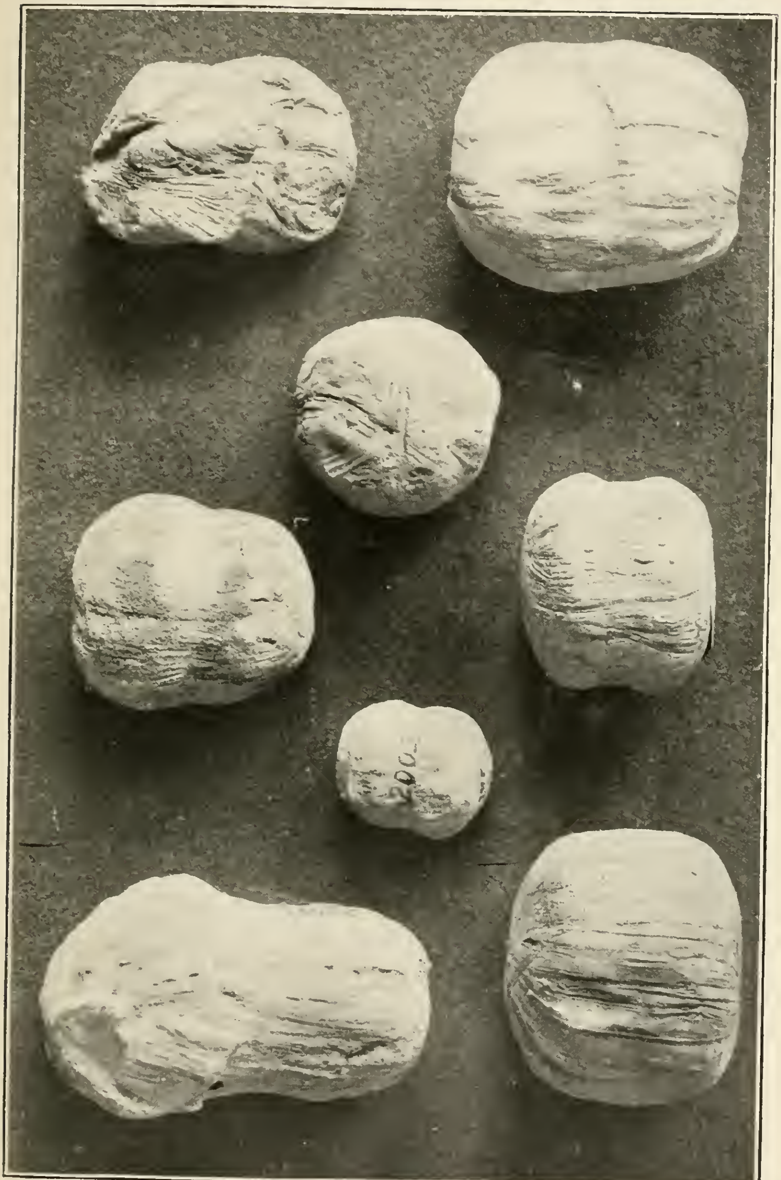
B. Shell Ornaments, from Stockton Mounds.

Barr collection.



OBSIDIAN KNIVES, FROM STOCKTON MOUNDS.

Barr collection.

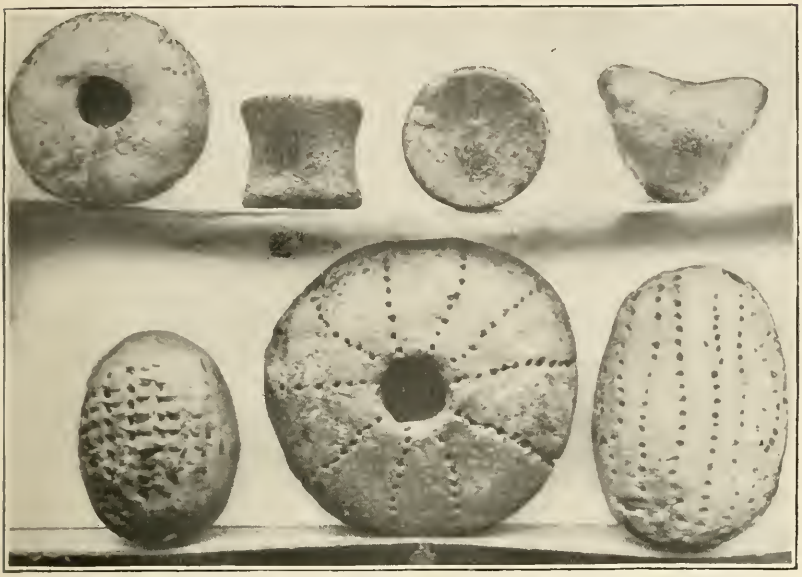


CLAY PELLETS FOR USE IN SLINGS, STOCKTON MOUNDS.

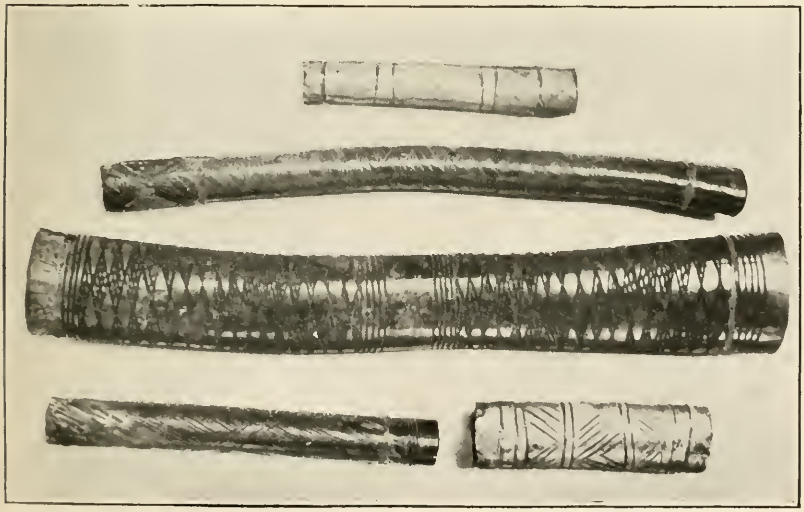
About three-fourths actual size.

Clay Pellets for use in Slings, Stockton Mounds.

About three-fourths actual size.



A. CLAY PELLETS AND ORNAMENTS, STOCKTON MOUNDS.



B. DECORATED BONE IMPLEMENTS, STOCKTON MOUNDS.

Meredith collection.

differing from that of the coastal belt on the west and from the foothills and sierra on the east. There was a tendency toward sedentary life, fostered, no doubt, by an unfailing food supply, which consisted of fish and waterfowl in great plenty, and many vegetable products, including acorns, seeds, roots, and various kinds of fruit. The occurrence of inundations in the lowlands must have interfered to some extent with full sedentation, the people being driven periodically into the higher plains and foothills.

It seems likely that the earthworks scattered along these valleys were built by one or more of the tribes found in possession—the Wintun, the Maidu, the Mutsun, the Yokuts, and the Shoshone (Powers)—since neither the works themselves, their contents, nor the miscellaneous artifacts of the valley present features discordant with the condition and achievements of these peoples. I believe that no important distinction has been drawn between the implements and utensils of the mounds and those of the surface of the country generally. The osseous remains exhibit no novel or distinctive features.

Implements and utensils have a wide range in form and in the classes represented, but withal are simple in character and indicate no unusual advance in culture. They include mortars, milling plates, pestles, and rubbing stones, of usual range of form, cylindrical steatite vases of local type (Plate 24 *a*), stone pipes, rings, discoidal stones, grooved pebbles, and flaked implements of many forms. Certain obsidian implements of the Stockton district present exceptional characters (Plate 25). There are also tools of bone and shell and ornaments in great variety. There are many objects of baked clay, globular, discoidal, dumb-bell shape, etc., some of which may have served for use in slings (Plates 26, 27 *a* and 28). This use of clay balls is noted as occurring among some of the modern tribes. The artistic sense was evidently not greatly developed among these people, as attested by the almost entire absence of the carving or engraving of life forms. In Plate 28 *b* a number of bone implements obtained from these mounds and tastefully decorated with incised workings are shown. They are, for the most part, whistles, or flutes, and correspond closely with similar objects found in mounds and middens along the California coast. Among the pendant ornaments of abalone shell are specimens representing, apparently, a double-headed bird, suggesting the double-headed eagle of European nations (Plate 24 *b*), but the conception is quite as likely to be of purely native origin. In general the contents of the mounds include few relics of recent origin.

Enterprising archæologists in Stockton have made valuable collections from the mounds of the neighboring lowlands. Mr. H. C. Meredith has published a number of articles describing and illustrating his explorations and finds, and Mr. J. A. Barr has made a most valuable collection, chiefly from local mounds. Prof. Edward Hughes, of the city schools, has also taken a deep interest in local archæology and kindly drove out with our party to the neighboring flats, where a number of mounds were examined.

The objects shown in the accompanying plates belong to the Stockton collections or were presented to the U. S. National Museum by Stockton collectors. Brief descriptions are given in connection with the plates and more detailed information may be obtained from the writings of Mr. Meredith.[1]

TULARE RESERVATION, TULARE COUNTY.

On our way south from San Francisco to Los Angeles we made it a point to stop at Porterville, in Tulare County, long enough to pay a visit to the Tulare Indians[2] located on South Fork of Tule River, 20 miles eastward from the village. Their reservation was originally situated on the fertile lowlands where the river valley opens out upon the plain, but this land was acquired by the whites and is now largely under cultivation. The Indians were removed to the upper valley, where they now dwell in comfortable, though simple, frame houses. Here the narrow, rocky banks of the river rise abruptly into massive and precipitous mountains. It is indeed a secluded and lonely spot, an ideal retreat for the humble remnant of a people once laying claim to the broad, rich lowlands now traversed by railways and dotted with incipient cities. The houses are scattered at short intervals for 2 or 3 miles along the valley. A little farming is done and some stock is kept, and there is a school near the agent's residence, attended at the present time by twenty or thirty children.

Near the upper end of the reservation a most interesting spot, known as Painted Rock, or The Painted Rocks, was visited. Here the little stream is confined to a narrow gorge bordered by enormous masses of granite, over which the torrents pour in the wet season. At the sides, however, there is enough comparatively level ground to accommodate dwellings and small fields. This site, it appears, was a favorite resort of the native peoples, the Tulares or their predecessors, for a long period of years. The protected surfaces of the great granite blocks are still covered with symbolic paintings in bright colors, and some of the flatter exposed surfaces are pitted with mortar basins wherein the women of many generations have come to grind acorns and seeds. In Plate 29 are shown two excellent illustrations of one of these milling places, there being between forty and fifty more or less deeply sunken conical mortars visible. Another large, rounded mass near by contains upward of seventy-five of these pits, varying from shallow basins or incipient mortars to conical depressions a foot in depth.

[1] H. C. Meredith in Moorehead's Prehistoric Implements, p. 258; Land of Sunshine, October, 1899; American Archæologist, II, p. 319.

[2] The Yokuts of Powers. Tribes of California, Contributions to North American Ethnology, III, p. 369.

MORTAR ROCK, TULARE RESERVATION.

Portions of this rock are now covered with soil, so that a number of the mortars are probably hidden. Possibly some of the depressions may originally have been pot holes, worn by the descending waters of the cascade, but all are now manifestly artificial in contour. The present inhabitants do not appear to use these particular mills, but employ mortars, both fixed and portable, in the immediate vicinity of their dwellings. This may be the group of mortars referred to by Powers, who says that "in remote times they were accustomed to rub their acorns to flour, on a stone slightly hollowed, like the Mexican metate, which was a suggestion of the Mouse, but nowadays they pound them in holes on top of huge bowlders, which was a suggestion of the wiser Coyote. On a bowlder in Coarse Gold Gulch I counted 86 of these acorn holes, which shows that they must have been used many centuries."[1]

My own feeling about this matter is that the metate is a late rather than an early form of the millstone, since these great groups of mortar pits must be very old, and the mortars dug up at considerable depths in this valley as well as elsewhere are generally globular. I was especially interested in observing that the process of shaping stone by pecking with hammers is known to the Tulares. Some specimens show recent work, and inquiry of Mr. James Alto elicited the statement that the women shaped mortars and pestles in this way, employing "days pecking and pecking."

At one of the dwellings, which had the appearance of an ordinary, comfortable farmhouse, the entire family was engaged in thrashing and cleaning up the recently harvested crop of beans. Plate 30 shows the man threshing with a flail, while the women are seen separating the beans from the hulls by fanning in shallow basket trays. From the old woman of the household—the grandmother—who seemed to be owner of all domestic articles, we secured baskets, stone boiling sticks, mortars, and pestles. The large, roundish mortar shown in Plate 31 was in use by one of the women, but we were told that this piece had been found at a depth of several feet in digging an irrigating trench; that it was very old, and belonged, they believed, to peoples that had preceded the Tulares. However, such mortars, as well as others of varying form, were seen in use on the reservation.

The manner of using snares in capturing pigeons is shown in Plate 32. Roundish earthen platforms from 5 to 8 feet in diameter are constructed among the great bowlders in favorable locations, on which are set willow-twig loops for securing decoy birds. At one margin of the platform a brush or reed shelter is built, in which the man with the snares hides himself. The loops of the snares lie extended upon the platform, and when the birds, alighting to feed with the decoys,

[1] Tribes of California, Contributions to North American Ethnology, III, p. 376.

become entangled they are quietly withdrawn beneath the shelter and secured (Plate 32 *b*). The lower illustration, *a*, shows James Alto, the reservation policeman, emerging upon the platform from the shelter. Powers mentions the use of snares, probably of this class. He says that "for snaring quail, rabbits, and other small game they employed cords made of a kind of 'wild flax' found in the Sierras. I presume this 'wild flax' is milkweed (*Asclepias*)." In Plate 33 *a* we have a drawing of one of the snares and in *b* a game basket of peculiar form. In the same plate are included a pair of wooden fire sticks or tongs, *c*, and a looped stick for lifting stones from the boiling baskets, *d*. The native scrubbing brushes and the yucca bulbs from which they are made are illustrated in Plate 34.

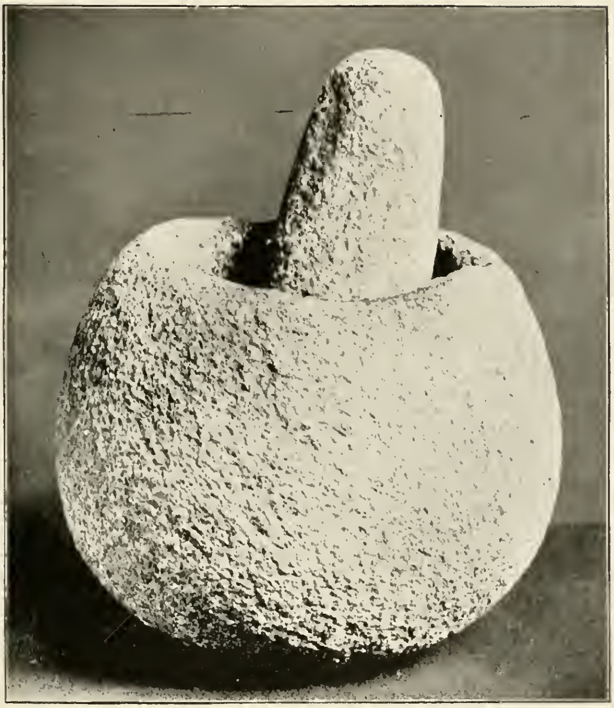
At one of the houses near the pictured rocks I was so fortunate as to obtain parts of a ceremonial costume, consisting of a feather headdress, ear ornaments, thorn needle with asphaltum head, etc., shown in Plate 35. The importance attached to these articles was made apparent by the care with which they were wrapped up in especially prepared coverings and hidden away. There was also a more complete costume in possession of one of the men of the family, but this could not be secured. It included the primitive skirt made of long strands, forming a fringe, upon which are strung pine nuts and beads. It was said that these were parts of old time ceremonial dance costumes, still used on great festal occasions.

The Tulares are among the most expert of basket makers. Plate 36 illustrates three winnowing baskets, and Plates 37 and 38 three bowl shaped pieces of excellent quality. The fine specimen shown in Plate 39 *a* and *b* and Plate 40 was obtained from the good woman, Mrs. Pedro Tennis, who had just completed it. The low, flat-topped bottle form is apparently peculiar to this tribe. Occasionally a piece is seen much flatter in the body than this specimen. The workmanship and æsthetic treatment are of a high order, and the deteriorating influence of modern conditions is seen only in the use of red worsted, which I suppose takes the place of red feathers of earlier times. The baskets in use to-day include also carrying baskets of usual California types.

The native names for the basket-making materials and for the various articles illustrated in the accompanying plates are not given for the reason that I had no time to verify the data secured from James Alto, although he seems a thoroughly honest and intelligent man.

I was particularly anxious to secure one of their gambling trays, which are large, flat basket plaques, but the last specimen in the valley, so it was said, had recently been carried away by a collector. We were so fortunate, however, as to secure an unusually old and fine example through the courtesy of Mr. and Mrs. C. F. Briggs, of San Francisco, who had obtained it from an old woman living on a ran-

THRASHING AND WINNOWING BEANS, TULARE INDIANS.

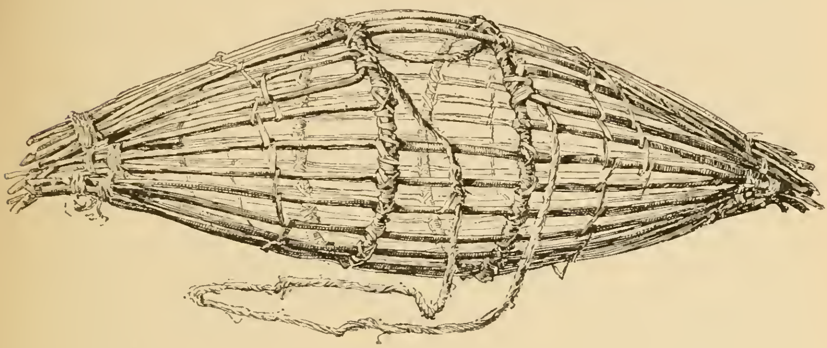


MORTAR AND PESTLE IN USE BY TULARE INDIANS.

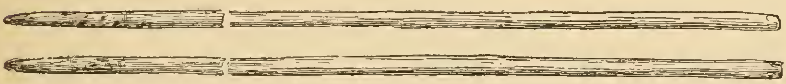
Diameter of mortar 10 inches.

PIGEON SNARING, TULARE INDIANS.

A



B



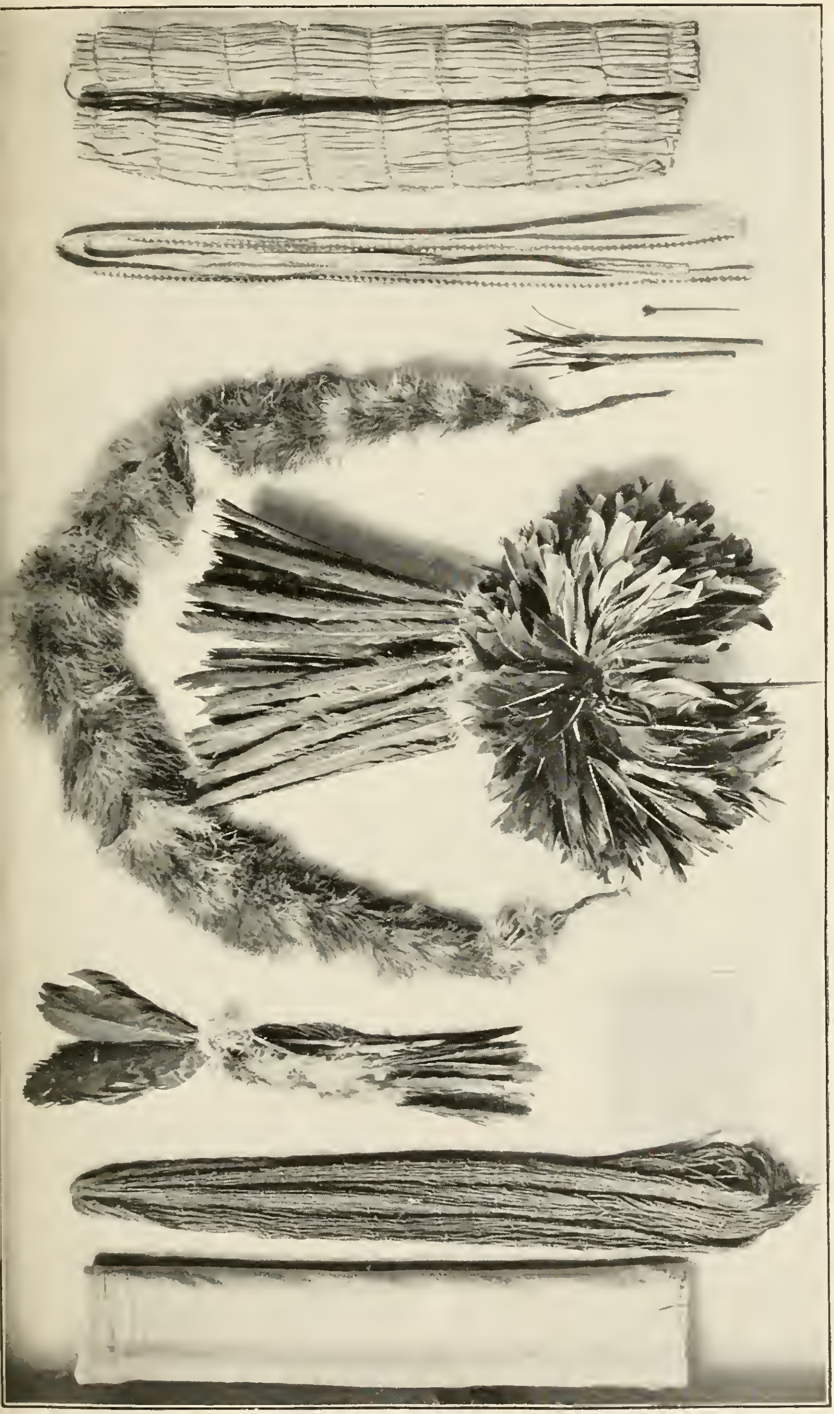
C

D

IMPLEMENTS, TULARE INDIANS.

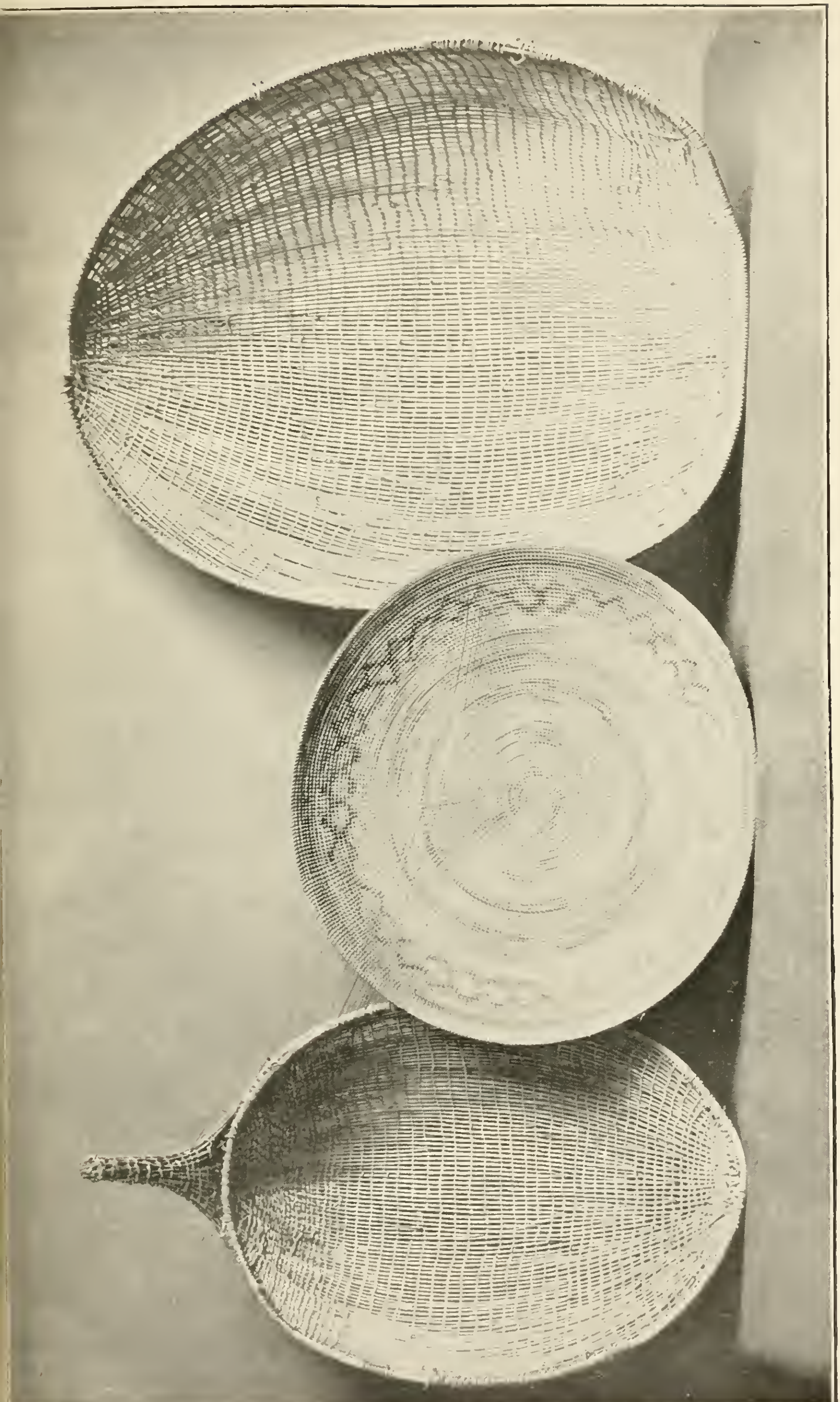
A, Pigeon snare; *B*, game basket; *C*, wooden fire tongs; *D*, looped boiling sticks.

YUCCA BULBS AND BRUSHES, TULARE INDIANS.



CEREMONIAL HEADDRESS AND MATTING CASE FOR SAME. TULARE INDIANS.

About one-seventh actual size.

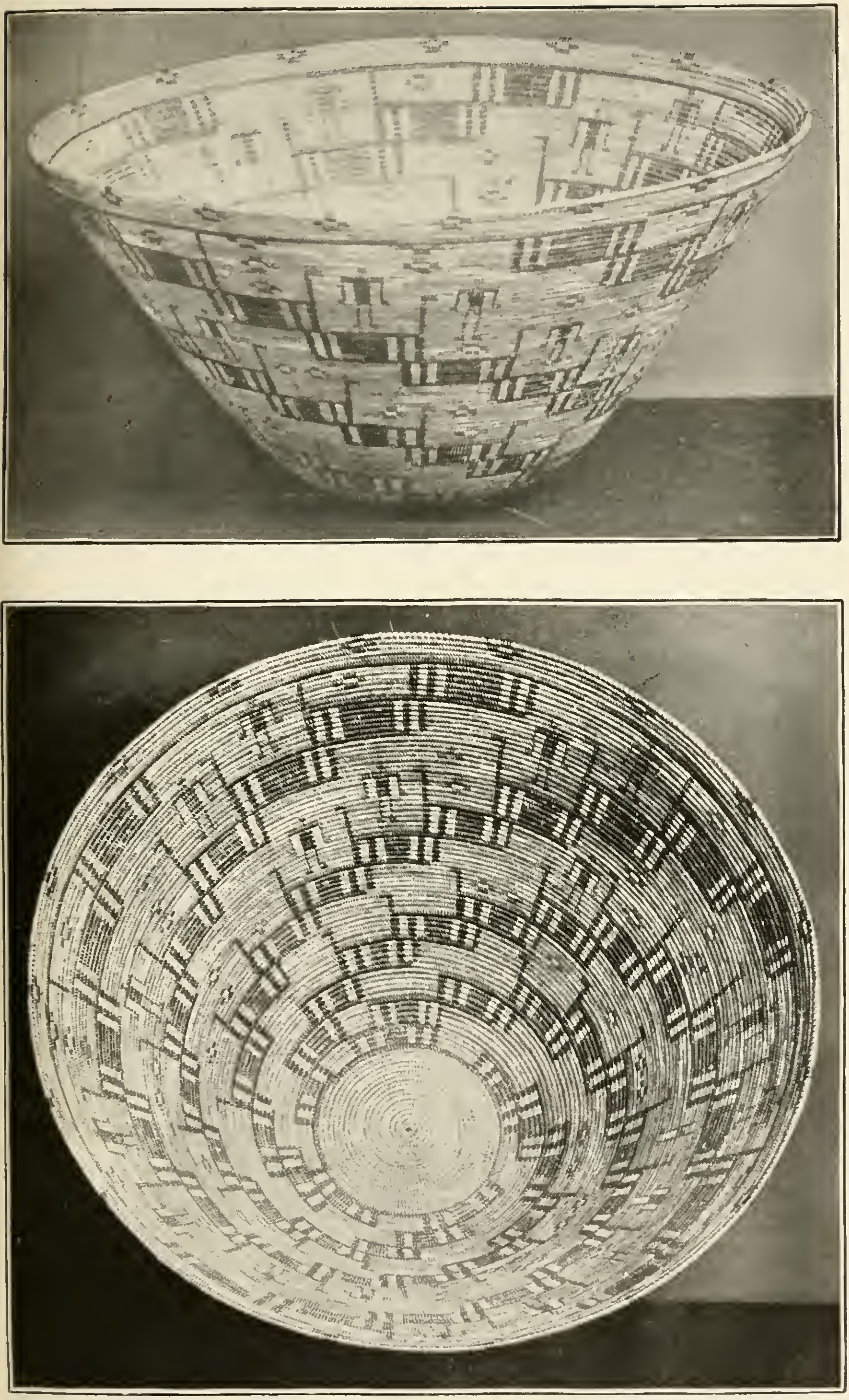


WINNOWING BASKETS, TULARE INDIANS.

Largest specimen 23 inches in length.

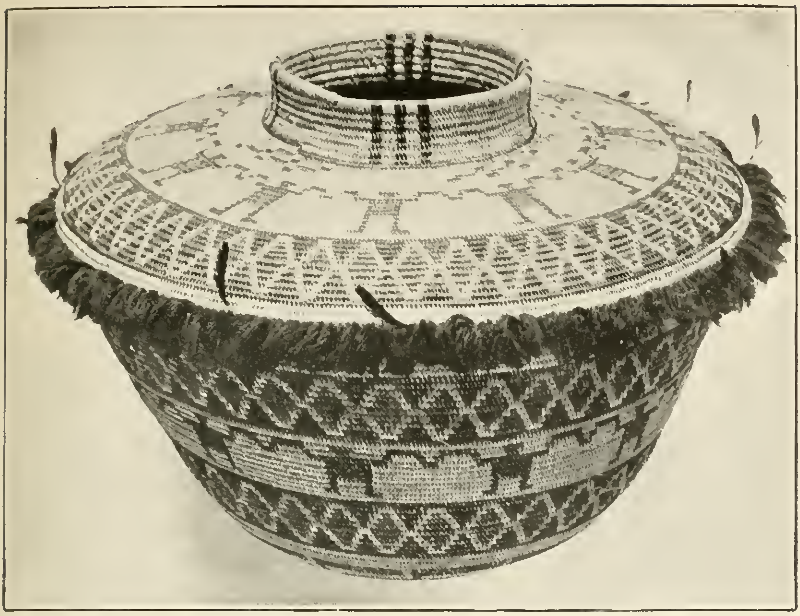
BOWL-SHAPED BASKETS, TULARE INDIANS.

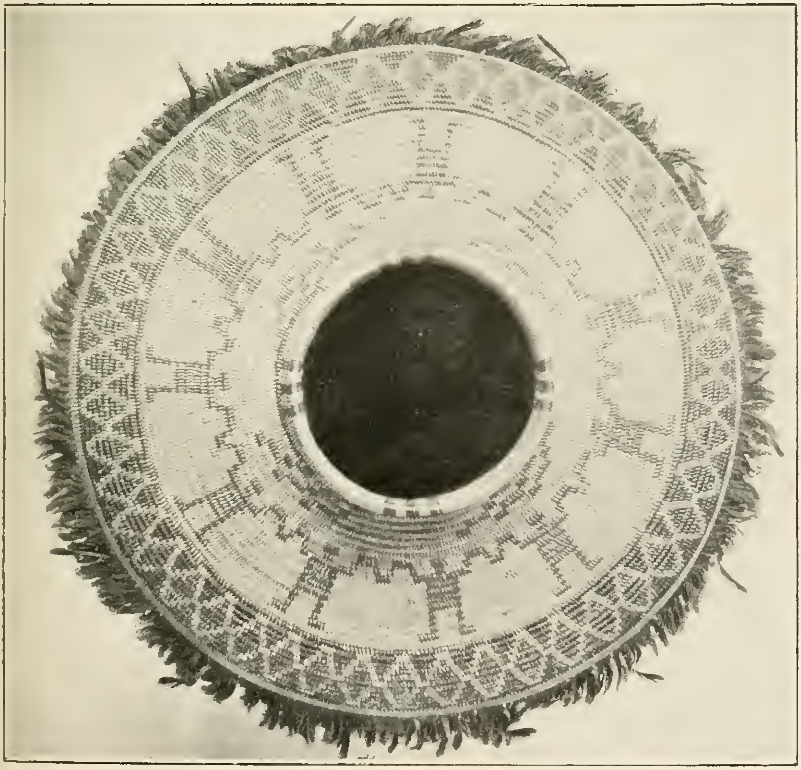
Diameter 15 inches.



BOWL-SHAPED BASKET. TULARE INDIANS.

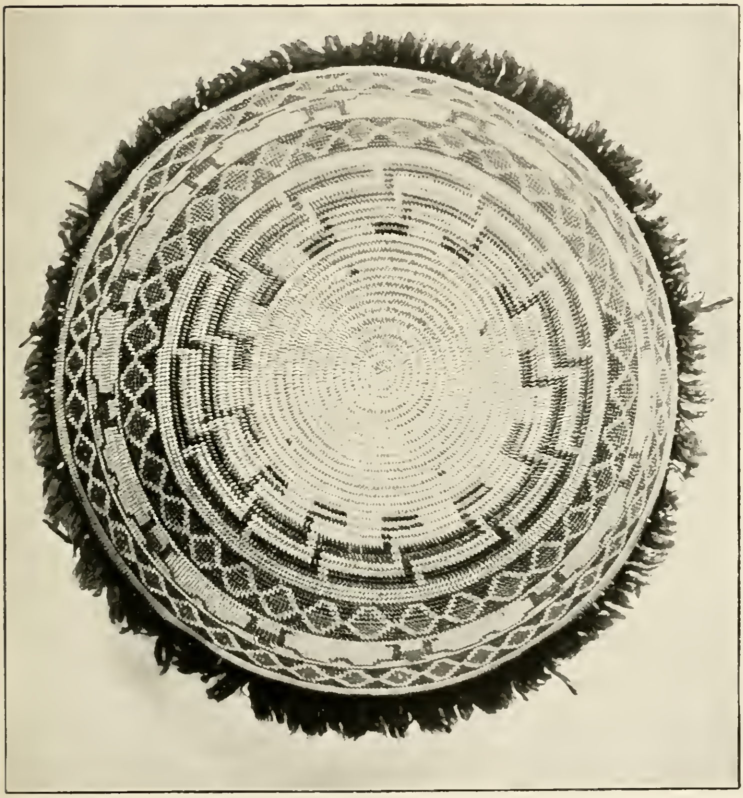
Diameter 17 inches.





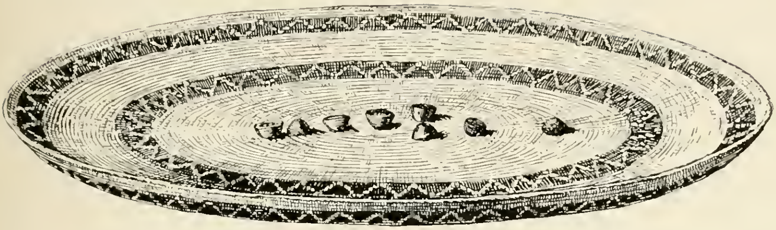
BOTTLE-SHAPED BASKET, TULARE INDIANS.

Diameter 11 inches.



BOTTLE-SHAPED BASKET, TULARE INDIANS. (VIEW FROM BENEATH.)

Diameter 11 inches.



TULARE GAMBLING TRAY.

Diameter 28¾ inches.

TULARE SQUAWS USING GAMBLING TRAY. PRIMITIVE COSTUMES.

cheria near Lemoore, in Kings County, who parted with her treasure only after the strongest persuasion on the part of the visitors. It is shown in Plate 41.

The following account of the game as played by the Tulares is quoted from Mr. Stephen Powers:

> The Gualala style of gambling prevails all over the State, but the Yokuts have another sort which pertains exclusively to the women. It is a kind of dice throwing, and is called u-chu-us. For a dice they take half of a large acorn or walnut shell, fill it level with pitch and pounded charcoal, and inlay it with bits of bright-colored abalone shells. For a dice table they weave a very large, fine basket tray, almost flat, and ornamented with devices woven in black or brown, mostly rude imitations of trees and geometrical figures. Four squaws sit around it to play, and a fifth keeps tally with fifteen sticks. There are eight dice, and they scoop them up in their hands and dash them into the basket, counting one when two or five flat surfaces turn up.
>
> The rapidity with which the game goes forward is wonderful, and the players seem totally oblivious to all things in the world beside. After each throw that a player makes she exclaims *yet-ni* (equivalent to "one-y"), or *wi-a-tak*, or *ko-mai-eh*, which are simply a kind of sing-song or chanting. One old squaw, with scarcely a tooth in her head, one eye gone, her face all withered, but with a lower jaw of iron and features denoting extraordinary will—a reckless old gambler and evidently a teacher of the others—after each throw would grab into the basket and jerk her hand across it, as if by the motion of the air to turn the dice over before they settled, and ejaculate *wiatak!* It was amusing to see the savage energy with which this fierce old hag carried on the game. The others were modest and spoke in low tones, but she seemed to be unaware of the existence of anybody around her.[1]

The account given by Mrs. Briggs is to the same effect. In Plate 42 I venture to reproduce a drawing illustrating the use of the gaming tray as set forth so vividly in Mr. Powers's account.

SOUTHERN CALIFORNIA.

Southern California has much to interest the student of archæology as well as the traveler seeking an ideal country. It is a region occupied formerly by numerous and probably greatly diversified peoples, presenting, however, no great dissimilarity in culture. Their contact on the east and south was with peoples lower in the scale of progress than themselves, and it appears that few elements of culture from the more distant regions ever crept in. A small number of widely scattered aboriginal communities still survive to the present day, but present no very considerable points of interest to the student, their original customs having been destroyed or greatly modified by mission rule.

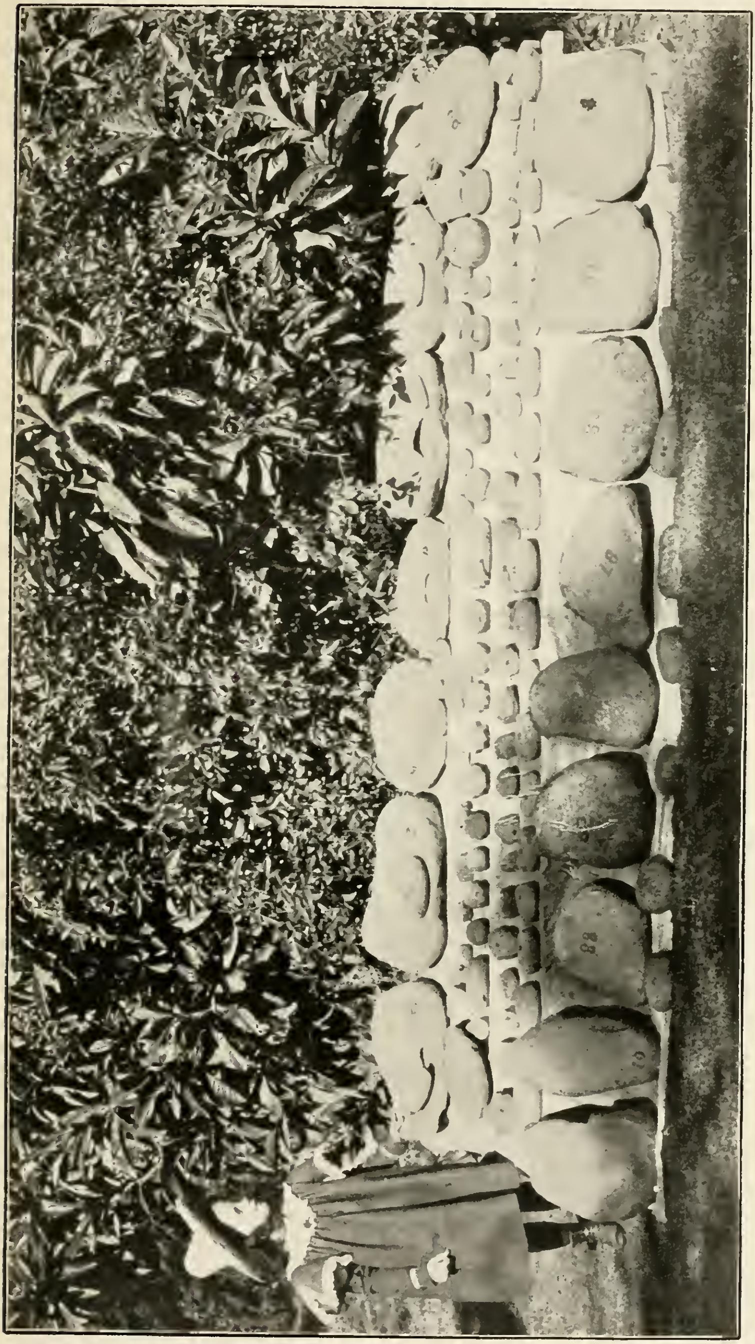
The region including Santa Barbara County and the group of islands lying off the coast is probably the richest, archæologically, in California and furnishes vast numbers of artifacts of usual classes, among which the mortar and pestle predominate to a remarkable degree. A

[1] Tribes of California. Contributions to North American Ethnology, U. S. Geographical and Geological Survey of the Rocky Mountain Region, III, 1877, p. 377.

number of enterprising collectors have occupied this field, and in Los Angeles I had the pleasure of studying some fine collections made by Dr. F. M. Palmer, a type series, well arranged and labeled, being displayed in the museum of the Chamber of Commerce. Mr. W. S. Campbell, a local dealer in Indian relics, has many interesting things, prominent among which are a number of rare and beautiful baskets made by the Santa Ynez Indians, a tribe now approaching extinction. Other collections made by Rev. Stephen Bowers are partly in his own hands and partly in possession of Mr. H. N. Rust, of South Pasadena. In addition, a large and valuable collection, not, however, purely local, is owned by Mrs. A. C. Low, of Pasadena. Mr. Rust's collection also contains an interesting series of objects from an ancient village site in the suburbs of Pasadena, and he permits me to introduce here two plates, in which are seen a large number of the objects collected—Plates 43 and 44. In this collection there are no globular mortars or cylindrical pestles, but numerous mealing plates showing extensive use, and many oblong and discoid mullers. Several annular and stellar shaped stones are unique. The whole group seems to indicate a people related in many ways with the tribes of the Sierra. The village site from which the specimens illustrated were collected is situated on the bluff overlooking South Pasadena and on the line of Buena Vista street. When the grading of this street was under way Mr. Rust watched the work daily, saving more than a hundred implements and utensils. He was able even to locate some of the lodge sites by the larger number and greater variety of specimens found within limited areas. Besides the stone implements shown in the plates, one bone awl and a fire stick were recovered. Few flaked implements are found in the Pasadena region, and there is no pottery, and burial places and human remains have been sought for in vain.

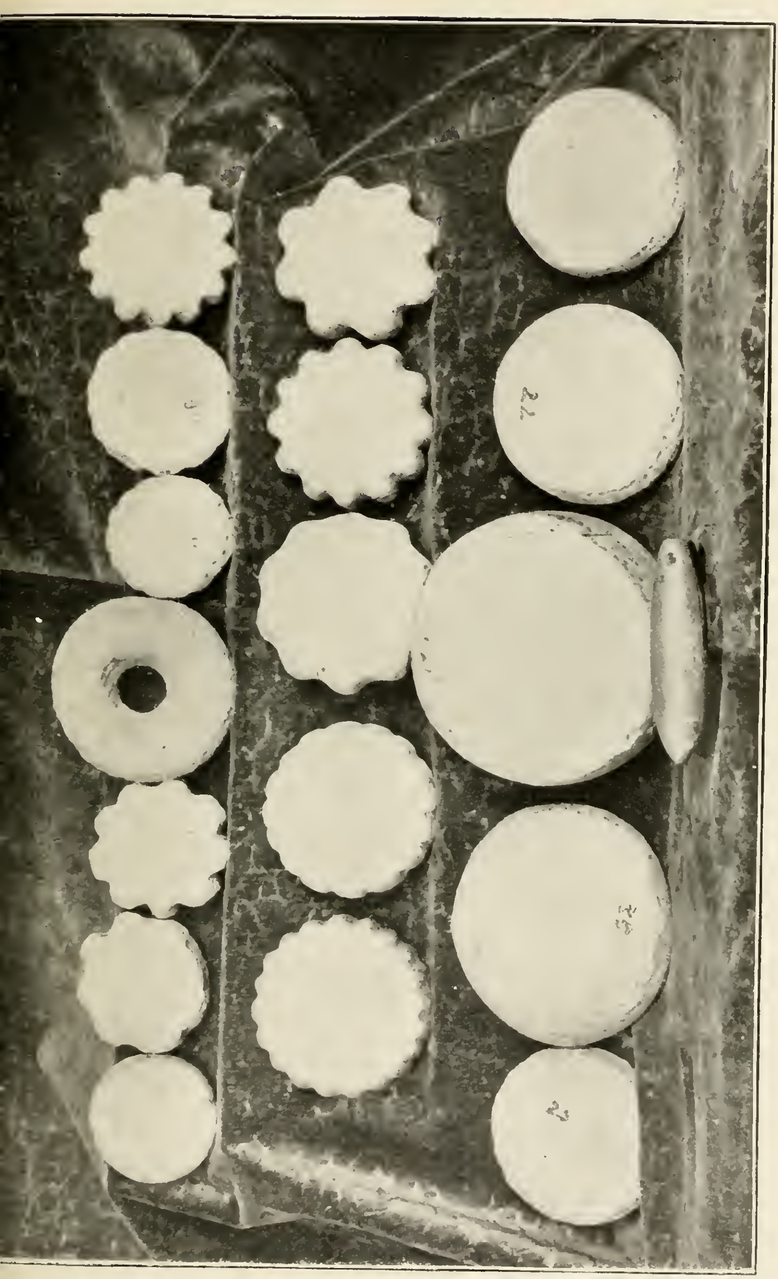
At Santa Barbara I was permitted to examine a valuable collection made by Mr. L. G. Dreyfus, and the museum of the local historical society has many specimens of interest. The region has been explored by a number of scientific students, including Schumacher, Henshaw, Yarrow, and Yates. The principal village site at Santa Barbara is on the extreme end of a picturesque promontory at the lower end of the city, and the sea is slowly cutting it away. The location of the burial ground is indicated in the view presented in Plate 45 by a group of apple trees seen distinctly in the lower picture. Near by, on the low ground, is a large oblong mound, now occupied by a residence and believed by Mr. Dreyfus and others to be of artificial origin.

From Los Angeles it is a short railway journey to San Pedro, on the coast, and a steamer voyage of 25 miles out into the Pacific carries one to Avalon, a village occupying an exquisitely picturesque little harbor near the east end of Santa Catalina Island. While at this place I had the opportunity of examining two of the noted archæological



PASADENA VILLAGE-SITE ARTIFACTS.

Rust collection.



PASADENA VILLAGE-SITE ARTIFACTS.

Rust collection.

VIEWS OF SANTA BARBARA POINT, THE SITE OF A PREHISTORIC CEMETERY.

sites of this island—the soapstone quarries of Potts Valley and the shell deposits of the isthmus. These sites were explored by Schumacher many years ago, and the rich collections obtained by him are now preserved in the museums at Washington and Cambridge. I need not do more in this place than briefly record my observations and impressions regarding these sites.

Early in the morning of November 2, 1898, I set out on horseback with Mexican Joe as guide, to find the soapstone quarries some 10 miles to the northwest. We climbed the steep slopes from Avalon, meandered the lofty sinuous crests of the island, passing across the shoulder of Black Jack—a mountain rising nearly 1,800 feet above the sea—and descended into Potts Valley, which, if my identification be correct, opens down to the sea on the north of the ridge. At many points we encountered outcrops of steatite, and evidences of ancient mining were apparent on all hands. There were shallow excavations and heaps of débris surrounded by fragments of partially shaped vessels and the rude stone picks, hammers, and chisels with which the quarrying and shaping work was done. Near the site of the principal quarry reported upon by Schumacher there has been some recent quarrying by white settlers, but fortunately the outcrop from which the aborigines cut so many pots remains undisturbed. At the head of the shallow amphitheater of Potts Valley, which descends to the shore half a mile or more below, some great masses of rugged rock rise from the otherwise smooth slopes. Portions of these masses are composed of soapstone, and the surfaces from which lumps of soft rock were cut are in plain view. A vigorous growth of cactus plants covers the lower part of the exposure, but enough remains in sight to tell the story of former enterprise. The scars left by the workmen extend over 400 or 500 square feet of the steep surfaces of the rocky mass, and the views shown in Plate 46 disclose the scars and chisel marks to excellent advantage. The work of removing the rounded masses of stone from which the vessels were to be shaped was identical in character with that observed in the many soapstone quarries of the Eastern States, but so far as the markings now remaining show, the cutting has been more skillful, and it seems not improbable that the work in the examples illustrated has been done with metallic tools. It is reasonable to suppose that the trade in soapstone pots, carried on extensively between the islanders and the tribes of the mainland, continued to flourish for a considerable period after the coming of the white man, and in the latest work iron picks and shovels must have been used. Scattered about this rock and on the slopes above and below were fragments of partially shaped and broken vessels, besides numerous rude cutting tools and picks of hard stone. The latter implements had been shaped by flaking with hammer stones, some of which are distributed with the débris.

My own contribution to the study of this interesting spot was the discovery of an ancient grave on the nearly level top of a rounded knoll some 40 or 50 feet above the upper quarry face. I happened to observe the broken edge of a soapstone platter projecting above the hard soil. In removing this specimen other objects were brought to light. Remnants of a skull and jawbone and numerous bones of the trunk were found, but all were so near the surface that they had been more or less dissociated and broken up. There were also parts of three or four steatite vessels, one small pot, a round shallow dish, two oblong dishes, and a flattish oblong plate with squared end, probably a baking plate. Other articles were evidently mere burial offerings made for the purpose and doubtless symbolic. They include a steatite hook of a form common in the region, a miniature pestle of steatite, a peculiar object, apparently a much conventionalized fish or finback whale, three handles of steatite utensils, apparently dipper handles, an obsidian arrow point, and some much decayed shell ornaments. A number of these objects are shown in Plate 47.

The relation of the grave to the quarry face is shown in Plate 48. The figure in the foreground represents my companion engaged in exploring the grave, and the worked soapstone surface is behind him at the right. Beyond are the rugged cliffs, with a bit of the sea visible at the left.

My study of this site was far from exhaustive, but I gained the impression that the ancient occupation had extended over a very long period. This must be the case if the vast number of utensils found in the region have had their origin in these quarries. I observed that the phenomena are practically identical with those of soapstone quarries of the east.

In a rock shelter some 200 yards southeast of the quarry examined I found evidence of ancient occupation. Deposits of kitchen-midden refuse cover the slope below, and in these were many abalone shells and some rude stone utensils, the latter including a flattish spatulate stone, one end of which was covered with asphaltum, as if used for a trowel in applying the liquid material.

Santa Catalina Island is extremely rugged and picturesque, and the coast is in large part inaccessible, but there are a number of small bays and inlets about the inner margins of which there is land enough to accommodate small settlements. One of the most favorable localities for a native village was at the point called the Isthmus, about 14 miles north of Avalon, where the opposite shores approach within a few hundred yards, and there is a low pass, not 20 feet in elevation, between the opposing beaches. The upper view in Plate 49 looks from this pass outward toward the Pacific, and the lower picture shows the opposite side turning toward the north. The houses in the latter view were occupied at the time of my visit, but I have learned from

TRACES OF ABORIGINAL WORK IN SOAPSTONE QUARRY, SANTA CATALINA ISLAND.

OBJECTS OF SOAPSTONE FROM A GRAVE, SANTA CATALINA ISLAND.

Dish 10½ inches in diameter.

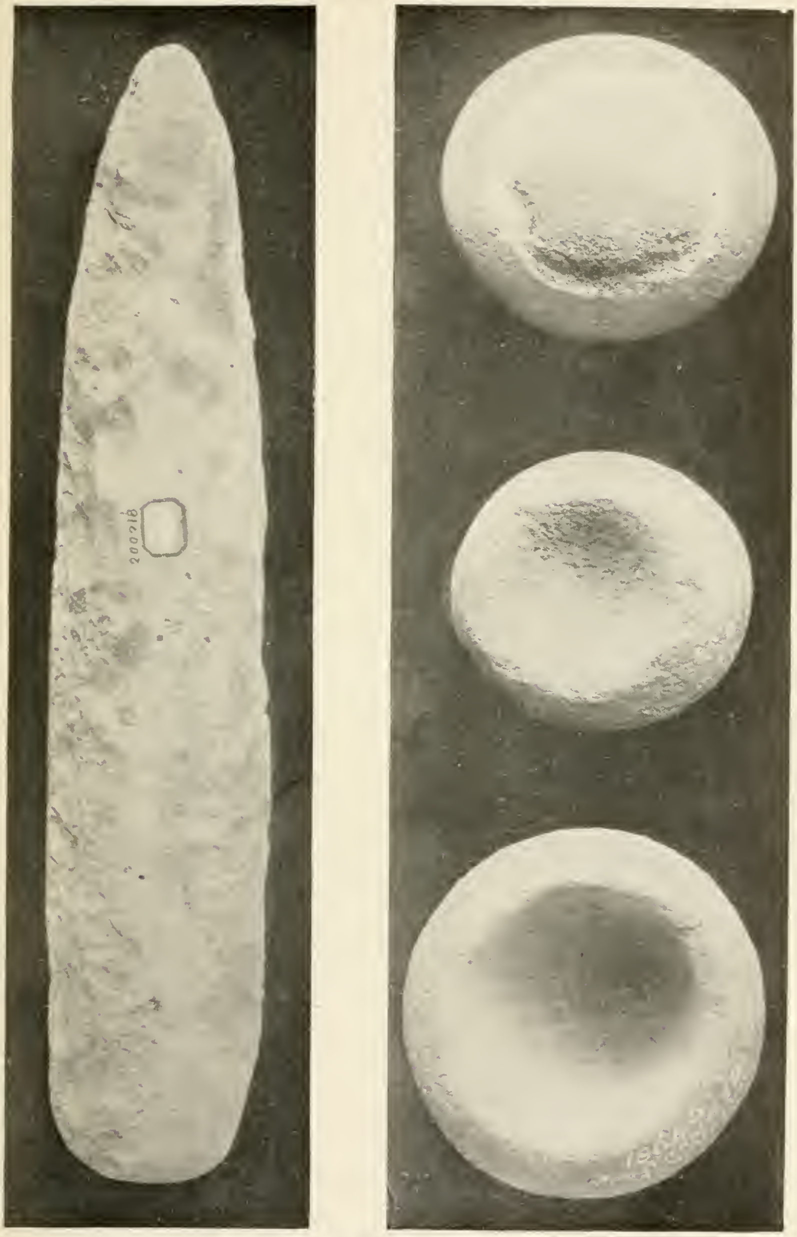
EXAMINING A GRAVE AT A SOAPSTONE QUARRY, SANTA CATALINA ISLAND.

A

B

VIEWS AT THE ISTHMUS, SANTA CATALINA ISLAND. ANCIENT CEMETERY OCCUPIED BY GROUP OF BUILDINGS.

A, Looking south; *B*, looking north.



Small Mortars, unfinished and finished, and unfinished Pestle.

Finished mortar $5\frac{1}{4}$ inches in diameter; pestle $16\frac{1}{2}$ inches in length.

Mr. E. L. Doran, of Avalon, who kindly carried me in his gasoline launch to this spot, that Banning Brothers, who own most of the island, have begun extensive improvements, changing the appearance of the place and obliterating the ancient cemetery. The houses in the view are situated on the village site examined so carefully by Dr. Paul Schumacher and reported upon by him in a number of publications. The site was covered by several feet of midden refuse composed of black earth and shells, and in which were many burials. It is clear that this site was extensively utilized by the natives, and that an important village stood here for a long period. It appears also that it was occupied at the time of the arrival of the whites and for a considerable period subsequently, as the graves contained many articles of iron and glass.

Numerous interesting details regarding the ancient remains of the island are given in a charming little book published by Mr. Charles F. Holder,[1] who has adopted the island as a home, and a map is presented in his work locating many village sites, cemeteries, and shell heaps. The evidences of occupation are so numerous and extensive that, as with the other islands of the group, there must have been formerly a large population, not differing essentially, however, in blood or culture from the people of the mainland.

Although soapstone was used so extensively on the islands and carried in great quantities to the mainland, other stones were not neglected, and sandstone especially was employed. In some cases, no doubt, it was cut from the living rock, but more commonly waterworn masses, already approximately shaped, were used. In some sections also concretionary forms were utilized, many of which were already rounded and hollowed out on one side, making the work of shaping easy. The manipulation of sandstone in the making of mortars and pestles is illustrated in Plate 50.

Mr. Horatio N. Rust, of South Pasadena, whose collections have already received attention, has had more or less intimate contact with a number of Mission tribes, and I prevailed upon him to visit the Coahuilas and other convenient communities for the purpose of making collections for the Museum. At Coahuila Mr. Rust called upon José Costa, prominent among the Indians of southern California. The family was found in a new wooden house, the old adobe residence having recently been destroyed by an earthquake. He found the old mother sitting under the brush shelter where she lives, making a basket. This, when finished, was purchased, and along with an unfinished specimen was forwarded to the Museum. In the collection also are specimens of the materials used. In making the better baskets she used a strong grass, which is scarce and much prized. It grows only high up

[1] Charles Frederick Holder, Santa Catalina, an Isle of Summer, San Francisco, 1895.

in the mountains. Mr. Rust found it on the banks of a small stream at Bergman post-office at an altitude of about 5,000 feet, growing in bunches like pampas grass and resembling that variety very closely. These people also make baskets of bulrushes which are dyed black. The rich brown mottling seen in many of the baskets is due to the natural color of the base of the bulrush, the upper stem being lighter in hue. Splints of a hard wood are also employed in basket making. A woman was seen reducing these to a uniform size by drawing them through a hole in a tin can cover, and often biting them into shape with her teeth. Children were learning to make baskets, and it appears that many more are manufactured than formerly, since ready sale is found for them. Southern California baskets are much coarser than those farther north in the State. They make rude baskets, from 3 to 5 feet in diameter and 3 feet high, of willow splints, in which they store grain, acorns, and other food products. These are placed upon scaffolds about 6 feet high, constructed by setting strong forked posts in the ground and laying poles across.

At Agua Caliente women were seen making pottery, and specimens were secured at Coahuila, Santa Rosa, and San Felipe. After grinding the clay in a mortar and kneading it they form the base of the vessel by placing a small portion upon a flat stone and bringing it into the desired shape with the fingers. When the base has assumed the form of a saucer they hold a smooth waterworn stone on the inside to support it, while with a smaller stone kept wet they rub the outside, curving the walls gradually upward; then drawing in the edge they form the neck by skillfully manipulating the clay with the fingers. To harden and even up the walls of the vessel they hold a smooth stone inside and beat the outside with a rude paddle. Specimens of the modeling tools were secured for the Museum. At Agua Caliente pottery is baked in an oven, to form which they dig into the side of a bank and line the walls with cow dung. The vessel is then introduced and covered with the fuel. When the fire is well under way they close up the opening and permit the vessel to remain until properly baked.

These people spin strong hempen and mescal cords by twisting the thread in the fingers. Next they hold the newly formed cord against the thigh and twist it under the palm of the hand. At Agua Caliente they make valuable saddle blankets of mescal fiber. These are woven on four stakes driven in the ground, the weavers sitting on opposite sides on the ground.

At Mallayhon Mr. Rust witnessed the spinning of hemp and the making of nets. The hemp is prepared by beating the ripened stems until the wood is thoroughly broken, when the bark fiber is separated and ready for spinning. The meshes of the net are tied about a stick held between the knees.

The dressing of deer skins required very simple devices. A smoothly shaved, flattish stick about 6 feet long was placed in a slanting position against a convenient tree. The skin was hung over the stick and held at the top by a peg, and the hair and flesh were removed by pressing the skin against the flat stick and scraping with an old iron drawing knife. The skin was first soaked in water until the hair and flesh were easily scraped off. In earlier times stone implements were used, the skin being spread on the ground or over a smooth rock. In finishing the Indians apply grease or brains and scrape and rub until soft.

The maguey or American aloe or mescal grows wild among th mountains of the California desert. To prepare it for food the Indians dig or cut out the bases of the stalks which bear the leaf stems. These vary from 6 to 20 inches in diameter. To cook them they dig a saucer-shaped pit from 10 to 20 feet in diameter, then set a large stone up in the center and pave the entire surface with smaller stones. Upon this they build a fire, mixing the mescal stumps and wood together and thus burn the woody fiber from the mescal. The smaller stumps are kept near the outside, and as they become sufficiently burned are thrown out, then the larger ones in turn. When they are done the mescal is piled about the central stone and covered with hot stones. Next they cover all with earth, allowing it to remain forty-eight hours. When the pile cools down the mescal is ready for use. Cooked specimens often measure 6 inches in diameter. The taste resembles that of sirup baked out of sweet apples. It is very agreeable food and will keep perfectly good for months.

Sometimes it is necessary to go a long way for wood to burn, and several families make their pits near together for the sake of company. When they have no metal they burn an ironwood of the desert and sharpen the end for a digging tool. The mescal is ready for cutting when it begins to send up its flower stalk. If the Indian can not cut and bake all he wants at the proper time he cuts out the growing flower stem, which checks the growth, and the plant keeps in this condition for months.

Acorns form an important article of food. The Indians crack them with the teeth or a stone, partly dry, then shell and dry again. When dry they are ground in stone mortars, then the fine flour is soaked in ollas to remove the tannin, and the mixture is poured into basins formed in the sand. For some days they pour water into the basins until the tannin is all filtered out; the flour settles in the sand basin as a thick paste. This is scooped up by hand and placed in an olla. Having thus secured the most of it without sand, they gather up the balance regardless of sand, put it in another olla, add water, stir it well, and pour off the paste, leaving the sand. In this way the "Byota" or acorn meal is prepared, sweet and wholesome, and much preferred by the Indian to our wheat flour.

THE MASTER OF THE HARPOON.

After E. W. Nelson.

ABORIGINAL AMERICAN HARPOONS:

A STUDY IN ETHNIC DISTRIBUTION AND INVENTION.

BY

OTIS TUFTON MASON,
Curator, Division of Ethnology.

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1874–1876. H. H. Bancroft. Native races of the Pacific States. New York, 1874–1876, 5 vols. (The bibliography in the first volume contains the titles of all early explorers on the west coast of America down to the time of publication.)

1888. Franz Boas. The Central Eskimo. Sixth annual report of the Bureau of Ethnology, etc. Washington, 1888, pp. 399–669, pls. ii–x, figs. 390–546. (Excellent bibliography of older writers.)

1890–1900. David Boyle. Reports on the Archæology of Canada. Toronto, Department of Education of the Province of Ontario, 1890–1900.

1877. William H. Dall. Contributions to North American Ethnology, I. Washington, 1877.

1887. Gustav Holm. Ethnologisk Skizze af Angmagsalikerne. Copenhagen, 1887, 1–164, 363–400 pp., 32 pls., map.

1891. P. Hyades and J. Deniker. Mission Scientifique du Cap Horn, 1882–1883, VII, Anthropologie, Ethnologie. Paris, 1891, 422 pp., 34 pls., map.

1894. A. G. Morice. Notes archæologiques, industrielles et sociologiques sur les Dénés occidentaux. Transactions of the Canadian Institute, 1894, 199 pp., figs.

1892. John Murdoch. Ethnological Results of the Point Barrow Expedition, etc. Ninth annual report of the Bureau of Ethnology. Washington, 1892 (1893). pp. 3–44, pls. i–xi, figs. 1–428. (Good bibliography.)

1899. E. W. Nelson. The Eskimo about Bering Strait. Eighteenth annual report of the Bureau of American Ethnology, Part I. Washington, 1899, 518 pp., 107 pls., 165 figs., map.

1888. A. P. Niblack. The coast Indians of southern Alaska and northern British Columbia. Report U. S. National Museum, 1888, pp. 225–386, pls. 1–70, figs. 1–297, map.

1891. J. W. Powell. Indian linguistic Families of North America. Seventh annual report of the Bureau of Ethnology. Washington, 1891, 1–142 pp.

1877. Stephen Powers. Tribes of California. Contributions to North American Ethnology, III. Washington, 1877, 635 pp., figs., maps.

1898. Frank Russell. Explorations in the far North, being a report of an expedition under the auspices of the University of Iowa. 1898, 290 pp., pl., map.

1894. Karl von den Steinen. Unter den Naturvölkern Zentral-Brasiliens. Berlin, 1894, 570 pp., 145 figs., map.

1900. James Teit. The Thompson River Indians of British Columbia. Memoirs, American Museum of Natural History, New York, II, Anthropology, I, 392 pp., pls. xiv–xx.

1883. Edward F. Im Thurn. Among the Indians of Guiana: being sketches, chiefly anthropologic, from the interior of British Guiana. London, 1883, 445 pp., 53 illustrations, and a map.

1894. Lucien Turner. The Hudson Bay Eskimo. Eleventh annual report of the Bureau of Ethnology, pp. 159–350, pls. 26–43, figs 121–155. Washington, 1894. (Edited by John Murdoch.)

ABORIGINAL AMERICAN HARPOONS:
A STUDY ON ETHNIC DISTRIBUTION AND INVENTION.

By Otis Tufton Mason,
Curator, Division of Ethnology.

INTRODUCTION.

The aborigines of the Western Hemisphere were intimately associated with the animal world. Their methods of taking animals for their activities were as follows:

1. Gathering without devices.
2. Gathering with devices.
3. Striking, stunning, bruising.
4. Slashing with edged weapons.
5. Piercing, by stabbing, by thrusting, by hurling, or by shooting.
6. Taking in traps or blinds.
7. Hunting by means of other animals.
8. Capturing with light, fire, and smoke.
9. Overcoming by asphyxiation, poisons, and drugs.

In piercing devices the ends proposed are two, namely, to reach some vital part, and hence to kill instantly, or to insert a barb or toggle under the skin and thereby retrieve the animal. These piercing devices may be divided into three subclasses, namely: Those with a smooth blade, called lances, for stabbing; those whose blades or working part have barbs on the sides for retrieving as well as piercing, and the harpoon subclass with movable head. A harpoon is a piercing and retrieving device with a movable head. Few other inventions of savagery show better the progress of thought in devising means for overcoming difficulties than the harpoon. In order to differentiate this implement from others of the piercing type, let it be understood that the head is always set loosely on the end of a shaft, to which it is attached by means of a line. Even when shot from a bow, missiles having this structure are called harpoon arrows. Every part of the harpoon, by its dimensions and form, by its presence or absence, or by its material and attachment, lends itself to classification in the studies of progress concerning the apparatus itself and its geographic distribution.

Between the sharpened stick or bone, which wounds by piercing and which is the fundamental device of all lanceolate weapons, and the harpoon, there are one or two intermediate forms among the Eskimo usually associated with the harpoon. They may be called the hinged lance head and the detachable lance head. In the first named the ivory or bone piece, into the front of which the leaf-shaped blade is set, is at its other extremity hinged to the foreshaft, like the loose shaft of a whale harpoon. The detachable lance head has a handle or tang of wood about a foot in length and less than an inch in diameter. On the front is set a leaf-shaped or a triangular blade, and the conical base of the tang fits into a socket in the end of the heavy shaft. In some examples there is an ivory barb projecting from the handle near the blade, which is a spear characteristic, but in this instance it was designed to retrieve the lance head and not the animal. E. W. Nelson figures and describes a great variety of these.[1] He says in relation to them that they are used when the seal or walrus has been disabled so that it can not keep out of reach of its pursuers, and the hunter paddles up close alongside and strikes the animal, driving the detachable head in its entire length. The head remains in the animal, and the hunter immediately fits another point into the shaft and repeats the blow, thus inserting as many of the barbed heads as possible, until the animal is killed or the supply of points exhausted. Every hunter has his private mark cut on these points, so that, when the animal is secured, each is enabled to reclaim his own. These lances are companions of harpoons, and examples will be shown in their proper connection.

The manner of functioning with the harpoon will be considered only incidentally here, inasmuch as there is abundant literature on the subject prepared by those who have been eyewitnesses of its action (see frontispiece). For the Eskimo the student may consult Dall (1877), Holm (1887), Boas (1888), Turner (1894), Murdoch (1892), and Nelson (1899). The older writings are abundantly quoted in these, and the titles of authorities for the western Eskimo will be found in H. H. Bancroft (1874–1876). It is with pleasure here acknowledged that the careful observations of these explorers on the spot have made possible this comparative study.

PARTS OF THE HARPOON.

The fundamental or ideal parts of the harpoon are head, loose shaft, foreshaft, shaft, ice pick, line, and float. These parts rarely all coexist in a single specimen, but the Eskimo have them all on their various harpoons, while each part also takes on a multitude of forms and itself is often quite complex. Besides these fundamental parts, there are also a number of accessories, which will be considered in their places.

[1] The Eskimo about Bering Strait, 1899, pp. 145–148, pl. LVII.

There are two varieties of harpoons, based on the shape of the head—the barbed and the toggle; but the former or simpler passes insensibly into the latter. Barbed harpoon heads are attached to the shaft by means of a connecting line tied to the butt or tang of the head, and may be used on animals with tough hides (see fig. 12). The toggle harpoon head is attached to its line or sling by its middle, the head is driven entirely into the animal, and toggling under the skin gives the firmest possible hold (see fig. 1). It will give the best idea of the apparatus to take up the parts of the harpoon in order, and after that to study the question of distribution.

PARTS OF THE BARBED HARPOON.

The parts of a complete barbed harpoon are barbed head, foreshaft, shaft, line, feather, and bladder (Plates 8, 9, 11, 16, 17, 18, and 19).

Barbed head.—The head of a barbed harpoon is a piece of wood, bone, antler, ivory, shell, or metal, with tooth-like projections from its margins pointing backward, so that it may pierce the hides of animals but can not be withdrawn. Its action is to ratchet and retrieve the game. The parts of a barbed head may be referred to as point, body, margins or edges, sides or faces, barbs, line hole or groove, and tang (see figs. 13, 18 and 81). As to position the barbs are unilateral or bilateral. The unilateral may be from one to many. Bilateral barbs are sagittate, alternate, or opposite. The tang is wedge-shaped, conical, or spindle-shaped, and in relation to the connecting line is roughened, notched, bulbous, or pierced.

Foreshaft.—The foreshaft of a barbed harpoon is a more or less cylindrical or pear-shaped piece of heavy material, bone or ivory, fitted on to the end of the shaft, and having a socket in front to receive the tang of the barbed head. In the rudest harpoons, such as the Fuegian, nothing of the kind exists. In some examples the foreshaft is elaborately carved in imitation of the heads of aquatic animals. The attachment of the foreshaft to the shaft is by means of a splice, a wedge-shaped tang and kerf, a socket in the shaft fitting a projection on the foreshaft, or a socket in the loose shaft fitting a projection on the shaft.[1] There is no other part of the mechanism which taxed aboriginal skill more than the joint between shaft and foreshaft. The socket in the front of the foreshaft for the tang of the barbed head has inserted in it a plug of wood having a small cavity into which the tang of the head fits loosely. The loose shaft and the shaft are bound fast together with sinew twine or fine rawhide line, the many ingenious knots appearing in the drawings (see fig. 83).

Shaft.—The shaft of a barbed harpoon is of wood, generally rigid, but of light weight. In length it varies from a few inches to many

[1] E. W. Nelson, The Eskimo about Bering Strait, 1899, pl. LVII *b*, figs. 33, 34.

feet; in thickness, from one-fourth of an inch to more than one inch. Its front end may be fitted to a foreshaft, but in the most primitive examples there is a rude split or a mere cavity dug for the tang of the barb. The manual or inner end of the shaft varies in form, being either tapering and without function, or fitted to receive the hook of a throwing stick, or notched for a bowstring, or having an ice pick of hard material securely fastened to it.[1] When not projected from a throwing stick or shot from a bow the barbed harpoon is held in or hurled from the hand. In that event hand rests or offsets are lashed to the shaft near the center of gravity.[2]

Connecting line.—The connecting line of a barbed harpoon at first was only a bit of string or thong uniting the head to the shaft. If there be no connecting line between head and shaft, the weapon is called a rankling arrow, because the head stays in the animal and causes death. However, the rude Fuegian inventors have gotten beyond that, for the thong is carried halfway down the shaft and made fast here and there with knots. The same happy thought is called by Murdoch an "assembling line," since it serves in case of a break in the shaft to save the pieces. In the larger harpoons and the more delicate ones the assembling line is a separate affair. The line of the more complicated barbed harpoons is fastened at one end through the line hole of the head. The other end is bifurcated, like the martingale of a bridle, or a kite string. One end of this martingale is tied to the shaft near the foreshaft, the other near the butt end of the shaft. When the harpoon is ready to be hurled the line is neatly rolled on the shaft, the head is placed in its socket, and a slipknot around the shaft takes the slack in the line. When the game is struck the head is pulled from its socket, the slipknot is released, and the line unrolls. The foreshaft being of bone, drops lowest in the water, so that the shaft acts as a drag. It serves also as a buoy, since the upper end, especially when feathered, bobs about over the water and shows the position of the game.

The feathering of the barbed harpoon is that of the arrow. Looking at this characteristic from the southward, the occurrence of feathers on the shafts of harpoons in lower Bering Sea is not abnormal. The float of the barbed harpoon is a small inflated bladder, stomach, or intestine attached to the side of the shaft, helping to keep the latter erect in the water. These structural elements are much more highly developed in the toggle series now to be studied. The barbed harpoon is of especial interest to the archæologist, who finds heads of bone or antler with holes and knobs or grooves for attaching the connecting line and every variety of barb, in both shell heaps and cemeteries throughout Canada and the United States.

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[1] The Eskimo about Bering Strait, 1899, pl. LIV and LV.

[2] Idem., pl. XLVII *b*, figs. 31–32.

PARTS OF THE TOGGLE HARPOON.

Toggle head.—In describing a toggle harpoon head it is necessary to orient it, not that the Eskimo is known to have held any portion of the apparatus uppermost habitually, but for the sake of convenience in comparing different types and styles. However, Captain Herendeen informs the author that so far as his personal observation goes the barb of a toggle harpoon head, like the cock feather in an arrow, is held uppermost. (See fig. 1.)

To orient a toggle it must be placed with the barb or spur at the rear end uppermost, the point away from the observer. It will then be possible to speak of the top, back, or upper side; of the bottom, belly, or under side; of the right margin and the left margin; of the front or point; and of the butt end or rear. In those large examples, wherein there are right and left barbs in the rear, with the blade in the plane of the widest diameter of the body (Cat. Nos. 45947, 63948, 53950, figs. 34–50), the top may be distinguished from the bottom by means of the line hole, which runs in a bent course through the body.

The parts of a toggle head have been discussed by Mr. John Murdoch.[1]

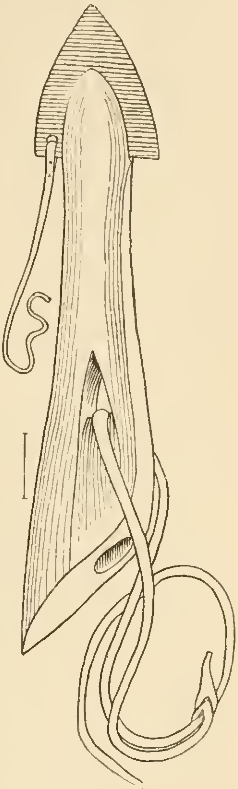


Fig. 1.
TYPE FORM OF TOGGLE HEAD.
Hudson Bay.
Collected by Ludwig Kumlien.
Cat. No. 25654, U.S.N.M.

When the toggle head is oriented it will be seen that it is possible to speak of the following parts: Body, blade, blade slit or kerf, line hole, line grooves, barbs (side and rear), socket for loose shaft, butt or rear end of the body, loose shaft, blade line, loose-shaft loop or running loop, head line or leader, ornamentations, and owner marks. Each one of these parts should be described and even its absence noted. The characteristics of these parts are as follows:

Body.—Its material, shape in outline and section, and dimensions.

Blade.—Its material, shape, relation to the body, whether a part of it or not; orientation, whether vertical or horizontal in the plane parallel with the line hole or across it.

Blade slit or kerf.—Whether saw cut or coarse; its orientation. The blade cover is frequently a case or cover for the entire toggle head.

[1] Ninth Annual Report of the Bureau of Ethnology.

Line hole.—The opening through the body of the toggle head for the rawhide sling or leader on which the toggle head hinges. In very modern examples and in the heads of small seal harpoons the hole is bored straight through, but in old specimens two much coarser holes are bored, one from each side of the belly inward and upward, meeting midway. All sharp edges within and without are carefully smoothed and rounded to protect the line and to facilitate the toggling. The points to be considered concerning the line hole are the shape, size, and method of boring, and its position with reference to the other parts of the toggle head. Line holes run directly through the narrow body type, but in a curved path through the belly of other types. In a few abnormal specimens it stands vertical, but in the great majority of examples it goes horizontally across the body. Holm figures toggle heads from east Greenland, in which the head is hinged to the foreshaft by means of a rivet.

Line grooves.—Gutters or channels extending backward from the line hole in which the rawhide line lies out of the way. In fact the line grooves are backward extensions of the line hole. Their width and depth have relation to the width and thickness of the rawhide line used. In old specimens they are wider and clumsier.

Barb or spur.—The projection backward in a toggle head at its butt end has for its function to catch into the flesh of the animal beneath the skin, so as to revolve the head ninety degrees, and thus to effect the toggling of the head in the wound, as in the fastening of a trace chain. In its way it is as important as the blade, and it will be seen that quite as much ingenuity has been spent on this part as on any other. If, for example, when the animal is struck, the spurs of the rear barb were covered by the rawhide line the head might not toggle; hence, in a toggle head of the old-fashioned type the line hole lies below the center of the mass. The entire projection of the toggle head back of the line hole may be called the spur to distinguish it from marginal barbs also sometimes present.

Shaft socket.—The socket is a conoidal excavation in the butt end of a toggle head, into which the forward end of the shaft or loose shaft fits loosely. It will be readily understood that the socket is centered as exactly as possible. There is little or no variation in this part except of size and neatness. When the toggle head has been thrust into a beast the foreshaft or the loose shaft must be withdrawn in order to allow the weapon to do its work.

Butt.—The butt or rear end of a toggle head is shaped in relation to the barb especially and also to the socket. In fact, the upper portion of the butt end is a part of the barb or spur. The exact method of shaping and treating this part seems to depend largely on the material, whether ivory, antler, or bone. The first named is solid, and the butt is acute angled above and sawed off square below. The other materials have more or less of spongy core or are hollow. In such examples the butt is mitered off with the acute angle at the barbs, and then scooped out and dished about the socket.

Blade line.—This is wanting in a great many examples. It is a little twine of sinew extending from the inner left-hand corner of the blade, where it is looped into a small perforation, backward to the first wrapping of the leather sling or leader.

Leader or sling.—The toggle sling is a loop of rawhide thong or sinew twine, a foot, more or less, in length, passing through the line hole of the toggle head at one end and at the other end attached to the main line by means of a splice, toggle, or clasp, to be described later. The two ends of this sling are spliced or joined after the neatest and most elaborate Eskimo styles. At one or more points the two sides of the loop are carefully united by wrapping (fig. 83). In the collections of the U. S. National Museum the smaller harpoon heads with leaders are accompanied with sticks of pine wood on which the apparatus is kept stretched when not in action (fig. 84). In the great harpoons, as will be learned in the description of the line, there is no leader or sling to the toggle head, which is hinged at once onto a bend in the end of the main line. Without the hinging line the movable head is only a rankling device. For instance, the loose head of many South American arrows, formed of a socketed bone of a monkey, remains in the wound, but not being attached to a line for retrieving it is not a harpoon head. The step between the two, however, is but a short one.

Loose shaft.—The part of a toggle harpoon which, at its forward end, fits into the socket of the head and in some way is hinged or joined to the foreshaft at its hinder end, as seen in figs. 2, 48, is called the loose shaft. The two varieties are the spindle-shaped and the conoidal. The former is joined on to the leader or sling of the toggle head by a running loop or grommet (fig. 83); the latter is strapped to the end of the shaft by a rawhide thong, and makes a ball-and-socket joint (fig. 49). In either case the body of the loose shaft is perforated with one or more holes. When the toggle head is in place on the loose shaft the line is drawn taut, so that the loop or bone eyelet on the line may be buttoned over its peg on the shaft (fig. 79).

Writers on the Eskimo harpoon say that the kneejoint between the loose shaft and the foreshaft is to prevent the accidental breaking of the shaft. Captain Spicer gives additional functions to this structure of the implement. He says that it aids in the shipping and unshipping of the toggle head with reference to the loose shaft after the eyelet on the line is over its peg on the shaft. When an Eskimo hunter would prepare his harpoon for striking, he puts the eyelet which is attached to the line over the peg on the shaft, sets the loose shaft at an angle in the socket of the shaft, puts the toggle head in position, and straightens up the loose shaft. This brings all taut for the stroke. As soon as the game is struck the shaft is pulled to one side by the movements of the animal, the loose shaft comes out of its socket and detaches itself from the toggle head. This enables the hunter to pull away his shaft easily and instantly.

Foreshaft.—The foreshaft of a harpoon is the working end of the shaft, and is usually a block of bone or ivory neatly fitted on. Foreshafts vary in material, being of antler, bone, ivory, or metal; in size and shape, from the delicate front of the sea-otter harpoon to the clumsy variety on the Greenland whaling harpoon; in the mode of attachment to the shaft, in the socket, and lashing for the loose shaft (see Plates 6, 8, 9, 10, 12, 15, and 18).

Fig. 2.
LOOSE SHAFTS OF TOGGLE HARPOONS.
Cumberland Sound.
Collected by Ludwig Kumlien and Lucien Turner.
Cat. Nos. 90165, 2991, 34098, 34063.
After Franz Boas.

Shaft.—The shaft of the harpoon is of wood; in treeless areas, of driftwood, but in the north Pacific it is a long, slender pole of cedar. For the purpose of study, shafts have to be considered in relation to materials, shapes, and sizes; to hand stops or rests for thrusting; to line pegs, throwing stick pegs, assembling line, etc. For catching sea-otter the dart shaft is half an inch in diameter and 4 feet long, while some of the clumsy Greenland examples are 2 or 3 inches in diameter, and the east Greenland deep-water variety and sled variety for killing on the ice at a distance have shafts many feet in length, requiring two men to work them.

The shaft has the double function of stabbing and retrieving. For the former (1) it may be thrust at the victim, in which case, in order to give a firmer grasp, a projecting piece of wood or bone or ivory is fastened near the center of gravity to stop the hand. Near this is frequently found a peg, over which is hooked the line to hold the head firmly on to the loose shaft. (2) It may be thrown as a javelin from the hands. (3) It may be hurled from a throwing stick. This method will be more fully described in a special paper. The series begins with the plain shaft, and includes the hand-rest type, the throwing stick type, the Giliak long pole and floating-head type, the east Greenland sled-point type, the east Greenland deep-sea shaft type, and the Amazon type, in which the throwing stick is cast overboard.

By the function of retrieving is meant recovering the game after it has been struck. For this purpose the shaft is in many cases thrown overboard, and, being attached by one end of the line, while the other is tied to the harpoon head in the animal, acts as a drag and a buoy to impede the progress of the animal and to show its position.

Ice pick.—On the butt end of the harpoon shaft may be found, in arctic examples, a long ivory pick for enlarging a hole in the ice in order to remove the game. This is replaced with a boat-hook arrangement in others. Types of the butt end of the shaft exist in the forms following:

1. The plain butt, without function.
2. The feathered end, akin to the arrow.
3. The socketed end, for throwing stick.
4. The Greenland type, with ivory feathering.
5. The pick.
6. The carved pick, Nunivak type, on lances with loose heads.

Nansen[1] traces the elaborate Greenland harpoon shaft, with its many accessories, thus:

1. The Indian arrow, with its variety of feathering.
2. The feathered harpoon darts in southeastern Alaska.
3. Farther north the disappearance of the feather and the occurrence of the small bladder on the shaft.
4. The harpoon, with line and skin float, the last named being detached from the shaft and attached to the head.

Line.—The line of the harpoon also has had its peculiar elaboration, answering to external exigencies and opportunities on the one hand, and to the ingenuity of the savage on the other. The Fuegian sinew thread, a few inches long, is far away from the Greenland whale line, and a series would take some such order as the following:

1. The Fuegian type, short sinew cord tied around both the head and the shaft.
2. The western Eskimo type, line tied to head and middle of shaft.
3. Martingale type, attached to shaft in two places.
4. With skin float, head fastened to line.
5. Entirely separate, with ivory or bone toggles for fastening to the leader strap of the head and to the float.

The harpoon line developed a deal of ingenuity in the textile art. Shredded sinew, thread, twine, and braid or sennit are in demand constantly. Rawhide line in great variety is also a necessity.

[1] Across Greenland, London, 1890, II, p. 260.

Here also originated the whole scheme of knots and splices, as will be abundantly shown in the illustrations that follow. The Eskimo made a button or frog on the end of a rawhide line by cutting a slit near the end and doubling the end back through the slit. They were extremely neat and skillful in fastening off lashings. Boas and Murdoch have given special attention to the Eskimo knots.

Fig. 3.
EYELET ON HARPOON LINE.
Cumberland Sound.
Collected by Ludwig Kumlien.
Cat. No. 34123, U.S.N.M.
After Franz Boas.

With the line, in its highest estate, go certain accessories, such as the eyelet, for making fast to a peg on the shaft (fig. 3), the line rack on the kaiak, and a multitude of ingenious inventions which Nelson calls "detachers," since they make it possible in the frozen Arctic for the hunter to take his apparatus apart under the most trying circumstances.

In order to prevent the line from getting out of order, a swivel is sometimes used. One brought from Cumberland Sound by Kumlien and described by him is represented in fig. 4. There was a ball in the hollow body of this instrument, which could not be pulled through any of the openings. One line was fastened to this ball, passing through the central hole, and another one to the top of the swivel. A simpler pattern is represented by Boas,[1] in which the ball in the socket would be a spherical knot on the end of the line.

Floats.—The sealskin bag used as a float on the end of the line of the harpoon for killing whale and beluga is in Unaleet ăgaŭ ŭk, bag; in Malemut Ăÿgt nŭk; the float, in both dialects, is Ōă tuk. Nelson describes two sizes. The smaller one is fastened to the line after the beluga has become unable to struggle much. The large float which has tired the beluga is at the end of the line. This small one is gradually slipped nearer by the man in the kaiak until it is distant 4 or 5 feet, when the *coup* is made and the prey secured. Boas describes and figures examples from Cumberland Sound (figs. 5, 6).

Fig. 4.
LINE SWIVEL.
Cumberland Sound.
Collected by Ludwig Kumlien.
Cat. No. 34121, U.S.N.M.
After Franz Boas.

By far the largest floats in the U. S. National Museum collection are those of the Aht or Nutka whalers off Vancouver Island. The skin of a seal is taken off whole, making a float 3 feet long and 2 feet wide.

Line rack.—Of the rack on the kaiak in front of the hunter (Unaleet, Achal ook; Malemut, A shal odk) for holding the rawhide line, Nelson

[1] Sixth Annual Report of the Bureau of Ethnology, p. 481.

says that the line is coiled on it with harpoon attached to one end and the large float to the other end, and lightly fastened back of the hunter. When the line has nearly run out the float is thrown overboard. The rack is fastened to the kaiak with grass strings, so that, should the line

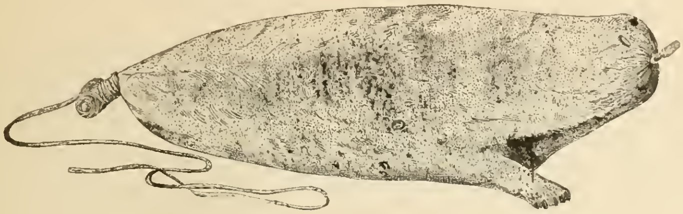


Fig. 5.
SEALSKIN FLOAT.
Cumberland Sound.
Collected by W. A. Mintzer. Cat. No. 30009, U.S.N.M.
After Franz Boas.

become entangled, the rack would be easily torn away without upsetting the craft. (Plate 14.) It would then act as an impediment to the progress of the animal.

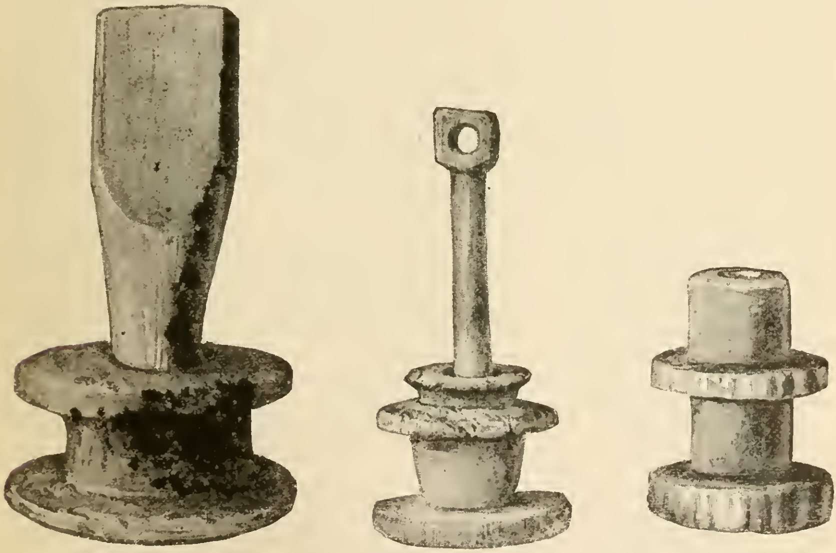


Fig. 6.
MOUTHPIECES TO FLOATS.
Cumberland Sound.
Collected by W. A. Mintzer and Ludwig Kumlien. Cat. Nos. 29986, 34118, 34119, 34120, U.S.N.M.
After Franz Boas.

In the accompanying plate (after Nelson) will be seen a great number of harpoon parts just mentioned. (Plate 1.)

16125. Small toggle harpoon head with stone blade and leader of rawhide done up on a short piece of wood. The cap belonging to this head is shown above. Nunivak Island. William H. Dall.

33465. Finger rest for harpoon, triangular in form and ornamented with a carving of a seal in low relief. Fastened on to a shaft by means of a lashing through three perforations. St. Michael. E. W. Nelson.

33632. Toggle head of a walrus harpoon of late pattern, since the carving is mechanical in outline. Norton Sound. E. W. Nelson.

33641. Finger rest for harpoon shaft in form of a bird's beak, fastened on to the shaft by a lashing through three perforations. Norton Sound. E. W. Nelson.

36097. Foreshaft of seal harpoon, cylindrical in form, showing wedge-shaped notch and the method of attachment to the end of the wooden shaft. Big Lake. E. W. Nelson.

37377. Toggle head of a walrus harpoon with stone blade, showing the method in which the leader of rawhide is attached to the loose shaft by means of sinew thread. Chalitmut. E. W. Nelson.

37417. Foreshaft of bone carved in shape of an animal's head and showing the method of attaching the foreshaft to the wooden shaft. Anagogmut. E. W. Nelson.

37671. Finger rest of bone, with triangular perforations for lashing to the wooden shaft. Kongigumogumut. E. W. Nelson.

38529. Slate blade of harpoon head. Lower Yukon. E. W. Nelson.

43461. Bone head of barbed harpoon for seals. Tang, wedge shaped; line hole, oblong; four barbs, all on one side. St. Michael. E. W. Nelson.

43865. Finger rest for large seal spears. In form of a seal's head; hole for lashing, triangular. Unalakleet. E. W. Nelson.

44077. Barbed head of large seal harpoon. Tang, wedge shaped; hole, circular; barbs, three on one side and two on the other. Mouth of Koyuk River. E. W. Nelson.

44405. Ice pick of ivory for end of large harpoon. Fastened by lashings through four perforations. Cape Nome. E. W. Nelson.

44421. Barbed head for seal harpoon. Line hole, oblong; barbs, two on one side and one on the other. Cape Nome. E. W. Nelson.

44699. Toggle head of seal or walrus harpoon, complete, with slate blade. Sledge Island. E. W. Nelson.

44703. Loose shaft of seal and walrus harpoon. Butt squared off and having a small spindle-shaped projection fitting in a socket on the top of the foreshaft. Sledge Island. E. W. Nelson.

44746. Iron head of seal and walrus harpoon. Sledge Island. E. W. Nelson.

44812. Finger rest for large harpoon. Sledge Island. E. W. Nelson.

45170. Finger rest for large harpoon. Sledge Island. E. W. Nelson.

45171. Finger rest for large harpoon. Sledge Island. E. W. Nelson.

45173. Cord fastener for large harpoon. Sledge Island. E. W. Nelson.

48276. Barbed head for harpoon. Nunivak Island. E. W. Nelson.

48293. Finger rest for large spear. In shape of a boat's rudder, set on by lashings around the shaft through three perforations in the rest. Nunivak Island. E. W. Nelson.

48471. Toggle head for harpoon (toy). Kegiktowik. E. W. Nelson.

48820. Slate blade of toggle harpoon head. Rasbonisky. F. W. Nelson.

63334. Old barbed and toggle head, for seal, combined, showing the method of providing shaft socket by lashing. St. Lawrence. E. W. Nelson.

63497. Foreshaft of barbed harpoon for seals. It fits into a wedge-shaped notch in the end of the shaft. St. Lawrence. E. W. Nelson.

63842. Finger rest. Head and neck of seal carved out from the material, probably antler. Attached by lashing to the thin, graft-like portion to the shaft. Point Hope. E. W. Nelson.

63843. Finger rest, Point Hope. E. W. Nelson.

63844. Finger rest, Point Hope. E. W. Nelson.

126812. Ice pick for harpoon. St. Lawrence. E. W. Nelson.

ACCESSORIES TO THE HARPOON.

After E. W. Nelson.

ACCESSORIES TO THE HARPOON.

Besides the hundred and one parts of the harpoon immediately attached to it there are unlimited accessories which have been called into existence at its demands. The hunter has a peculiar costume which he puts on when he goes harpooning. Certain kinds of food are demanded; a multitude of charms and lore are inseparable from the implement. In addition, the hunter takes along several devices to gain information, to decoy the game, and to add to his own comfort. All about the American coast where great fish or mammals existed the water craft were improved immensely. The Nutka dugout canoes and the Eskimo kaiak are unrivaled, and they are the ministers of the harpoon. In like manner the sled, the dog, the harness, the shifting tent owe their forms and usefulness to the ingenious mind which devised and perfected the harpoon, which is no doubt the most virile of all savage inventions.

Sometimes a small implement is used in the hunt to indicate the approach of the seal. It is called qipekutang, and consists of a very thin

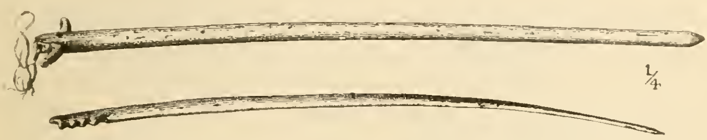


Fig. 7.

SEAL INDICATORS.

Point Barrow, Alaska.

Collected by P. H. Ray. Cat. No. 56507, U.S.N.M.

After John Murdoch.

rod with a knob or a knot at one end.[1] It is stuck through the snow, the end passing into the water, the knob resting on the snow. As soon as the seal rises to blow, it strikes the rod, which, by its movements, warns the hunter. Generally it is made of whale's bone. Sometimes a string is attached to the knob and fastened by a pin to the snow, as its movements are more easily detected than those of the knob. The natives are somewhat averse to using this implement, as it frequently scares the seals.[2]

When watching for a seal at his breathing hole, the Point Barrow native inserts into the hole a rod of ivory. When the seal rises, it pushes up this rod and thus warns the hunter when to shoot or to harpoon[3] (fig. 7).

The sealing stool is a small triangular plank with three short legs, on which a hunter squats when watching at a seal hole, where fre-

[1] Parry, Second Voyage, II, p. 550, fig. 20.

[2] Sixth Annual Report of the Bureau of Ethnology, p. 478.

[3] Murdoch, Point Barrow Expedition, p. 255, fig. 255.

quently he has to stand for hours motionless on the ice.[1] Murdoch makes the important statement that this device is not found elsewhere save at the Mackenzie mouth and in arctic Alaska (Robert MacFarlane's notes). Egede describes and figures a "sort of one-legged chair and a footstool." Also Cranz (fig. 81).

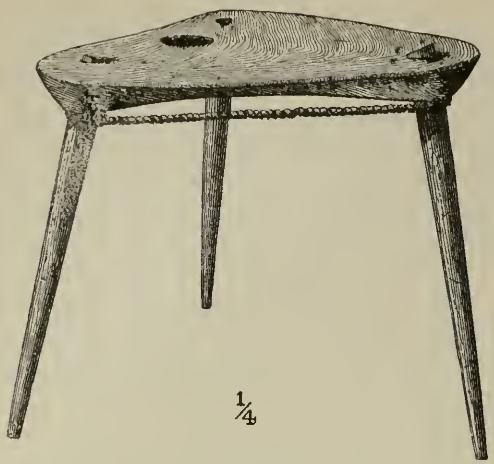


Fig. 8.
SEALING STOOL.
Point Barrow, Alaska.
Collected by P. H. Ray. Cat. No. 89887, U.S.N.M.
After John Murdoch.

Cat. No. 38754 (fig. 9) is an apparatus for joining the two parts of a harpoon line; it may be the leader attached to the line hole through the head or it may be on an extra line used to lengthen the distance between the head and the float. A collection of these from different areas would form an interesting study. The extreme cold of the region, stiffening the line and freezing the hands of the fisherman, makes it necessary to have some device which renders the rapid shipping and unshipping of the line certain and easy. In the example here shown the detacher is carved in the shape of a seal's head. The leader passes through the hole drilled in the neck of the animal, while the line to be attached is looped and pushed through the mouth of the seal, around a stud on top of the head, and hooked. While this attachment is secure enough where there is a steady strain, the hunter has only to push the loop backward, when it relieves itself from the button or stud and can easily be withdrawn. Especial attention is called in this example to the neatness with which the frapping is done on the rawhide thongs, the whale carved on the under side of the

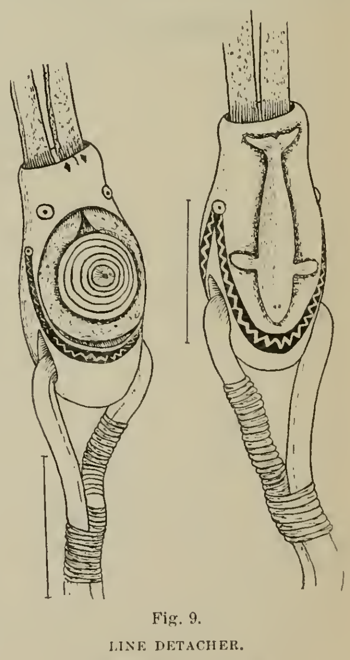


Fig. 9.
LINE DETACHER.
St. Michael, Alaska.
Collected by E. W. Nelson. Cat. No. 38754, U.S.N.M.

[1] Point Barrow Expedition, 1892, p. 255, fig. 256.

object, the curved line or serrate ornament, the owner mark on the back of the head, and the existence of the dot and circle ornament for eyes and on the button or side.

Figures 40 and 41, pages 144 and 145, in Nelson (1900), are good illustrations of this type.

Cat. No. 45060 (fig. 10) in the U. S. National Museum is a seal decoy from Sledge Island, collected by E. W. Nelson. It consists of a handle of pine wood rudely carved at the butt end to resemble the face of a seal, and at the other end into three prongs. Upon each one of these prongs is fitted a toe of a seal so that the three points will touch the same surface. Around each of these is wrapped, by half hitches, a continuous thread of sinew and loops passing around a jog or projection on the end of a stud in the handle just where it is pronged. This stud, of walrus ivory, has carved at the other extremity the head of a seal, the eyes, ears, and nostrils indicated by insertions of black substance like whalebone. The use of this, it is said by those who have traveled in Alaska, is to scratch upon the ice in order to imitate the noise made by the male seal and thereby attract his mate. On hearing the noise above, the seal that is under the ice comes to the breathing hole and is soon dispatched by the hunter.

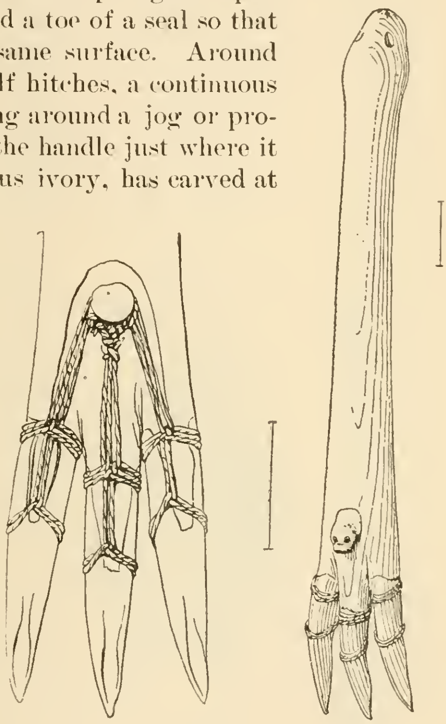


Fig. 10.
DECOY FOR SEAL.
Sledge Island, Alaska.
Collected by E. W. Nelson. Cat. No. 45060, U.S.N.M.

The ice scoop, an accessory to the harpoon, found all over the arctic regions, is shown in fig. 11, *a* and *b*. The first example, fig. 11*a*, is from the Amur region; 11*b* shows a similar device from Cape Nome, Alaska, south of Bering Strait. After the seal is struck with the harpoon down through the small breathing hole, it is necessary to enlarge the opening in order to withdraw the body of the animal. This is done with the pick on the butt end of the harpoon. As soon as the opening is large enough the hunter proceeds to remove the broken ice at once by means of a scoop, the essential parts of which are the handle, the bow, and the webbing. In the example from Schrenk here figured the very primitive way of attaching the spoon to the handle is worthy of notice. The spoon is kite-shaped in form, the butt ends crossing and lashed to the handle a little above the lower ends, which rest underneath a short bit of wood or across the spoon at either end by means of a rawhide thong. The examples of this apparatus are figured in Nelson, Murdoch, and Boas.

Among the accessories to the harpoon, the throwing stick or board, called atlatl by the Mexicans, must not be omitted. True, the cunning device was used all around the Pacific Ocean and across the Arctic for projecting spears as well as harpoons, and there are other methods of using the harpoon effectively; but the elaboration of the atlatl throughout was greatly stimulated by association with the harpoon. The proper discussion and illustration of this accessory, however, would far exceed the limitations of this article, and will therefore be reserved for a separate paper. A map showing the distribution of the atlatl in the Western Hemisphere would be marked on Greenland, Labrador, Baffin Land, Mackenzie River, all about Alaska to British Columbia, Santa Barbara, cliff dwellings of the Colorado, throughout Mexico, Central America, Florida, Colombia, the Orinoco, and the Amazon on several of its great tributaries, especially in the Mato Grosso.

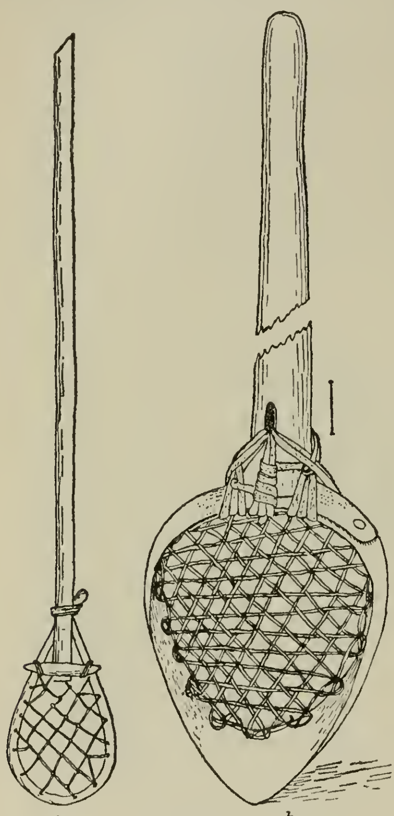
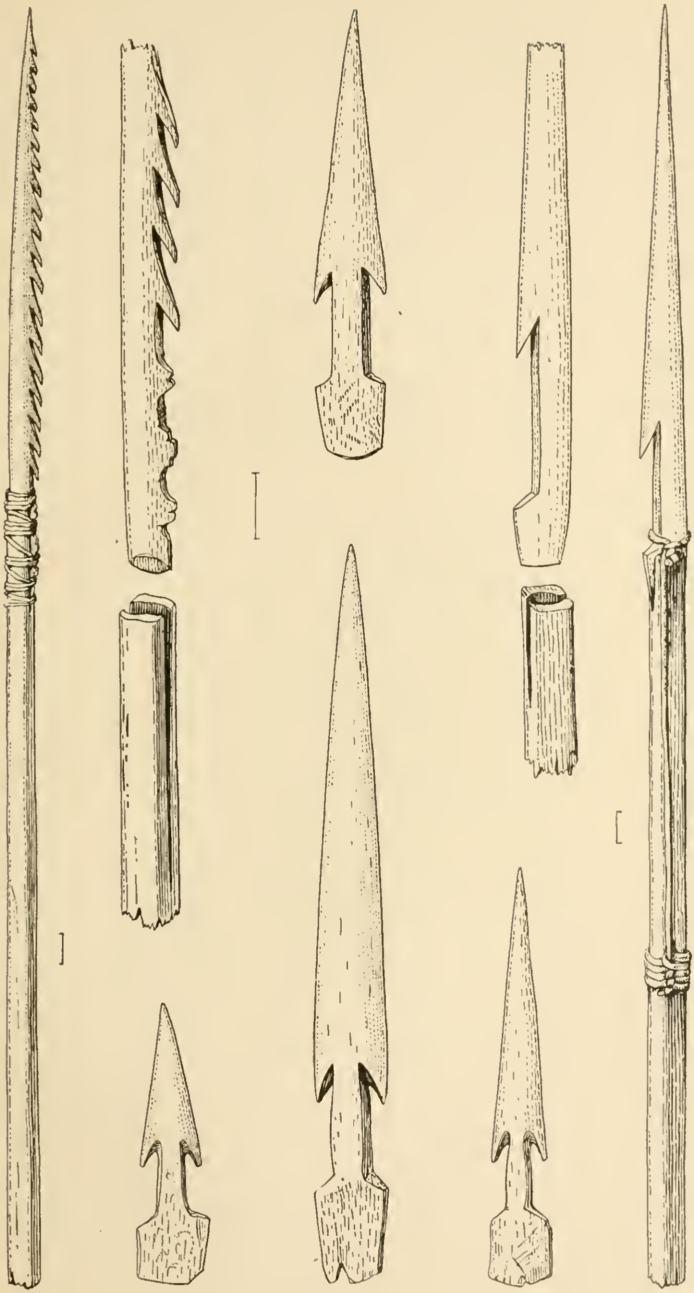


Fig. 11.
ICE SCOOPS.
Amur River and Bristol Bay.
Collected by E. W. Nelson; *a*, after Schrenk; *b*, Cat. No. 45409, U.S.N.M.

SOUTH AMERICAN HARPOONS.

The continent of South America was not favorable to the harpoon. Most of its shores descend at once into the inhospitable deep sea. Except at its narrow and bleak coast southward, animals best captured with the harpoon did not abound. Inland there were pampas and forests, better suited to bolas, spears, slings, blow tubes, and the bow. It is in the Straits of Magellan, on the west coast, and in the open waters of the great rivers that a rude barbed harpoon and excellent harpoon arrows existed. Nor can the thought be slighted that outside of the favored Cordilleras, the luxuriance of nature overpowered the inventive faculty, which indeed is developed among difficulties so long



FUEGIAN BARBED HARPOON HEADS.

Collected by United States Fish Commission steamer Albatross.

Cat. Nos. 127566, 131217, 131218, 178805, U.S.N.M.

as there is hope, but gives way to despair when nature even by her riches shuts the door against invention. This part of the South American Indian's equipment was not of a high order, since his patent which he received for his cunning was so meager.

Fuegian type.—About the Straits of Magellan are three linguistic families of Indians—the Onan, the Alikulufan, and the Yahgan. The first named are believed to be closely related to their neighbors, the Patagonians of the mainland. The other two families make canoes of bark and live on sea products. Their inventions, aside from their ingenious canoes, are not of a high order. Since the days of Magellan, 1520, until now, they have been spectators of Caucasian activities, yet they adhere to their ancient forms and are among the lowliest of the tribes now on the earth.

Fig. 12.

FUEGIAN BARBED HARPOON.

Collected by Thomas and Leslie Lee. Cat. No. 79091, U.S.N.M.

In the Fuegian barbed harpoons the transition from the spear is immediate, for it is only a matter of a short piece of sinew string or leather thong uniting the head with the shaft. If the barbed head of bone be firmly fixed in the split end of the shaft, the implement is a spear; if the barbed head fit loosely by its butt into a socket or, what is really the case, into the riven end of the shaft, and is joined to the shaft by a short cord or thong, as is shown in fig. 12 (Cat. No. 79091, U.S.N.M.), the implement is the most primitive of harpoons. The transition is not only immediate but easy. When the end of the shaft is merely split to hold the tang of the long bone spearhead, it is impossible to make a rigid joint by any amount of wrapping.

In the examples studied for this paragraph, collected by the U. S. Fish Commission steamer *Albatross*, the spearheads have many serrate barbs on one edge of the blade, and the tangs, instead of being smooth and tapering, are roughly notched to prevent the head from being drawn out of the end of the shaft (Plate 2). In like manner the harpoon heads of bone have tapering points of greater or less length, with two large barbs, one on each side, or one barb projecting near the base. In spears the tang is not fitted neatly into a socket at the end of the shaft, but the latter is merely split and bound with sinew or thong; but the open socket for the harpoon head is wrought with more care. The Fuegian harpoon is thrust with both hands or thrown. It has no hand rest on the shaft to make the blow more effective, nor did these natives have knowledge of the harpoon arrow or the throwing stick, a device prevalent in many other parts of America for propelling the harpoon. The shaft as now seen is a creditable part of the implement, being often 12 feet long and cut out with eight sides rather than round. The thong also is carefully knotted to the shaft a few feet from the barbed head, its length nicely adjusted to the setting of the harpoon for action.

Chilean type.—On the Atlantic slope from the Straits of Magellan to the mouth of the Rio Negro, the bow and arrow (formerly), the long-handled spear, but, more than all others, the different varieties of bolas, were the hunting implements. To find the harpoon it will be necessary to cross the Cordilleras and visit the archipelagos of the Pacific coast. Here amidst the greatest abundance, having little contact with Europeans, the tribes of Aucanian and those of unknown affinities plied a harpoon not much in advance of those of Fuegia (fig. 13 *C*). It is to all intents and purposes a good North American arrow, chipped head, foreshaft, lashing crossed over the barbs of the head, and conical base for making a joint with the shaft.

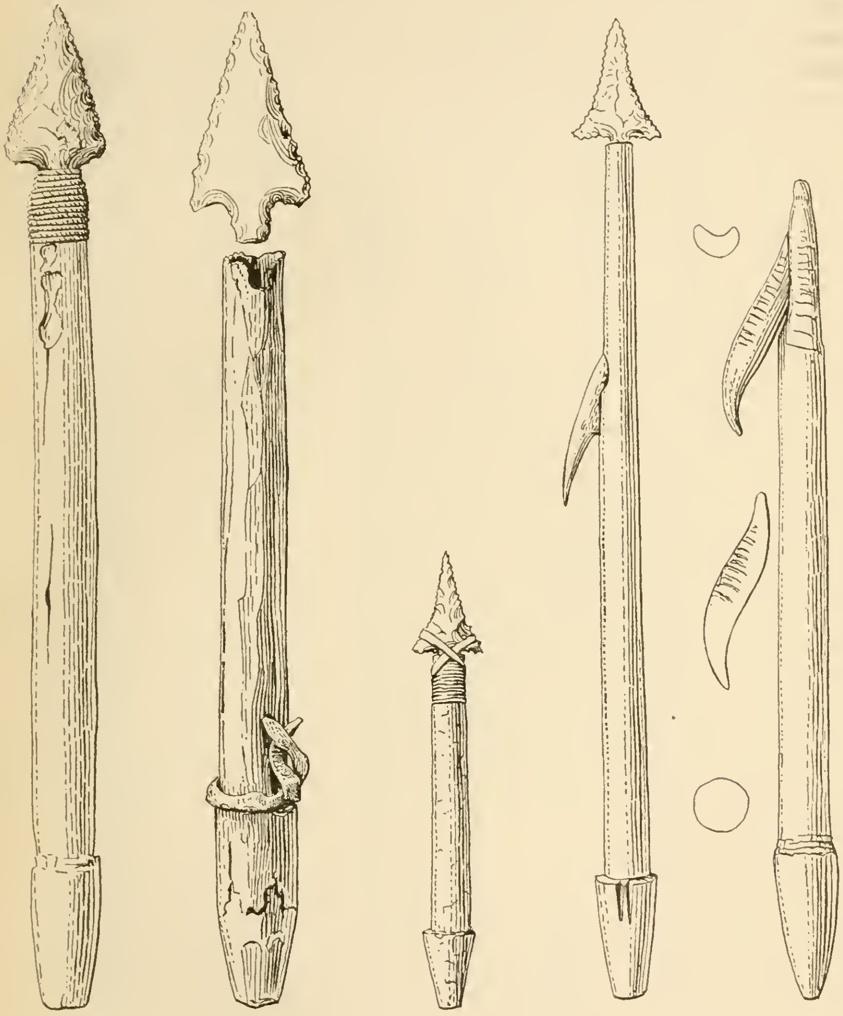
Fig. 13, A and B represent barbed harpoon heads in the U. S. National Museum from Arica, Peru. The heads are of chipped stone set by a tang into a socket in the end of its foreshaft or tang and bound with fine string. The column of the foreshaft is cylindrical, terminating below in a bulb, which serves both to hold the connecting line and to make a loose joint with the shaft.

In the Blake collections, Peabody Museum, is a similar barbed harpoon from Chacota, Peru, with point or blade of stone, tang of wood, and with conical butt end to fit in a socket.[1] Comparing these examples with the Fuegian type, the great advantage which one people may have over another caused by differences of material is apparent. The Fuegian, in order to join the head with the shaft of the harpoon, knows nothing better than to split the front of the handle and make the joining as secure as possible by lashing with rawhide, or sinew cord, which shrinks in drying. Soon, however, this becomes loose again, and makes it necessary to repeat the process of fastening. It is a poor joint at best. As soon as the fisherman, coming northward, discovers the tough and straight cane, a new device is possible, and a better joint. Indeed, nature bores the hole regular in form for the butt end of the harpoon head. By cutting the stem of the cane just above the joint an ideal socket is effected. When the harpoon head is set securely into this socket and the outside wrapped with stout thread, the best of joints is effected. The butt end of all South Ameri-

[1] Eleventh Annual Report of the Peabody Museum, p. 290, fig. 15.

can harpoons, within the area of the cane, belong to the type here shown regardless of tribe or location.

In Stübel, Reiss, and Koppel Kultur und Industrie Sudamerikani-



A B C D E

Fig. 13.

BARBED HARPOON HEADS.

Chile and Peru.

A-C, Cat. Nos. 136850*a* and *b*, U.S.N.M.; D, Peabody Museum; E, Charles Read.

scher Völker, is figured a harpoon from Arica, Peru. It consists of a head of syenite and a tang of wood. The stone head is barbed and the tang of wood is fastened with a seizing of woolen cord. At the lower end of the wooden tang there is a projection for a cord which fastened the head to the upper end of a shaft or reed cane. The lower end of the tang is conical, to fit into the end of the cane. There is a rudeness about the Peruvian and Chilean harpoon heads worthy of attention. The better classes of this ancient people were skillful in many arts. There is in these appliances of capture, therefore, evidence of a humble fishing caste, or of a tribe not identical with Aymaras and Kechuas. The spirit of invention was not entirely wanting in this area, however, as *D* and *E*, fig. 13, show. The last named is taken from Charles Read's paper in the Journal of the Anthropological Institute (volume xix, page 60). Side barbs are set on the side of the wooden tang of the head, partly let in, partly cemented, and in one example served. All the elements here rudely put together will again appear on this same Pacific coast at its northern extremity in their latest elaboration.

In the Hassler collection of the Field Columbian Museum are barbed harpoons from southern Brazil. The bone of an animal forms the point and a barbed piece of hard wood the tang of the head, which is attached by a short piece of rope to the end of the long shaft. In some examples the bone is socketed and set on the end of the tang; in others a spindle-shaped bone is lashed diagonally to the beveled end of the tang. Attention is here specially invited to the bone which forms the body and blade of this head, because it is an ideal, if not the real, beginning of all toggle heads of harpoons. A short piece of bone, conical in form, is cut out so as to be sharp in front and cup-shaped in the rear. If this is set on the end of a hard wood foreshaft and driven into the body of a fish or other animal it remains there and rankles. The arrow shaft is withdrawn, but if the bone be tied to the shaft it becomes a retriever. It toggles in the body of the game. The attachment of spurs at the base of this head brings about the made-up toggle head of the north Pacific coast.

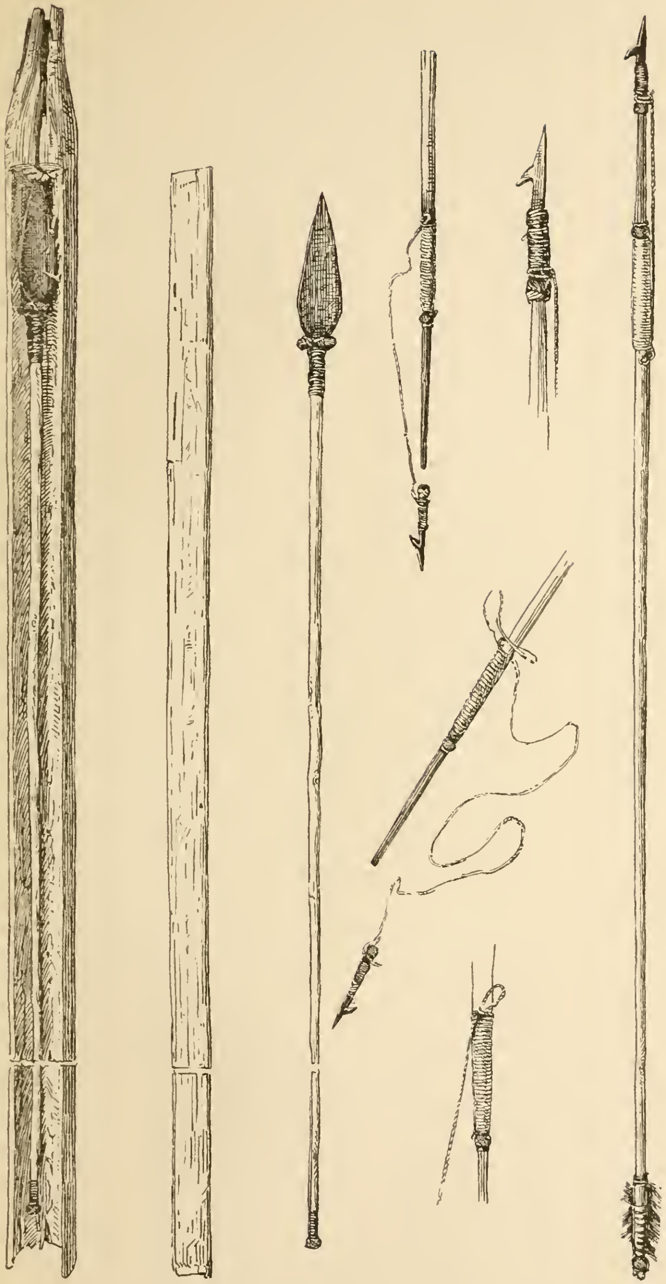
The turtle harpoon arrow in the Solimoens, Brazil, has a lancet-shaped point of steel fitted into a peg, which enters the tip of the shaft. This head is secured to the shaft by a twine of pineapple fiber, 30 to 40 yards long and neatly wound around the shaft. When the blade enters the shell the head of the arrow pulls out and the animal dives to the bottom, leaving the shaft floating. The Indian, on perceiving a movement in the water, shoots his arrow into the air and it never fails to pierce the shell of the submerged animal.[1]

The Amazon Indians hunt the manatee for food in small canoes and kill it with harpoons, the blades of which are made of shells.[2]

The Upper Shingu tribes hunted and fished with bow and arrow, though fishing was sparingly done in this way. The harpoon arrows

[1] Bates, On the Amazons, 1875, p. 293.

[2] Acuña, New Discovery, Hakluyt, No. 24, 1859, p. 69; Bates, loc. cit., 1875, p. 245.



HARPOON ARROW AND SHEATH, VENEZUELA.

Museum of the University of Pennsylvania.

of the Bororo Indians of the headwaters of the Paraguay River, in southwestern Brazil, are used for capturing alligators and large fish. The shaft is of the Uba reed, and at the butt end has two whole feathers laid on flat. The head consists of a shaft of hard wood about 2 feet long, to which are fastened the point and barb, made of a piece of bone or very hard wood, sharpened at both ends, and laid on the top of the foreshaft diagonally so as to form the piercing portion in front and the hook in the rear. The barb is lashed on to the foreshaft by means of a twined string, the other end of which is attached to the shaft, so that when the head is drawn out the shaft itself serves as a buoy. For about 2 feet the outer end of the reed shaft is wrapped with the same cord that connects the reed with the shaft. The inner end of the foreshaft fits into the hole of the reed (fig. 14). Length of this spear, 6 feet. It is pictured in Von den Steinen, 1894, page 484. Among the Bororo (Tupian family) is to be found a modification of this type of harpoon in which the shaft is not fastened to the line but held in the hand of the fisherman, who dives after his game.

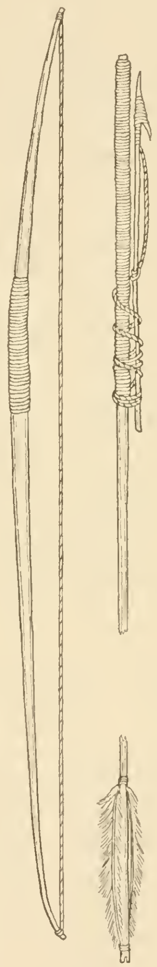


Fig. 14.
HARPOON ARROW.
Bororo Indians, Brazil.
After Von den Steinen.

A harpoon arrow of the Venezuelan Indians is shown in Plate 3. The specimen is in the museum of the University of Pennsylvania. The shaft is of reed, without a joint. At the shaftment there are two half feathers set on radially and held in place by wrappings of black and white thread in alternate bands. In a few places the thread passes over the shaft of the quill, and elsewhere the bands of thread do not touch the feather and have nothing to do with the lashing. At the nock, a ball-like projection is formed by the wrapping of thread. A piece of hard wood is inserted in the notch to fit through the bowstring. At the front end of the shaft a similar object is wrapped around the end to strengthen the socket of the foreshaft, which is a reed of black palm about 8 inches in length, sharpened at its lower end, and driven into the reed. It tapers gradually toward the fore end, where it fits into the head. The head consists of a barbed point of iron and a socket piece or a shank of wood, into which the iron is fitted. At the base of this shank is a short wrapping of twine, mixed with gum, resembling a turk's-head knot. This acts as a stop to the line. The same wrapping extends from the line outward nearly to the barb on the point. The harpoon line, which is 10 feet in length, is tied around the head at one end and at the top of the shaft at the other end. When this weapon is set ready for action, the barbed head is placed on the end of the foreshaft. The line having been wrapped neatly around the top of the shaft, almost to its end, a loop or slip-knot is formed at the last turn, and drawn tight. When the game is struck, the head is withdrawn, the slip-knot untied, the line unwound, and the heavy portion of the shaft drops into the water, the feather projects into the air, and the apparatus acts both as a drag and as a signal. Excepting the iron point, which might easily be replaced by one of bone, the whole apparatus is aboriginal, and the wide prevalence of this particular combination of parts leads to the belief that we have here an early and unchanged American harpoon arrow. It is interesting also from the point of view before mentioned, that it is a step in the progress of the toggle head. If a Columbia River Indian were to fasten a spur on the end of the cup-shaped socket, the combined barbed and toggle heads, to be more fully illustrated and described, would be realized. This form of harpoon head, in which the socket is on the movable part instead of being in the end of the shaft, is quite well diffused in the Amazon drainage and on the Pacific coast. It is not found in the shell heaps or mounds of eastern United States, but is common in western Canada and universal among the Eskimo.

The harpoon arrows of the tribes in British Guiana are used for shooting fish, pacu (*Pacu myletes*), which abound at all seasons of the year, according to Im Thurn, in most of the large rivers of Guiana. When the river is high and the water is turbid with rain the pacu are distributed equally in all parts of the stream and are almost invisible. When, however, in the dry season, the river is low and the water clear, when the rocks which form the rapids are partially uncovered, and the "pacu grass," a small water plant (*Lacis*), which clothes these rocks, comes into flower, then the pacu collect at the falls to feed on the leaves. Large numbers of Indians then camp at the sides of the falls to shoot these fish. Such a scene is highly picturesque. The place is generally a wide extent of river bed, apparently inclosed by the forested banks, and entirely occupied by a curious confusion of rocks and white, rushing water. On a rock in the midst of, and almost covered by the tumbling water, stands an Indian, his feet crushing the delicate, star shaped, pink flowers of the lacis, and every muscle in his naked, cinnamon-colored body bearing witness to the intensity of his watch. His bow is half drawn, the arrow is in position, but its point rests idly on the rocks. The water is rushing and tumbling so wildly that an unpracticed eye can see nothing below its surface. But the Indian sees. Quickly the bow is raised, the aim is taken, the arrow flies, and its shaft is there, dancing and tumbling in the water, carried here and there by the terrified rushes of an unseen pacu, in the body of which the arrowhead is embedded. But the line not only connects arrowhead and arrow shaft, but its other end is held firmly in the hands of the Indian, who now easily hauls the fish on to the rock. Sometimes, instead of waiting on a rock, in his eagerness he stands in the midst of the almost overwhelming rush of the water, stooping, the better to resist its force. In either case, if he is skillful, he gets a large number of fish. Im Thurn saw 15 pacu, averaging about 7 or 8 pounds in weight, shot by one man in twenty minutes. When enough have been taken the Indian loads his canoe and returns to his temporary camp. The fish are then cut open and cleaned, their sides are slit again and again, salt is rubbed in, and they are put on the rocks to dry in the sun.

It is not, however, only in the falls that the Indian shoots fish, though he rarely gets pacu elsewhere. In the smooth reaches of the river he shoots others of various kinds. Indeed, he can almost always and everywhere find fish to shoot, and he seldom fails to hit them when they are once seen. When the water is smooth two other fish arrows are used. Of these one[1] differs from the harpoon before mentioned in that a short line connects only the head—which in this case also is slipped on to the shaft—and the shaft, instead of being carried on the arm of the shooter. The struggles of the fish when hit immediately cause the shaft to slip out of the head, and the former, which is very long and light, floats on the top of the water, but remains connected with the fish by the line, and so serves as a buoy and marks the position of the fish.[2]

NORTH AMERICAN HARPOONS.

Between the northern and the southern continents of the Western Hemisphere the mode of communication was by land or by water. By land the dividing line between North and South America was very near the route of the projected Nicaraguan Canal. The gold-working Chibchas of British Columbia had as their northern boundary the San Juan River. By water there was no partition between the continents. The Caribian and the Arawakan tribes encountered by Spanish explorers all about the Caribbean Sea were also found away southward in the Orinoco drainage and farther. There will be no surprise, therefore, on finding the same devices of captuie widely distributed. The same animal will be killed in many places with similar harpoons, because in the struggle for survival among weapons this or that form proved the fittest; also because of that subtle, imaginary kinship between men and animals of prey which encourages the man to follow animals of particular species. The barbed head, with tang fitting into a socket at the end of the shaft, and the socketed head, whose cup-shaped base fits on to a pointed foreshaft, continue to exist with little change until

[1] Im Thurn, Among the Indians of British Guiana, 1883, p. 235, fig. 9*b*.

[2] Idem., pp. 235–237.

California is reached. The barbed harpoon head with cup-shaped base there takes on spurs and becomes a toggle head without barbs.

Of harpoons on the Mosquito coast of Nicaragua and Honduras Squier says:

> The women were left on the beach and three men apportioned to each boat—a paddler, a torch bearer, and a striker. Torches made of pine splinters; spears of two kinds—one (*sinnock*) fixed by a shank at the end of a long, light pole and kept in the hand; the other (*waisko-dusa*) shorter, staff hollow, iron-barbed head, fastened to a line passing through rings by the side of the shaft, wound to a light wood float. When thrown the head remains in the fish, the line unwinds, the float rises to the surface to be seized by the fisherman, who hauls in his fish at leisure.[1]

The same author says that the Mosquito Indians capture thousands of turtles with harpoons.

The Ulva Indians, of Bluefields Lagoon, pursue the manatee. One man sits in the stern of a flat-bottomed dugout (pitpan) to steer, one crouches in the bow with a harpoon, the rest kneel on the bottom, lances in hand. The boat is covered with boughs to resemble floating trees. The man at the bow launches his harpoon, the animal makes a plunge, the boughs are thrown overboard, and the lance men make ready. The bowsman gradually hauls in his line and the animal, after some maneuvering, comes to the surface, where it is stabbed with a lance. After a series of struggles it is secured.[2] These processes of paddling, harpooning, throwing the boughs overboard, hauling in the line, and stabbing with the lance may be carefully noted, in prospect of coming descriptions relating to harpoon work by the Eskimo.

Clavigero describes the Mexican tlacochtli or dart, a small lance of otalli or some other strong wood, the point of which was hardened by fire or shod with copper, or itzli, or bone, and many of them had three points. The Mexicans fixed a string to their darts in order to pull them back again. This weapon was especially dreaded by the Spaniards.[3] The line affixed to the darts is a harpoon characteristic. The three-pronged barbed harpoon head is also to be seen on Lake Patzcuaro at present.

A turtle harpoon[4] of the Seri Indians of Tiburon Island, in the Gulf of California and the mainland adjoining, is shown in fig. 15. It comprises a point 3 or 4 inches long, made from a nail or bit of stout wire, rudely sharpened by hammering the tip (cold) between cobbles, and dislodging the loosened scales and splinters by thrusts and twirlings in the ground; this is set firmly and cemented with mesquite gum into a foreshaft of hard wood, usually 4 or 5 inches long, notched to receive a cord and rounded at the inner end. This rounded end fits into a socket of the main shaft, which may be either a cane stalk or a section

[1] E. G. Squier, Mosquito Shore, London, 1856, p. 74.

[2] Idem., p. 104.

[3] History of Mexico, II, Philadelphia, 1817, p. 166.

[4] W J McGee, Seventeenth Report of the Bureau of Ethnology (1898), p. 187.

of mesquite root, while a stout cord is firmly knotted about the tang of the head and either attached to the outer end of the main shaft or carried in the hand of the user. The shaft is usually 10 or 12 feet long, with the socket in the larger end, and is manipulated by a fisherman sitting or standing on his balsa. On catching sight of a turtle lying in the water, he approaches stealthily, preferably from the rear, yet in such wise as not to cast a frightening shadow, sets the foreshaft in place, guides the point close to the victim, and then by a quick thrust drives the metal through the shell. The resistance between the turtle shell and the metal holds the point in place, and although the head is jerked out at the first movement of the animal, the cord prevents escape; and after partial tiring, the turtle is either drowned or driven ashore, or else lifted on the craft. Dr. McGee quotes the following minute account of Seri turtle capture:[1]

An Indian paddles himself from the shore on one of these by means of a long elastic pole of about 12 or 14 feet in length, the wood of which is the root of a thorn called mesquite, growing near the coast; and although the branches of this tree are extremely brittle, the underground roots are as pliable as whalebone and nearly as dark in color. At one end of this pole there is a hole an inch deep, into which is inserted another bit of wood in shape like an acorn, having a square bit of iron 4 inches long fastened to it, the other end of the tree being pointed. Both the ball and cup are first moistened and then tightly inserted one within the other. Fastened to the iron is a cord of very considerable length, which is brought up along the pole, and both are held in the left hand of the Indian. So securely is the nail thus fixed in the pole that although the latter is used as a paddle it does not fall out.

A turtle is a very lethargic animal, and may frequently be surprised in its watery slumbers. The balsa is placed nearly perpendicularly over one of these unsuspecting sleepers, when the fisherman, softly sliding the pole through the water in the direction of the animal till within a foot or two of it, suddenly plunges the iron into its back. No sooner does the creature feel itself transfixed than it swims hastily forward and endeavors to liberate itself. The slightest motion of the turtle displaces the iron point from the long pole, which would otherwise be inevitably broken and the turtle would as certainly be lost; but in the manner here described it is held by the cord fastened on to the iron which has penetrated its back, till, after it has sufficiently exhausted its strength, it is hoisted on board the canoe by the fisherman, who proceeds to the shore in order to dispose of his prize.

A barbed head, with wooden shaft, together forming a turtle spearhead, is shown in fig. 16, by McGee (1898, p. 193).

The only approach to the harpoon type in all the Pueblo region is an insignificant apparatus for capturing vermin. But the cliff dwellers had the throwing stick, and a spear with a head of stone set on a tang of wood conical at its inner end, like so many found in Peru and Chile. The Yokut Indians (Mariposan family) on Tulare Lake, California, are said by Powers to erect brushwood shelters over the water, in which the Indian lies flat on his belly peering down through a hole.[2] When a fish passes under, he strikes it with his two-pronged

[1] Hardy's Travels, 1829, p. 296.

[2] Stephen Powers, Tribes of California, 1877, p. 376.

harpoon (1877, p. 376). No other region in America illustrates more aptly what has been previously said about the dependence of culture-progress on the bounty of nature. The Tulare women are among the most skillful basket makers in the world, and their ware is sought far and wide. The material is at hand. But the Tulare men have reduced the harpoon to its lowest terms, for two reasons—the animals requiring a better perfected implement are not at hand, and the materials for constructing the weapon are not forthcoming.

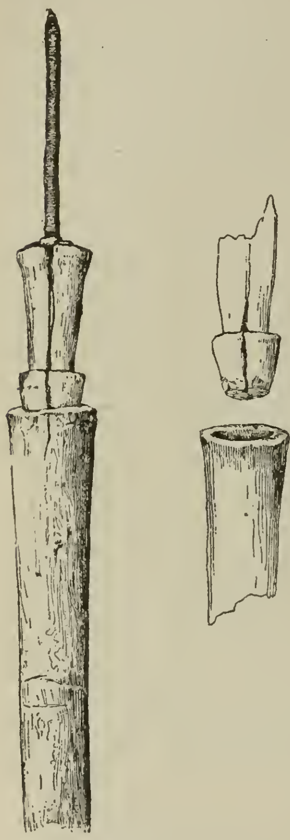


Fig. 15.
TURTLE HARPOON.
Seri Indians.
Collections of the Bureau of Ethnology.
After W J McGee.

The Indians of the Sacramento Valley, in California, not being subjected to the prohibition of the game laws, are allowed to capture game at any season of the year, and when the salmon are in the river to spawn they take them by means of toggle harpoons, one of which is nearly 25 feet in length.

The Sacramento near its head is very swift, and in its passage across different ledges of various degrees of softness excavates large pools or holes in its bed, each having a small fall, and there is a rapid beyond. The water in these holes, which are often very large, is comparatively still, and they make welcome resting places for the tired salmon before they attempt the passage of the rapid above. The water is beautifully cold and clear, and the fish can be seen crowding together on the bottom. The Indians repair to one of these holes to the number of twenty or more. Some station themselves at the rapids above and below; others wade out to an isolated rock, or a log projecting into the stream. All hold their harpoons in readiness, and at a signal from the leader strike. At the first onslaught each manages to secure a fish, which is detached from the harpoon head and thrown on the bank. The harpoons, having toggles of steel which become detached from the stock when they enter the fish, and being attached to the shaft by cords, turn flat against the fish's side and make escape impossible when the salmon is pierced through. Sometimes three or four hundred are thus harpooned from one pool.[1] The Wintun

[1] Hallock, Forest and Stream, VI, June 1, 1876.

Indian ties two poles together near one end, sets them in deep water near the shore, the bottoms a few feet apart; on this he sets a log, one end resting on the shore. From this fishing station he harpoons the black-backed salmon. The shaft is often 15 feet long; the head, a joint of deer's bone, is 3 inches long, with socket to fit on the end of the foreshaft and line tied about its middle. This head is driven quite through the fish and toggles on the other side. The reader can not fail to recall the toggle heads of bone in the heart of Brazil. The Yurok also spear salmon from booths with toggle harpoons.[1] The Wintuns belong to Powell's Copehan family. They are skillful arrow makers and their women dainty weavers of twined basketry. But the abundance of the game as well as its accessibility have acted here, as in all other places, to deter the inventive faculty. The thrusting of a toggle quite through a fish was indeed an effective mode of capture, but it did little to elevate the mind of the captor.

Fig. 16.
BARBED HARPOON HEAD.
Seri Indians.
Collections of the Bureau of Ethnology.
After W J McGee.

The head of the harpoon used by the Nacum Indians of California was made of deer's horn and was about 2 inches long, with a socket on one side that fitted into the pole. When a fish was struck the point left the pole, to which it was attached by a sinew a foot or more long. It has been observed that the toggle harpoon so well known on the Pacific coast of the United States north of San Francisco, as well as British Columbia and Alaska, made no advances as an invention. The Nacum Indians are too far inland to have had the stimulus for improving an apparatu which demands sea room for development.

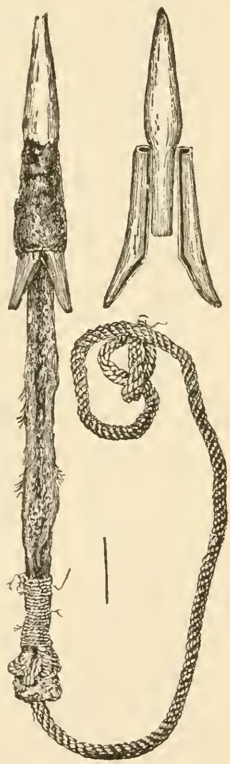


Fig. 17.
TOGGLE HARPOON.
Hupa Indians, California.
Collected by P. H. Ray. Cat. No. 126525, U.S.N.M.

The Hupa and Humboldt Bay Indians construct the toggle heads of their salmon harpoons as follows: A point of antler, bone, or metal from 2½ to 3½ inches in length, more or less flattened and sharp at the tips, is armed at its lower extremity with

[1] Stephen Powers, Tribes of California, 1877. See his index, under fishing.

two barbs laid alongside, lashed down, and covered with pitch. (Fig. 17.) In the same lashing is included one end of the leader, a short strap of deer rawhide. Into a slit at the other end is spliced the line, a piece of rope from 1 to 3 feet long, attached at its opposite end to the side of the shaft. Some spears have two or more prongs, each armed with one of these toggle heads. When the fish is struck its struggles detach the toggle head and it is retrieved by means of the line and pole. Toggle heads of similar type are in use among all the salmon-eating Indians of northwest California.[1]

In the figure shown will be seen the transition of the rankling arrow head of South America into a toggle head. There must be point, barbs, or spurs, line attached between ends, and socket in every harpoon. In this noteworthy type the point and the flukes or barbs are separate, and the socket is ingeniously effected by the combination of point, spurs, and rawhide leader.

The spring salmon, says Gibbs, are taken on the rivers Sacramento, Klamath, Columbia, and Kwinaiutl with a harpoon, the points or barbs attached loosely by a thong, so as to give play to the fish. On some of the rivers, where the depth permits, weirs are built to stop their ascent.[2]

The relationship of weirs, dams, and stops of various kinds with the harpoon may be mentioned in this connection, since the California and Oregon tribes, barred out from ocean fishing by absence of archipelagoes, were compelled to invent equivalents. The old-time harpoon was even then adequate, but engineering schemes were stimulated and so the intellect was quickened. The cooperative results in dam building, strengthening as they did the social tie, are not to be despised. Indeed, Powers, who knew those tribes half a century ago, has much to say about their manliness and resource, both in fishing and hunting. The same will be found true not only on the Atlantic side of the United States but on both sides of South America.

It must not be overlooked that the Pacific Ocean all along the Mexican and Californian coast was no friend to the canoe. Fishing was done inland. The coastal plain, indeed, was the pasture land of vast marine herds that needed no shepherds, but at the proper season they rounded themselves up and proceeded into the various open streams to their spawning grounds, where they were slaughtered without mercy and in such way as to awaken little thought in the minds of their captors.

Cat. No. 131358 in the U. S. National Museum is a barbed head of a harpoon from the Nal-tunne-tunne Indians, Oregon, collected by Rev. J. Owen Dorsey, consisting of an iron arrow head with long sharp barbs on each side and a wooden shank barb piece having two unilateral

[1] Smithsonian Report, 1886, Pt. 1, p. 224, pl. xix, fig. 80.

[2] George Gibbs, Contributions to North American Ethnology, 1877, I, p. 195.

flukes (fig. 18). On this wooden shank, the butt end of which fits loosely into the socket of the shaft, is a projection to hold the string connecting head and shaft. This tribe of Indians belong, as their name shows, to the Déné or Tinné Indians, whose home is in central Alaska and the western portion of the Dominion of Canada. This Athapascan family is represented on the Pacific coast also by the Hupa, Wailaki, Saiaz, and many other tribes given by Powell (1891, p. 55). The time of their migration is not known, but extensive movements have taken place since the coming of the whites. They have added nothing to the inventions of the locality. The barbed harpoon blade, with barbs also on its shank, is widespread.

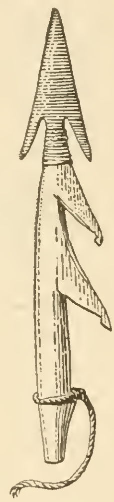


Fig. 18.
BARBED HARPOON HEAD.
Naltunne Indians, Oregon.
Collected by J. Owen Dorsey. Cat. No. 131,358, U.S.N.M.

Sixty years ago Wilkes described harpooning at Walla Walla, on the Columbia River, as very much like that at Willamette Falls, except there is no necessity for planks to stand on. The Indians use hooks and spears attached to long poles, both of which are made to unship readily and are attached to the pole by a line 4 feet below its upper end. If the hook were made permanently fast to the end of the pole, it would be liable to break and the large fish more difficult to take. The Indians are seen standing along the walls of the canals in great numbers fishing. It is not uncommon for them to take twenty or twenty-five salmon in an hour.[1] Wilkes brought home one of their harpoon heads, which is combined barbed and toggle, made up as follows: The head is of iron, triangular in shape, with a large barb on one side. The shank is set in between two pieces of bone, which serve three purposes, namely, to hold the shank firmly, to become two spurs at their outer ends, and to form a socket for the end of the shaft by the hollow between them. The line or leader is laid on the joint between them and the whole lashed securely together and dipped into hot pitch. The line is of many strand braid.

One of the oldest pieces in the U. S. National Museum, Cat. No. 1439, collected by Lieutenant Whipple, is of similar type, only there is not a bit of iron about it. So far as its materials and form are concerned, it might have come down from aboriginal times. The blade is of bone, having two large flukes or barbs on one side cut out. In this example also the spurs at the butt end, which form the toggle, are of bone. The leader joining the head to the shaft is a strap of rawhide. The blade, spurs, and line or leader are neatly joined together with thread and pitch, so as to provide a socket for the end of the shaft.

[1] Charles Wilkes, Exploring Expedition, IV, p. 384.

Those who understand the difficulties which beset the savage artisan in making a good joint will appreciate this efficient combination.

The Twana Indians, of Washington State, make one kind of salmon hook of a straight piece of steel about 6 inches long, and sharp. On each side of it pieces of bone are tied. A line is attached and also a pole 15 or 20 feet long, in such a way that by means of the pole it may be driven into the fish, the pole drawn out, and the hook remain, held by the string, when it is drawn in.[1]

They (the Twana) sometimes use harpoons for seal fishing. The point is of iron, and the spear and line used as with the salmon hook just described.[2]

The shaft of the Quinaielt salmon harpoon is made of cedar, the fork of the wood of the salmon berry; the toggle heads of wood or metal.

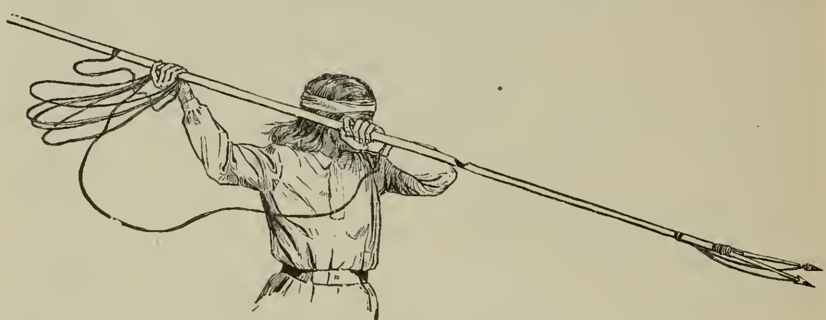


Fig. 19.

SALMON SPEAR.

Quinaielt Indians, Washington.

Collected by C. Willoughby.

The loop of cord, which is 16 feet long, is for the left hand. The length of the spear is nearly 16 feet. This spear is used on the bar of the river at low water.[3] This most interesting specimen recalls the heart of Brazil. There a short piece of monkey's bone was pointed in front, while nature formed the socket at the base to fit over the foreshaft. In the Quinaielt specimen the monkey bone is replaced by a combination of bone and metal, the cup-shaped cavity at the base fits also over the foreshaft, but a short line or leader passes from the middle of the head to the fore end of the shaft. This is a full-fledged toggle harpoon of a primitive type (fig. 19).

The Indians of Neah Harbor, says Wilkes, capture the whale with a buoy made of a seal's skin, which is blown up after the manner of bladder, forming a large oblong float. These floats are 4 feet long by 18 inches or 2 feet in diameter, and are made fast by a rope to the harpoon or spear which is thrown at the whale, and becoming fastened to it pre-

[1] M. Eells, Hayden's Bulletin, 1877, pp. 3, 63, 78, 79, 81.

[2] Idem., p. 80.

[3] Smithsonian Report, 1886, Pt. 1, p. 271, fig. 4.

vent its diving down to any great depth. After having a number of these joined to it the animal is unable to quit the surface and is finally captured.

All those whose sealskin floats are attached to the animal now divide the booty. Those who are entitled to a share are easily known, for each float has a different pattern printed upon it.[1]

From Vancouver Island around the interminable coasts of North America to eastern Greenland the float is only in a few places absent from the harpoon in some form. It may be, as in this example, the hide of an immense seal, perhaps of a smaller seal, elsewhere a bladder or intestine inflated. On the coast of British Columbia, in the absence of sealskins, the unconquerable genius of invention substitutes a large bag or wallet of cedar bark, and the Labrador Eskimo attaches a bit of plank to the butt end of his harpoon shaft. The motive is the same. A huge animal, to be captured, must not only be stabbed, but held back by an unwearying device which takes the place of the hunter's hand and arm.

The Makah, living on the northwestern point of Washington State, pursue the whale in their dugout canoes. On one occasion, says George Gibbs, a canoe was gone five days. Their tackle consists of a harpoon, the point formerly edged with shell, now usually with copper, very firmly secured to a line and attached lightly to a shaft about 15 feet long, to which also the line is made fast; a sealskin float is attached to another line and serves to buoy the whale when struck. The scene of the capture is described by eyewitnesses as very exciting, ten canoes being sometimes engaged, the crews yelling and dashing their paddles with frantic eagerness. When taken, the whale, buoyed up with floats, is towed in triumph to the village and cut up.[2]

The Makahs belong to the Wakashan family, whose chief abode is on the outer side of Vancouver Island. They are the Nutkas of Captain Cook and of the early explorers. But in this connection they are at the gateway of the North Pacific archipelago, where, after a lonesome search stretching from Magellan Straits, the student encounters the Caribs of the west. One after another Wakashan, Salishan, Haidah, or Skiddegatan and Tlinket, or Koloschan come out to meet him in their graceful dugouts of cedar.

The Makah whaling harpoon consists of a barbed head, to which is attached a rope or lanyard, always of the same length, about 5 fathoms, or 30 feet. This lanyard is made of whale's sinews twisted into a rope about an inch and a half in circumference and covered with twine wound around it very tightly, called by sailors "serving."

The harpoon head is a flat piece of iron or copper, usually a saw blade or a piece of sheet copper, to which a couple of barbs made of

[1] Charles Wilkes, Exploring Expedition, IV, p. 486.

[2] George Gibbs, Contributions to North American Ethnology, 1877, I, p. 175.

elk's or deer's horn are secured, and the whole covered with a coating of spruce gum. Formerly the blades were of mussel shell. The shaft is made of yew, in two pieces, which are joined in the middle by a very neat scarf, firmly secured by a narrow strip of bark wound round it very tightly. The length is 18 feet; thickest in the center, where it is joined together, and tapering thence to both ends. To be used, the staff is inserted into the barbed head, and the end of the lanyard made fast to a buoy, which is simply a seal skin taken from the animal whole, the hair being left inward. The apertures of the head, feet, and tail are tied up air-tight, and the skin is inflated like a bladder. One example collected by Swan is 3 feet long (fig. 20).

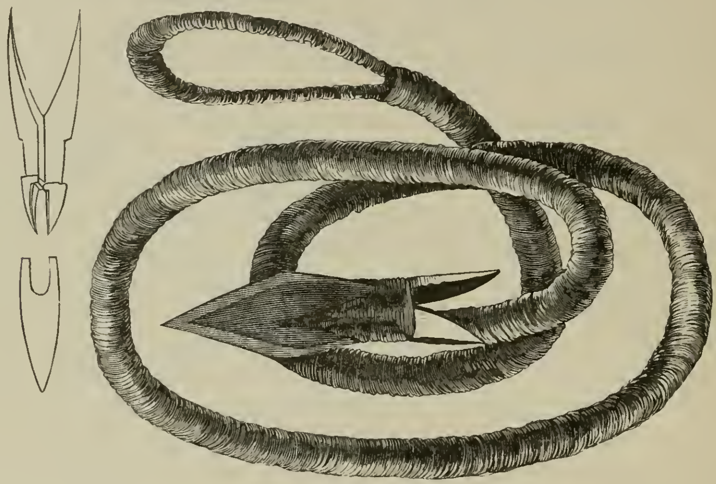


Fig. 20.

TOGGLE HEAD AND LINE.

Makah Indians, Washington.

Collected by James G. Swan.

When the harpoon is driven into a whale the barb and buoy remain fastened to it, but the staff comes out, and is taken into the canoe. The harpoon which is thrown into the head of the whale has but one buoy attached; but those thrown into the body have as many as can be conveniently tied on; and, when a number of canoes join in the attack, it is not unusual for from thirty to forty of these buoys to be made fast to the whale, which, of course, can not sink and is easily dispatched by their spears and lances. The buoys are fastened together by means of a stout line made of spruce roots, first slightly roasted in hot ashes, then split with knives into fine fibers, and finally twisted into ropes, which are very strong and durable. These ropes are also used for towing the dead whale to the shore.[1]

[1] James G. Swan, Smithsonian Contributions, XVI, pp. 19–21.

The Makahs, according to Swan, are not active in vocations or pursuits other than fishing and whaling, and obtain some of their supplies by barter from neighboring tribes and white men. They devote very little time to agricultural pursuits or to the capture of land animals, but excel in the management of canoes, making long voyages from land for fish, and fearlessly attacking the whale. They manufacture their own fishing apparatus, and take especial pains with their harpoons and lances, for which instruments they have the greatest regard. The principal implements used by the Makah whalers are harpoons, lances, ropes, and buoys. The harpoon heads were formerly made of shell, but at present are of sheet copper or steel, with barbs of elk or deer horn, tightly seized to the blades by cords or strips of bark, the whole being covered with spruce gum. The lanyards attached to the harpoon are made of the sinew of the whale twisted into a rope and served with fibers of nettle. The lances are of metal, with sockets for the ends of the poles. The poles for the harpoons and lances are

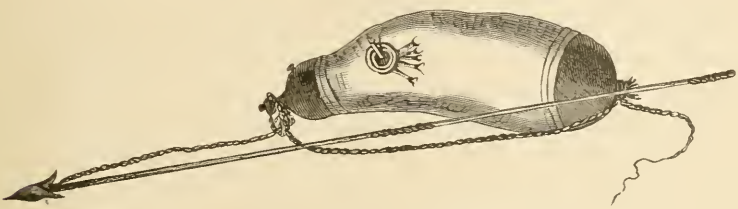


Fig. 21.
SEALSKIN FLOAT.
Makah Indians, Washington.
Collected by James G. Swan.

heavy and unwieldy, but durable and strong. The buoys are of sealskin with the hair inside, inflated when used, and attached to the harpoon lanyards. These buoys are used for the double purpose of impeding the progress of the whale, so as to enable the Indians to kill it, and to prevent the animal from sinking when dead.

All whaling implements which have been used in the capture are regarded with especial favor and handed down from generation to generation, and it is deemed unlucky to part with them. These Indians did not acquire the art of whaling from white men, and still employ the apparatus and processes which have come to them through countless generations. One point deserves especial consideration. The process of wrapping their harpoon lanyards, commonly known as "serving," has been in use by all seafaring men for a number of years. The Makah Indian has his serving stick and mallet, manufactures his twine from the fibers of the nettle, and "serves" his lines as neatly as do the fishermen of the Eastern coast, and it is said they were familiar with the process before the advent of the whites.[1]

[1] James G. Swan, Indians of Cape Flattery.

The implements used by the Makah Indians for catching salmon were a hook and a spear. The former is in size as large as a shark hook, having a socket at one end formed of wood. These hooks are made by the Indians from files and rasps, which they purchase of the traders, and are forged into shape with ingenuity and skill. The socket is made from the wild raspberry bush (*Rubus spectablis*), which, having a pith in its center, is easily worked and is very strong. This socket is formed of two parts, firmly secured to the hook by means of twine, and the whole covered with a coat of pitch. Attached to this hook is a strong cord about 3 feet long. A staff or pole from 18 to 20 feet long, made from fir, is used, one end of which is fitted to the socket in the hook, into which it is thrust, and the cord firmly tied to the pole. When the hook is fastened into a salmon it slips off the pole and the fish is held by the cord, which enables it to perform its antics without breaking the staff, which it would be sure to do if the hook were firmly fastened.[1]

Giglioli figures a barbed harpoon head (Kaheita), made of whale's bone, brought from Nutka by Captain Cook, and now in the Natural History Museum of Florence. It has two barbs on one side and is attached to a line 10 mm. thick, served with twine.[2] This most interesting object, 10 inches long, reduces the harpoon head to its lowest terms. It reminds the student of the Fuegian type, or, better, of the universal American fundamental barbed type. At the base or joint—and this is one of the crucial points for invention—there is merely the rudest kind of pivot to fit into the socket at the end of the shaft. There is no perforation, or even bulb, to hold the line. The shank is simply hacked to make it rough. Some old pieces in the U. S. National Museum, of bone, antler, iron, and copper, collected by Gibbs, McLean, and Fisher, have from one to four barbs on one side, and have line holes or projections for the end of the connecting line.

Ellis says that the Nutka (Wakashan) Indians had two kinds of harpoons—one of bone, the other of shell. The former—that is, the barbed head—is 6 inches long, pointed, having barbs on one side. Of the one with the shell blade, the butt end is "so contrived by means of a socket as to fix upon a pole 10 feet in length. The shaft is forked at the end, so that two pieces of the bone are to be fixed on at the same time." To the shank of the barb a strong line is attached, to the other end of which is fastened a seal skin, blown up. The float is said to prevent the animal from keeping under water. It was dispatched with the lance.[3] This corresponds precisely with the specimens in the National Museum collected by Swan in recent times. In one of his examples the mussel shell, ground to a razor edge, forms the

[1] James G. Swan, Northwest Coast, New York, 1857, pp. 40 and 41.

[2] Appunti intorno ad una collezione, etc., Florence, 1895, p. 131, pl. III.

[3] Ellis, An Authentic Narrative, I, p. 221.

blade, and it is so neatly fitted between the spurs forming the toggle and covered with pitch as to make a sure and efficient weapon. All that the iron did later on was to replace the rather brittle edge of shell, without modifying any other portions of the intricate apparatus.

Marchand's account of the harpoon in Barclay Sound, west side of Vancouver Island, is here given. The strong lance, which may be called their unerring lance, is intended for striking the whale when he presents himself on the surface of the water, and never does an American fail to wound him at the first stroke. Instantly the slighter lances are employed for darting the harpoons, to each of which is fastened one of the long pieces of rope. The other end of the line is fixed to one of those large bladders filled with air. This sort of balloons, floating on the water, cease not to indicate the place where to find the whale, dead or wounded, that has carried with him a harpoon, and the fishermen, directed by this signal, follow him up and celebrate by songs of joy their victory and conquest. But the most difficult is not, undoubtedly, to deprive the monster of life. It remains for them to get possession of him, and it would never be believed, if we were not assured of the fact, that with skiffs so slight and ticklish as canoes hollowed out of the trunk of a tree a few men should succeed in dragging the space of 4 or 5 leagues an enormous mass and contrive to run it on shore on a beach, where they can cut it up.[1] A glimpse at the ethnographic chart of North America shows that the Aht or Nutka division of the Wakashan family occupies the western portion of Vancouver Island, while the coast of British Columbia belongs to the Haeltzukan branch, as shown by Boas. The same author fixes the limits of the Chimmesyan family on the coast between the Koloschan and the Haeltzukan tribes.[2] All about Puget Sound were Salishan tribes, and a small contingent of the same family approach the harpoon area at the mouth of the Bella Coola River.

Harlan I. Smith dug up at the junction of Thompson and Fraser rivers two barbed harpoon heads 9 inches long, made of antler. They have two barbs on one side and a hole for the connecting line.[3]

In a future paper the fishhooks of the same area will be discussed, from which it can be more clearly shown how the idea of the bent finger and its imitators in bone and wood has also dominated the form of the fish spear and the harpoon.

Niblack[4] figures both barbed and toggle harpoon heads among the Haida Indians of Queen Charlotte Islands, British Columbia, a little

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[1] Marchand's Voyage, London, 1801, I, pp. 492–493.

[2] Fifth Report of Committee on Northwest Tribes of Canada, British Association for the Advancement of Science, 1889.

[3] Memoirs, American Museum Natural History, New York, II, p. 137, fig. 20.

[4] Report U. S. National Museum, 1888, pl. XXIX.

farther north. The barbed heads are of steel. The piercing end of each is lanceolate. The barbed portion is toothed or notched in its entire length, six barbs on the one side and five on the other, alternating. The tang is oval, perforated, and has a small loop or clevis riveted fast to it. Through this is secured a plaited lanyard or loop of seaweed, by means of which the head is attached to the foreshaft or to the main line. Each one of these fits in a cedar case, made by splitting a piece of wood, hollowing it out, and then lashing the parts together, a method adopted by these Indians in their musical instruments and various receptacles.

The toggle harpoon (Cat. No. 88929, U.S.N.M.) of the Haida Indians, figured by Niblack, is still more interesting, being quite similar to the harpoon arrowheads of the South American tribes. The head is of steel, the piercing ends in the form of a spike. At the other end the metal is split open and one portion extended backward for a barb or spur. Just where the spur unites with the body a rawhide line is wrapped to form a shallow socket. Into this the end of the loose shaft fits, being cut off in the form of a wedge at the end. The other end of the loose shaft is widened out to fit into a socket in the end of the shaft. The thong which is wrapped around the head is also securely fastened to the foreshaft at its middle and looped at the other end, to be spliced on to the long line for securing the game. (Cat. No. 88803, U.S.N.M.)

Captain Cook draws attention to the barbed harpoons on Cook Inlet, made of fir, about 4 feet in length. They are mentioned here to mark the northern terminus of the unilateral barb, but they will be described fully later on. One end is formed of bone, into which, by means of a socket, another small piece of bone, which is barbed, is fixed, but contrived in such a manner as to be put in and taken out without trouble. This is secured to the middle of the stick by a strong, though thin piece of twine composed of sinews. These darts are thrown with the assistance of a thin piece of wood 12 or 14 inches long. The middle of this is slightly hollowed for the better reception of the weapon, and at the termination of the hollow, which does not extend to the end, is fixed a short, pointed piece of bone to prevent the dart from slipping. The other extremity is furnished with a hole for the forefinger, and the sides are made to coincide with the other fingers and thumb in order to grasp with greater firmness.[1]

The Chilkotin Indians in western Canada spear salmon with a double-headed toggle harpoon. The shaft is a long pole, upon the inner end of which are spliced two short pieces of wood which serve as foreshafts. The head of the harpoon is made of three separate pieces, the point or spike and two flukes or spurs, all securely lashed together in such a way that a cavity is left in the base for the end of the foreshaft. The

[1] Second Voyage, III, p. 14.

line is tied at its ends around the heads, just above the flukes or barbs, and the middle of the line is securely held in place near the end of the shaft by a lashing of line. When the salmon is struck the toggle is fastened in the animal's body and is withdrawn from the ends of the foreshaft. The short line between the head and the shaft enables the fisherman to play with the victim and to land it more successfully.[1] Similar toggle heads on a bifurcated shaft are to be seen among the Thompson River Indians of British Columbia. This weapon is used for harpooning salmon from the shore while they are running. The handle is 15 feet or more in length and has two prongs securely spliced on to the end of the shaft (fig. 22). The Thompson River specimen is similarly made up of three pieces, the point and the two spurs, but these last do not bend outward, as in the Chilkotin example, but lie close against the foreshaft, leaving a narrow cavity to fit over the end of the latter, which is whittled in the form of a wedge. The line or leader which holds these two barbs to the front end of the shaft is braided, and the ends are caught under the lashing by means of which the toggle is built up. James Teit says that when the fish is struck the barb points are detached, and the fish, with the toggle in its body, is hauled ashore by means of the line. In some forms of the spear the whole foreshaft is detachable. There are also examples in which only one toggle head is used, and there are also spears with fixed heads. In that case the weapon is thrust through the body of the fish.[2] Batchelor figures a similar double-headed toggle harpoon among the Ainu.[3]

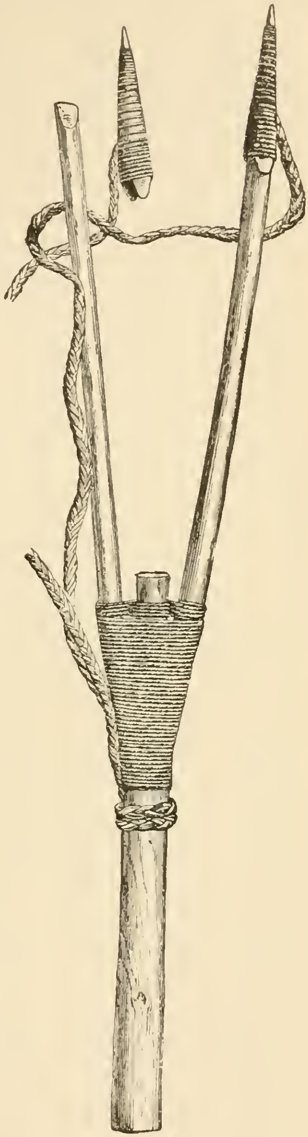

Fig. 22.

TOGGLE HARPOON.

Thompson Indians, British Columbia.

Am. Mus. Nat. History, N. Y

After James Teit.

On the eastern side of North America it will be convenient to begin with Florida. Looking over Mr. Cushing's collections from San Marco, in the south-

[1] A. G. Morice, Notes on the Western Dénés. Trans. Canadian Institute, 1894, p. 71.

[2] James Teit, Thompson River Indians, 1900, p. 251, fig. 231.

[3] The Ainu of Japan, Chicago, 1893, p. 154.

western corner of the State, and Mr. Sawyer's drawings, made at the time they were excavated, does not reveal harpoons; but two varieties of throwing sticks were dug up. Cushing found no barbed heads. It was a great surprise to find the atlatl or spear and harpoon thrower in Florida. In 1895, when Cushing first heard of the wonderful remains at San Marco, Von den Steinen had just revealed the finding of the same implement in the Mato Grosso, Lumholtz and Seler announced its existence in northern Mexico, and the author discovered it in the cliff dwellings of the Verde. Cushing's are the central finger-hole type and the two-holed type for the fore and the middle finger. As the Gulf Stream sweeps past the Orinoco mouth, across the Caribbean sea to Yucatan, and thence in a narrower and swifter current past Florida Keys, one is not surprised to find a Mexican weapon there.

Mr. H. A. Ernst says: "The Seminole Indians of the Everglades now use white man's hooks, but adhere to the old-fashioned harpoon, which is used in catching fish and terrapin." The reader will find abundant evidence of the use of barbed harpoons in the Southern Straits in quotations from Adair, Barker, Bartram, de Bry, and Hennepin. Adair accompanied the Indians killing sturgeons in Savannah River with green swamp harpoons. These are long, sharp-pointed green canes, well bearded and hardened in the fire. When they discovered a fish they thrust into its body one of the harpoons. "As the fish would immediately strike deep, its strength was soon expended in violent struggles against the buoyant force of the green dart. As soon as the top end of the dart appeared again on the surface of the water, we made up to the fish, renewed the attack, and in like manner continued until we had secured our game."[1] These southern harpoons were of the very lowest grade, if they were worthy of the name at all. The motives for devising a highly organized type did not exist.

In Rau's Prehistoric Fishing, barbed harpoon heads are figured. These were taken from mounds, shell heaps, and other remains, from Maine to Michigan. They all belong to the barbed variety, and are of the simplest kind. Three types might be said to exist in Dr. Wilson's collection in the National Museum, the sagittate, in which the barbs are equal on the two sides of the point; the forms with multiple barbs of the same number on either side; those having an uneven number of barbs on the two sides, usually two on one edge and three on the other, and those with any number of barbs on one side, as on the north Pacific coast. At the tang end barbed harpoons are divided into two classes by means of the connecting line which joins the head to the shaft, namely, the notched tang and the pierced tang. These again are further subdivided, for the notch may be only a scratching or roughening of the surface or a bulb, and the piercing may be only a small hole or

[1] C. C. Jones, Antiquities of the Southern Indians, New York, 1873, Chapter XIV.

large opening. About the Great Lakes barbed harpoon heads are plentiful, notched and pierced.

Charlevoix describes the sturgeon spear of the Iroquois fishermen on the Great Lakes. Two men go out in a canoe, one to paddle, the other, in the bow, holding a barbed harpoon dart secured to the canoe by a long cord. Ingersoll compares this to the Columbia River sturgeon chaser. The hook is like a gaff attached to a short wooden socket fast to a line, the other end of which is tied to the canoe. The operation of catching is described by Swan.[1] On the authority of Dr. W. M. Beauchamp the barbed harpoon had a wide variation among the Iroquois and the tribes on the Great Lakes. They are, as regards their barbs, unilateral and bilateral, and as to the tang, notched, bulbed, and pierced. The bilateral and sagittate forms are earlier and in larger numbers. Recent Mohawk, Cayuga, and Seneca sites yield large specimens. Both kinds are most plentiful at the inlet of Onondaga Lake, the outlet of Oneida Lake, and near Chaumont Bay, in Jefferson County. At Brewerton more harpoon heads have been found than in all the rest of New York and, perhaps, than all the eastern United States. It is an excellent place for the work of the harpoon. The large Iroquois harpoon had only a short point. The counties in New York yielding barbed harpoons are Jefferson, Montgomery, Madison, Onondaga, Cayuga, and Livingston. They are found in village sites and camps, rarely in graves, coming out of the ashes, says Beauchamp, in fine order.

Dr. Beauchamp has made a thorough study of the bone harpoon head in the Iroquois country in New York. The reader will have to consult his Bulletin of the New York State Museum to appreciate the endless variety of forms carved out by this quick-minded race. There are pierced, bulbed, and notched bases, unilateral and bilateral barbs, wide and narrow blades, single barbs and multiple barbs, long barbs and short barbs, alternate and opposite barbs. One would require the vocabulary of the botanist for leaves to define the shapes in Beauchamp's figures.

Josselyn tells us that among the New England Indians bass and bluefish were taken in harbors and in the mouths of barred rivers, the fishermen being in canoes and striking the fish with a "fizgig," a kind of dart or staff, to the lower end of which was fastened a sharp, jagged bone with a string to it. As soon as the fish was struck the hunter pulled away the staff, leaving the barbed head in the fish's body, and fastened the other end of the string to the canoe. Thus they hauled often as many as ten great fish to the shore.

Sturgeon were taken in this way at night on the fishing banks, where they were feeding upon small fishes called lances, sucking them out of the sand. The Indian lighted a piece of dry birch bark and held it

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[1] Ernest Ingersoll, The Field, London, LXII, p. 413.

over the side of the canoe; the sturgeon, seeing this light, mounted to the surface, where it was slain and captured with a fizgig.[1]

Dr. Fewkes calls attention to walrus-ivory spear points in Nova Scotia similar to those used by the Eskimo. The walrus frequented the coast of Prince Edward Island within historic times. The points are not definitely described.[2]

ARCTIC HARPOONS.

The Eskimo harpoons are of every variety, barbed or toggle. The dependence of the people largely on aquatic animals for food, dress, house, furniture, tools, and utensils of all sorts makes some kind of retrieving device absolutely necessary. They use the lance also most effectively, but the weak spear, with which the Indian tribes are wont to pick fish from the water, would be of little use among the Eskimo. The variety of animal life, both in size and habit, as well as differences of terrestrial conditions, have stimulated the Eskimo mind to the utmost in devising the most varied additions to what was in the beginning quite simple. Here, also, along the Arctic shore, more than in all other environments of the Western Hemisphere combined, suggestions of improvement have come from without. It is nature's pedagogic institute. More than that, harpoon heads, large and small, of most appropriate patterns, have been made by machinery and traded to the Eskimo by whalers and fur hunters. In this part of the paper the specimens will be described as they occur. The question of the derivation of each feature will then be more easily settled.

A. B. Meyer calls attention to this and says that the little toggle heads of harpoons were not invented in their present form. Semper encountered them among the Negritos of the Palanan, north coast of Luzon, for pig shooting, in the form of harpoon arrows. Meyer describes an example from Bataan, after A. Schadenberg, and figures examples from Palanan and Bataan. All of these have 3-feathered shafts, spindle-shaped loose shafts, attached to both head and shaft by a short line, and iron heads, including both barb and toggle characteristics. The barbs are sometimes at right angles to the plane of the line hole, in other examples in the same plane. In some the toggle head has a conical projection for a socket, the latter being on the end of the loose shaft. Of the last-named pattern the Eskimo examples have no parallel forms.[3]

The Eskimo province may be divided into the following areas or subdivisions:

Area 1. East Greenland, west Greenland, Labrador, and Hudson Bay.

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[1] John Josselyn, Two Voyages to New England, 1674, p. 140.

[2] American Antiquarian, XVIII, 1896, p. 6.

[3] A. B. Meyer, Die Negritos, IX, folio series, publications of the Royal Dresden Museum, p. 14, figs. 1 and 2; pl. VI, figs. 2 and 3; pl. VIII, figs. 1 and 2.

Area 2. The central Eskimo of Boas.

Area 3. The arctic Eskimo, from the mouth of the Mackenzie River, including Point Barrow and Kotzebue Sound.

Area 4. The Bering Sea Eskimo, including Bering Strait southward to Norton Sound, the lower Yukon, Nunivak Island and the mainland, Bristol Bay, and Kadiak.

EAST GREENLAND HARPOONS.

In this seemingly out-of-the-world location the harpoon is far from its original form. All specimens are toggled and iron enters surprisingly into their composition. Holm (1887) figures the different varieties in his Plates 15, 16, 29, 30, 32, 33.

The hinged lance is here also with shaft of wood, having hand rests on the sides, assembling lines of rawhide to hold the parts together, and foreshaft with flat top, from the middle of which a short cone projects. Some lances have, instead of hand rests for thrusting or hurling from the hand, the throwing stick or ajagsick. The head of the hinged lance consists of three parts, the iron blade (1), set in a shank of ivory (2), and this is fastened into a block of the same material (3), with flat base, in the center of which is a cavity just fitting over the cone on the top of the foreshaft. This block is hinged to the foreshaft by means of elastic rawhide thongs piercing it and the shaft [1] (fig. 23).

The plainest variety of east Greenland has a wooden shaft, with chisel-shaped ice pick at the end. The toggle head is of bone or ivory, with iron blade, flat, cone-shaped body, two line holes quite through the body, united by a groove on the back, into which the line sinks. The shaft socket is in the center of the base, two wing-like barbs flanking it. The complete sealing harpoon is modeled after that of west Greenland, having eyelets instead of hooks for the throwing stick, and being covered all over with little figures of animals, reminding one slightly of the Aleutian hat and the bark onlaying of the Amur people.

The barbed leisters or fish spears, with two or more barbs, are turned by these Eskimo into a toggle arrangement quite unique in America. The piercing ends are of iron or bone and hinged as in a pair of scissors, the cutting end piercing the animal, the other end lying against the shank. When they have entered the flesh these points turn at right angles and toggle.[2] A most curious device is the adaptation of this hinged head to a seal harpoon, provided with a little sled on the fore end of a very long shaft. It will be seen later on that the west Greenlanders use for deep-sea fishing for seals a very long shaft worked by two men, and that the Giliaks make a harpoon shaft nearly a hundred feet long, with a float on the fore end.[3]

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[1] Holm, East Greenland, 1887, pl. xv.

[2] Idem., pl. xv, *a* and *b*.

[3] Schrenk, Reisen und Forschungen in Amurlände, 1881, p. 546.

A harpoon (Cat. No. 168960, U.S.N.M.) from east Greenland, presented by the Copenhagen Museum, is shown in Plate 4. While in general appearance the weapon is similar to those of the same character in southwest Greenland, the head is a type peculiar to the eastern part of the peninsula. The body is of narwhal ivory, conical in outline, a long, lanceolate blade fastened in by means of a rivet. The point of the loose shaft enters directly into the base, which is flanked by two conspicuous barbs or spurs. A strip of iron is riveted across the lower portion on either side to strengthen it. An interesting feature in this specimen is the line hole, which consists of two separate perforations, united on the back with a groove or countersunk cavity to prevent the line from chafing. The loose shaft, which has been neatly spliced at the upper end, has a flat surface at the base, with a projection in the middle, fitting into a cavity on the front of the foreshaft, and the two are tightly hinged together by means of a lashing of elastic rawhide. The use of this joint has been elsewhere explained. The foreshaft is in this specimen a cap of ivory, squared off on top, and the middle left projecting for the socket on the base of the loose shaft. The shaft is of wood, and has on its surface the following attachments: A knob of ivory at the lower end, three hooks or pegs for the throwing stick, one to catch into its base or working end, and two near each other fitting into holes in the manual end of the throwing stick, as seen in the figure. Near these pegs is a hook of ivory, over which fits a catch of the same material on the line, serving to hold the toggle head firmly upon the top of the loose shaft when the weapon is set ready to be plunged into the body of the animal. The throwing stick has a perforation at the working end instead of a peg. The line of rawhide is fastened immediately into the head of the harpoon and has a toggle at the other end to be attached to the line of the float. The other accessories to harpoons of this class are to be seen in Plates 14, 15, and 16 of Holm (1887).

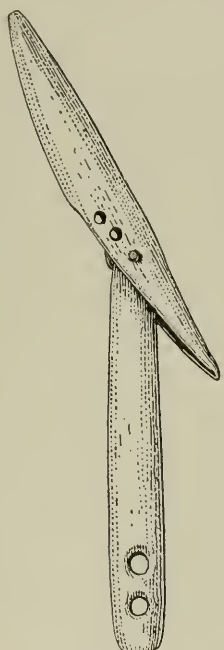
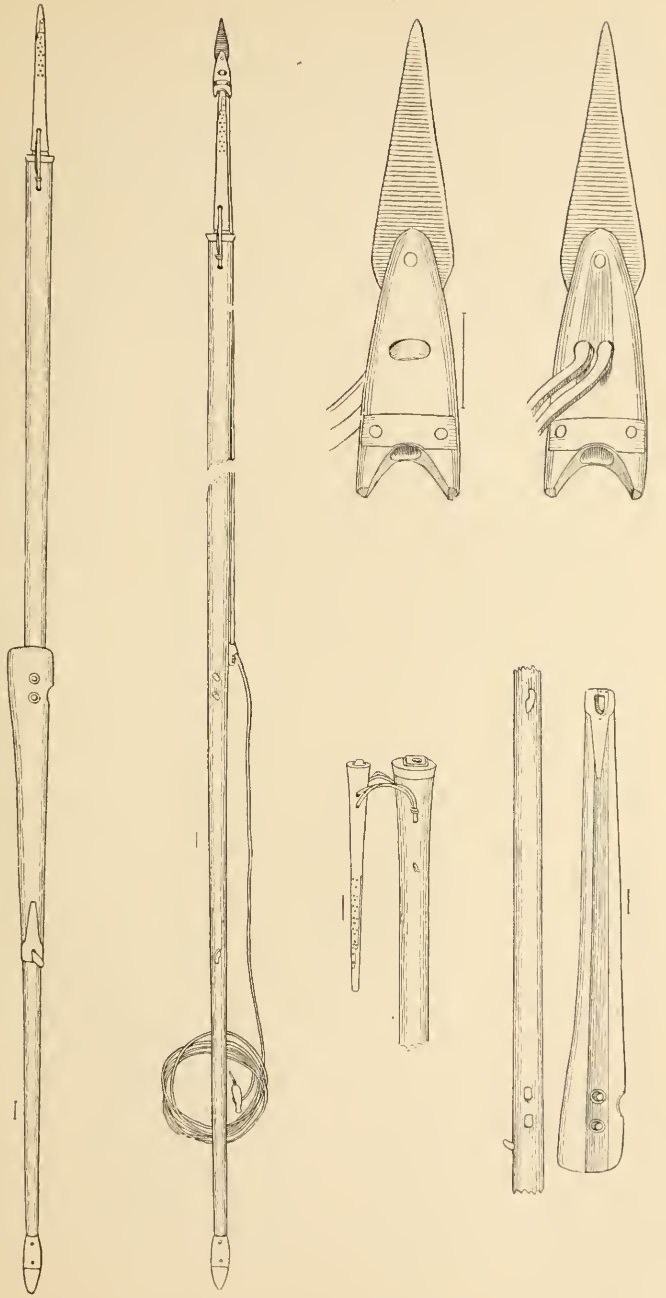


Fig. 23.
HINGED TOGGLE HEAD.
East Greenland.
After Gustav Holm.

WEST GREENLAND.

The oldest accounts of the Eskimo refer to those of Greenland and Labrador, but some of their apparatus remains quite primitive. Again, in a preliminary work like this the area can not be accurately subdivided. The natives themselves are fond of wandering about, and



TOGGLE HARPOON, EAST GREENLAND.

Gift of Copenhagen Museum.

Cat. No. 168960, U.S.N.M.

they leave their ideas as well as their accouterments. The task of discrimination is further embarrassed by the collector's unfortunate habit of labeling a specimen with the name of the place where he procured it, himself frequently not knowing the place of its manufacture. The numbers on the specimens are arranged as they occur in the catalogue of the U. S. National Museum.

Hans Egede, the apostle to Greenland (1721–1736), gives the following description of the harpoon and its uses:

When the Indians of Greenland go whale catching they put on their best apparel, fancying that if they did not come neatly dressed the whale, who can not bear slovenly habits, would shun them. About fifty men and women set out in one of the large boats called kone-boats. The women carry along with them their sewing tackle, consisting of needles and thread, to sew and mend their husbands' spring coats should they be torn, and also to mend the boat in case it should receive any damage. The men go in search of the whale, and when they have found it they strike it with their harpoons, to which are fastened lines or straps 2 or 3 fathoms long, at the end of which they tie a bag of a whole seal skin filled with air; so that when a whale finds itself wounded and runs away with the harpoon it may the sooner become tired, the air bag hindering it from being long under water. When it thus loses strength they attack it again with their spears and lances until it is killed; then they put on their spring coats, made of dressed seal skin, all of one piece, with boots, gloves, and caps, sewed and laced so tight together that no water can penetrate them. In this garb they jump into the sea and begin to slice the fat off all around the body, even under the water; for in these coats they can not sink, since they are full of air, so that they can, like the seal, stand upright in the sea. They are sometimes so daring they will get upon the whale's back while there is yet life in him, to cut away the fat.

They go much the same way to work in killing seal except that the harpoon is lesser, and to it is fastened a line 6 or 7 fathoms long. At the end is a bladder or bag made of a small sealskin filled with air, to keep the seal, when he is wounded, from diving under water and being lost again. In the northern parts, where the sea is frozen over in the winter, the Eskimo use other means. They first look out for holes which the seals make with their claws, about the size of a half penny, that they may catch their breath. After they have found a hole they seat themselves near it upon a chair made for the purpose, and as soon as they perceive the seal come up to the hole and put its snout into it for air, they immediately strike it with a small harpoon to which is fastened a strap a fathom long, which they hold in the other hand. After it is struck and can not escape, they cut the hole so large that they may get the animal up through it, and as soon as they have its head above the ice they can kill it with one blow of the fist.

A third way of catching seals is to make a great hole in the ice, or in the spring they find holes made by the seals. Near to these holes they place a low bench upon which they lie down upon their bellies, having first made a small hole near the larger one, through which they let softly down a perch 16 or 20 yards long, headed with a harpoon, a strap being fastened to it which one holds in his hand, while another, who lies upon a bench with his face downward, watches the coming of the seal, when he cries "Kae," whereupon he who holds the pole pushes and strikes the seal.

The fourth way is this: When the seals, in the spring, are lying upon the ice near holes which they themselves make to get up and down, the Greenlanders, clothed in sealskin, holding harpoons in their hands, creep along upon the ice, moving their heads backward and forward and snoring like a seal till they come so near them that they can reach the animal with their harpoons and strike them.[1]

The Greenlanders, says Nansen, use two forms of the great harpoon: (1) the Unak, with butt end finished in a bone knob; it is longer and slighter than (2) the Ernangnak, having on its butt end two feathers of bone, commonly whale rib, to increase the weight and guide the flight.[2] The line is made of young walrus (*Odobœnus rosmarus*) or of bearded seal hide (*Phoca barbata*), from 15 to 18 yards long and one-fourth inch wide. The float is the skin of a young ringed seal (*Phoca fœtida*) taken off whole, the hair removed, the apertures all tied up, and the whole dried. The line is coiled on the kaiak stand.[3] He calls the great Greenland and Hudson Bay harpoon, thrown from the hand without the throwing stick, Sigagut. In the work above referred to a spirited description of the harpoon and its accessories will be found (pp. 62–64), with figures.

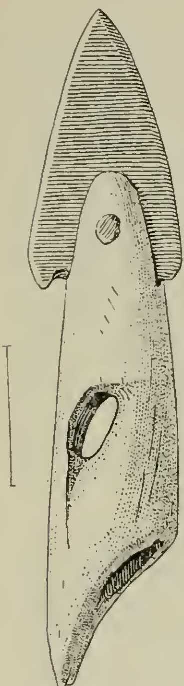


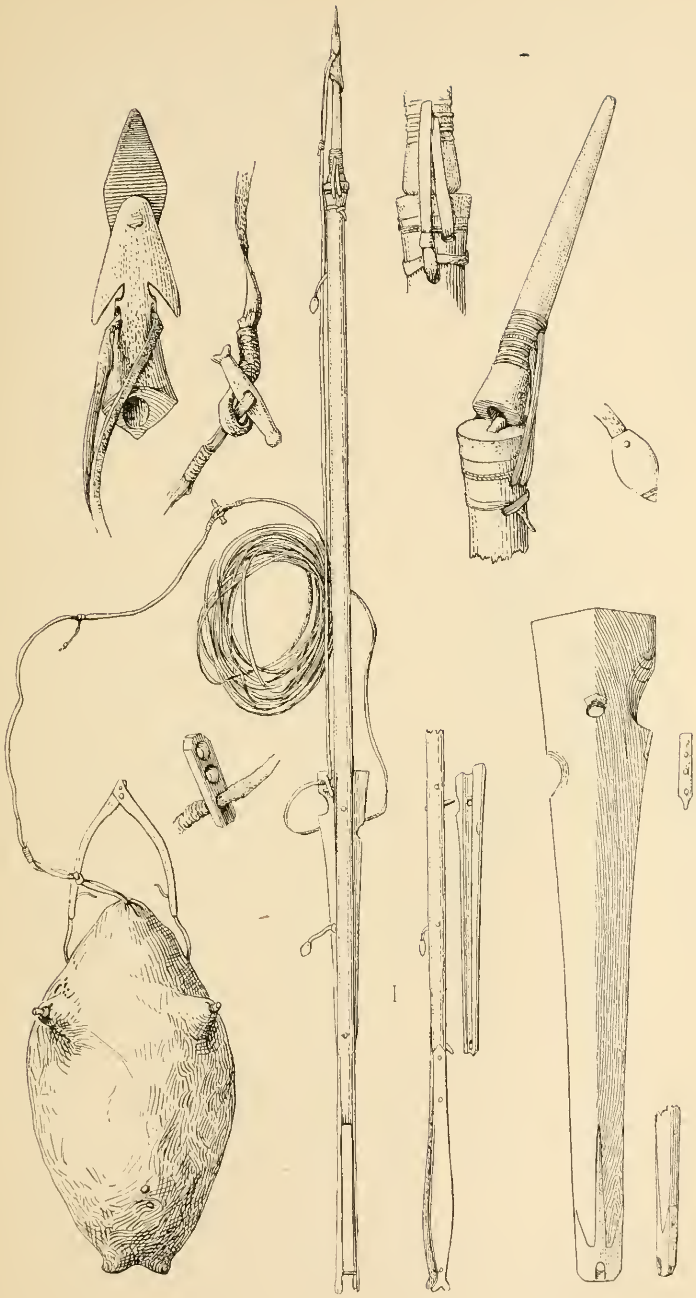
Fig. 24.
TOGGLE HEAD.
West Greenland.
Collected by S. F. Baird.
Cat. No. 9836, U.S.N.M.

Before giving in detail the structure of the western Greenland harpoon, attention must again be called to the difficulty of making neat distinctions. Recent explorations by Peary especially assign Smith Sound material to the Central Eskimo; at least it is intermediate. The constancy of iron in the oldest specimens also demands that no hasty conclusions be drawn concerning the original Eskimo harpoon, either as to its design or ornamentation.

A toggle head from Greenland (Cat. No. 9836, U.S.N.M.), with a triangular blade of iron slightly barbed on one corner, fastened into the slit by a rivet of iron, is shown in fig. 24. The body is conical; the line hole is cut across the body and across the plane of the blade. It is an elliptical opening, and its diameter is not in a line with the axis of the body. It has one spur for a barb, and the socket for the foreshaft is wide and shallow. It is the gift of S. F. Baird.

A modern toggle head of a whale harpoon (Cat. No. 19510, U.S.N.M.), from Greenland, is seen in fig. 25. This unfinished specimen shows the last step in the development of the machine-made toggle head. Everything about the specimen demonstrates this—the mathematical form, the saw cut for the blade, the socket for the foreshaft, the angular barb, and especially the large line hole cut straight across the body of the toggle head. In the primitive examples this last feature cost

[1] Egede's Greenland, pp. 102–106.
[2] Nansen, Across Greenland, 1893, p. 37.
[3] Idem., p. 33.



SEAL HARPOON FROM WEST GREENLAND.

Collected by N. P. Scudder.

Cat. No. 35670, U.S.N.M.

the maker a great deal of trouble. He had to bore two holes slanting toward each other and meeting inside, to unite these by removing the rough surface, and to separately prepare grooves to receive the line. This is the gift of J. H. Clark.

Plate 5 in the U. S. National Museum is a complete seal harpoon from west Greenland (Cat. No. 35670). The head is a combination of barb and toggle, sagittate in outline, with a slender waist and wide base; a very gracefully-made specimen. The blade is rhomboidal, but squared off in the saw cut and riveted with iron. The oblong line hole passes straight through the waist and has slight line grooves.

There are three barbs. Those on the side are angular, prominent, and sawed out, so as to present three flat surfaces inside; the terminal barb angular, formed by the two sloping faces of the back and the beveled surface of the butt; socket for the end of the foreshaft narrow and clean cut. The butt end has no bend or curve in it, but is formed by a single cut in the same plane.

The line is drawn through the line hole, bent, and the end fastened down 6 inches from the toggle head, and held fast by a seizing of sinew three-ply braid, laid on for an inch in half hitches.

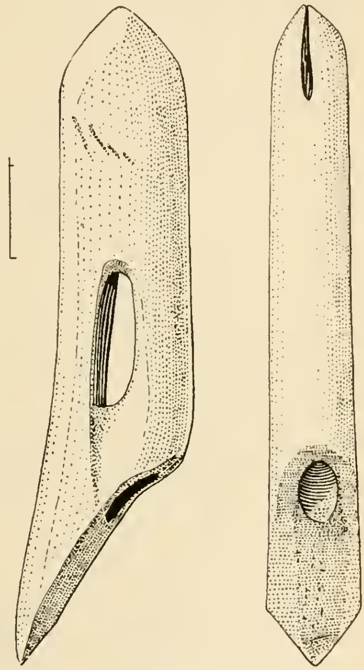


Fig. 25.

TOGGLE HEAD.

West Greenland.

Collected by J. H. Clark. Cat. No. 19510, U.S.N.M.

At a distance of 50 inches from the toggle head is an eyelet of bone, $1\frac{1}{2}$ inches long and half an inch wide, having rectangular outline and pierced with three holes, through one of which the line runs. Just beyond this eyelet is a wrapping of sinew string acting as a stop. The whole line is over 30 feet long and terminates in a toggle of reindeer antler, with a knob at one end and a bifurcation at the other end. This is to hook into a loop in the line of the float, to be now described.

The hide of a young seal was drawn off over the neck, care being taken to keep the legs and other parts complete. After being turned right side out, the hide was sweated, depilated, and again turned wrong side out and all openings carefully fastened up air-tight. But into the puckered orifice of the neck a stout rawhide loop was inserted and made fast and into one forefoot a bone mouthpiece was firmly lashed. About this specimen, as on many other floats, little holes were stopped by studs of wood or hard animal substance, set in when the hide was green, which, shrinking, renders the joint perfectly tight. As mentioned, into the puckered neck of the float was knotted a bend or loop 6 inches long. This would serve as a handle and be inseparable from the float. A stout piece of rawhide line, 3 or 4 feet long, was bent to form a loop at each end. Into one loop the float-loop was spliced, and into the one on the other end of the line the toggle of the harpoon line hooks. The bends in the ends of the short float line are seized down by means of sinew braid in half hitches. The float is always associated with the kaiak, and therefore it has attachments for it, as well as for the line. In the end of the float, where the float loop is fastened, and on either side of the latter, two short rawhide lines are inserted and made fast on the inside. These short pieces are run into the ends of a device, made from two pieces of antler, for slipping under one of the cross lines on the deck of the kaiak. For this purpose a hole was bored up in the end of each one of these pieces 1 inch, met by a hole bored half way in at the side, and half an inch above another hole was bored quite through. The line from the float is drawn up the hole at the end, out at the meeting hole, and through the upper hole, where it is fastened with a peg, the two holes being united on the outside by a countersink to prevent abrasion by ice. A wooden peg wedges the line fast in the inner hole. The two front ends of the pieces of antler are united by an iron rivet. These details are mentioned to call attention to the cunning makeshifts of savages working with the poorest tools. The maxim, "Where there's a will there's a way," is quite true among the Eskimo.

The shaft is a typical Greenland form and consists of loose shaft and rawhide hinge or connecting line, foreshaft, shaft, and "feathers."

The loose shaft is an elongated cone of ivory 7½ inches in length, having at a distance of 1 inch from the butt a raised ornament of rings and bands turned as in a lathe, the middle band with cross ridges. Two holes are bored, one above the other, through this ornament, and three holes through the fore end of the wooden shaft for the rawhide thong that forms the elastic joint between loose shaft and foreshaft. This thong is doubled at its widest end and the whole drawn through one of the shaft holes, not tightly; it passes (1) through the lower hole of the loose shaft, (2) back through a hole in the shaft, (3) up through the outer hole in the loose shaft, (4) back through the loop in the first end, then through the third hole of the shaft and once wrapped around, the end being tucked under as in making a single knot after the whole is drawn as tight as possible.

The base of the loose shaft is squared off and socketed. The foreshaft is only half an inch long, but forms an ellipse 1½ by 1¼ inches in diameter. It has a pivot or projection on top to fit into the socket of the loose shaft and is excavated below to fit over a tenon in the end of the wooden shaft, which is kept from splitting by a wrapping of sinew twine.

The shaft, of pine wood, 5 feet 2 inches long and 1¼ inches thick, tapers somewhat toward the butt end. Upon it are the following additions: Buttons for holding the shaft on the kaiak, peg over which the eyelet on the line catches to hold the head on the loose shaft, two pegs for the throwing stick, and bone feathers.

The buttons for holding the apparatus on the kaiak are two little almond-shaped bits of ivory, attached to the shaft near either end by means of a short rawhide thong. These buttons are tucked under the cross lines on the deck of the kaiak, but on occasion do not offer any ratchet to prevent withdrawal. The throwing stick pegs for the two holes in that apparatus are of bone and extend quite through the shaft near either end. The west Greenland shaft for the seal harpoon is unique in having the pegs on the shaft and not on the throwing stick.

The butt end of the shaft is squared for the attachment of the two "feathers" carved from whale's bone. The end of the shaft is beveled off and grooved.

It must be borne in mind that as a rule the North American Indians have three feathers on their arrows, radiating outward; the Eskimo have two, laid flat on the flat shaftment. Now on the west Greenland smaller harpoon, at either side of the butt, is a strip of whale's bone 16 inches long, from 1½ inches wide, and one-eighth inch thick, both exactly alike, with long leaf-shaped outline terminating in a fish-tail bifurcation. These two plates are pegged on for 5 to 6 inches, so that their outsides are flush with the shaft, and their butt ends are held apart in place by an ivory peg or cylinder. The area of this device or attachment is very circumscribed. It is not shown by Boas, Kumlien, or Turner. The throwing stick is of light, coniferous wood, very broad in the manual part and tapering gracefully toward the working end. The top is slightly rounded up, the bottom of two surfaces meeting in a ridge along the middle. The shaft groove is an inch wide and from one-fourth to one-eighth inch deep, extending the entire length of the piece. It is right-handed, having a deep under-cut notch on the left margin for the thumb, just back of which on the margin is a pretty bit of bone pegged on. The hole in the manual part for the peg has in front of it a washer of bone set in to prevent the peg from wearing the hole larger. Into the working end of the throwing stick is neatly set a T-shaped bit of whale's bone, held in place by pegs quite through both bone and wood. At the outer end of this bone is a large hole slanting forward and into it the rear peg on the shaft fits. When pulled straight ahead the hook holds firmly, but when the throwing stick begins to turn away from the shaft the hole unhinges from the peg. All this action with least resistance is provided for in the device. Collected by N. P. Scudder.

A flat toggle head (No. 45855, U.S.N.M.) with a gibbous section has the back more compressed than the belly. The front end is rounded, the blade slit not deep, and rivet hole large. The line hole is curved upward and has deep line grooves. Barbs, two on the outer margins, formed by a slightly incurved cut into the butt end. The butt is whittled away so that the toggle head is just as long on the belly as on the back. Length, 3 inches. Gift of the Copenhagen Museum. Example 63951, gift of Governor Fenckner, is somewhat similar, but the back is longer and the notch between the tips of the barbs is not angular.

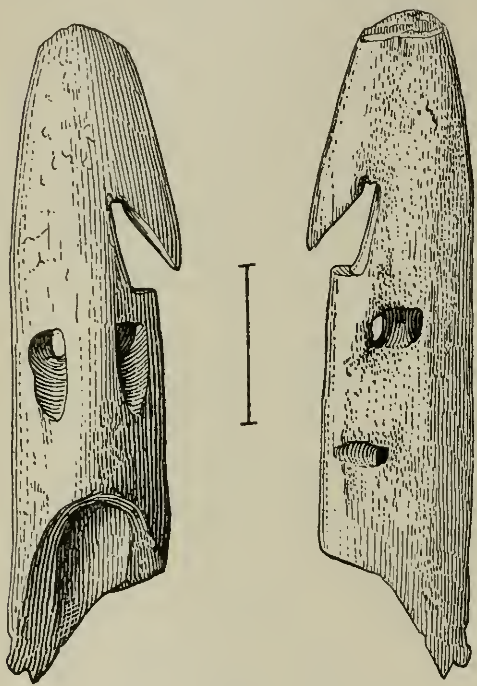


Fig. 26.

TOGGLE AND BARBED HARPOON HEAD.

West Greenland.

Gift of Copenhagen Museum. Cat. No. 45883, U.S.N.M.

Example No. 45670 in the U. S. National Museum is the point of a large harpoon from Greenland. The blade, of iron, was inserted in a saw cut in the end of the shank and riveted with iron, now decayed by rust. The shank, of whale's rib, is rectangular in the section at the front and circular in other parts. Between the rectangular and circular portions are four barbs. At the angles the butt end is conical to fit into a socket. In the end of the shaft, 3 inches above, two holes are pierced for the insertion of a thong forming a hinge between the loose shaft and the shaft. Total length, $15\frac{3}{4}$ inches. Gift of the Copenhagen Museum. No. 63939 is a broken and unfinished specimen of the same type.

Example No. 45872 in the U. S. National Museum is the loose shaft and point of a barbed harpoon combined, from south Greenland. The front end is furnished with two barbs on one side and the top is pointed. The butt end is cylindrical to fit into the foreshaft, and 2 inches above it are three holes bored for the rawhide thong which attaches this part to the shaft. The noticeable feature in this old piece is the presence of the barbs on the loose shaft and the entire absence of toggle attachments. Length, 14 inches. Gift of the Copenhagen Museum.

Fig. 26 is a combined toggle and barbed harpoon head from western Greenland (No. 45883, U.S.N.M.), all in one piece of antler. The body is narrow and flat, the spongy part of the material being the back of the implement, while the belly, which takes the strain of the line, is the outside hard portion of the antler. For a blade, the fore end was sharpened to a point. There is no evidence of a metal blade having been used in this head. The line hole is formed by two slanting holes meeting on the back of the body, so as to leave a small opening on the back, a feature not common in Greenland specimens, but observed in many from the Amur region (Plate 7). The line grooves extend only half an inch backward, and then suddenly terminate. Originally there were doubtless three barbs: one, a strong hook on the left-hand margin between the point and the line hole, and two barbs at the butt, spread out like a fish tail, the tips being cut in an ornamental manner (see Plate 8, from Von Schrenk). The socket for the foreshaft is only three-fourths of an inch deep. The butt end is cut off with a long bevel, steep on its lower half and sloping more and more outward. Length, 4¼ inches. Collected by Dr. Emil Bessels, but special locality not given.

A toggle head of bone from western Greenland (No. 45884, U.S.N.M), conoid in form and double convex in section, is shown in fig. 27. The blade, which was of metal, is wanting, and the blade slit is wide for such a small specimen, the rivet hole neatly bored. Line hole, of two cone-shaped cavities, meeting in the body of the implement, and having slight line grooves. There is but one barb, pointed on the back, a little to the right-hand side of the middle. The socket for the end of the foreshaft is cone-shaped. Length, 2½ inches. Gift of the Copenhagen Museum. This specimen, though exceedingly plain in shape, does not mark an early form of toggle harpoon head, but a later period, when they were made in great numbers, sometimes by machinery, and sold to the Eskimo, who found it easier to provide themselves in this way than to make them by their rude tools.

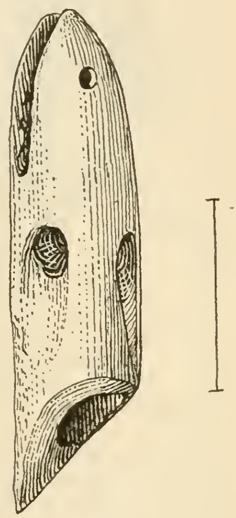


Fig. 27.
TOGGLE HEAD.
West Greenland.
Gift of Copenhagen Museum.
Cat. No. 45884, U.S.N.M.

An old toggle head of a harpoon from north Greenland (No. 45885, U.S.N.M.), collected by Emil Bessels, is shown in fig. 28.

The body is of bone, the back nearly flat, being the soft part of the material, and the belly, which is more rounded, is of the outer, hard part of the bone, this being necessary in order to take the strain of the line.

The blade in this example is missing, and was inserted in a saw cut at the rounded end of the body and held in place by a rivet.

The shaft socket is a conical hole centered between the back and the front surfaces and flanked by barbs whose points are formed by the meeting of the back, the belly, and the socket or excavation in the rear for the foreshaft.

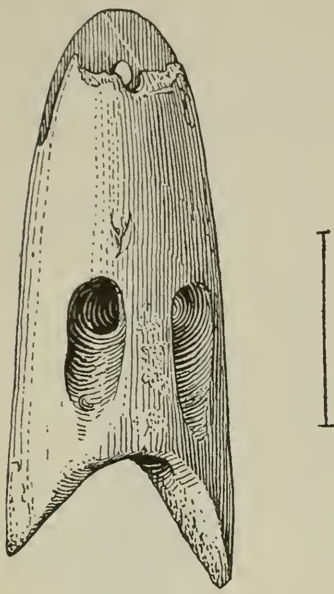


Fig. 28.

OLD TOGGLE HEAD.

North Greenland.

Collected by Emil Bessels. Cat. No. 45885, U.S.N.M.

The line hole is formed by the meeting of two holes bored in from the under side and not quite through to the top. Line grooves project backward from the line hole so as to render all smooth to prevent the thong from chafing. Length, $2\frac{1}{4}$ inches.

A combined barbed and toggle head (Cat. No. 45886, U.S.N.M.) from west Greenland is shown in fig. 29, and is a gift of the Copenhagen Museum. The body is of bone, the back being formed of the hard or outside portion. The kerf for the blade is wide, and the latter, missing in this specimen, was fastened in with a rivet. On either side of the blade are two marginal barbs, cut out squarely as with a saw; from the tang of these barbs the body widens out to the tip end of the spur or flukes. The line hole is formed by two distinct conical bores, which meet at their inner extremities, forming at the same time a continuous cavity and line grooves. The butt is bifurcated, and the cavity for the end of the foreshaft seems to have been bored out after the barbs were formed. This fine old piece is worthy of note in that both types of harpoon head, the barbed and the toggle, are preserved. The specimen represents also what Murdoch considers to be the original form, since the barbs, the blade, and the line hole are in the same plane, while in the better and more improved varieties the blade is set in at right angles to the line hole.

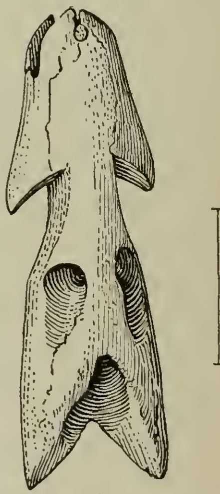


Fig. 29.

OLD BARBED AND TOGGLE HEAD.

West Greenland.

Gift of Copenhagen Museum. Cat. No. 45886, U.S.N.M.

A barbed harpoon head of bone (Cat. No. 45887, U.S.N.M.), all in one piece, from northwestern Greenland, is shown in fig. 30. It is shaped like a barbed and tanged arrowhead, with a line hole through the tang in the plane of the blade. The tang abuts squarely on the end of the shaft and the front of the blade is sharpened to an edge. The barbs are not of equal length. Length, $1\frac{3}{4}$ inches; width, $1\frac{5}{16}$ inches. From Greenland. Collected by Dr. E. Bessels.

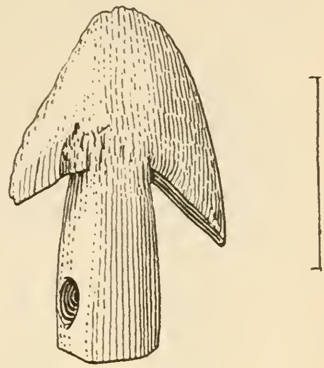


Fig. 30.
BARBED HARPOON HEAD.
Northern Greenland.
Collected by Emil Bessels. Cat. No. 45887. U.S.N.M.

Cat. No. 45888 (Fig. 31) is a barbed head of whale's rib, but there is not enough remaining to indicate whether it had toggle attachments. Length, $4\frac{1}{4}$ inches. Gift of Copenhagen Museum.

These old pieces are most interesting connecting links between the simple barb and the toggle head. They might be named conservative harpoon heads, which, while trying the new device, can not at once lay the old barb aside.

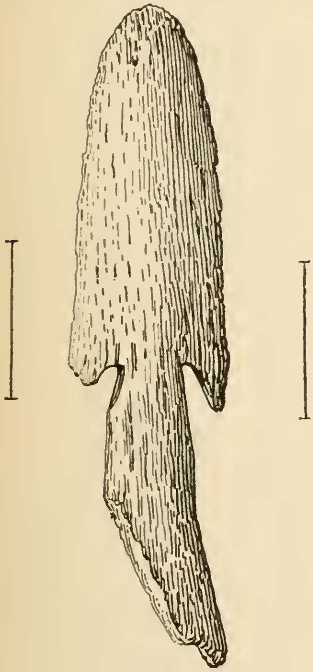


Fig. 31.
OLD HARPOON HEAD.
North Greenland.
Gift of Copenhagen Museum. Cat. No. 45888, U.S.N.M.

A toggle harpoon head (No. 45889, U.S.N.M.) from western Greenland, made of bone all in one piece, is shown in fig. 32. It is double convex in section and the point is formed by shaving down the faces of the body. The line hole passes through the bone in a direction perpendicular to the plane of the blade, and the single barb is formed by beveling the end. The line grooves are slight, and the cavity for the shaft large, its margin continuous. Length, $5\frac{1}{2}$ inches; width, one-half inch; depth, fifteen-sixteenths inch. Gift of the Museum of Ethnology, Copenhagen. An entirely aboriginal form, with no metal about it. From this it is not to be inferred that the piece antedates the coming of the whites.

The loose shaft of a toggle harpoon (Cat. No. 45893, U.S.N.M.), made of wood, from south Greenland, deserves consideration. It is spindle-shaped, elongated on one end, and short at the other, elliptical in cross section. Through the thickest portion two holes are bored for the rawhide thong which unites it to the shaft. Examples of this part of the harpoon in wood are very rare. Length, $9\frac{1}{2}$ inches. Gift of the Copenhagen Museum.

An ancient barbed and toggle harpoon head (Cat. No. 45910, U.S. N.M.), made from a bit of hollow bone, from northern Greenland, collected by E. Bessels, is shown in fig. 33. The point has been cut off so that it is impossible to say how the blade was set on. The barbs on the margin in front of the line hole have been cut out squarely but their points have evidently been reduced. It is possible, however, that their present form represents nearly the shape of the original material. At this point it is proper to make an observation which applies very largely to the forms of aboriginal implements. The savages understood how, in an emergency, to secure the largest amount of result with the least amount of effort. It is with inventions as with language. A long word is not employed when a shorter one will suffice, and a servile imitation of any type specimen is not attempted when the result can be reached more directly. Hence, while objects of a certain class resemble one another in general, no two are alike in detail. The line hole is cut through the soft part of the bone by two conical perforations meeting in the middle, and the line grooves appear to have been made by the same instrument. The back of the body of this toggle head is very hard bone, and the spur bends upward and outward, following the natural curve of the material. The base is cut off by a nearly plane surface. The socket for the foreshaft is a cylindrical hole bored straight into the bone from the rear, apparently with an instrument of iron. It is not conical as in the great majority of Eskimo harpoon heads.

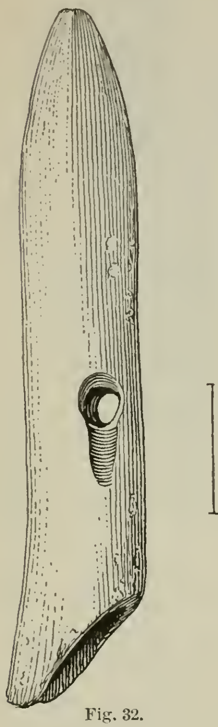


Fig. 32.
TOGGLE HEAD.
West Greenland.
Gift of Copenhagen Museum.
Cat. No. 45889, U.S.N.M.

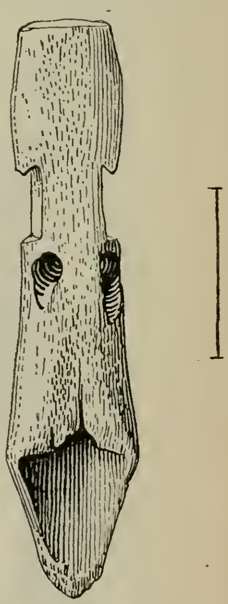


Fig. 33.
OLD BARBED AND TOGGLE HEAD.
West Greenland.
Collected by Emil Bessels. Cat. No. 45910, U.S.N.M.

A toggle harpoon head, made of antler (Cat. No. 45947. U.S.N.M.), from north Greenland, the gift of the Copenhagen Museum, is shown in fig. 34. It is in the form of a flat cone with convex sides. The kerf or saw cut is wider than in the more modern examples, because the blade was of stone and held in place by a rivet of bone. The line hole is most primitive and interesting, being formed, not by a sloping cavity, but by means of a drill. The socket at the base is also conical, opening into the line hole, and two barbs of equal size are formed by cutting away the material of the back. This bifurcation is found on many Greenland specimens. Those who are acquainted with the Eskimo handicraft in localities where steel tools do not abound are interested to note what free and varied use these natives make of drills of different sizes. There are twenty examples of boring on this little toggle head, for the rivet, for the line hole grooves and socket, and besides for mending a crack in the material. For this last purpose we have not only perforations for the sinew mending, but gutters bored one twenty-fourth of an inch deep, into which the cord was countersunk. This will be better seen by an examination of the illustration.

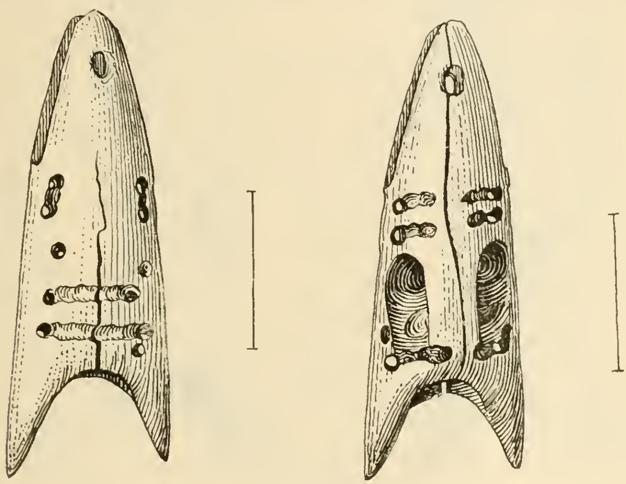


Fig. 34.

OLD TOGGLE HEAD.

North Greenland.

Gift of Copenhagen Museum. Cat. No. 45947, U.S.N.M.

The point of a barbed harpoon (Cat. No. 63938, U.S.N.M.), from Greenland, must be mentioned. The point is arrow-shaped, symmetrical, with two barbs. The tang is spindle-formed, with a cone at the butt end and pierced in two places for the insertion of the line connecting with the shaft. Length, 5¼ inches. Gift of Governor Fenckner.

Similar to this is Cat. No. 63937, U.S.N.M., an old specimen from the same locality. These examples have their counterpart in the numerous points of the small barbed seal harpoon of the western Eskimo.

An old barbed and toggle harpoon head (Cat. No. 63940, U.S.N.M.) from west Greenland, the gift of Governor Fenckner, is shown in fig. 35. The material is bone. The blade is wanting, and the blade slit has been cut away. There are three rivet holes, and one of them, seen on the right side of the left-hand figure, is double. The barbs on the margin are cut out square, as with a saw, but the sides of the tang are curved in, leaving shoulders at their base, from which point the body curves outward to the end of the spurs. The line hole is formed, as in most examples of this kind, by two independent conical bores which meet at their inner point. Line grooves are connected with these. The base is not cut off in a plane surface, but has the appearance of being scooped out, beginning on the under side with a perpendicular surface, which slopes more and more toward the

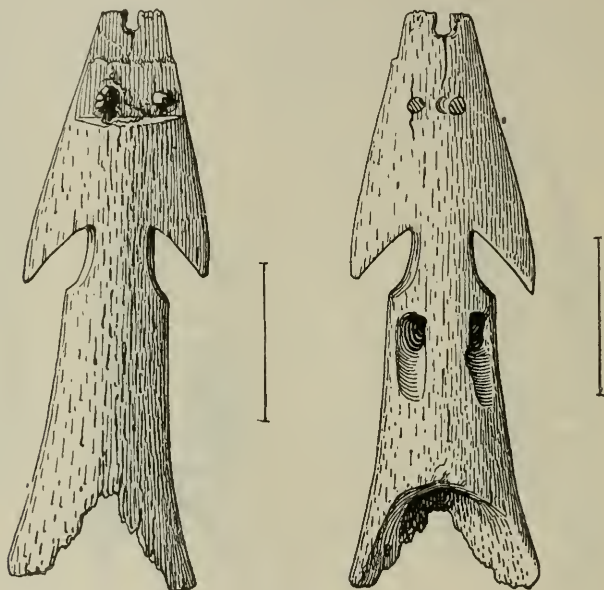


Fig. 35.

OLD BARBED AND TOGGLE HEAD.

West Greenland.

Cat. No. 63940, U.S.N.M.

horizontal as the ends of the barbs are approached. This specimen is noteworthy for conserving the two types of harpoon heads in one, the barbs on the sides, and the toggle.

A combined barbed and toggle harpoon head (No. 63941, U.S.N.M.) of antler from Greenland is represented in fig. 36. It is rhomboid in cross section, sagged downward in the middle, and delicately made. The blade, of iron, formerly present, but now wanting, was held in place by a rivet. The line hole, formed by the meeting of two excavations, is curved, but not visible on the back. Line grooves short and whittled out. Barbs, three—two in front of the line hole and one at the butt. The barbs on the margin in front are sharp and prominent for such a small specimen, the cut of each being three-sided. The rear barb is cocked up and pointed, and its edges ornamented each with two crenate notches. Butt cut off at a sharp angle, nearly in a single plane; socket wide and shallow. Between the line holes and the socket is an ingenious combination of perforations and gutters for repairing. Length, 3$\frac{3}{4}$ inches. Gift of Governor Fenckner, of Greenland.

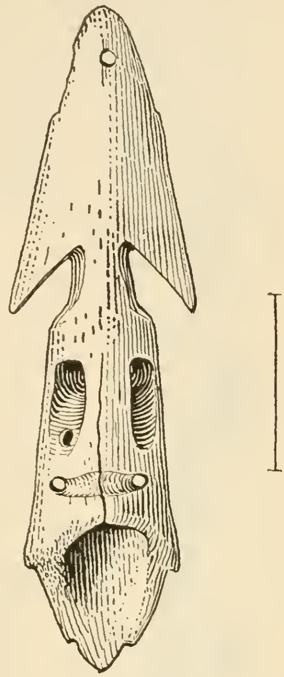


Fig. 36.
BARBED AND TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner. Cat. No. 63941, U.S.N.M.

Of this same type and pattern, but ruder, is Cat. No. 45910, from Greenland, made of bone, and somewhat dilapidated. The hard bone forms the back, and the excavations on the belly are in the spongy portion; the reverse of this is usually true. The slight barbs on the edges are quite squarely sawed out and the single barb at the rear much bent upward. Length, 3$\frac{3}{8}$ inches. Gift of the Copenhagen Museum.

A combined barbed and toggle head (Cat. No. 63942, U.S.N.M.) from Greenland, made of bone, is shown in fig. 37. Body flat on the belly, and conformed to the shape of the material on the back; an unwise method, because in this case the spongy tissue has to take the strain. Separate blade, none, the material being sharpened to a point and edge. Line holes small, set at an extraordinarily acute angle to each other and barely continued through to the back. Line grooves scarcely visible. Barbs, four—two broad, angular teeth in front, one on either side, and two angular toothed projections behind. Socket shallow and wide. Butt end gouged or dished out, so as to give free play to the loose shaft, and leaving the barbs, looking from the under side, like a pair of fins. Length, 4 inches. Collected by Governor Fenckner. With this example should be compared Nos. 63940 and 45886—the former of whale's rib, the latter of antler. Both these examples are of the same general pattern, but have had iron blades. It should be noted as a local peculiarity that the former has a three-sided notch at the front barbs, the latter only a two-sided notch.

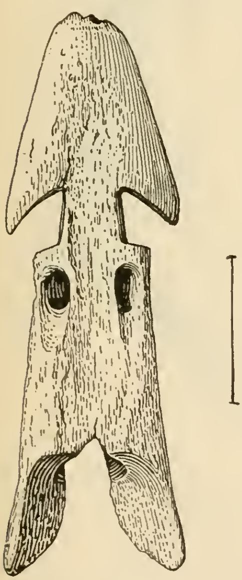


Fig. 37.
BARBED AND TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner. Cat. No. 63942, U.S.N.M.

A toggle head of ivory (Cat. No. 63943, U.S.N.M.) from Greenland, in shape of a compressed cone, elliptical in section, narrow and sharp at the point, is shown in fig. 38. The blade, of iron, is much rusted and held in by an iron rivet. Line hole straight through the sides in a plane parallel to the blade. Line grooves short and slight. There is one barb terminating the back, but slightly bifurcated. The socket for the foreshaft is wide and shallow and the butt end whittled off with a slight incurve. Length, 3⅝ inches. Gift of Governor Fenckner. Example 63944 is broken, but similar, the butt-end curve being deeper and the tip not bifurcated (fig. 39). A toggle harpoon head (Cat. No. 63945, U.S.N.M.)

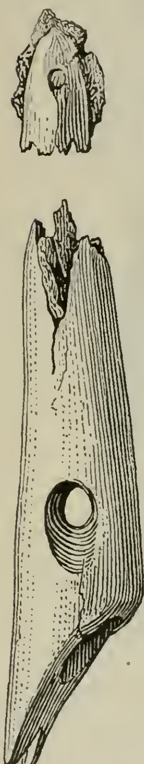


Fig. 38.

TOGGLE HEAD.

West Greenland.

Gift of Governor Fenckner. Cat. No. 63943, U.S.N.M.

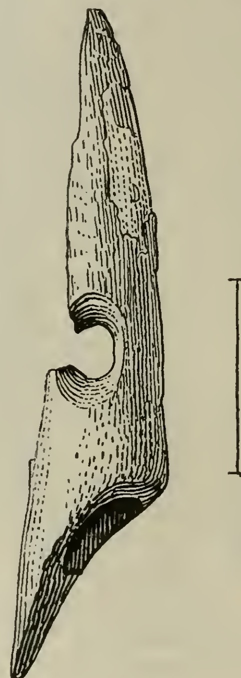


Fig. 39.

OLD TOGGLE HEAD.

West Greenland.

Gift of Governor Fenekner. Cat. No. 63944, U.S.N.M.

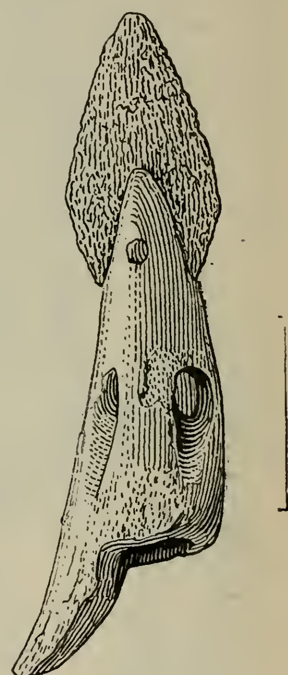


Fig. 40.

OLD TOGGLE HEAD.

West Greenland.

Gift of Governor Fenckner. Cat. No. 63945, U.S.N.M.

from Greenland, made of bone and iron, is shown in fig. 40. The body is conoidal, the hastate iron blade being inserted into a saw cut in the pointed end and held by a copper rivet. The line hole lies parallel to the plane of the blade; line grooves slight. The barb is bisected by the plane of the blade, as in many older specimens, but this sets the line hole perpendicular and entirely on the right face of the body. It is possible that the specimen had formerly two barbs. Shaft cavity cut off square below, the spur-like barb extending backward and upward. Length, 3½ inches; width or thickness through line hole, seven-eighths inch; depth, five-eighths inch. Gift of Governer Fenckner. Similar to this specimen is Cat. No. 63949 (fig. 41), of bone, in form of a flat hexagonal prism, the point abruptly cut off. Line holes cut upward through the two lower faces. In this example the spur is on the left-hand side, if the line hole be taken as underneath. It is a little difficult to understand how such an implement would toggle and hold. Length of 63949, 2½ inches. Greenland. Gift of Governor Fenckner.

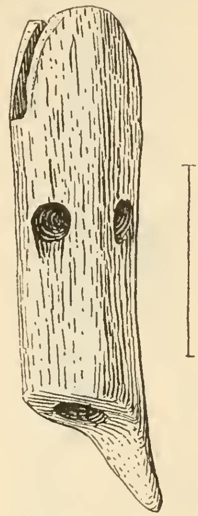


Fig. 41.

TOGGLE HEAD.

West Greenland.

Gift of Governor Fenckner. Cat. No. 63949, U.S.N.M.

An old toggle harpoon head (Cat. No. 63946, U.S.N.M.), from west Greenland, made of bone all in one piece, in section a rounded triangle, is shown in fig. 42. The blade is formed by whittling the material to a pyramidal point with four faces. The line hole is bored straight through in the plane of the blade, enlarged and the rear edges whittled down for line grooves. Barbs, two, in fish-tail pattern on the back. Socket, three-fourths inch deep; butt, whittled out with slight incurve; length, 2¾ inches. Gift of Governor Fenckner. Example 63947 (fig. 43), from the same locality, is a modern specimen of bone, on the same order, but an iron blade was inserted at the point. The line-hole cavities pierce the back, the grooves are deeper, and the butt end is scooped out. Length of 63947 is 2¾ inches; from Greenland. Gift of Governor Fenckner.

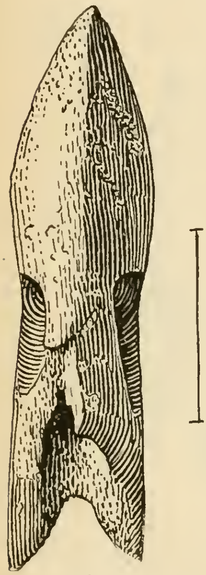


Fig. 42.

SMALL TOGGLE HEAD.

West Greenland.

Gift of Governor Fenckner. Cat. No. 63946, U.S.N.M.

A toggle head from western Greenland (Cat. No. 63948, U.S.N.M.), in shape of a long rectangular pyramid with rectangular cones, is shown in fig. 44. Point formed by whittling down the sides. The blade slit lies in the plane of the long diagonal of the body. Line hole

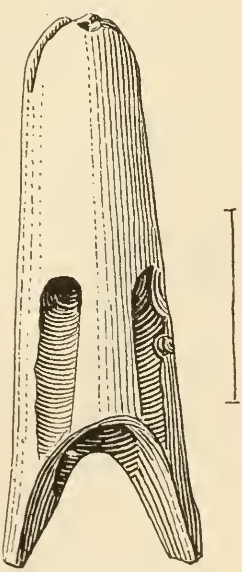


Fig. 43.

OLD TOGGLE HEAD.

West Greenland.

Gift of Governor Fenckner. Cat No. 63947, U.S.N.M.

run in perpendicular to the two lower sides or faces, having slight line grooves. Barbs two, one on the right margin, one on the left, their tips lying in the bisecting plane of the toggle head. Socket extending into the line hole. Butt end whittled away equally above and below. Length, 2¾ inches. Gift of Governor Fenckner. Cat. No. 63950 is of the same type, 2¼ inches long.

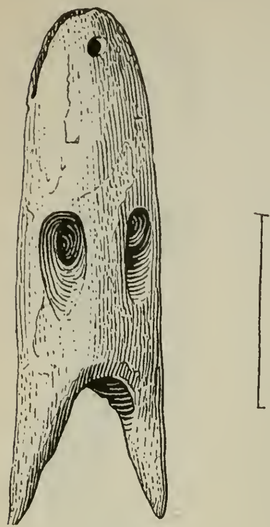


Fig. 44.
OLD TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner. Cat. No. 63948, U.S.N.M.

A grave relic (Cat. No. 63950, U.S.N.M.) representing a small toggle head of a harpoon from Greenland, the gift of Governor Fenckner, is shown in fig. 45.

The body, rhomboidal in section, the back and front being about alike, is made of a segment from the columnar portion of a bone. The fact that both sides are equally hard necessitates the forming of the shaft socket in the hollow part of the bone. The barbs are cut out of the two angles or wings on the two sides of the body. The line hole is interesting, being effected by cutting two holes perpendicularly into the two faces of the belly, meeting in the hollow part of the bone. Each of these is flanked with a shallow gutter in which lies the line. The forming of a toggle head out of the middle column of a bone instead of a piece of ivory, antler, or solid bone is rare. Length, 2 inches.

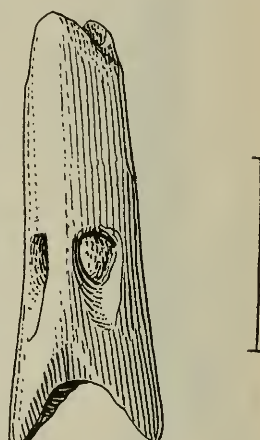


Fig. 45.
SMALL TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner. Cat. No. 63950, U.S.N.M.

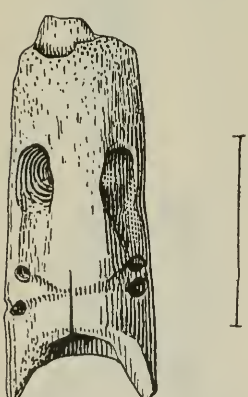


Fig. 46.
OLD TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner. Cat. No. 63951. U.S.N.M.

An old toggle head (Cat. No. 63951, U.S.N.M.) from west Greenland is shown in fig. 46. The point has been broken off, but enough is left to show a small portion of the blade slit. It belongs to the type of specimen 45855, and the socket in the base for the foreshaft is flanked by two equal barbs. A common type in harpoon heads from this area. The line hole on the end side is formed by the meeting of two conical bores, afterwards smoothed down so as not to injure the line. This method of forming the hole by the meeting of two separate cones is well known to students of archæology. Four small perforations are seen between the line hole and the socket, drilled for the purpose of stopping the further opening of a crack in the base.

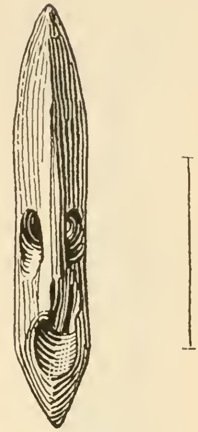


Fig. 47.
SMALL TOGGLE HEAD.
West Greenland.
Gift of Governor Fenckner
Cat. No. 63952, U.S.N.M.

A small toggle head of bone (Cat. No. 63952, U.S.N.M.), blackened by age, from west Greenland is shown in fig. 47. It is square in cross section, one angle extending from tip of the point to tip of the barb and having a pyramidal point. There is no blade. Line holes bored straight in from the two lower surfaces, line grooves short and deep. Barb one, socket half an inch deep, butt end beveled off diagonally from lower edge to upper edge. Length, 2¼ inches. Collected by Governor Fenckner.

Cat. No. 63963 in the U. S. National Museum is a harpoon of bone from southwestern Greenland. It consists of two parts, the shank and the hinged toggle. The shank is pierced at one end to act as a hinge and at the other end in two places for the attachment of a shaft. The toggle is spindle shaped, hollowed on one side, and pierced with three holes to facilitate the hinging. This specimen is evidently an imitation or adaptation in bone of the iron fluke in the harpoons of the whalers. Length of shank, 4½ inches. Gift of Governor Fenckner.

Fig. 48.
SHAFT OF SMALLER HARPOON.
South Greenland.
Collected by Chief Signal Officer, U. S. A.
Cat. No. 72566, U.S.N.M.

The smaller harpoon shaft (Cat. No. 72566, U.S.N.M.), from southern Greenland, is illustrated in figs. 48 and 49. This figure is introduced for the purpose of showing the details of the shaft, which are quite local. The loose shaft is made of bone or ivory, square at the base and socketed to fit over a small projection on the foreshaft. Two holes are bored through the former, and through these and two in the end of the shaft a stout rawhide thong passes and is tightly drawn to form an elastic spring, useful in the shipping and unshipping of the loose shaft. What answers to the foreshaft in this specimen is simply a cap of ivory with a little projection on the top. The hinging line is not attached to it in any way. The ivory pegs driven into the shaft near its lower end are for the throwing stick, which is peculiar to this region, and for the eyelets used in tightening the line when the toggle is in place and ready for action.

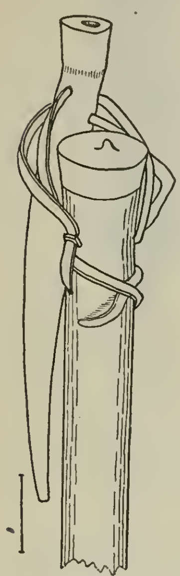


Fig. 49.
FORESHAFT AND LOOSE SHAFT OF FIGURE 48.

Especial attention is drawn to the lower end of the shaft, on which are pegged or riveted two plates of ivory, which not only resemble feathers on an arrow, but must perform a similar function. The foreshaft is so light that it could be of little use in giving directness to the flight of the weapon, but the feathers of ivory fastened on at the end would remedy this defect and steady the shaft in the air. It is thought by some that the existence of these plates of ivory on the base of the shaft is an indication of the descent of the harpoon from the arrow.

A kaiak lance (Cat. No. 74126, U.S.N.M.) from Holstenberg, Greenland, was collected by Capt. J. W. Collins. The shaft is of pine wood, elliptical in section, tapering in both directions from the hand rest and at the front, and swells out to fit neatly the foreshaft or cap of bone. Upon the narrow side of the shaft in front of the middle portion are the finger rests, which consist of a peg of wood driven into a hole on one side and on the other a flat portion of bone set in a quadrangular mortise, and having at the outer end on one side a groove for the finger.

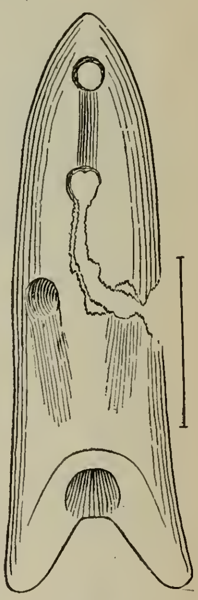


Fig. 50.
OLD TOGGLE HEAD.
Upernavik, Greenland.
Collected by Theodore Holm.
Cat. No. 130371, U.S.N.M.

The piece of bone corresponding to the foreshaft is not more than half an inch in length, perfectly flat across the outer end, and at its middle portion is a slight projection or pivot. The loose shaft is of narwhal tusk, flattened in cross section and mortised into a piece of bone in form of a truncated cone. Its widest portion, with a slight socket in the middle, sits flat upon the cap or foreshaft. This particular combination is of a more advanced type than the ordinary ball-and-socket joint with the Cumberland Sound Eskimo, growing out of the fact that these Greenland Eskimo have been for many centuries in contact with the Scandinavians. In this case the two flattened surfaces cause the lashing to act as a spring holding the foreshaft or blade piece straight in front of the shaft. These two parts are united by means of a bit of rawhide passing through two holes in the foreshaft and three holes in the loose shaft a foot from the end. The lashing is similar to that of the Cumberland Sound types, with slight local differences of administration. In front of the blade piece is the blade of iron, lanceolate in form, with truncated base set in a saw cut at the tip and held fast by a copper rivet. This lance is for stabbing the walrus or whale at close quarters from the kaiak. Length of shaft, 62 inches; loose shaft, 8½ inches; blade, 3½ inches.

An old toggle harpoon head (Cat. No. 130371, U.S.N.M.) from Upernavik, Greenland, is shown in fig. 50. It has an iron blade riveted on to the front of the body, parallel to its broadest diameter. The line holes were bored in from two directions, and apparently perforated the body after the manner of the toggle head used on the Amur River and figured in Schrenck. Length of body, 3⅜ inches. Gift of Theodore Holm.

A harpoon for killing whales (Cat. No. 90103), used by the Little Whale River Indians on the coast of Labrador, is shown in fig. 51. The shaft is of wood, the foreshaft of bone. The base of it is wedge-shaped, and fits into the slit at the end of the shaft, being held in place by a lashing of sinew cord. On the end of the foreshaft fits the toggle head, with iron blade held fast by two rivets. The body of the toggle head is rectangular in cross section. The line hole passes through the sides and is not seen on the lower part. The wide barbed end is cut into three or four tooth-shaped parts. The line is of rawhide, plaited. The peculiarity of this harpoon is a board, somewhat circular in form, on the lower end of the shaft, which acts as a drag to the wounded animal, in place of a seal-skin float. The line passes between this board and the shaft, and has a handle or toggle fastened at the other end to be held in the hand of the fisherman.[1]

If Hearne be correct, the Eskimo west of

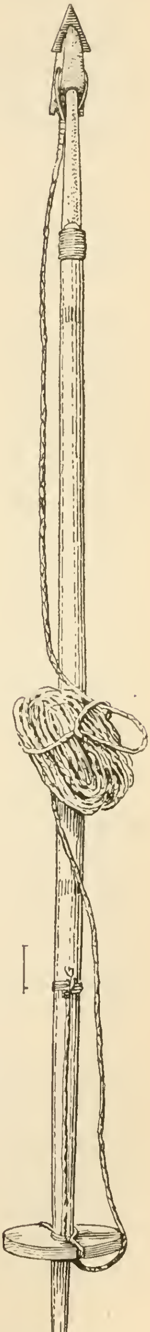


Fig. 51.
MODEL OF HARPOON.
Whale River, Canada.
Collected by Lucien Turner, after Murdoch. Cat. No. 90103, U.S.N.M.

[1] Lucien Turner, Hudson Bay Eskimo, 1894, p. 314, figs. 138, 139.

Hudson Bay have no other method of catching fish, unless it be by spears and darts; for no appearance of nets was discovered either at their tents or on any part of the shore. This is the case with all the Eskimo on the west side of Hudson Bay; spearing in summer and angling in winter are the only methods they have yet devised to catch fish, though at times their whole dependence for support is on that article.[1]

HARPOONS OF THE CENTRAL ESKIMO.

Coming to the central Eskimo, Boas says of them that they inhabit the northeastern part of the continent and the eastern islands of the Arctic-American archipelago. In Smith Sound they inhabit the most northern countries visited by man, and their remains are often found at its northern outlet. The southern and western boundaries are the countries about Fort Churchill, the middle part of Back River, and the coast west of Adelaide Peninsula.[2] In this monograph will be found an excellent bibliography of that area, which has been famous in historic times for the efforts made there to find the northwest passage between the two great oceans.

The harpoon or principal lance (unahk, Kane) of the Eskimo is attached to the sealing line. The rod or staff is divided at right angles in two pieces, which are neatly jointed or hinged with tendon strips, but so braced by the manner in which the tendon is made to cross and bind in the lashing that, except when the two parts are severed by lateral pressure, they form but a single shaft. The point, generally an arrow-head of bone, has a socket to receive the end of the shaft; it disengages itself readily from its place, but still remains fast to the line. Thus when the kaiaker has struck his prey, the shaft escapes the risk of breaking from a pull against the grain by bending at the joint, and the point is carried free by the animal as he dives. At the right center of gravity of the harpoon, that point at which a cudgel player would grasp his staff, a neatly arranged cestus or holder (noon-sok) fits itself on the shaft. It serves to give the kaiaker a good grip when casting his weapon, but slides off from it and is left in the hand at the moment of drawing back his arm.[3]

In the weapons used for killing their game there is considerable variety, according to the animal they are pursuing. The most simple of these weapons is the "oonak" (Parry), which they use only for killing the small seal. It consists of a light staff of wood 4 feet in length, having at one end the point of a narwhal's horn, from 8 to 10 inches long, firmly secured by rivets and wooldings; at the other end is a smaller and less effective point of the same kind. To prevent losing the ivory part, in case of the wood breaking, a stout thong

[1] Hearne, Journey, etc., London, 1795, p. 159.
[2] Franz Boas, The Central Eskimo, 1888, p. 414.
[3] E. K. Kane, The Grinnell Expedition, New York, 1854, pp. 478 and 479.

runs along the whole length of the wood, each end passing through a hole in the ivory, and the bight secured in several places to the staff.

A considerable degree of ingenuity is displayed in an appendage called "siatko," consisting of a piece of bone 3 inches long, having a point of iron at one end and at the other a small hole or socket to receive the point of the oonak. Through the middle of this instrument is secured the allek, or line of thong, of which every man has, when sealing, a couple of coils, each from 4 to 6 fathoms long, hanging at his back. These are made of the skin of the oguke, as in Greenland, and are admirably adapted to the purpose, both on account of strength and the property which they possess of preserving their pliability even in the most intense frost.[1]

Formerly the harpoon (unang, Boas) consisted of a shaft having at one end an ivory point firmly attached by thongs and rivets, the point tapering toward the end. The point was slanting on one side, so as to form almost an oblique cone. Thus it facilitated the separation of the harpoon head from the unang. On the opposite end of the shaft another piece of ivory was attached, generally forming a knob. The material used in making the shaft was wood, bone, or ivory, according to the region in which it was manufactured. In Iglulik and in Aggo the narwhal's horn was the favorite material for the whole implement, a single horn being sufficient to make a whole shaft. Wherever wood could be procured small pieces were ingeniously lashed together. As the shaft is apt to be broken by the struggles of the animal when struck by the weapon, it was strengthened by a stout thong running along the whole length of the shaft.[2]

A strange method of hunting is reported by Ross[2] as practiced by the Netchillirmiut. Eight men slowly approached the basking seal until it raised its head, when those in front stopped and shouted as loud as they could, on which three others ran up with incredible swiftness, and the leader struck it with the spear.[3]

Boas says that when the smaller bays are sufficiently frozen to permit, the hunters will visit the edge of the newly formed floe in order to shoot the seals, which are afterwards secured by the retrieving harpoon.[4]

A fine old toggle head (Cat. No. 8278) from Smith Sound, was collected by Dr. I. I. Hayes. The body is of ivory, thin, spatulate in form, and lenticular in cross section. The blade of iron is almost concealed in a deep saw cut and fastened with an iron rivet. The line hole has been bored out with a drill that was too small and enlarged by cutting. One side of the body having split off, and the other side cracked, the

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[1] Parry, Second Voyage, London, 1824, p. 507.

[2] Narrative, etc., London, 1835, II, p. 451.

[3] Sixth Annual Report of the Bureau of Ethnology, p. 485.

[4] Compare Murdoch's account of the retrieving harpoon, Sixth Annual Report of the Bureau of Ethnology, p. 420.

Eskimo has ingeniously drilled a series of holes along the margins and repaired the socket by means of sealskin thongs rolled backward and forward. The line in this case is a coarse thong of walrus hide, which is looped through the line hole and fastened by a wrapping with a smaller thong, in which the Eskimo has exhausted his ingenuity by a variety of knots and splices.

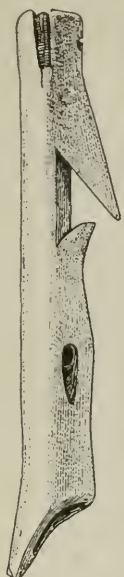


Fig. 52.

OLD BARBED AND TOGGLE HEAD.

Upernavik, Greenland.

Collected by I. I. Hayes. Cat. No. 8279, U.S.N.M.

A combined barbed and toggle harpoon head of bone (Cat. No. 8279 U.S.N.M.) from Upernavik, Greenland, is shown in fig. 52. Body long, irregular cylinder, whose diameter varies in proportion to the strain at each point, cut off quite abruptly at the point. The economy of material is noteworthy. Blade cut shallow; iron blade broken off, but its lower margin remains in the cut, held in place by means of an iron rivet. Line hole small, curved up and strengthened on the outside by an additional thickness of the body. Line grooves slight. Barbs, two, the front one a very prominent hook, triangular underneath, its rear margin also a shallow hook with rounded edge. In this respect the specimen is unique in the U. S. National Museum. The rear barb is cocked up and pointed. In the tip of this barb is a hole half an inch deep, and three small perforations for rivets are to be seen above it. The precise use of these perforations is not known. Socket an inch deep, the butt end whittled off with a slight incurve. Length, 6 inches; diameter, three-fourths inch. Collected by Dr. I. I. Hayes.

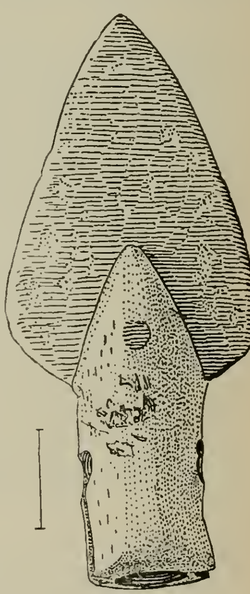


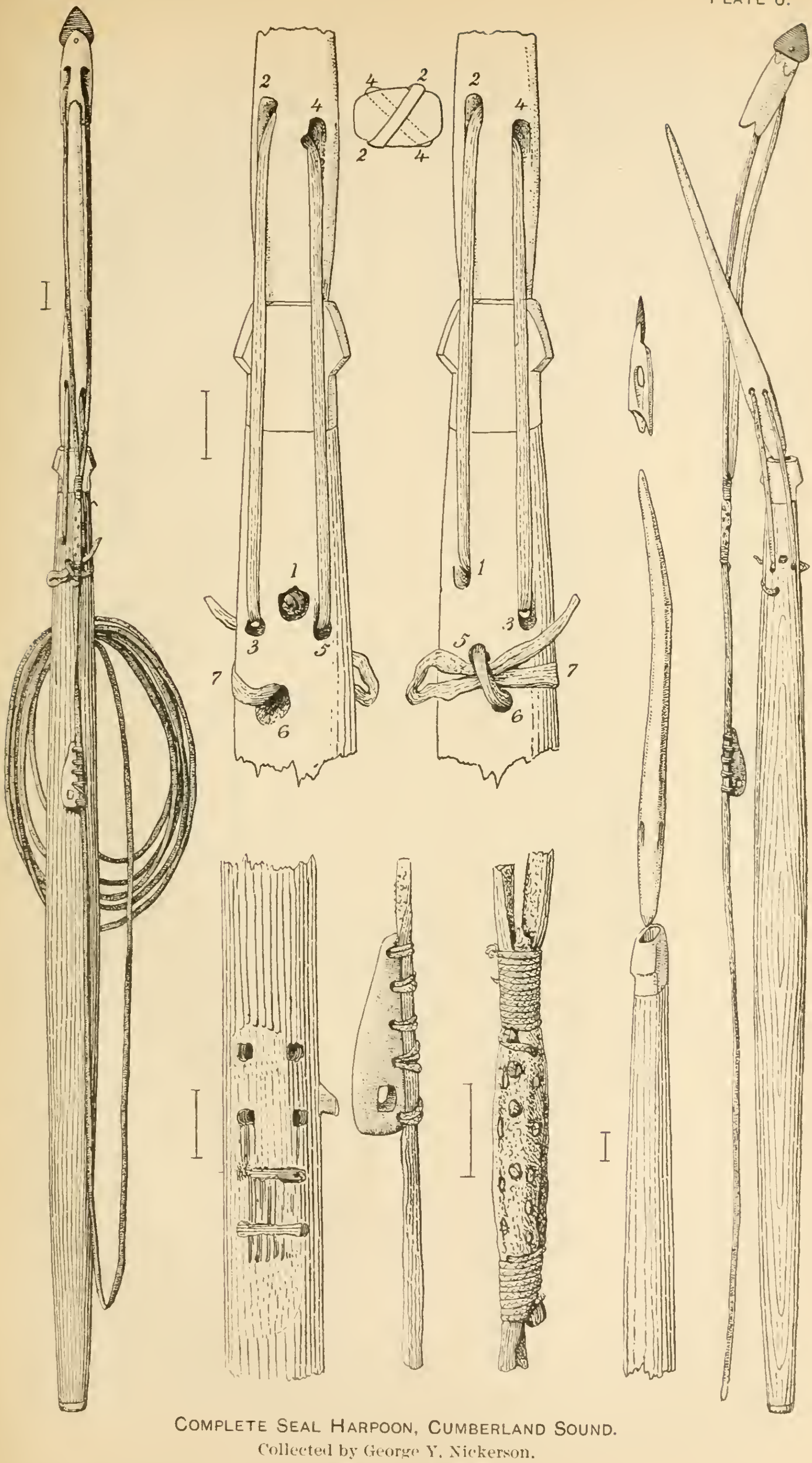
Fig. 53.

LOOSE HEAD OF A LANCE.

Repulse Bay.

Collected by C. F. Hall. Cat. No. 10136, U.S.N.M.

A loose head of a lance (Cat. No. 10136, U.S.N.M.) is given in fig. 53. A careful inspection of this specimen, and others like it, will show that it lacks the essential qualities of a harpoon, namely, of being hinged to the end of the shaft and of retrieving. There is neither barb nor toggle on this specimen or others of the same class. The hinged lance, either in the form of a weapon to be thrust or of one to be thrown from hand or bow or throwing stick, is exceedingly rare. Only in the areas where immense sea mammals are hunted is it thought necessary to guard in this way



COMPLETE SEAL HARPOON, CUMBERLAND SOUND.

Collected by George Y. Nickerson.

Cat. No. 19519, U.S.N.M.

against breaking the shaft. Indeed, it will be found that the Eskimo on the other side of the continent do not hinge the lance head, but merely socket it and leave it in the animal stabbed. Collected by Captain C. F. Hall.

An old, much weather-beaten toggle head of bone (Cat. No. 10404, U.S.N.M.), without blade, from Repulse Bay, is shown in fig. 54. The body is perfectly flat on the back and uniformly ridged below, so that in section the form is that of a hat with narrow rim. The blade slit in the truncated tip shallow and wide and there is no show of rivets. Linehole, large and straight through, with wide grooves before and behind it. There were evidently two barbs, but after some mending one has disappeared. The butt was beveled nearly in a plane surface. Sockets half an inch deep. Length, 3¾ inches. Collected by Captain C. F. Hall.

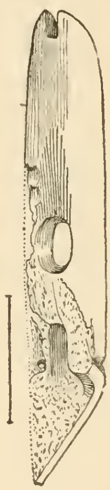


Fig. 54.
TOGGLE HEAD.
Repulse Bay.
Collected by C. F. Hall.
Cat. No. 10404, U.S.N.M.

Example 19519, in the U. S. National Museum, Plate 6, is a complete toggle harpoon for seals, from Cumberland Sound region, collected by George Y. Nickerson. The shaft (qijuqtenga) is of hard pine wood, quadrangular in section, with rounded corners, thick in the middle, and tapering toward either end. The foreshaft (qatirn) or socket piece, about 2 inches long, is of walrus ivory, mortised neatly upon a tenon at the end of the shaft. In longitudinal section it is in the shape of a tanged lance blade, with the point truncated. The upper and outer end of the qatirn has a rounded socket for the reception of the loose shaft, to be described. At the lower end of the shaft is an ivory cap, set on and held in place by two wooden dowels. Upon the narrow margin of the shaft, absent in this specimen, is set a hand rest (tikagung), as a stop for the hand of the hunter when making his thrust. At right angles to the tikagung is a peg or button of ivory, which fits into the telliqbing or eyelet piece of ivory on the line. The loose shaft is a stout piece of ivory, spindle shaped, with a long taper in front and a very short tapering butt end. This fits like a ball at the socket joint into the socket.

At the end of the qatirn or foreshaft two holes are bored through the loose shaft 3 inches from the socket joint. Corresponding holes are bored through the shaft 4 inches from the front end. An inch farther back from these two holes two other holes are bored near together.

Looking at this apparatus from one side, a seal-skin thong passes from the back forward through the upper left-hand hole in the shaft, up through the left-hand hole in the loose shaft, back and through the upper right-hand hole in the shaft, and up and through the right-hand hole in the loose shaft, and down to the lower right-hand hole in the shaft, through and back through the lower left-hand hole in the shaft, half way round the shaft, and gathered in a loose knot through the lower bend of the thong on the front side of the shaft. This ingenious joint deserves especial attention. It is put in place while wet or green, and by its shrinking forms a close hinge for holding the loose shaft in the socket of the foreshaft. When a large animal is struck and the loose shaft rammed into its body, the violent motion, instead of breaking the brittle ivory, unbends the ball and socket joint, the thong serving as a hinge.

The toggle head (tokang) is of walrus ivory, flat on one side and obtusely angular on the other. On this same side are two large angular cuts, forming a perforation entirely through but not piercing the back. Barbs, two.

The line (alirn) is of stout rawhide bent through the hole in the toggle head, and the end is joined to the standing part by being sewed together, and also seized or wrapped at either end of this sewing. On the alirn, at a point exactly corresponding to the hand rest, is sewed or run the teliqbing, which is a somewhat flat piece of ivory, having five holes for the stitching or braid of sinew and a quadrangular hole cut in the broad part to fit over the ivory peg on the side of the shaft, which draws the line perfectly tight and holds the toggle head on the tip end of the loose shaft. The line may be continued to any length, where it terminates in a loop, and one or more bladders (avatang) may be attached to it. Length of shaft, 41 inches; loose shaft, 16 inches; tokang, 5 inches.

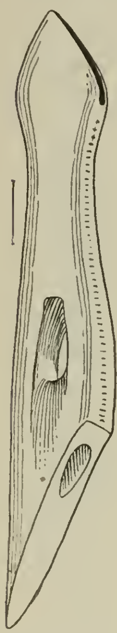


Fig. 55.

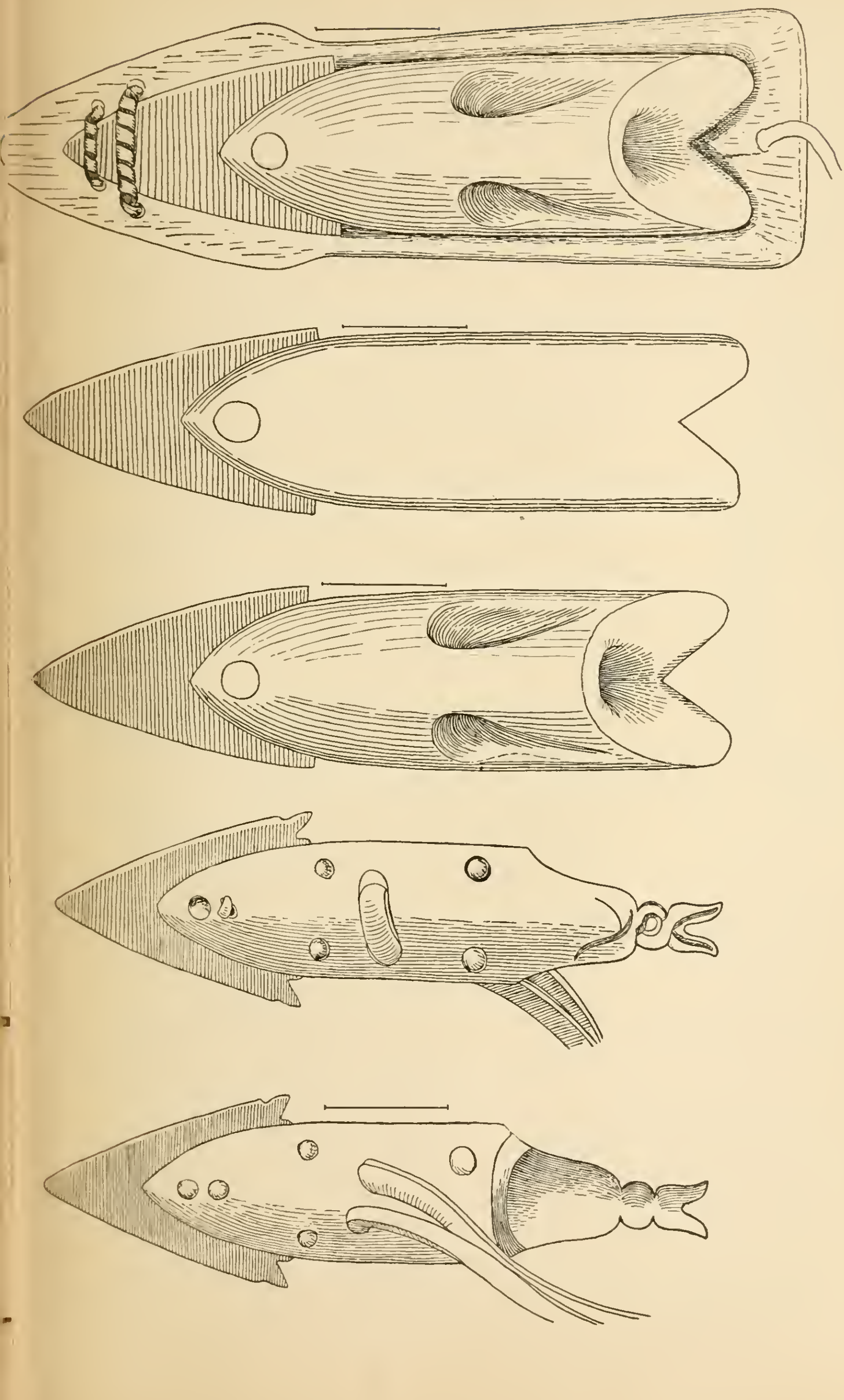
HEAD OF WHALE HARPOON.

Hudson Bay.

Collected by J. H. Bartlett. Cat. No. 25654, U.S.N.M.

The head (Cat. No. 25654, U.S.N.M.) of a whale harpoon from Hudson Bay is shown in fig. 55. It is made of walrus ivory, and probably by machinery. The U. S. National Museum possesses a large number of harpoon heads of this type. The angle on the back is sharp and the front is hexagonal. The specimen conforms to a model or type as if made in large numbers for trade with the Eskimo.

The blade is of iron and neatly fitted into a socket in the bluntly pointed tip end of the body. At the upper inner corner of the blade is a perforation for the reception of a small line of sinew, which serves to retain the blade if it becomes detached from its slit. The socket is a shallow conical cavity, made to fit on the outer end of the loose shaft. The butt end is a long bevel, slightly incurved. The line hole is made with great care, being a large triangular opening with ample grooves on either side for the play of the line. The material is



TOGGLE HARPOON HEADS, AMUR RIVER AND CUMBERLAND SOUND.

Amur example, after Von Schrenk; Cumberland Gulf example, Cat. No. 34064, U.S.N.M.

Collected by Ludwig Kumlein.

cut away economically at every point, so as to protect the line from abrasion. There is no separate becket, but the end of the line is spliced into itself to form a loop.

No. 25554 is similar to the foregoing in most respects. The outline is a little more artistic, but the general form and functioning of the parts are precisely the same. Length of blade, 2½ inches; length of body, 6 inches.

Plate 7 is a typical broad toggle harpoon head (Cat. No. 34064, U.S.N.M.) from Cumberland Sound. The ivory body is lingulate in outline, nearly flat on the back, and rounded beneath for line hole and socket. Blade triangular, oblong, set 1 inch into the saw cut, and held in place by a large copper rivet. No blade hole is present. Line hole well back, large, bent up a little, and running into very deep line grooves. Socket wide and shallow. Barbs, two, formed by the bifurcation of the back. Butt end curved in and somewhat gouged out. Length, 5¾ inches. Collected by Ludwig Kumlein. The head fits back downward into a cover carved of a piece of pine wood. The point lies under two loops of baleen passed through the wood and frapped. A rawhide thong fastened into the butt serves to wrap the toggle and cover together. Other specimens in the Museum, collected in the same locality by Mr. Kumlein, have precisely the same characteristics. The specimens are more slender. It will be noted that the blade, the barbs, or spurs at the base, and the bottom or inside of the line hole are in parallel planes. This is to be regarded as the old or primitive style. In the more modern heads, as will be seen, the line hole is perpendicular to the plane of the blade. Front and side views of a large toggle head from the Amur are given to show how the old type survives in out-of-the-way places far apart, while the new type holds the intermediate localities. (Schrenck, Plate 42.)

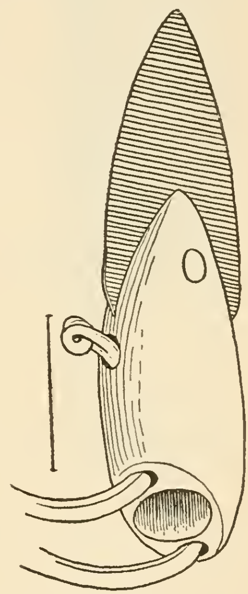


Fig. 56.
HEAD OF WHALE LANCE.
Cumberland Sound.
Collected by L. Kumlein. Cat. No. 34067, U.S.N.M.

The head of a whale lance (Cat. No. 34067, U.S.N.M.) from Cumberland Gulf, collected by Ludwig Kumlein, is shown in fig. 56. The body is of ivory, in the form of a flattened conoid. The blade of iron is leaf-shaped, set into a saw cut at the point in the plane of the widest diameter of the head, and held in place by a brass rivet. The shaft socket is a deep cone. On either side of the head a line hole is made by two borings, one vertical and the other horizontal and larger. Into each a line or thong of seal hide is drawn, with a knot on the upper end which fits into the horizontal bore and forms a button or stop. These two thongs unite about a foot below the head to form one continuous line. Length of head, 3⅝ inches.

Fig. 57.

TOGGLE HEAD, TAKEN FROM DEAD WHALE.

Cumberland Sound.

Collected by Ludwig Kumlein, after Franz Boas. Cat. No. 34069. U.S.N.M.

A broad, flat harpoon head (Cat. No. 34069, U.S.N.M.) of walrus ivory (tokang), taken from a large *Balæna mysticetus* caught in Cumberland Sound in 1878, is shown in fig. 57. This specimen was collected by Ludwig Kumlein. The body is lingulate in form, with a sharper curve below. The iron blade, broken off at the point, is deep, set into a saw cut, and riveted with iron. Near the left-hand corner is bored a blade hole for a securing line. The line hole is large, curved upward, and the grooves are deep for the thick rawhide line, but they do not perforate the head and they are not seen on the back of the toggle head. The butt end is gouged out in a spoon-shaped cavity and is bifurcated to form two barbs, and these are split at their hinder extremity. The tips of the barbs have ornamental notches. The socket below the plane of the barbs is wide and shallow. Mr. Kumlein believes that this head was thrust into the whale while it was a yearling, as the Eskimo do not attack a large one with their own weapons. Length, 4 inches.[1]

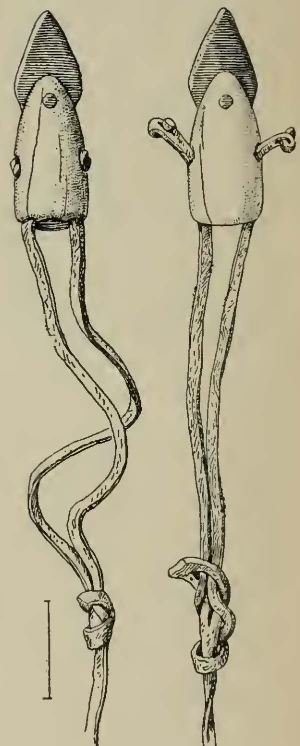


Fig. 58.

LOOSE HEAD OF LANCE.

Cumberland Sound.

Collected by Ludwig Kumlein. Cat. No. 34068, U.S.N.M.

A loose head of a seal lance (Cat. No. 34068, U.S.N.M.) is shown in fig. 58. Body is of ivory, blade pentagonal in shape, and fastened in with a rivet. The body is conoid in form, with a square base. The socket for the end of the foreshaft is conical, and alongside of this at the margin two holes are bored, opposite each other, perpendicular for a notch, at which point they are met by two other

[1] Sixth Annual Report of the Bureau of Ethnology, p. 490, fig. 422.

holes bored in horizontally. Into these holes fit two rawhide thongs, by means of which the loose heads are attached firmly to the end of the shaft. The noticeable feature about this specimen is the thoroughly aboriginal style of boring the holes and of attaching the thongs. The slit is cut near the end of the thong, and through this the outer end passes, being bent backward. This forms a button which fits exactly into the horizontal hole on the side of the head. At the other end of the thongs in the drawing are shown methods of splicing practiced by the central Eskimo. There is nothing which exhibits their ingenuity more effectively than the way in which the difficulties are overcome by simple processes.

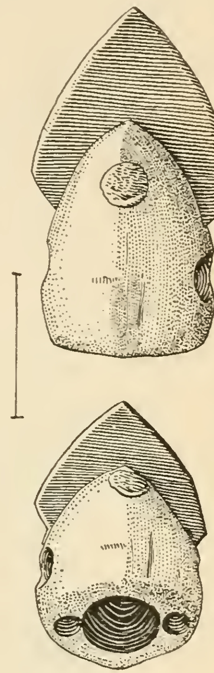


Fig. 59.

LOOSE HEAD OF LANCE.

Cumberland Sound.

Collected by Ludwig Kumlein Cat. No. 34077, U.S.N.M.

A lance head (Cat. No. 34076, U.S.N.M.) from Cumberland Sound is shown in fig. 60. It can not be called either a toggle head or a barb, since it possesses neither characteristic. It is simply a pivoted lance head. Body, flat. Blade, of iron, irregularly rhomboidal, made to fit into the saw cut by a nail head driven under the edge, held in place by an iron rivet.

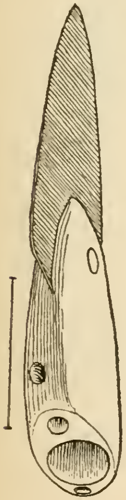


Fig. 60.

LOOSE HEAD OF LANCE.

Cumberland Sound.

Collected by Ludwig Kumlein. Cat. No. 34076, U.S.N.M.

There is no line hole in the harpoon acceptation, but on either side of the socket a hole is bored forward in the plane of the blade and met by a larger one bored inward half an inch from the butt end. Into each hole a rawhide line is made fast by means of a knot peculiar to the Eskimo, effected by cutting a slit a short distance from the end of the line and tucking the end backward through the slit. This knot will enter the larger hole on the side, but will not pull through the smaller longitudinal one. The socket is conical, wide, and fully an inch deep. Length, 2 inches. Collected in Cumberland Sound by Ludwig Kumlein. Similar to this are 34068 and 34077 (fig. 59), and Boas figures another specimen after Kumlein's drawings.

Cat. No. 73529 in the U. S. National Museum is a whale lance (anguvigang), from Cumberland Sound. The shaft (qijuqtenga) is of hard pine wood, possibly from a ship. Cross section elliptical and flattened. It is tapering in the middle in both directions. The foreshaft (qatirn) is a short head of bone mortised upon the end of the shaft, truncated arrow shaped, in longitudinal cross section. On the narrow side of the shaft, about one-third of the distance from the foreshaft, is a hand rest (tikagung) made of, a quadrangular bit of bone. This is perforated from side to side, laid against the shaft and lashed with a

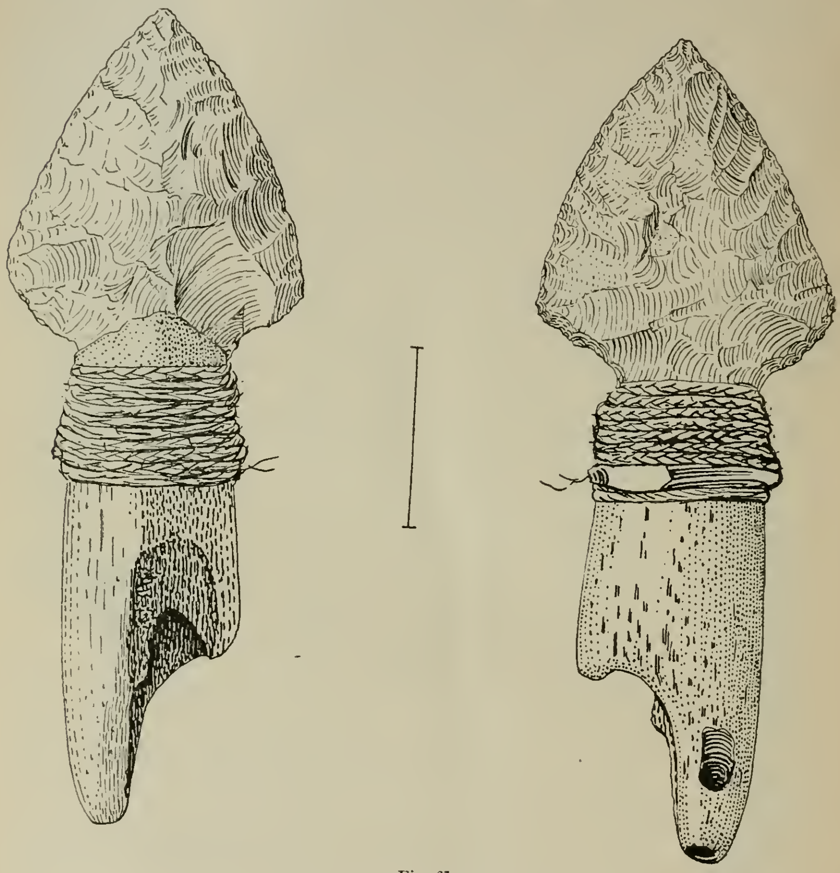


Fig. 61.

OLD TOGGLE HEAD WITH STONE BLADE.

Cumberland Sound.

Collected by Geo. Y. Nickerson. Cat. No. 19521, U.S.N.M.

strip of baleen. At right angles to this on the broad side of the shaft is a peg protruding, resembling the peg for the line, but it is evidently an added part, as it has no function.

The loose shaft of ivory has a blunt pivot on the inner end which fits into a socket in the foreshaft to form the ball-and-socket joint (lgaming). The head is irregular, hexagonal in cross section and in a saw cut in the front end a leaf-shaped blade of iron is inserted and riveted. The loose shaft and the foreshaft are hinged together, as in other specimens, by a thong of rawhide. This ingenious joint is most effective as a universal hinge. It can be easily unloosed and made tighter. By a universal hinge it is meant that in every direction the loose shaft is sustained in a line with the shaft by the rigidity of the rawhide, which is not so strong, however, but that when an extraordinary strain is placed upon the loose shaft the rawhide will give way in any direction and allow the pivot to come out of the socket and save the apparatus from breakage. No long line is used with this form of apparatus. A similar specimen is figured from the Berlin Ethnological Museum, by Dr. Franz Boas.[1] Length of shaft, 43 inches; loose shaft, 16 inches.

The harpoon of the Cumberland area, as shown by the previous descriptions and illustrations, is far more primitive and less affected by contact with Europe than that of Greenland or Hudson Bay type. In closing a study of this region attention is called to fig. 61, Catalogue No. 19521 in the U. S. National Museum. It can not certainly be defined as a barbed head, nor as a toggle head. It has the form of the toggle head, but the line hole, instead of passing through the body above the socket, is a perforation in the end of the spur. A hole has been bored through this end in a line parallel to the axis of the body and is met by another perforation on the side of the spur. The connecting line evidently passed up through this opening and was toggled by means of an Eskimo knot formed by cutting a slot near the end of the thong and turning the end back through the slit. The socket does not differ from that of other harpoons. The head, however, is a large and lanceolate blade of chipped stone, reminding one of the whale lance blades brought home by Ray from Point Barrow and described by Murdoch. The tang of this blade fits upon an offset at the end of the body and is held in place by a knot, also of sinew braid. The perforation in the spur for the connecting line is almost unique in the collections of the U. S. National Museum. One other specimen has a perforation at this point, fig. 52, Catalogue No. 8279. In this specimen, however, the perforation seems to have no function, since through the body of the toggle head there is a regular line hole with line grooves.

HARPOONS OF ARCTIC ALASKA.

The situation, the climate, the people, and the natural resources of this area are minutely set forth by Murdoch. The harpoon, as will be seen, is related to all these. In his treatise on Point Barrow Eskimo the last-named writer describes and figures both seal darts and toggle harpoons, and these are included in our subject. He says that the Eskimo use, to capture the smaller marine animals, a dart or small harpoon having a loose barbed head of bone fitted into a socket at the end of the shaft, to which it is attached by a line of greater or less

[1] Sixth Annual Report of the Bureau of Ethnology, p. 496, fig. 432.

length. It is always contrived so that when the head is struck into the animal the shaft is detached and acts as a drag. At Point Barrow only the small form of dart is used. In ancient times a larger weapon, with bladder on the side of the shaft, was employed. All kinds of marine animals are also pursued with toggle harpoons of the same general type, but of different patterns for different animals. They are divided into two classes, those intended for throwing and those which are thrust with the hand. Both classes agree in having only the head attached permanently to the line fitted loosely to the end of the shaft, and arranged so that when struck into the animal it is detached from the shaft and turns under the skin at right angles to the line. The harpoons of this arctic Alaskan area are then explained and figured in great detail by Murdoch.[1]

The same writer says that before the introduction of iron it was discovered that when the blade of the toggle harpoon is inserted parallel to the line hole the toggle head is less liable to pull out. At any rate, by a kind of necessity, the blade part of the oldest forms is transverse to the line hole. Also, by the exigencies of the broad body of bone and ivory, the blade of the Amur and eastern Eskimo regions is inserted parallel to the line hole.

Late in the autumn, when the pack is driven toward the land by the north wind, the ice forms rapidly. The hunters travel over it, as soon as it will bear their weight, to look for the "alloos," or breathing places, formed in the new ice when quite thin; this is gently raised by the animal's head into a slight mound, and a small hole opened with its nose and breath. These spots would escape notice were it not for the congealing of the breath forming a little hummock of hoar frost on the surface. It is this which reveals to the hunter an "alloo," or breathing place of a seal. Every seal has not its own breathing places, but more probably the instinct of the animal causes it to form many when the ice is thin, and many are frozen up for want of attention. Later in the season, as the ice grows thicker, it floats higher, leaving a larger and longer air space beneath, as the seal, when it visits the "alloo," scratches away the ice on the under side.

By these places the hunter takes his position, and, for fear the seal will catch the scent of his person, he carries a small three-legged stool on which he squats, taking his position on the lee side of the seal hole, watching and listening for the game. Of course he can not see the seal, but if there is a little wind he can see the vapor of its breath and hear the slight ripple in the water caused by the act of breathing.

When the hunter discovers the presence of the seal, his spear is sent crashing through the thin dome of ice into the animal, and so small

[1] Point Barrow Expedition, 1892, pp. 218–240.

are the quarters that the seal is seldom missed. The ice is then broken away and the hole enlarged until the game can be removed, this work being done with the ever-present ice pick.

The implements used in this method of hunting seal are a harpoon, to the staff of which is attached an ice pick, a line, and a stool to stand on. The stool serves the purpose of keeping the feet of the hunter dry, for newly formed ice is always very damp, and the long, patient waiting by the alloos would wet the feet of the hunter, after which he could not remain because of the intense cold, for furs are little protection if wet. At this season open water is formed by the current moving the ice, which presses together, leaving small spaces of open water. Seal passing these spaces will often come to the surface to breathe, and at such times fall an easy prey to the hunter's rifle and retrieving harpoon.

I am indebted for the information given above to Captain Herendeen, who lived many years at Point Barrow. He also says that whale fishing is carried on in the months of April and May.

On arriving home from the great spring reindeer hunt, about the 1st of April, the Eskimo have a few days of feasting and consultation. The wooden dishes of steaming venison are carried to the council house, "Cuddigon Igloo," where the men are gathered to talk over the coming whale hunt, and the sages tell of the conditions of ice required to make a favorable and successful season.

The wooden part of everything that is put into the umiak or freight boat is whittled or scraped off clean and smooth, so that the wood looks bright and new.

The women prepare the sealskin floats or pokes, as they are called by the American whalemen, as follows: A seal is captured and the skin cut around the head near the eyes. When the skin is cut free from the blubber and turned back, and the flippers are reached, they are unjointed near the body of the seal and the process continued until the carcass is removed. The blubber is scraped clean from the flesh side of the skin, and the bones carefully removed from the flippers. This is a delicate piece of work, for to cut the skin would ruin it for a float. After this is accomplished all natural vents to the body are closed by tying them around an ivory stud made for the purpose. Through one of these a hole is drilled to inflate the poke. The neck is passed over a stick about 6 inches long by 1 inch in diameter, then sewed up and the stick brought up to the seam and very firmly lashed with braided sinew. The poke is now blown up and stretched as much as possible by rolling and standing on it. Again it is scraped to remove the oil, and hung up in its inflated state to dry. After a few days it is oiled with the oil from the stone lamp. This dries more quickly than raw oil, and when dried again a coating is formed which is quite impervious to water. The lashing is now removed from the neck, the skin carefully turned hair side out, a permanent lashing put on the neck and stick, when the poke is blown up again and is ready for use.

The harpoon line is made of walrus hide, very strong and often double. Its end is made fast around the lashing between the stick and the poke. Two pokes are used on the harpoon line, which terminates in a bridle. Still another poke is used as a trailer, the harpoon line being not more than 5 fathoms in length. The third poke or trailer has a small line 15 or 20 fathoms long. This trailer keeps on the surface and tells the hunters the position of the whale, thus making the pursuit much easier.

The harpoons used are to be found in the U. S. National Museum collection. The staff is about 10 feet long, tapering at each end. It is never thrown, but thrust into the whale, and great force is needed to drive this rather bulky instrument through the tough fibrous blubber when the cutting portion is formed of stone, as was always the case before the advent of the white man. These people are so governed by superstitions that they fear dire disaster would overtake them if they did not use the stone cutting points of their fathers on the first whale; after that they can use what seems best for the occasion.

The other implements to complete the outfit of an umiak are as follows: Three pokes well inflated and ready for use, and from three to five more all ready to be blown up; a paddle for each person, the one used for steering being much larger than the others; an implement for bailing the umiak, made of the reindeer antler, as it is very desirable to remove the water as soon as possible after it leaks in; a long knife, fixed on a pole 10 feet in length, for cutting blubber and lean meat under water; three gaffs (hooks on poles) of different lengths, varying from 6 to 12 feet, the hooks of ivory; these are useful to hook on to the portion of flesh to be cut off; a little bag with plugs whittled out to put in the mouthpiece used to inflate the pokes; these plugs are often broken, and an extra one must be kept on hand; a large wooden scoop to bail when a quantity of water gets into the umiak; a spare whale harpoon; a crutch to lash in the prow of the umiak to rest the harpoon on; the two tips of this rest are carved in a rude semblance to a whale's head; the skin of a crow, some eagle feathers, and a little earth in a small bag from the grave of some noted whale hunter, for good luck; some of these crow skins have been used many years and are in a most dilapidated condition, but are highly esteemed, for they have been present at the death of many a whale; great wisdom is accredited to the eagle and the crow, and it is considered quite the proper thing to use this talisman in order to overcome the cunning of the whale; a couple of toggles made of ivory, in the shape of a whale; and straps to lash the pectoral fins of the whale when towing, so the fins will not drag heavily through the water; a bag of provisions. The men of the boat's crew carry their guns to shoot passing seals during the weary wait for the whale to come. Two women will be found in most crews. Each woman carries a sealskin bag to thaw out the snow for drinking purposes; the snow is put in the bag and its mouth firmly tied; it is then placed on her back between the inner and outer coat. The women also have their sewing outfits, to mend any breaks in the umiak.

In hunting through the ice the Eskimo of Point Barrow used a different shaped harpoon, with a long ivory piece on each end and a smaller head. As the seal comes up to blow they hurl this spear through the hole; then they drown the seal. After the animal is dead they haul it through the ice, picking the ice away until the hole is large enough to get the seal out. The animals do not freeze quickly, because they have such a coating of blubber. (Mr. Charles Browers.)

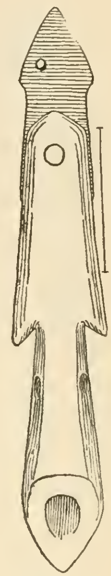


Fig. 62.

BARBED AND TOGGLE HEAD.

Mackenzie River. Collected by C. P. Gaudet. Cat. No. 1328, U.S.N.M.

A combined barbed and toggle harpoon head (Cat. No. 1328, U.S.N.M.) of antler, from the Mackenzie River district, is shown in fig. 62. Body sagittate, tapering to a flat angular tip. Blade of iron, with a long rectangular tang and a triangular point with slight projections at its base. The tang is snugly fitted into the slit and held by an iron rivet. There is a line hole at one angle of the point, but it may have been there previously, since these Eskimos especially work up all the old iron they get their hands on.

Line hole straight through the body behind the lateral barbs, and without slight grooves. Barbs, three; two on the sides, on an arrowhead, ornamented with longitudinal lines, and one terminating the back in a point. Socket half an inch deep. Butt end having two faces, the lower almost at right angles with the body, the upper whittled thin under the barb. Length, 3¾ inches. Collected by C. P. Gaudet. To this special type belong also many other examples. The National Museum is under infinite obligations to Messrs. Robert MacFarlane, B. R. Ross, and R. Kennicott for Mackenzie River materials.

A barbed seal harpoon (Cat. No. 16675, U.S.N.M.) for throwing stick. The shaft is of light pine wood, tapering backward, and is slightly thickened at the butt end. It is attached to the foreshaft by means of a socket and shank on the foreshaft. The foreshaft is of whale's bone, cylindrical. The tang is a plug cut on the end of the bone, fitting into the socket of the foreshaft. A hole is bored through the tang, through which the assembling line passes to hold the two parts together. The socket for the point is elliptical in section. No feathers are used. The point is of bone, delicate in form. Shank oval in section. Barbs, three on each margin. Line hole oblong. The line is of rawhide, one end fastened through the line hole by a triple splice. About midway the line is split and the two ends are fastened as a martingale—one around the shaft near the foreshaft, the other 18 inches from the butt end, both by a clove hitch. The assembling line on this specimen is short. It is pressed into the wood just below the juncture with the foreshaft and passes forward, then through the perforations in the foreshaft and backward, where it makes three clove hitches and then is continued backward, where the upper end of the martingale is attached, and is fastened off by a half hitch, the end being pressed into the wood. This specimen is from Kotzebue Sound, collected by W. H. Dall. Length of shaft, 49¼ inches; foreshaft, 5 inches; point 2¾ inches.

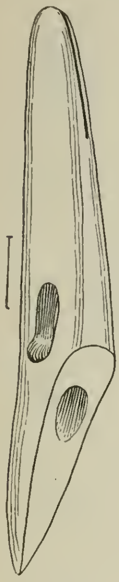


Fig. 63.
TOGGLE HEAD.
Diomede Island,
Collected by E. W. Nelson. Cat. No. 38775, U.S.N.M.

A large toggle head of a harpoon without blade (Cat. No. 38775, U.S.N.M.), from Diomede Island, is shown in fig. 63. It is of a typical form. The body is high and narrow, elliptical in outline, but having flattened faces here and there. The line hole is cut straight through, and is a flat ellipse in outline, 1⅛ inches long and three-eighths inch wide, with no attempt at line grooves. There is one immense barb formed by the back prolonged, ridged, and cocked up. The shallow socket is in a long cut or chamfer forming the butt end. Length, 8¼ inches. Collected by E. W. Nelson. To this same class of long, slender heads with large line hole belong the following specimens, with polygonal cross section.

Cat. No. 48589 (fig. 64), from Kotzebue Sound, collected by Nelson, is a little model in walrus ivory of a precisely similar head, with perpendicular blade and very long bevel at the butt end.

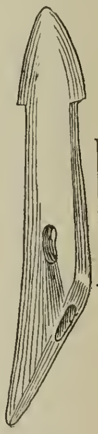


Fig. 64.
MODEL OF TOGGLE HEAD.
Kotzebue Sound.
Collected by E. W. Nelson. Cat. No. 48589, U.S.N.M.

A typical Alaskan walrus toggle head (Cat. No. 49167, U.S.N.M.), from Diomede Island, is shown in fig. 65. The body is of walrus ivory, conoid, with sloping faces on the back. Blade of iron, large in proportion, square at the base, set 1½ inches into the slit, and held by a bone pin.

Line hole oblong, straight through, widened behind, and flanked by two short grooves. Barb, one, angular; socket for the end of the shaft half an inch deep. Butt end cut off in a plane slightly warped at the socket. Length, 5 inches. Collected by E. W. Nelson.

A toggle head of a whale harpoon (Cat. No. 56601, U.S.N.M.), from Point Barrow, Alaska, collected by Captain Ray and described by Murdoch (1892, p. 238), is shown in fig. 66. Specimens of this kind are made for the market. The blades are triangular, the corners somewhat rounded off. The body is of coarse whale's bone, from the rib or jaw. Only two out of a large number collected by Ray are of ivory. The blade of this example is of brass, set into a saw cut in the end of the body and held in place by a bone rivet. The body is somewhat quadrangular in section, the line hole is well back from the blade, and the body widens from the front to this point. The line grooves extend outward beyond the base. The single spur is long and inclined upward. The base, contrary to the usual pattern, is somewhat convex. In the great mass of toggle harpoons the base is either concave or formed by two planes which make a different angle with the axis of the specimen. But in this case the contrary is true. The socket for the foreshaft is wide and deep.

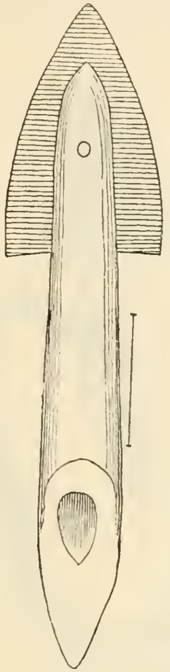


Fig. 65.
TOGGLE HEAD.
Diomede Island, Bering Strait.
Collected by E. W. Nelson
Cat. No. 49167, U.S.N.M.

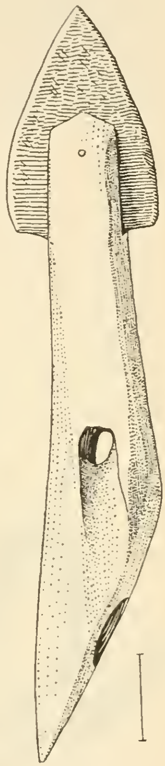


Fig. 66.
TOGGLE HEAD OF WHALE HARPOON.
Point Barrow.
Collected by P. H. Ray.
Cat. No. 56601, U.S.N.M.

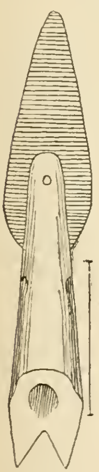


Fig. 67.
TOGGLE HEAD.
Point Barrow, Alaska.
Collected by P. H. Ray. Cat. No. 56614, U.S.N.M.

A small toggle head (Cat. No. 56614, U.S.N.M.) of bone, from Point Barrow, for catching seal, is shown in fig. 67. Body conoid, flattened laterally. Blade lanceolate, just fitting at its base into the slit of the head and fastened with an iron rivet. Line hole straight through and flanked by deep grooves. Barbs, two, formed by a file cut in the back. This is a common practice on hundreds of modern specimens. Socket for the shaft shallow and distinctly margined. Butt end formed by the meeting of two planes. Length, 3 inches. Collected by P. H. Ray.

A new style toggle head (Cat. No. 56620, U.S.N.M.) from Point Barrow, is shown in fig. 68. A large number of specimens of this type were brought home by the Ray expedition. The body is of antler and the blade is set into the saw cut at right angles to the plane of the body, barbed. The line hole is in the plane of the blade. The socket for the foreshaft divides the base into two parts with different slope, the one nearly perpendicular, the other with a slight angle, so as to form the barb. Of this specimen Murdoch says, "It is a newly made model in reindeer antler of the ancient harpoon, but evidently by a man used to modern patterns, so that the blade is set in at the wrong angle."

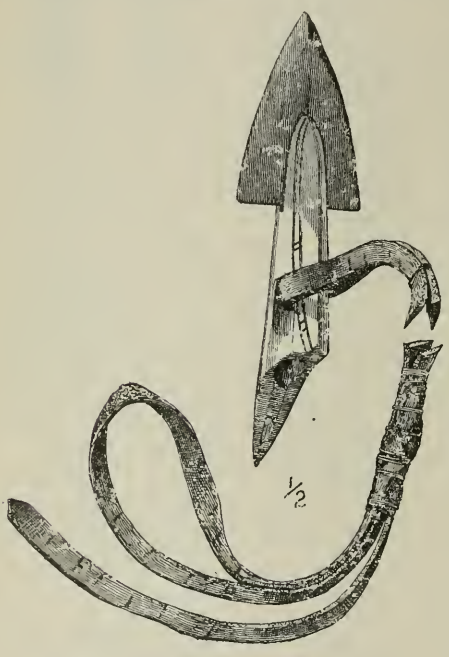


Fig. 68.
TOGGLE HEAD WITH LEADER.
Point Barrow.
Collected by P. H. Ray, after Murdoch.
Cat. No. 56620, U.S.N.M.

Walrus harpoons (Cat. Nos. 56670 and 56672, U. S. N. M.) from Point Barrow, Alaska, collected by P. H. Ray, are shown in figs. 69 *a* and *b*. The shaft of the former is of spruce, 71 inches long, rounded, and tapering from the middle in both directions. The club-shaped foreshaft is of ivory and has a wedge-shaped tang which fits in a cleft at the end of the shaft. The shaft and foreshaft are fastened together by a whipping of seal thong put on wet, one end fastened through a hole in the shaft, and the whole kept from slipping by a ridge on each side of the tang. In the tip of the foreshaft is a deep, round socket to receive the loose shaft, a tapering rod of walrus ivory, secured by a piece of seal thong passing through a transverse hole above the shoulder. One end is spliced to the thong; the other end makes a couple of turns outside of the lashing between the shaft and the foreshaft. On the side of the shaft and just above the middle is a line catch.

No. 56772 is a similar togglehead harpoon with the line hole in the plane of the blade, foreshaft with square base, spindle-shaped foreshaft, leader looped into the line hole and doubled at the outer end, to be spliced with the end of the line. On the shaft is a hook to be used in tightening the apparatus when the head is in place and also a stop

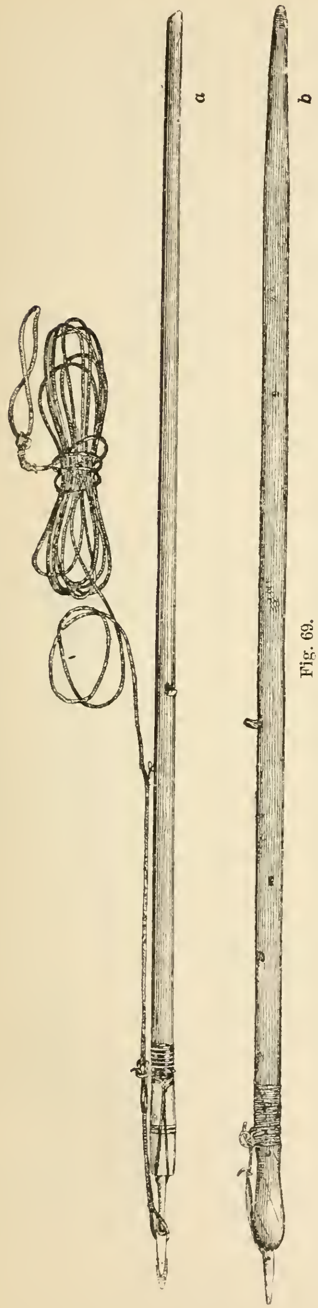


Fig. 69.

WALRUS TOGGLE HEAD HARPOONS.

Point Barrow.

Collected by P. H. Ray, after Murdoch. Cat. Nos. *a*, 56770; *b*, 56772, U.S.N.M.

Fig. 70.

SEALING HARPOON.

Point Barrow.

Collected by P. H. Ray. Cat. No. 56774, U.S.N.M.

for the hand in thrusting. The details of this specimen are carefully worked out by Murdoch (p. 225).

A sealing harpoon (Cat. No. 56774, U.S.N.M.) from Point Barrow, Alaska, collected by P. H. Ray, is shown in fig. 70. With respect to the use of this implement, Murdoch says that as the seals come up for air to their breathing holes or cracks in the ice a harpoon is used which has a short wooden shaft armed with an ice pick, and a long, slender loose shaft suitable for thrusting down the small breathing hole. It carries a toggle head, but has only a short line, the end of which is made fast permanently to the shaft. Such harpoons are used by all Eskimo wherever they are in the habit of watching for seals at their breathing holes. The foreshaft is simply a stout band for the end of the shaft; the loose shaft is of bone and has two holes to receive the end of the assembling line, which not only holds the loose shaft in place, but connects the other parts of the shaft so that in case the wood breaks the pieces will not be dropped.[1]

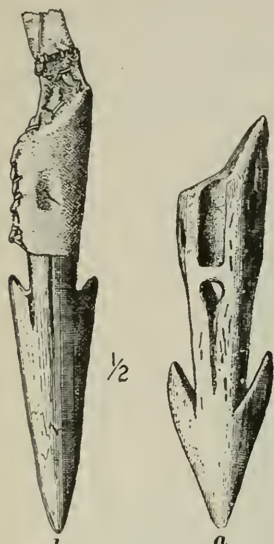


Fig. 71.

OLD BARBED AND TOGGLE HEADS.

Point Parrow.

Collected by P. H. Ray, after Murdoch. Cat. Nos. *a*, 89331; *b*, 8954, U.S.N.M.

An old bone harpoon head (Cat. No. 89331, U.S.N.M.) from Point Barrow, which is a compromise or transition between the barbed harpoon head and the toggle head, is shown in fig. 71*a*. Two long barbs on the margins are bilateral and symmetrical. Blade transverse to line hole, as in the small seal dart heads. The shaft socket groove is flanked on its margins with slots, through which a thong may have passed to complete the apparatus. Two specimens are figured by Murdoch. Length, 4¼ inches. Collected by P. H. Ray, U. S. A.[2]

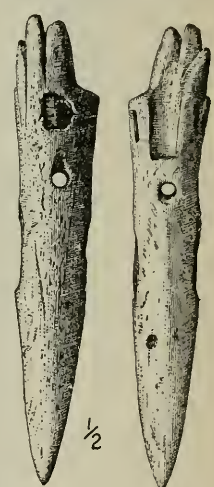


Fig. 72.

OLD TRANSITION HARPOON HEAD.

Point Barrow.

Collected by P. H. Ray, after Murdoch. Cat. No. 89337, U.S.N.M.

Murdoch calls attention, in fig. 71*b*, to the similarity of No. 89544, U.S.N.M., to a harpoon head collected by Nordenskiold at the ancient Onkalon house at North Cape.[3]

[1] Ninth Annual Report of the Bureau of Ethnology, fig. 239.

[2] Sixth Annual Report of the Bureau of Ethnology, p. 220, fig. 209 *a* and *b*.

[3] Ninth Annual Report of the Bureau of Ethnology, fig. 211, p. 220, quoting Voyage of the Vega, I, p. 444, fig. 5.

A bone harpoon head (Cat. No. 89337, U.S.N.M.) from Point Barrow is shown in fig. 72. It marks a step in the transition from barbed head to toggle in that the barbs are absent; a slot on each margin of the body marks the places where they might have been inserted. The line hole is transverse to the blade. The barb of the toggle head is four-pronged and sits awry with reference to the blade. Length, 4½ inches. Collected by P. H. Ray, U. S. A.[1]

A combined barbed and toggle harpoon head (Cat. No. 89377, U.S.N.M.) from Point Barrow, rhomboidal in section, conoidal behind the barbs, body all in one piece, of bone or antler, long, slender, tapering from butt to point like a lance blade, is shown in fig. 73. When the line hole is horizontal the blade is vertical. The line hole is a small round perforation. Line grooves, narrow; furrows, uniform.

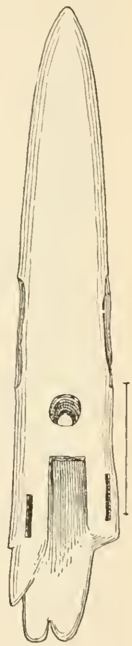


Fig. 73.
BARBED AND TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray. Cat. No. 89377, U.S.N.M.

There were at one time, possibly, barbs on the margins of the blade, for there exists on each, at a distance of 2 inches back from the point, a groove seven-eighths inch long, three-eighths inch deep, and less than one-eighth inch wide, undercut in front. Into this groove or slat could have been inserted marginal barbs of bone, or perhaps of stone. The barb at the butt end is made up of a series of four-lobed projections of different lengths.

The socket is a squared mortise into the bone, with one side quite open. On the margins of this space elongated slots are cut into an open, depressed space on the back, and the socket is completed by coiling around through them a string of animal tissue.

With this specimen should be compared an example from North Cape, with top and bottom barb, oblong line hole decorated by furrows along the sides toward the tip, terminating in two branches and a cross line.[2] Length of 89377 is 5 inches. Collected by P. H. Ray.[3]

A combined barbed and toggle harpoon head (Cat. No. 89378, U.S.N.M.) from Point Barrow, of antler, all in one piece, is shown in fig. 74. The body is long, slender, and angular in its outlines, a flat triangle in section in front and pentagonal behind the barb. Line hole straight through very near the butt end and parallel to the plane of the point and lateral barbs. Line grooves deep cut for a small rawhide line.

There are three barbs, one on each margin, acute, the opening two-sided; the rear barb is a sharp termination of the rigid back. Socket for

[1] Ninth Annual Report of the Bureau of Ethnology, p. 220, fig. 210.
[2] A. E. Nordenskiold, Voyage of the Vega, New York, 1882, p. 335.
[3] Ninth Report of the Bureau of Ethnology, p. 220, fig. 210.

the shaft half an inch deep, butt end cut off, with two faces and a ridge in the middle. Length, 5½ inches. Collected by P. H. Ray. It is well known that all such angular material has been made with steel tools. The only attempt at decoration is a series of four short grooves extending forward from the angles of the lateral barb—a common feature in Eskimo art.

Fig. 74.
COMBINED BARBED AND TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray.
Cat. No. 89378, U.S.N.M.

An ivory harpoon head (Cat. No. 89379, U.S.N.M.) from the Eskimo camp near Point Barrow, which marks that step in the transition from the barbed head to the toggle head in which the line hole, line grooves, and shaft socket of the latter are complete, is shown in fig 75. Length, 5 inches. Collected by P. H. Ray.[1] It is compared by Murdoch with a Chukchi form.[2] The blade is long and tapers backward from the tip to the equal barbs, giving to this part of the specimen the form called sagittate, and occupying two-thirds of the length of the head. The tang of the blade and barbs expands to form the body, through which the line hole passes directly, perpendicular to plane of the blade. The line grooves are straight and uniform in depth. The body widens from the barb on the side that is to become the spur or rear barb, the other side being straight. The shaft socket is in perfect alignment, and the base is a single gracefully curved plane to the point of the spur.

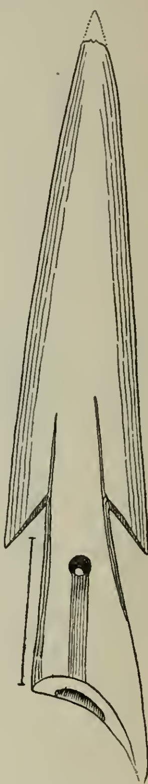


Fig. 75.
BARBED AND TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray.
Cat. No. 89379, U.S.N.M.

A curious fragment of a combined barb and toggle harpoon head (Cat. No. 89381, U.S.N.M.) is shown in fig. 76. The parts are all from one piece of ivory: the barbed head is transverse to the line hole, the line hole is somewhat triangular, and the specimen is much discolored and disfigured, showing that it is old. Either owing to the poverty of material or on account of breakage, the after part of the toggle head is too narrow for a socket to the foreshaft. In order to remedy this defect the Eskimo hunter has made a furrow or cavity

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[1] Figured by Murdoch in Ninth Annual Report of the Bureau of Ethnology, p. 220, fig. 211.

[2] A. E. Nordenskiold, Voyage of the Vega, New York, 1882, p. 335.

on the side and cut square holes in the margins of this cavity, through which a rawhide line could be run several times, and this would serve the purpose of the socket. This device may be seen on one other specimen in the collection. Collected by Philip H. Ray, Point Barrow.

An old harpoon toggle head (Cat. No. 89382, U.S.N.M.) from Nuwuk, in the Point Barrow region, made of bone, all in one piece, is shown in fig. 77. In fact, it is a barbed head, like that of the seal dart, becoming a toggle head. The part answering to the blade is a point on the bone with a single barb on the lower side or belly. From the base of the barb the body widens to the butt end. The line hole is transverse to the blade. The butt is cut off diagonally. The socket is wanting, but the bone is concave on one side. Mr. Murdoch thinks that a socket was provided by the lashing, as in Example 89381.[1] Length, 3 inches. Collected by P. H. Ray.

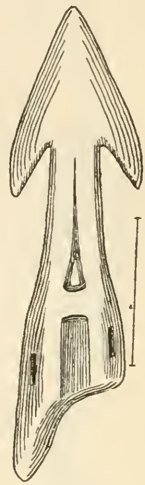


Fig. 76.
COMBINED BARBED AND TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray.
Cat. No. 89381, U.S.N.M.

An old-style toggle head (Cat. No. 89748, U.S.N.M.) for a harpoon is shown in fig. 78. The body is of bone, quadrangular in section. The head is of chipped stone, with a tang set into the kerf in front of the body and held in place not by a rivet, but by a lashing of sinew twine. The line hole is at the extremity of the body, where it begins to taper to the spur or barb, which is slightly bifurcated at its outer end. This is called an old-fashioned specimen because the blade of stone is in the plane of the greatest width of the body and is bisected by the line hole.[2]

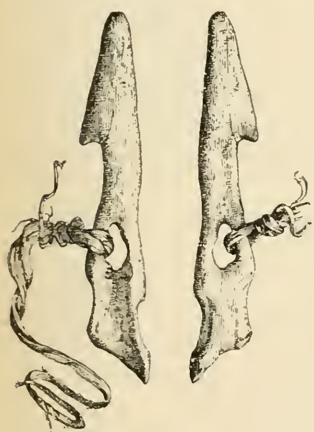


Fig. 77.
OLD TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray, after Murdoch.
Cat. No. 89382, U.S.N.M.

A retrieving seal harpoon (Cat. No. 89907, U. S. N. M.) from Point Barrow, collected by Ray, is shown in figs. 79 and 80. This specimen was supposed by Murdoch to have been invented after the introduction of the rifle, but in his description[3] he makes the remark that though it is used at the present day for nothing but retrieving, the fact of similar specimens having been brought by the officers of the *Blossom* shows that

[1] Ninth Annual Report of the Bureau of Ethnology, p. 219, fig. 208.
[2] Idem, p. 221, fig. 212.
[3] Idem, p. 231.

it antedated the rifle. Such a retrieving harpoon is called nauliga. The shaft (ipúa) is of ash, 4 feet 5 inches long and 1 inch in diameter, tapering very slightly to each end. The ice pick (túu), of walrus ivory, 14 inches long and 1 inch wide, has a round tang fitting into a hole in the butt of the shaft. Close to the shaft a small hole is drilled in one edge of the pick, and through this is passed a bit of seal thong, the ends of which are laid along the shaft and neatly whipped down with sinew braid, with the end wedged into a slit in the wood. The foreshaft (ukumailuta) is of walrus ivory, 4½ inches long and 1½ inches in diameter at the thickest part, and secured to the shaft by a whipping (nĭ'xma) of seal thong. The loose shaft (ígimû) is also of ivory and 2 inches long, and secured by a thong (ĭpíuta) spliced into a loop through the hole at the butt, as previously described. The end is hitched round the tip of the shaft with a marlin hitch, followed by a clove hitch below the whipping. The ivory finger rest (ti'ka) is fastened on with a lashing of whip cord (white man's) passing round the shaft. The line catch (ki'lerbwĭñ), which was of ivory and shaped like those on the walrus harpoons, has been lost in transportation. The head differs only in size from those intended for the bearded seal, except in having a hexagonal body. It is 3.3 inches long and has a blade of iron fastened into a body of walrus ivory with a single wooden rivet. While there is no detachable leader, the head is attached by a separate piece of the same material to the line (tûkăksia), which is 86 feet 10 inches long and made of a single piece of fine seal thong about one-eighth inch thick. This shorter piece is about 27 inches long, and is passed through the line hole and doubled so that one part is a little the longer.

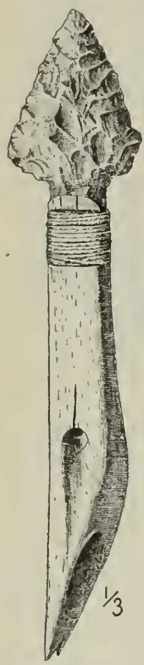


Fig. 78.
OLD STYLE TOGGLE HEAD.
Point Barrow.
Collected by P. H. Ray, after Murdoch. Cat. No. 89748, U.S.N.M.

It is fastened strongly to the end of a line by a complicated splice made as follows: A slit is cut in the end of the main line, through which are passed both ends of the short line. The longer part is then slit about 2 inches from the end, and the shorter part passed through the slit, and a slit cut close to the end of it, through which the longer end is passed. The whole is then drawn taut and the longer end clove hitched round the main line.

Catalogue No. 129585 in the U. S. National Museum is a barbed harpoon (for throwing stick) from Cape Blossom, and collected by Capt. M. A. Healy, of the U. S. Revenue Marine. The shaft is of light pine wood, tapering back toward the butt end. It is socketed to receive the shank or tang of the foreshaft, which is plug-shaped and

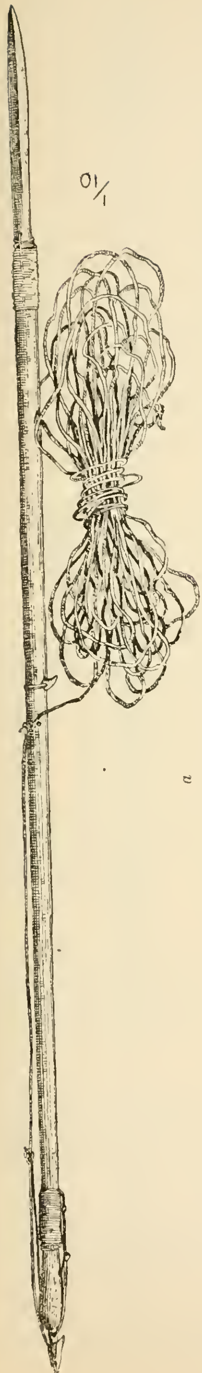


Fig. 79.
RETRIEVING HARPOON.
Point Barrow.
Collected by P. H. Ray, after Murdoch. Cat. No. 89907, U.S.N.M.

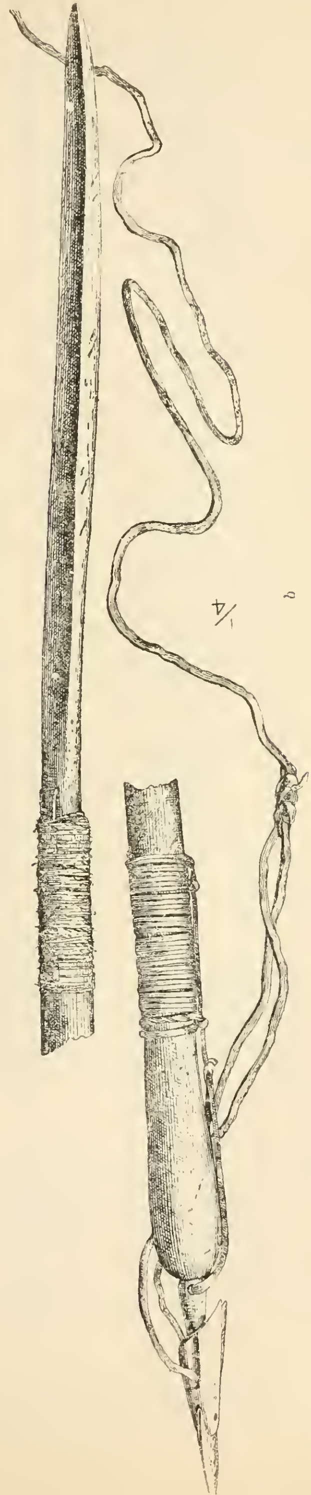


Fig. 80.
Detail of Fig. 78, after Murdoch

fitted in, all being held together by sinew braid. The foreshaft is of whale's bone, cylindrical. The socket for the point is oblong. Feathers, two, especially noteworthy. The tip end of a half feather is punched into the wood near the neck, bent at right angle and carried forward and lashed down by the assembling line. The fibrous part of the feather is on the inside, between the rib and the shaft of the harpoon. This style of feathering is seen on example 48153, from Sledge Island, with three feathers: on 34020, from Norton Sound, and on several specimens from Golofnin, and does not occur any farther south. The point is of bone, concave on one side and convex on the other. Barbs, three on one margin and two on the other. The tang of the point is wide and flat. The line is of seal hide; martingale formed by splitting the line in the middle and tying the two ends to the shaft. There are two assembling lines—one extending from the upper knot of the martingale to the joint of the shaft and foreshaft, where it forms the seizing between the two; the other begins with the lower knot of the martingale, where one end of sinew thread is punched into the wood, passes backward, and is fastened off by a clove hitch. It then returns to the starting point, where it is again fastened off, and goes on to the feather by a series of turns and half hitches, laid on much as the sinew on the sinew-back bow. This is very interesting. Length of shaft, 44 inches; foreshaft, 4½ inches; point, 2 inches.

Example No. 129574, in the U. S. National Museum, is a barbed harpoon from Cape Krusenstern, Kotzebue Sound. The delicate shaft is conical in shape, tapering from the foreshaft backward, and slightly flattened in its thicker portion. It is socketed in the larger end for the reception of the foreshaft, and slightly stained red.

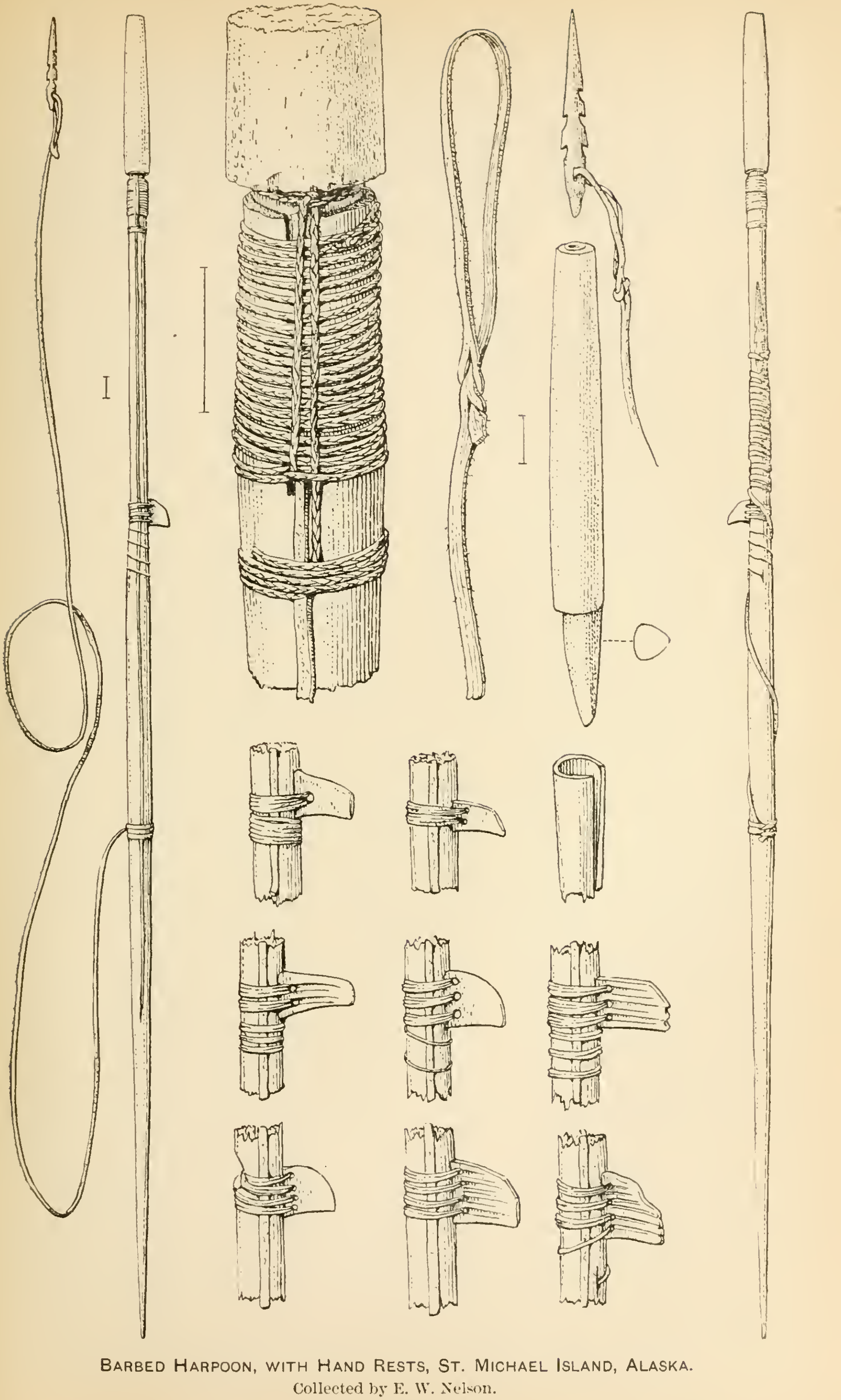
The foreshaft is of whale's bone, cylindrical in shape. The tang fits in the open socket of the shaft, and on the outside the two bodies are trimmed down so as to form one continuous surface. Seizing of sinew twine. The socket for the point is quite large and extends across the wooden plug inserted in the end of the bone.

The hand rest is a slight hook of ivory set in the shaft, pierced with one triangular hole and held by a wrapping of sinew thread, which is also continued around the shaft a dozen times and fastened off by being punched into the wood.

The point is of bone, flat on one side and rounded on the other. Broad shank. Line hole almost circular. Barbs, three on one margin and two on the other. On the flat side of the point a shallow gutter is cut from the line hole forward.

The line is of seal skin. One end passes through the line hole and is fastened by a common slip knot; the other end is made fast to the shaft, about 9 inches behind the hand rest, with a clove hitch of three turns.

The assembling line is of rawhide, one end caught under the seizing



BARBED HARPOON, WITH HAND RESTS, ST. MICHAEL ISLAND, ALASKA.

Collected by E. W. Nelson.

Cat. No. 36068, U.S.N.M.

between the shaft and foreshaft, and the other end pressed into a groove in the wood and held by a small wedge.

This delicate specimen is the only example of the class of barbed harpoons with hand rest coming from a point north of Bering Strait. Length of shaft, 4 feet 3 inches; foreshaft, 7 inches; point, 3 inches. Collected by Capt. M. A. Healy, of the U. S. Revenue Marine.

HARPOONS OF BERING SEA.

The harpoons of this area were fully described and figured by Nelson in 1899, who had the advantage of having seen the specimens at work. The massive harpoons of Greenland and the central Eskimo are wanting here, but the greatest variety of forms and parts is to be found. Again, if the flat varieties of eastern Asia, with line hole in the plane of the blade, are the more aboriginal, their nearest kin are to be seen, not in Bering Sea, but around Greenland. It is as when an Oxford professor, wishing to know something of his old-time kin, visits, not the nearest English town, but the heart of some New World colony. The Bering Sea Eskimo have been profoundly affected by the vigorous prosecution of the fur trade during the past century and a half. The possession of steel tools has revolutionized their fine art; but, fortunately for this study, the harpoon has kept more loyally to its ancient models. There are barbed varieties, toggle varieties, and some are mixed. There are those which are thrust with the hands, others are hurled from the hand, and very many are cast from throwing sticks. Of this last-named implement a number of type forms are to be seen between Mackenzie River and Sitka. Here also will be found feathered harpoons, those with bladders attached to the shaft, and harpoon arrows. In the more southern portions of the Bering Sea area the harpoon attains a finesse in structure and appearance nowhere else seen. The collections from this area made by Nelson, Turner, Dall, Applegate, and Johnson are unparalleled for comparative study.

Among a large collection of these seal darts or barbed harpoons from Unalakleet, in the northeast corner of Norton Sound, a great majority have cylindrical foreshafts made of whale's bone, but one or two specimens have the heads of walrus ivory and the front end tapered in conical form. Farther south this characteristic is more abundant. Barbs on the points are three on one margin and two on the other, and two on one margin and one on the other.

According to Lucien Turner, the harpoon darts with very thick foreshafts and elongated bladders attached to the shaft are for salmon. They are confined to Bristol Bay and the south side of the Alaskan peninsula, so far as the U. S. National Museum is concerned.

Cat. No. 33859 in the U. S. National Museum is a barbed harpoon thrown from the hand by means of a hand rest on the shaft. Quite similar is No. 36068, as shown in Plate 8, described in Nelson, 1899

(p. 138). Unless otherwise mentioned the specimens described below were collected by E. W. Nelson.

The shaft is of soft wood, tapering backward to a point, oval in cross section, and stained red in the front portion. For the attachment of the foreshaft a roughly conical socket is excavated, and on the upper side of this socket a slot is cut through from the outside. In the harpoons whose foreshafts are attached in this way this slot is universal—that is, the tang of the foreshaft is not driven into a cavity which it fits, but is set in a cavity with two margins which can be driven close together by the shrinkage of the seizing.

The foreshaft is of whale's bone, nearly cylindrical, and cut off square in front. The tang is conoidal in form and terminates with a shoulder where it joins the body of the foreshaft. A plug of wood is inserted in the front end of the foreshaft, with a socket for the tang of the point. Feathers, none; but on the side of the shaft, just behind the center of gravity, is a flat piece of antler or bone set on and held in place by a lashing of rawhide thong. This serves as a stop for the end of the harpoon, the latter being driven like a javelin from the hand, without the use of a throwing stick of any kind.

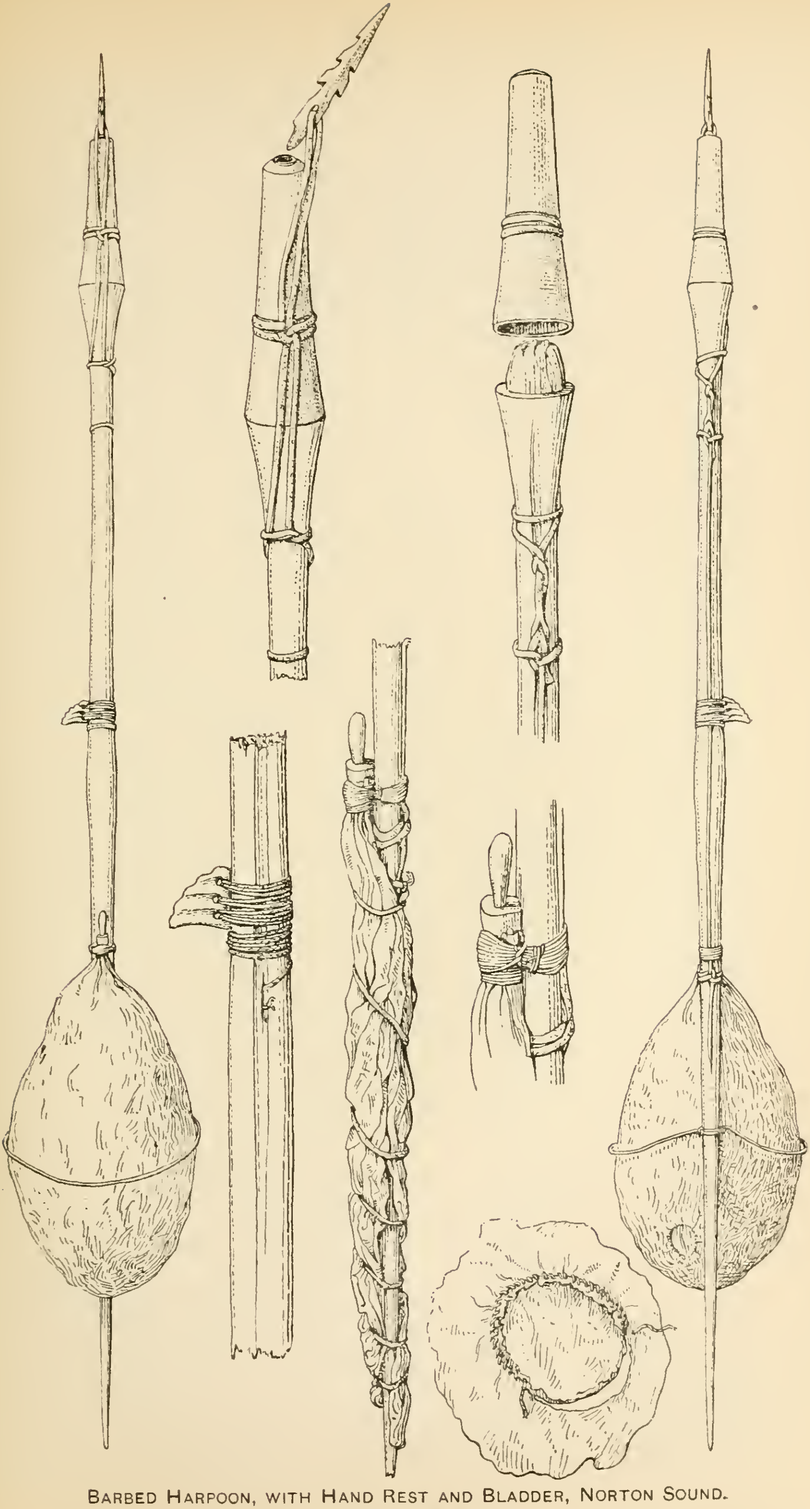
The point is of bone, flattened on one side and round on the other, much larger than that of the variety hurled with a throwing stick. The shank is a flattened cone. Barbs, three on one margin and two on the other. In all of this class of harpoons the edges or sides of the point are sharp, and the margins of the barb are straight on one side and curved on the other. The line hole is oblong.

The line is of rawhide thong, one end attached to the point and the other end to the shaft back of the middle by a clove hitch.

The assembling line is fastened around the tang of the foreshaft near the shoulder and is continued back underneath the lashings, of different kinds, to near the top end, where it is driven into the wood and forms a smooth fastening.

Length of shaft, 52 inches. Length of foreshaft, 8 inches. Length of point, 4 inches. This specimen is from St. Michael. Collected by E. W. Nelson.

A toggle-head harpoon (Cat. No. 33888, U.S.N.M.) from Norton Sound is shown in fig. 81. The head is of ivory. The noticeable features about it are: The blade is in the same plane as the line hole; the line hole goes directly across the body of the head; the shallow socket is exactly behind it and in a line with the saw cut. There is a single barb or spur projecting behind the socket on top of the toggle head. The foreshaft is a long spindle of bone, tapering in front to fit the socket of the toggle head, and having a short cone at the base for the cavity in the end of the foreshaft. A hole is pierced through the foreshaft and a loop or becket passed through this opening and around the line, so that when the animal is struck the foreshaft is withdrawn from



BARBED HARPOON, WITH HAND REST AND BLADDER, NORTON SOUND.

Collected by E. W. Nelson.

Cat. No. 33933, U.S.N.M.

the head and remains attached to the line. This feature should be carefully noted. The shaft is of wood, the foreshaft of ivory, and swollen or bulbous at the outer end. It fits into the wedge-shaped cut on the end of the shaft and is held tight by a lashing of rawhide. This lashing continues the whole length of the shaft, being caught around it at intervals with half hitches, forming an assembling line. Attached to the shaft is a hand rest about the center of gravity and a sharpened piece of bone at the other end. The line from the toggle head, after passing through the loop on the loose shaft, is attached to the shaft about the middle, so that the latter forms a drag when the animal is once struck. This implement is not thrown by means of a throwing stick, but from the hand of a hunter. Collected by E. W. Nelson.

A barbed harpoon (Cat. No. 33910, U.S.N.M.) from the Norton Sound area, to be thrown from the hand and not from a throwing stick, is shown in fig. 82. The shaft tapers from the front to the rear end, and has a hand rest on the side, held down by sinew thread. The foreshaft is a cylinder of bone, and fits into the open socket of the shaft by means of a projection or tenon. The harpoon head is a barbed piece of bone. The line passes through the line hole in the head and is wrapped several times around the shaft, fastened off with a series of half hitches, and nearer to the butt end. The assembling line, in this example, is different from the one just described. When the animal is struck, the head is withdrawn from the foreshaft, the thong unwraps from the shaft, which stands straight in the water and acts as a drag to the captured animal. It is from St. Michael.

A barbed harpoon with hand rest (Cat. No. 33933, U.S.N.M.), from St. Michael, Alaska, is shown in Plate 9. The shaft is of pine wood, elliptical in section, pointed in the rear, widening toward the middle and then narrowing again toward the foreshaft. The foreshaft is of bone or antler, a flat cylinder in section and a truncated cone in outline. It has a hole in the base and is fitted over a projection or tenon in the end of the shaft. This method of joining is worthy of notice. The shoulder of the shaft forms a neat joint with the rear of the foreshaft. In the middle

Fig. 81.

TOGGLE HEAD HARPOON.

Norton Sound.

Collected by E. W. Nelson.
Cat. No. 33888, U.S.N.M.

of the body of the foreshaft a gutter is carved to receive the knot in the line. A hand rest on the middle of the shaft is triangular in outline, with a wavy margin and short flutings on the surface. It is pierced with three holes and set against the side of the shaft, where it is laid in place by wrappings of sinew thread. The fastening off of the lashing by being punched in the soft tissue of the wood is quite characteristic in Eskimo manufactures. The head has three barbs, one on one margin and two on the other, and is flattened on one side and angular on the other. The tang is flat and shouldered. The line hole is an oblong opening, just large enough to hold the rawhide thong and give it play. The line, which serves also for assembling line, is of stout sealskin. The small bladder is attached to the shaft. Its mouthpiece and lashings are well shown in the drawings.

Fig. 82.
BARBED HARPOON.
St. Michael Island.
Collected by E. W. Nelson. Cat. No. 33910, U.S.N.M.

Specimen No. 33948 in the U. S. National Museum is a bridle harpoon for a throwing stick, from the mouth of the Yukon River, collected by E. W. Nelson. The shaft is of light pine wood, top-shaped at the tip, suddenly narrowed, and then gradually widened to the butt end, where it is quite expanded. It is socketed for the shank of the foreshaft. The foreshaft is of ivory, attached to the shaft by a tang which fits into the socket. It is perforated just below the shoulder for the reception of a loop of rawhide, which is caught on either side under the seizing, binding the shaft and foreshaft together. This serves as an extra strengthening or as a retrieving device. The tip end of the foreshaft is tapered and a wooden plug inserted for the reception of the point. Two whole feathers are attached in the usual manner, punched into the wood, all their tip ends and the butt ends held down by a wrapping of the assembling line. The assembling line passes from the front end of the shaft to the inner end of the feathers. The point is of ivory, line hole oblong, tang conical, with a shoulder. Martingale of sinew string, the two ends fastened in the usual place—one near the foreshaft, the other back of the middle, fastened by a clove hitch. The assembling line acts as a lashing for the shaft and the foreshaft, passes backward by the regular series of half hitches, and is fastened off at the butt end as a seizing to the feathers. Especial attention is called to the hole near the tang of the foreshaft; a similar hole is found through the inner end of the foreshaft near the tang. This peculiarity is almost entirely confined to the area between Cape Dall and Nunivak. Length of shaft, 46 inches; foreshaft, 5 inches; point, 3½ inches.

Specimen No. 33952 in the U. S. National Museum is a barbed harpoon without bridle for throwing stick, from Askeenuk, below Point Dall, collected by E. W. Nelson. The shaft is of light pine wood, nearly uniform thickness throughout, slightly expanded at the butt, and cut into a truncated wedge in front, which fits into a smaller slot in the foreshaft. The foreshaft is of ivory, almost cylindrical, and a little expanded in the front and tapering toward the tip, into which a plug of wood is inserted for the reception of the tang of the point. Into the butt end of the foreshaft is sawed a wedge-shaped slot on the ends of the wings. These formed projections are left for the lashing which joins the two parts together. The lashing is also held in place at the other extremity of the joint by shoulders on the foreshaft wrapped with sinew braid, which forms a strong joint. Three feathers are pressed into the wood near the butt end and wrapped with sinew braid at their inner extremities, the braid continuing to form the assembling line of the shaft. Here, as in other examples, a dozen or more turns are closely wrapped around the shaft about a foot from the end. The point is of bone. Barbs, three on one side and two on the other. Line hole oblong and quadrangular. Tang conical and shouldered. Through the line hole is fastened a narrow sealskin thong 3 feet or more long. This is attached by its other end around the shaft near the joint with the foreshaft by a clove hitch. When the point is driven into a seal by means of a throwing stick, the tang is withdrawn from the foreshaft, which sinks in the water, and the shaft floats with the feathers upward to act as a buoy and also as a drag to slacken the pace of the animal. Similar to this are Nos. 33950, 33949, 33954, and 33955. In all of these the line is fastened to the shaft near the foreshaft. Length of shaft, 44½ inches; foreshaft, 6½ inches; point, 3 inches.

Examples Nos. 34004, 34011, 34016, 34020, 34002, 34008, 34017, 34022, 34018, 34001, 34023, 34014, 34003, 34021, 33992, 33991, 33999, 33994, 33978, and 33995 in the U. S. National Museum are barbed seal harpoons for throwing sticks, and form a large collection of these objects from various places around Norton Bay. They have foreshafts of whale's bone, cylindrical, attached to the shaft by a shank fitted into a socket in the end of the shaft.

The shank of the foreshaft is somewhat wedge-shaped in cross section, the edge of which is run through a slot extending from the outside to the inside of the end of the shaft, to allow the shrinking of the sinew wrapping on the outside to bind all the parts strongly together.

Most of these specimens from this area have two feathers, though in some cases there is only one.

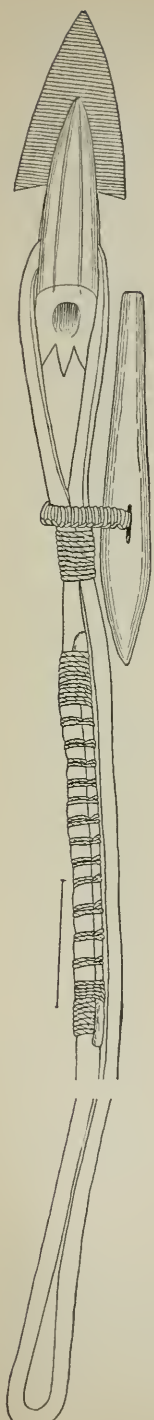


Fig. 83.
TOGGLE HEAD AND ACCESSORIES.
Kuskokwim River.
Collected by E. W. Nelson. Cat. No. 37380, U.S.N.M.

The head and contiguous parts of a small toggle harpoon (Cat. No. 37380, U.S.N.M.) for seal, from Chalitmut, collected by E. W. Nelson, is shown in fig. 83. The body of the head is of ivory, somewhat rectangular in cross section, but carved and flattened on both sides in parts of threes. The blade is set into a saw cut at the tip of the head and not held by any rivet. The socket for the loose shaft is a slender cone truncated within, the front end of the loose shaft being sawed off. The butt end of the body is beveled out. A long slope and three barbs are formed at the hinder edge of this bevel and ornamented with concentric circles and lines. The line hole passes straight through the body, as in many other examples of this type. The loose shaft is a spindle-shaped piece of bone, longer on the front slope. The hinder end is sharpened to fit into a groove. In the end of the foreshaft a hole is bored through the thick portion of the loose shaft, and through this hole and around the leader or line is formed a grommet of sinew cord. The two ends of the leader are overlapped and united by a notch.

A small toggle harpoon (Cat. No. 37395, U.S.N.M.) of the Alaskan Eskimo, at Chalitmut, on the north of Kuskokwim Bay, is shown in fig. 84. It is a type of the region and is made with a great deal of artistic skill. Blades are nowadays of brass, copper, and other metals, often of slate, inserted into a small toggle head of ivory transversely to the plane of the barbs, the plate intersecting the barb, which is bifurcated and sometimes trifurcated. The body is also ornamented with graceful lines, herring bone patterns, and circles. Into the socket of the headpiece is inserted the point of a small bone loose shaft, which fits by its lower end into a shallow socket of the foreshaft. Through the line hole of the head is a loop of rawhide, the ends neatly spliced together by a frapping with sinew string. The loose shaft is kept from being lost by a little grommet, made of sinew passing through it and around the rawhide loop. The whole work of all these specimens is very neatly done. Length of head, $1\frac{3}{4}$ inches. Collected by E. W. Nelson.

Catalogue No. 37955 is a toggle head of seal harpoon. The parts of this specimen which are attached are the head, with its loop or leader, and the loose shaft, with its runner or grommet of rawhide passing over and inclosing the leader of the head.

The body is of bone or ivory in the form of a flattened cone. The spur is beveled and curved up at the point. Two delicate barbs are parallel on the outside and divided by a furrow along the back. Blade of iron, triangular, with convex edges, inserted in the blade slit and riveted. Plane of the blade parallel with the line hole. Shaft socket in the spur narrow and deep. Line hole transversely through the body. Line grooves extended to the end of the barbs and ornamented with engraved lines. Leader of rawhide, neatly spliced by seizing at the ends, and the space between lashed with double hitches passing between the rawhide ends. A narrow seizing holds the two elements close to the toggle head. It may be questioned whether the peculiar curves of back and belly give the head a start in toggling itself in the wound.

Fig. 81.
TOGGLE HEAD AND ACCESSORIES.
Kuskokwim River.
Collected by E. W. Nelson. Cat. No. 37395, U.S.N.M.

Foreshaft of bone, spindle-shaped, and attached to the loop of the toggle head by a small running loop or grommet of rawhide.

Length, $3\frac{1}{4}$ inches. Eskimo of Sfagamute, north of Bristol Bay. Cat. No. 37955, U. S. National Museum. Collected by E. W. Nelson.

The illustration in Plate 10 shows the construction of the larger Bering Sea harpoons (Cat. Nos. 43346 and 153727), cast from the hand, and used in killing large seals, walrus, and white whales. They have stout wooden shafts, from 4 to 7 feet long, with a hand rest near the center made of bone or ivory, neatly fitted on and held in place by a lashing of baleen, rawhide, or sinew cord. The foreshaft is of bone and ivory, neatly fashioned, fitted to the end of the shaft by a tenon and socket, and held firmly by a seizing of baleen. The foreshaft is pierced near its base for the line which holds all the parts together, and has a socket on top for the loose shaft. At the butt end of the shaft is a bone pick, attached by a wedge-shaped joint, the bone fitting into a kerf in the wood. The upper part of the pick is bored through for the assembling line. Around the joint is a lashing of baleen, neatly laid on, the assembling line being neatly interlaced with the wrapping. Especial attention is called to the fastening off and the knots on the shaft. The foreshafts of the large Bering Sea harpoons belong to the two quite distinct forms, the spindle-shaped and the conoidal. On the left side of Plate 10 is shown the form and mounting of a spindle-shaped loose shaft, and on the right side that of a conoidal form. In this example the projection is on the loose shaft and the socket in the foreshaft. In both forms a hole has been bored through the loose shaft for the assembling line. In these harpoons the heads belong to Murdoch's later type; that is, the blade and line hole are in the same plane, at right angles to the longest diameter of the cross section of the toggle head. The blades of these harpoons are of slate, iron, brass, and, in a few specimens, of jade-like material. The toggle head is attached to the main line by means of what Murdoch calls the leader, which is a stout rawhide thong, 1 to 2 feet long, passed through the line hole, the two ends being overlapped and seized together; near the head a few turns of fine thong or sinew twine hold the two sides of the loop together, forming a becket. At the other end the leader is spliced into a becket on the end of the line. The line, when the head is ready for action is "done up" on the shaft, the far end being securely tied. When the game is struck, the head is withdrawn, the loose shaft unstripped, the line unrolls, and the shaft acts as a drag.

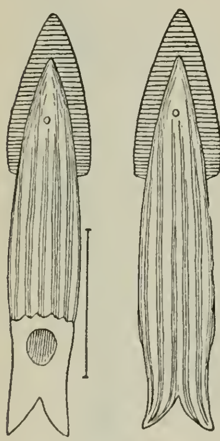
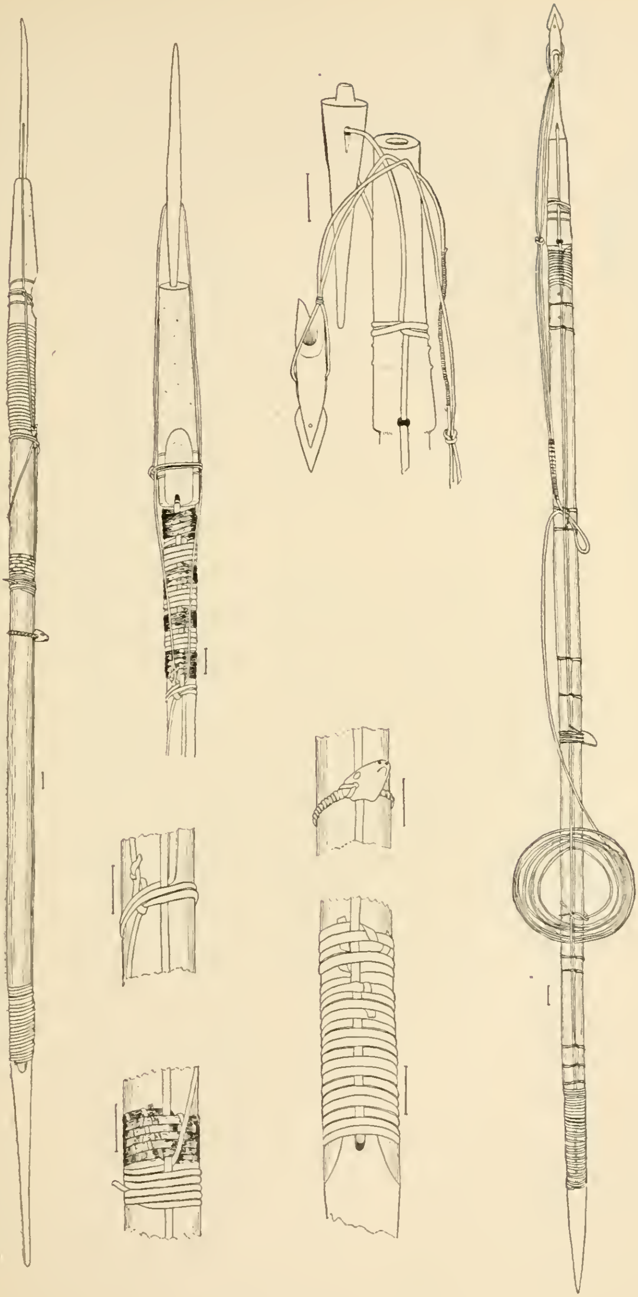


Fig. 85.
TOGGLE HEAD.
Cape Nome, Alaska.
Collected by E. W. Nelson. Cat. No. 44484, U.S.N.M.

An artistic little toggle head of bone and iron from Cape Nome (Cat. No. 44484, U.S.N.M.), on the northern shore of Norton Sound, is shown in fig. 85. Body is somewhat pyramidal, the upper and lower surface being elegantly fluted and ridged. The blade is deltoid, with square butt and slightly convex margins, set deeply into the tapering point of the body in the plane of the line hole and fastened with a bone rivet. The line hole passes straight through the body of the toggle head, the ends being flanked by triangular line grooves. Barbs, two cocked up and flared outward and bounded by the ornamental ridges, which closely follow the outlines of the back and terminate gracefully in the tips of the barbs. Butt end a curved plane, upright below and tapering above.

A cast-iron toggle head (Cat. No. 44747, U.S.N.M.), from Sledge Island, Alaska, just south of Bering Strait, all in one piece—exactly



LARGER BERING SEA HARPOON.

Collected by E. W. Nelson.

Cat. Nos. 43346 and 153727, U.S.N.M.

similar to the little seal harpoon heads of ivory—blade of iron, and bifurcated barbs, is shown in fig. 86.

Collected by E. W. Nelson. This is the last word in the inventional history of the toggle harpoon-head. From this point it enters the world-embracing commerce, being cast in metal and sold to island peoples all about the Pacific Ocean. It has no voice in settling the question how far similarities in aboriginal arts argue for contact or sameness of mind and its environments.

Fig. 86.
IRON TOGGLE HEAD.
Sledge Island.
Collected by E. W. Nelson. Cat. No. 44747. U.S.N.M

Specimens Nos. 45429 and 45430, in the U. S. National Museum, are barbed harpoons from Cape Nome, the northwestern corner of Norton Sound, Alaska. These are similar to the Sledge Island specimens without feathers, one of them having the assembling line of sinew thread and the other of rawhide.

The measurements of No. 45429 are: Shaft, 45½ inches; foreshaft, 4 inches; point, 3 inches. Measurements of No. 45430 are: Shaft, 46 inches; foreshaft, 4 inches; point, 2¾ inches.

A bone toggle head (Cat. No. 46154, U.S.N.M.) of medium size, from Port Clarence, just south of Bering Strait, Alaska, is shown in fig. 87. Body conoidal in form, elliptical in section, and higher than broad. Blade of iron, deltoid in form, set deeply in the slit and riveted with bone or wood. Line hole straight through, wider behind and run out into well-defined line grooves. Barbs two, formed by the bifurcation of the back, being angular, cocked up, and flared out. Socket for the foreshaft shallow and having a sharp edge on the butt, which is a single curved surface, nearly perpendicular below, quite elongated above the socket. Length, 3½ inches. Collected by Dr. T. H. Bean. Of similar character to No. 46154 are many other pieces in the Museum. In fact, when the shape arrives at a certain stage beyond the inventor, it seems to turn into the highroad of mechanical monotonies.

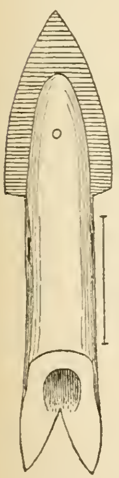


Fig. 87.
TOGGLE HEAD.
Port Clarence. Alaska.
Collected by T. H. Bean. Cat. No. 46154. U.S.N.M.

Plate 11, Catalogue No. 48156 in the U. S. National Museum, is a barbed seal harpoon projected from a throwing stick, from Sledge Island, on the northwestern shore of Norton Sound, collected by E. W. Nelson. The shaft is of light pine wood, tapering gently from tip to butt and slightly flattened in cross section. The tip end is socketed for the reception of the tang of the foreshaft. The peculiarity of four specimens from this locality is that the socket is split very little on the outside, to allow for shrinkage in hafting. The foreshaft, as in most other specimens, is of whale's bone and cylindrical. The shank for fastening to the shaft is shouldered and notched for the attachment of the assembling line. No feathers; but on another specimen, No. 48153, three half feathers, with plume inside, attached to their ends, as in example No. 129585, from Cape Blossom. The point is of bone, flat on one side and rounded on the other. Barbs, three on one margin and two on the other. The shank of the point is flat. The line is of dark seal rawhide, attached by one end through the line hole of the point by means of two double splices an inch apart. It is split near the middle, the two ends being fastened to the shaft about 18 inches apart by means of a clove hitch.

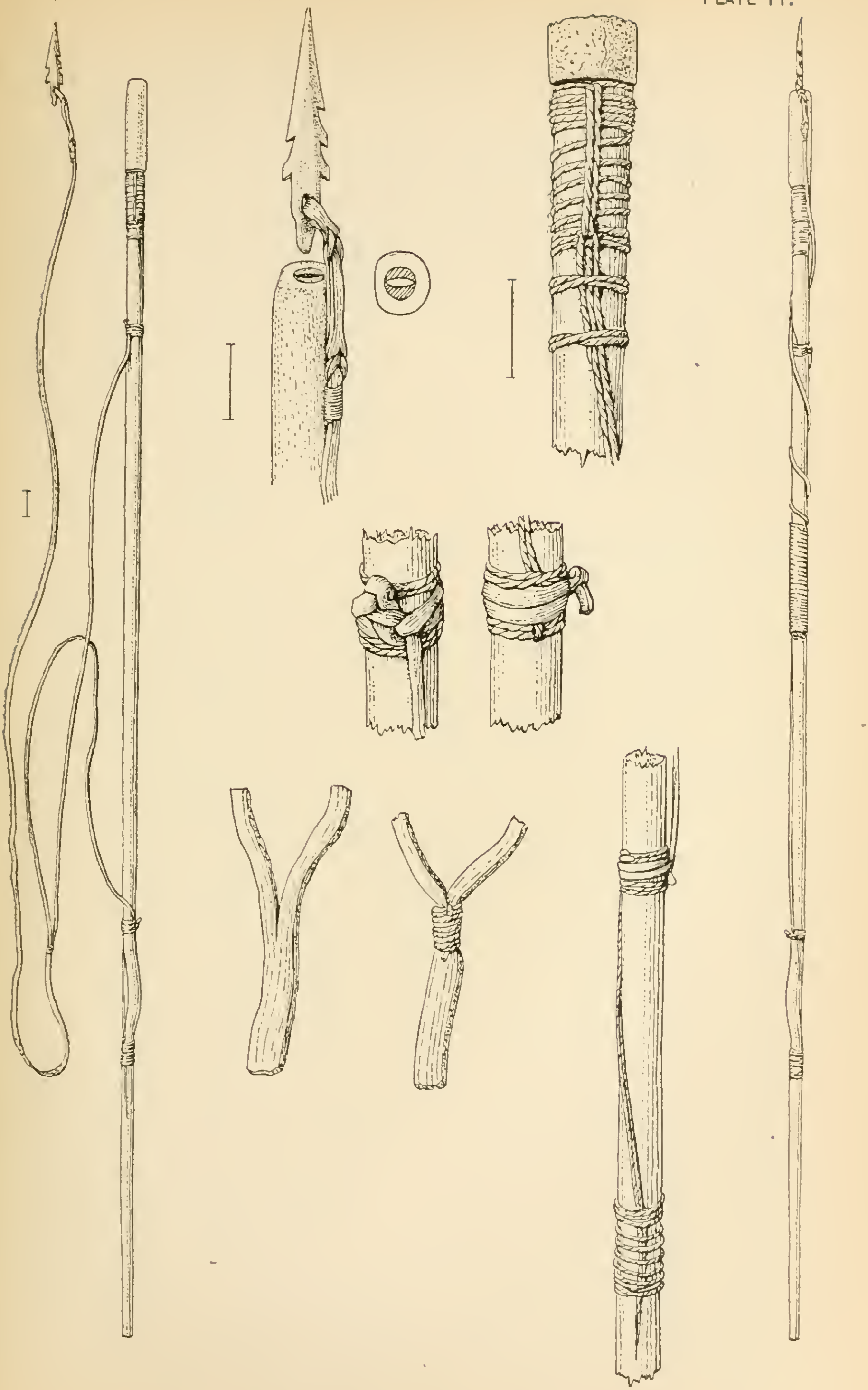
The front assembling line is looped around the shank of the foreshaft by a clove hitch wrapped around the end of the shaft to prevent slipping, and is continued to the upper attachment of the martingale. Between its two knots the martingale acts as an assembling line. From the hindmost knot of the martingale an assembling line of sinew thread proceeds backward for 4 inches, where a dozen turns are made and the end is punched into the wood near the end of the shaft. Between the two knots of the martingale the shaft has been mended by a series of half hitches and clove hitches made in sinew thread.

In specimen No. 48154, from the same locality, the upper assembling line is in fine seal rawhide. Length of shaft, 46 inches; foreshaft, 4 inches; point, 3 inches.

Specimen No. 48365 in the U. S. National Museum is a barbed harpoon for throwing stick, from Nunivak Island, south of Yukon mouth. The shaft is of soft wood, nearly uniform in thickness throughout, truncated and wedge-shaped at the upper extremity to fit into a corresponding cut in the foreshaft. Especial attention might be called to the expansion of the small end of the wedge to correspond with depressions in the shouldering on the parts of the foreshaft which overlap the wedge, in order to prevent the joint from coming apart. This is a step toward a dovetail.

The foreshaft is of walrus ivory, slightly expanded in front and conoid on the top. The tang has a wedge-shaped saw cut to fit on the end of the shaft. The two flanges are shouldered where they join the body of the foreshaft, and have notches cut on them at the outer extremity for the lashing. This is driven on the end of the shaft and the two are seized together by means of sinew braid laid on neatly. A small plug of wood is inserted in the outer end of the foreshaft, having a conical socket for the butt end of the barb.

At the base of the shaft there are two sets of black feathers, one above the other. Each feather is whole, its inner end seized to the shaft by means of the assembling line, which is wrapped several times



BARBED HARPOON FOR THROWING STICK, SLEDGE ISLAND.
Collected by E. W. Nelson.
Cat. No. 48156, U.S.N.M.

around. The top ends of the feathers are firmly driven into holes in the wood.

The head is of ivory, flat on one face and angular on the other. The shank is nearly conical, fitting into the socket of the foreshaft. Line hole elongated. Barbs, three on one margin and two on the other.

The line or martingale of the harpoon is of rawhide; the undivided end is passed through the line hole of the head and tied in a bowline knot. The two ends of the martingale are attached to the shaft near the feather and near the foreshaft by clove hitches. The sinew braid by means of which the shaft and foreshaft are seized together is continued on toward the feathers, with here and there a half hitch, until it reaches the rear feathers, where it forms the seizing, and then passes backward to become the seizing of the front set of feathers, and it is fastened on by being punched into the wood in a similar way to the top end of the feathers.

Among the Eskimo tools there is a little ivory point belonging to the outfit of the bow-and-arrow maker, used especially for making holes in soft wood, into which the ends of feathers and lines are punched to form a smooth fastening. It seems to be very effective. Length of shaft, 3 feet 7 inches; length of foreshaft and shank, 7¾ inches; length of point, 3 inches. Collected by E. W. Nelson.

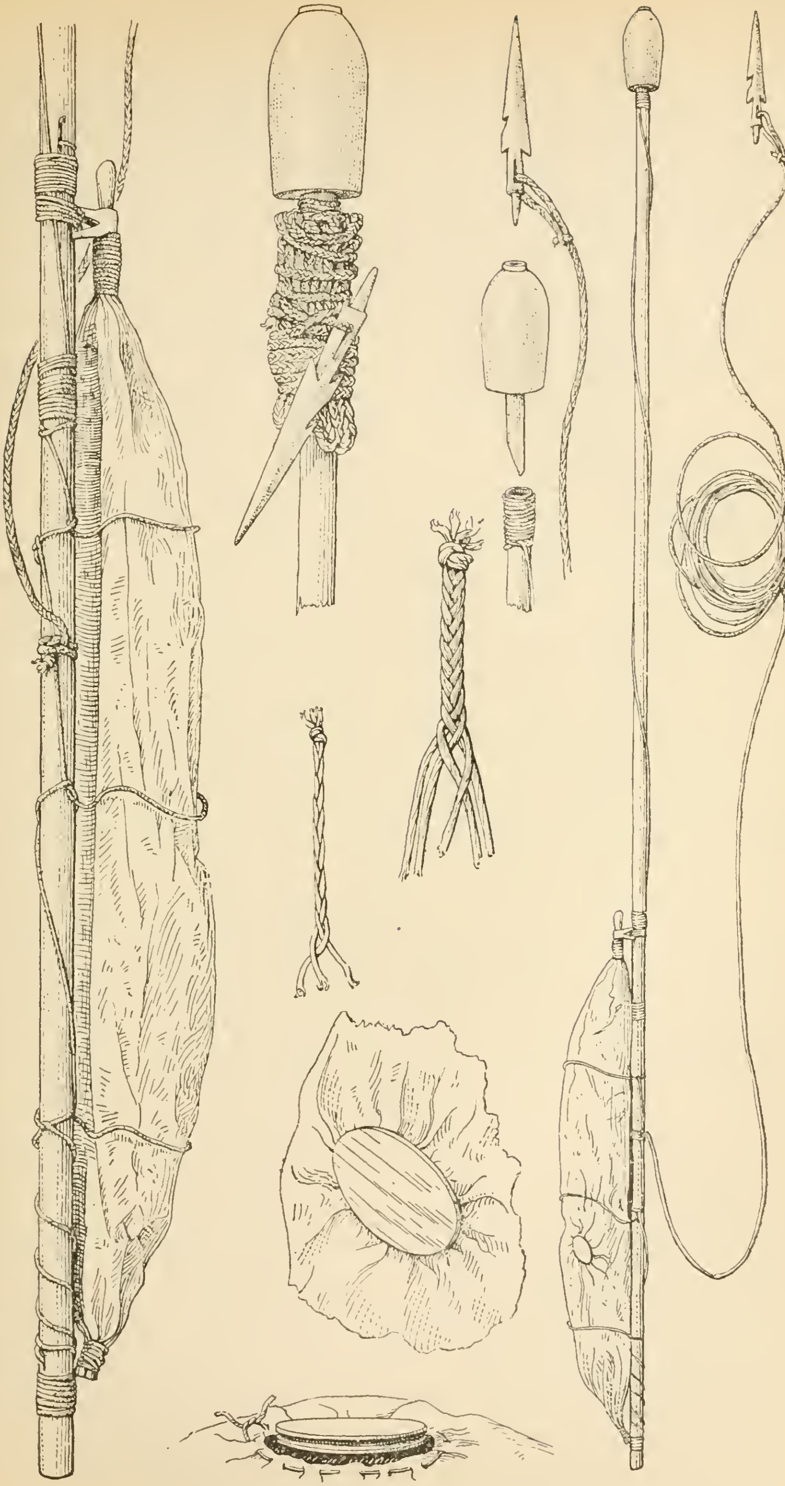
A sea-otter harpoon dart Pishudak, (Cat. No. 72415, U.S.N.M.), from Bristol Bay, Alaska, is shown in Plate 12. In its composition it resembles a large number of specimens used in an important industry. It will be described, therefore, in detail. The head is of ivory, flat on one side and angular in section on the other. There are three barbs, two on the left margin, one on the right; the line hole is oblong. The tang fitting into a socket at the end of the foreshaft is a little cone, shouldered above. The line is of braided sinew, fastened into the line hole of the barbed head by a bend and knot. The other end in this and kindred specimens has not the martingale, but is tied to the shaft near the middle of the bladder. When the animal is struck, the barbed head pulls out from the foreshaft, the line unrolls from the shaft, the bone head drops, and the bladder rises. The apparatus acts then both as a drag and a signal. The foreshaft, of bone, is bill-shaped, cut off square at the base, excepting a slight tenon in form of a cylinder to fit into a socket at the front end of the shaft. In the front end of the foreshaft a cylinder of pine wood is set, and this must be noted on all barbed harpoons. The purpose is to give the tang of the head a firmer hold when the weapon is ready for action. The shaft of this and other like specimens is of wood, tapering just slightly from front to rear. The socket for the tenon of the foreshaft is carefully bored, and wrapped with sinew braid. The same braid is continued down the shaft for assembling line, and serves also for attaching the float, which in all small harpoons of this class is made from bladders, stomachs, or intestines of seal or walrus. They are cleaned out, one end fastened up securely, and into the other a mouthpiece with plug is set for purpose of inflation. The subject is discussed by Nelson.[1] In the example shown the process of inserting a stud or plug into the float where it has been pierced is illustrated. Length of shaft, 44 inches; length of foreshaft, 2½ inches; length of barb, 4½ inches. Specimen No. 11356 is quite similar. Length of shaft, 46¼ inches; length of foreshaft, 3 inches.

Examples No. 8004 to 8007 in the U. S. National Museum are feathered harpoon darts from Bristol Bay. The shaft is very little expanded in front and slightly expanded at the nock. There are three half feathers neatly trimmed and bound on in front by the assembling line which is also used to seize the foreshaft, wrapped around the shaft and ends at the feathers. The feathers are seized at the nock with a strip of split quill and are further held in place by a thread which holds the midrib of the feather to the shaft of the dart at five places. The feather seizing at the nock is noticeable in all of these specimens and separates them from the others in the collection.

The foreshaft, of ivory, is conical, smaller at the butt end, where it is inserted into the shaft by means of a shoulder plug which is driven into the socket at the end of the shaft. The front end of the foreshaft is abruptly conical and finished off with a wooden plug which has a pit or socket for the barbed point. The point is of bone and has two barbs on one side and one on the other. Length of shaft, 44¼ inches; of foreshaft, 5½ inches; of point, 3 inches. Collected by Dr. T. T. Minor. Similar to these are Nos. 19378 and 19380, collected by the Rev. James Curley, having in all respects the same characteristics, excepting that the seizing at the nock is not of quill, but a continuation of the thread which holds the shaft of the feather to the shaft of the spear.

Plate 13 (Cat. No. 90416, U.S.N.M.) is a sea-otter spear from Ugashik, Bristol Bay, Alaska. The shaft is of wood, tapering from the fore end to the rear end. The head is of bone and has two barbs on one margin and one on the other. The line hole is small and has no line grooves. The tang is whittled off thin to fit into a delicate socket on the end of the shaft. The leader or loop on the barbed head is a narrow strip of sealskin doubled through the line hole and seized together. The ends are also united in such a way that the loop is closed in the middle. At the other end the thong is doubled, passed through an eyelet, over the projecting point to form a "detacher." On the shaft at five places are bands of birch bark and around these are wrapped sinew twine in half hitches for the purpose of retrieving the parts of the shaft if it should be broken. The bladder is a portion of the intestine of a seal, having

[1] The Eskimo about Bering Strait, 1899, pp. 40 to 145.



SEA OTTER HARPOON, BRISTOL BAY, ALASKA.
Collected by C. L. McKay.
Cat. No. 72415, U.S.N.M.

a delicate mouthpiece of ivory, neatly set on to the side of the shaft by wrappings of sinew thread passed through two holes bored in its upper portion. The other end of the bladder is bound to the rawhide thong, which is secured by being pushed under the wrapping of sinew thread between it and the birch-bark packing. The line is of rawhide and is securely fastened to the "detacher" at one end by a bend, which is held in place by a figure-of-8 wrapping of sinew thread. The rest of the line is wound about the shaft when the spear is ready for action, the other end being attached to the shaft between the two ends of the bladder. When the animal is struck, the head unships, the line unrolls, the head of the shaft drops into the water and the whole acts as a drag and a signal to show the position of the game.

Examples Nos. 90417 to 90419 in the U. S. National Museum are feathered sea-otter harpoon darts from Ugashik, north of the Alaskan peninsula. The shaft is of light pine wood, very nearly cylindrical, and tapering slightly toward the front. The foreshaft is of bone and has a plug on the inner or butt end which fits into a socket on the end of the shaft, and the joint is seized by a fine sinew or intestine braid, the inner end of which is continued backward with half hitches for an assembling line. Near the feather a band of this braid an inch in width is formed, and 4 inches above the feather is another one around the inner end to the feathers. There are three feathers, seized in front by the assembling line, and at the nock by a separate wrapping of braid. They are split and further held down by a light thread, which binds the shaft of them to the shaft of the dart in five places by half hitches.

This method of attaching the feathers is found in Nos. 8004 to 8006 and seems to be typical of the region.

The line or martingale is attached to the shaft 4 inches behind the foreshaft and 4 inches in front of the feather. The point is small and has three barbs on one side, and is attached to the line by means of a hole bored in the shank and fitted into the foreshaft by a tang which is nearly cylindrical. Length of shaft, 4 feet; of foreshaft, 5½ inches; of point, 1¾ inches. Collected by William J. Fisher.

The darts are called Nagik kujat; the bone foreshaft, Mamkuk; the line, Punak; the bone head, Kugichalugak; the feathers, Nakchute.

A complete toggle harpoon (Cat. No. 160337, U.S.N.M.), with line float and line board, from Kusilvak, at the mouth of the Yukon River, in Alaska, is shown in Plates 14 to 15. The toggle head shown in Plate 15 is of ivory, a delicate object, perfect in all its details. In outline it resembles the head of a duck. The blade is set into the saw-cut at the point of the body, and in the plane of the line hole, which is bored straight through from margin to margin. The barb is cut into three points, which form a part of the ornamentation. Through the line hole passes a long loop, which is neatly spliced at its ends and wrapped and knotted so as to keep it in shape. At its other extremity it unites with the end of a long rawhide line, which in turn is looped at its other end to a becket or loop of sealskin float, and frequently an additional line is spliced between the two. This line rests upon a flat board frame, which is thus described.[1]

The float board consists of a strong, oval hoop of spruce made in two U-shaped pieces, with the ends brought together and beveled to form a neatly-fitting joint, which is wrapped firmly with a lashing of spruce root; the sides have holes by which a thin board is fastened to the under side, the ends of which are notched in front to form a coarsely serrated pattern with five points that are inserted in slots cut in the front of the hoop. The front of the board is oval, and the sides taper gradually to the points of two projecting arms, which extend 4 or 5 inches below the bow; between these arms a deep slot is cut, with the inner border rounded. The board has a round hole in the center and a crescentic hole on each side (Plate LIV, fig. 10).

On the kaiak the float board is placed in front of the hunter with the arm-like points thrust beneath the cross lashing to hold it in position, and upon it lies the coil of float line with the spear attached and resting on the spear guards on the right rail of the boat; the end of the line is passed back under the hunter's right arm to the float, which, fully inflated, rests on the deck just back of the manhole.

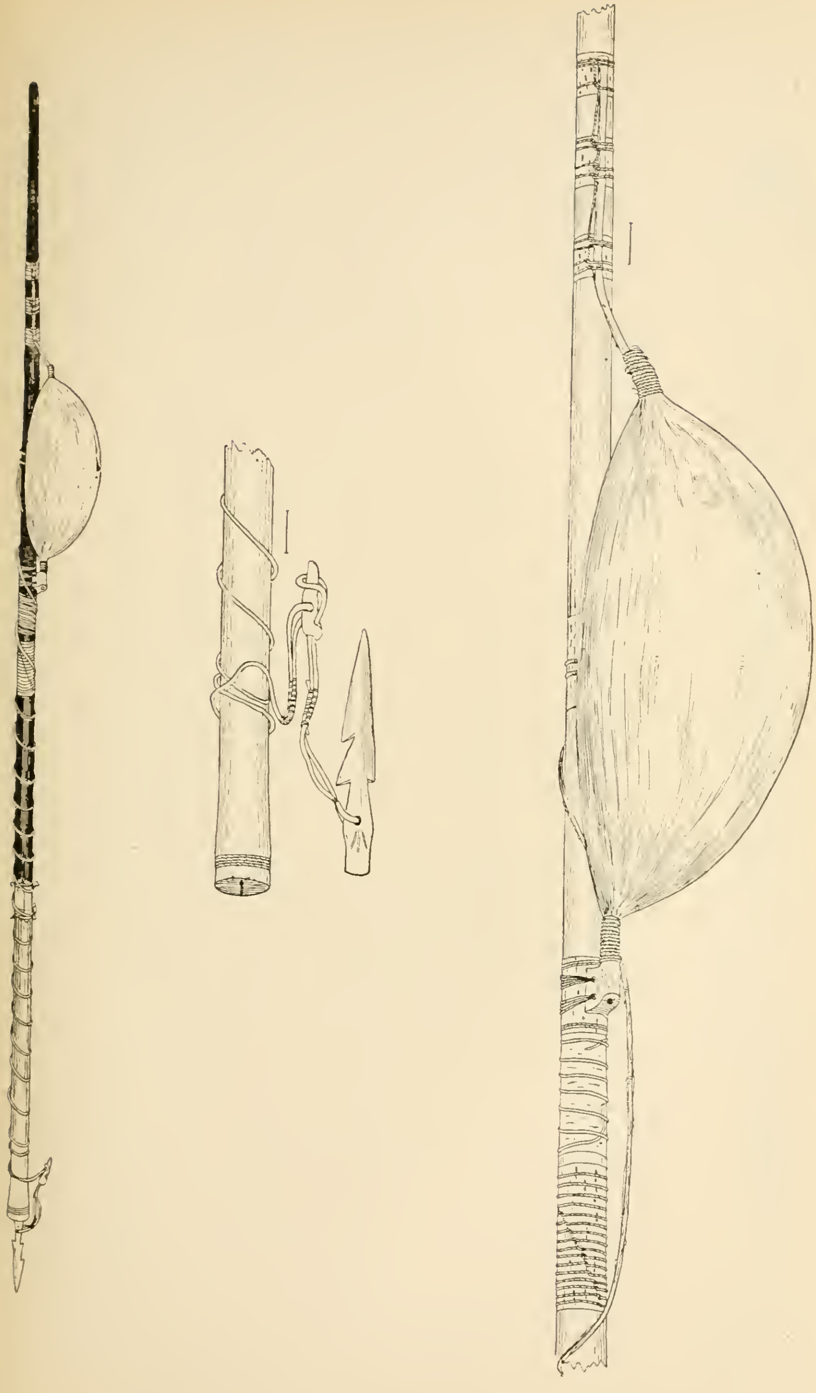
When the spear is thrown, the coil runs off rapidly and the float is thrown overboard. In some cases, when the prey is vigorous and leads a long pursuit, another line, like that shown in figure 9, Plate LIV, is made fast through the semilunar orifices in the center of the float board, which latter, when drawn through the water by means of this cord, assumes a position nearly at a right angle to the course of the animal and forms a heavy drag to impede its progress.

When hunting on the ice, the float board, with the line coiled upon it, is carried in the left hand of the hunter and the spear in the right hand while he watches along the borders of the leads or holes for the appearance of the seals. When he succeeds in striking one, he holds firmly to the line until the animal is exhausted, or, if necessary, the float board attached to the line is cast into the water, while the hunter hurries to his kaiak and embarks in pursuit.

In plate 15 will be shown the method of uniting the toggle head with the loose shaft, this with the fore shaft, and the fore shaft with the shaft. This last joint is worthy of study, with its curious tenon and shoulder fitting into a socket at the end of the shaft. Especial attention is called to the manner in which the shaft is cut away a short distance on the outside to allow the lashing of sinew to draw the joint perfectly tight. Attention is also called to the method of fitting the splicing, at which the Eskimo are quite adept. On the surface of the fore shaft the dot and ring ornaments occur. This decoration, wherever found, is an emblem of the existence of steel tools. Very little ornament exists on the old Eskimo weapons found in localities away from contact.

The head of a toggle harpoon (Cat. No. 168625, U.S.N.M) from Bristol Bay, collected by William J. Fisher, is shown in fig. 88. The head is of bone, back sharp edged, front rounded, and the whole a flattened wedge shape at right angles to the line hole. The blade, of slate, is triangular, with convex sides, and glued into a saw cut in the end of the head. This socket for the loose shaft is square in section and shallow. The butt end of the body is beveled as in most harpoons of this class, but in such manner as to form an offset on the margin of the socket, and

[1] Nelson, The Eskimo about Bering Strait, 1899, p. 138.



LONG-HANDLED BARBED HARPOON, BRISTOL BAY, ALASKA.

Collected by William J. Fischer.

Cat. No. 90416, U.S.N.M.

the single barb is formed by the meeting of the sharp back with the two edges of this bevel. The line hole passes straight through the body and is flanked by shallow wide grooves. The loose shaft is a piece of pine wood flattened and wedge-shaped at its butt end to fit into a wide socket at the end of the foreshaft, shouldered about 2 inches from this end and then tapering to the point of juncture with the body of the toggle head. The loose shaft passes into the shallow socket of the head, where it is hinged. A rawhide thong is passed through the line hole and tightly seized on either side of the loose shaft 3 inches below its outer end. This forms a hinge, so that when the body of the toggle head is drawn down the point of the loose shaft comes out of the socket, and the parts are held together by the wrapping or seizing. The two are further secured together by a grommet of spruce root. When in rest the wedge-shaped butt end of the loose shaft passes between the two sides of the rawhide line, and in unhinging from the toggle head this part also flies out in an opposite direction. At the end of the rawhide line is a loop for the attachment of a longer line.

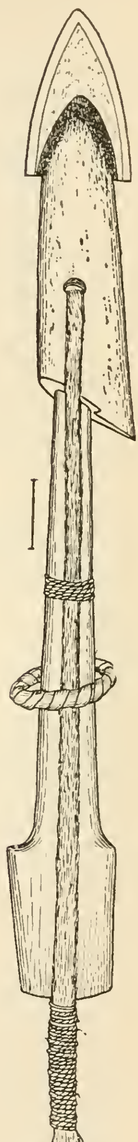


Fig. 88.
TOGGLE HARPOON HEAD.
Bristol Bay.
Collected by Wm. J. Fisher. Cat. No. 168625, U.S.N.M.

This old example is very interesting indeed, forming a connecting link between the Eskimo toggle head and the forms allied to it among the Indian tribes farther south. Length of head and blade, 6½ inches; loose shaft, 9¼ inches.

Plates 16 and 17 (Cat. Nos. 16407, 19382, and 72412, U.S.N.M.) show the forms of harpoon arrows in use on the north and the south side of the Alaskan peninsula. The last mentioned, No. 6 on the plate, from Bristol Bay, is farthest removed from the arrow and nearest the harpoon with its club-shaped head and bilateral barbs. The line hole in the barbed head, the line running from head to shaft, the socket for the head, the joint between head and shaft, are all suggestive of the small seal harpoon. No. 5 on the plate, from Cook Inlet, in its head approaches very near to the simplicity of the Fuegian barbed harpoon. The half feathers set on radially are more Indian than Eskimo. Fig. 4 on Plate 16 is the delicate sea-otter arrow from Kadiak, the paragon of aboriginal projectiles. The specimen is fully illustrated on Plate 17.

This is the most elaborate and ingenious arrow known, and all of its parts, in every specimen, are most delicately finished. Such a weapon may well have been used in hunting the most costly of fur-bearing animals—the otter.

The shaft is of spruce, gently tapering toward the neck, which is large and bell shaped. Into the end of the shaft is inserted a foreshaft of bone, and into the end of this fits the barb. Feathers, three, symmetrically trimmed and seized at both ends with delicately twisted sinew thread. The barbed head is perforated, and through these perforations is attached a braided line at least 10 feet long. The other end of the shaft is secured to two points on the shaft by a martingale. When not in use the line is coiled neatly on the shaft and the barb is put in place in the foreshaft. When the arrow is shot, the barb enters the flesh of the otter, the loose fastening is undone, the line unrolled, the foreshaft drops into the water; the shaft acts as a drag and the feathers as a buoy to aid the hunter in tracing the animal. (See Plate LII, fig. 4.)

Fig. 1. Arrow with line unrolled, showing relation of parts.

Fig. 2. The shaftment. Attention is drawn to the delicate seizing with sinew thread, the natty trimming of the feather, the most efficient nock.

Fig. 3. The lines and knots. Notice is given of the elegance of the braid, the efficient manner of "doing up" the line, the peculiar knot for the martingale.

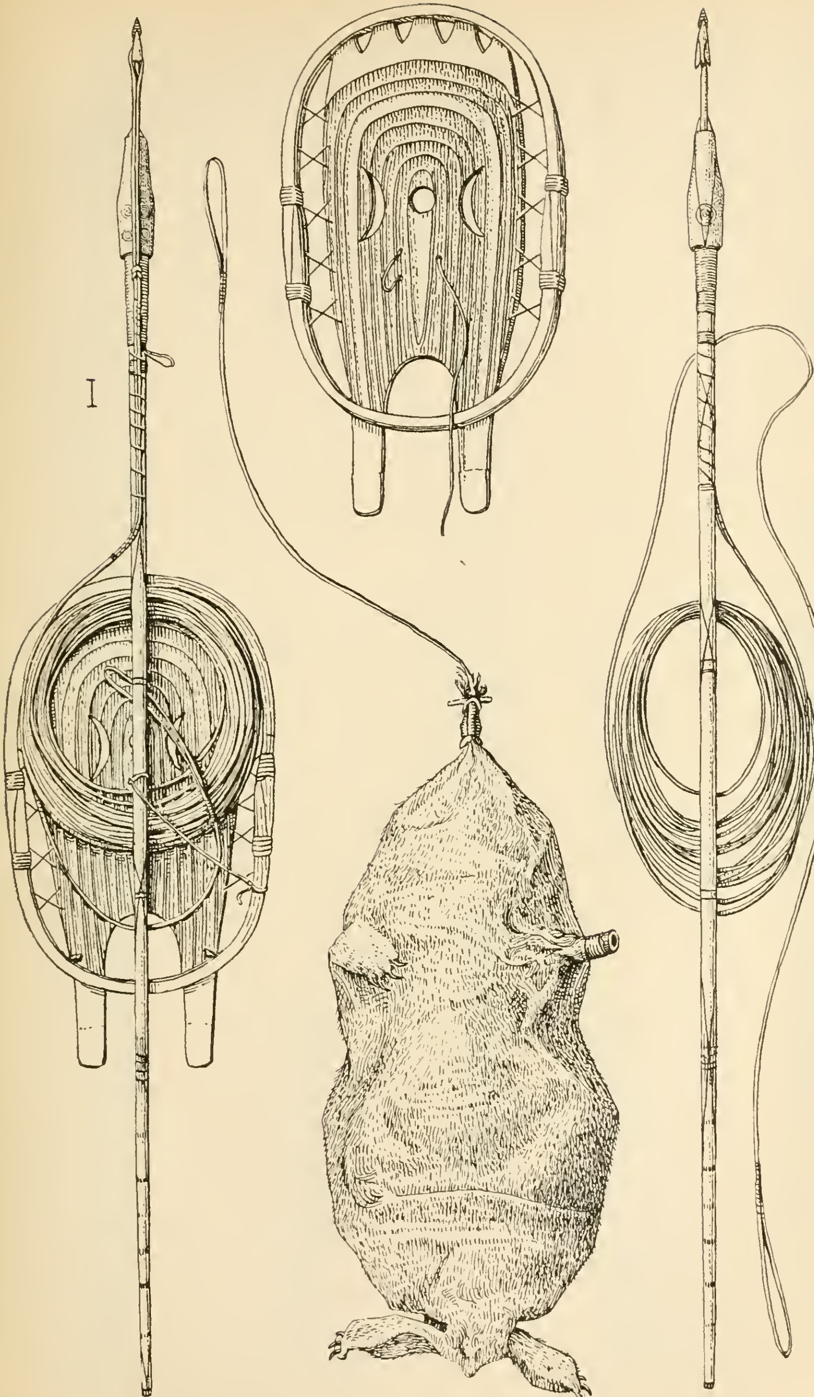
Fig. 4. The arrow ready to be shot.

This form of arrow, with its southern type of sinew-backed bow, is found also on the Kuriles, where they were taken by Aleuts, carried over by the Russians to hunt sea-otter.

The arrows numbered 1, 2, and 3 in Plate 16 are from the same areas as the harpoon arrows just described, namely, from Bristol Bay to Kadiak. The heads are essentially those of harpoons, and are set into the ends of the shafts in the loosest manner by a slight conical projection fitting into a socket. When the animal is struck the head withdraws itself and remains in the wound. A short piece of string between head and shaft would convert these three missiles into harpoon arrows. To make the likeness more complete, No. 3 has a wooden cap over the blade.

Cat. No. 72518 in the U. S. National Museum is a sea-otter harpoon dart or Pishudak from Chernoborn Island, Cook Inlet. The bladder, shaft, assembling line, foreshaft, martingale, and barb are similar to the others in all respects excepting the attachment of the foreshaft to the shaft. A projection from the butt of the ivory foreshaft forms a wedge which tapers in two directions. In fact, the foreshaft is dovetailed into the end of the shaft and seized with a sinew braid or sennit, which acts as the assembling line. See Plate 16 for details of Cat. No. 19382, a harpoon arrow from the same locality. Length of shaft, 45½ inches; of foreshaft, 3 inches; of point, 5 inches. Collected by William J. Fisher.

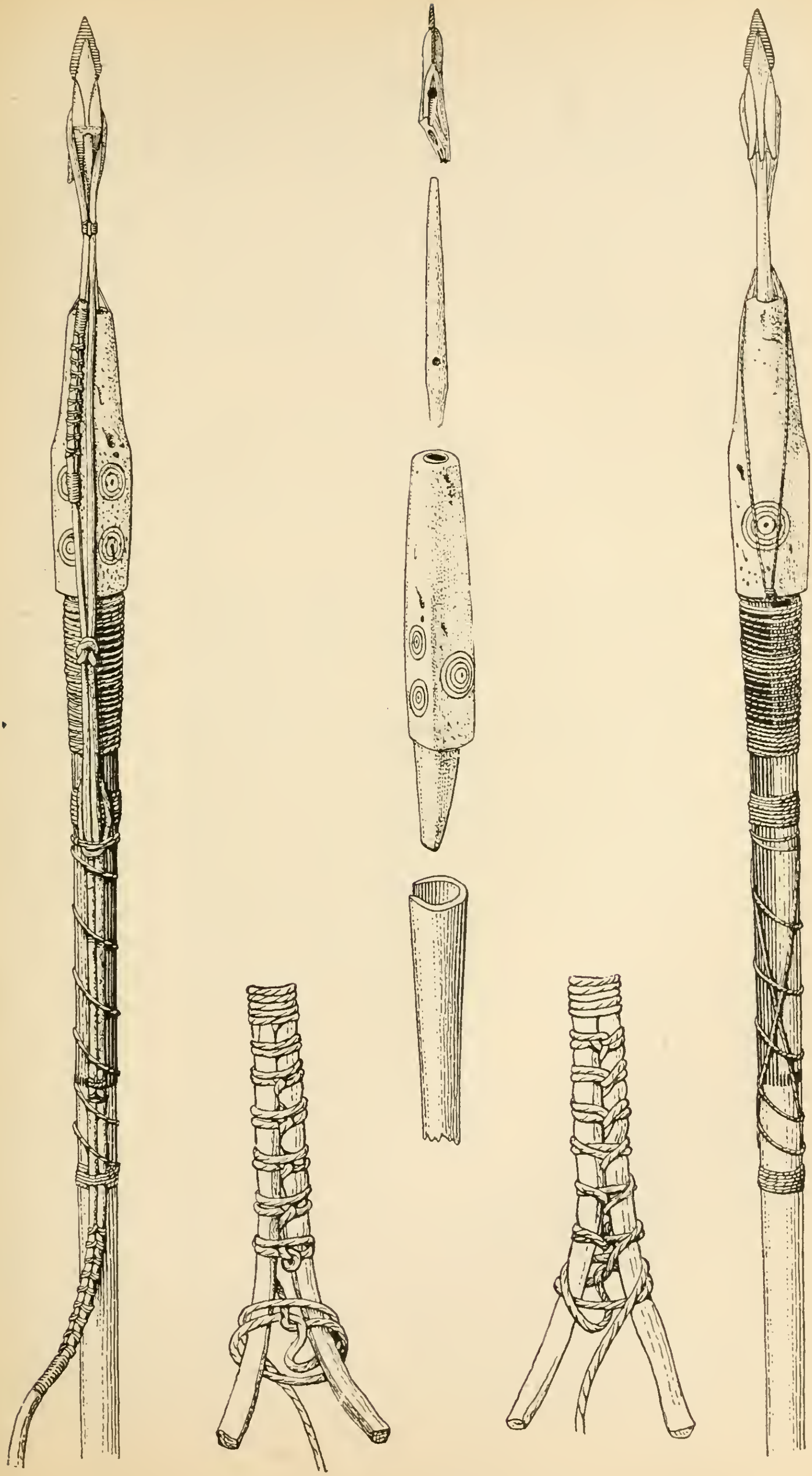
Plate 18, Cat. No. 175825 in the U. S. National Museum, is a sea-



TOGGLE HARPOON, LINE, AND FLOAT, KUSILVAK, YUKON RIVER.

Collected by E. W. Nelson.

Cat. No. 160337, U.S N.M.



DETAIL OF KUSILVAK HARPOON IN PLATE 14.

otter dart from Unalaska. The shaft is of spruce wood; it is light and delicately made, not quite cylindrical, but becoming thicker toward the front. The foreshaft is of whale's bone, thicker where it joins the shaft, tapering smaller towards the front, and expanding at the tip end; flattened a little in cross section. A plug of wood is inserted in the socket at the tip end. The point of ivory has two barbs on one side and one on the other, and an extension or knob at the butt end, around which the line is fastened by a marlin hitch. The line is of sinew braid or sennit three-ply in the open parts, and six-ply between the martingale and the point. The martingale is tied, one end around the foreshaft and the other a little back of the middle of the shaft, by a clove hitch.

The shaft has in front a wedge with square front and shouldered in the rear. This wedge fits exactly into a slot in the butt end of the foreshaft. A small piece of birch bark is wrapped around the joint for packing and all the parts seized together very neatly with the finest sinew thread.

In this example, as in all others of its class, the shaft is painted red; on some of them the paint extends to the foreshaft. On a few examples bands of black paint are added at the butt end. Length of shaft, 42 inches; of foreshaft, 7½ inches; of point, 2¼ inches.

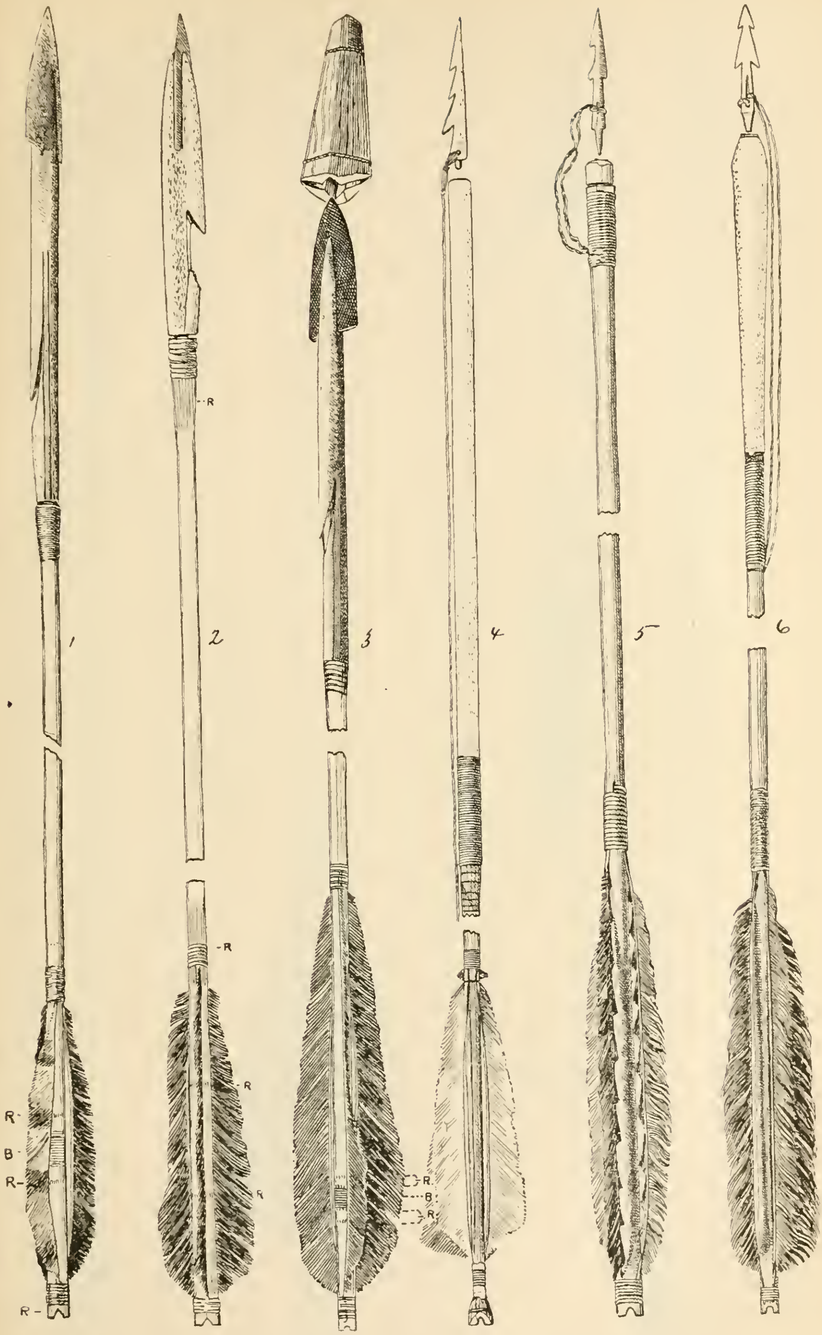
Feathers on the shaftment or butt end of the shaft, three, set on radially. The nock of this specimen is not unlike the foreshaft in form, only, in place of the notch to fit the bow string, there is a flat cone on the tip end with a small pit on the end to catch into the ivory hook on the foreshaft. By comparing this specimen with the harpoon arrows in Plates 16 and 17 the student has the best possible opportunity of seeing the close kinship between the harpoon and the arrow. It is entirely a matter of propulsion, whether from the hand, from a bow, or from an atlatl or throwing stick.

Plate 19 (Cat. No. 11362, U.S.N.M.) represents a barbed harpoon with bladder and hand rest. From Kadiak, and collected by Vincent Colyer.

The shaft is of pine wood, tapering gradually from the point to the butt. At the front end the shaft is widened out into a cylindrical form for about 2 inches and notched in like a spool. There is no foreshaft in this specimen. The socket for the point is lenticular in cross section and the spool-shaped space is filled with a wrapping of fine sinew braid. The shaft is ornamented with rings and longitudinal stripes in black, and the space between the two attachments of the martingale is painted solid black.

The point is of walrus ivory or hard bone, delicately made. There are two barbs on one side near the butt, which at a side view resemble the hoof of an animal. At the inner margin of one of these, three little dots and lines are added by way of ornament. On the other side is a small barb or hook, which could scarcely be of any use. The tang is not tapered or shouldered, but is quite wide. The line hole is round, and into it is set a thong of rawhide, doubled and joined together at its ends and likewise near the barb by a lashing of sinew thread. Just above the point, where the two ends of the thong are bound together with sinew thread, a braided cord of sinew passes between the two ends of the thong and is made fast by a half hitch, a knot being tied in the end of the braid to prevent its coming undone. The braid constitutes the line of the harpoon. A few feet from the point, where the braid is attached to the rawhide leader of the barbed head, it is separated into two smaller braids, and these become the branches of the martingale, the ends of which are attached, one under the bridle, the other 3 feet from the front end of the shaft. The hand rest is a short piece of the black horn of the mountain goat. Its base fits on the shaft. Through a hole in this horn a lashing of sinew thread passes around the shaft several times. The bladder has at one end a delicate mouthpiece of ivory set against the shaft, held in place by sinew thread passing through perforations in the mouthpiece. At the other end the bladder is attached to the shaft by means of a rawhide thong tied a few inches away. At five different places on the shaft, namely, the two points of attachment for the martingale, the place of the hand rest, and the two points of attachment for the bladder, are bands of white birch bark, which serve both for ornament and as a soft packing to hold the different lashings in place. The manner in which the line is done up on the shaft when the harpoon is ready for action, by means of a loose knot, which is easily untied, is shown. In every respect this is a well-made and graceful implement. Length of shaft, 8 feet 5 inches; point, 8 inches.

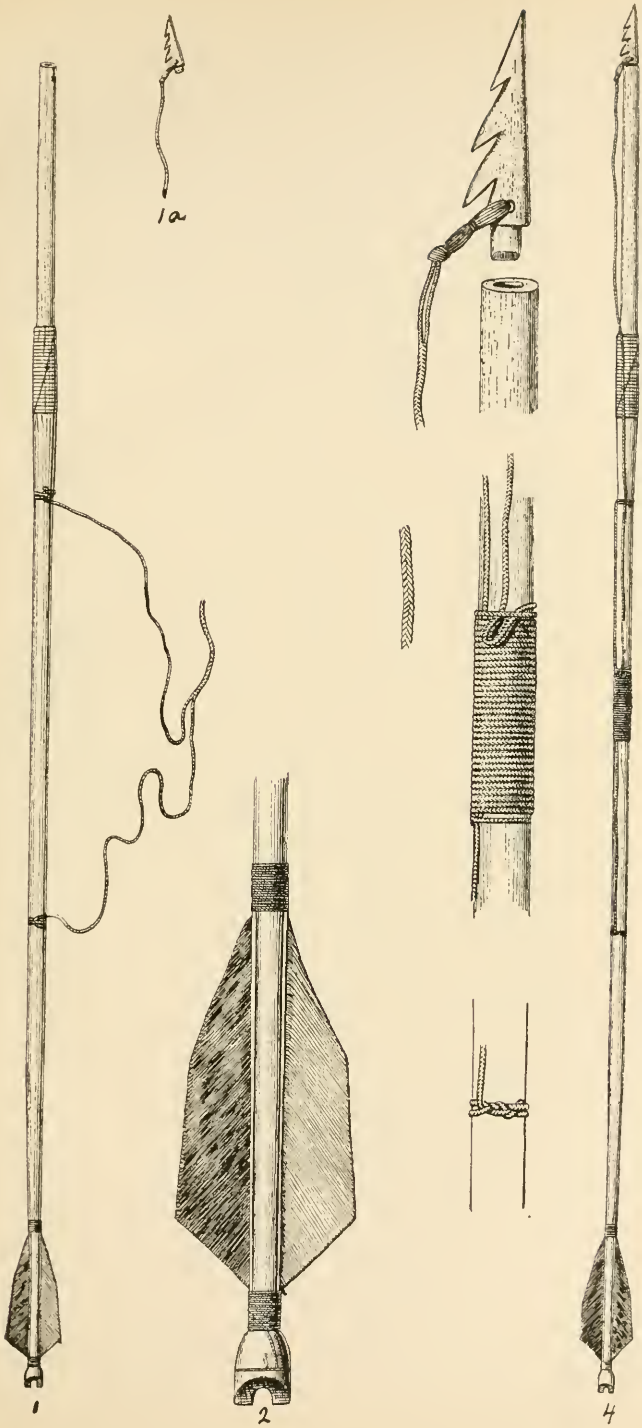
The Samoyed harpoon, on the testimony of Nordenskiold, consists of a large and strong iron head, very sharp on the outer edge and provided with a barb. The head is loosely fixed to the shaft, but securely fastened to the end of a slender line 10 fathoms long, generally made of walrus hide. The line is fastened at its other end to the boat, in the fore part of which it lies in a carefully arranged coil. There are from five to ten such harpoon lines in every hunting boat. When the hunters see a herd of walrus, either on a piece of drift ice or in the water, they endeavor, silently and against the wind, to approach sufficiently near to one of the animals to be able to harpoon it. If this succeeds, the walrus first dives and then endeavors to swim under water all he can. But he is fixed with the line to the boat and must draw it along. His comrades swim toward the boat, curious to ascertain the cause of the alarm. A new walrus is transfixed with another harpoon, and so it goes on until, one after another, all the harpoons are in use. The boat is now drawn forward at a whizzing speed, although the rowers hold back with the oars; but there is no actual danger so long as



BARBED SEA OTTER HARPOON ARROWS, ALASKAN PENINSULA.

Collected by W. H. Dall, James Curley, and Charles L. McKay.

Cat. Nos. 16407, 19382, 72412, U.S.N.M.



DETAIL OF SEA OTTER HARPOON ARROW ALASKAN PENINSULA.

all the animals draw in the same direction. If one of them seeks to take a different course from that of his comrades in misfortune his line must be cut off, otherwise the boat capsizes. When the walruses get exhausted by their exertions and by loss of blood, the hunters begin to haul in the lines. One animal after another is drawn to the stem of the boat, and there they commonly first get a blow on the head with the flat of a lance, and when they turn to guard against it a lance is thrust into the heart.[1] Whatever view one takes regarding the blood kinship between the peoples of northeastern Asia and those of North America, or between the languages of the two areas, the kinship of inventions is not to be denied. How far a device may travel or be transmitted without changing so much as one word in any language or one drop of blood is not known. A whale has been known to carry a harpoon head half way around the world and deliver it safely to a company of natives on the other side; and a throwing stick, with which harpoons are hurled, drifted from Bering Strait to western Greenland.

Fig. 89.
MODERN HARPOON HEAD OF IRON.
Cumberland Sound.
In Berlin Museum für Völkerkunde, after Franz Boas.

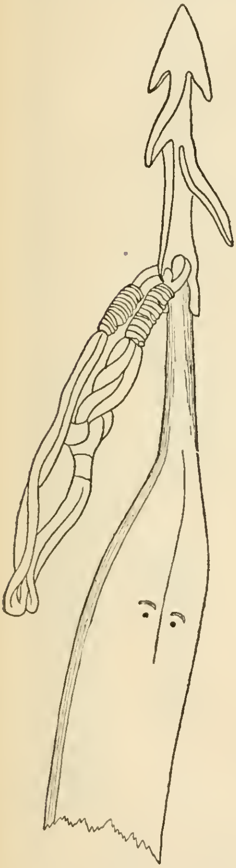


Fig. 90.
IRON TOGGLE HEAD.
Amur River.
After von Schrenk.

The harpoon has been briefly traced throughout the Western Hemisphere. It remains to notice one or two forms in which the sailor and the blacksmith have supplanted almost entirely the aboriginal mechanic. Boas figures an iron toggle head (1888, p. 473) now in the Berlin Museum of Ethnology. It is of iron, preserves the general shape of the native barbed and toggle head, the blade, spurs, and line hole being in parallel planes. The natives, according to Boas, also file these heads out of bits of iron. The end of the line is bent, run through the line hole, and fastened down by a compound splice (fig. 89). The fact has been already mentioned that toggle heads of bone were made wholesale

[1] A. E. Nordenskiold, Voyage of the Vega, I, 1881, p. 156.

in former times, and traded to the Eskimo for valuable furs. In the National Museum there is among the Nelson collection a small toggle head of cast iron all in one piece, fig. 86, the model of which was a native example of ivory and iron.

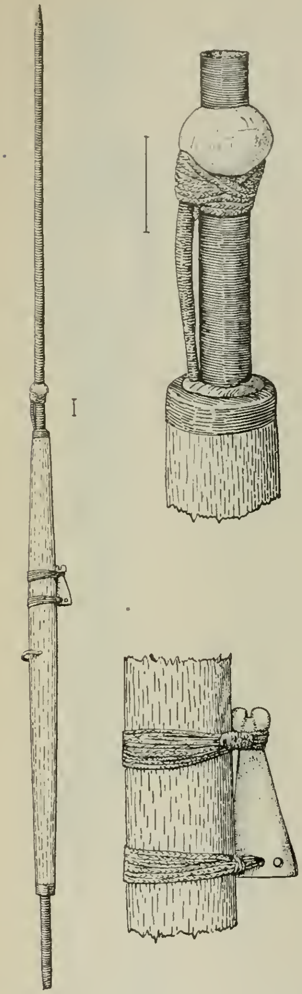


Fig. 91.

SHAFT OF TOGGLE HARPOON.

Cumberland Sound.

Collected by Geo. Y. Nickerson. Cat. No. 19518. U.S.N.M.

Fig. 90 is taken from Schrenk,[1] and shows the same invasion of iron into native arts. The object is a combined barbed and toggle head, in which, however, the barbs play the chief part. The leader, of rawhide, preserves its ancient bends and knots, and the eyes peeping from the foreshaft are certainly survivals of the ancient régime.

A harpoon (Cat. No. 19518, U.S.N.M.) from Cumberland Sound, collected by George Y. Nickerson, is shown in fig. 91. It is an interesting mixture of ancient forms with modern. The shaft is a well-turned, spindle-shaped piece of oak wood. The hand rest is an old ivory piece, turned to right angles, set into the shaft for a short distance, and bound on with two seizings of sinew braid. Just below the hand rest is an iron loop through which the line runs. The foreshaft is a long bar of iron, set into the head of the shaft and packed, the joint being made fast by means of an iron ferrule. Near the inner end of the shaft is a padding of rawhide, connected a few inches away with the end of the shaft by a stiff rawhide sprig.

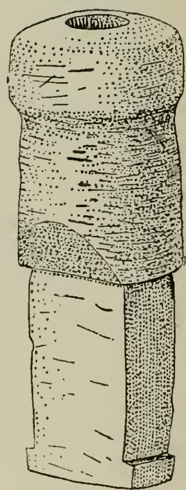


Fig. 92.

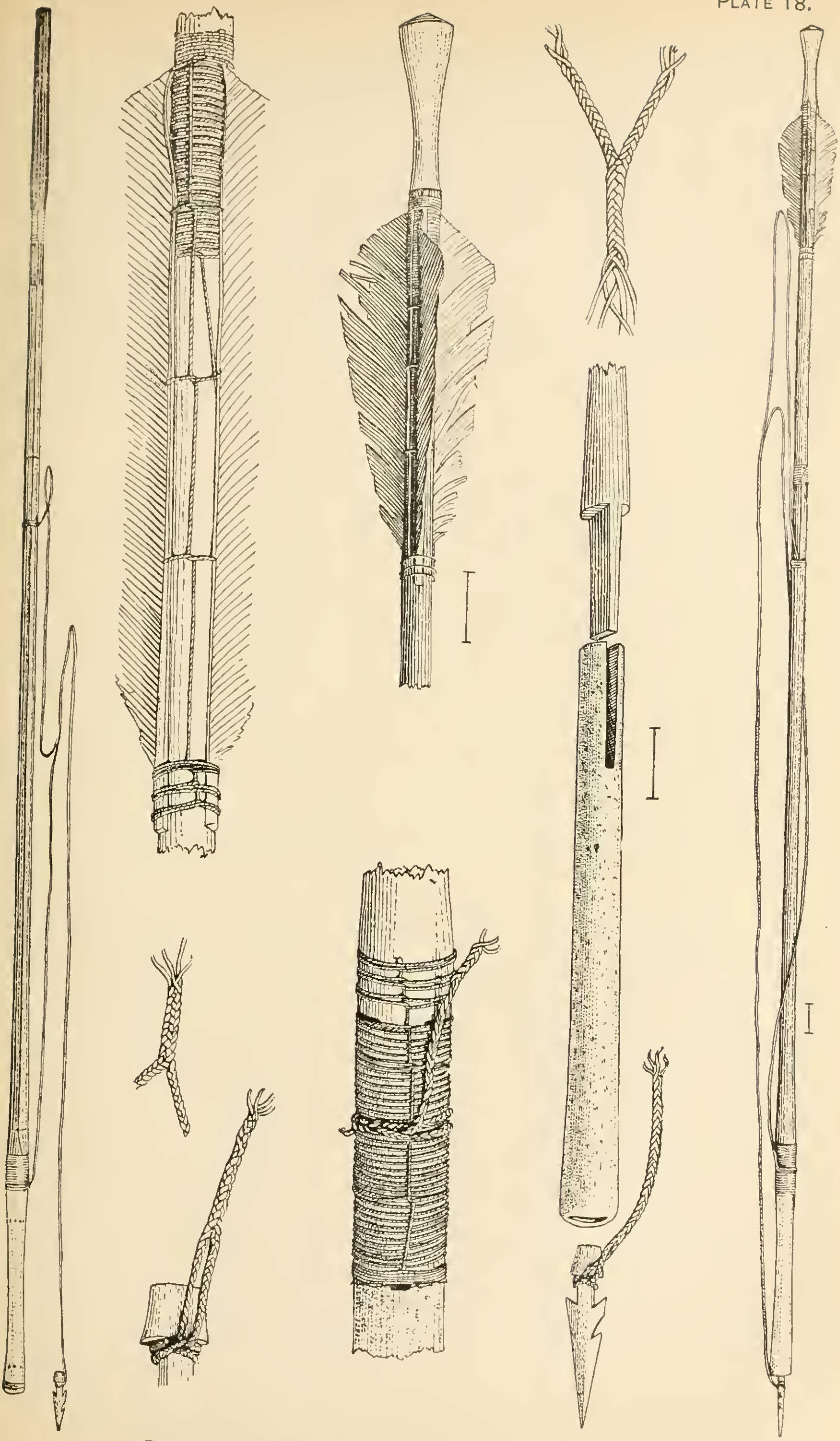
BONE FORESHAFT OF HARPOON.

Bristol Bay.

Collected by Charles McKay. Cat. No. 72403, U.S.N.M.

The object of this ball is not known, but it may have acted as a buffer for catching the blow. The ice pick at the butt end of the shaft is also

[1] Plate 42, fig. 2.



BARBED HARPOON DART FOR THROWING STICK, UNALASKA.
Collected by United States Fish Commission.
Cat. No. 175825, U.S.N.M.

of iron. It is impossible to conceive of a more excellent illustration of the fading out of an ancient primitive form and the gradual introduction of new elements.

The bone foreshaft (Cat. No. 72403, U.S.N.M.) of a large whaling or walrus harpoon from Bristol Bay is shown in fig. 92. It is the last expression in the use of modern tools for the preparation of a very ancient device. If this be compared with the gash in the end of the Fuegian harpoon, it will be seen that great progress has been made at this particular point. The upper part is carefully turned and the lower part cut with a tenon, so formed that when placed at the end of the shaft the strain in every direction is provided for. Collected by Charles L. M. McKay.

CONCLUSION.

The harpoon is the most complicated of the devices invented by uncivilized peoples. In a hemisphere capable of awakening every kind of human wants and needs, furnishing an infinite variety of supplies to these from place to place, providing one sort of materials for the harpoon here and quite another sort there, inhabited by native tribes endowed with great range of genius, it would be expected that a universal weapon should take on every possible form. Just as the whale ship of yesterday, its friend and contemporary, has been replaced by the ship driven by steam, so the Eskimo at present kills the seal, the walrus, the whale, and the arctic land mammals with a rifle and explosive cartridges instead of the ancient harpoon. Should the Eskimo use his great weapon at all, it will be, as Murdoch shows, to retrieve his game on the edge of the ice after it is shot, and not as a killing device.

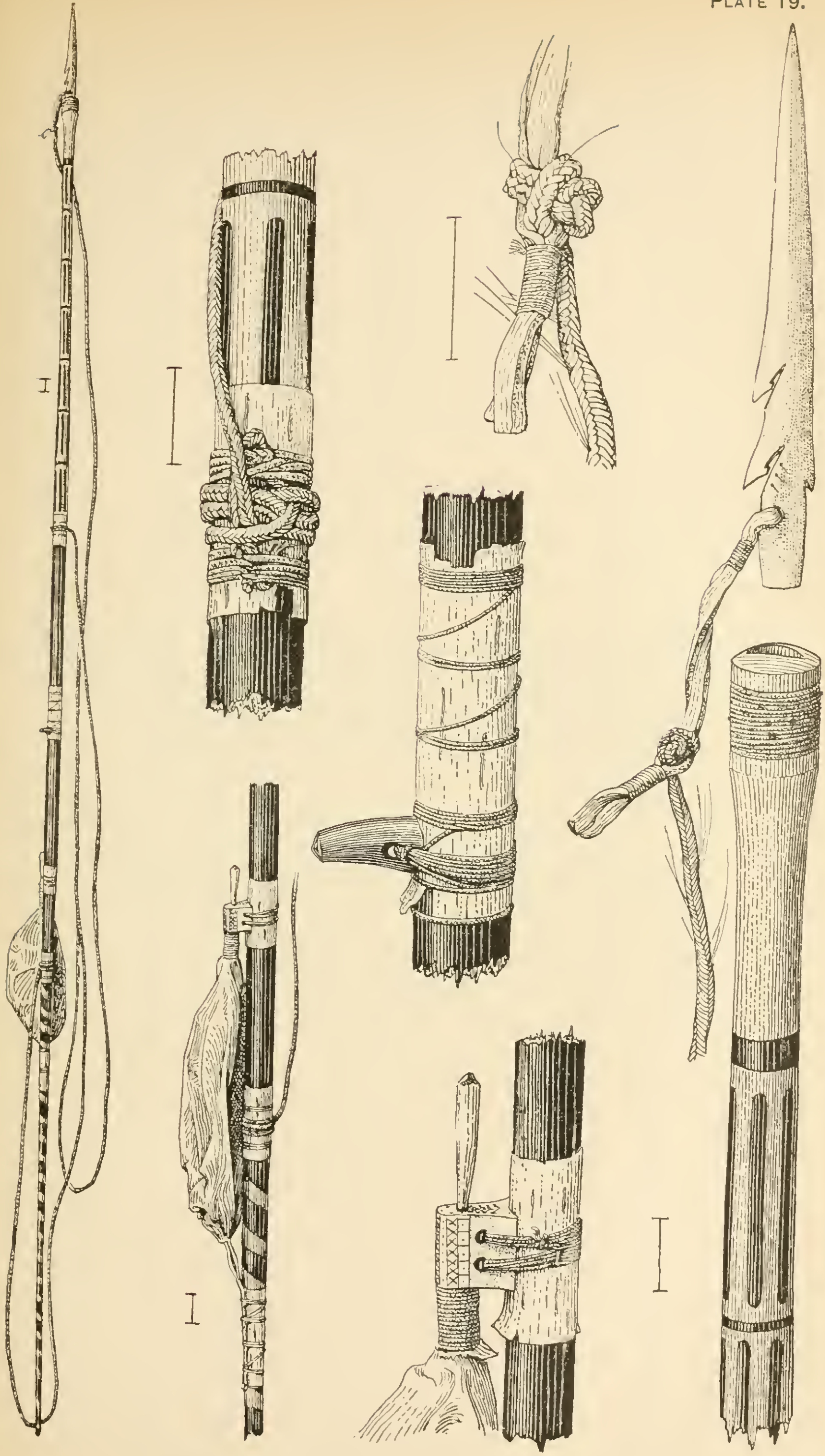
Both the ship and the harpoon served benevolent purposes, since they fostered and stimulated ingenuity until the fullness of time for steamships and firearms arrived. The harpoon is the climax of piercing inventions, which include daggers, lances, spears, javelins, and arrows of all kinds—held in the hand, hurled from the hand, either unaided or with the help of hand rest, amentum or atlatl, or shot from a bow. As was noted in the preceding drawings and descriptions, the harpoon had no limit in its application, being equally efficient on the land, in the air, in the water, or through the ice, at long range or short range, with short or long shaft, in some examples this part a hundred feet in length. The simplest forms have three rude parts; the most highly developed a score or more. Besides its own complexity, it has in the arctic area dominated the kaiak in its upper part, as well as the dress of the man, and called forth any number of accessories for decoying, finding, watching, taking out of the water, and carrying home.

When it is remembered that every part of this complex apparatus must be most efficacious for its region and quarry, and not bulky, one is not astonished to find a great variety of patterns in the structure and in the knots on the lines. The Eskimo themselves were not all agreed on these points. Hence, for example, Murdoch discusses the question whether the blade of the toggle head should be in the plane of the line hole or across it. Again, the length of the shaft and other characteristics were, in certain limits, fitted to the hunter. One has only to look through Nelson's plates to be convinced that there was a range of individual choice in many parts. While, therefore, it is correct to say that all harpoons of the different types resemble one another in the same area, it is equally proper to add that no two harpoons are alike.

Besides the lesson in the history of invention which this study affords, other questions arise. What help do these technical specimens offer to the ethnologist and the archæologist in deciding race, language, migrations, and antiquity? Can it be said of a harpoon, or some of its parts, found without label in a collection, that it was made by this or that tribe, or that it came from a certain area? Or, if in a shell heap or village site or grave certain harpoon parts are found, will a comparison with the drawings or descriptions in this paper tell who the makers of these relics might have been? In the first place, if the technical products of peoples now living are to throw light upon ethnic and archæologic investigations, these products must be collected in large numbers and the identity of those who made and used them must be settled beyond controversy. With reference to precious material gathered after the discovery and scattered in private and public collections, it is safe to label them as to tribe and locality by the help of specimens lately acquired by scientific collectors. In this way the mouths of these dumb witnesses will be opened. It must not be forgotten, however, that unity of race is a matter of blood, of kinship; that unity of speech is a matter of lip and ear, and requires some close contact; while unity of industry is a matter of eye and hand and may be easily communicated from afar.

On the question, how much of all this invention is of native growth and what proportion is exotic, wide differences of opinion still exist.

To begin with, all iron and all work of iron are in a sense new, added, accultural; not out and out, but in varying proportion and for the most part merely substitutional. The iron blade takes the place of a stone blade only as a better stone. It is hammered and ground similarly. The simple tools alter shapes but little; they merely cut, saw, grind, and pierce better than the old. But a more vigorous substitution took place in the barter of devices between savage tribes widely separated, but made acquainted, first in their own commerce, and afterwards by the fishing and fur trading interests of the white settlers.



BARBED HARPOON WITH FLOAT, KADIAK, ALASKA.

Collected by Vincent Collyer.

Cat. No. 11362, U.S.N.M.

A SKETCH OF THE HISTORY OF CERAMIC ART IN CHINA, WITH A CATALOGUE OF THE HIPPISLEY COLLECTION OF CHINESE PORCELAINS.

BY

ALFRED E. HIPPISLEY,

Commissioner of the Imperial Maritime Customs Service of China.

LIST OF ILLUSTRATIONS.

PLATES.

A SKETCH OF THE HISTORY OF CERAMIC ART IN CHINA, WITH A CATALOGUE OF THE HIPPISLEY COLLECTION OF CHINESE PORCELAINS.[1]

By Alfred E. Hippisley,
Commissioner of the Imperial Maritime Customs Service of China.

For such information as we possess regarding the history of the ceramic art in China, we have till recently been chiefly indebted to the labors of the famous French sinologue, M. Stanislas Julien, who, under the title of L'Histoire et la Fabrication de la Porcelaine Chinoise, translated, and published in 1856, the History of the Manufactory of Chingtê-chên (a small town in Kiangsi province, but for centuries the most important seat of the Chinese porcelain industry), a work written by a local magistrate in 1815 from older documents, and to the valuable letters from the same town written in 1712 and 1722 by the Jesuit missionary Père d'Entrecolles, the priest in charge there, which have been published in the collection of Lettres édifiantes et curieuses. Within the past three years, however, very valuable additional light has been shed upon this subject by the labors of two gentlemen who are at once collectors and Chinese scholars, S. W. Bushell, M. D., physician to H. B. M. legation, Pekin, and F. Hirth, Ph. D., a member of the imperial maritime customs service of China. Doctor Bushell has been fortunate enough to secure from among the dispersed library of the Prince of I the manuscript of a descriptive catalogue (of which native experts see no reason to doubt the authenticity), with illustrations painted in water-color, of eighty-two celebrated specimens of old porcelain seen in the collections of noted connoisseurs or possessed by the author himself, one Hsiang Yüan-p'ien (styled Tzŭ-ching), a native of Tsui-li, an

[1] In 1887 Mr. A. E. Hippisley, a commissioner of the imperial maritime customs service of China, deposited in the U. S. National Museum a large and important collection of Chinese porcelains, with the understanding that the Museum should print a descriptive catalogue, which it did in the Annual Report for 1887–88. The edition of this catalogue having long ago been exhausted, and the demand for it having recently increased, owing to the current interest in all matters relating to China, it is now republished with emendations and with the addition of a number of plates illustrating type examples from the various provinces represented.

ancient name of Chia-ho, now Chiahsing-fu, in Chehkiang province, who was a celebrated collector of all kinds of antiquities during the latter half of the sixteenth century. A translation of this work, with explanatory details by Doctor Bushell, has been published in the journal of the Pekin Oriental Society, under the title of Chinese Porcelain before the Present Dynasty, and it is, I believe, to be shortly republished in an amplified form with reproductions of the original drawings. Should this be done, the work would, in my opinion, form by far the most important and valuable contribution to our knowledge of this interesting subject. The information regarding Chinese porcelain which has been bequeathed to us by native authors is to be found in their encyclopedias or in special treatises chiefly based upon the encyclopedias. These are, however, compilations of such vast extent that the authors had not, nor could be expected to have, the intimate knowledge of an expert upon all of the very many subjects treated in them. Hearsay evidence or unverified rumors have thus but too often been allowed to crystallize into permanent record, with the result that it is impossible after an interval of centuries to attempt to reconcile the many contradictions of statement contained in the different works. In this catalogue, however, are contained the reproductions in color of eighty-two specimens of the choicest productions of a period extending over upward of five centuries, from A. D. 960 to 1521, either possessed or seen by the artist, and scattered notes from the pen of one of the most noted connoisseurs of his age regarding the respective merits and rarity of the various kinds of ware. Existing realities are presented to us in place of the vague generalities and contradictory essays of the encyclopedists, and there can, I apprehend, be little doubt as to the comparative value of the two varieties of evidence. Doctor Hirth's contribution—Chinese Porcelain: A Study in Chinese Mediæval Industry and Trade—is an important paper, treating chiefly of Chinese céladon porcelain and its distribution over the Mohammedan world.

EARLIEST MENTION OF PORCELAIN.

According to the legendary records of the prehistoric period of Chinese chronology, porcelain was already manufactured under Huang-ti, an emperor who is said to have entered upon a reign of one hundred years in B. C. 2697; and the Emperor Yu-ti-Shun, another monarch of the legendary period, is believed to have himself made porcelain before mounting the throne in B. C. 2255. Under the succeeding dynasty of Chou, mention is made of an official director of pottery, and the processes of fashioning on the wheel and of molding are distinguished; sacrificial wine jars and altar dishes, coffins, cooking utensils, and measures being mentioned among the articles produced. Later Chinese writers have, however, long admitted that the productions of that age could only have been of earthenware (possibly glazed), and that no greater antiquity can be claimed for the manufacture of real porcelain than the reign of the Han dynasty, which held the throne of China from B. C. 202 to A. D. 220, and that after this date progress in the system of manufacture was for a long period but slow. At one time, early in the present century, European archæologists were inclined to believe than an antiquity might be conceded to Chinese porcelain almost equal to the wildest claims of Chinese historians.[1] Some small porcelain bottles, decorated with flowers and inscriptions in Chinese, having been brought to Europe by M. Rosellini, who stated that they had been found in undisturbed Egyptian tombs dating from at least 1800 B. C., it was concluded that the manufacture of porcelain must have existed in China anterior to that date. M. Julien discovered, however, that the inscriptions upon these bottles were written in the cursive character, a style of writing not introduced till B. C. 48; and later Mr. (afterwards Sir Walter) Medhurst, then an interpreter in the Hongkong government service, was able with Chinese aid to identify the inscriptions with quotations from poems written during the T'ang dynasty, and later than the seventh century of the Christian era. Any title to such great antiquity in the manufacture of Chinese porcelain, based on these bottles, which had evidently been surreptitiously introduced into the tombs by Arabs, thus fell to the ground. Indeed, M. du Sartel, who has published an exhaustive work on La Porcelaine de la Chine, argues that the manufacture of true porcelain in China did not begin till some centuries later than the period assigned to it by M. Julien, who dates it from the reign of the Han dynasty and somewhere between the years B. C. 185 and A. D. 87. This point will be considered when we come to the reign of the T'ang dynasty, the period in which M. du Sartel claims true porcelain was first made.

HAN DYNASTY, B. C. 202 TO A. D. 220.

It is during the Han dynasty that mention is first made of *Tz'u*, the Chinese designation of porcelain. It was then made at Hsinp'ing, a district in the State of Ch'en, and corresponding with the modern Huaining district, in Honan province.

WEI DYNASTY, 221 TO 265.

Under the Wei dynasty, which from A. D. 221 to 265 enjoyed, with the dynasties of Wu and of Han of Szechuen, divided supremacy as rulers of China, manufactories are mentioned at several places in the department of Hsi-an, in Shensi province (the products of which were known as Kuanchung-yao), and at Loyang, in Honan province (products termed Loching-t'ao), as supplying porcelain for the imperial palace.

[1] Rosellini, I Monumenti dell' Egitto, 1834. Sir John Davis, The Chinese, 1836. J. Gardener Wilkinson, Manners and Customs of the Ancient Egyptians, 1837.

CHIN DYNASTY, 266 TO 419.

Under the Chin dynasty (A. D. 266 to 419) another manufactory is mentioned as existing in the present department of Wênchou, in Chehkiang province, which produced porcelain (known as Tung-ou t'ao) of a blue (or possibly céladon) color which was held in high esteem.

SUI DYNASTY, 581 TO 617.

Under the Sui dynasty, in spite of its short-lived existence, considerable progress appears to have taken place. Mention is made of a green porcelain manufactured under the directions of Ho Chou or Ho Kuei-lin, president of the board of works, to replace glass, the method of making which had been forgotten "since its introduction into China by Indian or Syrian artisans about A. D. 424."[1] A celebrated workman, named T'ao Yü,[2] is said to have produced porcelain so like jade, that is, semitransparent and of vitreous appearance, that his vases were known as "artificial jade;" and about the close of this or the beginning of the following dynasty porcelain, white in color and bright as jade (known as Ho-yao, i. e., Ho porcelain), was manufactured by Ho Chung-ch'u, a workman who came from Hsinp'ing, the district where porcelain (*tz'u*) had its first origin under the Han dynasty. An imperial decree of 583 ordered the establishment of a manufactory at the place now known as Chingtê-chên (so named from the title of the period,[3] Chingtê, in which it was inaugurated) for articles for the use of the imperial household, and several others sprang up in the vicinity shortly afterwards.

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[1] F. Hirth, China and the Roman Orient, pp. 230 et seq.

[2] The producer's reputed name, meaning as it does "faïence or kiln jade," sounds apocryphal, and seems more likely to have been the term by which this ware was known.

[3] It being contrary to etiquette to mention the personal name of a Chinese sovereign, the practice was introduced B. C. 163, under the earlier Han dynasty, of the monarch, on his accession to the throne, selecting some title for his reign in place of the title of Prince so-and-so, which had been usually employed prior to the time of Shih Huangti, B. C. 221. These titles were usually so chosen as to be of happy augury, but if, in spite of such good omen, disorder or misfortune ensued or some other reason seemed to render a change advisable, one title would be abandoned in favor of another. This title is termed *nien-hao*, "the year designation," because so long as it lasted the date of all events was chronicled as such and such a year of such and such a title, or *nien-hao*. Upon his death, however, the emperor received an honorific title, and but one title, no matter how many *nien-hao*, or "year designations," he may have employed while alive, under which the religious ceremonies due to him were offered, and which is therefore termed the *miao-hao*, or "temple designation." Thus it results that when in Chinese literature a deceased emperor is personally alluded to he is spoken of under his "temple designation," while if the date of an event which occurred during his reign is quoted it is said to have taken place in such and such a year of the appropriate "year designation." Take, as an instance, the last emperor of the Yüan dynasty, who reigned from 1333 to 1367; if spoken of personally his title would be Shunti of the Yüan dynasty; but if the year 1334 were

T'ANG DYNASTY, 618 TO 906.

Under the succeeding, the T'ang dynasty, which ruled from 618 to 906, the manufacture appears to have spread over the greater part of the empire, and to have reached in some places a degree of excellence far in advance of that previously attained. The following varieties are specifically enumerated (in the reverse order of their merit):

The *Hungchou-yao*, a yellow-black porcelain from Hungchow, the present department of Nan-ch'ang, in Kiangsi province.

The *Shou-yao*, a yellow porcelain from Shouchou in (present) Kiangsu province.

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spoken of, it would read "the second year of (the) Yüan t'ung (period)," and similarly 1336 and 1343 would read "the second year of (the) Chihyüan period)" and "the second year of (the) Chihchêng (period)." Owing to the fact that dates are thus rendered by the Chinese foreign writers have at times erroneously spoken of the *nien-hao*, or "period," as the reign, whereas the *miao-hao* or "temple designation" alone corresponds to the Western idea of reign, so far as any time prior to the Ming dynasty is concerned. During the Ming and its successor, the present dynasty, however, each emperor has practically used but one "year designation" throughout the period he has occupied the throne, because though Ying Tsung of the Ming dynasty employed two such designations they were separated by an interregnum of seven years' duration; and though T'ai-Tsung-Wên, of the present dynasty, also employed two, he seldom or never comes to the notice of foreign writers. The term "period" being in any case an inconvenient one, and the "year designation" under the Ming and the present dynasty being synchronous with the reign, it seems hypercritical to insist on uniformly translating *nien-hao* by "period" in the case of emperors of those dynasties, especially as consistency would require that names so well known to every schoolboy, as Kànghsi, Yungchêng, and Chienlung be replaced by the proper titles, Shêng-Tsu-Jên Huangti, Shih-Tsung-Hsien Huangti, and Kao-Tsung-Shun Huangti. In the following pages, therefore, the *nien-hao* or "year designation" has been rendered "period" prior to the accession of the Ming dynasty in 1368, and subsequently to that date as "period" or "reign," according to circumstances.

The dates upon porcelain are also usually recorded by the use of the *nien-hao*, as above described, though other marks are mentioned by Chinese writers, and if the article has been manufactured for the special use of some emperor or prince, it will possibly bear the name of the pavilion or portion of the palace for which it is specially intended. Chinese writers state that the practice of marking the date of manufacture was instituted by the Emperor Chên Tsung of the Sung dynasty, when, on the establishment of the government factory at Chingtê-chên, he ordered that each article manufactured should be marked with the *nien-hao* then used "Chingtê, 1004 to 1007." Foreign writers on the marks upon porcelain specify other marks of the same dynasty, but upon what authority is not clearly specified. So far as my own knowledge goes, I am unaware of any such date-marks being inscribed under the glaze prior to the Ming dynasty. Since that time, putting aside monochromes, which, in probably the majority of instances, bear no mark, they have been employed uninterruptedly, except during a portion of K'anghsi's reign. In 1677 the magistrate in charge at Chingtê-chên forbade the practice alike of inscribing the date and of portraying the actions of celebrated personages, on the ground that if the article were broken, disrespect might be shown to them or to the emperor. During this period, which was of but short duration, however, a leaf, a censer, and other marks replaced the *nien-hao*.

The *Yo-yao*, a blue porcelain, according to Julien, but the color was more probably a pale green, for the Ch'a ching, a Treatise on Tea, written in the eighth century, says cups of this ware gave to the infusion a green tint—from the department of Yochou, in (present) Hunan province.

The *Wu-yao* and *Ting-yao*, of colors unspecified, from the department of Wuchou, corresponding with the present department of Chinhua in Chehkiang province; and from the department of Tingchow, corresponding with the present district of Chingyang in the Hsi-an department, Shensi province, respectively.

The *Yüeh-yao*, a blue, or for the same reason as in the case of *Yo-yao* a pale-green porcelain, much sought after from the earliest times, from Yüehchou, corresponding with the present department of Chaohsing in Chehkiang province; and lastly

The *Shu-yao* or Szechuen porcelain, easily first among the productions of that age, snow-white in color, with a clear ring, thin but strong, and graceful in shape, fram the city of Ta-i, in the department of K'iungchou, in (present) Szechuen province.

THE ANTIQUITY OF TRUE PORCELAIN.

As already stated, M. du Sartel declines to admit the antiquity attributed by M. Julien, on the authority of the native work he translated, to the production of true porcelain in China, namely, the time of the Han dynasty, and somewhere between the years B. C. 185 and A. D. 87. His arguments, however, are marked by strange inaccuracies. Having referred the productions of Hungchou, Shouchou, Yochou, and Yüehchou, which, as above, Chinese authors claim to have been first manufactured under the T'ang dynasty, back to the Ch'in dynasty, that is, to a period nearly two centuries earlier, M. du Sartel argues that the remarks made in the Treatise on Tea above referred to (which, when enumerating the varieties of T'ang porcelain, classifies them merely according to the suitability of their colored glazes to impart an agreeable tint to tea held in them) tend to show that the bowls or cups in question could not have been transparent porcelain, bearing a decoration in the colors named under the glaze, but must have been of an opaque substance, covered internally with a thick colored glaze. In this view he considers himself supported by the description given of the Sui dynasty manufactures. This, he argues, gives an idea of transparence, but the transparence is due merely to the use of a more vitreous composition or to a more thorough baking than had been previously customary, and the white color and other distinctive qualities of true porcelain are only to be first found in the productions of the T'ang dynasty—that is, in those productions which M. du Sartel, in disregard of the statements of Chinese writers, the only authorities we have to guide us, himself elects to refer to this dynasty. Secondly, he argues that the porcelain manufactured under the Sui and preceding dynasties is uniformly denominated *t'ao*, that from the latter half of the T'ang dynasty this word is replaced by the designation *yao*, which has continued in use up to the present time, and that the change in name coincides with a change in the character of the porcelain manufactured.

The word *yao* as a designation of porcelain came into *general* use, it is true, at the beginning of the T'ang dynasty, but that fact would scarcely justify the conclusion that it was designedly introduced in order to mark a synchronous change in the character of the ware, since the same word, which is in any case but a neutral term applicable to any kind of pottery, is met with four centuries earlier to designate some of the products of the Wei dynasty; and besides, in the titles of the chapters in the Provincial Topographies dealing with these manufactures, also in the Treatise on Pottery (the T'ao shuo, written by Chu T'ung-ch'uan during the reign of Chien-lung, 1736 to 1795, *the* authority on this subject), and in the work translated by M. Julien, it is the word *t'ao*, not *yao*, that is used to designate porcelain. Chinese terminology is but an insecure foundation on which to base arguments, and it might with no less fairness be contended, as the Chinese author translated by M. Julien does contend, that the introduction of the character *tz'ŭ*, signifying "porcelain," and employed down to the present day to designate the pottery of the Han dynasty, was rendered necessary by the production of an article hitherto unknown, and that this article was true porcelain.

On different grounds from those advanced by M. du Sartel, Doctor Hirth, also, refers the earliest manufacture of true porcelain to the T'ang instead of to the Han dynasty. He says: "The Chêng-lei-pên-ts'ao, the pharmacopœia of the Sung dynasty, compiled in 1108, under the head of 'Porcelain Earth' (Kaolin) or Pai-ngo, quotes from the writings of T'ao Yin-chü that 'this substance is now much used for painting pictures,' and from the T'ang pên-ts'ao, the pharmacopœia of the T'ang dynasty, compiled about 650: 'This earth is now used for painters' work, and rarely enters into medical prescriptions; during recent generations it has been used to make white porcelain.'" As T'ao Yin-chü was a celebrated author on pharmaceutical and other scientific subjects, who died A. D. 536, Doctor Hirth argues that had the *pai-ngo* or kaolin been used in his time on an extensive scale in the manufacture of chinaware, so learned a writer would almost certainly have mentioned the subject, and he therefore concludes that porcelain earth for the manufacture of pottery came into use later than 536, and at some time during the T'ang period, prior to 650, about which date the pharmacopœia of that dynasty was compiled.

This negative testimony does not, however, dispose of the strong argument in favor of the earlier date, afforded by the coining during the Han dynasty of a new word, *tz'ŭ*, to designate the productions of that age, a word which, as already stated, is still in ordinary use to designate porcelain. On this point Doctor Hirth thinks he has detected that the word *tz'ŭ* has had different significations at different epochs, for while in the Shuo-wên, a glossary published A. D. 100, *tz'ŭ* is defined as "earthenware," it is defined in the dictionaries of the Sung period—nine centuries later—as "hard, fine-grained pottery;" and calling attention to the fact that there are now two forms of this character in use, the original form with the radical denoting "brick or earthen material," and a later form with the radical "stone," he thinks that "this substitution by later generations for the original sign of a character of the same sound, but with a radical more appropriate to the category of the word as it was at the time understood, may be regarded as indicating a change from the original meaning."[1] Even if this be true, no data are thereby afforded to help fix even the approximate date of change in the method of manufacture. For after the change in the system of manufacture had taken place, a considerable period would almost certainly elapse before an author of sufficient literary importance to impose a new style of writing on the nation would learn sufficient regarding the altered ingredients employed to have the corresponding modification in the descriptive word suggested to his mind, and a still longer period would elapse before this newly coined word would pass into current use.

The authors translated by M. Julien, too, state distinctly that the introduction of the later form—that with the radical "stone"—and the continued use of it are due to ignorance and error. At Tz'ŭ-chou, a district anciently within the department of Changtê, in Honan province, but now belonging to the department of Kuangp'ing, in Chihli province, a kind of porcelain was made during the Sung dynasty which enjoyed a very high reputation, the plain white specimens bringing even higher prices than the celebrated productions of Tingchow, which it closely resembled. This ware was known as *Tz'ŭ* ware, or porcelain from Tz'u-chow, and thus this form of the character, which was originally a local designation, not an intentional modification of the older form introduced to typify a modification in the system of manufacture, passed into general use to designate not merely this special class, but (erroneously) all porcelain.[2]

ORIGIN OF TERM "PORCELAIN."

It is a curious coincidence that no less diversity of opinion has existed regarding the date at which the western equivalent of this word *tz'ŭ*, the term "porcelain," was introduced and the article it has at different

[1] F. Hirth, Ancient Chinese Porcelain, p. 2.

[2] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 29: This is, I think, probably the true explanation of the change of form; for the only correct way of writing this character recognized at the present time by the Imperial Academy is the original form, with the radical "earthenware," not that with the radical "stone,"

times been used to designate. Père d'Entrecolles affirms that the name porcelain was first given by the Portuguese to the Chinese vases imported by them into Europe in 1518, but further researches into the history of the word by M. Brongniart and M. de Laborde show that the name arose from a supposed resemblance in appearance of surface between the transparent pottery of the East and certain shells which had been previously so designated. M. de Laborde says:

Les anciens ayant trouvé ou cherché une ressemblance entre ce qu'ils appelaient porca et certaines coquilles, donnèrent à celles-là le nom de porcella. Le moyen âge accepta cette analogie en appelant porcelaine une famille entière de coquilles, et aussi les ouvrages qui étaient faits de nacre de perle, et, par métonymie, la nacre seule tirée de la coquille.

A partir du XIV[e] siècle, les gardes des joyaux décrivent en grand nombre dans les inventaires, et les experts mentionnent et estiment dans leurs rapports, des vases, des ustensiles de table, des tableaux de dévotion, et des joyaux faits de la porcelaine. Cette expression á travers quelques variantes sans importance, reste la même et s'applique aux mêmes choses jusqu'au XVI[e] siècle; de ce moment elle se bifurque pour conserver d'une part sa vieille signification, et s'étendre de l'autre à des vases et ustensiles d'importation étrangère qui offraient la même blancheur nacrée. C'était la poterie émaillée de la Chine qui s'emparait de ce nom auquel elle n'avait droit que par une analogie de teinte et de grain.

M. du Sartel is strongly of opinion that the word porcelain was used in its present sense far earlier than the date assigned by M. de Laborde, and in support of his view quotes the mention of "pourcelaine" in royal inventories dating from 1360 to 1416 for France, and from the beginning of the sixteenth century for the Roman Empire. These documents appear to me, however, rather to support M. de Laborde's views; for the details given in the French inventories of representations on the articles named, of our Lord, the Blessed Mother, and of Saints, and of their decoration with jewels,[1] would seem to make the possibility of their being oriental porcelain more than doubtful; while the inventories belonging to the Roman Empire—that is, from the date M. de Laborde says the word was applied to oriental pottery, do mention articles undoubtedly of real porcelain, all, with one exception, in monochrome.

A statement quoted by M. du Sartel from Pierre Bélon, of 1553, is worth reproducing, as evidence that in the latter half of the sixteenth century the word porcelain was still applied to shells, to mother-of-pearl, to oriental pottery, and even to Italian faience. He says:

Des vaisseaux de porcelaine, qu'il a vus vendre en public au Caire, lesquels vases de porcelaine sont transparents et coustent bien cher au Caire et ilz disent mesmement qu'ilz les apportent des Indes, mais cela ne me sembla vraysemblable; car on

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[1] With regard to the last mentioned, it should be stated that in the magnificent Dresden collection, formed chiefly by Augustus the Strong, King of Poland and Elector of Saxony, between 1694 and 1705, there is a small ivory-white plate with uncut rubies and emeralds in gold filigree let into the paste, with the character *fu*, happiness, on the foot in blue under the glaze, which is said to have been brought by a crusader from Palestine in the twelfth century.

n'en voirroit pas si grande quantité ni de si grandes pièces s'il les falloit apporter de si loing. Une esguière, un pôt ou un autre vaisseau, pour petite qu'elle soit, couste un ducat; si c'est quelque grand vase, il coustera davantage.

Et les voyant nomméz d'une appellation moderne et cherchant leur étymologie françoise, j'y trouve qu'ils sont nomméz du nom que tient une espèce de coquille de porcelaine. Mais l'affinité de la diction Murex correspond à Murrhina; toutefois je ne cherche l'étymologie que du nom françois en ce que nous disons vaisseaux de pourcelayne, scachans que les Grecs nomment la mirrhe de Smirna, les vaisseaux qu'on vend pour ce aujourd'hui en nos païs, nommez de pourcelaine, ne tiennent tache de la nature des anciens; et combien que les meilleurs ouvriers de l'Italie n'en font point de telz, toutefois, ils vendent leurs ouvrages pour vaisseaux de pourcelaine, combien qu'ils n'ont pas la matière de mesme.[1] [2]

THE FIVE DYNASTIES, 907 TO 959.

To the T'ang succeeded the epoch of the five dynasties, all of them short-lived and naming themselves successors to some one of the more important dynasties that had preceded them.

Under one of these, the Posterior Chou, during the reign of the Emperor Shih-tsung (954 to 959), a celebrated porcelain, far superior to any yet produced, was manufactured in the district of Pien, the present department of K'aifêng, in Honan province. It is described as being sky-blue in color, of brilliant surface, thin as paper, and giving out a clear musical sound when struck, the only defect being that the base was apt to be disfigured by the remains of the coarse sand on which the vessel had rested in the furnace, and which had become attached to it during the process of baking. The color was adopted in obedience to an imperial order that porcelain intended for palace use should thenceforward be "as blue as the clear sky after rain." This porcelain, which was consequently termed *Yü-yao*, "Imperial porcelain," and, after the accession of the succeeding dynasty, *Ch'ai-yao*, "Ch'ai porcelain" (Ch'ai being the Emperor's family name), was very highly prized, and becoming in subsequent years, owing to its delicate make, exceedingly rare, the smallest fragments were treasured as cap ornaments or necklace pendants. Porcelain, blue in color and with the characters "blue as the clear sky after rain" stamped in the glaze, is at the present time to be obtained in China. It is scarcely necessary to state, however, that such specimens do not date from the time of Shih-tsung; on the contrary, they are of quite modern manufacture. Already in the sixteenth cen-

[1] Du Sartel, Porcelaine Chinoise, p. 33.

[2] Florio, in his Italian dictionary (1598), gives "*Porcellana*, a kinde of fine earth called Porcelane, whereof they make fine China dishes called Porcellan dishes. *China*, a Venus basin," i. e., a Venice basin. It may remain a question whether Majolica, exported by way of Venice, was called *China* from a supposed resemblance to oriental porcelain, or whether the wares alluded to by Florio were in fact oriental. Minsheu, in his Spanish dictionary (1599), gives "*Porcellana*, a kinde of earthen vessell painted; costly fruit dishes of fine earth, painted"—quoted in Marryat's History of Pottery and Porcelain, p. 242.

tury Hsiang Tzu-ching writes in the preface to his catalogue, "In the present day men search for a fragment of this porcelain without being able to find one, and declare it to be but a phantom."[1]

EARLIEST PORCELAIN EXTANT DATES FROM SUNG DYNASTY.

In truth, the description which has been attempted of the varieties of porcelain hitherto enumerated possesses merely a historical interest. No specimens manufactured prior to the advent of the Sung dynasty have survived to the present day, and even of the Sung productions the finer kinds have entirely disappeared. Such specimens as have weathered the storms and dangers of the subsequent eight centuries are, so far as I am aware, only céladons of considerable solidity—chiefly Lungch'üan or Chünchow ware—or small pieces of no great fineness. Three centuries ago even the finest varieties were already scarce, as is evident from a passage in the *P'ing hua-p'u*, an essay on flower-pots and flowers in pots, from the pen of Chang Ch'ien-tê, an author who wrote near the close of the Ming dynasty, that is, about the beginning of the seventeenth century:

In ancient times no vases were made of porcelain, and up to the T'ang dynasty all such vessels were of copper. It was not till then that pottery came into vogue. After this period we find a large number of classes of porcelain, such as the kinds known as Ch'ai (that described above), Ju, Kuan, Ko, Ting, Lungch'üan, Chünchou, Changshêng, Wuni (all of the Sung dynasty period), Hsüantê, and Ch'ênghua (of the Ming dynasty). Among antiquities, copper articles are the best; of porcelain, the Ch'ai and Ju kinds, though the best of all, have ceased to exist; Kuan, Ko, Hsüan, and Ting porcelains are the most precious curiosities of the present day; whereas the porcelains called Lungch'üan (the heavy old céladons of modern collectors), Chünchou, Changshêng, Wuniê, and Ch'enghua are esteemed as objects of only secondary value."[2]

As Chang Ch'ien-tê further says that he constantly met with specimens of Juchou porcelain, and since vases of that ware are figured in Hsiang Tzŭ-ching's catalogue, it would appear that this highly esteemed porcelain must have disappeared from the market towards the close of the sixteenth century. It is curious, too, that while Chang Ch'ien-tê places the productions of the Ch'ênghua period (1465 to 1487) at the foot of the list of porcelains of "only secondary value," the prices paid for this ware within a century of its production were very high. In Hsiang Tzŭ-ching's catalogue the price paid for a tazza-shaped cup is stated to have been 60 taels (or $90 gold); and of two miniature wine cups he says, "these are choice specimens of the wine cups of this celebrated reign, and are valued at 100 taels ($150 gold) the pair, yet now even for this money it is impossible to get them."[3]

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, p. 72.

[2] F. Hirth, Ancient Chinese Porcelain, p. 10.

[3] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 55, 59.

SUNG DYNASTY, 960 TO 1259.

The porcelain manufactured under this dynasty appears to have far excelled in quality and delicacy of workmanship all that preceded it, the Ch'ai-yao alone perhaps excepted. The shapes and ornamental decorations appear to have been modeled, as a rule, after ancient bronzes, figured in illustrated catalogues of the most celebrated specimens of such vessels (as the Po-ku-t'u), published during the Hsüan-ho period, 1119 to 1125, and the K'ao-ku-t'u; and when not modeled after such ancient designs, the vessel took the form of some natural object, as a tree or flower or of some animal, real or imaginary. In the former the pattern was engraved with a pointed style in the paste, and was broken here and there by lions' or dragons' heads in bold relief, with an elaboration and wealth of ornament hitherto undreamed of. That a remarkable degree of proficiency had by this time been obtained in the ceramic art is evident from the descriptions preserved by Hsiang Tzŭ-ching of some specimens of Tingchou ware seen by him.

(1) A sacrificial jar in the form of an elephant from an ancient bronze design. The body forms the wine vessel, the uplifted trunk the spout, a narrow canopy arching over the saddle the handle, to which is attached a round cover ornamented with geometrical and spiral scroll borders surmounted by a knot. The rope girths and ornamental details engraved under a white glaze.

(2) A branched pricket candlestick—a slender pillar on a solid foliated stand curves at the top to end in a phœnix head, from the back of which hangs a ring chain, which suspends the stem of a lotus, branching into three flowers to hold the candles, which are shaded by a huge overhanging leaf. Ornamented with engraving under a pure white glaze.

(3) A jar which was of irregular quadrangular section, carved in relief after an ancient bronze design, with lobes on the body, a scroll border below, and a band of ornament in the form of coiled dragons round the neck. Loop handles terminating in horned heads and with rings hanging from them project from the neck. Covered with glaze the color of ripe grapes, transparent and of a perfect luster—a beautiful vase to hold flowers for the table.[1]

INTRODUCTION OF COLORED DECORATION.

Prior to the Sung dynasty the external color of all porcelain appears to have been solely determined by that of the glaze, and to have been almost entirely monochrome. In a few instances vases were covered with parti-colored glazes, which were apt to flow into one another in the heat of the kiln, and so gave rise to the fortuitous productions known as *Yao-pien* (the French *flambés*), articles the decoration of which "changed during the process of baking." The Sung porcelain was essentially, I believe, of the same character, the coloring of the article produced being determined only by the kind of glaze which was spread over the paste or biscuit.

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, Nos. 33, 80, 18.

With the sole exception of the Nanfêng ware, and a portion of that from Linch'uan, produced during the Yüan dynasty, none of which seems to have survived to the present day, but which is described as having been decorated with flowers coarsely painted under the glaze, I can find nothing in the works of Chinese writers on this subject to justify the concession of a greater antiquity than the early part of the Ming dynasty—that is, the first half of the fifteenth century—to the ornamentation of vases with arabesques and scroll work, with landscapes, historical scenes, or genre paintings in several colors.

This conclusion, if correct, is a point of considerable importance as an aid in determining the true age of specimens which are at times credited with an origin far remote. It is true that céladon vases, into the ornamentation of which leaves enter, are sometimes described as having the leaves veined with dark green, but these deeper shades may result from the fact that the ornamentation has been engraved in the paste, and that the coloring matter has sunk into the line of engraving, thereby producing a darker shade along the lower levels. Other specimens of céladon ware had one or sometimes two bands of ornamentation of a deeper green than the body of the vase. This deeper tone might, however, have been produced by a double layer of glaze; in any case the peculiarity would not amount to ornamentation in several colors in the sense in which I use that expression. Again, the single specimen of black Tingchou porcelain illustrated (and indeed ever seen) by Hsiang Tzŭ-ching is described as "a duck-headed vase, bottle shape, with swelling body and ringed neck, which curves over to end in a duck's head, a round orifice with a small cover being on the convexity of the curve. The black color is painted on the head and neck, gradually fading away on the body of the vase, which is enamelled white."[1] This description conveys the idea that the head and neck of the duck were covered with black glaze, the body of the vase with white glaze, and that in the baking the former spread downwards and gradually merged into the white of the body. It in no way invalidates the conclusion above suggested.

It will be advisable to examine in greater detail the several varieties of porcelain manufactured under this dynasty, following the order of merit usually ascribed to them by Chinese writers.

JU-YAO.

Ju-yao or Juchou porcelain.—Chinese authors state that the porcelain manufactured at Tingchow (see p. 324), being unfit for presentation to the Emperor, the establishment of a factory for the manufacture of more suitable articles was ordered at Juchow, in Honan Province. According to some writers the defect of the Tingchou ware was its

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 35.

gritty character; according to others, the frequency of cracks caused by too rapid or careless baking. As, however, they agree in ascribing the introduction of *Ju-yao* and its success to the early part of the Sung dynasty—that is, to the very time from which date the finest specimens of the Tingchou porcelain—it is difficult not to conclude that native authors, writing centuries later, have ascribed the establishment of this factory to erroneous causes.

The finest specimens, which were very thin and delicate, were superior to imperial ware (*Kuan-yao*), and were of either plain or crackled [1] surface, with the ornamentation engraved under the paste. The *craquelure*, though coarse in inferior specimens, must in the better grades have been very close and fine, as it is described as resembling fishroe. But that not crackled was the most highly esteemed. Hsiang Tzŭ-ching, describing a beaker of old bronze design with engraved decoration under a bluish-green color not crackled, speaks of it as "a rare kind of Juchou ware." In color it was céladon. In one place this porcelain is described, it is true, as being like the sky after rain, but as elsewhere it is stated to have resembled the *Ko-yao*, or

[1] Crackling (*craquelure*) was originally considered in Europe a defect of baking, which resulted from a lack of homogeneity between paste and glaze, causing one to contract more rapidly than did the other. It was not till a comparatively recent date that the actual facts came to be appreciated, namely, that in the eyes of the Chinese the *craquelure* is a species of decoration, and that they have a special kind of enamel, into the composition of which steatite enters largely, the sole object of which is to produce this curious appearance. By means of this enamel they can at will cover the surface of a vase with any one of a variety of *craquelure*, either large "like cracks in ice," or small as "the fish roe," "the dodder," or "the crabs' claws." In some specimens bands are found crackled separating other bands not crackled; or colors, usually either black or red, are rubbed into the crackling to render it more apparent, or to impart a tinge to the entire surface. In other specimens again, though for what reason is not known, the paste, after having been decorated, is covered with a crackled glaze, and a second decoration, having no apparent connection with that beneath, is painted above the glaze. The colors of the Juchou, government (*Kuan*), Ko, Lungch'üan and Chünchou porcelains were all some shade of what the Chinese call *ch'ing*. Now *ch'ing* means in some combinations blue, in others a pale dull green, as of the fresh olive, which is called by the Chinese *ch'ing-kuo, the ch'ing* colored fruit. Père d'Entrecolles, when writing of the Lungch'üan ware, describes its color correctly as *teinte d'olive*. M. Julien, however, in spite of a hint given from the technical annotator M. Salvetat, which might have set him right, rejected this sense on what seemed to him sufficient grounds, and insisted on (erroneously) translating this word throughout his work as "blue," though by so doing he had to make his porcelain "as blue as [green] jade"—with the result that subsequent writers on this subject have failed to derive any assistance from his work in determining the origin and history of céladon porcelain. Hirth, Ancient Chinese Porcelain, p. 7.

Céladon was originally the name of the hero in the popular novel *l'Astrée*, written by Honoré d'Urfé in the seventeenth century. Céladon was attired in clothes of a kind of sea-green hue with gray or bluish tint, and his name thus came to be applied to the clothes he wore, precisely that designated by the Chinese as ch'ing.

crackled céladons in color, though somewhat darker in shade, there seems no reason to doubt that its real tint was bluish-green—that is, céladon—especially as the specimens of this ware illustrated in the catalogue translated by Doctor Bushell are so painted.[1] Hsiang Tzŭ-ching, the author of this catalogue, after describing a vase 6½ inches high, which is stated to have cost 150,000 cash, or about $150 gold, says, "Specimens of Juchou ware are very rare, and, when met with, are usually plates and bowls. A perfect unbroken vase like this is almost unique, and as it excels Kuan and Ko porcelain both in form and glaze, it is far more valuable." Within three or four decades later, as has already been stated, it seems to have been impossible to find any specimens at all of this ware.

KUAN-YAO.

Kuan-yao—that is, official or Government porcelain—was the produce of the imperial factories established under the Sung dynasty between the years 1107 and 1117 at Pienliang, the present department of K'aifêng, in Honan province, and after the removal southwards of the court before the advancing Mongols, at the southern capital, Hangchou, in Chehkiang province. During the Takuan period (1107 to 1110) the shades specially affected were, first, pale white like the moon, the French *clair de lune;* second, pale bluish-green; and third, dark green; but during the Chingho period (1111 to 1117) the only color employed was bluish-green, both dark and pale in tint. This porcelain was very thin, and in some cases crackled all over so finely as to resemble crab's claws, with the red brim and iron-colored foot distinctive of the true céladon. The *Po-wu-yao-lan*, quoted in the *T'ao-shuo* Treatise on Pottery (chap. 2, p. 9), explains this latter expression as follows:

> As regards *Kuan-yao*, it should be known that the porcelain earth found at the foot of the *Fênghuang-shan*, or Phœnix hill, near Hangchou, is red; for this reason the foot (the base on which the vessel rests when being fired, and which is therefore not covered by the enamel), resembles iron in color. This was at the time called "red-mouthed and iron-footed." The term "red mouth" refers to the brim or opening of the vessel, which becomes red by the enamel flowing down and away from it, so as to be much thinner on the brim than it is on the body of the vessel, thus allowing spots of red paste to become visible.

Doctor Hirth, after quoting this explanation, adds:

> The red or iron colored bottom, usually appearing in the shape of a ring, is a characteristic feature of the Lungch'üan céladons; but if the above explanation is correct, the bottom of Lungch'üan vessels differed from *Kuan-yao* bottoms, since the paste of Hangchou céladons (the southern *Kuan-yao*) is said to be red in itself, whereas that of the *Lungch'üan-yao* is originally white, and merely turns red in such parts of the surface as are not covered by the enamel.[2]

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[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 63. S. W. Bushell, Chinese Porcelain before the Present Dynasty, Nos. 19, 22, 34.

[2] F. Hirth, Ancient Chinese Porcelain.

From Hsiang Tzŭ-ching's catalogue it would seem as if there were originally two recognized classes of this ware—ordinary *Kuan-yao* and *Ta-kuan*, or superior *Kuan-yao*. Among the latter he mentions an ink slab for the Emperor's use, in which "an oval was left unglazed in the center for rubbing the ink on, showing the red paste." Both were céladon in color; in the superior variety (*ta-kuan*), however, the glaze appears to have been more brilliant—it is described as "clear and lustrous, like an emerald in tint." The two specimens of this ware described were both coarsely crackled. The ordinary *Kuan-yao* was in some cases crackled with a glaze varying from pale green to deep onion; in other specimens uncrackled, the latter being seemingly of a lighter tint than the crackled; the ornamentation, consisting of a variety of scroll designs or of some geometrical patterns broken by animals' heads in relief, was engraved under the glaze.[1]

After the court had been removed south to Hangchou, Shao Ch'êng-chang, superintendent of the Northern Imperial Park, is said to have established a factory in the residence of the junior director of the palace. Made of very pure clay, with great grace of form and covered with a transparent, brilliant glaze, this porcelain, which was termed *Nei-yao* porcelain of the palace or *Kuan-yao*—Government porcelain—gained a high reputation.

TING-YAO.

Ting-yao, or porcelain of Tingchow, was manufactured originally in the district of that name in Chihli province, near the present department of Chêngting. It was known as *Pei-ting* or Northern Ting (960–1126), in contradistinction to the *Nan-ting* or Southern Ting, produced at Hangchow after the retreat of the court southward before the advancing Mongols in 1127. The former was the more highly prized, and the finest specimens of this ware were those produced, it is said, during the period Chêngho (1111 to 1117) and Hsüanho (1119 to 1125). In color they were brilliant white, purple, or black; and though the *Ko-ku-yao-lan* (a work treating of antiquities, completed in 1387), as quoted in the *T'ao-shuo*, or Treatise on Porcelain, from which the authors translated by M. Julien derive most of their information regarding the ceramics of earlier dynasties, gives as the test of Tingchow porcelain "the purity of its white color and brillancy of its glaze," it is evident that the connoisseur Hsiang Tzŭ-ching experienced a stronger affection for his "beautiful purple glaze, uniformly brilliant and transparent, resembling the tint of ripe grapes or of the aubergine (egg-plant)" and his black, than he did for the white glaze, though it were, in his own words, "uniformly lustrous and translucent, like mutton-fat or fine jade." Both the purple and black varieties were far rarer than

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[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, Nos. 2, 5, 8, 13, 15, 17, 47, 50, 53, 73.

the white. "I have seen," says the collector, "hundreds of specimens of the white, scores of purple-brown, but the black is extremely rare, and I have only seen the one specimen I have described in my whole life"—and he then had in his possession at least one of the specimens more than fifty years. It is, I think, in this rarity of the purple and black glazes that the explanation of the dictum above quoted is to be found, and probably they were unknown to its authors. The varieties mentioned in the *Ko-ku-yao-lan* as inferior to the white do not include these colors, and seem to result from impure clay or defective glaze.

The same work (the *Ko-ku-yao-lan*) says that one of the signs of the genuineness of this ware was the presence of marks on it like tears. This probably means granulations, for it is explained that these marks were caused by the manner in which the enamel was thrown upon the white paste. Specimens having ornamental designs engraved in the paste were the best, though the plain or unornamented were also highly esteemed; the second class consisted of such as had the ornamentation worked into the enamel, and a third of such as had the decoration printed or pressed upon them with a mold, the ornaments chiefly used being the Chinese peony or *Pæonia moutan*, the *hsüan-ts'ao* or *Hemerocallis fulva*, and the flying *fênghuang* (Phœnix). In Hsiang Tzŭ-ching's catalogue, however, eleven specimens, all undoubtedly of the finest quality—six of the white glaze, four of the purple, and one of the black—are described, into the ornamentation of no one of which enters either of these so-called "usual" patterns; the decoration in every case is in general character exactly similar to that found on the Juchow ware already described.

Tingchow ware was well imitated during the Yüan dynasty (1260 to 1367) by one P'êng Chün-pao at Hochow, in Kiangnan province, and later on very successfully at Chingtê-chen.[1] His productions, known as P'êng porcelain, after himself, and Ho porcelain, from the locality, are described as "fine in paste and white in color, looking very much like real *Ting-yao*."

LUNGCH'ÜAN.

Lungch'üan-yao (Lungch'üan porcelain) was manufactured from the early part of the Sung dynasty (end of tenth or beginning of eleventh century) in the district of that name, situated in the department of Ch'üchow, Chehkiang province. The ornamentation was engraved under the glaze, which was of various shades from the color of grass to deep onion-green, sometimes crackled and sometimes not crackled; and occasionally bands of foliate or scroll pattern are found of deeper tone than the rest of the vessel. The biscuit, which was of fine clay, turned brown when the absence of glaze had exposed it to the effect of heat

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, pp. 21, 61. F. Hirth, Ancient Chinese Porcelain, pp. 13 *et seq.*

during baking, though when covered by the glaze and in fractures it remained white, and on the base or foot was a ferruginous ring. The specimens which survive are mostly coarse and thick, but as the best examples were considered but little inferior to *Kuan-yao*, these probably represent only the rougher and inferior grades. In the designs no little artistic merit is shown at times. One specimen which is described by Hsiang Tzŭ-ching (and I have myself seen one exactly similar) consists of a whorl of palm leaves surrounding a hollow stem to hold flowers. Another is "a sacrificial urn moulded in the form of a hornless rhinoceros, the body hollowed out to hold wine, with a peaked saddle on the back as cover, after a bronze design from the *Po-ku-t'u* encyclopædia." The author translated by M. Julien says that this ware was subsequently successfully imitated at Chingtê-chên, and that the latter surpassed the originals in beauty. Doctor Hirth, however, avers on the authority of native connoisseurs that the pure Lungch'üan products can be distinguished from all imitations; first, because it is a peculiarity of the clay used in the manufacture of the former alone to turn brown or red on the surface when left exposed during baking, while the biscuit remains white where covered; and, secondly, because, owing to this peculiarity of the clay, the ferruginous ring on articles of white porcelain manufactured elsewhere can only be produced by artificially coloring the foot or base; an act which, of course, admits of ready detection on the part of an experienced collector.[1]

KO-YAO OR CHANG-YAO.

Subsequently, after the removal of the court southward in 1127, according to an authority quoted in the Topography of the Chehkiang province, the brothers Chang, natives of Ch'üchow, but having their factory in the Lungch'üan district, gained a high reputation for their porcelain. These brothers are known as Shêng-i, the elder-born, and Shêng-êrh, the second-born. The produce of the former's kiln was called *Ko-yao*, or elder-brother's porcelain, to distinguish it from that manufactured by the younger Chang, which was termed *Chang-yao* or *Chang Lungch'üan yao*, i. e., Lungch'üan porcelain made by Chang (the younger). Both are céladon in color, though the elder brother's ware appears to have been lighter in tint, and both have the distinctive marks of céladon, the red mouth or opening and ferruginous ring on the foot. The main difference between the two seems to have been that the *Ko-yao* was crackled—so closely in the best specimens as to resemble the fish-roe—whereas the *Chang-yao* was uncrackled. In other respects the descriptions are curiously conflicting. The history of the Chingtê-chên factory says that *Ko-yao* was extremely thin, while the *Wu-ts'a-tsu*, a work of the Ming dynasty, speaks of it as the one kind of por-

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 69. F. Hirth, Ancient Chinese Porcelain, pp. 31 *et seq.* S. W. Bushell, Chinese Porcelain before the Present Dynasty. Nos. 12, 16, 23, 25–27, 29, 32, 36, 67, 77.

celain of this epoch "of which it is not too difficult to obtain specimens, owing to its peculiar heaviness, which enables it to last long." As compared with the more ancient porcelain of Lungch'üan, the productions of the two Chang are described as "smaller, more graceful in shape, and showing greater delicacy of workmanship."[1]

CHÜN-YAO.

The *Chün-yao* was a porcelain made from the early part of the Sung dynasty, in the district of Chünchow or sometimes wrongly corresponding to the present district of Yü-chow, in the department of K'aifêng, Honan province. It was sometimes molded in grotesque forms (as a lamp formed of a hornless dragon with scaly body and four short legs, the serpent-like head protruding with mouth open to receive the wick and body hollowed into a receptacle for oil), but was usually modeled after ancient bronzes and ornamented with scroll or floral patterns under the glaze, which, according to Hsiang Tzú-ching, was either vermilion-red or aubergine purple—the two most valuable colors—moonlight white (*clair de lune*) or pale green, and sometimes marked with granulations. The authorities quoted in the *T'ao-shuo*, or Treatise on Pottery, would lead one to believe that the best pieces had two or more colors of glaze on the same vase. The higher quality, according to them, consisted of pieces having a color red like cinnabar and green like onion leaves and kingfisher's feathers, which is commonly called parrot-green, and aubergine purple, or of pieces red like rouge, green like onion leaves and kingfisher's feathers, and purple like ink; these three colors being intact and unchanged by baking. M. Julien enumerates seven varieties: (1) green or blue like plums; (2) purple-brown like the aubergine; (3) red like the *Pyrus japonica;* (4) pig's liver; (5) mule's lungs; (6) mucus; (7) sky-blue. But such differentiation appears erroneous, for the Treatise on Pottery says:

> Pieces that have one or two numbers on the bottom as a trade-mark, and are of a color resembling pig's liver—since the red, *ch'ing* (céladon), and green colors got mixed together like saliva hanging down through not being sufficiently fired—are not to be distinguished as different kinds; for such names as mucus or pig's liver, which are given to this class of porcelain, have been invented for fun's sake. Among these porcelains those which have bottoms like the flower pots in which sword grass is grown are considered the most excellent; the others, namely, those which have ton-shaped censers, Ho-fang jugs, or Kuan-tzŭ, are all of a yellowish sandy paste, for which reason they are not good in appearance.[2]

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[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, pp. xxvi, 70. F. Hirth, Ancient Chinese Porcelain, pp. 31, *et seq.* S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 11.

[2] The translation followed is Doctor Hirth's, but the sense is better brought out by Doctor Bushell's more correct rendering, which runs thus: "Among these porcelains the flower pots and saucers for growing sword grass are the most beautiful, the others, namely, the barrel seats, censers and boxes, square vases and jars with covers," etc. (North China Herald, 12th May, 1888.) The words here rendered, "the flower

The same authority adds that none of these porcelains lasted long. Specimens are, however, I believe, still to be found. Hsiang Tzŭ-ching, after describing a small jar, of globular form, with two boldly designed phœnixes molded in high relief as handles, interrupting a border of spirally ornamented medallions, adds:

Chünchow porcelain is put at the bottom of the Sung potteries, yet a jar like this one, of elegant form, good color, and fine engraved work, equals, if not excels, as a flower vase, one of Ju, Kuan, Ko, or Ting pottery. It is marked beneath with the numeral *wu*, five, an additional proof that it is really a Chün piece.[1]

TUNG-CH'ING-YAO.

Tung-ch'ing-yao, or céladon porcelain, from the eastern capital, was produced at factories situated in the department of K'aifêng, Honan province, the so-called eastern capital of the Sung monarchs, before their retreat southward, from 960 to 1126. It was of various shades of céladon, uncrackled (seemingly), with the ornamentation engraved under the glaze. The description given by Hsiang Tzŭ-ching of a small vessel of this ware will convey a truer idea of its character than the vague disquisition of the encyclopædists.

"It is of hexagonal form, with lobed border, decorated in panels, with formal sprays of flowers, plum blossoms, polyporus fungus, and grass, chrysanthemum, bamboo, etc., carved in relief under a glaze of bright green color like jade, raised in faint millet-like tubercles."[2]

LESS CELEBRATED VARIETIES.

In addition to the above celebrated productions of the Sung dynasty, the following less remarkable varieties may be mentioned:

The *Hsiao-yao*, from the Hsiao district, in the department of Hsüchou, Kiangnan province, extremely thin and brilliant, white in color, and very elegant in shape and workmanship.

The *Chichow-yao*, from the district of that name, corresponding with the present Luling district, in the department of Chi-an, Kiangnan province; both white and violet, the latter closely resembling the

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pots and saucers for growing sword grass," are translated by M. Julien "les plats sous le pied desquels on a peint un glaieul." This misconception of the meaning has, as Doctor Hirth points out, led astray all later writers on porcelain and its marks, who have thus been led by Julien into describing the *acorus* as a mark, when found on the foot of a vessel of its being a Kiun (Chün) piece of the finest quality. Doctor Hirth also draws attention to the fact that the expression *t'u-ssŭ-wên*, translated by Julien when treating of one class of this porcelain as showing "veines imitant les soies (poils) du lièvre," really means showing veining like the *cuscuta* or dodder—*t'u-ssŭ* being the name of that plant.

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 20, 30, 41, 79. S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, pp. 74, 75. F. Hirth, Ancient Chinese Porcelain, pp. 16, 17.

[2] S. Julien, op. cit., pp. 67–69; S. W. Bushell, op. cit., No. 70.

violet porcelain of Tingchow. The best was made by the family Shu; that produced by the daughter, Shu Chiao, realizing almost as much as *Ko-yao* (the elder Chang's porcelain). Her large vases for holding flowers would fetch several ounces of silver each. Regarding the violet variety, the technical annotator of M. Julien's work adds the following note: "Il est probable que ces porcelaines violettes étaient fabriquées à l'état de biscuit, et colorées ensuite avec un émail plombeux coloré par le manganèse. Cette considération reporterait à l'année 960 de notre ère les glaçures plombifères; ce n'est qu'en 1283 qu'un potier de Schlestadt trouva le procédé de vernir la poterie au moyen du plomb, et put créer une fabrication véritablement industrielle."

The *Hsiuchow-yao* and *Ssuchow-yao*, from the districts respectively of the same name in the Kiangnan province. They resembled the (white?) Tingchow porcelain, but were far inferior in quality.

The *T'ang-yi-yao* and *Têngchow-yao*, manufactured in the T'ang and Têngchow districts of the department of Nayang, Honan province—both céladon, but, like the next, inferior to Juchow ware.

The *Yaochow-yao*, from the district of that name in the department of Hsi-an, Shansi province. They were originally céladon, but vases of white porcelain, possessed of considerable merit, though lacking in grace and strength, were subsequently produced.

The *Wuni-yao*, from the department of Chienning, Fukien province—a céladon made from black coarse clay, lacking in polish and with dry looking glaze.

The *Chien-yao*, from the department of Chienchow, the present district of Chienyang, in the department of Chienning, Fukien province—thin, of pale black color and of high polish, it was highly esteemed; some specimens were studded with granulations resembling drops or yellow pearls.

The *Yühang-yao*, from the Yühang district, in the department of Hangchow, Chehkiang province—a kind of céladon, resembling *Kuan-yao*, but inferior, possessing neither the same crackle nor brilliancy.

The *Lishui-yao*, from Lishui district, in the department of Ch'üchow, Chehkiang province—heavy and thick, resembling in color the Lungch'üan (that is, céladon) ware, but far inferior to it.[1]

YUAN DYNASTY, 1260 TO 1349.

Under the Mongol dynasty, the Yüan (1260 to 1349), the manufacture of porcelain generally appears to have retrograded. Exceptions, however, must at least be made in favor of that produced for the special use of the Emperor. This ware—to judge from the specimens

[1] S. Julien, L'histoire et la Fabrication de la Porcelaine Chinoise, pp. 12–21.

described by Hsiang Tzŭ-ching—was white in color, with the ornamentation faintly engraved in the paste. Plates, bowls, etc., are said to have borne the characters *shu-fu*, "the palace," inscribed on the interior on the foot. Hsiang Tzŭ-ching[1] says that this *shu-fu* porcelain was copied from the Tingchow ware of the Northern Sung dynasty, and the vase in his own collection he considers altogether like a Ting piece in its form, in the color of the paste, and in the engraved design.

The details given by native writers regarding the productions of this period are scanty in the extreme. They mention, however, that at Lungch'üan céladons were produced on the model of the Chang ware, but the clay used was coarse and dry, and failed to give the fine color which had characterized the older productions.

At Ho-chow, in the Kiangnan province, P'êng Chün-pao produced, as already stated, some excellent porcelain, known as New *Ting-yao* and from the name of the district in which it was produced, *Ho-yao* or ware of Ho, and closely resembling the older ware from Tingchow. Made from fine, white, plastic clay, it was very thin and céladon in color. Other varieties mentioned are:

The *Hsüanchow-yao*, from the department of that name in Kiangnan province, very thin and white in color.

The *Linch'uan-yao*, from the district of that name in the department of Fuchow, Kiangsi province, was a porcelain made from soft white clay. It was thin, and generally white, with a light yellow tinge; but some bore flowers coarsely painted.

The *Nanfêng-yao*, from the district of that name in the department of Chienchang, Kiangsi province, was a somewhat thick porcelain, in many cases ornamented with flowers in blue. These two latter kinds appear to have been very famous under the Yüan dynasty, and to have been much preferred to the productions of Chingtê-chên.

The *Hut'ien-yao*, manufactured in the neighborhood of Chingtê-chên, was either a yellowish-black, or, if white, had a tint of that color.[2]

No specimens of these wares have, however, so far as I am aware, survived to the present day, and among those which Chinese connoisseurs now declare to be red products of the Yüan dynasty one seldom sees any but such as are of a uniform whitish purple with deep red splashes.

MING DYNASTY, 1368 TO 1649.

Under the Ming dynasty the ceramic art made great progress, both in the fineness of the ware and in the excellence of the decorative workmanship. It would appear that under the Yüan dynasty imperial

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 21.

[2] S. Julien, L'Historie et la Fabrication de la Porcelaine Chinoise, pp. 23, 24, 86.

orders were not invariably executed at the government factories, but were frequently intrusted to private enterprise. None, however, of the articles tendered was accepted unless considered perfect, and the test was so severe that as much as 90 per cent was at times rejected. Under the Ming dynasty, however, the manufacture appears to have been more and more restricted to the Chingtê-chên factories, which thenceforward practically monopolized the production of artistic porcelain. The administration was reformed, and officers were dispatched from the capital with the orders, the execution of which they had to superintend, and on completion to deliver to the palace—duties which, like most others of emolument and dignity, were absorbed by eunuchs during the reigns of the last emperors of that dynasty.

In their paintings, which are always in water color, the Chinese, while of course requiring on the artist's part a knowledge of the technique adequate to a proper treatment of the subject chosen, admire chiefly a boldness of stroke which proves complete mastery over the pencil, and a facility of conception which permits of improvisation, so to speak: that is, of the elaboration of the original design *currente calamo*, and without having previously outlined a sketch of it upon the object to be decorated. This style of painting is termed *pi-i*, "following the will of the brush." An artist who first sketches out his design and then carefully and elaborately fills in the details, a style which is depreciatingly termed *kung-i*, "mechanical," occupies in their estimation a very subordinate position. And the characteristics of the two styles are so clearly defined, or at least are so patent to the practiced native eye, that a single glance almost suffices to enable a connoisseur to determine to which of the two a painting belongs.

In a country, too, where painting as a profession does not exist, and where the interchange of fans or scrolls painted by the donors, as one of the most ordinary forms of courtesy, generates, if not a profound knowledge of the art, at least a very general practical proficiency in it, it has resulted that the most noted artists are to be found among the class enjoying the most leisure—that formed of the successful competitors in the literary examinations which constitute the one entry to official employment. In this way the more highly esteemed style of painting, with its bold free stroke, came to be considered (as indeed it practically was) the almost exclusive production of the literary or official class. Hence when, during the Ch'ênghua period, the decoration of porcelain in many colors came to be that most highly prized, it became customary to have the designs drawn by the most celebrated artists among the palace officials and to transmit them to the manufactory to be there executed by the most skilled painters.

Owing to the care thus exercised in obtaining decorative designs from the brushes of the best artists and in having them executed by the most able workmen, the manufacture reached a higher point of excellence during this (the Ch'ênghua) period than at any other time during the Ming dynasty, and the steps of development which led to this result may be distinctly traced.

As has been remarked earlier, decoration by painting in colors as distinct from the general coloring imparted by glaze was, I believe, first reached under the Ming dynasty. In the Yunglo period (1403 to 1424) it took the form of decoration in blue under the glaze. Special attention was paid to this style during the Hsüantê period (1426 to 1435), and owing probably to the adoption of a special kind of foreign blue (known in Chinese as *Su-ni-po*, which appears to have been obtainable during this period alone), a brilliancy of color was attained which was never afterwards quite equaled. At the same time, however, a brilliant red color attracted universal admiration. At first this was used by itself either as a uniform coloring over the outside of bowls and cups, or for the delineation of fishes or peaches upon the white ground, the contrast of the two colors, both striking in brilliancy, being highly admired. Then a form was adopted which, while it gave due prominence to the highly prized crimson, admitted of the introduction of other colors in a subordinate capacity, such as vessels in the shape of persimmons (*Diospyros kaki*) on a leafy branch forming the handle, the fruit being red, and the leaves and stalk of their natural colors, green of various shades and brown respectively. From this form of decoration it required but a step to reach the use of the enamel colors for which the Ch'ênghua period (1465 to 1487) is famous.

The use of enamel colors continued during the Hungchih period (1488 to 1505), some of the specimens being scarcely inferior to the best pieces of Ch'ênghua ware, but gradually gave way in public favor to a pale yellow glaze covering an ornamentation engraved in the paste. This was also the most highly esteemed production of the Ch'êngtê period (1506 to 1521); though the efforts to obtain further supplies of blue from the west being crowned with success, a revival in favor of "blue and white" china took place during this and especially the following reign till the supply was once more exhausted.

Peculation, misgovernment and its attendant disorders, and an increasing difficulty in finding the finer qualities of clay combined to cause a steady decline from this period onward in the artistic excellence of the porcelain produced. The rapidity of the downward course was considerably accelerated by the enormous extent of the imperial orders for the supply of the palace, which, sometimes aggregating 100,000 pairs of articles on a single occasion, taxed the resources of the government factories beyond their strength, with the result that, in order to economize money and labor, colors which were expensive or difficult to procure were replaced by others less costly and more simple in their ingredients, and artistic beauty and excellence of workmanship were sacrificed to promptness in providing the supplies ordered. It is the gradual dispersion of the articles comprised in the vast orders issued during the Lungch'ing (1567 to 1572) and Wanli (1573 to 1619) periods that has provided the bulk of the specimens in the possession of modern collectors of what has come to be considered (though, in view of the much higher artistic merit of the ware produced under earlier emperors, very unfairly considered) the characteristic Ming porcelain, porcelain somewhat coarse in make, faulty in shape, and decorated with paintings which, though characterized by boldness of design, are usually marked by want of care in execution.

While, however, the work of the government factories showed these unmistakable signs of decadence, strenuous efforts were made by a few isolated private manufacturers to raise the art to its earlier level of excellence. The imitations by Chou Tan-ch'üan of the beautiful old Tingchow ware, and the cups of Hao Shih-chi of a "dewy-dawn red" and of eggshell (the latter at times only weighing one-fortieth of an ounce apiece), are spoken of in terms of the highest admiration, and brought fabulous prices. But though these efforts were, if the statements of Chinese writers can be relied upon, crowned with complete success, so far as the artist's individual productions were concerned, they were inadequate to prevent the downward tendency exerted by the government establishments at Chingtê-chên, which had already for a long while almost monopolized the production of porcelain in China.

During the remainder of the period that the Ming dynasty held the throne its energies were so much occupied in endeavoring to suppress internal disorder and in resisting the attacks of the Manchu Tartars on its northern frontiers that no attention was paid to the ceramic art.

From 1403 to 1424.

During the Yunglo period (1403 to 1424) much white porcelain, with ornamentation in blue under the glaze, commonly known in Europe as "blue and white china," was manufactured, which holds third place in regard to excellence among this class of ware produced during the Ming dynasty, that of the Hsüantê period (1426 to 1435) occupying the first and that of the Ch'ênghua period (1465 to 1487) the second place. The blue employed is said, in the annals of Fouliang, to have been brought from some Mohammedan country as tribute, and was thence known as Mohammedan blue. During the Yunglo and Hsüantê periods it was termed *Su-ma-li* or *Su-ma-ni* blue, and during the latter *Su-ni-po* also. Where this blue came from and whether these Chinese designations are the reproductions of the name of a country or of a color has never been determined. Doctor Hirth, while pointing out the resemblance of the former in sound to smalt (mediæval Latin *smaltum*), and of the latter to Schneeberg, "under which name the Saxon blue afterwards became famous all over the world,"[1] thinks a search into Arabian

[1] F. Hirth, Ancient Chinese Porcelain, p. 65.

or Persian records of that day may yet supply the missing explanation. Whatever it was, the supply was exhausted during the Ch'ênghua period. Somewhat later, however (during the Chêngtê period, 1506 to 1521), Tatang, the governor of Yünnan province, succeeded in obtaining further supplies of Mohammedan blue by paying for it twice its weight in gold; and during this and the greater part of the subsequent reign (Chiaching period, 1522 to 1566) it continued available—a fact to which is doubtless attributable the excellent color of the productions of that time. Towards the close of the latter reign, however, the supply again gave out, when an incinerated cobaltiferous ore of manganese (termed *wu-ming-i*) replaced the western product; the color obtained from this native ore, far from equaling the brightness and transparency of the foreign blue, however, showed a dull and heavy tint after baking.

EGGSHELL PORCELAIN.

Eggshell porcelain of very delicate workmanship was produced, but owing to its extreme fragility good specimens are now difficult to obtain. It appears also to have had a tendency to crack during the process of firing. These porcelains are termed among the Chinese *t'o-t'ai*, or porcelain from which the "embryo" or biscuit has been removed, and are divided into two classes: "True *t'o-t'ai*," the very thin, also known as eggshell (*tan-p'i* or *luan-mu*), and "semi *t'o-t'ai*," the somewhat thicker. The true *t'o-t'ai* especially present great difficulties in the manufacture and require extraordinary dexterity in the handling, for so thin is the portion of the body the workman allows to remain that it seems as though all had been removed; and it is only quite recently that the Government manufactory at Sèvres has succeeded in producing such porcelain, and then by an entirely different process—by casting or *moulage en barbotine.*

The work translated by M. Julien states that while the production of this ware originated during the Yunglo period, it was only the thicker variety that was then made, and that the true *t'o-t'ai* dates from a later epoch, having been produced during the Ch'ênghua period (1465 to 1487) at the government manufactory and during the Lungch'ing (1567 to 1572) and Wanli (1573 to 1619) periods at private factories. This statement appears, however, to be erroneous; for in No. 295 of this collection will be found a specimen, so at least Chinese experts state, of the semi *t'o-t'ai* (though it seems difficult to believe that a bowl of such size could be made much thinner and yet be of practical utility), and in Nos. 289 to 294 specimens of the true *t'o-t'ai*, both having the inscription *Yung-lo-nien-chih*, "Made during the Yunglo period," engraved in the old seal character on its foot. Moreover, the one specimen of this ware described by Hsiang Tzŭ-ching is a small cup "as thin as paper," called *t'o-t'ai*, "bodyless," *i. e.*, true *t'o-t'ai*, *not* semi *t'o-t'ai*, of which he says "there are not a few of these wine cups left, yet they are highly appreciated by collectors of taste." [1] Specimens of the Ch'ênghua eggshell will be found in Nos. 296 to 303.

In spite of the extreme thinness of this ware, many specimens—such as Nos. 289 to 294, already referred to—are adorned with very elaborate designs engraved under the glaze (an operation requiring exceptional delicacy of workmanship), which are scarcely visible unless the vessel be held against the light or be filled with liquid. These specimens possess additional interest from the fact that they enable us to picture to ourselves what the porcelain manufactured for the special use of the palace under the Yüan dynasty (the *Shu-fu*) and the Tingchow ware of the Sung dynasty were like; though, of course, these latter had not the thinness and delicacy of the eggshell porcelain. For Hsiang Tzŭ-ching, after describing a specimen of *Shu-fu* porcelain decorated with dragons in the midst of clouds and with lion's head handles, all faintly engraved in the paste under a white glaze, states that "the porcelain of our own dynasty (the Ming) of the reigns of Yunglo and Hsüantê, decorated with patterns engraved under a white glaze, was made after this *Shu-fu* porcelain, which was itself copied from the Tingchou porcelain of the northern Sung dynasty." [2]

From 1426 to 1435.

Among the porcelain manufactured during the Hsüantê period (1426 to 1435), that covered with crimson glaze or bearing designs in that color holds the highest place in the eyes of Chinese connoisseurs. "It truly stands preeminent among the celebrated porcelains of different dynasties, a precious jewel of our own times," says Hsiang Tzŭ-ching. Some of the descriptions left by this author are worth reproducing. (1) An incense burner from an old bronze design. "The upper two-thirds of the body and the handles, which are molded in the form of fish, are covered with a deep red glaze of rosy dawn tint, the lower part enameled white, pure as driven snow, the two colors mingling in a curved line, dazzling the eyes." (2) A wine pot ($6\frac{1}{2}$ inches high), copied from a similar vessel of carved jade used by the emperor. "The body, slender below, swelling towards the top, is decorated with engraved cloud scrolls and bands of geometrical and spiral pattern, with conical cover, spirally curved handle, and spout moulded and engraved in the form of a phœnix head, all covered with deep-red (*chi hung*) glaze." It is said to have cost the owner 200 ingots of silver in paper notes, a sum Doctor Bushell estimates to be equivalent to about £600.

Another style of decoration much esteemed at the time for open vessels was "three red fish on a white ground pure as driven snow, the fish boldly outlined and red as fresh blood, of a brilliant color

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 61.

[2] Idem, No. 21.

dazzling the eyes." Occasionally these fish would be represented on the outside swimming on waves engraved in the paste, with two more on the inside. Though no less than four vessels so decorated are described by Hsiang Tzŭ-ching, they are stated to have been even then "precious specimens of this rare kind of porcelain"—they are certainly so now.

A rarer kind of decoration still was three pairs of peaches in red on a white ground—of these "only two or three were then known to exist within the four seas," that is, the Empire.

A still rarer decoration, found on a wine cup, is described as "the white ground decorated inside and outside with cloud scrolls engraved in the paste, a scroll border above colored crimson: the handle a dragon of bold design moulded in high relief coiled round the top, with teeth and four claws fixed in the rim, enamelled vermilion red." (Vessels with a dragon moulded in relief upon the brim are, it may be added, always highly esteemed by the Chinese when intact, partly because of the artistic ability required to successfully execute the design, and partly because old specimens are seldom met with undamaged.) "Only one or two of these beautiful little cups remain throughout the Empire, and 100 taels ($150 gold) is not considered too much to pay for a specimen." Hsiang Tzŭ-ching states that the brilliancy of this crimson glaze was obtained by the addition of powdered red gems from the west to the ordinary materials. Doctor Bushell, commenting upon this statement, says "this is impossible, and the colors being painted on under the glaze shows it to have been a copper silicate, the same doubtless that gave the bright red (*hsien hung*) to the monochromes of the period."[1] M. Julien states that among the colors for porcelain painting brought from China by M. Itier (an employé in the ministry of finance, who accompanied the French ambassador to that country) and presented in 1844 to the manufactory at Sèvres, was one named *pao-shih-hung*, "precious stone red," which when analyzed by M. Salvetat proved to be merely "oxyde de fer avec du fondant."[2]

A decoration first met with in the productions of this period is obtained by the entire excision of a delicate pattern, by some sharp instrument, from the biscuit of which the cup or bowl is formed. When the vessel is dipped in the glaze, the latter fills up the excised open work with a thin film sufficiently thick after baking to retain the liquid in the cup, though so thin that the pattern is thrown out as a transparency upon the more opaque body. This decoration is commonly known among English collectors as "lace-work," and the French term pieces so decorated réticulés.

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[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, Nos. 6, 10, 40, 54, 56, 58, 60, 69, 71, and p. 117.

[2] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 91.

From 1465 to 1487.

During the Ch'ênghua period (1465 to 1487) the production of porcelain bearing a blue decoration under the glaze continued, but owing chiefly to the fact that the supply of *Su-ni-po* blue from abroad was exhausted and partly from the growing preference for ornamentation in enamel colors, this ware was inferior in color to that of the Hsüantê period; and it is for the decoration in enamel colors that this period is chiefly and justly famous.

One authority states that among the productions of this period are the most beautiful of wine cups, the upper part of which is adorned with a Chinese peony (*Pæonia moutan*) and having at the base a hen and chickens full of life and movement.[1] Hsiang Tzŭ-ching thus describes a pair:

> They are of rounded form, swelling below, so thin and delicate that one weighs less than a third of an ounce. The cockcombs, narcissus, and other flowers, the flying dragon fly and crawling mantis, painted after life, in green, yellow, and crimson enamel. These are choice specimens of the wine cups of this celebrated reign, and are valued at 100 taels [say $150] the pair, yet now even for this money it is impossible to get them.[2]

Another miniature wine cup described by him is said to have been purchased for 60 ounces of silver ($90), while a pair in the possession of one of the high officers of the court under the Emperor Wanli is said by another writer to have been valued at 1,000 ounces, or $1,500. Whatever may be thought of the last statement, the prices mentioned by Hsiang Tzŭ-ching are fully confirmed by contemporary writers. The Treatise on Pottery (the *T'ao-shuo*) quotes from a work written towards the end of the Ming dynasty as follows:

> On the days of new moon and of full moon I often went, while at the capital, to the fair at the Buddist temple Tz'ŭ-ên-ssŭ, where rich men thronged to look at the old porcelain bowls exhibited there. Plain white cups of Wanli porcelain were several ounces of silver each, those with the marks of Hsüantê and Ch'ênghua were twice as much more, up to the tiny cups decorated with fighting cocks, which could not be bought for less than a hundred ounces of the purest silver, pottery being valued far more highly than precious jade.[3]

From the time of the Emperor Wanli it was the endeavor of every man of taste, whose wealth could support such a strain, to set wine cups of Ch'ênghua ware before his guests. Considering how many pieces of this choice porcelain must have been thus sacrificed, it is not surprising that it is almost impossible to procure specimens at the present day—nearly three hundred years after they were selling at twelve times their weight in gold—though Doctor Bushell states that "one may be occasionally seen in a Chinese collection preserved in an ebony box

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 94.

[2] S. W. Bushell, Chinese Porcelain before the Present Dynasty, No. 59.

[3] Quoted by Bushell, p. 98.

softly lined with padded silk." Four specimens of these cups are contained in the collection—Nos. 300 to 303.

From this period also are supposed to date many of the large vases which form so prominent a feature in the European collections, decorated with historical scenes, in the coloring of which green plays so large a part, and which have in consequence been termed by French writers "la famille verte." They are really, however, more modern. "The finest," as Doctor Bushell truly remarks, "belong to the reign of K'anghsi, so that one of a pair is often found with a Ming mark beneath, the other with a censer, flower, or other emblem (of the K'anghsi period); yet some connoisseurs pride themselves on being able to distinguish the genuine Ming in this class from the false, confessing, however, that it is a difficult matter."[1]

This period is also noted for its eggshell porcelain. It was not, however, invented at this time, but, as we have already shown, first manufactured during the Yunglo period. The four small plates of this ware (Nos. 296 to 299) are worthy of special note, not only for their extreme thinness and transparency, but for the very unusual style of their decoration—landscapes in enamel colors above the glaze.

From 1488 to 1505.

During the succeeding period (Hungchih, 1488 to 1505), while enamel colors were still used, a very pale yellow glaze of the color of a newly husked chestnut was the tint most highly prized, the two kinds of decoration being at times combined. If the uniform yellow glaze was employed, ornamentation would be at times engraved in the paste or molded in relief beneath it. So little is said regarding the ware of this period by Chinese authors that it is worth while recording the descriptions of two choice specimens given by Hsiang Tzŭ-ching: (1) A wine pot "molded in the form of a gourd contracted in the middle, the brown stalk forming the handle of the cover, a winding branch the tapering handle, from which spring green tendrils and leaves and a miniature gourd, all worked in relief in the yellow body, a second miniature gourd being fashioned into the spout. Light yellow was the color most highly valued in this reign, but enamelling in color was also employed, as in this piece, which reminds one of the porcelain of the reign of Ch'ênghua;" (2) a teacup "in the form of a hibiscus flower, covered outside with a delicate yellow glaze imitating the natural tint of the flower; white inside. I have seen many specimens of Hungchih porcelain, but nothing to surpass these little cups."[2]

[1] S. W. Bushell, Chinese Porcelain before the Present Dynasty, p. 99.
[2] Idem, Nos. 7, 42, 46, 66.

From 1506 to 1521.

During the Chêngtê period (1506 to 1521), so far as the meager details chronicled allow us to judge, while decoration in enamel colors continued and the successful endeavors of the governor of Yünnan to obtain further supplies of Mohammedan blue caused attention to be again turned to the production of porcelain ornamented with designs in blue under the glaze, the ware most highly prized was that covered with a yellow glaze, introduced under the previous reign, over patterns engraved in the paste, and a red monochrome termed *chi-hung*. This term appears to have included two shades—one the *pao-shih-hung*, or "precious-stone red" already discussed under the Hsüantê period, (p. 335), and the *hsien-hung*, a bright red, produced by a silicate of copper. This color, the Chinese records state, could not be successfully produced subsequent to this period under the Ming dynasty, owing seemingly to inability to maintain a suitable condition of atmosphere in the kiln—a difficulty explained by M. Salvetat thus:

> Si l'atmosphère du four est trop réductrice, le cuivre passe à l'état de cuivre métallique; si l'atmosphère du four est trop oxydante, la coloration rouge disparaît et la couverte devient verdâtre (*Recueil des travaux scientifiques de M. Ebelmen*, Tome I, p. 437); le protoxyde de cuivre seul donne un silicate d'une couleur rouge.[1]

A curious kind of earthenware is mentioned by Hsiang Tzŭ-ching as having been produced in the Yi-hsing district, of the department of Changchou, Kiangsu province, by a celebrated potter named Kung Ch'un. Teapots of this ware were of a light brown like felt, or covered with a vermilion-red glaze. In either case the color is said to have changed to a bright green when tea was poured in, and to have gradually reverted to its original color, line by line, as the liquid was poured out. This curious peculiarity is said to have been merely the accidental result of some change effected by baking, but was highly prized by collectors—500 ounces of silver ($750) having been paid for the two specimens described by our author.[2]

From 1522 to 1566.

During the Chiaching period (1522 to 1566) the yellow glaze, so particularly affected during the two previous reigns, appears to have been entirely, and decoration in enamel colors to have been almost entirely, abandoned, the old style of ornamentation in blue under the glaze being chiefly admired, till the supply of that color from the west was again exhausted during the later years of this reign; and to the present day the "blue and white" of this period is much sought after by collectors. Apart from this, the only kind of ware at all remarkable

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, p. 97. S. W. Bushell, Chinese Porcelain before the Present Dynasty, Nos. 52, 78.

[2] S. W. Bushell, Idem, Nos. 44, 45.

mentioned by Chinese writers is cups intended for use upon the palace altars, and hence termed *t'an-chan*, which are said to have resembled white jade and to have been exceptionally beautiful. One maker, named Ts'ui, who is stated to have lived during this and the following reign, is however mentioned as a successful imitator of the porcelain of the Hsüantê and Ch'ênghua periods, his productions being known as Ts'ui-kung *yao-tz'ŭ*, "Mr. Ts'ui's porcelain ware."[1]

From 1567 to 1619.

During the Lungch'ing (1567 to 1572) and Wanli (1573 to 1619) periods it appears to have been difficult to obtain supplies of good clay; and this fact, combined with the increasing disorder throughout the Empire and the enormous extent of the supplies ordered for palace use, caused a marked deterioration in the quality of the ware produced, though the workmanship is at times highly spoken of, especially in the case of porcelain decorated in enamel colors—the most highly prized having marks on them resembling "millet grains," or a surface marked as with the pittings on orange peel (*l'apparance chagrinée d'une peau d'orange*).

While, however, the productions of the government factories were marked by an ever-increasing decadence, serious efforts were made by private producers to stay the downward tendency, and two individuals would seem to have won for themselves and their ware a very high reputation. Chou Tan-ch'üan, a native of Wumên, imitated the ancient masterpieces of Tinchow porcelain so successfully that the most expert connoisseurs failed, it is said, to detect the fraud, and willingly purchased them at such enormous sums as 1,000 ounces of silver each ($1,500). Another maker, of unknown origin, but whose name tradition says was Hao Shih-chiu, made cups of "liquid-dawn tint," bright as vermilion, and of egg-shell of a beautiful brilliant white, and weighing in some cases only just over half a pennyweight, or about one-fortieth of an ounce, for which extravagant prices were paid. This all sounds, however, much exaggerated. Other productions of his were céladon vases resembling *Kuan-yao*, or the elder Chang's ware (*Ko-yao*), except that they were not crackled, and vases of a color which the French term *feuille-morte*, or *fond laque*, a brown or coffee tint, derived from ferruginous clay. This artist was known as *Hu-kung*, "Mr. Pots," or *Hu-yin-tao-jen*, "the Taoist hidden in a pot," apparently pseudonyms adopted by him in allusion to an old legend preserved in the *Shên-hsien-chuan*, an ancient work on Taoist immortals, and signed his jars with the mark *Hu-yin-lao-jen*, "the old man hidden in the pot." According to the legend, Hu-kung, the Old Man of the Pot, was a magician, endowed with marvelous powers of healing, who lived

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise pp. 97, 100.

during the third and fourth centuries, and was accustomed to distribute in charity the vast sums he received in payment for his miraculous cures. He disappeared each night from mortal view, his retreat remaining a mystery till he was watched, when it was discovered that the leech was accustomed to withdraw at sunset to the interior of a hollow gourd which hung from a doorpost. Julien translated these characters as *le vieillard ou qui vit dans la retraite;* but, says Doctor Hirth, "it seems to me that these four characters have rather an epigrammatic sense, and if translated into Latin would be among the most delicious of Martial's Apophoreta; for the 'old man,' as the clever maker styles himself, 'is concealed in the pot,' like the fairy Hu-kung was in his, and although invisible, he himself—that is, his inventive genius—is contained in it. It impresses me as the most sympathetic device a ceramic artist could select as a mark."[1]

PRESENT DYNASTY, 1644 TO DATE.

The factories at Chingtê-chên, which had been closed during the last years of the Ming dynasty, were not reopened till the Manchu emperors had firmly seated themselves upon the throne—during the reign of K'anghsi (A. D. 1662 to 1722). He and his two successors, Yungchêng (1723 to 1735) and Chienlung (1736 to 1795), while maintaining the qualities which had enabled their race to gain its high position, at once adopted the civilization of the conquered nation. No less eminent as scholars and statesmen than as able generals, loving the magnificent but no less aiming at practical utility, they set vigorously to work to reform those portions of the theoretically admirable system of government which had been allowed to fall into decay, to improve and beautify the capital and its palaces, to diffuse education and to encourage the fine arts. The factories at Chingtê-chên were not slow to feel the effects of this change of system. The kilns increased rapidly in number, till at the date of P. d'Entrecolles' letters, they aggregated over three hundred in full activity, the fires of which at night so illuminated the hills surrounding the plain in which the town stands, that it seemed as some vast city abandoned to the flames, and over a million souls found a means of livelihood in its busy streets. The production was not characterized by activity alone, however. The ablest artists were employed to paint and to design ornamentation, to enhance the beauty of which they at times availed themselves of foreign ideas; odes from the emperor's pen were reproduced upon vases in facsimile, or short extracts were introduced as subjects for illustration; vases and cups were specially ordered to confer upon distinguished personages, their achievements being epitomized in the paintings which decorated these precious heirlooms (No. 169); the workmen and decorative artists were educated to

[1] F. Hirth, Ancient Chinese Porcelain, p. 72. S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, pp. 99, 103, 104, 206.

a higher level of proficiency; and the direction of the factories was confided to officers who were known to be possessed of the knowledge requisite for such a position. Progress was sure and rapid; and during the seventy-five years between 1698 and 1773—comprising roughly the latter half of K'anghsi's reign, the whole of Yungchêng's, and rather more than half that of Chienlung—the manufacture and decoration of porcelain in China attained a degree of excellence which in my opinion has never been reached, either before or since.

During the early part of K'anghsi's reign (1662 to 1722) green was, as it had been among the later productions of the Ming dynasty—during the Lunghch'ing and Wanli periods of 1567 to 1619—the predominating color employed in decoration, such porcelain being hence termed *la famille verte;* and to this period belongs, in part, much of the ware so decorated, which is usually ascribed to the earlier dynasty and is considered a characteristic Ming porcelain. To the colors applied under the glaze was now added a blue above glaze, which does not seem to have been known under the Mings. During the later years of this reign, however, green gave way to red as the predominating color, and a style of decoration was adopted which has been classed by M. Jacquemart and subsequent writers under the title of *la famille rose.* It is easily distinguished by its half tints and broken colors, having for decorative basis a carmine red lowered to pale rose, and obtained from gold, which is called in Europe purple of Cassius. The addition to their palette of this color, of yellow derived from antimony and of white from arsenical acid, enabled Chinese artists to considerably increase the variety and beauty of their decorations. A director of the government factories named Ts'ang Ying-hsüan is mentioned by Chinese writers as having about this time gained considerable distinction by his productions, which were of thin porcelain, covered with a brilliant, and, in the most highly valued specimens, monochrome glaze. The colors are stated to have been "snake-skin green," "mud-eel yellow," blue, and dappled yellow. Other, but less esteemed, colors were pale yellow, pale violet, pale green, and blue or red, both *soufflé.*

FROM 1723 TO 1796.

Shortly after the accession of Yungchêng, Nien Hsi-yao was, in 1727, intrusted with the direction of the imperial manufactories. He personally selected the materials and superintended the execution of the Emperor's orders. All the articles made by him—which are known as Nien porcelain, *nien-yao*—were graceful in form and of fine workmanship. They were chiefly monochrome in color, blue, bright and carmine reds, céladons, and "of egg color as bright as silver," but some were ornamented with painted flowers, either incised or plain. Some of the monochrome vases, dating from this or a slightly later period, have lately obtained an extraordinary vogue among foreign collectors and bring prices ridiculously above any value to which they could justly lay claim on the score of either rarity, color, or workmanship. A small vase only 8 inches high, of a dull white-pink shade upon an underground of pale sea-green, which has been dignified by the name of "peach blow" (in some specimens this underground forces itself into notice in the form of splotches on the pink), was offered to the writer in Pekin for less than $200 gold, and, having been purchased by a foreign dealer, was eventually sold in New York for $15,000. With Nien Hsi-yao was associated in the management a year later a Manchu officer in the lord chamberlain's office named T'angying, who fifteen years later succeeded to the sole direction. Possessing an intimate knowledge of the different varieties of clay and of the effects of fire upon them and on colors, he exercised the greatest care in the choice of materials, and every article made under his orders was remarkable for delicacy of workmanship, purity of form, and brilliance of coloring. He imitated with wonderful precision the most beautiful of the ancient designs, and his efforts at reproducing the most celebrated glazes were crowned with equal success. In addition, he is credited with the invention of several new styles of decoration, of which the most remarkable were: The use of European blues and violets, a ground of enamel black, white flowers or designs in gold upon a black ground, the French method of painting, and the *yao-pien* or *flambé* style. In a word, "under his direction," Chinese writers state, "the products of the imperial factories attained their highest perfection.[1]"

The work translated by M. Julien distinctly states that the introduction of the black grounds dates from the early part of Chienlung's reign. Treating, as this work does, of events of such comparatively recent occurrence, its reliability would at first glance seem scarcely open to doubt. I am, however, strongly of opinion that the statement is erroneous, and that black grounds originated some decades earlier. I have seen specimens which, the black ground apart, have all the characteristics of the K'anghsi period, and far inferior in delicacy of execution to specimens which were undoubtedly manufactured under the direction of T'angying, such as No. 93 of this collection. The accuracy of the statement in other respects is, however, confirmed by experience. The use of violet, or of magenta with a violet tone, with most happy effect, especially for grounds, is one of the characteristics of this period, while the best blues fully equal anything in that color produced during the best periods of the Mings.

Special attention, as has been seen, was also paid at this time to the production of *yao-pien*, of which Chinese writers distinguish three kinds—two due to celestial agency; one, the *flambé* glaze, to human ingenuity. As regards the latter, oxydulated copper, it is well known, furnishes vitrifiable painting with a fine red. This, thrown in a body on a

[1] S. Julien, L'Histoire et la Fabrication de la Porcelaine Chinoise, pp. 108 *et seq.*

vase, forms the tint called *haricot*, a kind of fawn color; with a further quantity of oxygen of equal amount a protoxide is formed, producing a beautiful green, that may be changed into sky-blue by increasing the oxygenation. The tints upon a vase may thus be modified almost indefinitely by a due regulation at different periods during the process of baking of the currents of air admitted. "When a clear fire placed in a strong current draws a considerable column of air, all the oxygen is not consumed, and part of it combines with the metal; if, on the other hand, thick smoke is introduced into the furnace, of which the carbonaceous mass, greedy of oxygen, absorbs everywhere this gas, necessary for its combustion, the oxides will be destroyed and the metal completely restored. Placed at a given moment in these given conditions, by the rapid and simultaneous introduction of currents of air and of sooty vapors the *haricot* glaze assumes a most picturesque appearance; the whole surface of the piece becomes diapered with veins and streaked colorations, changing and capricious as the flame of spirits, the red oxydulate, passing by violet into pale blue and to the green protoxide, evaporates itself even completely upon certain projections, which become white, and thus furnishes happy accidental combinations."[1] The supernatural changes are either of color, as when a piece of porcelain is taken from the kiln having developed a patch of some new color in a natural shape, or of form, "as when some unusually large slabs were requisitioned by one of the Ming emperors, which were transformed into beds and boats, with equipage complete, and forthwith broken up by the startled potters, as gravely reported by the official in charge by way of excuse for their absence."[2] In the Buddhist temple Pao-kuo-ssŭ in Pekin is a famous *yao-pien* image of Yuanyin, a finely designed figure enamelled in colors, light blue, crimson, yellow, and two shades of brown; of which, in an ode from his pen engraved on the shrine, the Emperor Chienlung says the goddess descended into the kiln to fashion an exact likeness of herself.

The reference to the introduction to "the French method of painting" is of so interesting a nature as to merit more detailed consideration.

The Jesuit missionaries of the seventeenth century gained for themselves a position of dignity and influence beside the Dragon throne such as no foreigner before or since has succeeded in attaining. This position, and a tolerance which saw nothing incompatible with the Catholic religion in the cherished observance of the Chinese—in the payment of official honors to the sage Confucius and in the performance of certain rites in honor of ancestors erroneously termed "ancestral worship"—caused a remarkable spread of Catholicism, which, owing to the labors of Father Ricci and his successors, had already established itself under the Ming dynasty, counting among its members many

[1] Jacquemart, History of the Ceramic Art, translated by Mrs. Palliser, p. 50.
[2] S. W. Bushell, Letter in North China Herald, May 12, 1888.

officials and the consort of the last of the line, who proclaimed himself emperor in the Kwangtung (Canton) province. But Pope Clement XI's bull *Ex illâ die*, confirming an earlier bull on the same subject dated the 4th November, 1704, by deciding that these observances were incompatible with Catholic belief, aroused violent anger on the part of the Emperor K'anghsi and dealt a blow to the missions from which they have never recovered. The Emperor died before the legate specially sent to China to carry out the bull could perform his promise to endeavor to persuade the Pope to modify its terms; and decrees of great severity were issued against Christianity by his successors, Yungchêng and Chienlung, to which Pope Benedict XIV replied in 1742, by issuing a bull deciding this unfortunate question in its narrowest sense. The severity of the imperial decree was, however, mitigated in favor of the missionaries at court—at first Jesuits, and after the dissolution of that order Lazarists; and a European divine continued to be a director of the board of astronomy down to 1814.

The influential position occupied by the Jesuits was both won and maintained chiefly by their high attainments in astronomy, in mathematics, and in geometry. It, however, enabled these able and enlightened representatives of western learning to exercise a considerable degree of influence upon other matters not directly connected with the studies for which they were chiefly famous, but in which their scientific education gave them the power and right to speak with authority. When, therefore, contemporaneously with the enjoyment by them of this position of influence, a style of decoration was adopted for porcelain and enamels for both imperial and general use purely European in its character—not only in the more intimate acquaintance, as compared with previous native drawing, of the laws of perspective displayed, but even in the reproduction of European dress and figures and eminently European scenes and pastimes—it seemed that this could scarcely be mere coincidence. It was more natural to suppose that under the direction of one of these able missionaries a school had been established in connection with the government porcelain factories for instruction in European designs, in European ideas of grouping floral ornamentation, and in the European style of painting generally. Père d'Entrecolles, it is true, makes no allusion in his famous letters to such a school. But, as they were written for the purpose of enlightening the west regarding the composition of the materials and the system of manufacture employed by the Chinese, the use of European designs in the decoration of porcelain might well have been passed over in silence, and the absence of such reference would not necessarily prove that such a school had not existed.

The supposition that some of the Jesuits were at this time more or less intimately associated with the manufacture and decoration of porcelain was supported by the belief, which is still current among Chinese experts, that the secret of the composition of the *sang-de-bœuf* coloring and of its peculiar glaze marked with pittings resembling those noticeable on orange peel (specimens of which are now so highly prized by collectors) was discovered by a missionary, and that its Chinese designation (*Lang-yao* or *Lang* ware) preserves to the present day the first syllable of the inventor's surname.[1] Researches kindly undertaken at my request by Abbe Alphonse Favier, the vicar-general of Chihli province, into the ancient episcopal records and valuable library at Pekin have, however, failed to discover any mention of the establishment under missionary direction of a school for the special purpose of porcelain decoration. Had it existed, the fact would undoubtedly have been chronicled in the records left by such careful and methodical workers as these Jesuit priests were; and the explanation which the existence of such a school would have afforded must therefore be abandoned. Abbe Favier, however, informs me that Brothers Castiglione and Attirer were noted painters at Pekin both of portraits and of landscapes, and that they formed a school, paintings by their pupils having come into his possession. It may, then, I think, be confidently assumed that the imperial family having in the first instance been struck with the beauty of the ornamentation on the enamel watches, snuff boxes, etc., which came to China from France during the reign of Louis XIV, a somewhat similar style of decoration was introduced about 1728, or shortly after, for articles intended for imperial use; and that subsequently the Jesuit brothers, Castiglione and Attirer, were commissioned to execute European designs, which were sent to Chingtê-chên, to be there copied on porcelain. As no article which was not perfect in every detail could be forwarded to Pekin, many of the pieces ordered for the court would then (as now) be rejected by the superintendent of the manufactory, and be retained by him or his subordinates. These would gradually pass into other hands, and, possessing at once the charm of novelty and the merit of being in a style appreciated at court, would serve as models in the decoration of more ordinary ware.

About the same period—that is, during the later years of Yungchêng's reign, which ended in 1735—Ku Yüeh-hsüan, a subordinate officer, I believe, in the directorate of the Chingtê-chên factories, introduced the use of an opaque-white vitreous ware for the manufacture of articles

[1] In China *omne ignotum pro magnifico* is especially true; and, as in the case of the beautiful red coloring of the Hsüantê period, so in the *sang-de-bœuf*, the brilliant tint is commonly believed to result from the use of powdered rubies. The fact that in the list of missionaries of that time I could find none with the surname Lang, caused me to doubt the reliability of this generally accepted explanation; and on expressing my doubts to the late Chang Yen-Moan, for many years a member of the Chinese foreign office and minister to the United States, who was himself an ardent collector of ancient paintings and porcelain, he assured me that the name had no connection with the Jesuits, but was derived from the surname of the governor of Kiangsi province at the time that ware was first made, Lang Ch'ao-t'ing.

of small dimensions, such as snuff bottles, wine cups, vessels for washing pencils in, etc. The vitreous nature of the body imparted a tone and brilliancy to the colors used in the decoration which was greatly admired; and, under the auspices of T'angying, all the artistic and technical skill of the government factory was lavished upon these little gems, which are certainly among the masterpieces, if not *the* masterpieces, of ceramic art in China, being valued more highly than jade by Chinese connoisseurs of the present day. The decoration of the best specimens of this ware will well repay minute study. The choice of groundwork is effective, the grouping of the colors soft and harmonious, the introduction of European figures is interesting, and the arrangement of flowers evidences the highest artistic skill. Nos. 324 to 327 are admirable specimens of this very rare ware. The earliest pieces were marked, usually in red, *ta-ch'ing-nien-chih*, "Made during the great Pure (the Ch'ing or present) dynasty," as in No. 323; the later pieces, during Chienlung's reign (1736 to 1705), had the mark within a square seal-like border, *Chien-lung nien-chih*, "Made during the reign of Chienlung," engraved in the foot, and filled with a thick, bright-blue enamel glaze. It is said that when specimens of this ware were submitted to the Emperor Yungchêng he expressed his high admiration of their beauty, but at the same time a regret that it should not be possible to obtain the same brilliant transparency of color upon the ground of greater purity which was afforded by the best porcelain as compared with the vitreous composition employed. T'angying's energies were immediately devoted toward fulfilling the Emperor's desire, his efforts being certainly crowned with a very large measure of success. He appears to have employed for his purpose a very pure glaze of a highly vitrifiable nature, and to have thereby obtained an enamel brilliancy that no other porcelain shows, and to have also secured to a considerable extent the same soft transparency in the decorative colors which was so much appreciated on Ku Yüeh-hsüan's vitreous ware. The manufacture of this porcelain appears to have been carried on simultaneously with that of the Ku Yüeh-hsüan proper, some dating from Yungchêng's reign and some from Chienlung's. The marks it bears correspond exactly with the later products of vitreous composition, and, indeed, owing to its origin, it is known as *fang-ku-yüeh-hsüan*, "modeled on the pattern of the Ku Yüeh-hsüan." Specimens of this porcelain, which is quite rare, are held in very high esteem by the Chinese, alike for the purity of the paste, the brilliance of the glaze, and the beauty of the decoration, and are considered among the finest productions of the period during which the manufacture attained its highest excellence. Nos. 328 to 336 are good specimens, and afford a fair criterion of the merits of this porcelain.

The three-quarters of a century above mentioned (1698 to 1773) was marked by the production of articles which are masterpieces of Chinese ingenuity and of skillful workmanship. Vases of various forms are fitted with a central ring, which, while it is separate from the vase and movable at will in a horizontal direction, still can not be detached. Other vases there are having the body formed of two shells, the outer portion consisting in part of a geometric design or of bunches of flowers in openwork, revealing a historical representation, or a group of flowering plants beautifully painted upon the inner tube. Others, again, exhibit the peculiarities of both these varieties combined, it being possible to make the openwork exterior revolve, in order to bring to light the painted decoration within, but without possibility of separating it from the vase itself. There are still others of which the exterior shell is divided into two, generally unequal, parts, each having scalloped or lambrequin edges some inches in depth, which fit exactly into one another, but are still movable, though neither can be detached entirely from the internal body. What process was adopted to secure this mobility and prevent the movable section from becoming attached to the other portions of the vase in the process of baking is a mystery which has never as yet, I believe, been satisfactorily explained. The beautiful hexagonal and octagonal lamp shades of delicately thin porcelain, either reticulated or ornamented with paintings and reticulated edges, are productions of this period equally admired and now no less rare than the above.

During Chienlung's reign a considerable change is noticeable in the style of ornamentation—a change undoubtedly brought about by the influence of foreign designs. During the latter portion of the Ming dynasty, though arabesque decoration was known to the Chinese under the title of *huei-huei*, or Mohammedan style, and was also utilized, the ornamentation upon porcelain, when it was not floral in its character or formed of historical or mythological scenes, consisted almost entirely of reproductions of the patterns found upon the brocaded satins of that date. Under the earlier emperors of the present dynasty, though the decoration was marked by greater wealth of detail and by far greater artistic skill than at any previous time, in remained in essential character the same. On Chienlung porcelain, however, it exhibits a decided tendency towards the styles of western decoration, showing in some cases a close resemblance to the foliate ornamentation which plays so important a part in the illumination of mediæval missals, in others to designs which are usually considered Persian or arabesque in their origin. This marked modification is no doubt due in part to the influence of the designs sent from Persia to be copied in China on porcelain ordered from that country, and after their return home to that of the Chinese potters (whom Shah Abbas I, about the year 1600, had invited to Persia, with the object of improving the manufacture of porcelain at Ispahan), and in part to the influence of the Limoges enamels, which had been sent by Louis XIV to the Emperor K'anghsi and which, subsequent to that date, succeeding emperors had obtained from the Jesuit missionaries. These enamels seem indeed to have served as models to be reproduced with fidelity in every detail. For M. du Sartel gives the drawing of a low, open porcelain cup with two handles in the collection of M. Marquis of Paris, which is described as being the exact counterpart of a Limoges enamel, even the signature J. L. (Jean Landrin, an enameller of that town) being reproduced upon the foot.

At about the same period it became customary for nobles and wealthy individuals in Europe to order services of porcelain from China bearing their family arms. Indeed if tradition can be trusted the practice originated two centuries earlier; for the Emperor Charles V (1519 to 1555) is said to have ordered from China a complete service ornamented with his armorial bearings and monogram. The service is supposed to have passed into the hands of the Elector of Saxony after the emperor's withdrawal to Innspruck, and some plates now in the Dresden collection, marked with a double C, inclosing the crowned double-headed imperial eagle, with coat of arms and collar of the Order of the Golden Fleece, are believed by the writers responsible for the above statement to be portions of this service. Judging, however, from the style of decoration, I am of opinion that this belief is erroneous, and that the plates in question were manufactured more than a century later than Charles V's abdication. The French *Compagnie d'Orient et des Indes Orientales*, whose title was shortly afterwards changed to *Compagnie de Chine*, during the short period it existed, 1685 to 1719, brought from China, together with an extensive supply of other porcelains, services specially ordered, bearing the arms of France, of Penthièvre, and of other distinguished families. Some of the services, as, for instance, the plates bearing the arms of England, France, and the provinces of The Netherlands, preserved in the Huis ten Bosch at The Hague, undoubtedly date from the first half of K'anghsi's reign, but the great majority are of later origin, and possess a considerable degree of excellence both as to form and decoration.

From 1796 to 1820.

The truly great monarchs K'anghsi, Yungchêng, and Chienlung[1] were succeeded by Chiach'ing (1796 to 1820), Chienlung's idle and dissolute son, whose administration was characterized by a feebleness hitherto unknown under Manchu rule, and was so detested as to occasion attempts to assassinate the vicegerent of Heaven—a stupendous crime in such a country as China. The porcelain factories, in common with all branches of the Government service, languished under the effects of this want of energy, and little worthy of special mention was manufactured. As the result of the high excellence

[1] Chienlung abdicated in order to escape disrespect to his grandfather by occupying the throne for so long a period as he had reigned.

already attained, good work continued to be performed, but it fell short of what the court had grown accustomed to, and no initiative was taken to attempt originality either in design or decoration.

From 1821 to 1850.

Chiach'ing was succeeded by his second son, who assumed the title of Taokuang (1821 to 1850), a ruler whose good intentions to root out the abuses that had grown up during his father's reign were largely neutralized by natural indolence. His difficulties were, besides, greatly increased by the war with France and England, and the outbreak shortly after of the great T'aip'ing rebellion, which during his reign and that of his son (Hsienfêng, 1851 to 1861) devastated sixteen out of the eighteen provinces of the Chinese Empire, and threatened the overthrow of his dynasty. Notwithstanding these serious causes for anxiety, he found time to devote some attention to the ceramic art, and the porcelain manufactured for his own use, and marked with the designation he gave to his own palace, *Shen-tê-t'ang*, compares not unfavorably with similar productions under Yungchêng and Chienlung, and is at the present day much sought after by Chinese connoisseurs.

From 1850 to 1888.

The productions of his successor are marked by rapid decadence, and the rebels, when they overran Kiangsi province, having entirely destroyed Chingtê-chên and its factories, the manufacture of porcelain ceased entirely.

During the reigns of his son T'ungchih (1862 to 1874) and nephew Kuanghsü (1875 to date) the manufacture has been renewed and great attention paid to its improvement, but it still falls far short of the classic periods of Yungchêng and of Chienlung. Some of the decorations in sepia exhibit considerable artistic merit, and a style of decoration consisting of flowers and butterflies in black and white upon a pale turquoise ground was highly appreciated some fifteen years ago among foreigners. The greatest measure of success has, however, of late years been gained in the reproduction of the *famille verte* decoration of the first half of K'anghsi's reign, and of this ornamentation or of plum blossom on black grounds. So good are these imitations that a practised eye can alone detect the false from the real, and I have known a pair of black-ground vases, only two or three years old, purchased by a foreign dealer for over $1,000, under the belief, no doubt, that they dated from the time of K'anghsi or of Chienlung.

INTRODUCTION OF CHINESE PORCELAIN INTO EUROPE.

M. Brongniart said that porcelain was first introduced into Europe by the Portuguese in 1518. Researches made since the publication of this work in 1844 prove, however, that oriental porcelain was known in

Europe many years prior to that date. In New College, Oxford, is still preserved a céladon bowl mounted in silver richly worked, known as "Archbishop Warham's cup" and bequeathed by that prelate (1504 to 1532) to the college, which was imported into England before the reign of Henry VIII. Marryat, in his history of Porcelain, also mentions some bowls which were given to Sir Thomas Trenchard by Philip of Austria when, after leaving England to assume the throne of Castile in 1505, he was driven back by a storm to Weymouth and entertained there by Sir Thomas. These bowls are said to have been preserved by the Trenchards, and to be of white porcelain decorated with blue under glaze. From M. du Sartel's work we learn that amongst presents sent by the Sultan to Lorenzo de Medici in 1487 were porcelain vases; and that this ware is mentioned about the same time in the maritime laws of Barcelona as one of the articles imported from Egypt. In letters, too, addressed by the Venetian ambassador at the court of Teheran in 1471 to his government frequent mention is made of porcelain; and some decades earlier, in 1440, the Sultan of Babylonia sent three bowls and a dish of Chinese porcelain (*de porcelaine de Sinant*),[1] to Charles VII, King of France, by the hands of a certain Jean de Village, the agent in that country of a French merchant named Jacques Cœur.

Nearly three centuries earlier still, mention is made in an Arabian manuscript, known as the Makrizi Manuscript, in the National Library, Paris, and translated by the Abbé Renaudot, of a service of chinaware, consisting of forty pieces of different kinds, sent with other presents to Nur-ed-din, the Kaliph of Syria, by his lieutenant, Saladin (afterwards the hero of the Crusades), soon after his conquest of Syria, in the year of the Hegira 567 (A. D. 1188). "This," says Mr. A. W. Franks in the catalogue of his own collection, now in the British Museum, "is the first distinct mention of porcelain out of China," but, in common with other writers on the subject, he refers the date of the present to 1171, though that year appears not to correspond with the Mohammedan date mentioned in the original text.

From Chinese sources (the *Ming-shih*, or History of the Ming Dynasty, and the Hsi-yang-ch'ao-kung-tien-lu, or Records of Tribute Missions from the West) we learn that the famous eunuch Chêngho carried Chinese arms as far as Ceylon during the reign of Yunglo (1403 to 1425); that under his successor in 1430 the same eunuch and an associate envoy, Wang Ching-hung, were sent on a mission to Hormuz and sixteen other countries, and that Chêngho dispatched some of his subordinates on commercial ventures to Calicut, on the coast of Malabar, and even as far west as Djiddah, the port of Mecca. "En 1431 ou 1432," says Heyd.[2] "on y vit même arriver plusieurs jonques chinoises

[1]Du Sartel, Histoire de la Porcelaine Chinoise, p. 28.

[2]Histoire du commerce du Levant, II, p. 445, quoting Quatremère's Mémoire sur l'Égypte, II, p. 291.

qui n'avaient pas trouvé à écouler leurs marchandises à Aden dans de bonnes conditions. On les y reçut avec empressement dans l'espoir que leur visite serait le début d'un traffic avec la Chine." The expedition was evidently a large one, and one of its objects was commercial intercourse, porcelain being specially mentioned among the articles with which the vessels were freighted. Porcelain had, however, reached these countries at a far earlier date. Marco Polo, traveling in 1280, mentions the trade in this ware from Quinsai, the present Hangchou, and from Zaitun, a port on the Fukien coast, which has been identified with Ch'üanchou (better known as Chinchew) by Klaproth and other writers, whose view has been adopted by Colonel Yule in his magnificent edition of that famous traveler's voyages, and with Changchou and its port, Geh-Kong (a short distance south from Chinchew, and inland), by Mr. George Philips, of Her British Majesty's consular service in China. And Ibn Batuta, an Arabian traveler, who wrote in 1310, states distinctly that "porcelain in China is worth no more than pottery is with us; it is exported to India and other countries, from which it is carried even to our own land *Maghreb*," that is, the sunset, the name given by the Arabs to all that part of Africa which lies to the west of Egypt.

ROUTE FOLLOWED.

Chinese history fully confirms the above statement, and, indeed, shows that this commerce had already long existed at the time Ibn Batuta wrote. In a gigantic compilation of the works of earlier authors undertaken during the reign of Yunglo (hence termed the *Yung-lo-ta-tien*), the manuscript of which was presented to the throne in 1407, is preserved "an account of the countries fringing the Chinese border" (*Chu-fan-chih*), written by Chao Ju-kua, who was inspector of foreign trade in Fukien during the Sung dynasty. As the author speaks of the time of Mohammed "as twenty-nine generations, or six or seven hundred years ago," his work would seem to have been written during the first half of the thirteenth century; but as he mentions a tribute mission sent by the Arabs to China in the K'aihsi period (1205 to 1208), probably later than the latter date. The compilation was, however, considered too extensive and the printing was never completed, though the more important works relating to periods preceding the Yüan dynasty were reedited and published by the Emperor Chienlung. One of these was Chao Ju-kua's work. It contains much valuable information regarding the Arab trade of the twelfth century, and, as it takes Chü'anchou (Chinchew) as the starting point from which all voyages start and distances are computed, it appears to support Klaproth's identification of Marco Polo's Zaitun with that town. From this work it is evident that a large and valuable trade was carried on between China and Brni in Borneo, with *Chanch'êng*, comprising a portion of Cochin China, with Cambodia (*Chênla*), with Java (*Shè-po*), with *San-po-ch'i*, which another Chinese work, the *Ying-hai-shêng-lan*, states to be another name of Palembang (*Po-lin-pang*) in Sumatra—at which latter place the products of China and countries south of it were stored up for barter with Arab traders for the goods of Europe, India, west Asia, and Africa—and with Lambri, on the northwest coast of the same island. Occasionally Chinchew junks proceeded onward to Coilom, a well-known seaport (the present Quilon) on the coast of Malabar, which is described under the name of Lampi; but as a rule it would seem that the trade westward was in the hands of the Arabs, and Chao Ju-kua mentions, indeed, incidentally that a family from Malabar was established in the southern suburb of Chinchew itself. From this point the goods were carried to Guzerat (*'Huch'a-la*), as part of the country of Lampi, and thence to the Arab colony in Zanzibar (*ts'êngpa*, Cantonese *ts'ang pat' ts'ang par*). Porcelain is distinctly mentioned among the principal articles carried away from China by the vessels to each of these ports and to Ceylon.[1] The correctness of this author's statements has lately been confirmed in a striking manner. Sir John Kirk, during his residence in Zanzibar as consul-general, formed a collection of ancient Chinese céladon porcelain, some of the specimens having been dug up from ruins, mixed with Chinese coins of the Sung dynasty.

Indeed it seems very probable that porcelain was sent at least as far west as India in the tenth century, or even earlier; for commercial relations between China and Sumatra are stated to have existed from the T'ienyu period (904 to 909) of the T'ang dynasty, and the name Sar baza, or Palembang, was known to Arab traders of that time, as we learn from translations of their travels by Renaudot and Reinaud. They were also acquainted with Chinese porcelain, for mention is made by one of them, Soliman by name, who visited China toward the middle of the ninth century, "of a very fine clay in that country, of which vases are made having the transparence of glass; water can be seen through them."[2] Indeed earlier, during the eighth century, Arab writers mention the presence in the Persian Gulf of fleets of large Chinese junks.

At that date the Arab trade with China was evidently extensive, and the colonies of Arabs at Canton and at Canfu, the port of Quinsai (the present Hangchow), very large. They are said to have been so numerous at the former place in the eighth century as to have been able to attack and pillage the city. While at Canfu the Soliman above referred to (the manuscript account of whose travels was written, says his commentator, Abu Zaid Al Hasan, in A. D. 851)

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[1] F. Hirth, Ancient Chinese Porcelain, pp. 45 *et seq.*

[2] Reinaud's translation, p. 34, quoted by M. du Sartel.

mentions the fact that "a Mohammedan held the position of judge over those of his religion, by the authority of the Emperor of China, who is judge of all the Mohammedans who resort to those parts. Upon festival days he performs the public service with the Mohammedans, and pronounces the sermon or kotbat, which he concludes in the usual form, with prayers for the Sultan of Moslems. The merchants of Irak—that is, Persia—who trade thither are no way dissatisfied with his conduct or administration in this port, because his decisions are just and equitable and conformable to the Koran." And the commentator on these travels, Abu Said Al Hasan, who probably wrote earlier in the tenth century, when speaking of the interruption then recently caused in "the ordinary navigation from Siraf to China," says this to have been occasioned by the revolt of "an officer who was considerable for his employment, though not of royal family," named Baichu. He laid siege to Canfu in the year of the Hegira 264 (A. D. 885). "At last he became master of the city, and put all the inhabitants to the sword. There are persons fully acquainted with the affairs of China, who assure us that, besides the Chinese who were massacred on this occasion, there perished 120,000 Mohammedans, Jews, Christians, and Parsees, who were there on account of traffic. The number of the professors of these four religions who thus perished is exactly known, because the Chinese are exceedingly nice in the accounts they keep of them."[1]

Apart, however, from the sea route, porcelain might possibly have followed the course of the overland traffic through central Asia, the use of which can be traced back to a very remote antiquity, some authorities claiming that there are indications of communication by this route between China and the West so early as 2698 B. C., and that in 2353 B. C. an embassy arrived in China from a country which is supposed to have been Chaldea.[2] There is, therefore, nothing impossible in the claim put forward that a small ivory-white plate having uncut emeralds and rubies, set in gold filigree, let into paste, and the Chinese word *fu* (happiness) marked on the foot in the seal character under the glaze, now in the royal collection at Dresden, was brought into Europe by a crusader of the twelfth century; provided, of course, the paste, glaze, etc., correspond with those which characterize the porcelain manufactured in China about that date or prior to it.

KIND OF PORCELAIN CARRIED WESTWARD.

What then was the porcelain that participated in this early trade? Chao Ju-kua, in the single instance, in which he alludes to its color, states it to have been "white and *ch'ing*, or céladon." It would almost necessarily have consisted of strong, coarse ware, in order to resist the

[1] Harris's Collection of Voyages (764), I, pp. 523 and 530.

[2] Sir Charles Wilson's Address before the Geographical Section of the British Association, Bath, 1888.

chances of breakage consequent upon the many transshipments incidental to these long voyages in the rude craft of those early ages, and to allow its sale at the comparatively cheap rates at which it was disposed of in Ibn Batuta's day. Colonel Yule has thought that during the Yüan dynasty it probably came from the Chingtê-chên manufactories, but this scarcely seems probable, for the *T'ao-shuo*, or Treatise on Pottery, says that no porcelain was then made there, except by imperial order and for the court. Zaitun—whether Chinchew, Changchow, or "the Amoy waters" (Doctor Douglas's compromise between the two)—as the headquarters of the western trade, would naturally receive supplies for export of *Kuan-yao* and of *Ko-yao* (both céladon in color) from the not far distant factories at Hangchow and Lungch'üan, respectively, as well as from the more distant factories, most of the productions of which were at this time also céladons. And céladon porcelains bearing all the distinctive characteristics of the Chinese manufactures of that nature have been discovered in almost all parts of the then Mohammedan world and in the countries visited by the early Arab traders.

Mr. Carl Bock, speaking in his Head Hunters of Borneo of the Dyak, says:

> Among his greatest treasures are a series of *gudji blanga*, a sort of glazed jar imported from China, in green, blue, or brown, ornamented with figures of lizards and serpents in relief. These pots are valued at from 100 florins to as much as 3,000 florins (£8 to £240) each, according to size, pattern, and, above all, old age, combined with good condition. According to native legend, these precious vases are made of the remnants of the same clay from which *Mahatara* (the Almighty) made first the sun and then the moon. Medicinal virtues are attributed to these urns, and they are regarded as affording complete protection from evil spirits to the house in which they are stored. A very full account of the various legends connected with these *gudji blanga* is given in Mr. W. T. H. Perelace's most interesting work *Ethnographische Beschreibüng der Dyaks*, pp. 112–120.[1]

Mr. Bock saw Doctor Hirth's collection of Lungch'üan céladons, and found in it pieces resembling the ware preserved by the Dyaks,

[1] The possession of these vessels by the Dyaks, their use and value, are also chronicled by earlier travelers. The belief in the efficacy of porcelain vessels to detect poison in liquids contained in them is of ancient date and not confined to Asia alone, though the manner in which the porcelain was affected by the presence of poison appears to have varied in different cases. Thus, Guido Pancirolli, the learned jurisconsult and antiquary of Padua (d. 1599), and his editor, Salmutti (Guidonis Pancirolli, J. C., claris. rerum memorabilium libri duo; ex Italico Latiné redditi et eotis illustrati ab Henrico Salmutti, Antwerp, 1612) say that the presence of poison caused the porcelain either to break or to change color; while Dumont, in his Travels in Turkey, 1699, says that it caused the liquid to effervesce in the center while it remained cool near the vessel itself, the Turks, owing to this property, preferring porcelain to silver as the material of dinner services. Salmutti mentions the presentation to himself of one of these vessels by an Austrian prince, and Paul Hentzner (Itnerarium Galliæ, Angliæ, Italiæ, 1616) says he saw some of them in the Farnese Palace at Rome.

but specimens are, it appears, common among them which bear no resemblance to any of the celebrated monochrome wares of the Sung and Yüan dynasties, a fact Doctor Hirth would explain by supposing that "they came from factories equally old, but less renowned, such as the place where the *Chien-yao* of the Sung dynasty was made, the city of Chien-yang in the north of Fukien, which is all the more likely since Chao Ju-kua, in his description of the trade with Borneo, specially mention 'brocades of Chien-yang' among the articles of import there."[1]

A controversy has, however, recently arisen as to whether the céladon vases found throughout the Mohammedan world are really of Chinese origin at all. Professor Karabacek, an Arabic scholar of Vienna, maintains that the "large, heavy, thick, green céladon dishes with the well-known ferruginous ring on the bottom, which have been found spread over all the countries of Arab civilization," are not of Chinese origin, basing his theory mainly on the statement made by Hâdschi Chalfa, an encyclopedist who died in 1658, that "the precious magnificent céladon dishes and other vessels seen in his time were manufactured and exported at Martaban, in Pegu." The Arab designation Martabani is applied by Professor Karabacek to the thick, heavy céladons. It would, however, appear to have been also applied to a variety of entirely different character.

Jacquemart, in his History of the Ceramic Art, quotes Chardin's Voyages en Perse as follows: "Everything at the King's table is of massive gold or porcelain. There is a kind of green porcelain so precious that one dish alone is worth 400 crowns. They say this porcelain detects poison by changing color, but that is a fable; its price arises from its beauty and the delicacy of the material, which renders it transparent although above two crowns in thickness," and then adds: "This last peculiarity has a great importance. It is impossible to suppose travelers would here allude to the sea-green céladon—this, laid upon a brown, close paste approaching stoneware, is never translucent. In the *martabani*, on the contrary, a thin, bright, green glaze is applied upon a very white biscuit, which allows the light to appear through. * * * Its name leaves no doubt of its Persian nationality. Martaban (*Mo-ta-ma*) is one of the sixteen states which composed the ancient Kingdom of Siam; it would not be impossible, then, that we must restore to this kingdom the porcelain mentioned in the Arabian story."

No porcelain, however, is known to have been made at Moulmien (Martaban), Bangkok, or Burma, and the burden of evidence is strongly against Professor Karabacek's contention of a non-Chinese origin for the *martabani* or céladon porcelain. Probably the designation *martabani* was applied to this ware in much the same manner as

[1] F. Hirth, Ancient Chinese Porcelain, p. 50.

"Combronware" was applied in England after 1623 to porcelains brought from China to that port on the Persian Gulf, and purchased there for shipment home by the factory of the India Company before it extended its operations to China (when these products came to be termed "Chinaware"), or in the same manner that "Indian China" is applied in America to porcelain shipped from Canton, and with as much reason.

Indeed, M. du Sartel, in accord with most other writers on the subject, maintains that no true porcelain was produced in Persia at all, and that the designation of such ware *Tchini* not only means that the earliest specimens and mode of manufacture were of Chinese origin, but that they one and all actually came from China. The Persians, it is true, manufactured a kind of ware which has been designated "Persian porcelain," but it was of so soft a nature that it could be not only scratched, but actually cut, with a knife, and was entirely distinct from hard, kaolinic porcelain. The supplies of the latter were, M. du Sartel maintains, derived entirely from China, to which country models, shapes, and special kinds of ornamentation were sent for reproduction, a custom which sufficiently explains the presence of a Persian name, or the word *fermaïche* ("by order"), written in Arabic characters, upon porcelain of undoubtedly Chinese origin.

This opinion requires, I apprehend, further investigation prior to its acceptance as fact. It is, however, recorded that Shah Abbas I, a great patron of all the arts, about the year 1600 invited a number of Chinese potters to establish themselves at Ispahan for the sake of introducing improvements in the manufacture of porcelain. Though several new methods were adopted, and though a new style of decoration, half Chinese, half Persian, was largely used for a long period after the arrival of these potters, it is generally admitted that no hard porcelain resembling that of China was even then produced in Persia. And one can not help being struck by the strong similarity, amounting practically to identity, between the vases contained in the cases devoted to so-called Persian porcelain in the Dresden collection and certain other vases in the same collection which are classed as Chinese.

CHINESE AND EUROPEAN SYSTEMS OF MANUFACTURE COMPARED.

Whatever the variety of the Chinese porcelain was which constituted so important a factor in this early Arab trade, and whatever the date at which it made its first appearance in Europe, specimens of it had, prior to the beginning of the second half of the seventeenth century, found a place in the collections of princes alone. About that time, however, Chinese porcelain became more generally known, and the fine quality of the glaze, its transparency, and the brilliant style of its decoration excited universal admiration. Strenuous efforts were at once made on all sides to discover the secret of its manufacture, but these researches, though resulting indirectly in other discoveries and in great progress in the European manufacture, were not crowned with success. They had, in fact, led to the creation, in France and England, of soft porcelain, which, if in some respects superior to the Chinese porcelain from a decorative point of view, was also more fragile and more easily scratched than the latter. This soft porcelain was made in France, at St. Cloud perhaps about 1695, at Chantilly in 1735, at Vincennes in 1740, and at Sèvres in 1756; and in England, at Chelsea in 1745, at Derby in 1748, and at Worcester in 1751. Recourse was then had to the Jesuit missionaries in China, with the result of obtaining the valuable letter from P. d'Entrecolles, dated 1712, supplemented ten years later by further details. The difficulty incident to translating technical Chinese expressions, combined with want of acquaintance with chemistry on the part of the author, as well as the primitive condition of that science more than one hundred and fifty years ago, prevented the practical use of the information supplied by P. d'Entrecolles. An attempt was made to secure the knowledge desired by obtaining specimens of the materials employed. The fact, however, that these were sent either in a partially fused state or in the forms of several almost impalpable powders mixed together prevented a recognition of their real nature.

What it had been impossible to learn by direct inquiry was, however, discovered by chance. In 1718 Bottger found an important bed of white and plastic clay in Saxony, and with it made the first "hard" porcelain manufactured in Europe. The government had this bed carefully guarded, imposed oaths of secrecy upon the staff employed, had a strict account kept of all the clay taken out, and transported it under armed convoy to Albrechtsburg, the place of manufacture, which was converted into a veritable fortress. In spite, however, of these precautions the secret leaked out in course of time, and with it the clay also, to Vienna and St. Petersburg. Later, in 1765, Guettard discovered in France the kaolin of Alençon, and Macquer, three years later, found the remarkable beds of Saint-Yrieix.

The History of the Porcelain manufactories at Chingtê-chên, translated by M. Julien, containing as it does a detailed account of the procedure followed there, permits a comparison between the systems employed in China and in Europe. In view of the interest attaching to such a comparison no apology is needed for the following brief notes on that subject, based chiefly upon the preface to M. Julien's work from the pen of M. Salvetat, a member of the directory of the government manufactory at Sèvres:

COMPOSITION OF PORCELAIN.

Porcelain is composed of two parts—the one, infusible, the paste (*pâte*), which is required to supply the body of the vessel, or, as the

Chinese term it, to give it "bone;" the other, fusible, the glaze (*glaçure*, *couverte*), which imparts its characteristic transparency to porcelain and at the same time prevents the vessel retaining its porousness or contracting under the influence of heat.

The principal ingredients of the paste are clays, which are classed according to their greater or less degree at the same time of plasticity and fusibility. The porcelain clay *par excellence* is kaolin, a white aluminum silicate produced by the decomposition of granitic or feldspathic rocks, almost infusible, and if not always perfectly white by nature, losing its tint in the kiln. It derives its name originally from that of the hill whence the manufactories at Chingtê-chên procured their supply of this clay. The main object of the glaze is, as has been said, while securing transparency, to prevent the paste remaining porous. Now, the substances unaffected by water but fusible by fire are quartz, silica, certain limestones, pegmatite, feldspar, silex, and the compounds resulting from a superficial fusion of these substances, which are then reduced to a fine powder. The relative proportion of these substances in the composition of the glaze may be raised at will with a corresponding diversity of result—M. Brogniart dividing the compound into three classes, each subdivided into three groups.

In ordinary language porcelain is classified under two grand divisions, hard paste and soft paste—*la pâte dure* and *la pâte tendre*. The latter is characterized by the presence, either naturally or artificially, of limestone products or alkalies, either in the condition of phosphates or in that of marl or chalk, which lower its degree of fusibility, so that it becomes fusible or at least soft at a temperature of 800° C. The absence of these matters in the hard paste causes it to retain its original consistency in far greater heat, and it can resist a temperature of 1,500° C., or above. Upon these two divisions are grafted several minor ones determined by the kind of glaze, which, according to its composition and mode of application, is termed *vernis*, *émail*, or *couverte*. After unglazed tiles and bricks, the primitive thin glaze, *vernis*, is found on the pottery of the Etruscans, ancient Arabs, Persians, and the early inhabitants of America; then, on that manufactured in Germany and Italy in the fourteenth century, a sort of transparent glass with a foundation of lead—a glaze still common in country productions. Later, in the fifteenth century, the true white enamel, *émail*, a mixture of salt, of lead and tin, the thickness of which concealed the color of the paste, was discovered in Italy and gained immortality for Luca della Robbia, of Florence, and Oragio Fontana, of Pesaro. In this category also belong the majolicas, faenza, the faiences of Nürnberg, Bernard Palissy's pottery, the faiences of Nevers, Rouen, and other places, ancient and modern. The *couverte* is confined to porcelain proper.

Crude Chinese kaolin, when cleansed by washing out its impurities, and ready for use in making the paste, gives a very white clay, soft to the touch, possessing a plasticity very similar to that of Saint Yricix, which is derived from decomposed pegmatite. The residue left by the washing contains a good deal of quartz, crystals of feldspar partially decomposed, and flakes of mica, as would be found in graphic granite. Analysis shows that the fusible portion consists chiefly of petrosilex and, by its composition and density, closely resembles the rock found in abundance at Saint Yricix, which, without addition, furnishes the glaze for hard porcelain at Sèvres.

The composition of Chinese and of the most celebrated of European porcelains may be compared in the following table:

[Average of six analyses.]

Constituents.	Chinese.	Sèvres.	Foecy.	Paris.	Limoges.	Vienna.	Saxony.
Silica	69.20	58.00	66.20	71.90	70.20	57.70	58.10
Alumina	22.60	34.50	28.00	22.00	24.00	36.80	36.70
Oxide of iron	1.60	....	0.70	0.80	0.70	0.70	0.70
Lime	0.65	4.50	Trace.	0.80	0.70	1.60	0.70
Magnesia	Trace.	....	Trace.	....	0.10	1.40	0.40
Alkalies	5.60	3.00	5.10	4.50	4.30	1.80	3.40
Total	....	100.00	100.00	100.00	100.00	100.00	100.00

Thus, generally speaking, Chinese porcelain contains more silica and less alumina than do the products of the manufactories of Sèvres, Vienna, and Saxony, respectively. The effect of the presence in greater or less degree of these components is well known by the Chinese, who say that to produce fine porcelain the ratio of alumina must be increased; to produce the commoner kinds that of silica must be increased. In Europe experience has taught the same results. The porcelain of commerce shows much the same composition as do the specimens of Chinese analyzed by M. Salvetat, also presumably ordinary ware and not the finest grades intended for imperial use, while in the three government establishments mentioned a larger ratio of alumina is introduced, because it resists high temperatures and is therefore necessary to enable the designs painted to maintain their sharpness of outline. In some cases the Chinese also employ ferruginous kaolins, which sensibly diminish the value of the manufactured article.

SHAPING THE PASTE.

In China the paste is roughly shaped, is turned, and is moulded when in a malleable state, in much the same manner as in Europe. Casting or *moulage en barbotine* appears to be unknown in China. The absence of this process, which has enabled European artists to produce such grand results, only increases our admiration of the manual dexterity which has enabled the Chinese to manufacture such numbers of jars of large dimensions and cups so thin as egg-shell porcelain, which can now, or could at least when M. Salvetat wrote, only be produced at Sèvres by casting. The sculpture, the hollowing out, the shaping, etc., are practiced also in China in much the same manner as in Europe. Among the happiest effects produced in this line are engraving in the paste, sculpture in relief on the paste, and the open work which the French term *pièces réticulées*.

One peculiarity of the Chinese system is the method of completing the foot in the unbaked state and after being covered with glaze. This custom of laying on the glaze before the article has been completed, the method in which the glaze is applied, and the composition of the glaze present, perhaps, the greatest contrasts with the corresponding manipulations employed in Europe. It is certainly curious that the Chinese after a practical experience extending through so many centuries should be ignorant of the advantages to be derived from submitting the article to a slight baking before applying the glaze, which is then in a condition termed by the French *l'état dégourdi*. Porcelain earth, like other clays, is dilutable by water, but it ceases to be so after exposure to a temperature which makes it red. On this property is based, in Europe, an expeditious and easy method of covering porcelain with glaze. The porcelain having been rendered indissoluble and absorbent by a preliminary slight baking, it may be covered with a uniform layer of suitable thickness by a simple immersion in water holding the finely crushed material in suspension, provided that the proportions of water and glaze (relatively to the thickness of the vessel to be covered) have been duly determined. The failure to employ this process is the more curious since, from Mr. Hoffman's sketch of the Japanese system of manufacture appended to M. Julien's work, it appears that in that country the glaze is applied to porcelain after preliminary baking.

GLAZE.

In Europe porcelain glaze is generally composed of pure pegmatite, finely crushed and applied by immersion after a preliminary baking. In Germany other substances, such as kaolin or paste, have been added to diminish its fusibility, but at Sèvres pegmatite from Saint Yrieix is alone used. The addition of lime in forming the glaze is a rare exception in Europe. In China, on the contrary, pure petrosilix is but very seldom used for this purpose. The greater part of Chinese and Japanese porcelains is covered with compound glazes, obtained by a mixture of substances of which the proportions vary according to the nature of the article, lime being the material added to the petrosilix to render it more easily fusible; and, in some cases, the ratio added is so large that it represents a fourth of the total weight. In the preparation of the glaze, the use of fern leaves is sometimes mentioned. The residue of the leaves after burning appears, however, to be cast aside, and what purpose these leaves exactly served has never been determined.

As regards the manner of applying the glaze the Chinese, as has been shown, are ignorant of the method of subjecting the porcelain to a preliminary baking and then utilizing the want of porousness thus gained to immerse the vessel in the liquid glaze. Instead, they apply it by aspersion and immersion or by insufflation. For example, take a cup. It is held by the outside slanting over a basin containing the liquid glaze. Sufficient of the glaze is then thrown on the inside to cover the surface. This is aspersion. The outside is then immersed in the liquid, the workman dexterously keeping the vessel in equilibrium with the hand and a small stick. The foot having remained in its original state, the cup is then carried, covered as it is with glaze, to the wheel that the foot may be hollowed and finished; a mark in color is added on the hollowed portion, which is then covered with glaze. When the ware is too delicate to be treated in this manner, the glaze is applied by insufflation. A piece of gauze attached to a hollow tube having been plunged in the colored glaze (red or blue) or uncolored glaze, the workman scatters the liquid from the gauze on to the vessel by blowing through the opposite end of the tube three, four, or even as many as eighteen times.

BAKING.

The porcelain being then ready for baking, it is taken to the kilns, which are usually situated at some distance from the workshops and belong to persons whose sole occupation is to superintend the baking. The large pieces are placed one by one in a separate seggar made by hand, covers being dispensed with by piling the seggars one on another. Several of the smaller pieces are placed in the same seggar, the floor under each being covered with a layer of sand and kaolin refuse to prevent adhesion. The porcelain being still in a soft state, great care must be exercised in placing it in its seggar. It is not touched, therefore, with the hand, but transferred into the seggar by an ingenious contrivance of cords and sticks. The bottom of the kiln is filled with a thick layer of gravel on which the seggars are piled, those under the chimney, the two seggars at the bottom of each pile, and that at the top being left empty, as their contents would not be thoroughly baked. The finest pieces are placed in the center, those with harder glaze at the entry near the hearth, and the coarsest farthest in. The piles are strongly bound together, and, the stacking of the oven being completed, the door is bricked up. From the description given of the kilns by P. d'Entrecolles it appears that they are much the same as those used in early times at Vienna and Berlin.

After the baking begins a low fire is kept up for twenty-four hours, which is then followed by one more powerful. At the top of the kiln are four or five small holes covered with broken pots, one of which is opened when it is thought the baking is completed, and by means of pincers a cage is opened to test the condition of the porcelain. The baking ended, firing is stopped and all openings closed during a period of three or five days, according to the size of the pieces, when the door is opened and the articles removed.

To bake porcelain decorated with soft colors or *du demi-grand feu* two kinds of kilns are used—one open, the other closed—the former of which bears a close resemblance to the enameler's kiln (*moufle*). This kind of furnace has been used in Germany to bake painted porcelain; but even in China the liability to breakage confines its use to articles of small size. The large pieces are baked in closed kilns, the general arrangement of which resembles that of the kilns known as moufles, but being circular in form, they are really porcelain kilns of small size.

DECORATIONS.

In the decoration of European porcelain one of three methods is followed: (*a*) The use of paste of different colors; (*b*) the introduction of the coloring matter in the glaze; (*c*) the application of the colors upon the white surface of the porcelain. The two former methods require the application of a temperature as high as that necessary to bake the porcelain; they are therefore termed colors *du grand feu*. The third method requires for the vitrifaction of the colors a much lower temperature; the colors used are therefore termed *de moufle*, or of the enameler's furnace. It is the use of this latter system which permits the reproduction with exactness of the works of celebrated oil painters.

The substances employed in the decoration of porcelain in China may be divided into two similar categories, colors *du grand feu* and *de moufle*.

Colors du grand feu.—The varieties of the grounds in these colors have played probably as important a part in the high reputation gained by Chinese porcelain as have the originality and rich harmony of the designs. The *blue* decoration under the glaze is made with the brush on the unbaked porcelain, the coloring matter being peroxide of cobaltiferous manganese, the shade, dark or light, depending on the quantity used, and the greater or less trending toward violet on the richness of the ore in cobalt. It resists the fire well, retaining great distinctness and at lower temperatures than are necessary at Sèvres. *Céladon* and the *red* grounds, at times showing an orange, at others a violet shade, had not been successfully reproduced in Europe when M. Salvetat wrote in 1855, and he considered their production in China as due rather to accident than design. The justice of this view is, however, perhaps open to question, for the Chinese appear to have at least an empirical knowledge of the conditions necessary to produce these colors, though they are unable in all cases to ensure those conditions. The *fond laque* or *feuille morte* is obtained by the use of oxide of iron, the amount of that metal and the nature of the gas surrounding the vessel in the kiln determining the tone of the color from a light shade to one resembling bronze, and warmth of color being obtained by an oxidizing atmosphere. *Black* grounds are produced in a variety of ways, either by the thickness of the colored glaze, or by laying several shades of different colors one on the other, or, again, by laying a blue glaze on a brown *laque*, or *vice versa.*

M. Salvetat writes that among the colors for the ground employed in China some are evidently applied upon the biscuit; that is, porcelain already fired at a high temperature. These are *violet*, *turquoise blue*, *yellow*, and *green*, all containing a pretty large proportion of oxide of lead; and, vitrifying as they do at a medium temperature, hold a place half way between the two main categories and may be therefore termed colors *du demi-grand feu*. Nothing approaching these colors, he says, is produced in Europe. To do so, however, would not be difficult, the green and turquoise blue owing their colors to copper, the yellow to lead and antimony, and the violet to an oxide of manganese containing but little cobalt.

Colors de moufle.—In Europe these colors are obtained by mixing one oxide or several metallic oxides together with a vitreous flux, the composition of which varies with the nature of the color to be developed. That most generally used is termed "the flux for grays." It serves not only for grays, however, but also for blacks, reds, blues, and yellows, and is composed of six parts of minium, two parts of silicious sand, and one part of melted borax. The colors are obtained by mixing by weight one part of metallic oxide with three parts of the flux, so that the composition may be expressed thus:

Silica	16.7
Oxide of lead	50.0
Borax	8.3
Coloring oxides	25.0
	100.0

In cases where, as with oxide of cobalt, the colors are produced by mixture with the flux and ought to have the required shade when applied, the metallic oxides are melted with the flux prior to use; in those, however, where the desired color is that inherent in the oxide, the tone of which would be changed by a double exposure to fire, as is the case with reds derived from iron peroxide, the union with the flux by melting is dispensed with. The colors so made suffice to permit the reproduction on porcelain of oil paintings; but it is essential that they all melt at the same temperature and after baking present a sufficient and thoroughly uniform glaze.

In Chinese decorations these conditions, insisted upon in Europe, are both absent. Some colors, such as the rose tints derived from gold, the blues, greens, and yellows, are brilliant, thoroughly melted, and so thick as to stand out above the general level of the surface: others, such as the reds derived from iron and the blacks, are much thinner, and are almost always quite dull or only slightly glazed when thin. The style of painting in Chinese differs entirely from the European. In the majority of the specimens the forms and flesh are not modeled: strokes of black or red define the outlines; the tones do not shade; the colors are laid in flat tints on which a damask is sometimes drawn afterwards, either in the same or in different colors, but the mixture on the palette of different crushed colors, which permits of so much variety in European painting, appears not to be practiced by them. Their colors (as indeed seemed probable from the lightness of the shades obtained, in spite of their thickness before analysis had confirmed the presumption) contained far less coloring matter than do the European, a peculiarity which makes them approach nearer to the vitrified substances known as enamel than to any other. They are characterized by great simplicity and a considerable degree of uniformity.

The flux, which is not distinct in color, is always composed of silica, of oxide of lead in but slightly varying proportions, and of a larger or smaller quantity of alkalies (soda and potash). This flux contains in dissolution, in the conditions of silicates, some hundredths parts only of coloring oxides. The number of these is very small, being oxide of copper for greens and bluish-greens, gold for the reds, oxide of cobalt for the blues, oxide of antimony for the yellows, and arsenical acid and stannic acid for whites. Oxides of iron to produce red and oxides of impure manganese to produce black are not used, because no doubt these colors can not be obtained from the oxides named by means of dissolution.

In Europe, in addition to the oxides already mentioned, important results are obtained from substances unknown in China. The shade derived from pure oxide of cobalt is modified by mixing with it oxide of zinc or alumina, and sometimes alumina and oxide of chromium; pure oxide of iron gives a dozen reds, shading from orange-red to very dark violet; ochers, pale or dark, yellow or brown, are obtained by the combination in different proportions of oxide of iron, of oxide of zinc, and of oxide of cobalt or nickel; browns are produced by increasing the amount of oxide of cobalt contained in, and blacks by omitting the oxide of zinc from, the composition which gives the ochers. The shades of yellow are varied by the addition of oxide of zinc or of tin to render them lighter, and of oxide of iron to render them darker. Oxide of chromium, pure or mixed with oxide of cobalt or with oxides of cobalt and of zinc, gives yellow-greens and bluish-greens, which may be made to vary from pure green to almost pure blue. Metallic gold supplies the purple of Cassius, which may be changed at will into violet, purple, or carmine. Other useful colors are obtained from oxide of uranium and from chromate of iron, of barium, and of cadmium.

In European colors all these coloring matters are merely mixed. In the Chinese the oxides are, on the contrary, dissolved. This peculiarity, no less than their appearance, closely connects the Chinese colors with "enamels." Both present the same coloring, obtained from the same oxides and a composition of flux very similar, sometimes identical. Transparent enamels are vitreous compounds, the composition of which varies, according to the amount of fusibility required, and which are colored by a few hundredths of oxides. Blues are supplied by oxide of cobalt, greens by protoxide of copper, reds by gold. Opaque enamels, yellow or white, owe their color and opacity either to antimony or to arsenic or stannic acids, together or alone. It had, however, been found impossible to utilize these enamel substances in the decoration of European porcelain, owing to the fact that they scaled off; and when the Chinese colors (as sent by MM. Itier and Ly) were experimented upon at Sèvres, they did precisely the same thing. When placed upon Chinese porcelain, however, they developed at a temperature below that used at the Sèvres manufactory for retouching flowers, and did not scale. The explanation is no doubt to be found in the fact that the paste of Chinese porcelain being more fusible than the European, the glaze must also be more easily fusible, and the lime introduced into it to increase the fusibility adapts it in some manner for closer union with the compounds forming the enamel.

If, then, the appearance of Chinese porcelain differs from that of European productions, if the harmony of their paintings offers greater variety, it is the necessary result of the process employed in China. All the colors used contain but little coloring matter and have no worth unless applied in a depth which gives their paintings a relief impossible to obtain by other means. The harmony of their decoration results from the nature and composition of their enamels.

Summary of collection.

	Specimens.
Porcelains:	
Sung dynasty (A. D. 960–1259)	1, 2
Yüan dynasty (A. D. 1260–1349)	3
Ming dynasty, Yunglo (A. D. 1403–1424)	4
Hsüantê (A. D. 1426–1435)	5–9
Ch'ênghua (A. D. 1465–1487)	10, 11, 134
Ch'êngtê (A. D. 1506–1521)	12
Wanli (A. D. 1573–1629)	13–25, 171–175
Ching or present dynasty, K'anghsi (A. D. 1662–1722)	26–84
Yungchêng (A. D. 1723–1735)	85–170
Chienlung (A. D. 1736–1796)	176–288
Chiach'ing (A. D. 1796–1820)	337–344
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Eggshell porcelain:	
Ming dynasty (A. D. 1403–1649)	289–303
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Vitreous (Ku Yüeh-hsüan) ware and porcelain reproductions of it	323, 336
Snuff bottles	345, 376–416
Bronzes	417–434
Lacquer and ivory	435–438

CATALOGUE.

1. *Small dish for washing pencils*, square, with upright sides, of white Sung dynasty (A. D. 960 to 1259) porcelain, coarsely crackled. Height, ¾ inch; diameter, 2⅜ inches.
2. *Low vase for washing pencils*, square, with sides bellying outwards from mouth downwards, having two four-footed lizards with long, curled tails moulded in relief cramped on rim, and heads looking into trough, of white Sung dynasty porcelain covered with stone-colored glaze. Height, 1½ inches; diameter, 3 inches and 3½ inches.
3. *Plate* of white Chünchow porcelain (*Chün-yao*) of Yüan dynasty (A. D. 1260 to 1349), covered with glaze of duck's-egg blue, of lighter tint at edge and brim, from which glaze has run, with large irregular splotches of claret red, shading into purple at edges, where it mixes with blue color of the body. Diameter, 7¾ inches.
4. *Low dish* of white porcelain with openwork edge formed by intersecting circles; decoration *inside*, six medallions, of dragons' *fêng huang*, and formal designs joined by conventional foliage; *outside* a light pattern in blue. Mark on foot, *Ta-ming-yung-lo-nien-chih*, "Made during the Yunglo period (1403 to 1424) of the Ming dynasty;" style of decoration and of writing in the date-mark shows it, however, to be of Japanese manufacture. Diameter, 9⅝ inches.

The *lung* or dragon is the chief of the four Chinese supernatural beasts, the other three being the *fêng huang* (usually translated phœnix), the *ch'ilin* (usually translated unicorn), and the tortoise. It is usually represented with scowling head, straight horns, a scaly, serpentine body with four feet armed with formidable claws; along the length of the body runs a line of bristling dorsal spines, and on the hips and shoulders are flame-like appendages. The claws appear to have originally numbered three on each foot, but the number has in subsequent ages been increased to five. The *Shuo-wên*, a dictionary published in the second century A. D., states that of the three hundred and sixty scaly reptiles the dragon is the chief. It wields the power of transformation and the gift of rendering itself visible or invisible at pleasure. In spring it ascends to the skies and in autumn it buries itself in the watery depths. The watery principle in the atmosphere is essentially associated with the *lung*, but its congener, the *chiao-lung*, is inseparably connected with waters gathered upon the surface of the earth. A denizen of such waters is also the variety *p'an-lung*, which does not mount to heaven. There is also a species of hornless dragon—the *chin-lung*. Kuan Tz'u (seventh century B. C.) declares that "the dragon becomes at will reduced to the size of a silkworm or swollen till it fills the space of heaven and earth. It desires to mount, and it rises till it affronts the clouds; to sink, and it descends till hidden below the fountains of the deep." The early cosmogonists enlarged upon the imaginary data of previous writers, and averred that there were four distinct kinds of dragons proper—the *t'ien-lung* or celestial dragon, which guards the mansions of the gods and supports them so that they do not fall; the *shên-lung* or spiritual dragon, which causes the winds to blow and produces rain for the benefit of mankind; the *ti-lung* or dragon of earth, which marks out the courses of rivers and streams; and the *fu-ts'ang-lung* or dragon of hidden treasures, which watches over the wealth concealed from mortals. Modern superstition has further originated the idea of four dragon kings, each bearing rule over one of the four seas which form the borders of the habitable earth. The *huang-lung* or yellow dragon is the most honored of the tribe; and this it was, which, rising from the waters of Lo, presented to the eyes of Fuhsi the elements of writing (see No. 36). The dragon, as chief among the beings divinely constituted, is peculiarly symbolical of all that pertains to the Son of Heaven—the Emperor, whose throne is termed *lung-wei*, the dragon seat, and whose face is described as *lung-yen*, the dragon countenance (see Mayer's Chinese Readers' Manual No. 451). At his death the Emperor is believed to be borne by dragons to the regions of the blessed. The dragon thus intimately associated with the Emperor is always depicted with five talons on each claw, and it is he alone, properly speaking, who can use such a device upon his property; the dragon borne by the princes of the blood has but four talons on each claw. The distinction, however, is not at present rigidly maintained, and the five-clawed dragon is met with embroidered on officers' uniforms.

"In Chinese Buddhism," says Dr. Anderson, in his Catalogue of Japanese and Chinese Paintings in the British Museum, "the dragon plays an important part, either as a force auxiliary to the law, or as a malevolent creature to be converted or quelled. Its usual character, however, is that of a guardian of the faith under the direction of Buddhas, Bôdhisattvas, or Arhats. As a dragon king it officiates at the baptism of S'âkyamuni, or bewails his entrance into Nirvâna; as an attribute of saintly or divine personages it appears at the feet of the Arhat Panthaka, emerging from the sea to salute the goddess Kuanyin, or as an attendant upon or alternative form of Sarasvâti, the Japanese Benten; as an enemy to mankind it meets its Perseus and St. George in the Chinese monarch Kao Tsu (of the Han dynasty) and the Shinto God, Susanò no Mikoto. * * * As to the origin of the relation of the cobra to Indian Buddhism, there appears to be little doubt that the Cobra kings represented a once hostile Scythic race of serpent-worshipers which first invaded India in the seventh century B. C., and that a subsequent alliance with portions of the foreign tribes gave rise to the stories of converted Nâgas and o' Nâgas who defended the faith. When the religion made its way into China, where the hooded snake was unknown, the emblems shown in the Indian pictures and graven images lost their force of suggestion, and hence became replaced by a mythical but more familiar emblem of power. The multiplication of the cobra head seen in the Âmravâti topes becomes lost in Chinese Buddhism, but perhaps may be traced in the seven-headed dragons and serpents of Japanese legend. The high position occupied by the dragon in Chinese imagination may perhaps be a relic of ancient serpent worship in that country. Illustrations of the identity of the dragon and serpent in Japanese art and the portrayal of creatures in transitional forms between the two are suggestive of such an origin."

Fêng, the name of the male, and *huang*, of the female, of a fabulous bird of wondrous form and mystic nature, the second among the four supernatural creatures. The compound of the two, *fêng-huang*, is the generic designation usually employed for the bird, and is frequently translated "phœnix." One writer describes it as having the head of a pheasant, the beak of a swallow, the neck of a tortoise, and the outward semblance of a dragon, to which another version adds the tail of a fish, but in pictorial representations it is usually delineated, as here, as a compound of a peacock and a pheasant, with the addition of many gorgeous colors. Very early legends narrated that this bird made its appearance as a presage of the advent of virtuous rulers, whose presence it also graced as an emblem of their auspicious government. It sat in the court of Huang Ti, who is credited with having entered upon a reign of one hundred years in B. C. 2697, while that sovereign observed the ceremonial fasts; and, according to the Classic of History, it came with measured gambolings to add splendor to the musical performances conducted by the great Shun (B. C. 2255 to 2206). The five colors of its plumage are supposed to be typical of the five cardinal virtues. As the *lung* or dragon has become the emblem of the Emperor, so the *fêng-huang* has become that of the Empress.

5–8. *Tea-cups* (4), with everted rim, of pure white, thin Hsüantê (1426 to 1435) porcelain, with very delicate flower pattern, from which the paste has been excised and replaced by thin film of glaze to render it capable of holding liquid. Beautiful specimens of this style of decoration generally known in English as "lace-work"—the *pièces réticulées* of the French. Mark on foot *Ta-ming-hsüan-tê-nien-chih*, "Made during the Hsüantê period of the Ming dynasty."

9. *Small fish-bowl* of Hsüantê white porcelain, with ornamentation of *mang* or unhorned dragons with pointed head among very conventional clouds, and geometrical pattern above running round brim, all incised in paste below a palegreen or céladon glaze. Mark on foot *Ta-ming-hsüan-tê-nien-chih*, "Made during the Hsüantê period of the Ming dynasty." Height, 6⅞ inches; diameter, 8 inches.

The *mang* would appear to be properly a huge serpent or boa constrictor. In paintings, however, and in sculpture it is usually represented as a lizard having a scowling head, with a beard at times depending from the chin, and four feet bearing claws but without talons. On the *mang-p'ao*, *i. e.*, *mang* robe, the court dress, no *mang*, properly speaking, appears, its place being taken by a four clawed or taloned dragon.

10. *Tall vase*, in shape of bag, with long neck bound around with a ribbon tied in bow, of Ch'ênghua (1465 to 1487) white porcelain covered with a yellow-black glaze. Height, 13¼ inches; diameter, 7⅝ inches.

11 *Slender vase* of pure white Ch'ênghua porcelain; decoration, immortals or genii engaged in literary contests and attended by servants in rocky valley, with bamboo thickets painted in bright blue under glaze. Mark *Ta-ming-ch'êng-hua-nien-chih*, "Made during the Ch'ênghua period of the Ming dynasty." Height, 10¼ inches.

134. *Pencil-holder*, circular in shape and very broad, of white Ch'ênghua porcelain; decoration, which is in beautiful shade of blue under transparent glaze—a long poem from the pen of the celebrated poet Li Tai-po, of the Sung dynasty, inculcating the epicurean philosophy, which may be summed up in Horace's words, *Carpe diem, quam minime credula postero.* The advice contained in the poem is being put into practice by a merry party round the festive board, whose actions seem to express the words of the Latin author, *Fruamur bonis quæ sunt; pretioso vino et unguentis nos impleamus, non prætereat nos flos temporis.* No mark. Height, 6 inches; diameter, 6⅛ inches.

12. *Small bowl* to hold flowers or water for use on ink slab, of white Ch'êngtê (1506 to 1521) porcelain, covered outside with milky blue glaze, inside plain, coarsely crackled inside and out. Mark *Ta-ming-chêng-tê-nien-chih*, "Made during the Ch'êngtê period of the Great Ming dynasty." Height, $2\frac{3}{4}$ inches; diameter, $4\frac{1}{2}$ inches.

13. *Jar*, of *potiche* shape, of Wanli (1573 to 1619) white porcelain; decoration, flying *fêng huang* and dragons (see No. 4), with flowers between, and above a border of formal pattern, resembling inverted spearheads; cover has small pattern running round it with dragon on top; ornamentation throughout is engraved in paste and of bright yellow upon a vivid green ground. Mark *Ta-ming-wan-li-nien-chih*, "Made during the Wanli period of the Great Ming dynasty." Height, $6\frac{3}{4}$ inches; diameter, $6\frac{1}{8}$ inches.

14, 15. *Bowls* (2), with scalloped brim, of white porcelain decorated with red and gold plum-blossoms, alternating with gourd-shaped vases having a decoration in gold on a blue ground or formal flowers, resembling pinks and chrysanthemums in white, red, and gold, or all gold, upon a salmon-colored ground, with long twisted ribbons attached, the decoration passing from outside over the brim to inside, where at bottom, confined by a double circle, is a blue dragon in white, green, and red clouds. Round foot on outside is small pattern. Marked as last, but decoration and caligraphy of date mark show the ware to be of Japanese manufacture. Height, $3\frac{1}{8}$ inches; diameter, $7\frac{3}{8}$ inches.

16, 17. *Jars* (2), circular in shape, the walls rising perpendicularly, of Ming dynasty porcelain, decorated with iris and leaves boldly outlined in relief and covered with thick glazes of different colors, the flowers being yellow and the leaves peacock-green upon a deep aubergine ground; brim green, with a formal panel pattern outlined in relief round neck and colored alternately with same deep glaze (yellow and peacock-green), inside thin peacock-green glaze. Good specimen of this highly-prized ware. No mark. Height, $6\frac{1}{4}$ inches; diameter, $6\frac{3}{4}$ inches.

18. *Jar* of white porcelain of Ming dynasty, of either Hsüantê (1426 to 1435) or Ch'ênghua (1465 to 1487) period. Decoration, Pei-tow (the Northern Pole star) and Nan-tow (the Southern Pole star) playing chess on mountain road, with boy bearing a bundle of dry branchlets, and an inscription in seal character, "Among the hills a thousand years seem but as seven days." Landscape and figures in beautiful deep blue under glaze and in pale and dark green enamel colors. Above, a formal pattern encircles the jar below the neck, round which are small sprays of flowers in brick-red with leaves alternately green and blue.

This represents the well-known legend of Wang Chih, who, having wandered in the mountains of Ch'üchow to gather fire-wood, came upon two aged men, the Southern Pole star, the genius of longevity, and the Northern Pole star, the genius of death, intent upon a game of chess. He laid down his ax and watched their game, in the course of which the former handed him something resembling a date-stone, which he was told to place in his mouth. No sooner had he tasted it than he became oblivious of hunger and thirst. After some time the donor turned to him and said, "It is long since you came here; you should go home now." Whereupon Wang Chih, proceeding to pick up his ax, found that the handle had moldered into dust. On reaching his home he found that centuries had elapsed since the time when he left it for the mountains, and that no vestige of his kinsfolk remained. Retiring to a retreat among the hills he devoted himself to the rites of Taoism, and finally attained to immortality.[1] Wang Chih is stated to have lived under the Chin dynasty in the third century B. C. The appearance of this South Pole star is supposed to announce peace throughout the world.

19, 20. *Jars* (2) with covers, of the small *potiche* shape, of pure white porcelain, with paintings in deep, dull blue under glaze, of children playing in garden and plucking flowers from the trees; cover ornamented with children, similarly painted, in grotesque attitudes playing. A reproduction of a popular Chinese painting, the Po-tzŭ-t'u, "Drawing of (*lit.* a hundred) Children." Mark on foot, a leaf, which makes these specimens date from the K'anghsi period (1662 to 1722), though the color is rather that of the Ming dynasty. Height, 10 inches.

21. *Wine-pot* of creamy white Ming dynasty Chienning porcelain (*Chien-yao*), termed by the French *blanc de Chine*. Tall, circular in shape, tied at center with ribbon. Spout formed by lizard with four legs and branching tail, which clings to rim and turns head outward, the wine issuing from its mouth. The handle is formed by a similar animal twisting head downward from rim to center of vessel. Has closely-fitting cover, surmounted by a knob formed of a diminutive lizard curled into the form of a ball. No mark on foot. Height, 9½ inches; diameter, 3½ inches.

22–24. *Seals* (3) of creamy white Ming dynasty Chienning porcelain (*blanc de Chine*), one large and two smaller, cubes in shape, each surmounted by a lion as handle boldly molded in relief, with long, straight mane and tail, and curly hair down back. Nos. 22 and 24 represent a lioness with one cub. No mark. Height, Nos. 22 and 23, 2¾ inches; No. 24, 3 inches; diameter, Nos. 22 and 23, 1⅝ inches; No. 24, 1¾ inches.

25. *Pencil-holder*, tall, circular in shape, of pure-white Ming dynasty porcelain, formed of sprays of lotus flowers and leaves admirably molded in relief and covered with lustrous, transparent glaze, the spaces between the flowers and leaves being excised to form open-work. No mark; bottom unglazed. Height, 3¾ inches; diameter, 2⅛ inches.

171. *Pencil-washer* of white Ming porcelain, of globular form, with low, open neck, and a handle on either side formed of a grotesque lion's head molded in relief. Decoration consists of six genii riding on a sword, a carp, a tiger, a hat, a bunch of sticks, and a dragon, painted in a deep blue through brick-red waves under glaze. Round neck and foot a narrow band of white studded with blue spots. Mark *Ts'ai-hua-t'ang*, the designation of a portion of some princely palace not yet identified. Height, 2⅞ inches; diameter, 3½ inches.

The sage riding the waves upon the sword is Lü Fung-pin, stated to have been born A. D. 755. While holding office as magistrate of Tê-hua, in modern Kiangsi, he is said to have met the immortalized Chung-li Ch'üan, who instructed him in the mysteries of alchemy. On his subsequently begging to be allowed to convert his fellow-countrymen to the true belief, he was, as a preliminary, exposed to ten temptations, which he successfully resisted. He was then invested with the formulas of magic and a sword of supernatural power, as the Taoist legends relate, with which he traversed the Empire during a period of four hundred years, killing dragons and ridding it of divers kinds of evils. In the twelfth century temples were erected to his honor under the title of Ch'un Yang. (Mayers, No. 467.)

[1] Mayers, Chinese Reader's Manual, No. 794.

He of the carp is Kin-Kao, "a sage who lived in northern China about the twelfth century. It it said that he wandered over the province of Chihli for two centuries, and then, taking leave of his disciples with a promise to return by a certain day, he plunged into the river. When the appointed time for his reappearance arrived, the pupils, with a great multitude, assembled upon the banks, and, having duly bathed and purified themselves, made offerings to him. At length, in the sight of ten thousand persons, he sprang from the water riding upon a carp. After tarrying with his friends for a month he again entered the river and was seen no more."[1]

The sage on the tiger is perhaps Chü Ling-jen, a rishi of marvelous powers.

He on the bundle of sticks is perhaps Damma, son of a king in southern India, "who," says Mr. Anderson in his catalogue, p. 511, "was the first Chinese patriarch. He arrived in China A. D. 520, and established himself in a temple in Loyang. During nine years of his stay there he remained buried in profound abstraction, neither moving nor speaking, and when he returned to consciousness of his surroundings his legs had become paralyzed by long disuse. In the *Butsu-zo-dzu-i* it is said he came to Japan A. D. 613, and died on Mount Kataoaka. The Chinese, however, maintain he died and was buried in China, but that three years after his death he was met traveling toward India, with one foot bare, and when his tomb was opened by the Emperor's order it was found empty save for a cast-off shoe."

The dragon genius is Ch'ên Nan, a sage possessed of supernatural powers to cure the sick, transmute metals, travel enormous distances, etc. Passing through a place where the inhabitants were praying for rain he stirred a pool where he knew a dragon lived, with a long iron pole. So plenteous a downpour at once ensued that all the rivers were filled.

172–175. *Plates* (4 small) of white Ming dynasty porcelain, decorated inside, the genius of longevity accompanied by the spotted stag, amid waves and clouds in deep blue upon brick-red waves. On the outside are the eight immortals venerated by the Taoist sect, in blue on vermilion waves. Mark as on last. The decoration shows them to have been intended to hold sweetmeats during birthday ceremonies.

The eight immortals venerated by the Taoists are Chung-li Ch'üan, Chang Kuo, Lü Tung-pin, Ts'ao Kuo-ch'iu, Li Tieh-kuai, Han Hsiang-tz'u, Lan Ts'ai-ho, and Ho Hsien-ku. Though some, if not all, of these personages had been previously venerated as immortals in Taoist legends, it would appear from the *K'ê-yü-ts'ung-k'ao* (chap. 34) that their defined assemblage into a group of immortalized beings can not claim a higher antiquity than the Yüan dynasty—that is, the end of the thirteenth or beginning of the fourteenth century.

Chung-li Ch'üan is reputed to have lived under the Chow dynasty (B. C. 1122 to 256). Many marvelous particulars are narrated respecting his birth and career, in the course of which he met Tung Hua Kung, the patriarch of the Genii, "who revealed to him the mystic formula of longevity and the secret of the power of transmutation, and of magic craft." He was eventually permitted to join the Genii, and has appeared from time to time as the messenger of Heaven. He is usually represented as a martial figure with a sword.

[1] Anderson, Japanese and Chinese Paintings in British Museum, p. 236.

Chang Kuo is said to have flourished toward the close of the seventh and middle of the eighth century. Leading an erratic life, he performed wonderful feats of necromancy. His constant companion was a white mule which could carry him thousands of miles in a single day, and which, when he halted, he folded up and hid away in his wallet. When he again required its services, he spurted water upon the packet from his mouth and the animal at once resumed its proper shape. According to Taoist legend, the Emperor Hsüan Tsung, of the T'ang dynasty, repeatedly urged him to visit his court and assume a priestly office there, but the ascetic wanderer rejected every offer. He is reputed to have entered immortality about 740 A. D. without suffering bodily dissolution. He is usually represented conjuring his mule from a wallet or gourd, or holding an instrument of music.

Lü Tung-pin said to have been born A. D. 755. While holding office at Tê-hua, in modern Kiangsi province, he is reputed to have met Chung-li Ch'üan (see *ante*) among the Lu Mountains, and was instructed by him in the mysteries of alchemy and the magic formula of the elixir of life. Having expressed a desire to convert his fellow-men to the true belief, a series of temptations, ten in number, was imposed upon him as a preliminary. These he successfully overcame, and was thereupon invested with the formulas of magic and a sword of supernatural power, with which he traversed the Empire during a period of four hundred years, slaying dragons and ridding it of various kinds of evils. In the twelfth century temples were erected to him under the title of Ch'un Yang. Like Chung-li Ch'üan, he is usually depicted as of martial bearing, armed with a sword.

Of Ts'ao Kuo-ch'in little is known. He is reputed to have been the son of Ts'ao-pin, the great military commander, who largely contributed to the establishment of the Sung dynasty upon the throne of China, and the brother of the Empress Ts'ao of the same dynasty. He would thus have lived in the eleventh century. He is usually represented as a military officer, holding a pair of castanets.

Li T'ieh-kuai, or T'ieh-Kuai-Hsien-Shéng, *i. e.*, "Li of the Iron Staff," or "the gentleman of the Iron Staff." His birth is assigned to no precise era; his name, however, is stated to have been Li, and he is described as of commanding stature and of dignified mien. He was entirely devoted to the study of Taoist lore, his instructor having been the philosopher Lao Tz'u himself, who for that purpose descended at times from Heaven and at others summoned his pupil to his celestial abode. "On one occasion, when about to mount on high," says the legend as given by Mayers (No. 718), "at his patron's bidding the pupil, before departing in spirit to voyage through the air, left a disciple of his own to watch over his material soul (*p'o*), with the command that if, after seven days had expired, his spirit (*hun*) did not return, the material essence might be dismissed into space. Unfortunately at the expiration of six days the watcher was called away to the deathbed of his mother, and, his trust being neglected, when the disembodied spirit returned on the evening of the seventh day it found its earthly habitation no longer vitalized. It therefore entered the first available refuge, which was the body of a lame and crooked beggar whose spirit had at that moment been exhaled, and in this shape the philosopher continued his existence, supporting his halting footsteps with an iron staff." Li T'ieh-kuai is, in consequence, usually depicted as a lame and ragged beggar exhaling his spiritual essence in the form of a shadowy miniature of his corporeal form, or conjuring five bats, symbolical of the five kinds of happiness (see No. 27) from a gourd.

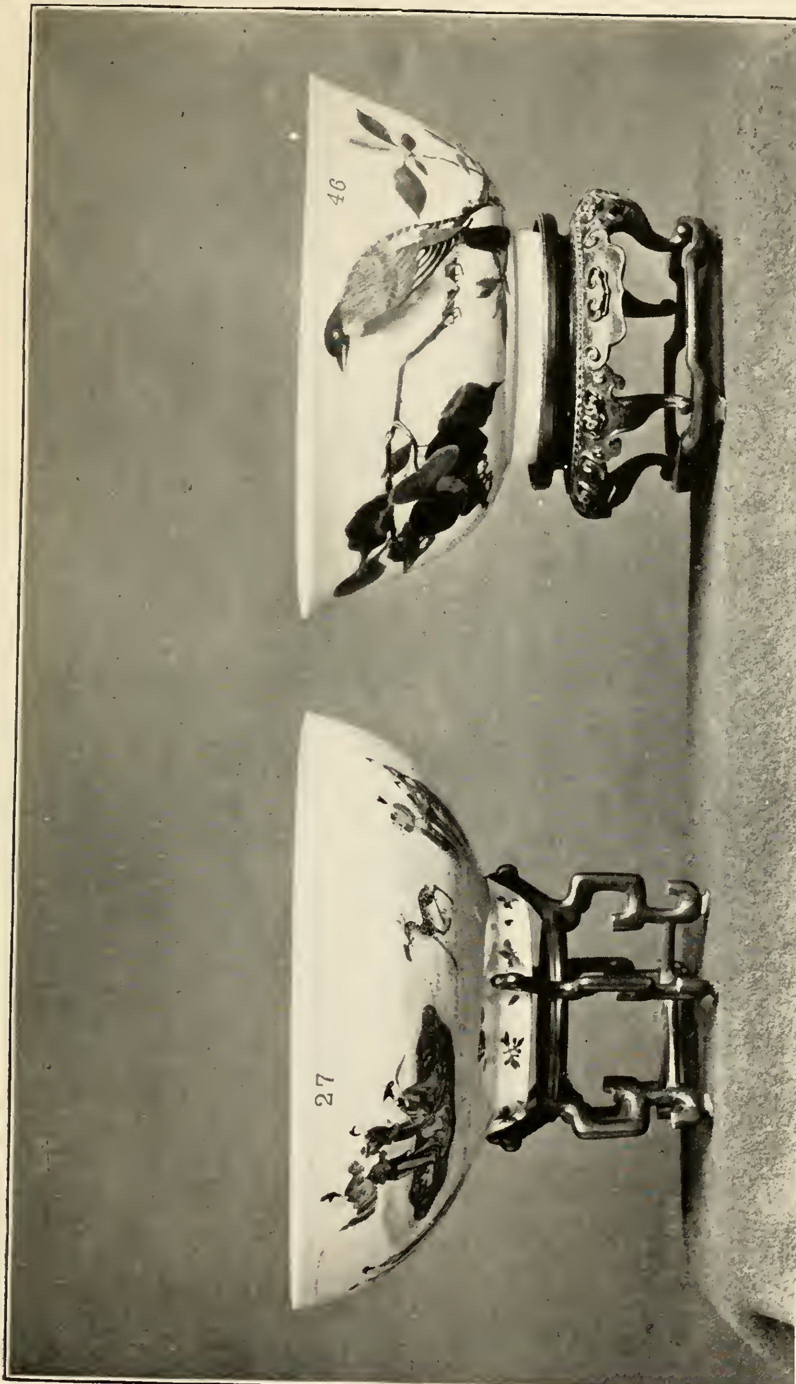
Han Hsiang-tz'u is reputed to have been the grandson of the famous statesman, philosopher, and poet of the T'ang dynasty, and to have lived in the latter half of the ninth century. He was an ardent votary of transcendental study, and the pupil of Lü Tung-pin (see *ante*), himself one of the immortals, who appeared to him in the flesh. Having been carried up into the peach tree of the Genii (see Nos. 27 and 28), he fell from its branches, and in falling entered into immortality. He is usually depicted playing upon a flute or sitting upon a portion of the trunk of a peach tree.

Lan Ts'ai-ho is of uncertain sex, but usually reputed a female. The *t'ai-p'ing-kuang-chi* states that she wandered abroad clad in a tattered blue gown, with one foot shoeless and the other shod, in summer wearing a wadded garment next the skin and in winter sleeping amid snow and ice. "In this guise," says Mayers, "the weird being begged a livelihood in the streets, waving a wand aloft and chanting a doggerel verse denunciatory of fleeting life and its delusive pleasures." Lan Ts'ai-ho is usually drawn as an aged man or as a female clad in leaves or rags, carrying a basket (?) to hold the alms given.

Ho Hsien-Ku was the daughter of one Ho T'ai, a native of Tsêng-ch'êng, near Canton, and was born in the latter half of the seventh century. Born with six hairs growing on the top of her head, she at fourteen years of age dreamed that a spirit visited her and instructed her in the art of obtaining immortality by eating powdered mother-of-pearl. She complied with this injunction and vowed herself to a life of virginity. Her days were henceforth passed in solitary wanderings among the hills, among which she moved as on wings, to gather herbs, and eventually renounced all mortal food. Her fame having reached the ears of the Empress Mu, a concubine endowed with a masterful intellect, who succeeded in usurping the sovereign power, and who, but for a revolution, would have deposed the dynasty of T'ang, she was summoned to court, but vanished from mortal sight on her way thither. She is said to have been seen once more, in A. D. 750, floating upon a cloud at the temple of the Taoist immortal Ma-Ku, and again some years later near Canton. She is sometimes represented clothed in a mantle of mugwort leaves and holding a lotus flower.

26. *Bowl* of white K'anghsi (1662 to 1722) porcelain, with scalloped edges dividing the vessel into eight flattened sections, each filled with a scene admirably painted, chiefly in blue, but with small details in enamel green, on a ground inside and out of deep yellow under thick transparent glaze. These paintings are copies from celebrated pictures, drawn by a famous artist named Fei of the Yüan dynasty, *i. e.*, latter half of the twelfth or early in thirteenth century, illustrative of the pleasures of the *Hsi-yüan* or Western Park. At bottom inside, a man holding a jar, also in blue. An admirable specimen of a highly prized ware. Mark *Ta-ch'ing-k'ang-hsi-nien-chih*, "Made during the K'anghsi period of the Great Pure or Ch'ing (the present) dynasty." Height, 3¾ inches; diameter, 7⅝ inches.

Of this ware the Ambassade de la Compagnie Orientale des Provinces Unis vers l'Empereur de la Chine ou Grand Can de Tartarie fait par



BOWLS OF WHITE K'ANGHSI PORCELAIN (NOS. 27 AND 46).

FOR EXPLANATION OF PLATE SEE PAGES 375, 378.

les Sieurs Pierre de Goyer et Jacob de Keyser (Leyden, 1665), and the Travels from Muscovy to China, by E. Ysbrant Ides, Ambassador from Peter the Great to the Emperor of China in 1692 (published in Harris's Collection of Voyages), say: "The finest, richest, and most valuable china is not exported, at least very rarely, particularly a yellow ware, which is destined for the imperial use, and is prohibited to all other persons."

The *Hsi-Yüan* was a park laid out by Yang Ti (A. D. 605 to 616), of the Sui dynasty. It was over 60 miles in circuit, and "exhausted the utmost degrees of splendor and beauty. When the foliage became decayed and fell, it was replaced upon the trees by leaves of silk. Here the imperial *débauché* was accustomed to ride on moonlit nights, accompanied by a cavalcade of thousands of the inmates of his seraglio." (Mayers.)

27. *Bowl* of pure white K'anghsi porcelain, wide spreading, decorated on *outside* with mythological subjects admirably painted in great detail and with great delicacy of brush in the characteristic tones of the latter half of this reign, vermilion-red and enamel colors. *Inside* a branch of the peach tree, bearing one fruit and several leaves, in green, shaded and varied with darker tints of the same color, with the exception of two, which show a great variety of shades of decay, the veins alone remaining in parts; on the peach, which, as here, is usually pointed in China, is the character *Shou* (longevity) in the "seal" style in gold. An almost unique specimen of the highest style of decoration during the period when the manufacture of porcelain had reached its highest point. (See Plate 1.)

This bowl from its decoration was undoubtedly intended for use in the palace on the occasion of an imperial birthday. The peach is one of the emblems of longevity, from a legend which traced them to the gardens of the fairy Hsi Wang-Mu, where they ripened but once in three thousand years, and conferred that term of life upon those who were fortunate enough to taste them. The legend runs thus: "In the first year of the period Yüan fêng in the Han dynasty (B. C. 110) the fairy Hsi Wang had descended from her mountain realm to visit the Emperor Wu Ti, bringing with her seven peaches. She ate two of the number, and upon the Emperor expressing a wish to preserve the seed, she told him that the tree from which they came bore once only in three thousand years, but each fruit conferred three centuries of life upon the eater. At that moment she perceived Tung-Fang-so peeping at her through the window, and, pointing to him, said: 'That child whom you see yonder has stolen three of my peaches and is now nine thousand years old.'"[1] The gum of the peach tree mixed with mulberry ash is used as an *elixir vitæ* by the Taoists.[2]

The decoration on the outside is an adaptation of the allegorical representation of the prayer for "happiness, distinction, and longevity" (*fu-lao-shou*), met with in Chinese paintings under many forms, but always with the same general characteristics. One of the immortals, the great sage Lao Tz'u, accompanied by attendants, the crane (*Grus viridirostris* Veillot), the stag, the hairy tortoise, all emblems of long life; another, Li T'ieh-kuai, with attendants, evolving from a gourd contracted at the center, five bats, emblematic of the five blessings—longevity, riches, peacefulness and serenity, the love of virtue, and an end crowning the life—the Chinese characters for *bat* and *happiness* having the same pronunciation.

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[1] Mayers, Chinese Reader's Manual, No. 572. [2] Idem, No. 707.

28–31. *Plates* (4) of white porcelain. Hsi Wang Mu, depicted as a beautiful female in the ancient Chinese dress, is represented accompanied by one of her attendant maidens holding a tray containing peaches and other articles, and by the spotted stag, symbolical of longevity, very delicately painted in enamel colors. The rim is ornamented with a narrow band in vermilion red of detached flowers of the Chinese peony (*Pæonia moutan*) and of butterflies. Mark *Ta-Ming-ch'eng-hua-nien-chih*, "Made during the Ch'ênghua period (1465 to 1487) of the great Ming or Bright (dynasty);" the colors and style of painting, however, point rather to the K'anghsi period as that of their manufacture. Diameter, 6¾ inches.

Hsi Wang Mu, literally Royal Mother of the West, is the legendary queen of the Genii, who is supposed to have dwelt in a palace in central Asia among the K'unlun Mountains, where she held court with her fairy legions. Upon some slight allusions to this personage in earlier works the philosopher Lieh Tz'u, in the fifth century, B. C., based a fanciful and perhaps allegorical tale of the entertainment with which King Mu of the Chou dynasty was honored and enthralled by the fairy queen during his famous journeyings B. C. 985. In later ages the superstitious vagaries of the Emperor Wu Ti of the Hau dynasty gave rise to innumerable fables respecting the alleged visits paid to that monarch by Hsi Wang Mu and her fairy troop; and the imagination of the Taoist writers of the ensuing centuries was exercised in glowing descriptions of the magnificence of her mountain palace. Here, by the borders of the Lake of Gems, grows the peach tree of the Genii, whose fruit confers the gift of immortality, bestowed by the goddess upon the favored beings admitted to her presence, and hence she dispatches the azure-winged birds, *Ch'íng-niao*, which serve, like Venus's doves, as her attendants and messengers. In process of time a consort was found for her in the person of Tung Wang Kung, or King Lord of the East, whose name is designed in obvious imitation of her own, and who appears to owe many of his attributes to the Hindoo legends respecting India. By the time of the Sung dynasty (the tenth century, A. D.) a highly mystical doctrine respecting the pair, represented as the first created and creative results of the powers of nature in their primary process of development, was elaborated in the *Kuang-Chi*. The more sober research of modern writers leads to the suggestion that Wang Mu was the name either of a region or of a sovereign in the ancient West.

32, 33. *Bowls* (a pair), everted, of thin white K'anghsi porcelain decorated with the eighteen *Lohan* or *Arhats* in groups, very delicately painted in vermilion. Mark as in No. 26. Height, 2⅜ inches; diameter, 6 inches.

In his Handbook of Chinese Buddhism, Dr. Eitel says that the original meaning of *Arhat* ("deserving") is overlooked by most Chinese commentators, who explain the term as though it were written *Arihat*, "destroyer of the enemy," *i. e.*, of the passions, and "not to be reborn," *i. e.*, exempt from transmigration. A third explanation, based on the original conception, is "deserving of worship." The Arhat is the perfected Arya, and can therefore only be attained by passing through the different degrees of saintship. It implies the possession of supernatural powers, and is to be succeeded either by Buddhaship or by immediate entrance into Nirvana. In popular acceptation, however, it has a wider range, designating not only the perfected saint, but all the disciples of S'âkyamuni, and thus it includes not only the smaller circles of eighteen and five hundred disciples, but also the largest circle of one thousand two hundred.

The first Sûtra (that of forty-two sections) was translated into Chinese in the year A. D. 67, during the time of the Later or Eastern Han dynasty, whose capital was at Loyang in Honan province, by Kâs'-yapa Mâtanga, a disciple of S'âkyamuni, who entered China with Han Ming-ti's embassy on its return from Badakshan. By its means the Buddhist doctrines first became known in China. Such translations from the Sanskrit form the earliest and still continue to be the most important part of Chinese Buddhistic literature; but from the fifth century onward they have been supplemented by original compositions in the Chinese language from the pens of native adherents to that religion. During the first eight centuries of the existence of the Buddhistic religion in China the smallest circle of S'âkyamuni's disciples comprised the same number as in India, sixteen, which was increased under the T'ang dynasty, in the ninth century, A. D., by the enrollment of two additional disciples to its present complement in China—eighteen.

34, 35. *Bowls* (2), everted, of thin white K'anghsi porcelain. Replicas of Nos. 32. 33, but of larger size. Mark, same as in No. 26. Diameter, 6¾ inches.

36. *Wine-cup*, tall, everted, of thin white K'anghsi porcelain; ornamentation: Between borders of Grecian pattern are diamond-shaped panels containing the *pa-kua*, in deep-blue under transparent glaze. Mark, as above. Height, 3 inches; diameter, 3½ inches.

The *pa-kua*, or eight diagrams, are the combinations which may be formed of three lines, whole or divided into two equal parts. They are said to have been developed by Fuh-hi, the legendary founder of Chinese polity, who is believed to have lived from B. C. 2852 to 2738 by aid of a plan or arrangement of figures revealed to him on the back of a "dragon-horse." These eight figures, which can be traced back to the two primary forms representing the first development of the *Yin* and *Yank* (the primordial essences) from the Ultimate Principle, together with certain presumptive explanations attributed to Fuh-hi, were the basis, according to Chinese belief, of an ancient system of philosophy and divination during the centuries preceding the area of Wên Wang (twelfth century, B. C.), but of which no records have been preserved beyond the traditional names of its schools. Wên Wang, the founder of the Chou dynasty, while undergoing imprisonment (B. C. 1144) at the hands of the tyrant Shou, devoted himself to study of the diagrams, and appended to each of them a short explanatory text. These explanations, with certain amplifications by his son, Chou Kung, constitute the work known as the "Book of Changes" of the Chou dynasty, which, with the commentary added by Confucius, forms the *Yih Ching*, the Canon of Changes, the most venerated of the Chinese classics. In this work, which serves as a basis for the philosophy of divination and geomancy, and is largely appealed to as containing not alone the elements of all metaphysical knowledge but also a clue to the secrets of nature and of being the entire system reposed upon these eight diagrams, a ceaseless process of revolution is held to be at work, in the course of which the various elements or properties of nature indicated by the diagrams mutually extinguish and give birth to one another, thus producing the phenomena of nature.[1]

37. *Vase* of white K'anghsi porcelain, in the shape of a gourd contracted in the middle (*hu-lu*), having a vine trailing over it, from which hang large bunches of

[1] Mayers, Chinese Reader's Manual, p. 333.

grapes on which a squirrel is feeding, in various shades of blue under a transparent glaze. Mark, as above. Height, 4⅞ inches.

This is a well-known Chinese motive. "The first picture of the squirrel and the vine" (says Anderson, catalogue of Japanese and Chinese paintings in the British Museum, No. 747) "appears to have been painted by Wing Yüan-chang, a famous artist of the Sung dynasty, A. D. 960 to 1259, and has been repeated by innumerable copies in China and Japan."

38, 39. *Plates* (a pair) of white K'anghsi porcelain, having a large-sized character in center, believed to be Thibetan, surrounded on the sides by three concentric lines of smaller characters of similar type; on outside are three similar lines of characters in deep blue under transparent glaze. Mark, as above. Diameter, 5⅞ inches.

40, 41. *Bowls* (a pair) of thin white K'anghsi porcelain. Ornamentation on outside consists of a delicately-drawn band of waves on lower portion where bowl springs from foot, with the *pa-kua* or eight diagrams (see No. 36) above. Inside, within double circle, at bottom, the *yin* and *yang*, all in deep blue under transparent glaze. Mark, as above. Height, 2¾ inches; diameter, 4¾ inches.

The circle represents the ultimate principle of "being," which is divided by a curving line into two equal portions, the positive and negative essences, *yang* and *yin*, respectively. *Yang*, the more lightly-colored portion, corresponds to light, heaven, masculinity, etc.; *yin*, the more darkly colored, to darkness, earth, femininity, etc. To the introduction of these two essences are due all the phenomena of nature.

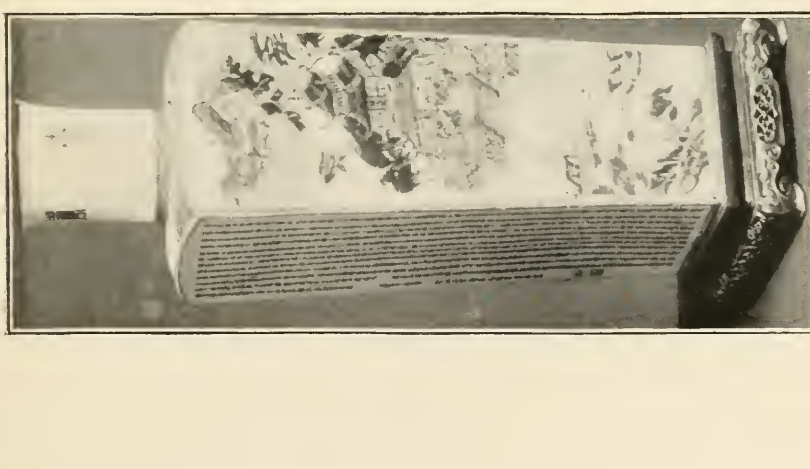
42, 43. *Bowls* (a pair), small, everted, of white K'anghsi porcelain, plain inside. Decorated on outside with iris, grasses, longevity fungus (*ling chih*, a species of (?) polyporus), tea-roses, and other flowers delicately painted in enamel colors upon a brick-red or vermilion ground. Mark, *K'ang-hsi-yü-chih*, "Made by special order of Emperor K'anghsi." Height, 2¼ inches; diameter, 4¼ inches.

44, 45. *Plates* (a pair) of white K'anghsi porcelain, having a "sitting" imperial five-clawed dragon on center, and similar flying dragons (see No. 4) amid clouds around the shelving side. Engraved in the paste under a thick deep-blue glaze (*bleu de roi*) which covers the entire plate inside and out, except the foot, on which appears within a double circle *Ta-ch'ing K'ang-hsi-nien-chih*, "Made during the K'anghsi period of the Great Pure (the present) dynasty." Diameter, 9⅞ inches.

46. *Bowl*, large, everted, of pure white K'anghsi porcelain, plain inside. On outside is a branch of peach tree bearing fruit and leaves, the latter in all stages from the light green of the newly burst leaf to the brown of the withered and worm-eaten, admirably painted. On the branch is seated a large bird, termed by the Chinese a paroquet, but having a red beak, brown breast, green plumage around neck and below it, with brown on back, and black and gray wings and tail. A fine specimen. Mark, as above. Height, 3½ inches; diameter, 8¼ inches. (See Plate 1.)

47, 48. *Wine-cups* (a pair), small, with straight lips, of white K'anghsi porcelain, covered outside with a monochrome dull glaze of violet magenta; plain inside, except at bottom, where are two plums and some beans delicately painted. Mark, as above. Height, 1⅝ inches; diameter, 3¼ inches.

49–52. *Bowls* (4), everted, of white K'anghsi porcelain, having imperial five-clawed flying dragons (see No. 4) engraved in paste, over which are sprays of roses and plum-blossoms, buds and leaves of various shades of green, open flowers and butterflies alternately yellow and aubergine purple-brown under a transparent glaze. Mark, as above. Height, 2¾ inches; diameter, 5⅞ inches.



VASES OF K'ANGHSI PORCELAIN (NO. 53) AND CHIENLUNG PORCELAIN (NO. 236).

FOR EXPLANATION OF PLATE SEE PAGES 379, 398.

53. *Vase*, of square body, contracting to form short, circular, everted neck, on which above each side of the body is the character for "longevity," *shou*, in four out of the hundred forms it may take in the "seal" style of writing. The four sides of the body bear two paintings in the distinctive colors of *la famille verte*, one of the famous club of the seven worthies of the bamboo grove amusing themselves with music, chess, and wine; the other a historical scene representing an ancient general on his way to attack the Man-tz'u, or Southern Chinese, giving audience during a halt upon the banks of the Yangtse. Between the paintings are lengthy disquisitions suggested by the subjects of the drawings. As these are dated "the 29th day of the 9th moon of the year of the cyclic characters *Kwei mo*," that is, 1703, it is justifiable to conclude that is the date of the vase, that being the only year to which these characters would apply during K'anghsi's reign to which the coloring shows it to belong. Mark, a leaf. Height, 18⅜ inches. (See Plate 2.)

The club of the seven worthies of the bamboo grove was an association of convivial men of letters, formed in the latter half of the third century, who were accustomed to meet for learned discussions and jovial relaxation in a grove of bamboos. The seven worthies were Hsiang Tz'u-Ch'i; Chi Shu-yeh, a celebrated functionary and man of letters, but no less renowned as a lover of the wine-cup and as a musician. He was also an ardent devotee of alchemy. Incurring the displeasure of Ss'u-ma Chao, minister of the last sovereign of the house of Wei, he was executed as a propagator of magic arts and heretical doctrines, when he showed his contempt of death by tuning his guitar on the way to execution; Lin Po-lun, who was wholly devoted to joviality and wished he could be accompanied by a grave-digger to at once inter him should he fall dead over his cups; Shan Chü-yuan, a statesman, under Wu Ti of the T'ang dynasty, celebrated for the patronage he extended to rising talent; Wang Chün-chung, a minister of Hwei Ti of the house of Chin, at once infamous for his avarice and for having intrusted the discharge of his duties to base underlings that he might abandon himself to a life of extravagance and pleasure; Yüan Chung-jung, famous as a lover of music and wine, and as a philosopher studying content and moderation in preference to the ways of ambition; and Yüan Tz'u-tsung, uncle of the last, a public functionary, but preferring the quietism preached by the philosophers Lao-tze and Chuang-tze, whose follower he professed himself to be, to the toils of public life.[1]

54, 55. *Plates* (a pair) of white K'anghsi porcelain, decorated inside with a painting in natural colors of the great Taoist sage and philosopher Lao-tze, with lofty head, seated under a tree; his attendant is preparing writing materials for his use. Round the brim are the eight Buddhistic emblems joined by conventional foliage of natural color, but of paler tones than the central design. Mark, as on No. 44. Diameter, 6⅛ inches.

Lao-tze was the founder of the Taoist system of philosophy. He is said to have been surnamed Li and named Êrh, but his history is almost altogether legendary. His biography, as given by the great historian Ss'u-ma Chien, who wrote the first comprehensive survey of the history of China from the legendary period of Huangti down to B. C. 104, contains, however, some particulars which may be considered authentic. According to this account he was the keeper of the records at Lo, the capital of the Chou dynasty, about the close of the sixth century B. C., and professed a doctrine of abstraction from worldly

[1] Mayers, Chinese Reader's Manual, Nos. 246, 411, 587, 799, 963, 968.

cares based upon speculations regarding *Tao*, Reason, and *Tê*, Virtue. This excited the curiosity of Confucius, who is said to have visited him and to have retired disconcerted at his bold flights of imagination. The veracity of the statement regarding this meeting is, however, open to doubt. After a long period of service Lao-tze is said to have retired to the West, after confiding to Yin Hsi, the keeper of the frontier pass of Han Ku, a written statement of his philosophy, the *Tao-tê-ching*, or Classic of Reason and Virtue. Later mystics improved upon this account by assigning a period of mythical antiquity and a miraculous conception through the influence of a star to Lao-tze's birth, alleging him to have been the incarnation of the supreme celestial entity. According to the *Lieh-hsien-ch'uan*. an account of the Taoist genii, he became incarnate B. C. 1321, in the State of Ts'u. His mother brought him forth from her left side beneath a plum tree, to which he at once pointed, saying: "I take my surname (namely, *Li*, a plum) from this tree." When born his head was white and his countenance that of an aged man, from which circumstance he derived his name of Lao-tze, the *Old Child*. The remainder of the account resembles that given above, except that he is made to live for centuries, eventually retiring to the West about B. C. 1080. No countenance is given, however, in the writings ascribed to his pen to supernaturalism of any kind, and the legends regarding his life have evidently been largely colored by the accounts given by Buddhistic writers of the life of S'âkyamuni. The ideas contained in the *Tao-tê-ching* of Lao-tze, which has been translated into English, French, and German, are thus summed up by Mr. Mayers:[1] "Creation proceeding from a vast, intangible, impersonal first principal, self-existent, self-developing, the mother of all things. The operation of this creative principle fulfilled in the nature of man, the highest development of which again is to be sought for in a return through 'quietism' and 'non-action' to the mother principle. The highest good is accordingly to be enjoyed in a transcendental abstraction from worldly cares, or freedom from mental perturbation. In a doctrine such as this it is not difficult to trace at least a superficial likeness to the theories of Brahminism, and whether originally derived from Hindu thought or not it is probable that the cultivation of Lao-tze's teachings had a potent influence in preparing the way for an influx of the metaphysical speculations of Indian philosophers to satisfy a mental craving not provided for in the simple materialism which Confucius expounded. At least the latitude allowed by the vagueness of Lao-tze's writings both enabled and encouraged his so-called disciples and adherents to graft upon the leading notions of his text an entirely adventitious code of natural and psychical philosophy, which, on the one hand, expanded into a system of religious belief, a simple travesty of Buddhism, and, on the other, became developed into a school of mysticism, founded apparently upon the early secrets of the professions of healing and divination, from whence it rose to occult researches in the art of transmuting metals into gold and insuring longevity or admission into the ranks of the genii. To all these professions and pretensions the title of the religion or teachings of Tao was given, although they were in reality

[1] Chinese Reader's Manual, No. 336.

in no wise countenanced by the doctrines of Lao-tze himself. His professed disciples, Lieh Tze and Chuang Tze in the fourth century, and Huai Nan Tze in the second century B. C., progressively developed the mystic element thus introduced, and a notable impetus accrued to it from the superstitious belief with which the pretensions of the alchemists were received by the Emperor Wu Ti, from whose period onward the reverence paid to the founder of the sect began to assume a divine character." In A. D. 666 he was for the first time ranked among the gods, being canonized by the Emperor as "The Great Supreme, the Emperor of the Dark First Cause," and his title was again enlarged in 1013. The achievement of corporeal immortality having been the chief aim of the sect named after him, the founder, Lao-tze, naturally came to be considered the God of Longevity, and as such he figures in all the paintings symbolical of a prayer for "dignity, happiness, and long life," being usually depicted as an aged man leaning upon a staff, his head being of abnormally lofty proportions.

The *pa-chi-hsiang* or "eight lucky emblems" are of Buddhistic origin and derived from India. Formed in clay or of wood, they are offered on Buddhistic altars, and largely enter into the architectural decoration of the temples. They are found with variations both of shape and of detail. In their ordinary form they are:

(1) A bell (*chung*), or more usually a wheel (*lun*), *chakra*, the wheel of the law, with fillets.
(2) A univalve shell (*lo*), the chank shell of the Buddhists, with fillets.
(3) A state umbrella (*san*), with fillets.
(4) A canopy (*kai*), with fillets.
(5) A lotus-flower (*lien-hua*), without fillets; sometimes represented as a *Pæonia moutan*.
(6) A vase with cover (*kuan*), with fillets.
(7) Two fishes (*erh yü*), united by fillets. Said by some to be figurative of domestic happiness.
(8) An angular knot with fillets, termed *ch'ang*, the intestines, an emblem of longevity.

Another style of decoration, also consisting of eight emblems, is that known as the *pa-pao*, or "eight precious things;" they vary considerably in form, and the explanations of their meaning are unreliable and conflicting. The more usual forms, all of which bear fillets, are: (1) an oblate spherical object (*chên*), representing a pearl; (2) a hollow disk inclosing an open square, possibly a copper *cash* emblematical of riches; (3) an open lozenge, placed horizontally; (4) a lozenge placed horizontally, with a section of a second lozenge in the upper angle; (5) an object resembling in shape a mason's square —the sonorous stone *ching*, emblematic by symphony of "goodness," "happiness;" (6) two oblong objects placed side by side, possibly books; (7) two rhinoceros horns shaped into quadrangular form; (8) a leaf of the *Artemisia*, an emblem of good augury. Other forms found in these emblems are a branch of coral, a silver ingot, a cake of ink; and the shell, lotus-flower, and fishes belonging properly to the "eight lucky emblems."

56, 57. *Plates* (a pair) of thin pure white K'anghsi porcelain, having a flying *Fêng huang* and an imperial five-clawed dragon (see No. 4) amid clouds contained by a floral scroll pattern within bands, all engraved in the paste. Round the rim is a border of bats set close to one another in vermilion red; and in center within a medallion, are the characters *hung-fu-ch'i-t'ien* "great happiness fills the heaven," in the old seal form engraved in the paste from beneath the foot, but reversed so that they read correctly on the upper side of the plate. Mark, *Ta-ch'ing-k'ang-hsi nien-chih*, "made during the K'anghsi period of the great Pure Dynasty." Diameter, 7⅝ inches.

58, 59. *Plates* (a pair) of white K'anghsi porcelain, for use on birthday occasions in the palace. The ornamentation consists in the center of the plate of a large *shou* (longevity) character in blue, containing a pointed peach of the genii in enamel glaze, upon which is represented a stork (*Grus viridirostis* Veillot) in blue (the peach and stork being emblems of immortality, see No. 27). Round this medallion is entwined conventional foliage in enamel colors, branching apart to afford eight spaces, in which are alternately a peach and the character *shou* in gold on blue medallion. Outside, on the rim, light-green bamboo stalks spring from rocks on which grows the red fungus of the immortals (*ling chih*). Mark as in last. Diameter, 8¼ inches.

60. *Vase*, circular in shape, of white K'anghsi porcelain, belonging to the *famille verte*. On it is represented a garden with a pavilion in the rear. In it the seven worthies of the bamboo grove (see No. 53) are depicted engaged in chess-playing, music, and writing upon the rocks, the main picture being confined by bands of arabesque ornaments interrupted by panels, containing scholars'[1] requisites, books, scrolls, etc., and above, around the neck, a rod-fishing scene. Mark as above. Height, 18¼ inches. (See Plate 3.)

61–68. *Panels* (8) of white K'anghsi porcelain, bearing representations of famous scenes from the celebrated historical novel *San kuo-chih*, or Records of the Three Kingdoms. This work, the most popular of its kind in China, details the triangular contest engaged in for the throne between Liu Pei, assisted by Chu-Ko-liang, Chang Fei, and Kuan Yü and Ts'ao Ts'ao, after his defection from Liu Pei, and the Sun family, which resulted in the partition of the Empire among the houses of Han of Szechuen, of Wu and of Wei, founded, respectively, by Liu Hsüan-tê, Sun Chung-mou and Ts'ao Mêng-tê (A. D. 220 to 280).

69–76. *Panels* (8) of white K'anghsi porcelain decorated with flowers and butterflies in enamel colors and gold, surrounded by a border of the same upon a pale-green ground picked out with black.

These panels were originally in the form of bricks of about an inch and a quarter thickness. It was customary in the seventeenth and eighteenth centuries for princes to have large couches, 6 to 8 feet in length and having two end pieces, of ebony beautifully carved. The one I have seen had five of these square porcelain panels or bricks let into the back with a circular panel above the central one of the five, and one in either end piece. They were so fixed by means of square projections from the wood-setting which fitted into corresponding holes left for the purpose in the bricks that one surface showed on either side of the setting with a rich and pretty effect, one surface displaying some historical scene, the other a group of flowers. Good specimens are now comparatively rare, and are much sought after by foreigners to saw in half for the manufacture of *cache-pots*.

77, 78. *Panels* (2) of white K'anghsi porcelain, of similar origin to the above, but of inferior style of painting.

79. *Brick* (small) of white K'anghsi porcelain, showing the appearance of Nos. 61 to 78 in their original condition, before the surface plates had been sawn away from the central portion into which fitted the wooden projections serving to keep the porcelain ornamentation in its position in the couch.

[1] Mayers, Chinese Reader's Manual, No. 134.

VASES OF WHITE K'ANGHSI PORCELAIN (NOS. 81 AND 60).

FOR EXPLANATION OF PLATE SEE PAGES 383, 382.

80. *Vase* of white K'anghsi porcelain; shape, slender *potiche*. The ornamentation in chief seems to depict a young officer leaving his post after a virtuous tenure of office, which has won for him not only promotion from the Emperor but also the love of the people he has ruled over. A young man dressed in pink is represented riding a piebald horse. (In the time of K'anghsi the Manchu officers despised and ridiculed Chinese luxury and ceremony, and with them the sedan chairs they have in later days adopted, with almost all else that is Chinese, from the conquered nation; and rode on horseback with but few attendants.) Over him an attendant is holding an official umbrella, which from its three flowers of different colors would appear to be a *wan-ming-san*, or "umbrella of ten thousand names," an offering made to a virtuous and upright officer on his departure from his post by a grateful people, and so called from the fact that it bears upon it the names of the donors either embroidered or in black velvet *appliqué*. He is preceded by men bearing lanterns and followed by an attendant carrying a scroll wrapped in imperial yellow silk, indicative of a communication from the throne. Round the part where the vase diminishes in size runs a band of floral pattern on a pink ground interrupted by panels containing grotesque representations of dragons, the whole bounded on either side by bands of a geometric pattern in blue—all painted seemingly above the glaze. No mark. Height, 10⅝ inches.

81. *Vase* of pure white K'anghsi porcelain, tall, the body bellying out from the foot and then gradually tapering upward. On one side is a character *shou* (longevity), on the other the character *fu* (happiness) in a diaper pattern in black upon a dark enamel green. In the center of each of these characters is a medallion about 4 inches in diameter, containing mythological representations appropriate to the character in which it is placed. On the former is the Genius of Longevity (as Lao Tze, see No. 54) riding a white stork into the midst of the Immortals. On the latter Tung Wang Kung, the consort of the Queen of the Fairies (see No. 28), is handing a baby the elixir of life, while another of the sages stands by holding the *ju-i*. Where the body of the vase springs from the foot is a band of formal geometric pattern and round the rim is a border of flowers on dark grey ground interrupted by white panels inclosing flowers, the whole supported by a narrow band of geometrical design. A beautiful specimen of K'anghsi ware. Height, 16¼ inches.

The *ju-i* is a curved baton, generally carved in jade or some other valuable material. It is probably of Buddhistic origin, as it is one of the seven precious things (Sansk. *Sapta Ratna*) and appears in Buddhist pictures in the hands of priests of high rank. It is also regarded as a symbol of the power of the faith. In China it is commonly considered an emblem of good luck, its name signifying "(May all be) as you wish," and is therefore frequently used as a present to friends or at a wedding. It is also a sign of authority, owing to the fact that it is believed to have been used in India as a scepter. (See Plate 3.)

82. *Vase* of pure white K'anghsi porcelain, tall, circular in shape, the outline rising most perpendicularly, but with a slight slope outward, then contracting gracefully to neck, which everts at brim. A child holding in his hand a pink lotus flower (*Nelumbium speciosum*) is being presented to a tall Rishi (? Lao Tze) standing, dressed in embroidered robes of pink, with Tung Wang Kung (see No. 28) dressed in robes of yellow and blue and holding in his hand the peach of the Genii. On neck are sprays of bamboo and the fungus (*ling chih*) of the Immortals. A beautiful specimen of K'anghsi ware. The figures are large, Lao Tze being 8 inches in height, and painted with considerable force and attention to detail. Height, 17¼ inches. (See Plate 4.)

83. *Vase* of white porcelain, small, with swelling body suddenly contracting to form long, tapering neck, covered with the deep red glaze known as *lang yao* or *sang-de-bœuf*, which has retreated from brim, though vase is colored inside. No mark. Height, 4½ inches.

84. *Vase* of white porcelain, pen-shaped, with short, narrow, everted neck. Covered with a deep green glaze, termed by the Chinese *lu-lang-yao* or green *lang* ware. (Regarding the origin of the Chinese designation of the ware represented by this and the preceding specimen, see page 346.) The glaze is coarsely crackled inside and out. This is the only specimen of *green* lang-yao I have ever seen. No mark. Height, 7⅜ inches.

85, 86. *Plates* (a pair) of pure white Yungchêng (1723 to 1735) porcelain. Ornamentation consists of two branches of the peach tree, one bearing pink, the other white blossoms. The branches spring from the foot, and, after spreading over the outside, cross the brim to cover the inside. Five peaches, varying from deep red at the pointed end to green near stem, are delineated on the inside and three on the outside. Above the flowers hover three bats on inside of plate and two on outside, thus forming a Chinese expression *pa-t'ao-wu-fu*, the eight peaches and the five forms of happiness (see No. 27), equivalent to "long life and every kind of happiness." The painting is admirable. Mark *Ta-ch'ing-yung-chêng-nien-chih*, "Made during the period Yung Chêng of the Great Pure dynasty." Diameter, 8⅛ inches.

87. *Rice bowl* of thin white Yungchêng porcelain with everted brim. Two sprays of roses spread so as to decorate the entire outside with bloom and leaves, the end of the spray with leaves and bud passing over the brim to inside. This and the next three numbers are beautiful specimens. Mark, as in last. Height, 2⅛ inches; diameter, 4⅜ inches.

88. *Rice bowl* of thin white Yungchêng porcelain. Two sprays of peach blossom, one bearing pink, the other white bloom, start from foot, spreading so as to decorate the entire outside and the ends of the sprays passing over the brim to the interior. Mark, as above. Height, 2⅛ inches; diameter, 4⅜ inches.

89. *Wine cup* of pure white Yungchêng porcelain, having a crooked branch of the dwarf plum bearing white bloom most delicately painted around the side. Mark, as above. Height, 2⅛ inches; diameter, 3⅜ inches.

90. *Wine cup* of fine white Yungchêng porcelain, with everted brim. Decoration: Four medallions of about 1 inch diameter, containing each a group of heavenly bamboos with red berries (*t'ien-chu*, *Nandina domestica*), convolvulus, etc., very delicately painted in natural colors. Mark, as above. Height, 2⅛ inches; diameter, 3¾ inches.

91, 92. *Saucers* (a pair) of white Yungchêng porcelain. Decoration: *Inside*, in center within a double circle, two imperial five-clawed dragons (see No. 4) with clouds and flaming sun engraved in paste, the clouds and one dragon being colored green, the other dragon aubergine purple on yellow ground; *outside*, round the rim, four flying *fêng huang* (see No. 4), between each two are cumuli clouds, all engraved in paste and colored green upon a yellow ground. On foot also yellow. Mark, as above, in aubergine purple. Diameter, 5⅝ inches.

93. *Saucer* of pure white Yungchêng porcelain. Plain inside; on outside the bulging rim is decorated with red lotus flowers (*Nelumbium speciosum*), blue cornflowers and conventional foliage on black ground. Mark, as above, in blue. A small but admirable specimen of the black ground porcelain produced by Fangying. (See Preface.) Diameter, 4½ inches.

94, 95. *Wine cups* (a pair) of pure white. Yungchêng porcelain, decorated with four medallions of formal floral scroll pattern. Mark, as in last. Height, 1⅝ inches; diameter, 2⅝ inches.

VASE OF K'ANGHSI PORCELAIN (NO. 82).

FOR EXPLANATION OF PLATE SEE PAGE 383.

96. *Rice bowl* (small) of pure white Yungchêng porcelain with straight rim, ornamented with five similar medallions of sprays of peach bearing some white, some pink bloom, and two peaches and two bats in each, symbolical of a long and happy life (see No. 27). Mark as above. This and next three numbers are beautiful specimens. Height, 2¼ inches; diameter, 3⅝ inches.

97, 98. *Rice bowls* (a pair, small) of pure white Yungchêng porcelain, decorated with three groups of fruit-bearing branches, one of peach, one of pomegranate, and one of *lung yen* (the "dragon-eye" fruit, *Nephelium longum*). Mark as above. Height, 2¼ inches; diameter, 3⅝ inches.

99. *Rice bowl* (small), fellow to No. 89.

100. *Plate* (?) of pure white Yungchêng porcelain covered with ornamentation no less remarkable for its wealth of detail than for the delicate harmony of its coloring. In the center is a circular elevation of about 1¼ inches diameter, which has been cut off and hollowed out; on the depression thus made, which is, however, still somewhat higher than the body of the plate, is painted the character *shou* (longevity) in blue on a yellow ground, which color forms the ground of the entire plate, but is scarcely visible so thickly is it covered with white, blue, and purple lotus flowers and formal foliage in subdued tints. Among these flowers and equidistant from each other are four *shou* characters in blue forming tiny medallions, surrounded by a corolla (which give them the appearance of *hsi-fang-lien* or Indian lotus flowers) in light pink and lake. Four similar ornamentations enliven the rim. Of the underpart the rim is plain yellow, and the bottom of the plate a very delicate blue-green, except in center, where, in space corresponding to the elevation on the upper side already mentioned, the four characters *Yung-chêng-nien-lchih* "Made in Yungchêng period," in the ancient seal style, appear in blue on white ground. Diameter, 5⅝ inches.

101, 102. *Dishes* (a pair) of white Yungchêng porcelain, circular in shape. The decoration inside consists of a pair of *yüan-yang* swimming amid pink lotus flowers and leaves in enamel colors, within a double ring; similar double ring at brim. On outside is similar decoration with border round the brim of small imperial five-clawed dragons amid clouds with sun. Decoration shows it to have been intended for wedding service in palace. Mark as on No. 85. Diameter, 7 inches.

The *yüan-yang* are the male and female, respectively, of *Anas galericulata*, commonly called by Europeans "Mandarin duck." These beautiful water fowl manifest when mated a singular degree of attachment for each other, and they have hence been elevated into the emblems of connubial affection and fidelity.

103, 104. *Bowls* (a pair) of white Yungchêng porcelain with everted brim. Decoration inside consists of, at bottom, a "sitting" imperial five-clawed dragon in vermilion within a double ring, with similar ring at brim. On outside are two flying multi-colored *fêng huang* (see No. 4) separated on either side by an imperial five-clawed dragon, one green, the other red, among flowers and delicate foliations in enamel colors; around the brim is a narrow border of the Eight Buddhistic Emblems (see No. 54) joined by conventional foliate ornaments. Mark as on No. 85. Height, 2⅝ inches; diameter, 6 inches.

105. *Plate* (large, open) of pure white Yungchêng porcelain beautifully decorated with a bunch of large sprays of rose, pink peach, white peach, bamboos, and longevity fungus (*ling-chih*), which, after spreading around the outside, pass over the brim and cover the interior. Mark as on No. 85. A fine specimen, beautifully painted. Diameter, 19⅞ inches.

106. *Vase* of pure white Yungchêng porcelain of gourd shape, contracted in the middle (*hu-lu*), decorated with a spray of vine, leaves green, grapes purple and shades of light brown, tendrils blue; on the ground is a gray squirrel eating some of the grapes it has plucked from the vine. Mark as on No. 85. Interesting to compare this with No. 37, a corresponding specimen of K'anghsi ware. Height, $4\frac{7}{8}$ inches.

107, 108. *Plates* (a pair) of white Yungchêng porcelain. Decoration inside consists of spreading gourd vines with green leaves, white open flowers, pink buds, and four gourds, contracted at middle, in shaded yellow, all in enamel colors; between the gourds and in center are five bats (the five kinds of happiness), all within a double ring, with similar ring at brim. On outside similar decorations run round the bellying rim. Mark as on No. 85. Diameter, $10\frac{3}{4}$ inches.

109. *Plate* of white Yungchêng porcelain. Decoration inside, five formal flowers of vermilion, with blue corolla and yellow centers, inclosed in a conventional ornamentation of green leaves and blue tendrils within a double ring, with similar ring at brim. On outside a similar decoration, containing eight of the same flowers, covers the rim. Mark as on No. 85. Diameter, $10\frac{3}{4}$ inches.

110. *Vase* of pure white Yungchêng porcelain, bellying gently outward for two-thirds of height, when it contracts suddenly to form slender neck. Decoration consists of a branch of white peach and young bamboos, which spread from foot upward and outward, beautifully painted. A fine specimen, but unfortunately cut at neck. Mark as on No. 85. Height, $7\frac{5}{8}$ inches.

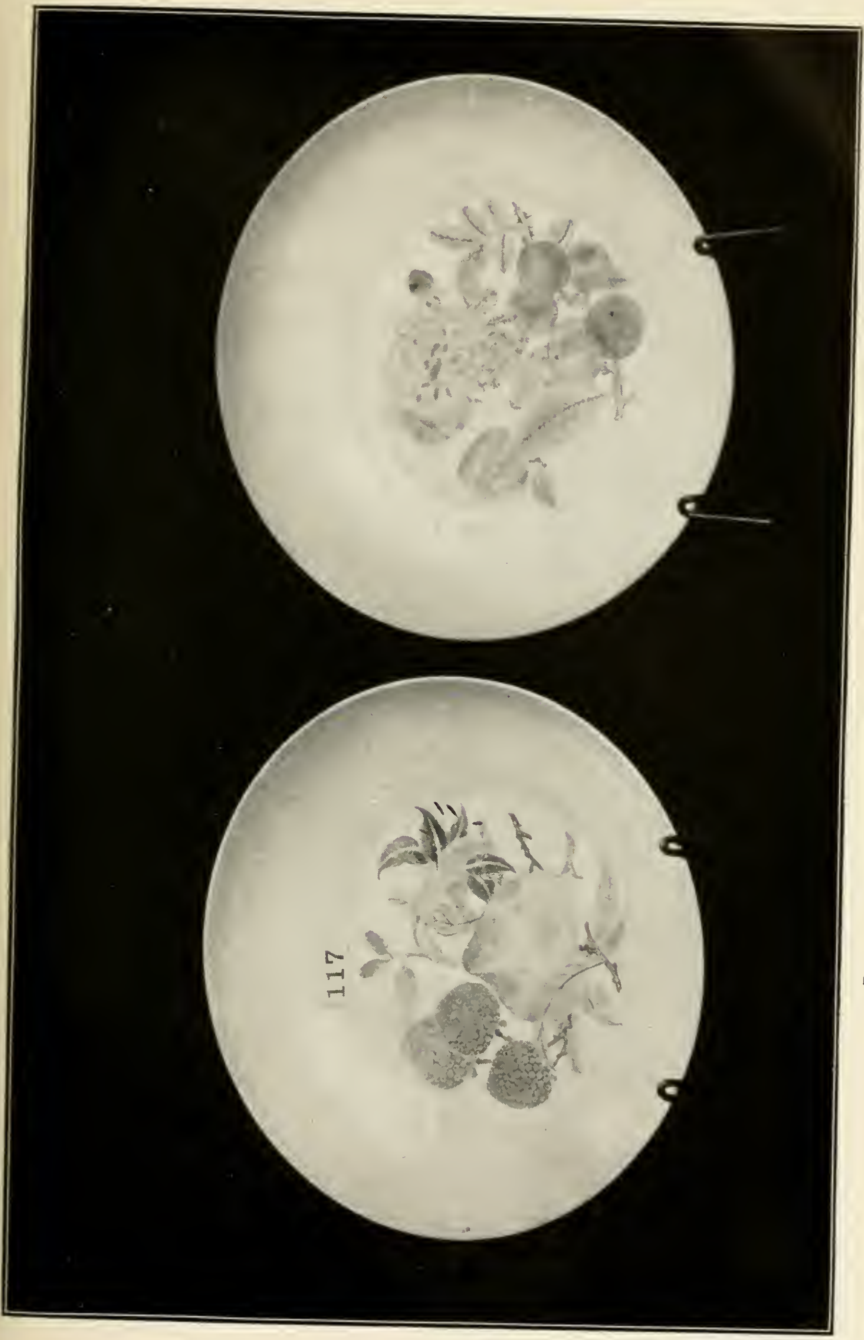
111. *Pencil-washer* of white Yungchêng porcelain, bell-shaped. On it is depicted the mountainous shore of a lake with jutting promontories, on which are cottages, with men fishing, all in claret red under a faintly gray transparent glaze. Mark as on No. 85. Height, $2\frac{7}{8}$ inches.

112. *Tea-cup*, with cover, of thin white Yungchêng porcelain, shaped like an inverted bell. On it is depicted a landscape of rolling hillocks separated by streams spanned by rustic bridges, delicately painted, with fine strokes, in brown, rocks shaded with reddish brown, grass land between hillocks of delicate pale green. Cover similarly decorated. Mark, a dragon in deep blue enamel above glaze. Height, $2\frac{1}{2}$ to $2\frac{3}{4}$ inches; diameter, $4\frac{1}{2}$ inches.

113. *Vase* of pure white Yungchêng porcelain, of globular shape. Covered with pale blue monochrome bearing four uncolored medallions within gilt bands, on each of which is painted a landscape scene representing one of the four seasons, drawn by a master hand. The winter scene is specially worthy of notice, the snow covering of the mountains, roads, and roofs being admirably brought out by throwing a slight haze over the background. Into a large circular hole in the top of the globe is inserted a flower holder of cloisonné (dating from Chienlung's reign, that is, subsequent to 1735), with seven openings for single flowers. No mark. Height, $8\frac{5}{8}$ inches.

114, 115. *Plates* (a pair) of pure white Yungchêng porcelain. Decoration consists of sprays of chrysanthemums of various colors—on one they are white, pink, red, and yellow; on the other blue, pink, cream, and vermilion—beautifully shaded, with leaves of several tones of green in enamel colors above glaze. Where the plate rises from the body to the rim it is fluted. Mark as No. 85. Diameter, $6\frac{3}{4}$ inches.

116. *Pencil-washer*, of pure white Yungchêng porcelain, in shape resembling a low circular dish of which the brim curves inward. The decoration consists of two *mang* (see No. 9), which, grasping longevity fungus and holding a branch of same in the mouth, with forked tails terminating in elaborate scroll form,



PLATES OF WHITE YUNGCHÊNG PORCELAIN (NOS. 117 AND 188).

FOR EXPLANATION OF PLATE SEE PAGE 387.

run around the center; confined above and below by a band of formal scroll pattern—delicately painted and shaded in a vitreous lake or carmine color (Chinese *yen-chih*, rouge) above glaze. No mark, but unmistakably made under the direction of T'ang ying (see page 347). Height, 1⅝ inches; diameter, 5 inches.

117. *Plate* of delicate white Yungchêng porcelain, with everted brim. Decorated inside with a group of three fresh lichees (*Nephelium lichi*), a peach, and a yellow lily most beautifully painted in enamel colors of natural shade above glaze. The outside is entirely colored with a deep rose, which imparts a blush to the white inside. This and the following number are admirable specimens of the celebrated "rose-back plates." No mark. Diameter, 7¾ inches. (See Plate 5.)

118. *Plate*, exactly similar to last, but with different decoration. The group here consists of a deep-red Chinese peony (*Pæonia moutan*), a small peach, and a branch of *lung yen* (the "dragon-eye" fruit *Nephelium longum*). Diameter, 7¾ inches. (See Plate 5.)

119. *Bonbonnière*, of pure white Yungchêng porcelain, of flattened globular shape, box and cover of equal size. On latter a "sitting" imperial five-clawed dragon (see No. 4), in deep red, well painted and shaded, among deep-blue flossy clouds. Round the box are two similar dragons flying in pursuit of sun. Admirable specimen of the ware; the outlines are crisp and clear, and the colors bright, contrasting pleasantly with the pure white of the ground. Mark *Fui-ss'u-t'ang-chih*, "Made at the order of the Fui-ss'u-t'ang Pavilion." Height, 4 inches; diameter, 6¼ inches.

As each artist gives some more or less romantic designation to his studio, so the Emperor and princes give some fanciful name to their palace, or a portion of it, which is not unfrequently found upon porcelain specially made for use in a special hall or pavilion, or for use by the owner of the "hall." In this case *Fui-ss'u-t'ang* was the designation given to a portion of his palace by the Imperial Prince Ho, living during Yungchêng's reign, who enjoyed one of the eight titles of hereditary princedom by blood royal conferred upon as many of the most noted Manchu captains at the time of the conquest of China. These hereditary princes are commonly termed "iron-helmet princes," and the distinction is one very seldom conferred since. During the present reign an exception has been made, as a reward for his distinguished services, in favor of Prince Kung, who for a quarter of a century was head of the Board of Foreign Affairs.

120, 121. *Tea-cups* (a pair), with covers, of thin white Yungchêng porcelain, decorated with two imperial five-clawed dragons, pursuing sun amid clouds, all in deep red, the clouds, the dragons, and the scales of the latter being outlined in bright gold; covers bear similar decoration. Mark *Ching-ss'u-t'ang*, an imperial or princely hall mark, as yet unidentified. Height, 3¼ inches; diameter, 4¼ inches.

122, 123. *Plates* (a pair) of white Yungchêng porcelain. Ornamentation consists of six characters in "seal" style among chrysanthemum flowers and leaves surrounding a seventh character inclosed within a wreath. On outside, round the brim, eight characters in "seal" style among chrysanthemums and flowers, all in deep blue under glaze. Mark as on No. 85. Diameter, 10¾ inches.

124. *Vase* (small) of white Yungchêng porcelain. From a low, broad foot the outline slopes without curve to about two-thirds of height and then contracts at an

angle of slightly under 90 degrees to form narrow, straight, slender neck. The body is covered with conventional trailing flowers and leaves, confined above and below by a narrow band of geometrical pattern. At junction of neck with body is a smaller band of leaves and flowers, and above another row of flowers between two narrow bands of foliate scroll-work, another band of which runs round the foot, all in deep blue under glaze. Height, 7½ inches. (See Plate 7.)

125. *Vase* (small) of white porcelain, of delicate shape, somewhat resembling a pear, decorated with a group of peonies springing from a mass of rockery, boldly painted in deep blue under a glaze, which has a yellowish tint, owing to the closeness of the crackle (*truité*). A good specimen. No mark. Height, 6⅛ inches. (See Plate 6.)

126. *Wine-pot* of white Yungchêng porcelain, cubic in shape, with tall, slender, rectangular handle; decorated with chrysanthemums and ornate foliage, with a deep band of formal scroll-work at base, and foliate scrolls round the neck. A small flower pattern runs along the outside of the spout and of handle, all in good blue under glaze. Along the sides of the handle runs a Grecian pattern, and along those of the spout a floral scroll, moulded in relief under glaze. No mark. Height of body, 6¼ inches to top of handle.

127. *Wine-cup* of fine, transparent, white Yungchêng porcelain, bearing five medallions, each formed by a *fêng-hwang* (see No. 4), with long curved wings, carefully painted in deep blue under glaze. Mark as on No. 85. Height, 2½ inches; diameter, 3½ inches.

128. *Vase* of pure white Yungchêng porcelain, circular in shape, bellying outward to two-thirds of height, then contracting slightly to form low, open neck at point of contraction. Two handles, one on either side, formed of grotesque elephants' heads holding a ring in trunk in relief under glaze. Decoration consists of a child leading one water buffalo, with two others following more or less willingly, among spreading weeping willows, beautifully painted in deep, bright blue under glaze. An admirable specimen. No mark. Height, 8¼ inches; diameter, 7 inches. (See Plate 7.)

129. *Vase* of pure white Yungchêng porcelain. In shape a half globe with tall, slender, everted neck rising from the center. Decoration consists of one of the Taoist genii (? Lao Tze) in long, flowing yellow robe, with white hair and long, crooked stick, accompanied by an attendant standing under a spreading pine close beside dark-green-blue rocks. The pine trunk is delicately shaded in brown, the leaves of deep green, and the figures painted with the delicacy of miniatures. Attached is a metrical inscription to the following effect:

> Above a sheer abyss crag o'erhangs crag,
>   Whose heads aloft in purple distance soar,
> Whose look to mind recalls the five Star-gods
>   Who help'd great Shun to rule in days of yore;
> And shady glens betwixt form cool retreats
>   Where sages meet to con their mystic lore.

It is recorded that the "Five Old Men," the spirits of the Five Planets, appeared at court B. C. 2246, and assisted the Emperor Shun with their counsels till he abdicated in favor of Yü, when they disappeared. Shun then dedicated a temple to the five planets and offered sacrifices in their honor, whereupon "five long stars" appeared in the heavens with other auspicious signs.

This and the following number are beautiful specimens. The paintings upon them are from the brush of Wang Shih-mei, styled Yen-k'ê, a celebrated artist of the present dynasty.

Height, 7 inches; diameter, 4⅝ inches. (See Pate 6.)

VASES OF WHITE YUNGCHÊNG PORCELAIN (NOS. 130, 125, AND 129).

FOR EXPLANATION OF PLATE SEE PAGES 389, 388.

VASES OF WHITE YUNGCHENG PORCELAIN (NOS, 133, 128, AND 124).

FOR EXPLANATION OF PLATE SEE PAGES 389, 388, 387.

130. *Vase* of pure white Yungchêng porcelain, a pendant to the above, and bearing a decoration only differing in details. The inscription here reads:

> The sage is gone on pleasure bent,
> Answer'd the boy 'neath pinewoods' shade;
> Where? I know not—but in these hills
> Where clouds hang thick o'er some deep glade.

Height, 7 inches; diameter, 4¼ inches. (See Plate 6.)

131. *Wine-cup* (small) of pure white Yungchêng porcelain, decorated with three groups, each containing three sprays of bamboo delicately painted in green enamel color above rich glaze. Mark as on No. 85. Height, 1¾ inches; diameter, 3¾ inches.

132. *Wine-cup* (small) of pure white Yungchêng porcelain, decorated with sprays of pine, bamboo, and plum-blossom, symbolical of a long life (see No. 181) delicately painted in deep blue under a brilliant transparent glaze. Mark as on No. 85. Height, 2 inches; diameter, 3⅝ inches.

133. *Vase* of pure white Yungchêng porcelain, shaped like a gourd contracted in the middle. Entirely covered with clouds, through which appears an imperial five-clawed dragon, all in deep transparent blue, contrasting well with the pure white ground. No mark. Height, 9 inches. (See Plate 7.)

134. *Pencil-holder*, circular in shape and very broad, of white Ch'ênghua porcelain (1465 to 1487). Decoration, in beautiful shade of blue under transparent glaze, a long poem from the pen of the celebrated poet Li T'ai-po, of the Sung dynasty (A. D. 699 to 762), inculcating the Epicurean philosophy, which may be summed up in Horace's words, *Carpe diem, quam minimum credula postero.* The advice contained in the poem is being put into practice by a merry party round the festive board, whose actions express the words of the Latin author: *Fruamur bonis quæ sunt; pretioso vino et unguentis nos impleamus, non prætereat nos flos temporis.* No mark. Height, 6 inches; diameter, 6⅞ inches.

135. *Rice-bowl* of pure white Yungchêng porcelain ornamented with trailing gourd and leaves moulded in relief under a thick céladon glaze. Mark as on No. 85. Height, 2½ inches; diameter, 4¾ inches.

136. *Vase* of pure white Yungchêng porcelain with no ornamentation. Hexagonal in shape, bellying outward for one-third of height, then rapidly contracting to form long tapering neck, on which, on either side, is an open ear-shaped handle covered with a uniform céladon glaze. Mark as on No. 85. Height, 10⅜ inches.

137. *Vase* (small) of white Yungchêng porcelain, circular in shape, with narrow neck and ornamented with groups of lotus flowers moulded on the paste in relief and covered with thick, pale céladon glaze. No mark. Height, 5⅞ inches.

138–145. *Rice-bowls* (8) of thin, transparent white Yungchêng porcelain. Decoration on outside, formal Chinese pinks, with trailing leaves moulded in relief, the bowl springing from a lotus flower moulded in relief above foot; inside, at foot, a lotus flower engraved in the paste. Covered inside and out with a thick, transparent, céladon glaze. Mark as on No. 85. Height, 1⅜ inches; diameter, 4½ inches.

146. *Vase* of white Yungchêng porcelain, gradually bulging from base till suddenly caught in to form short, narrow, everted neck, and covered with monochrome glaze of dull carmine. Mark as on No. 85. Height, 8¾ inches.

147. *Incense-burner* of white Yungchêng porcelain, in shape of low, broad pan, with a small ring handle on either side, covered inside and out with a dappled-black and dark-green glaze—*soufflé*—to imitate old discolored bronze. Highly valued by Chinese collectors. Height, 2⅝ inches; diameter, 5¼ inches.

148, 149. *Plates* (a pair) of very thin, pure white Yungchêng porcelain; small and covered with a delicate imperial yellow brilliant glaze. On foot, which is alone left white, mark as on No. 85, in blue. Diameter, 3¾ inches.

150. *Vase* (small) of white Yungchêng porcelain, of bulbous shape, with long narrow neck, covered with monochrome deep lake or carmine thick vitreous glaze, covered with pittings, in the terminology of French writers, *ayant l'apparence chagrinée d'une peau d'orange*. Height, 7¾ inches.

151, 152. *Rice-bowls* of white Yungchêng porcelain, everted. Plain inside. On outside are imperial five-clawed dragons flying amidst formal foliated scrolls, engraved in paste, the entire outside being covered with a monochrome brilliant glaze of deep green. Mark as on No. 85. Height, 2¾ inches; diameter, 5¾ inches.

153, 154. *Fish-bowls* (a pair) of Yungchêng earthenware covered with a curious glaze, termed by the Chinese *t'ieh-hsiu*, "iron rust," and having the appearance of holding minute iron filings in suspension. Mark as on No. 85, engraved on the foot. Height, 2¼ inches; diameter, 3 inches.

155. *Vase* of pure white Yungchêng porcelain, of slender shape, curving gently outward to two-thirds of height, when it contracts to form slender neck, terminating in a flat open mouth. Covered externally with a bright, transparent crimson glaze, which has thickened at base of neck and assumed a darker shade. Colored glaze has been very carefully applied, so that interior and brim of mouth remain pure white. No mark. A specimen of *Nien-yao*—that is, of the porcelain made under the direction of Nien Hsi-yao. (See page 342.) Height, 9 inches.

156, 157. *Screens* (a pair) of pure white Yungchêng porcelain, oblong in shape, and decorated with landscapes in sepia: (1) A village under shelter of rocks on lofty bank of a river, on opposite bank a valley and water-fall overshadowed by trees; (2) a handsome pavilion on rocky eminence and approached by long, winding river-side road, overlooks the river, on which boats are seen sailing. Fair specimens of the "ideal landscapes" of Chinese artists. No mark. Height, 14 inches; length, 14¼ inches.

158. *Rice-bowl* of white Yungchêng porcelain, decoratéd with lilies, irises, and Chinese pinks of various hues painted in enamel colors of natural tones above glaze upon a deep violet ground. Mark *Yung-chêng nien-chih*, "Made during the Yungchêng period." Height, 2⅝ inches; diameter, 5¾ inches.

159, 160. *Rice-bowls*, small (a pair), of pure white Yungchêng porcelein. On a purple-violet ground are sprays of a small blue flower with conventional foliage, which form four panels colored lemon yellow, on which are purple peonies, with green leaves painted in enamel colors of natural tones above glaze. Mark as on last. Height, 3⅝ inches; diameter, 4⅝ inches.

161. *Snuff-bottle* of pure white Yungchêng porcelain, of flat circular shape, decorated on either side with a group of cream-yellow chrysanthemums and vermilion-colored *coleus*, painted with great delicacy. Mark *Lo-Ku-t'ang*, "the Hall of Delight in Antiquity," a princely designation as yet unidentified.

162. *Hanging-vase* of skimmed-milk-color white Yungchêng porcelain, of amphora shape, but without arms. A *mang* (see No. 9) boldly molded in relief, with head aloft and light coral red in color, curls round the neck. The vase is covered with a thick, brilliant, transparent glaze, except at base, where runs a deep band, and at brim, where runs a narrower band, of geometrical scroll-work in dull white above glaze. No mark. Height, 4⅝ inches; diameter, 2¾ inches.

163. *Vase* of pure white Yungchêng porcelain. In shape a half-globe with tall, slender, everted neck rising from center. A *mang* (see No. 9) in high relief, beautifully molded, with tail having scroll-like terminations, curls down-

PILGRIM BOTTLE OF WHITE CHIENLUNG PORCELAIN (NO. 176).

FOR EXPLANATION OF PLATE SEE PAGE 391.

ward round the neck, grasping a large branch of longevity fungus; the *mang* and fungus are of deep vermilion; the leaves of latter are green, covered with thick, brilliant transparent glaze. No mark. A lovely specimen of T'angying's ware. (See page 347.) Height, 7 inches; diameter, 4⅛ inches.

164–167. *Rice-bowls* (4) of white Yungchêng porcelain covered with closely-crackled (*truité*) glaze, having a purple tint rubbed into the crackling. Decoration, inside, at bottom, a peach with six leaves, forming a medallion; outside, four of the Buddhistic emblems (see No. 54), each supported on either side by a spray of flowers, to which it is attached by long flowing ribbons. Mark as on No. 85, in black on crackled foot. Height, 2 inches; diameter, 5¼ inches.

168. *Pencil-washer* of earthenware in shape of a longevity peach sliced in half. It is covered inside with thick white-blue glaze studded with deep pittings, as of burst bubbles, a rose and bud at bottom; outside is colored with the natural shades of an unripe peach. The handle is formed of the woody stock, which throws out smaller shoots running over the sides of fruit, upon which are full-blown flowers, unopened buds, leaves, and green fruit moulded in high relief and painted in natural colors. A curious specimen of a ware much esteemed by the Chinese. No mark. Height, 1½ inches.

169. *Cup* of pure white Yungchêng porcelain of circular shape, everted. Decoration consists of, *inside*, waves at bottom, at sides bats, and at brim a border of Grecian pattern, all engraved in paste under transparent glaze; *outside*, between bands of a very delicate diaper pattern of red at brim, and of green with light-red center at foot, is depicted a high officer (possibly the Emperor himself) with two attendants descending the steps of a pavilion built under the shade of wide-spreading trees, and bearing in his arms the *ju-i*, or emblem of power, to meet a military officer, who, having just dismounted from his horse, around which stand subordinate officers and attendants, is advancing to meet the former. The inscription *Ch'u-chiang-ju-huang-chih-pei*, "Cup of him who departed as General and returned as Grand Secretary," shows the cup to have been ordered by the Emperor to confer upon some high officer who had been commander-in-chief in some war, and who had been invested with the high distinction of grand secretary upon his return crowned with victory. It should be added that in China military officers always occupy a relatively lower rank than do civil officers, and that the dignity of grand secretary, of which there are four, is the highest to which any subject, not of princely rank, can attain. Who the officer so honored in this instance was has not been as yet determined. Apart from the intrinsic interest attaching to such a specimen, the cup is remarkable for the miniature-like delicacy and wealth of detail which characterize the painting. Mark *Hsü-hua-t'ang-chih-tsêng*, "Made for Hsü-hua Pavilion (the designation of part of the imperial palace—that is, for the Emperor) to confer upon" some high officer. Height, 2 inches; diameter, 4¼ inches.

170. *Vase* of white Yungchêng porcelain. Circular in shape, circumference rising straight to one-half the height of vase, when it suddenly contracts to form long, narrow neck. Decoration consists of formal flowers, peaches, and foliage in natural colors on light-blue ground, except where three gold circles form as many medallions on the white ground, on which are painted groups of chrysanthemums and red *coleus* in natural colors. No mark. Height, 8 inches; diameter, 4¼ inches.

171. *Pencil-washer* of white Ming porcelain: For details see above, page 371.

172–175. *Plates* (small) of white Ming porcelain: For details see above, page 372.

176. *Pilgrim-bottle* of pure white Chienlung (1736 to 1796) porcelain of wheel shape on an ovate foot, with low circular neck attached by foliated handles. Decoration on front and back consists of a central boss bearing a formal

foliate pattern, and surrounded by a band of Grecian pattern; round the boss as center are eight lambrequin panels, each containing one of the eight Buddhistic emblems (see No. 54), the panels being confined by another band of Grecian pattern. This ornamentation and a band of Grecian pattern round the brim of neck are moulded in relief on the paste, and, together with the plain edge of the foot, are covered with a rich céladon glaze. The neck, arms, remainder of foot, and flat surface of disk of wheel (or vase) are ornamented with lotus flowers and leaves in bright, deep blue under glaze. Beneath foot, mark *Ta-ch'ing-chien-lung-nien-chih*, "Made in the Chienlung period of the Great Pure Dynasty." A very beautiful specimen. Height, 18⅝ inches; diameter of disk, 9⅜ and 14¼ inches. (See Plate 8.)

177. *Vase*, small, of elongated drum shape, of pure white Chienlung porcelain, with ornamentation in deep blue beneath transparent glaze, consisting of formal interlacing scroll-work forming lotus-shaped panels containing the fungus of longevity (*ling-chih*), surmounted by *svastika;* around the rim another band of delicate foliated scroll-work. Mark as in last. Height, 3⅝ inches.

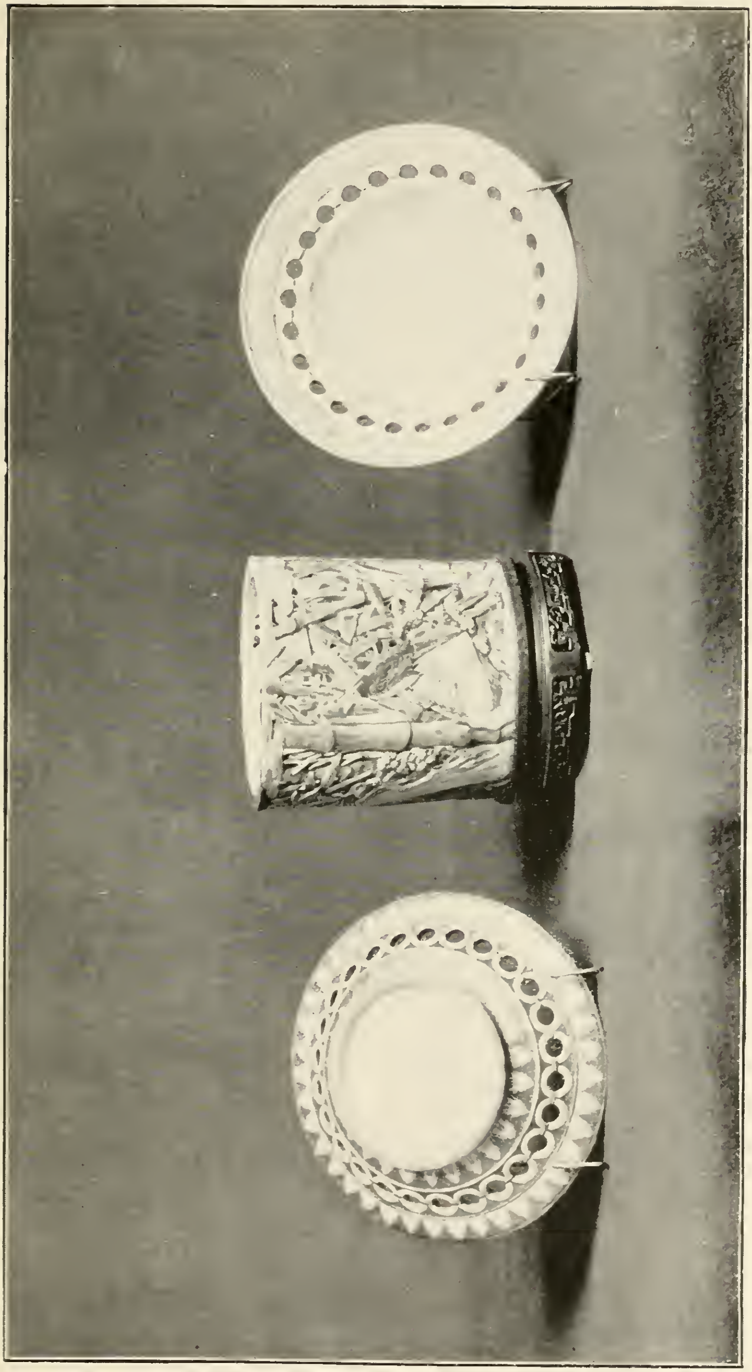
The *svastika* is a mystic diagram of great antiquity. It is mentioned in the Râmâyana and found in the well temples of India, as well as among all the Buddhistic people of Asia, and, as the emblem of Thor, among Teutonic races. In China it is the symbol of the Buddha's heart, *i. e.*, of the esoteric doctrines of Buddhism, and is the special mark of all deities worshipped by the Lotus school.

178. *Vase* of pure white Chienlung porcelain, of flattened bulbous shape, with long tapering neck, covered with bats and clouds in blue, delicately shaded under glaze, confined above by narrow band and below by a double broader band, partly round the foot and partly on body where it begins to bulge, of conventional scroll-work. A handle on either side of neck, formed by a *mang* (see No. 9), finely molded in relief, clambering upward from body of vase. Mark as in last. Height, 7⅝ inches.

179–180. *Vases* (2) of pure white Chienlung porcelain. The shape resembles that of a pear, swelling gently as it rises until it suddenly contracts to terminate in a short, narrow, everted neck. At neck a light formal pattern, below which is a collar of scroll-work in panel form. Upon the body are sprays of peony (*Pæonia moutan*), plum blossom, and chrysanthemum above, and below branches, each bearing fine fruits, of pomegranate, peaches, and lichees; confined at foot by a deep band of upright leaves—all in deep blue, shaded, under a thin transparent glaze. Mark as in last. Height, 12½ inches.

181–182. *Rice-bowls* (2) of white Chienlung porcelain, ornamented with designs well painted in deep blue under a transparent glaze; *inside*, at bottom, a medallion of conventional ornate scroll-work; *outside*, three clusters, one of bamboo, one of plum-blossom, and one of pine. Mark as in last. Height, 2⅝ inches; diameter, 5¼ inches.

P'ênglai-shan (Mount Horai of the Japanese) was one of the three Isles of the Genii, supposed to lie off the eastern coast of China, in which flowed the fountain of life in a perpetual stream, giving sempiternal vigor to the happy denizens of this paradise who drank its waters. The pine, the bamboo, the plum, the peach, and the fungus of longevity grew forever on its shores; the long-haired tortoise disported in its rocky inlets, and the white crane built her nest in the limbs of its everlasting pines. All these have thus come to be emblematical of long life. The first three, however, are almost always found in combination under the title of *sung-chu-mei* (pine, bamboo, and plum); the remainder either separately and alone or as adjuncts to the appropriate genii.



PLATES OF CHIENLUNG PORCELAIN (NOS. 191 AND 192) AND PENCIL HOLDER (NO. 221).

FOR EXPLANATION OF PLATE SEE PAGES 393, 397.

183, 184. *Vases* (2) of white Chienlung porcelain of *potiche* shape, but with everted neck, requiring no cover; bearing ornamentation of bats, emblematical of happiness, and lotus flowers with formal foliage interlacing of various shades of blue under transparent glaze; at neck a band of formal design and at foot a deeper band of same. On either side a sort of handle molded in relief, of a tiger's head holding a ring in the mouth. Mark same as last. Height, $8\frac{1}{4}$ inches.

185. *Vase*, small and slender, of pure white Chienlung porcelain, of double thickness at neck, the outer layer of paste terminating below in an everted scalloped-edged ruffle, curving outward and downward. Ornamentation consists of roses and chrysanthemums painted in deep blue under thick, transparent glaze, leaving three medallions of pure milk white, in which, as open-work, chrysanthemums and bamboos, roses, and plum blossoms are respectively molded with great delicacy in relief under thick white glaze. Round the projecting edge at neck runs a foliated scroll engraved in relief under a white glaze. A very beautiful specimen. Being intended to hold flowers, the open-work of the medallions has required the presence of an interior vase, separate in the body but uniting at the neck, to hold water. No mark. Height, 5 inches. (See Plate 13.)

186, 187. *Rice-bowls* (2) of white Chienlung porcelain. Ornamentation: *inside*, two circles inclosing a "sitting" imperial five-clawed dragon (see No. 4) amid clouds; *outside*, two flying dragons of the same character amid clouds; all in very deep, beautiful blue under a transparent glaze. Mark *Ta-ch'ing-chien-lung-nien-chih*, in seal character in blue. Height, $2\frac{5}{8}$ inches; diameter, $5\frac{3}{4}$ inches.

188. *Pilgrim-bottle* of white Chienlung porcelain of same shape as No. 176, but of smaller size, and bearing precisely same decoration, which is, however, in deep blue, shaded, under a transparent glaze. Mark same as in last. Height, $13\frac{1}{2}$ inches; diameter, $5\frac{3}{4}$ and 10 inches.

189, 190. *Vases* (a pair) of white Chienlung porcelain bellying outward above foot, then gradually contracting to form slender neck, terminating in a small globe. The ornamentation of the body consists of sprays of chrysanthemums, peach, plum blossom, pomegranate, peonies, and lichees, confined below by a band of formal panel scroll-work, surmounting a band of clouds, and above by two bands of Grecian pattern inclosing between them one of formal panel scroll-work, surmounted by a second band of foliate scroll, the decoration being in deep blue under a transparent glaze. Mark same as on No. 187. Height, 11 inches.

191, 192. *Plates* (a pair) of white Chienlung porcelain. Unique specimens, displaying great artistic skill as well as wealth and beauty of ornament. At rim is a band having a foliate pattern incised in the paste, of conventional flowers and foliage in enamel colors on a magenta ground. Separated from this by a narrow bar of gold is a second band of open-work circular chain pattern of alternately blue and gold links on a ground of pale green, bearing a delicate ornamentation in black. Another thin bar of gold divides this band from the body of the plate, which is of lemon yellow, having a foliated pattern engraved in the paste. On the lemon-colored ground are seen the five poisonous reptiles, the flying centipede, the snake, the scorpion, the lizard, and the toad, with peony flowers and antidotes against the venom of these reptiles, namely, patch-work bags containing sprays of the *yü* plant (? dogwood) and the *p'u* or typha rush, all in enamel colors of natural tint. On *outside*; on either side of perforated chain, which is painted as on inside, is a band of leaf pattern in shades of green on a deep orange ground picked out with a foliate pattern in gold. On foot is a simple ring studded with gems of green enamel in high relief on deep orange ground. Mark in vermilion same as on Nos. 186, 187. Diameter, 8½ inches. (See Plate 9.)

At the *Tuan yang* festival, on the 5th day of the 5th moon of each year, special offerings are made to these insects, and rough paintings of similar design to these plates are then hung over the door of each house.

193. *Vase* of white Chienlung porcelain, slender in shape, sloping gently outward to about two-thirds of height, then gently contracting to form neck, which curves outward at brim. Upon a ground of delicate pale green throughout is painted the decoration, which consists of conventional flowers and foliage of varied colors outlined in gold. This main decoration is confined at foot by a deep border of formal foliated scroll pattern in brick red on a yellow ground, and at base of neck by a narrow border of same, from which springs a crown of banana leaves of light green, veined with gold and outlined with blue; above this is a band of conventional flowers and foliage confined by a foliate scroll outlined with blue and gold on a yellow ground. Mark in gold same as on Nos. 186, 187. Height, 13¾ inches.

194. *Vase* of white Chienlung porcelain. Circular in shape, curving gently outward till at four-fifths of its height it contracts to form a short neck curving outward at brim. On a ground of pea green covered with a foliated pattern engraved in the paste branches of yulan (*magnolia conspicua*), red peach blossom, peonies with full-blown flowers of red and of yellow, with vermilion buds, spring from a cluster of rocks on which stands the sacred *fênghuang* (see No. 4), all beautifully painted and shaded in natural colors under brilliant glaze, the greens being enamels. Inside of vessel, gold. Mark as in Nos. 186, 187. Height, 19¼ inches. (See Plate 10.)

195. *Vase*, tall, circular in shape. On a pea-green ground covered with a small foliate pattern incised in the paste is an old man, holding a long crooked stick and dressed in a long vermilion cloak, with a tall conical cap upon his head, to whom a boy dressed in pink is presenting on bended knee a bat, while four other bats hover in the air, well painted under a brilliant glaze. No mark. Height, 14⅝ inches. (See Plate 10.)

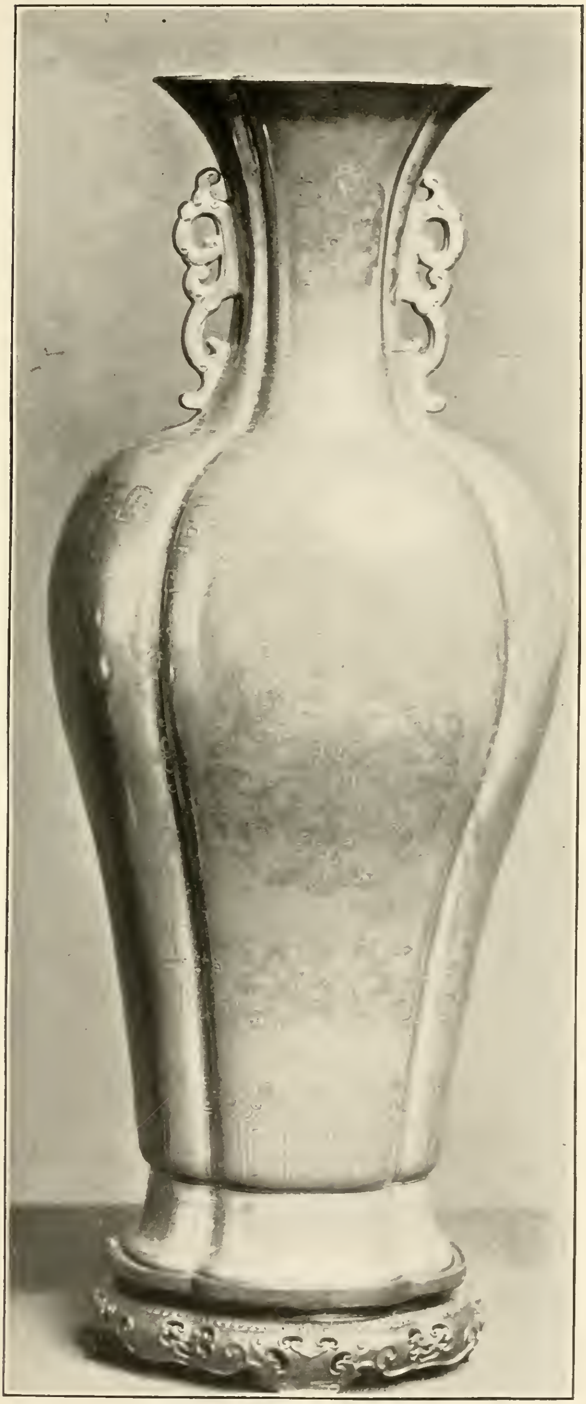
A common motive with Chinese artists is the presentation to Lao Tze (see No. 54), the great philosopher and founder of the Taoist sect, of an immortality peach by Tung Wang Kung, the consort of the legendary Queen of the Fairies, Hsi Wang Mu, or by one of his attendants, on the Sage's arrival at her mountain palace in the K'unlun range (see No. 28). The same subject is here depicted, a bat replacing the peach. Since the pronunciation of the character for "bat" is the same as of that for "happiness," the five bats symbolize the "five blessings or happinesses." Lao Tze is receiving the first, "longevity;" the remaining four—riches, peacefulness and serenity, love of virtue, and an end crowning the life—hover over his head.

196–201. *Wine cups* (6) of white Chienlung porcelain, colored, *inside*, pale green; *outside*, deep blue (*bleu de roi*), on which spread sprays of peony, yulan (*magnolia conspicua*), and grasses delicately painted in gold, and confined at brim and where cup springs from the foot by a band of Grecian pattern, also in gold. Good specimens, well preserved. Mark as on Nos. 186, 187. Height, 1⅝; diameter, 2¾ inches.

202, 203. *Vases* (a pair) of pure white Chienlung porcelain, of shape termed by Chinese *hai-t'ang*, (*Cydonia japonica* and *Pyrus spectabilis* or *baccifera*), slender, gently bulging to two-thirds height, then contracting slightly to neck, everted at mouth, entirely covered with deep-blue glaze (*bleu de roi*); divided by flutings into four sections throughout, each section or scallop decorated with

VASES OF CHIENLUNG PORCELAIN (NOS. 195 AND 194).

FOR EXPLANATION OF PLATE SEE PAGE 394.



VASE OF CHIENLUNG PORCELAIN (NO. 202).

FOR EXPLANATION OF PLATE SEE PAGE 394.

ornamental scroll work and peach sprays with conventional medallions formed of longevity fungus, from which spring lotus flowers, over each of which hovers a bat with extended wings (symbol of happiness). Around foot is a deep border formed by a band of flowers supporting a second band of conventional foliate scroll work. Round the neck is a border, partly of geometrical pattern, partly of foliate scroll work; above, in middle panel, a medallion of peach branches with leaves and fruit flanked on sections of side panel, which are formed by a gilt handle similar to conventional scroll work on body, by narrow spray of similar peach. Round the rim is a narrow band of bats with outstretched wings. The ornamentation, which typifies "long life and happiness," is throughout of bright gold. Inside a pale green. On foot of same, color mark as on No. 186. Unique and very beautiful specimens. Height, 18 inches; diameter, 6⅝ and 8 inches. (See Plate 11.)

204, 205. *Vases* (a pair) of pure white Chienlung porcelain, circular in shape, bulging suddenly above foot to one-half height, then contracting to form long neck, everted at brim. Decoration consists of an imperial five-clawed dragon pursuing sun and five bats among clouds over breaking waves at foot; beautifully molded in relief under white glaze. Round the foot a band of Grecian pattern incised in paste under glaze. Mark as on No. 186. Height, 12 inches; diameter, 8 inches. (See Plate 17.)

206. *Vase* of white porcelain, globular in shape, with straight, somewhat broad neck. Decoration: From a mass of rocks, colored blue, green, and white, and on which grow red and white peonies, springs a spreading tree, with green trunk and leaves, some white, some green. Among the branches stands a stork on one leg, another stork is shown flying from among clouds above, while four more stand below in various positions on and around the rocks, the storks being white, with black legs, tails, and beaks and red crests. The ground color of the vase is brown aubergine, covered throughout with a brilliant transparent glaze. The date is uncertain, but the style of decoration indicates that it may belong to a period considerably anterior to Chienlung's reign; it certainly is not of a later date. Height, 15¼ inches.

Represents the home of the stork of immortality on P'êng-lai-shan (see No. 181). (See Plate 12.)

207–210. *Tea cups* (4) of thin white Chienlung porcelain, with wide mouths. Decorated with slight sprays of conventional lotus flowers and leaves, forming four panels, in each of which is a small similar flower with a butterfly on outstretched wings above in deep tones and one in light tones below. Very beautifully painted. Mark as on No. 186. Height, 2⅝ inches; diameter, 4¼ inches.

211, 212. *Cups* (a pair), small, of pure white Chienlung porcelain, with wide mouths. Inside plain. On outside, on thick violet ground, are sprays of iris; Chinese pinks of various colors, red peonies, and yellow peonies spring from the foot of cup. Mark as on No. 186. Height, 1¾ inches; diameter, 3⅝ inches.

213. *Hanging vase*, flat, of pure white Chienlung porcelain. On an imitation wooden stand, colored vermilion, with a scroll pattern (representing the carving usual on such stands) in gold, stands a vase of the shape of a gourd contracted at the middle (*hulu*), conventionalized by giving a scalloped outline to the two globular portions, into which the gourd is shaped by the central contracting band. On the lower and larger portion is a panel outlined in gold, and of lower level than the surrounding body. On the panel is a landscape painting of mounted Tartars, in official dress, hunting; the body is decorated with delicate foliations in gold, studded with conventional star-shaped flowers of various but subdued colors. A narrow band of panel scrolls in brick red, edged with white on a green ground, and a second band of delicate blue and pink flowers on a pale-yellow ground, contract the gourd at the center.

Above, on the smaller swelling, the ground of which corresponds with that of the larger swelling below, is a second gold-edged panel containing a four-line stanza signed by the Emperor Chienlung, himself an ardent sportsman, extolling the pleasures of the chase. The outward sloping neck is decorated with a band of scalloped upright banana leaves on the same ground as covers the lower portion of the vase. Mark as on No. 186. The landscape and figures admirably painted; style of decoration shows great artistic skill. Height, $8\frac{1}{2}$ inches.

214. *Wine pot* and cover of pure white Chienlung porcelain. Of slender, graceful form, entirely covered with plain gold. No mark. Height, $8\frac{3}{4}$ inches.

215, 216. *Bowls* (a pair) of white Chienlung porcelain. Everted brims. Covered inside with a straw-colored glaze. Outside the ground is of brick-red, showing in the natural white of the porcelain a decoration of conventional lotus flowers, chrysanthemums, and foliage, shaded with the color of the ground, vermilion. Mark as on No. 186. Height, $2\frac{6}{8}$ inches; diameter, $5\frac{1}{8}$ inches.

217. *Pencil-holder* (small) of enamel, on copper, cylindrical, with four gilt dragon handles. Divided into two sections by three narrow horizontal bands, one at top, one at foot, and the third midway between, of minute convolvulus, peony, iris, and chrysanthemum blooms on white ground. The two sections thus formed have a ground of diaper-pattern in deep olive green; on the upper section in each space between the bands is a panel containing a miniature landscape in crimson; on the lower are two long panels of landscapes with men fishing with rod and line, separated by two smaller panels each containing a European lady holding a flower, delicately painted. Specimen of the work of T'angying (see page 347). Mark as on No. 186. Height, $2\frac{1}{2}$ inches; diameter, $1\frac{3}{4}$ inches.

218. *Vase* of white Chienlung porcelain. Shaped as a slender gourd. Contracted at middle by a band of narrow pointed leaves above, and another below, a central ribbon, moulded in relief; from upper and smaller swelling spring two ear-shaped handles, covered entirely with dull monochrome glaze of deep olive or "tea-dust" (*ch'a-mo*) color. Mark as on No. 186 impressed in foot. Height, 10 inches.

219. *Flower-holder* of white Chienlung porcelain. In shape a much-flattened globe, from which springs a wide everted neck closed at top, with three perforations to hold single flowers, covered with brilliant deep blue (*bleu de roi*) glaze. Mark as on last. Height, $3\frac{1}{4}$ inches.

220. *Vase* (small) of pure white Chienlung porcelain. From a small stand, vermilion color, bearing a geometrical scroll pattern in gold—to imitate a stand of carved wood—springs the vase, gently bulging to two-thirds height, when it contracts to form everted neck. The body is of dull light blue, on which are conventional flowers in various shades of pink and yellow with scroll foliage in shades of green, veined with darker tints of same, confined at foot by a panel band of delicate pink edged with dull green, and, at contraction below neck, by a band of foliated scrolls of pink outlined with deep green, the pink becoming lighter till it merges in a narrow band of vermilion studded with small open circlets of gold. The decoration at base of neck consists of a bulging band of yellow, bearing conventional flowers of various shades of pink and yellow, and green scroll-like foliage. Above on the trumpet-shaped neck is the same dull, light-blue ground as on body, bearing pink and white flowers with delicate green leaves, confined below by a band of upright banana leaves of palest green outlined with white and veined with black, and above by a band around the brim of vermilion, bearing scroll-work in gold. Inside pale sea green. On foot of same, mark as on No. 186. A choice specimen. Height $5\frac{7}{8}$ inches. (See Plate 13.)

VASE OF WHITE PORCELAIN (NO. 206).

FOR EXPLANATION OF PLATE SEE PAGE 395.

221. *Pencil-holder* of pure white porcelain, of broad circular shape. Consists of beautifully molded openwork representing a bamboo grove strewn with rocks partially covered with stone crop, on one of which is a "painted" thrush about one-half natural size. The bamboo stalks are of pale green enamel, the fibers at joints shaded in brown, leaves of emerald merging into peacock green; rocks light green, delicately shaded into blue at hollows and under parts; thrush very delicately painted in brown, shaded with darker tint of same, every feather being defined. An exceptionally fine specimen. Mark *lü-chu-shan-fang-chên-ts'ang:* "The precious treasure of the house of green bamboo hill." Height, 6 inches; diameter, 5¾ inches. (See Plate 9.)

222. *Pencil-holder* of white Chienlung porcelain. Tall, cylindrical in shape. Formed of sections of slight bamboos kept in place by a ribbon at top and another at base, passing through the center of the bamboos and tied in bows. Painted in gray, well shaded in black under rich glaze. No mark. Height, 4⅝ inches; diameter, 2¾ inches.

223. *Hanging-vase* of pure white Chienlung porcelain. From well-molded stand of dull vermilion, with rectangular supports representing a carved wood stand, springs the elliptical shaped vase with short, bulging neck. The body of the vase consists of a deep magenta ground, on which are conventional flowers of alternate blue, violet, and yellow, shaded with deeper tones of same colors, and scroll-like foliage of deep green at center, passing into lightest green or white at the edges. In center is a scallop-edged panel, bearing in large old-seal characters a poem composed by the Emperor and bearing his seal. Mark beneath foot as on No. 186. Height, 10 inches; diameter, 2½ and 8¾ inches.

224, 225. *Jars* (a pair), with covers, of white Chienlung porcelain. Globular in shape. On a bright yellow ground are four groups of growing plants of white lotus tipped with pink, of white plum blossoms with pink centers, of white and pink peonies, and of white and pink lotus flowers and green leaves, the outlines and veining of which are engraved in the paste, confined above and below by bands of panel and foliate scroll patterns combining the same colors as those used upon the flowers—green, white, and pink. Over the mouth is a close-fitting cover ornamented with two butterflies and two sprays of plum blossom on the same deep yellow ground—all covered with a brilliant transparent glaze. No mark. Height, 10½ inches.

226. *Vase* of white Chienlung porcelain, shaped as a gourd contracted at middle (*hulu*). Entirely covered with an elaborate design of trailing gourds (of same shape as vase) with conventional scroll-like leaves and bats outlined in gold and shaded partly in gold and partly in silver upon a dull olive green or "tea dust" (*ch'a-mo*) ground. A very rare specimen. Mark as on No. 186. Height, 8 inches. (See Plate 13.)

227. *Pencil holder* of white Chienlung porcelain, of slender, cylindrical shape. The philosopher Lao Tsze, on his way to the palace of the Fairy Queen, Hsi Wang Mu (see No. 28), is represented soaring upon a cloud, arranging his shoe. In the distance is the mountain palace of the fairies, with the Queen's azure-winged attendant birds (*ch'ing niao*), all beautifully moulded in high relief under a brilliant, deep yellow glaze. No mark. Height, 5 inches; diameter, 1½ inches.

228–233. *Wine cups* (6) of white porcelain, plain inside. Nos. 228, 230, 231, 233 are studded with small, conventional, star-like flowers, circular in shape, of various colors delicately shaded, on a céladon ground. Nos. 229 and 232 bear the same flowers, but outlined and shaded in gold on a dull black ground. No mark. Height, 1¾ inches; diameter 2⅝ inches.

234. *Plate* of white Chienlung porcelain, entirely covered with a brilliant, pale céladon glaze, above which is depicted in bright gold a clump of bamboos springing from rocks, with a short poem eulogistic of their beauty. Mark as on No. 186. Diameter, $1\frac{5}{8}$ inches.

235. *Vase* of pure white Chienlung porcelain, of flattened, bulbous shape, with straight, slender neck. Outlined by engraving in the paste are flaming sun, colored carmine, and conventional clouds colored white, blue, green, and carmine, and above foot waves of brilliant green, with foam and breaking edges of pure white. The ground outside of the incised decorations is deep imperial yellow, on which are two imperial five-clawed dragons (see No. 4), one descending from the clouds, the other rising from the waves, beautifully drawn and shaded in deep brown, the yellow ground appearing through the shading. At rim of neck is a foliated scroll border engraved in the paste and colored white with blue outline; inside colored yellow. No mark. Height, $11\frac{7}{8}$ inches. (See Plate 14.)

236. *Vase* of pure white Chienlung porcelain of *lancelle* shape. In tumbling waves of brilliant blue (shaded) with light foam crests is a four-clawed dragon of resplendent white beautifully moulded in high relief, covered with a very thick, transparent vitreous glaze. A beautiful and effective ornament. No mark. Height $14\frac{7}{8}$ inches; diameter, $7\frac{3}{8}$ inches. (See Plate 2.)

237. *Snuff-bottle* of pure white Chienlung porcelain, with stopper to match. Circular in shape, very thin and flat. Upon a pale lemon-yellow ground are two round scalloped gourds on trailing stems, bearing five-petal flowers, some white, some pink, and leaves of various shades of green delicately shaded, with a butterfly on either side below with outspread wings, painted in delicate tones and with considerable skill. Mark *Chien-lung-nien-chih:* "Made in reign of Chienlung."

238. *Vase* of white Chienlung porcelain, pear-shaped, with low, narrow everted neck. On a white ground are four imperial five-clawed dragons (see No. 4), well drawn and shaded in carmine amid chrysanthemums and formal lotus (the so-called western lotus) with trailing scroll-like foliage, all in deep blue, confined at foot and at top by a deep band of foliated panel-pattern in blue, with small ornament in magenta in center. Above this band at top and extending to foot of neck is a band of longevity fungus in magenta with blue scroll leaves. Round the neck a circlet of banana leaves pointing upward. Mark as on No. 186. Height, 14 inches. (See Plate 15.)

239. *Snuff-bottle* of pure white Chienlung porcelain, small, of circular shape, somewhat flattened, with a handle formed by a grotesque lion's head holding a ring in its mouth moulded in relief on the convexity of either side, colored vermilion and picked out with gold. On the body are stalks of pink and white peonies, pink rose, white yulan (*magnolia conspicua*) and red plum blossom springing from rockery, very beautifully painted under a brilliant transparent glaze. Mark as on No. 186. Height, $1\frac{7}{8}$ inches.

240, 241. *Bowls* (a pair) of pure white Chienlung porcelain, with everted brim. Decorated inside at bottom with octagonal ornament and, alternately, formal flowers and butterflies rising from the eight sides of the ornament; above and round the sides, four gourd-shaped vases delicately ornamented with geometrical and scroll designs and bats and chrysanthemums, suspended over them being elaborate hexagonal canopies with long streamers dependent from the six angles. Outside are four medallions of pure white, inclosed by gold band and containing a group of table articles, of which the chief is a vase containing a branch of plum or other blossom, with a small delicately ornamented jar covered with canopy and streamers depending from the branch; the remaining articles being dishes of fruit, a water-holder, incense-burner, etc., delicately painted. Between the medallions a small conven-

VASES OF WHITE CHIENLUNG PORCELAIN (NOS. 220, 226, AND 185).

FOR EXPLANATION OF PLATE SEE PAGES 396, 397, 393.

VASE OF WHITE CHIENLUNG PORCELAIN (NO. 235).

FOR EXPLANATION OF PLATE SEE PAGE 398.

VASE OF WHITE CHIENLUNG PORCELAIN (NO. 238).

FOR EXPLANATION OF PLATE SEE PAGE 398.

tional lotus flower below, and a larger flower of same above, with scroll-like foliage on a deep magenta ground, which is covered outside the flowers and leaves with delicate foliate ornamentation engraved in the paste. Earliest specimens of the so-called "medallion bowls" which a few years ago brought such high prices in England. Mark as on No. 186. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{7}{8}$ inches.

242. *Dish* of white porcelain, of low, slightly ovate shape, formed by a lotus leaf (*Nelumbium speciosum*) curling up at edges, veining incised on inside and in relief on outside; a flower and seed-pod ascend on outside from beneath leaf to rest on its edge, while a lizard crawls from inside having its body on the leaf-edge and head raised aloft. Covered throughout with fine "peacock" green glaze, uncrackled. No mark. Diameter, $8\frac{1}{2}$ and $9\frac{3}{4}$ inches.

243. *Snuff-bottle* of pure white Chienlung porcelain, of flattened ovate shape terminating in long, slender neck. On one side is Yang Kuei-fei, and on the other Hsi Shih clad in rich embroidered robes playing on the guitar, painted with great delicacy above brilliant glaze. No mark.

Yang Kuei-fei, the daughter of an obscure official in the modern Szechuen, was introduced by the designing minister Li Liu-fu into the seraglio of the Emperor Ming Huang, of the T'ang dynasty (died A. D. 762). Becoming enamored of her beauty, the Emperor abandoned the wise counsels of Chang Yüeh, Chang Chin-ling, and other ministers, under whose administration the empire enjoyed great prosperity, and sank, year by year, more deeply in the toils of amorous dalliance. The Princess Yang's three sisters were also introduced into the seraglio and endowed with valuable fiefs. No outlay was spared in gratifying the caprices and covetousness of this family of favorites, and the nation was sacrificed to the licentious enjoyment of the court, till at last the people rose in revolt, the aged monarch was forced to take refuge in western China, and, after undergoing the misery of witnessing the butchery of his favorites, to abdicate in favor of his son.

Hsi Shih, the daughter of humble parents, but the *ne plus ultra* of loveliness in Chinese tradition. A report of her consummate beauty having reached the ears of her sovereign, Kou Chien, Prince of Yüeh, a state occupying the east coast of China below the Yangtse in the fifth century B. C., he had the girl trained in all the accomplishments of her sex and sent her as a present to his victorious rival, the Prince of Wu, in the hope that her charms might prove his ruin. The stratagem was successful and Fu Ch'a, Prince of Wu, abandoning himself to lustful dalliance, was ere long defeated and crushed. It is said of Hsi Shih that finding her beauty was enhanced by an air of melancholy, she was accustomed to knit her brows as though in pain, and this device, adding as it did to her attractiveness, was copied by rival beauties, who vainly sought to equal her charms.[1]

244. *Vase*, white Chienlung porcelain, bulging from foot to two-thirds height, then contracting to short everted neck. Ornamented with long trailing stalks of conventional lotus flowers and leaves moulded in relief on paste; confined below by foliate panel ornamentation, also in relief, with shading engraved in the paste, and above, by a band of same, having above it a band of geometrical pattern and round the neck a foliate band, both engraved in the paste and covered by a céladon glaze so faint as to be almost white. No mark. Height, $12\frac{5}{8}$ inches.

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[1] Mayers, Chinese Reader's Manual, No. 571.

245. *Vase* of white Chienlung porcelain, pear-shaped like No. 238, but more slender, having nine imperial five-clawed dragons (see No. 4) surrounded by flecks of flame soaring in mid-air and rising from waves which are incised in the paste around foot, all finely moulded in relief, with crisp outline on the paste and covered with a deep peacock-green glaze coarsely crackled. A beautiful specimen of this rare ware. No mark. [M. du Sartel gives a drawing in his work of a similar vase, which he (erroneously) refers to what he terms *la première époque*—that is, the early portion of the Ming dynasty, fifteenth century.] Height, 14 inches. (See Plate 16.)

246. *Pencil-holder* of pure white Chienlung porcelain, of cylindrical shape with much everted mouth and corresponding foot, and bound in middle by a raised band ornamented with flowers and leaves; from either side of this band springs a circlet of veined banana leaves, atl incised in the paste under a brilliant transparent glaze. A Chingtê-chên copy of a similar article of the Tingchow ware of the Sung dynasty, an ancient bronze vessel having served as the original model. No mark. Height, 2⅝ inches; diameter at mouth, 3¾ inches.

247. *Bowl* of white Chienlung porcelain with everted brim. Decorated, outside, with grasses, yellow lotus flowers, blue and red pinks, peonies, and leaves of various shades of green well painted on somewhat dull vermilion ground; with flowers on white ground at bottom inside. Mark as on No. 186. Height, 2⅝ inches; diameter, 5¼ inches.

248–251. *Rice bowls* of white Chienlung porcelain, with everted brim. On outside, bands at rim and above foot, of foliated scroll work in white shaded with vermilion on a ground of same color, confine a plain white space on which is written in vermilion characters a long poem composed by Emperor Chienlung and bearing his seal and date of "the spring of Ping-yen," that is, 1746. On inside on plain white ground, at bottom branches of pine, plum blossom (emblems of longevity, see No. 181) and the "Buddha's hand" citron (*Citrus sarcodactylus*) in vermilion; on side two bands of scroll work similar to those on outside. Mark as on No. 186. Height, 2⅛ inches, diameter, 4¼ inches.

252. *Wine cup* of thin, pure white Chienlung porcelain, with wide, open mouth. Inside plain, covered with brilliant transparent glaze. On outside, between two narrow bands of Grecian pattern at rim and above foot is a very close and delicate ornamentation of lotus flowers and leaves, engraved, as is the Grecian pattern, in the paste, which is unglazed. On this, as ground, appear two imperial five-clawed dragons moulded in relief and beautifully drawn and shaded in vermilion under brilliant glaze. Mark as on No. 186. A very curious and beautiful specimen. Height, 2 inches; diameter, 4¼ inches.

253. *Plate* of white Chienlung porcelain, decorated inside with red peony (*Pæonia moutan*), white yulan (*Magnolia conspicua*) and buds on a deep blue ground ornamented with a foliate decoration engraved in the paste. On outside under brim five bats, symbolical of the five kinds of happiness, in vermilion. Mark as on No. 186. Diameter, 8 inches.

254, 255. *Plates* of white Chienlung porcelain, similar to above. Decoration on inside consists, however, of sprays of red rose, asters, and pomegranate on a green ground similarly ornamented with foliate decoration engraved in paste. Mark and size the same at last.

256. *Plate* of white Chienlung porcelain. On light whitish carmine ground ornamented with conventional lotus flowers and leaves in deep carmine, on which are five foliated panels containing landscape scenes in enamel colors, in foreground of each of which is a European clad in the dress of the Louis the Fourteenth period, bearing a sword, a branch of coral, a *ju-i* (see No. 81), a crutch, and the model of a European house on a salver. Outside decoration and mark same as on No. 253.

VASE OF WHITE CHIENLUNG PORCELAIN (NO. 245).

FOR EXPLANATION OF PLATE SEE PAGE 400.

257. *Plate* of white Chienlung porcelain. On a vermilion ground ornamented with conventional lotus flowers and leaves in gold are five foliated panels containing landscapes painted in enamel colors. Outside decoration and mark same as on No. 253.

258. *Plate* of white Chienlung porcelain. On pale yellow-brown mottled ground resembling agate are five foliated panels containing landscapes in enamel colors, in foreground of each of which is a child carrying a halberd, a lotus flower, a *ju-i*, a Buddhistic sacred relic (*shé-li*) on a salver, and one pursuing a butterfly. Outside decoration and mark same as on No. 253.

259. *Plate* of white Chienlung porcelain. On a light green ground covered with delicate cloud-like ornaments in black are sprays of lotus, roses, peonies (*Pæonia moutan*), plum blossoms, and chrysanthemums in natural colors. Outside decoration and mark as on No. 253.

260. *Bowl* (small) of white Chienlung porcelain. Plain inside. Outside, on a pale, rich, céladon ground are flowers painted in vermilion, with leaves of enamel green. Mark as on No. 186. Height, $1\frac{3}{4}$ inches; diameter, $3\frac{3}{4}$ inches.

261. *Vase* (small) of white Chienlung porcelain, of slender jar shape. Covered with a broad, double band of modified Grecian pattern in relief on basket-work ground engraved in the paste, confined above and below by bands of foliate design in relief with incised shading. Round the neck circle of banana leaves in relief with incised shading, all under transparent glaze having a céladon tinge. Mark as on No. 186. Height, 7 inches.

262, 263. *Plates* (a pair) of white Chienlung porcelain, circular with upright edges, small. In center is a gourd and two sprays of flowers tied with flowing ribbons held by a bat with outstretched wings amid clouds, very delicately moulded in relief and covered throughout with a pale céladon glaze. Mark as on No. 186. Height, 1 inch.

264. *Vase* of pure white Chienlung porcelain, curving inward slightly above foot, then bulging gradually to two-thirds height, when it contracts gradually to near mouth, which is slightly everted. At foot, a narrow band of conventional lotus flowers and leaves. Above, confined by band of foliated design engraved in the paste are four conventional lotus flowers with scroll-like leaves and flying bats so arranged that five bats (*wu fu*, or five kinds of happiness) appear round each flower. At base of neck is a narrow band studded with small dots (gems) in relief. Above, round the neck, a broad band of ornamentation similar to that on body, confined at top by band of foliated scroll work. The ornamentation throughout is moulded, boldly but with great delicacy, in relief upon the paste, and is covered with a brilliant deep céladon glaze approaching white in the highest portions of the relief. Mark as on No. 186, but in shape of a seal and in high relief. A unique and very beautiful specimen. Height, $11\frac{1}{4}$ inches. (See Plate 17.)

265. *Vase* of pure white Chienlung porcelain, of flattened bulbous shape with long slender neck which represents half of total height. Upon the body of the vase is a *mang*, the tail of which curls upward round the neck (see No. 9), very boldly moulded in relief with head erect and long beard depending from chin, covered throughout with a brilliant céladon glaze, the *mang* being spotted with marks of red and brown mixed, shading off into the glaze, and on the body of the vase are curious cloud-like splotches of deepest olive green shading off at the edges. Mark as on No. 186. Height, $12\frac{3}{8}$ inches.

266. *Vase* of white Chienlung porcelain of slender bulbous shape with neck ending in trumpet-shaped mouth, entirely covered outside with a uniform glaze in color between vermilion and deep carmine. Rim of mouth and inside plain. Mark as on No. 186. Height, $11\frac{3}{4}$ inches.

267. *Pencil-washer* of white Chienlung porcelain, in shape resembling an S scroll with tall perpendicular sides. Inside biscuit unglazed. Outside covered with a uniform deep green (called by Chinese "cucumber green") closely crackled (*truité*). No mark. Height, 1¼ inches; length, 3½ inches.

268, 269. *Vases* (a pair) of white Chienlung porcelain, a pomegranate fruit in shape—of the kind termed *flambé*. The mixed blue and white colors which cover the mouth and inside, flow down and become specially prominent in the hollows at junction of the sections, the latter being a brilliant purple red, and the conflicting tints gradually merging into one another at the edges of contact; all covered with a brilliant thick vitreous glaze.

270. *Vase* of white Chienlung porcelain shaped as a gourd contracted in the middle. Covered with deep red having a somewhat mottled appearance on lower globular portion, under a brilliant, thick vitreous glaze, the edge of the mouth inside and out being white, though the color appears inside farther down. No mark. Height, 8⅝ inches.

271. *Vase* of white Chienlung porcelain, of ancient bronze design, in form of two diamond-shaped vases of which one-fourth of the length has been cut off and the sections united; at either end an elephant's head with trunk forms a handle just below neck, which is of same shape as that of the body of vase. Covered with splotches, which have run into one another, of several dull colors, black, bottle green, and deep lake, giving the appearance of mottled agate, under a thick glaze. The porcelain is coarsely crackled like ice. No mark. Height, 5¼ inches.

272. *Vase* of white Chienlung porcelain, of small *lancelle* shape, bearing chrysanthemum flowers and leaves engraved in paste, over which under a rich vitreous glaze is a wavy pattern in yellows and browns resembling agate. No mark. Height, 6½ inches.

273. *Vase* of white Chienlung porcelain, bulging from above foot, then contracting concavely to form slender neck much everted at mouth. Decoration consists of bamboos and chrysanthemums outlined and shaded in black on deep blue ground, covered with thin but brilliant glaze. Edge of mouth black, inside plain white. No mark. Height, 11⅜ inches.

274, 275. *Plates* (a pair) of white Chienlung porcelain coarsely crackled. Ornamented with circular splotches arranged in pattern around a large central one, in which white, red, and blue colors appear, giving each splotch the appearance of a crushed purplish red fruit. Covered with a thick vitreous glaze, which has collected between the splotches and thus formed a sort of framework of bottle-green hue. Outside similar splotches are arranged regularly around brim. A curious variety of *flambé* style. No mark. Diameter, 9⅜ inches.

The use of spiked metal supports to keep vessels of porcelain in position within the kiln has been generally considered peculiar, in the East, to the Japanese system of manufacture. The marks of a seven-spiked stand on the feet of these plates show, however, that metal supports within the seggars have also, at least occasionally, been employed by the Chinese.

276. *Vase* of white Chienlung porcelain, of slender bulbous shape with long tapering neck, of the *flambé* variety. From its appearance one would judge the decoration to consist of a deep red ground on which has been blown (*soufflé*) a blue and white composition, which had formed a multitude of closely packed blue and white circles, of irregular edge owing to their having ran in the baking, under a thick, brilliant vitreous glaze. At mouth the color has disappeared, discovering the white porcelain under a crackled glaze. Lower down inside the color reappears. No mark. A very fine specimen. Height, 16 inches.

VASES OF WHITE CHIENLUNG PORCELAIN (NOS. 264 AND 204).

FOR EXPLANATION OF PLATE SEE PAGES 401, 395.

277. *Vase* of pure white Chienlung porcelain, of bulbous shape, long neck ending with a small globe. Inside without color. Outside is entirely covered with a deep *sang-de-bœuf* red, with streaks like fleecy clouds of blue discovering white, the edges of which shade into black or very deep purple where the colors mingle, under a thick vitreous transparent glaze, crackled about mouth. No mark. An exceptionally fine specimen. Height, 13¾ inches.

278. *Fish bowl* (small) of white Chienlung porcelain, globular, colored *sang-de-bœuf* under a deep vitreous glaze. Rim white; then, on inside, red close to rim, and lower down where glaze has run in baking, streaked—of good color. No mark. Height, 3 inches.

279. *Vase* of white Chienlung porcelain. Globular in shape, upper part of globe being cut at an angle of 45° to long neck which everts at mouth. On either side of neck is a handle formed by an elephant's head with inward curved trunk moulded in relief on the paste. Covered with *flambé* colors, red, blue, and white, which both inside and out merge into one another, each predominating in turn, under a thick vitreous glaze pitted like orange-peel. Mouth rim remains white. No mark. Height, 14⅛ inches.

280. *Vase* of white Chienlung porcelain, in shape of an inverted bulb, with small low neck covered with blue, red, and white *flambé*. Predominating color is red, but mottled with purple tints with blue and white appearing in places, under deep vitreous glaze pitted like orange-peel. No mark. Height, 8 inches.

281–284. *Screen panels* of white Chienlung porcelain. Two central panels, each 23¾ inches high by 9½ inches broad, are flanked on either side by a panel of same height and 5⅜ inches broad. On these is depicted, beautifully painted, Lao Tze, with lofty forehead and flowing white beard, in the mountain home of the Immortals, receiving two children riding the stag of longevity, with other children playing around, and genii coming to pay homage to the great sage, some on foot descending the mountains, some approaching on clouds, with Hsi Wang Mu herself preceded by her attendant birds (see No. 28). Around are twelve panels 3½ inches wide and in length some 9½ inches and some 11⅝ inches, covered with formal lotus flowers and conventional scroll-like foliage, all in natural colors. A very beautiful piece of furniture, the frame being carved black wood.

285. *Fish bowl* of thick white Chienlung porcelain, bulging gently from base to wide open mouth. Among thick fleecy clouds of soufflé blue-black is a very boldly drawn, flying, princely four-clawed dragon with row of large spines running along back, body of slightly yellow tinge, the scales beneath belly, horns, and nose white. No mark. Height, 8½ inches; diameter, 10¾ inches.

286. *Plate* of enamel upon copper base; decorated with a painting of Wang Chih watching two genii engaged in game of chess (see No. 18) under tree in valley between rising hills; confined above and below by band of foliated scroll pattern in black, picked out with gold on a light-blue ground; outside around rim a foliated scroll pattern in blue on white ground. Mark, a *fêng hwang* (see No. 4). Diameter, 8⅜ inches.

287. *Plate* of enamel upon copper base; decorated with a painting of the famous poet Li T'ai-po, and companion in open country among rocks and trees engaged in the enjoyment of wine, of which, to judge by the size of the blue jar in background, they have a plentiful supply; outside decoration and mark same as on last. Both admirably painted. Diameter, 8⅜ inches.

Li T'ai-po (A. D. 699 to 762) is the most famous among the poets of China, and scarcely less noted for his love of wine. The curiosity of the Emperor Hsüan Tsung of the Sung dynasty having been aroused by the accounts made to him of the poet's genius, Li T'ai-po was summoned to an interview in the palace, where he was received with exaggerated honors. The Emperor himself handed the dishes, his favorite and haughty concubine was required to rub the ink for his use, and the chief eunuch and privy counsellor, Kao Li-Sze, had to divest him of his boots when overcome by wine. The Emperor's favorite, smarting under the indignity to which she thought herself subjected in his honor, barred the door to his official employment, and Li T'ai-po led "for the remainder of his life a wandering existence, celebrating in continual flights of verse the praises of bacchanalian enjoyment and of the beauties of nature in the various localities he visited." (Mayers.)

288. *Teapot* and cover of earthenware from the Ni-hsing district in Kiangsu province. Of globular shape, much flattened. Round the lower portion are pine and plum trees very delicately moulded in bold crisp relief; above, separated by a band of Grecian pattern incised in the paste, a single row of "old seal" characters in relief, from which it appears that the teapot was made at the special order of the Emperor Chienlung. On the cover is a scroll pattern, in relief, confined on either side by a band of Grecian pattern, and round the knob in the center is another band of same. A very beautiful specimen of this ware. Height, 2⅞ inches; diameter, 4½ inches.

SPECIAL GROUP OF EGG-SHELL PORCELAIN.

289–294. *Wine cups* (6) of pure white Yunglo (1403 to 1424) porcelain of the variety termed *t'o-t'ai*, "bodiless," or "egg-shell," with broad, open mouth. Round the sides is a delicate ornamentation of flowers and leaves faintly engraved in paste under a white enamel. On foot the mark, *Yung-lo-nien-chih*, in seal character—"Made during the Yunglo period"—engraved in the paste. Unique specimens at the present time. (See page 335.) Height, 1⅜ inches; diameter, 3⅝ inches.

295. *Bowl* of pure white Yunglo porcelain, called *t'o-t'ai*, or "egg-shell," or, perhaps, *p'an t'o-t'ai*, "semi-bodiless," though a bowl of this size would have little practical utility were it of less substance. Covered with white enamel over imperial five-clawed dragons (see No. 4) among clouds faintly engraved in the paste. Mark same as on last. The ornamentation on this and the six last specimens becomes more distinct when the articles are filled with liquid. Height, 2⅜ inches; diameter, 8 inches.

296–299. *Plates* (4) small, flat, of the very thin white Ch'ênghua (1465 to 1487) porcelain, termed *t'o-t'ai*, or bodiless. Decorated with landscapes representing pavilions with beetling rocks behind on the bank of a lake or river, crossed by row-boats having mat awnings, and a lofty-peaked mountain in the dim haze of distance, painted in brilliant enamel colors above glaze. On brim, outside, are—three on each plate—sprays of roses, pinks, chrysanthemums, iris, lotus, and coleus, also in brilliant enamel glaze. On foot, faintly engraved in paste, mark *Ch'êng-hua nien-chih* "Made during the Ch'ênghua period." Very rare specimens. Diameter, 4½ inches.

300–303. *Wine cups* (4), of the very thin, pure white Ch'ênghua porcelain, termed *t'o-t'ai*, "bodiless," or egg-shell. Small, tall, and slender, with everted rim. On each is a miniature group of the Seven Worthies of the Bamboo grove (See No. 53) with an attendant bringing a jar of wine and flowers. The porcelain is so thin that the design, with all the details of color, can be distinctly perceived from the inside. Mark in blue characters under glaze *Ta-ming-ch'êng-hua-nien-chih*, "Made during the Ch'ênghua period of the great Ming dynasty." Admirable specimens of the highly prized wine cups of this period, which even in the sixteenth century brought extraordinary prices. (See page 337.) Height, 1⅞ inches; diameter, 2 inches.

304–313. *Wine cups* (10) of the thin, pure, white K'anghsi (1662 to 1722) porcelain, termed *t'o-t'ai* "bodiless," with wide, open, everted mouth. Each is decorated with a single spray either of roses, red plum blossom, pomegranate, peach, peony (*Pæonia moutan*), chrysanthemums, or of *yüan yang* (see No. 101) swimming among lotus flowers painted in enamel colors, the branches being outlined in blue under glaze. On each is a short poem extolling the beauty of the flower it accompanies. Mark on foot *Ta-ch'ing-K'ang-hsi-nien-chih*, "Made in the K'anghsi period of the Great Pure dynasty." Delicate specimens. Height, $1\frac{7}{8}$ inches; diameter, $2\frac{1}{2}$ inches.

314. *Water holder*, for use on student's table when preparing ink, of the pure white Yungchêng porcelain, termed *t'o-t'ai*, "bodiless." In the form of a lotus leaf with crinkled edge, of which one-half (that forming the receptacle for water) turns up at edges, forming a small basin, which is half covered by the remainder of the leaf, arching over from the stalk. In the recess of the bent leaf are a pink, a beetle, and a fly, of tiny dimensions, painted with extreme delicacy and care. The top of the stalk and veining of the leaf are incised in the paste, and, owing to the thinness of the latter, appear in relief underneath. A most beautiful specimen. Height, 1 inch; length, $3\frac{1}{4}$ inches.

315–318. *Wine cups* (4) of thin, white Yungchêng (1723 to 1735) *t'o-t'ai* or "bodiless" porcelain, of slender shape, with everted brim. Decorated with ideal landscapes exquisitely drawn and shaded in sepia under glaze. Mark, *Ta-ch'ing-yung-chêng-nien-chih*, "Made in the Yungchêng period of the Great Pure dynasty." Height, $1\frac{3}{4}$ inches; diameter, $2\frac{1}{8}$ inches.

319,320. *Plates* (a pair) of thin, white Chienlung (1736 to 1795) *t'o-t'ai* or "bodiless" porcelain. Covered over with white enamel, in middle of plate two *ju-i* crossed (see No. 81), with the figure of the two Primordial Essences (see No. 40) in the center, and around the rim the eight Buddhistic emblems (see No. 54), all faintly engraved in the paste. No mark. Exceptionally fine specimens. Diameter, $7\frac{7}{8}$ inches.

321,322. *Rice-bowls* (a pair) of white Chienlung *t'o-t'ai* or "bodiless" porcelain. Covered with white enamel over scroll-like sprays of conventional lotus flowers (*hsi-fang-lien-hua* or lotus of the west) and leaves engraved in the paste inside and out, but in such manner that the two patterns do not coincide in their outlines, and that, if bowl be regarded from inside or from outside, the pattern on the side looked at is alone visible. Mark *Ta-ch'ing-chien-lung-nien-chih*, "Made in the Chienlung period of the first Great Pure dynasty," engraved in the paste under foot. Height, $2\frac{3}{8}$ inches; diameter, $5\frac{1}{8}$ inches.

SPECIAL GROUP OF VITREOUS WARE AND OF PORCELAIN MADE, WITH IT AS MODEL, TO SECURE A LIKE TRANSPARENCY OF COLOR WITH INCREASED BRILLIANCY OF GROUND.

323. *Snuff-bottle* (small) of dull, opaque, white vitreous ware, of flat elongated *potiche* shape, decorated with red lotus flowers and green leaves. Mark *Ta-ch'ing-nien-chih*, "Made during the Great Pure dynasty," the distinctive mark of the earlier productions of Ku Yüeh-hsüan. (See page 347.) This ware is so highly esteemed by the Chinese that it sells for higher prices than would similar articles of jade. Height, $2\frac{7}{8}$ inches.

324. *Water-holder* (small) of dull, opaque, white Ku Yüeh-hsüan vitreous ware of cylindrical shape. Decorated with a landscape very beautifully painted in natural colors, representing a young shepherd clad in Chinese dress, but whose features are unmistakably European, tending a ram and two ewes on a grassy sward confined by lofty rocks, among which grow herbs and flowering trees. The painting is characterized by all the delicacy of touch of a miniature. Mark in form of a seal engraved in foot and filled with blue enamel, *Chien-lung-nien-chih*, "Made in the Chienlung (1736 to 1795) period."

This and the next twelve specimens, namely, down to No. 336, inclusive, were made under the supervision of T'wang ying (see page 33). Height, $1\frac{7}{8}$ inches; diameter, $1\frac{3}{4}$ inches.

325. *Pencil-holder* of same ware, of cylindrical shape. Decorated with a group of the Seven Worthies of the Bamboo Grove (see No. 53) conversing together or examining a scroll bearing a landscape with pine trees, on a green sward edged with beetling rocks and flowering trees. An exquisitely drawn picture. Mark as on last. Height, $2\frac{3}{8}$ inches; diameter, $2\frac{3}{8}$ inches. (See Plate 20.)

326. *Wine-cup* (small) of same ware. Around the foot is a band of delicate red scroll-work on a yellow ground, with a very narrow band above of white foliate pattern on black ground. This and a broader foliate pattern at rim of the dull white color of the glass carefully shaded with straw-yellow upon a very pale green ground, confine the body of the cup, on which a yellow scroll-work forms two landscape panels. The intermediate spaces, slightly smaller than the panels themselves, are completely filled with peonies, chrysanthemums, convolvulus, lilies, asters, and many other flowers. A more artistic or delicately beautiful ornamentation than this and that of the following cup it would be difficult to find. Mark as on No. 324. Height, $1\frac{3}{4}$ inches; diameter, $2\frac{1}{8}$ inches. (See Plate 20.)

327. *Wine-cup* (small) of same ware. Around the foot is a band of same pattern as in last with an arabesque design above in carmine on a pink ground. Within this and a similar band around brim are delicate foliate patterns of the dull white color of the glass shaded with light brown on a ground of the same color, which confine the body of the cup. Here on a ground of the natural color of the ware is a fine damask in olive-green supporting four panels confined by yellow scroll-work—two square and two oblong. The former contain valley landscape scenes in winter season, and the latter similar scenes in summer season, very delicately painted in deep pink or carmine. Mark as on No. 324. Height, $1\frac{3}{4}$ inches; diameter, 2 inches. (See Plate 20.)

328, 329. *Rice-bowls* (a pair) of thin, pure white Yungchêng (1723 to 1735) porcelain covered with a very brilliant, transparent vitreous glaze to secure the delicate transparency in the coloring remarkable in the Ku Yüeh-hsüan ware (Nos. 323 to 327), and hence termed, as are Nos. 330 to 336, by the Chinese, *fang-ku-yüeh-hsüan*, modeled after that ware. Decorated with branching sprays of plum blossom beautifully drawn and shaded in sepia above the glaze, the artist's idea being explained by a stanza to the following effect:

> The student sees the outline sharp
> Of plum-bloom by the moonlight cast
> On window blind, and breathes the scent
> Of unseen flow'rets wafted past.

Mark as on No. 324. Height, $2\frac{1}{2}$ inches; diameter, $4\frac{7}{8}$ inches. (See Plate 19.)

330. *Tea-pot* of pure white Chienlung porcelain of globular shape and covered with brilliant vitreous glaze, upon which are very beautifully painted groups of white and of pink lotus flowers, and leaves crinkled into many, but quite natural, shapes and showing the dark upper and light lower sides, with buds and seed-pods. On cover are groups of the same flowers and leaves arranged in three clumps around the knob, which is a flattened globe bearing the character *shou* (longevity) in carmine. On tea-pot is the inscription: "Pure as the virtue of the perfect man," that is, as jade, which from a passage in the "Classic of Ceremonial" is considered the symbol of such virtue, "harmonious as the strength of him who fulfills all his duties to his fellow-men." Mark as on No. 324. Height, $4\frac{1}{4}$ inches. (See Plate 18.)

331, 332. *Cups* of same porcelain and bearing precisely the same decoration. No. 330 came from the collection of the Prince of I. Several months later these

TEAPOT AND CUPS OF CHIENLUNG PORCELAIN (NOS. 330 AND 332).

FOR EXPLANATION OF PLATE SEE PAGE 406.

RICE BOWLS OF YUNGCHÊNG PORCELAIN (NOS. 328 AND 329) AND VASE OF CHIENLUNG PORCELAIN (NO. 336).

FOR EXPLANATION OF PLATE SEE PAGES 406, 407.

corresponding cups, which doubtless at one time belonged to the same owner, were purchased from among unclaimed goods in a Peking pawnshop. Curiously, however, the seal attached to the inscription on the cups, though evidently by the same hand as is that on the tea-pot, differs from the seal on the latter. Height, $1\frac{3}{4}$ inches; diameter, $2\frac{1}{2}$ inches. (See Plate 18.)

333, 334. *Vases* (a pair) of pure white Chienlung porcelain, of flattened globular shape, with slender neck representing half total height, and everted brim, covered with brilliant vitreous glaze, on which the decoration is painted. Around the foot is a band of light blue ornamented with delicate foliate scroll in violet. Above the band runs another band of panel ornamentation in carmine edged with dull green, which with a band below neck of conventional dragons, alternately green and pink, on a magenta ground, inclose the body of the vase. This, on a deep blue ground, ornamented with conventional clouds of yellow, green, blue, and red, and bats of pink shaded with carmine, and of yellow shaded with orange, bears four medallions with pure white ground of dazzling brilliancy, containing groups of flowers most delicately painted—peonies and bamboos; lilies, longevity fungus, and red-seeded heavenly bamboo (*Nandina domestica*), lilies and poppies, and yellow hibiscus and green and red coleus. At foot of neck is a band of orange, the neck itself being of lemon yellow ornamented with conventional flowers and foliage in many colors, confined below by a band of foliated pattern in blue, shaded with deeper tones of the same color, and above by a similar band, outlined with a dotted border of blue, in carmine and shaded with the latter color, the decoration ending in a narrow border of pale yellow pattern outlined with black. The colors are subdued in tone, producing a very rich and harmonious effect. Mark as on No. 324. Height, $7\frac{1}{4}$ inches. (See Plate 21.)

335. *Bowl* (small), with slightly everted brim, of thin white Chienlung porcelain covered with brilliant vitreous glaze. On a pale lemon yellow ground are large conventional peonies, of which the outer petals are of magenta purple and the inner petals of blue, having a magenta center, with buds of same colors, and leaves of various shades of green. Inside plain. Mark as on No. 324. Height, $2\frac{5}{8}$ inches; diameter, $4\frac{1}{4}$ inches.

336. *Vase* of pure white Chienlung porcelain covered with brilliant transparent vitreous glaze. Of very graceful shape, resembling a much-flattened bulb with long tapering neck which represents three-fifths of total height. Ornamented with beautifully drawn red roses, yellow orchids (*Malaxis* and *Epidendrum*) with leaves of deep green to former and of delicate grass green to latter. In this case at least the delicate transparency so admired on the real vitreous ware has been attained. Appended is the following inscription, sealed with the author's *nom de plume*; that is, his favorite designation: "The four seasons changed to an everlasting spring," "The perfect man of pure and world-wide fame."

As flow'rs imprison'd hold each eve
  In loving clasp the sweet moon's rays,
So man, by loving flow'rs, each year
  Surely prolongs his length of days.

(See Plate 19.)

* * * * * * *

337. *Vase* (small) of white Chiach'ing (1796 to 1820) porcelain, in shape of a gourd contracted in the middle. On either side is a medallion formed by the character *shou* (longevity) on the lower swelling, and on the upper is a grotesque winged bat, with two three-clawed dragons curling from top and encircling the lower (*shou* character) medallion. The dragons have foliated flames springing from their sides. The decoration, which is well drawn and shaded in deep blue under glaze, is completed by a band of Grecian pattern round

the foot and by a band of foliated scroll-work round the rim. Mark *Ta-ch'ing-chia-ch'ing-nien-chih*, "Made during the Chiach'ing period of the Great Pure dynasty." Height, 7 inches.

338, 339. *Bowls* for growing narcissus, of white Chiach'ing porcelain of ovate shape divided into four scallops. Between a band at rim and another at foot of foliated scroll pattern is the decoration in chief, which, on each curved panel or scallop, consists of a character *shou* (longevity) in seal form surmounted by a bat, the decoration thus signifying "long age and every happiness," and supported on either side by conventional (or western) lotus flowers and leaves. The decoration is throughout in relief in whitish celadon on a ground of dark celadon. Mark as on No. 337. Height, 2¼ inches; length, 7¾ inches.

340. *Vase* of white Chiach'ing porcelain, of slender bulbous shape with long tapering neck, covered inside and out with deep green glaze (known to the Chinese as "apple-green",) closely crackled. Mark as on No. 337. Height, 12¼ inches.

341, 342. *Plates* of white Chiach'ing porcelain with scalloped edges. Inside are five bats surrounding a medallion formed of the seal character *shou*—*i. e.*, long life and every happiness—in vermilion, shaded, on a white ground. On outside, round the convex brim are branching sprays of plum blossom and two birds left white on a vermilion ground and shaded with the color of the ground. Mark as on No. 337. Diameter, 5⅝ inches.

343. *Bowl* (small) of white Chiach'ing porcelain, with everted brim. Inside plain. Outside entirely covered with flowers of many varieties in red and cream yellow on white ground—hence termed by the Chinese "cup of 100 flowers." Mark as on No. 337. Height, 2¼ inches; diameter, 4 inches.

344. *Vase* of white Chiach'ing porcelain, of cylindrical shape, with low neck slightly everted and, on either side, below contraction toward neck a handle in shape of an ancient altar, covered entirely with olive green dappled (*souflle*) with deep blue black. Mark as on No. 337. Height, 9¼ inches.

345. *Snuff bottle* of enamel upon copper, of flattened globular shape. Body is entirely covered with a representation of a celebrated "picture of the hundred children" playing in a garden with pavilion and trees, etc., painted with great care and detail. On the neck is a band of foliate scroll pattern in deep blue upon a ground of very light shade of same color, and above it a band of delicate yellow-brown grass on a ground of light green. Mark as on No. 337. Height, 2½ inches.

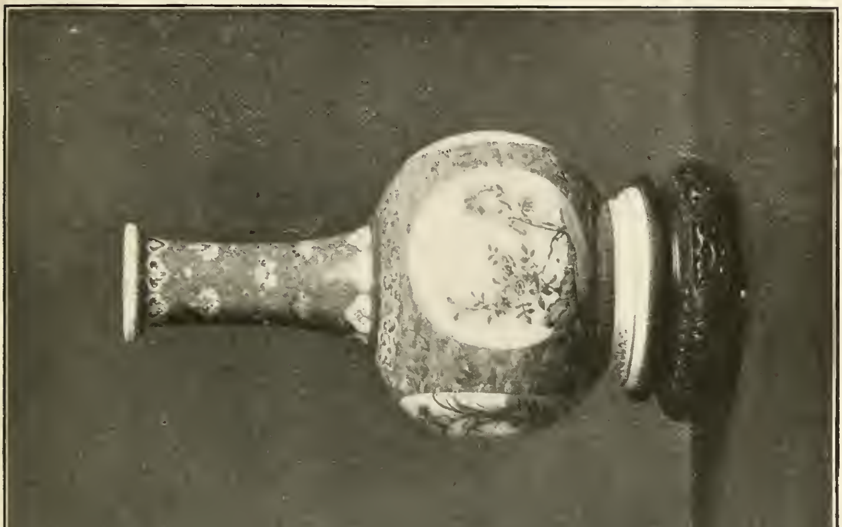
346, 347. *Bowls* (large), a pair, of white Taokuang (1821 to 1851) porcelain with wide open mouths. Inside plain. Outside are sprays of bamboos, with crisp, bold outline left white upon a deep brick-red ground. Mark *Ta-ch'ing-tao-kuang-nien-chih*, "Made in the Taokuang period of the Great Pure dynasty." Height, 2⅜ inches; diameter, 7⅛ inches.

348. *Tea-cup* and cover of thin white Taokuang porcelain, with wavy brim. On a ground of waves closely engraved in paste are Han Hsiang-tz'u and an attendant sailing on a tree toward a pavilion far away in the clouds, and on the cover is a woman (? Lao-yü) riding a *fêng-huang* (see No. 4) towards a distant pavilion among the clouds. Mark as on last. Height, 3⅜ inches; diameter, 4 inches.

Han Hsiang-tz'u is one of the Eight Immortals of Taoist fable. He was an ardent votary of transcendental study, to whom Lü Tung-pin, another of the Immortals, appeared and made him his pupil. He is represented riding upon a tree trunk to immortality, in reference to the legend that having been carried into the peach-tree of the genii (see No. 27) he fell from the branches and entered upon a state of immortality.

PENCIL HOLDER AND WINE CUPS OF KU-YÜEH-HSÜAN WARE (NOS. 327, 325, AND 326).

FOR EXPLANATION OF PLATE SEE PAGE 406.



VASES OF WHITE CHIENLUNG PORCELAIN (NOS. 333 AND 334).

FOR EXPLANATION OF PLATE SEE PAGE 407.

349. *Pencil holder* of unglazed pure white Taokuang biscuit, of broad cylindrical shape. Decorated with a landscape of good design moulded in high relief, representing an old man riding a mule, followed by an attendant, over a two-arched stone bridge across a mountain torrent towards a monastery built among a grove of trees on a valley slope. Behind are towering hills, with roofs of other monasteries and a pagoda appearing here and there among the peaks. Mark as on No. 346 in relief. Fine specimen. Height, $5\frac{3}{8}$ inches; diameter, $4\frac{1}{2}$ inches.

350–352. *Wine cups* (3) of white Taokuang porcelain. Inside, at bottom, is a pink lotus flower bearing in center a Buddhistic ornament in gold. On outside around the brim is a border of the Eight Buddhistic Emblems (see No. 54) in vermilion, each two being separated by a *shou* or "longevity" character in seal form in pale green. Below are the seven paraphernalia of a *Chakravartti* or universal sovereign (Sanskrit *Sapta Ratna*). Between each pair is, below, a small castle on rocks; above, grotesque animals' heads with dependent bead-fringe—all painted in colors and gold. Mark in Mongolian characters *Baragon Tumet*. Height, $1\frac{3}{4}$ inches; diameter, $2\frac{3}{4}$ inches.

Mark. A daughter of the Emperor Taokuang married the Prince of Western Tumet, a principality of Southern Mongolia, and these cups are probably part of a service made for her as a wedding present at the Imperial potteries.

The *Sapta Ratna* consist of (1) the golden wheel or disc, (2) lovely female consorts, (3) horses, (4) elephants, (5) divine guardians of the treasury, (6) ministers in command of armies, and (7) the wonder-working pearl.

353, 356, 366. *Rice-bowls* (3) of pure white Taokuang porcelain with slightly everted brim. Inside at bottom, within a double ring, are sprays of chrysanthemum, peony, plum blossom, and pine, and around the sides four large sprays of the same plants, the pine, however, giving place to the lotus. Outside, on a ground covered with a foliate design closely engraved in the paste under a lemon-yellow glaze, are four pure white medallions, gold-edged, containing groups of peony, *Magnolia yulan*, plum, chrysanthemum, and lotus, beautifully painted. Between the medallions are longevity fungus and conventional lotus with scroll-like foliage. Mark as on No. 346. Height, $2\frac{3}{8}$, $2\frac{1}{2}$, and $2\frac{5}{8}$ inches; diameter, $5\frac{3}{4}$, $5\frac{3}{4}$, and $5\frac{3}{4}$ inches.

354, 355. *Rice-bowls* (a pair) of pure white Taokuang porcelain with slightly everted brim. Inside is a star-like decoration at bottom with eight foliated points in vermilion, shaded with deeper tones of the same color and outlined with gold, between the points being conventional flowers of deep blue, shaded with darker blue. The outside decoration is same as on last except that the four medallions, instead of containing flowers, are ornamented with landscapes of lake and mountain scenery, representing the four seasons. Mark as on No. 346. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{7}{8}$ inches.

357. *Rice-bowl* of pure white Taokuang porcelain. On a ground closely covered with a foliate pattern engraved in the paste under a lemon-yellow glaze are vases decorated with blue containing sprays of peony, a plate of pomegranates, etc., in enamel colors. Between the flowers are three gold-edged medallions containing, one a water buffalo, another a ram, and a third a ewe in grassy meadows with flowering trees. Mark as on No. 346. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{3}{4}$ inches.

358, 359. *Rice-bowls* (a pair) of pure white Taokuang porcelain with slightly everted brim. Inside at bottom, within a double circle, is the philosopher Lao T'ze (see No. 54), riding on a water buffalo meeting the Queen of the Fairies, Hsi Wang-mu (see No. 28), at whose feet are a number of birds, with clouds and birds around, all in blue, shaded with deeper tones of the same color. Outside on a ground closely covered with a foliated pattern engraved in the paste under a deep blue glaze are four medallions, gold-edged, and in spaces between them are cumulus clouds in various colors. On the medallions are four mythological subjects which have eluded efforts at identification, namely, two maidens in a pavilion among trees and rocks; three maidens in a meadow under the shade of trees approaching an altar; a maiden clad in a green robe and holding a rope, seated upon a cloud with seven magpies at her feet; and, lastly, a maiden in a red robe upon a cloud also with seven magpies. Mark as on No. 346. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{7}{8}$ inches.

360, 364. *Rice-bowls* (a pair) of pure white Taokuang porcelain. Inside at bottom, within a double circle, is a wicker hand basket containing chrysanthemums, peonies, and other flowers, around which are four groups of longevity fungus, plum blossom, pomegranate, chrysanthemums, and grass in deep blue, shaded with darker tones of same color. Outside on a ground closely covered with foliated pattern engraved in paste under a deep magenta glaze, bearing conventional lotus flowers with scroll-like foliage in enamel colors, are four gold-edged medallions containing sprays of red and of purple peonies alternating with groups of pomegranate flowers and fruit on a pure white ground. Mark as on No. 346. Height, $2\frac{5}{8}$ inches; diameter, $5\frac{3}{4}$ inches.

361, 365. *Rice-bowls* (a pair) of pure white Taokuang porcelain. Color and decoration same as on No. 240. Mark as on No. 346. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{3}{4}$ inches.

362, 363. *Rice-bowls* (a pair) of pure white Taokuang porcelain, slightly everted at brim. On inside are five bats in vermilion (symbolical of the five happinesses, (see No. 27), irregularly placed at bottom. On the outside are iris, the veining, etc., being in thick color in high relief, also conventional pink lotus, red peony, and flowers resembling the fox-glove and blue corn-flower, with scroll-like foliage, all beautifully drawn in enamel colors of bright tints on thick pale lemon-yellow ground. Mark as on No. 346. Height, $2\frac{1}{2}$ inches; diameter, $5\frac{7}{8}$ inches.

367. *Bowl* (small) of white Taokuang porcelain, with everted brim. Decorated with a spray of white plum and longevity fungus beautifully painted, and with a poem from the pen of the Emperor Taokuang bearing his seal. Mark *Shên-tê-t'ang*, a designation applied by that Emperor to a portion of the imperial apartments and inscribed on the porcelain specially ordered by him for use there. Height, $2\frac{1}{4}$ inches; diameter, $4\frac{1}{4}$ inches.

368. *Circular dish* of white Taokuang porcelain, decorated with sprays of peonies in vermilion below glaze and pink above glaze, and with delicately painted butterflies and bees hovering over the flowers, the sprays spreading around the rim and then crossing the brim to cover the interior of the dish. Mark as on last. Height, $1\frac{1}{2}$ inches; diameter, $6\frac{3}{8}$ inches.

369, 370. *Rice-bowls* (large, a pair) of white Taokuang porcelain. Inside plain. Outside, on a plain white ground not engraved, is the same decoration as on No. 240. The mark for some reason has been ground away. Height, $2\frac{3}{4}$ inches; diameter, $6\frac{7}{8}$ inches.

371. *Jar* of earthenware. The ornamentation, which is in high relief, consists of two bands of foliate scroll-work, confining an umbrella, a cylindrical flower-pot containing coleus, a gourd-shaped vase, and two rolled-up painting scrolls crossed, alternating with sheaves of ornate foliage, under a black-green glaze. Height, $3\frac{3}{4}$ inches.

372–375. *Plates* (4) of pure white Taokuang porcelain covered with brilliant glaze and decorated with beautifully painted sprays of white plum blossom and of pink roses, which, after trailing around the deep rim, cross the brim and cover the inside of the plate. Mark as on No. 346. Diameter, $4\frac{7}{8}$ inches.

MISCELLANEOUS COLLECTION OF SNUFF-BOTTLES.

376. Of white porcelain and flat, circular in shape, formed by two lotus leaves, one of deep red grading into light green at center, the other of deep green grading into pink at center, with butterfly settled upon each. Admirably moulded. No mark.

377. Of white porcelain and ovate in shape, decorated on one side with a Chinese rebus, three shrimps grasping reeds, which reads *San-hsia mi-Ch'uan-lu*. If the third character be omitted, the phrase—by the substitution of characters differently written, but having the same pronunciation—means "three generations have gained positions in the first class at the highest literary examinations." On the opposite side, eighteen crabs, a similar rebus, meaning "at eighteen gained second place at the highest literary examination." Mark *Tao-kuang-nien-chih*, "Made in reign of Taokuang."

378. Of white porcelain, in shape of a young girl, dressed in a jacket of blue damask and trousers of red and gold brocade. She has the contracted feet of the Chinese women. Body hollow, stopper formed by one foot, which is removable from trousers. No mark.

379. Of white porcelain, in shape of a boy, intended to represent T'ung Fang-so (see No. 27), dressed in a robe of red and gold brocade open to skin from neck to waist, green undergarments, and a summer season official hat, which is removable and forms stopper. No mark.

380. Of white Chienlung (1736–1795) porcelain and flat ovate form. The cream-yellow paste is engraved to represent waves, on which a boat containing two of the Eight Immortals (one male and one female, see No. 172) is being rowed among lotus flowers. Moulded in high relief and painted in enamel colors. Fine specimen. Mark *Ta-ch'ing chien-lung-nien-chih*.

381. Of white porcelain and flat ovate shape. Decorated in colors with a rebus on either side—a saddled elephant bearing a jar-shaped houdah, reading in Chinese *Hsiang pei t'ai p'ing*, which also means "Peace rules in the north," and a tub full of green growing wheat, reading *i t'ung ta ch'ing*, "the whole Empire (owns) the Great Pure dynasty." Mark *Chien-an-ya-chih*, "Made for Chien An-ya," an unidentified name.

382. Of white Chienlung (1736 to 1795) porcelain and of flat circular shape, decorated with mythological personages painted in colors. Mark as on No. 380.

383. Of white Chienlung porcelain and of small *potiche* shape, decorated with plum trees of the pink and white blossom varieties, perched on which and on ground are one hundred magpies, symbolizing "a hundred, that is, every kind of happiness," the magpie, from its merry-sounding chatter, being termed "the bird of happiness." Mark as on No. 380.

The magpie is especially dear to the present occupants of the throne of China from the part it played in the divine origin of their first ancestor. The Chinese chronicle runs as follows: Immediately east of the pumice peaks of the Ch'ang-pai-shan (Long White Mountain) is a high mountain called Bukuli, at the foot of which is the small lake or pool Buhuli. After bathing one day in this pool, the maiden Li Fokolun found on the skirt of her raiment, placed there by a magpie, a fruit which she ate, and which caused her to give birth to a boy of an appearance different from ordinary people, whence she called him *You heaven-born to restore order to the disturbed nations.* His surname she called Aisin-Gioro, his name Bukuli-yung-shun. She disappeared, and he, embarking in a small boat, floated with the river stream. In the neighborhood of a place where peoples of three surnames were at war, he disembarked, and was breaking off willow branches, when one of the warriors, coming to draw water, saw him.

Amazed at his strange appearance, the warrior hastily retired to inform the people of the remarkable man he had seen. The curious people went to the bank and asked his name and surname, to whom he replied: *I am the son of the heavenly maiden Fokolun, ordained by heaven to restore peace among you,* and thereupon they nominated him king, and he reigned there in Odoli City, in the desert of Omohi, east of Ch'ang-pai-shan." Another version of the legend states that there were three heavenly maidens Angela, Changhela, and Fokolun. The first two returned to heaven, while Fokolun remained on earth to nurse the miraculous babe till he grew up. Then she told him to wait till a man came to fish. The fisherman came and adopted the boy, and Fokolun ascended to heaven. Père Amyot, from whom this account is taken, identifies Fokolun with a sixteen-armed goddess whom he calls Pussa, or the Chinese Cybele, but described at the present day as a Boddhisatwa, a celestial candidate for Buddhahood. The story continues that Aisin-Gioro, in spite of his heavenly birth, was put to death by his people, and only his youngest son, Fancha, escaped by the aid of a magpie, which alighted on his head as he ran and made his pursuers think him the stump of a tree. Fancha fled from Odoli across the Ch'ang-pai-shan to Hotuala and there, some two centuries before the birth of Nurhachu, the first Manchu chieftain who took up arms against the Chinese, he laid the foundations of the future dynasty of China. (James, The Long White Mountain, p. 31.)

384. Of white porcelain and bulging cylindrical shape, bearing an Imperial five-clawed dragon, well drawn in blue under glaze twisting around the bottle. No mark. Height, $3\frac{7}{8}$ inches.

385. Of white porcelain, cylindrical in shape, the lower portion divided into two fluted sections by three double bands. Decorations, branches of pine, bamboo, and plum-blossom, symbolical of long life (see No. 181), in deep blue under glaze. No mark. Height, 3 inches.

386. Of rock crystal, flat and circular in shape, the two faces of a Carolus dollar being carved in relief on the sides. No mark.

387. Of agate, in shape, a flat oblong with beveled corners, showing an admirable representation of a horse feeding, naturally formed in the stone, in brown on a dull opaque white ground. No mark.

388. Of pure white porcelain and of much flattened globe shape, decorated with a rebus on either side admirably painted in deep blue under glaze: (1) Three crabs holding reeds, reading *san p'ang hsieh ch'uan lu,* and also meaning "three generations gained the first class at the metropolitan examinations;" (2) two pigeons perched in a willow tree, reading *erh pa* (*k'o*) *têng k'ê,* and also meaning "at eighteen to be successful in the examinations." Mark *Yün-shih-ya-chih,* "made for Yün Shih-ya"—an unidentified name.

389. Of white porcelain, tall and cylindrical in shape; decorated with children playing, of the natural color of the porcelain on a ground covered with thick black glace. No mark.

390. Of brown agate and ovate in shape. The surface is carved so as to show monkeys of a yellow-white color gamboling in trees and on ground.

391. Of white porcelain covered with a dark olive or "tea-dust" (*Ch'a-mo*) glaze and pear-shaped.

392. Of cream-white porcelain and of ovate form. On a light green ground, confined above and below by a narrow waving border of brick red, and moulded to represent waves are the Eighteen *lohan* (Chin.) or *arhat* (Sanskrit), the immediate disciples of the Buddha (see No. 32) in high relief. On the cover are waving bands of brick red and green alternately. Good specimen. No mark.

393. Of white porcelain and globular shape, decorated with an imperial five-clawed dragon in clouds pursuing the sun, painted in vermilion. Mark, a dragon.
394. Of white porcelain and shaped as a small jar with wide mouth; decorated with landscapes in deep blue under glaze. No mark.
395. Of white Yungchêng (1723 to 1735) porcelain and of cylindrical shape; ornamented with imperial five-clawed dragons amidst clouds engraved in the paste under a brilliant white glaze. Mark as on No. 85.
396. Of white porcelain and of bulbous shape with slender neck, covered with a mottled decoration of white, blue, and red wavy streaks. No mark.
397. Of white Yungchêng (1723 to 1735) porcelain and of elongated globular shape, decorated in deep blue under glaze with a representation of two of the Seven Worthies of the Bamboo Grove (see No. 53) with attendant carrying books, under a tree near entrance to a pavilion. Mark as on No. 85.
398. Of coarse porcelain, said to be of Sung dynasty (960 to 1278), and of globular shape with short neck and everted brim, covered with thick white glaze coarsely crackled. No mark.
399. Of white porcelain and jar-shaped with wide mouth; decorated with imperial five-clawed dragons with open mouths and red tongues rising from waves and flying through clouds in pursuit of sun—all in deep green. Broad flat cover ornamented with a similar dragon "sitting" in deep green. Mark as on No. 346.
400. Of white porcelain and cylindrical in shape, decorated with a group of lotus flowers and leaves, and flags in deep blue under glaze. No mark.
401. Of white porcelain and of slender *lancelle* form, bearing conventional lotus flowers (the so-called "Western lotus") and leaves, engraved in the paste under brilliant glaze. No mark.
402. Of white Yungchêng (1723 to 1735) porcelain and of cylindrical shape, decorated with painting in deep blue under glaze of a wrestling match in the courtyard of a *yamên* or official residence, in presence of the occupant. Mark as on No. 85.
403. Of white porcelain covered with a crackled glaze and moulded in form of a rat feeding on a corn cob which it is holding between its feet. No mark.
404. Of white porcelain and of circular shape, decorated with a landscape in colors. Mark (unidentified), "*Yu-t'ang-ya.*"
405. Of white porcelain and of bulbous shape, with slender neck; decorated with painting in deep blue under glaze, representing the Eighteen Lohan (Chinese) or Arhat (Sanskrit), the immediate disciples of the Buddha (see No. 32). The mark attributes the snuff-bottle to the Ch'ênghua period (1465 to 1487), but it more probably belongs to the K'anghsi (1662 to 1722).
406. Of white porcelain and of bulbous shape, with tapering neck, covered with a brilliant deep blue (*bleu de roi*) glaze. No mark.
407. Of creamy white porcelain and of flattened, circular shape; on a ground representing waves engraved in paste are genii paying homage to the maiden immortal Ho Hsien-Ku (see No. 32). A fine specimen of this ware. No mark.
408. Of white porcelain and of tall, ovate form, with cup-shaped neck; well moulded in open-work representing imperial five-clawed dragons amid clouds and flame, confined at top by foliate scroll and Grecian pattern bands, all colored deep vermilion; cover to match. No mark.
409. Of white Ming dynasty porcelain and of tall, cylindrical shape, decorated with a painting in blue and vermilion under glaze of the Three Heroes, Chang Liang, Ch'ên P'ing, and Han Hsin. No mark.

Chang Liang was one of the earliest adherents and afterwards chief counsellor of Liu Pang, the founder of the Han dynasty, whose cause he embraced B. C. 208, and to whose triumph he materially contributed by his wise counsels. He died B. C. 189.

Ch'ên P'ing was of very humble origin, but his virtue having brought him into prominent notice he rose to high rank. Subsequently, like Chang Liang, he espoused the cause of Liu Pang B. C. 205, and made himself famous on six occasions by master strokes of policy, which greatly aided the successful issue of the contest for the throne.

Han Hsin was a grandson of the Prince of Han, whose territory had been seized by the Ch'in dynasty. He also espoused the cause of Liu Pang, whose armies he commanded. After subjugating principality after principality he was raised to princely rank, but having been accused of high treason his person was seized. He was, however, amnestied and given the government of T'ai-yüan, but again fell under suspicion and was this time executed by the Empress Lü B. C. 196.

410. Of white porcelain and pear-shaped. On a white ground closely covered with peony sprays bearing blue leaves and vermilion flowers and buds is an imperial five-clawed dragon, also in vermilion. No mark.

411. Of white Yungchêng porcelain and of cylindrical shape, decorated with a painting in brilliant blue under glaze, in the autumn evening (as the accompanying inscription states) an old gentleman, followed by attendant holding an umbrella over his head, enters a lamp-hung ferryboat to cross the river. Mark as on No. 85.

412. Of white porcelain and of pear shape. The ornamentation is of unusual style, and seems to show the impress of Japanese influence. On a ground of magenta-vermilion appear medallions of the natural color of the porcelain, on one of which is the character *shou* (longevity), on another pomegranate fruit, on another a group of pine, bamboo, and plum blossom (symbolical of long life; see No. 181), and on others conventional flowers or diaper patterns. No mark.

413. Of white unglazed (biscuit) porcelain, and of flattened globular shape, bearing four-clawed dragons rising from waves and flying through flames and clouds in pursuit of the sun, drawn and shaded in black. No mark.

414. Of white Chienlung (1736 to 1795) porcelain, and of flat, jar shape. On either face, on white ground, sprays of peony, chrysanthemums, and other flowers spring from among rocks, painted in enamel colors. Round the sides and on neck are conventional flowers and scroll-like foliage in vermilion. Mark *Chien-lung-nien-chih*, "Made during reign of Chienlung."

415. Of white porcelain and of squat jar shape, covered with thick, black glaze, except on portions where appears the decoration, which is in blue under white glaze, and represents a father's return home. The son runs to meet him, while the wife, seated on a stool, awaits his coming, behind her being a large loom at which she has been working. Broad, flat cover of porcelain in imitation of jade, ornamented with the figure of *yin-yang*, the Two Primordial Essences (see No. 40). No mark.

416. Of agate. A life-like representation of a toad with wart-like excrescences all over the back. Handle of spoon is of deep-red coral elaborately carved into a bunch of peonies and leaves.

MISCELLANEOUS COLLECTION OF BRONZES.

417. *Low, open tripod brazier*, bearing three long panels, of which the ground is excised, leaving Arabic characters in relief. Mark in relief *K'ai-yüan-nien-chih*, "Made in the K'ai-yüan period" of the T'ang dynasty, A. D. 713 to 842. Height, 5¼ inches; diameter, 10½ inches.

418. *Incense-burner*, in shape of a beautifully formed fruit of the "Buddha's hand" citron (*Citrus sarcodactylus*), hollowed out to hold incense. Beneath, at

lower end, is a knotted stalk which forms the handle and passes under the fruit so that the joints form supports on which the fruit rests, and leaves curl along its side. Mark in relief *Ta-ming Hsüan-tê-nien-chih*, "Made in the Hsüan-tê period (1426 to 1435) of the great Ming dynasty." Length, 9 inches.

419, 420. *Candlesticks* (a pair). From hexagonal pots on carved stands rises a lotus stalk out of which springs a bunch of buds and leaves, the central stalk bearing a fully opened flower which holds the candle. Delicately modeled and of good workmanship. Probably of same date as last. Height, 13½ inches.

421. *Tripod incense-burner*, formed of a circular bowl having a band of Grecian pattern round the rim with lotus flowers in relief below, and resting on three feet formed of elephants' heads, richly harnessed, with curved trunks. A handle on either side formed of similar elephant's head. The cover is formed of an elephant lying down among lotus flowers in open-work, and bearing on its back a basket of fruit. Height, 7⅝ inches; diameter, 3⅝ inches.

422. *Vase.*—Around rim is a band of Grecian pattern with a deep one of foliated scroll-work below. The body is divided by two raised bands, the upper one almost in middle of the vase, between which are the character *shou* (longevity), forming medallions, with two bats on either side; outside of this division a geometrical pattern resembling honeycomb, with a small medallion of divinities in center. Round the foot a band of geometrical panel scroll-work. On either side, on level of the upper raised band already mentioned, is a handle formed by a rectangular projection inlaid with silver, supporting a lion or "dog of Fo." The ornamentation throughout is inlaid with silver. Marked *Ssŭ Lou*, a famous maker in the Sung dynasty (960 to 1278), but in reality an imitation, of comparatively modern date.

423, 424. *Snuff bottles* of flat oblong shape with beveled corners. On a ground divided by bands into small squares, each containing a flower, is a central medallion containing immortelles. Ornamentation throughout in silver. Mark as on last.

425. *Pencil holder* of cylindrical shape, bearing a landscape of river scenery with lofty, well-wooded mountains rising on either side, beautifully drawn and inlaid with gold.

426. *Incense burner* of open circular shape standing on three feet. Upon a ground of lines of Grecian pattern are four small medallions containing grotesque animals. Round the rim and the tall looped handles rising from it is a wavy pattern in inlaid silver, the ornamentation throughout being similarly inlaid. Mark as on No. 422.

427. *Vessel* (small) formed of a removable cup fitting into a circular body, lined with silver and decorated with inlaid work in the same metal. On the cup, on a ground of foliate pattern, confined above and below by a band of Grecian pattern, are four small medallions containing landscapes. The circular lower portion bears similar decoration. Good specimen.

428. *Tripod incense burner* of circular shape on tall, slender feet; on body and legs a wavy, cloud-like pattern in outline; round the sides of rim and of tall rounded handles a band of Grecian pattern; on top of rim a scroll pattern, ornamentation throughout being inlaid in silver. Mark *Ssŭ Lou*, this being a genuine specimen of the work of this celebrated artist of the Sung dynasty much prized by Chinese connoisseurs. Height, 4 inches.

429. *Tripod incense burner* of circular shape, on low feet, with cover. The body is ornamented with very delicately drawn landscapes inlaid with gold, having on either side a gilt lion-head handle. Cover in open work resembling a closely spoked wheel, surmounted by a lion, all gilt. No mark. Height, 3⅝ inches.

430. *Tripod incense burner* of circular shape, on low feet. Body ornamented in manner similar to last and with similar handles. Cover consists of openwork flowers and foliage surmounted by a lion in relief, all gilt. No mark. Height, 3⅝ inches.

431. *Tripod incense burner* of circular shape, on low feet. On body, between two gilt lion-head handles, are two panels on which are sculptured in relief and gilt sprays of plum blossom, chrysanthemum, etc., and the mythical creatures *fênghuang* (see No. 4) and *ch'ilin.* Cover consists of openwork chrysanthemums and leaves surmounted by a lion, all gilt. No mark. Height, 4¼ inches.

Ch'ilin, ch'i being the designation of the male, and *lin* of the female, is the generic name of one of the four supernatural creatures of Chinese tradition. It is described as having the body of a deer, the tail of an ox, and a single horn, and as being the noblest form of animal creation. It is said to attain the age of one thousand years, and to be the emblem of perfect good, its apparition being considered the happy portent of good government or of the birth of virtuous rulers. Nevertheless, the apparition of one of these marvelous beasts was considered by Confucius as an omen of approaching evil, so manifestly inappropriate was it to the disorder of his times; and he concluded the history of his native state of Lu with the record of this event.

432. *Tripod incense burner*, of broad, circular shape, on low feet. Round the sides of brim and of tall rounded handles runs a Grecian pattern. On body, covered with square diaper pattern, containing in each diaper a flower of five rounded petals, are four panels containing representations inlaid in silver, as is the rest of the ornamentation, of grotesque animals. Mark as on No. 422. Height, 4½ inches.

433–434. *Pencil holders* of cylindrical shape, in imitation of basket work, over which are crawling tortoises and frogs, evidently of Japanese manufacture.

MISCELLANEOUS COLLECTION OF OLD LACQUER WARE.

435. *Box* of scalloped circular shape. On top, over ground of dark-green diaper, a landscape in red lacquer carved in relief, with a number of children playing. The sides are ornamented with a carved diaper pattern, the scallops being red, and deep green, with red centers alternately. This and two following numbers are specimens of the celebrated lacquer ware produced at Suchou, in Kiangsu province, during the reigns of Yungchêng and of Chienlung. Height, 1¾ inches; diameter, 3¼ inches.

436. *Box* of circular shape and of red color throughout. On a diaper ground are sprays of plum blossom and fruit in high relief, the fruit being diapered like the ground. Height, 2¼ inches; diameter, 5⅝ inches.

437. *Snuff bottle*, heart shape. On a diaper ground of deep green are sprays of plum blossom, *Malaxis* and *Epidendrum*, and longevity fungus in high relief, in red. Height, 2⅝ inches.

438. *Ivory*, representing four segments of bamboo, in the interior of each of which is a spray of lotus, of plum blossom, of peony, and of chrysanthemum, respectively, beautifully carved out of a solid block. Admirable specimen of old ivory carving. Length, 2¾ inches; diameter, 1⅜ inches.

CONTRIBUTIONS TO THE HISTORY OF MUSICAL SCALES.

BY

CHARLES KASSON WEAD,
Examiner, U. S. Patent Office.

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CONTRIBUTIONS TO THE HISTORY OF MUSICAL SCALES.

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I. INTRODUCTION.

In the development of musical scales four stages may be recognized:

1. The stage of primitive music, where there is no more indication of a scale than in the sounds of birds, animals, or of nature. Students of the origin of music may give free rein to their fancy in this period, and the uncertain musical utterances of living primitive peoples may be construed in accordance with almost any prepossession of the hearer.

2. The stage of instruments mechanically capable of furnishing a scale. This stage has been almost entirely overlooked by students and is the special subject of the following paper.

3. The stage of theoretical melodic scales—Greek, Arab, Chinese, Hindu, Mediæval, etc. All the original treatises concerning these scales imply that a stage of development has been reached far in advance of the second. Thousands of pages have been written on this stage, largely polemical and lacking in insight, for the subject has been a dark one; but Ellis and Hipkins's work of 1885 has thrown a flood of light on it.

4. The stage of the modern harmonic scale and its descendent, the equally tempered scale, which are alike dependent both on a theory and on the possibility of embodying it in instruments. The relation of this scale to the present study will be noticed later.

These four stages, of course, overlap even in the same locality; they correspond in a rough way to the recognized four culture stages, namely: the savage, barbarous, civilized, and enlightened.

At the outset it should be recognized that the only working hypothesis the physicist can use is that of the instrumental origin of scales. Helmholtz's view that the harmonics in the voice and in the tones of instruments were influential in settling the positions of the notes of our scale is obviously consistent with this hypothesis; and his opinion that this influence acted on other scales need not be wholly rejected, though some of his historical authorities were untrustworthy, and some of his coincidences between other scales and the harmonic scale can be explained in other and simpler ways. Writers less careful than Helmholtz have made the assumption that these harmonics and the constitution of the ear must have guided primitive musicians to a substantially harmonic scale; and one writer has even maintained that instruments corrupted the taste of men. But as yet there has been no such body of facts collected in support of this assumption as need delay one following out the other theory. Of course the knowledge of the scales is only a stepping-stone to the understanding of the music and something of the life of a people; so some day the materials worked into shape by the physicist may be built into a fairer structure by the psychologist.

The broad fact which underlies all study of scales was recognized by the Greek musician Aristoxenus three centuries before the Christian era. He pointed out that the voice, in speaking, changes its pitch by insensible gradations, while in singing it moves mostly by leaps. We recognize the same fact when we say that a singer follows a *scale*, but do not say it of a speaker. The one, to use the common figure, ascends or descends a ladder or staircase; the other follows a continuous slope, and may never step twice in the same place. Now, it is quite possible that in a song the voice may always move by leaps, and in repeating the song always take the same leaps as closely as can be observed, yet never strike a note which it has struck before; just as one may toss a stone up and down on a hillside, marking each time where it lands, and after a hundred tosses finds it had not landed twice at quite the same level, or in striding up and down hill may never plant his foot twice at the same level. I think this was the character of the songs of the first stage and of much primitive song to-day, though the evidence is too scanty to be conclusive.

However this may be, it is certain that most peoples who have attained any moderate degree of civilization have attempted to limit the number of steps to be taken by the voice in any song between the highest and lowest note, and to fix these steps by rules, so that many men may learn them and be in substantial agreement. Various old writers give the rules in vogue among Greek theorists; in the last century Amiot described the Chinese rules, while in the last two decades the rules of Arab, Hindu, Japanese, and Siamese musicians have been made accessible. The most familiar rules, as is well known, depend on that law of vibrating strings which is followed by a violinist in his fingering—namely, that the frequency of vibration of parts of any stretched string is inversely as the length of the parts, provided the tension does not change. Our latest rule, historically derived from one of the many Greek and Arab rules by subdividing the whole tones, so giving twelve steps to the octave, is embodied on the neck of a guitar or mandolin; here it is obvious that the successive stopping points as marked by frets get closer and closer together as the pitch rises. All musicians know that this number of notes, twelve, is found confusingly great for ordinary playing, and know the principles by which the player selects certain notes for any tune. But this multiplicity of notes has an important bearing on all studies on nonharmonic music made by harmonic musicians. For every sound within the compass of the instrument comes very near to some one of the twelve notes and may readily be represented thereby, owing to the difficulty the hearer has in estimating deviations from the familiar series and in noting them down. The results of this approximation are to mask all deviations from the twelve-tone piano scale, whether intentionally or accidentally made, and to make it appear to musicians, first, that nearly all the music of the world is performed substantially in our scale; and second, that any other theoretical scales, such as those found among Orientals, or described by our European ancestors, are merely mathematical jugglery and of as little significance as proposals for a change that occasionally appear in modern musical or scientific journals.

It is the purpose of this paper first to describe several types and forms of instruments widely used, each embodying a principle of scale building distinctly unlike ours, though sometimes giving a result that seems surprisingly familiar. Nearly all these instruments, it will be noted, belong to what was called above the second or barbarous stage, though a few of them come from countries where musicians have reached the third and fourth stages. A second purpose is to present a new and generic principle of primitive scale-building applicable to the various types of instruments discussed.

But before going further it must be recognized that the word "scale" has many meanings. Perhaps the lowest and loosest is—the series of sounds used in any musical performance, arranged in order of pitch. The one that will most closely fit the present needs is—the series of sounds produced upon a particular instrument; while the most exact definition, but one applicable only where musical principles are well developed is this:

A scale is an independently reproducible series of sounds arranged in order of pitch, recognized as a standard and fitted for musical purposes.

While the last two definitions imply an instrument in which the scales are embodied, the limitation is in appearance only, for there is no evidence that any musicians do have a standard series of tones, unless they have one or more instruments embodying it, and have learned the series directly or indirectly from such an instrument.

II. STRINGED INSTRUMENTS.

In sharp contrast to that widely used division of a string which we know on the guitar, showing decreasing distances between the frets as the pitch rises, we find many instances of a uniform spacing of the frets through a considerable distance. Instances from four countries may here be cited:

1. The well-known architect, Viollet-le-Duc,[1] gives a figure (fig. 1) of a mandolin from the end of the sixteenth century which shows frets for the first seven semitones pretty uniformly spaced; the frets for the next five to complete the octave are again uniform, though closer than before, and the following five are also uniformly spaced and still closer. Figures in other books[2] of European lutes, viols, etc., very often show a similar equal spacing. These are too numerous to be lightly treated as artists' blunders. Two instruments in the United States National Museum are illustrated in Plate 1.

Fig. 1.
EUROPEAN MANDOLIN.
After Viollet-le-Duc.

2. Among the Greek rules given by Ptolemy is one for the division called *Diatonon homalon*, in which the whole string being twelve units long the points for stopping would be at 11, 10, 9, and 8, giving C, a note between D♭ and D, E♭, F, and G. Here it will be noticed the intervals get larger and larger as the pitch rises. Again, Carl Engel[3] refers to Drieberg's drawing of the ancient Greek guitar in the Berlin Museum, which has "seven frets at equal distances," but objects to it as it does not give a diatonic scale. The tracing of this drawing furnished by Professor Howard, of Harvard, adds to Engel's data the fact that the whole compass of the six intervals is slightly more than an octave (fig. 2).

Fig. 2.
GREEK GUITAR.
After Drieberg.

3. Among the instruments described in the Arabic treatise of the

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[1] Dictionnaire raisonné du mobilier français, II, 1871, pl. LI.

[2] M. Prætorius, Syntagma Musicum, II, 1618. Reprint, 1894. Plates V, fig. 3; VI, fig. 1; XVI, fig. 1; XVII, fig. 4; XX, figs. 1, 3.

Bonanni, Description des instruments harmoniques. 2d. ed. Rome, 1776. Plates LII, LVII, LX, LXXI.

J. Ruhlmann, Geschichte der Bogeninstrumente, 1882. Plates IX, figs. 2, 5, 6, 13; X, fig. 16; XIII, figs. 3, 8.

[3] Music of the Most Ancient Nations, 1864, p. 205.

famous Al Farabi,[1] who died 950 A. D., is the short-necked *tanbour* of Bagdad, usually having two strings: on this a fret was first placed at one-eighth the length of the string from the upper end, and this space then divided into five equal parts. As the compass on each string was but little over a whole tone, each step was about a quarter-tone. These ligatures or frets are called "heathen" or "pagan," and the tunes played on them "heathen airs," clearly indicating that there was a scale native to the people whom the Mohammedan armies had conquered, a scale utterly different from either that of the lute or the *tanbour* of Khorassan, with their resemblances to Greek scales. Three hundred years later, or about 1250 A. D., Safi-ed-din,[2] a famous musician of Bagdad, wrote for his pupil, the son of the Vizier, a Treatise on Musical Ratios. He based them on string lengths, and in discussing instruments gives a figure of the frets on the neck of the lute, and it is noteworthy that these are equally spaced over a distance of a quarter length of the string. Further, he explains how of the ten frets in this short distance, located by various rules, five were fixed by arithmetical bisection or halving of the space between two frets already fixed; one of these, midway between what we should call D and E, if the open string gives C, was called the "Persian middle," and was very much in use in his time. Safi-ed-din[3] further describes, in two connections, a division of the Fourth, like the Greek one already quoted, where the string lengths are 12, 11, 10, 9, saying it is consonant and much used; in fact it is preferred to one that is substantially like the theoretical diatonic scale; still it should be added that when he comes to arrange intervals to make up two octaves he puts our arrangement along with the most agreeable half dozen genera.

4. In India there has been in modern times a curious reversion from an elaborate historical scale of twenty-two steps to the octave, of which no modern Hindu or European knows the theory, to an equal linear division;[4] one-half of the string on the *sitar* is bisected; the first or end quarter-length is then divided into nine parts, each marked by a fret, and the second quarter-length into thirteen parts similarly marked. Out of the twenty-three tones within the octave the player selects a limited number, five, six, or seven, rarely eight, for any particular tune. Most of the notes used are found on calculation to be deceptively close to the notes of our chromatic scale, and so may be easily confounded with them by European hearers.

5. This arithmetical division has been advocated by European

[1] Land's translation in Travaux de la 6e session du Congrès internationale des Orientalistes à Leide, 1883, pp. 107–114.

[2] Carra de Vaux's translation in Journal Asiatique, XVIII, 1891, p. 330.

[3] Idem, pp. 308–317.

[4] Tagore, Musical Scales of the Hindus, Calcutta, 1884, supplement. Partly quoted by C. R. Day, Music . . . of Southern India, 1891, and Ellis, Journal Society of Arts, XXXIII, 1885, p. 502.

theorists, as by Jamard[1] in a treatise of 1759, a copy of which is in the Lenox Library, New York; and Fétis[2] in his brief account of this author refers to others who maintained similar views.

III. INSTRUMENTS OF THE FLUTE TYPE.

The simple flutes are instruments of a type more primitive and more widely distributed than fretted stringed instruments. These instruments are sometimes side-blown, as is the case with the modern flute; or end blown, as one blows into a key or pan's pipe; or blown with a whistle mouthpiece, like the flageolet; or blown with a weak reed, as the oboe. For the purposes of this discussion the mode of exciting the vibration is immaterial. All of them embody the law that the frequency of vibration of a column of air in a tube depends mainly on its length, and the variation in length of the air column so as to produce several sounds from one tube is produced by opening holes in the sides of the tube. In practice these holes never can open so freely to the outside air that the portion of the tube beyond them may be considered as removed (the possibility or necessity of cross-fingering proves this to the player), so the proper location and diameter of the holes to produce the notes of our scale of even quality are fixed, not by a simple law as the frets on the guitar are located, but by laborious experimenting to get a standard instrument which is then reproduced with Chinese fidelity.

Now, as one looks over a collection of wind instruments, like the splendid one in the U. S. National Museum, or examines flutes figured in books, it will be easy to recognize that there are two principal types—(A) those having the holes spaced at sensibly equal distances, and (B) those having two groups each of three equally spaced holes, the interval between the nearest holes of the two groups being obviously greater than that between the holes of each group. As the common primitive method of making the holes is by burning, the holes are generally more uniform in diameter than those on European flutes of a century ago.

Illustrations of flutes of type A are found in Engel's Musical Instruments, some of which are copied on Plate 2. Dr. Wilson's paper on Prehistoric Art[3] has many more illustrations, as the figures of bone flutes from Costa Rica and British Guiana, of pottery flutes from Mexico and the Zuñi Indians, of tubes with a simple reed from Egypt and Palestine, of wooden flutes brought from Thibet by Mr. Rockhill, and a wooden flute from the Kiowa Indians. Fétis[4] has a cut of the staghorn flute from the stone age with three equidistant holes, referred

[1] Jamard, Recherches sur la Theorie de la Musique.

[2] Fétis, Biographie universelle des Musiciens.

[3] Report of the U. S. National Museum for 1896, pp. 325–664.

[4] Histoire générale de la musique, I, p. 26.

to by Wilson (p. 526). So far as is known not one of the peoples from whom these instruments have come has any musical theóry, but some of them do have a principle of instrument construction; for a partly educated young Kiowa Indian, in Washington a few years ago, in a party under charge of Mr. James Mooney, showed the writer how the holes on a flute on which he played were located by measuring three finger-breadths from the lower end to the lower hole, and then taking shorter but equal spaces for the succeeding holes. The interpreter added that he had seen the holes spaced by cutting a short stick as a measure. The late Mr. F. H. Cushing has furnished the additional fact that measurement by finger-breadths is very common among Indians; and Dr. Fewkes[1] gives a figure to show how the prayer sticks, used by the Hopi Indians in the Snake ceremonials at Walpi, are measured off into seven parts by the distances from creases on the hand to the tip of the finger. On the Kiowa flute (Plate 4, No. 2) the distance between the centers of the holes is 32 mm., which is two medium finger-breadths. Some instruments of this type belonging to the U. S. National Museum are shown in Plates 3 and 4.

But it is not only among primitive and prehistoric peoples that such a succession of holes is found. The common military fife has it. The bagpiper recently seen on the streets of Washington used a chaunter (oboe), the holes of which were at sensibly equal distances, so conforming to the well-known fact that the bagpipe scale is intentionally unlike the harp scale. A Japanese *Fouye* with 7 holes figured in the catalogue of the Kraus collection at Florence shows to the eye holes at nearly equal spaces, and has, as reported, the steps of the scale increasing in length as the pitch rises. From Egypt[2] there have come twenty-five 3- and 4-hole ancient flutes, or more exactly, oboes, and a few of 5, 6, and more holes. One of the 4-holed instruments from a tomb of about 1100 B. C. shows the holes 35 mm. apart and the lowest hole twice this distance from the bottom. Villoteau's[3] plates of modern Egyptian instruments show various types of tubes with equally spaced holes.

Flutes of the second or B type with two groups of equal-spaced holes were sold in quantities at the Java village at the World's Fair held in Chicago in 1893 (Plate 6, No. 1). No two of the instruments seemed to have the same length or location of holes, but this grouping was unmistakable. Of this type is also a curious ancient Chinese instrument, the *Tche*, described by Amiot,[4] closed at both ends with

[1] Journal of American Ethnology and Archaeology, IV, 1894, p, 25–26.

[2] Loret, Journal Asiatique, 8th ser., XIV, 1889, pp. 111, 197. Musical Times, London, XXXI, 1890, pp. 585, 713.

[3] Description de l'Egypt, État moderne, II, 1809, plate cc.

[4] Mémoires concernant l'histoire . . . . des Chinois, VI, 1780, p. 76, pl. VI, fig. 42. Mahillon, Brussels Conservatory Catalogue I, No. 865.

an embouchere at the middle and holes symmetrically placed on each side dividing the whole length into thirds, quarters, and sixths; so, if the whole length is called 12, the mouth hole is at 6 and the finger holes at 2, 3, 4, 8, 9, and 10. Mahillon copied the instrument, but did not close the ends, and reports the scale as a chromatic one from E to A ♯. Most of the old European wood wind instruments figured by Prætorius[1] (1618) are conspicuously of this type, as the appended Plate 5 shows without necessity of description, and various similar instruments of the Museum collections are figured in Plate 6.

IV. INSTRUMENTS OF THE RESONATOR TYPE.

1. The next group includes a variety of instruments of the resonator type, a type that is widely distributed and conforms to a law hitherto unrecognized as capable of furnishing a scale; though Sondhaus in 1850 stated the law and tried a few rough experiments. The mathematicians[2] have proved that a mass of air in a confined space with a very small nearly circular opening, as a short-necked bottle or a whistle, has a frequency of vibration proportional to the square root of the fraction which expresses the diameter of the hole divided by the volume of the cavity; and if there are two such openings so placed that the flow of air through one does not interfere with that through the other, the numerator of the fraction will be the sum of the two diameters. Now extend the same principle, and one may have a series of sounds rising in pitch as one after another of several holes in the wall is opened; and provided the character of the vibration is not essentially changed, the frequency of vibration of these notes will increase as the square root of the sum of the diameters of the holes opened. Suppose, for example, that a vessel has one mouth-hole of diameter 2 and several properly placed finger-holes of diameter 1; then on successively opening these a scale may be produced having vibration frequencies in the ratio of the square roots of 2, 3, 4, 5, etc. A moment's consideration will show that in such a scale the intervals between successive sounds become less and less as the pitch rises, instead of becoming greater as is the case with strings or flutes where the spacing of frets or holes is uniform.

The most elaborate and beautiful illustrations of instruments of this type are from graves in Central and South America. (See Plate 7.) The United States National Museum has many whistles from Chiriqui in Colombia, most of them giving but a single high note; these differ substantially, it will be noticed, from stopped organ pipes, since in the latter the mouth extends the full width of the tube. Whistles with one or two finger-holes have come from Mexico and San Salvador, but the most complete and perfect are from Costa Rica. Of these the one

[1] Syntagma Musicum, pls. IX and X.

[2] Rayleigh, Theory of Sound, II, 1878, Chap. XVI.

bearing the catalogue number 59970 (Plate 7, fig. 1) has served as the type specimen, and is the instrument which led to this investigation. It has a globular body with bird's head, a mouthpiece about in the position of a bird's tail, and four finger-holes on the back symmetrically placed; these holes seem to be precisely equal in diameter, and equivalent in musical effect, so the order of fingering is a matter of indifference, and all the tones are clear and distinct; in Dr. Wilson's paper.[1] Mr. Upham, who is a violinist, notes them as F, A, C, D, E. On measurement the volume was found to be 36.0 cc., the equivalent diameter of the tràpezoidal mouth hole 1 cm., and the diameter of the finger holes .65 cm.; these diameters, however, need a correction on account of the thickness of the walls, since the air can not pass freely through the rather thick wall. The final result of the calculation is to give, with all finger-holes closed, the note F on the highest line of the treble staff, to within half a semitone, and on opening the finger-holes in any order to give the succession of intervals 4, 3, 2, and 2 equal semitones, with a mean error of only one-eighth E. S. According to the theory the series of intervals depends only on the ratio between the diameters of the holes and the mouth hole, in this case 1 to 1.62; so the series of tones has vibration frequencies approximately as the square roots of 1.6, 2.6, 3.6, 4.6, 5.6, or of 1, 1.62, 2.24, 2.86, 3.48; but the pitch of all depends on the quotient of the radius of the mouth-hole by the volume. Although the theoretical correction for thickness of wall can not be quite precise, it affects all the holes to nearly the same extent, and the greatest probable error that can be assumed will not change the whole compass more than half a semitone; so the calculated scale would still be substantially what the ear confirms—F, A, C, D, E, or in syllables *do*, *mi*, *sol*, *la*, *si*.

The Museum has several other Costa Rican instruments also of pottery quite similar in appearance to this, but not capable of giving such clear tones, or quite so perfect in the equality of the holes. If the holes are unequal in diameter, in thickness of wall, or in location with reference to the vibrating mass of air, the order of pitch will depend on which holes are opened instead of merely on how many; with five holes sixteen combinations are possible; but of the eleven instruments in the Museum eight give only five notes each, two give seven notes, and one gives nine notes. If the finger-holes are small relatively to the mouth hole, the compass is small, so one high-pitched whistle has a compass of only six semitones—G to C♯—and another runs from B to E; three have a compass of seven E. S., that is, a musical fifth, and two each have, respectively, eight, nine, and eleven semitones.

Still other National Museum instruments, similar in principle, but ruder in workmanship and more grotesque in form, have come from Chiriqui, Columbia, and are figured in Dr. Wilson's report, pages 628

[1] Report of United States National Museum for 1896, p. 617.

to 646. In other museums similar instruments are to be found. A few from Chiriqui were briefly described forty years ago as belonging to the American Ethnological Society.[1]

In the American Museum of Natural History in New York, as reported by Prof. F. W. Putnam, half a dozen such three- and four-hole whistles from the region of Santa Marta, Colombia, are to be seen; while under his charge at Cambridge, Mass., there are a number from the Uloa Valley, Central America;[2] of those figured, three have three finger-holes and are said to give five notes each.

In the Brussels Conservatory Collection[3] there are twenty-five terra cotta instruments from Mexico; two of them are clearly of this resonator type, giving five notes and having a compass, respectively, of eight and eleven E. S. (fig. 3). Lastly, a similar instrument described and figured by Dr. Walter Hough, in the Report on the Columbian Historical Exposition at Madrid, 1892–1893, has the small compass of six E. S. The point should again be emphasized that with these instruments the notes get closer and closer together as the pitch rises; for instance, on the type instrument the successive intervals are in whole numbers 4, 3, 2, 2, E. S.; on the Brussels instruments, 3, 2, 2, 1, and 4, 3, 2, 2; on the Madrid specimen, 2, 2, 1, 1. A chart (Plate 10) will show more accurately what the four intervals are with any specified ratio of holes, and whether there is appreciable error in expressing the interval in whole numbers. Of course the calculations assume uniformity in the blowing, for it is easy for the performer to vary the notes by a considerable amount. Still, it is a surprise to find how well these simple scales satisfy the ear.

Fig. 3.
TERRA COTTA WHISTLE.
After Mahillon.

A sort of stone flageolet from Costa Rica appears to be connected with these instruments in principle (Plate 7, fig. 8). This is closed at one end and has a small mouth opening and four finger-holes arranged in pairs; its scale of seven notes from five holes proves that the holes are not acoustically equivalent, but the two of each pair are found to be nearly equivalent; so on trial it appears that the square root formula may be applied, by giving to the mouth-hole the value 5, to each of the nearer holes the value 1, and to the other holes the value 2; then the vibration frequencies will be as the square roots of the numbers 5 to 11. The calculated intervals from the lowest note are 1.6, 2.9, 4.1, 5.1, 6.0, 6.8 E. S.; the observed intervals are 2, 3, 4, 5, 6, and 7 E. S.

[1] Magazine of American History, IV, 1860, pp. 144, 177, 240, 274.

[2] Memoirs of the Peabody Museum, I, No. 4, pl. IX.

[3] Mahillon's Catalogue, II, Nos. 852, 853.

2. A pottery whistle found in the ruins of Babylon, dating probably from about 500 B. C., is in the Museum of the Royal Asiatic Society, London[1] (fig. 4). Rowbotham[2] says this is similar to the reindeer joint used by the cave men. Its extreme length is 3 inches and it has two finger holes. The three notes are stated to be C (of 525 d. v.), E, and G; but the holes not being quite equal, the E from one of them is a quarter of a tone flat. By blowing hard the G can be carried up to A. The chart (Plate 10) shows that if the interval C–G is exact, with equal holes the intermediate note E will be a very little sharp of the piano note, but the difference is only about 1 per cent, one-fifth of a semitone, and so is utterly negligible in notes of such uncertain intonation.

Fig. 4.
BABYLONIAN WHISTLE
After Engel.

3. Striking comparisons have sometimes been made, and especially by the late Prof. Terrien de la Couperie, between the Assyrian and early Chinese civilizations. Whatever their relations may have been, it is curious that the only instrument of the resonator type, having several finger holes and coming from a people who had a musical theory, is the *Hsüan* (Van Aalst)[3] or *Hiuen* (Amiot)[4] of the Chinese, said to have been invented some 2,700 years before our era, and still used in the Confucian ceremonies, though very rarely seen. It is described as a hollow cone of baked clay about 3½ inches high, having a mouth-hole at the top, three equal finger-holes on one side, and two equal holes on the other. The descriptions available are inconsistent and incomplete, but that given by Amiot a century ago is the fullest. He reports the scale as *re, fa, sol, la, do, re*, and as he gives a cut (fig. 5), also the diameters of holes and the external measures, an approximate calculation can be made of the scale by the laws of resonators. The pitch of the fundamental comes out D above middle C, and the other notes, F, G, and A, for one side; then starting anew for the other side we get C and D, all within a quarter of a semitone. This, it will be noticed, is a five-

Fig. 5.
CHINESE RESONATORS.
After Amiot.

[1] Engel, Music of the Most Ancient Nations, p. 75.
[2] History of Music, II, p. 628.
[3] Chinese Music, Shanghai, 1884, p. 82.
[4] Mémoires concernant l'histoire . . . des Chinois, p. 225.

step scale, like most of the theoretical Chinese scales. The agreement between the mathematical theory and observation is strikingly close.

4. All the cases thus far referred to have been of prehistoric or very ancient instruments. But some curious little instruments of this type are figured by Frobenius[1] (fig. 6) as "a splendid parallel between the cultures" of some West African tribes and the natives of New Pomerania. These are little whistles made out of gourds (a, b, d) or pottery (c). They have the mouth-hole and two, three, or four finger-holes. No dimensions are given. Kraus, of Florence, figures and describes[2] a similar instrument from Melanesia made of a gourd 6 cm. in diameter, having three finger-holes close to the mouth-hole (fig. 7). The scale is stated to be A, B, C♯, E, F, but no further measures are given. However, this series is easily obtained by assuming the diameter of the mouth-hole to be 1.0, of one hole 0.3, and of the others 0.6; apparently D♯ is omitted.

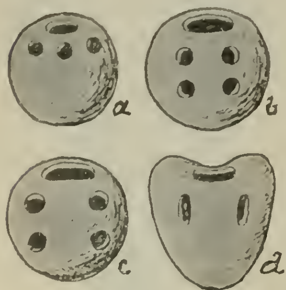


Fig. 6.
GLOBULAR WHISTLES.
After Frobenius.

In the Finsch Collection in the American Museum of Natural History, in New York City, there are several similar gourds of different sizes having three finger-holes. They are labeled "Bläsekugeln," "used by women."

5. In Europe there have been many instruments depending on the same general principle of resonance in a nearly closed cavity (in distinction from the open or closed organ-pipe principle), but not conforming to the simple law already set forth. Prætorius[3] in his famous book of 1618 gives figures and descriptions of several such instruments, along with the recorders, flutes, violins, etc., that one reads of more frequently; for instance, he says the fagotti are sometimes closed at the extreme end, but have a side hole; the Cornamuse has the end closed and holes in the side. Besides these he describes various instruments having stopped bodies on reeds—the rankett, bear pipes, etc., and similar forms on the organ. These things have all gone out of use along with the other delicate and weak-toned instruments of their times. To-day musicians demand tones more powerful and richer in harmonics than instruments of this type can give. But a curious survival or revival of this earlier type occurred in the middle of this century, which is told of in Groves's Dictionary of Music. A blind peasant, named Picco, gave public performances in London on a

Fig. 7.
GLOBULAR WHISTLE.
After Kraus.

[1] Der Ursprung der Afrikanischen Kulturen, 1898, p. 150.
[2] Archivio per L'Antropologia e la Etnologia, XVII, 1887, pp. 35–41, fig. 5.
[3] Syntagma Musicum II, pp. 44, 48, 85.

flageolet 2 inches long and having only three holes. By partially or wholly closing the end of the tube with his hand he made use of the resonator principle to lower the pitch of his notes; so he obtained a compass of more than two octaves. The instrument is similar to Prætorius's *schweigel*[1] except that it is shorter, and the accuracy of the notes performed would depend almost wholly on the performer. Later a traveling troupe appeared in European cities with seven instruments called ocarinas. These are familiar to us, being on sale everywhere. They are properly resonators, but the holes are more numerous than in the instruments already considered and vary widely in size. The scale, which the instruments furnish with more or less precision, is not dependent on any simple principle, but is adjusted by the maker by varying the sizes of the holes so as to conform to a scale fixed on other instruments.

V. THE INFLUENCE OF THE HAND.

All the instruments of the three groups now discussed are "fingered;" that is, the acoustical dimensions of the vibrating string or mass of air are varied as the player manipulates the fingers of one or both hands. These instruments therefore involve a feature not associated with drums and other instruments of percussion, or with primitive harps. Instead of using the hand as a whole, the more delicate fingers are utilized separately; so the simple instrument becomes in a peculiar sense a part of the player's means of self-expression and is specially responsive to his own moods, as many legends of the power of music testify. But leaving to the musical writers such comparisons between instruments, it is important to the physicist to recognize that the dimensions of the human hand have fixed absolutely some dimensions of these instruments.

The first thing to strike one, considering the hand from this point of view, is the fact that only with difficulty can the five digits be brought into line, so the thumb is not used on primitive instruments for fingering, so far as observed. In the more highly developed flutes there may be a hole for it on the back side, while on our own flutes, clarinets, etc., it governs one or more keys. Similarly, the little finger does not readily fall in line with the three longer ones, and, besides, is much weaker. The remaining three fingers on a hand of medium size can be brought into a space of about 1 cm., or spread to span perhaps 12 cm. (5 inches). To fix one's ideas before comparing these limits with measures on some actual instruments, it will be convenient to recall that on piano keyboards the distance between key-centers an octave apart is 165 mm. (6½ inches), the same as on a spinet of 1602; but on the physiologically designed Janko keyboard, with the octave distance

[1] Syntagma Musicum, p. 39, pl. ix.

140 mm. ($5\frac{1}{2}$ inches), an ordinary hand can readily span an octave and a Fifth, because the fingers are not forced into line.

Examining first some string instruments, it is found that on a guitar of New York make (No. 55690, U.S.N.M.) the distance between frets ranges from 33 to 14 mm. The greatest distance noticed between frets is on the large Siamese *Kra Chappee* (No. 27310, U.S.N.M.), where there are three spaces, respectively, of 71, 73, and 77 mm. A similar instrument examined at the World's Fair held in Chicago had the corresponding spaces 60, 60, and 67 mm. The string lengths to the first frets were, respectively, 878 and 740 mm. The smallest distance observed between frets is the above-cited 14 mm., except that the Syrian lute, *Bizug* (No. 95144, U.S.N.M.), has two spaces of 12 and 13 mm. On most instruments the frets cease when the limit of 20 to 25 mm. is reached. It is obvious that these and similar data for fretted instruments are not of much importance unless one can know that the hand was not shifted from one fret to another.

With our instruments shifting is notoriously common, but the histories of the violin report that two or three centuries ago it was a notable thing for a player to shift. The usual theory of the old many-stringed instruments, of which the Arab lute is a particularly good example, required the strings to be tuned in Fourths, and the string lengths were not too great for the four fingers to govern all the frets within this range—that is, in a quarter-length of the string—so a shift would be unnecessary. On the Arab lute[1] there were sometimes ten very unequally spaced frets in this space, but for any one tune only a few of them were used, and in the principal modes, '*Ochaq* and *Rast*, one fret each for the index and ring fingers sufficed to give substantially our diatonic scale.

With simple wind instruments the case is quite different, for several fingers must be used simultaneously to cover holes, so the hand can not be shifted. In the Kiowa flute referred to above the uniform distance between holes is 32 mm.; in the stone whistle from Mexico, 20 mm.; in the four Egyptian flageolets and oboes figured by Villoteau (his Plate c c) the intervals are, respectively, 12, 15, 15, and 36 mm. These distances require only a convenient spread of the fingers. Many other measures can readily be obtained from the accompanying figures with their appended scales.

If the musician has a theory demanding that the holes be so near together or so far apart as to make direct fingering inconvenient or impossible, keys with long or short levers are added, as on modern flutes and clarinets, while among the Romans extra holes were bored to provide for several genera, the holes not needed for any tune being closed by plugs or rotating rings.

In a few cases wind instruments are found so long that the player's

[1] Land, Travaux de la 6e Congrès des Orientalistes, 1883, pp. 107–114, or Ellis, Journal of the Society of Arts, XXXIII, 1885, p. 502.

arm is too short to reach the lower end. Then, necessarily, the holes to be fingered are located at the middle or upper end of the tube, but the holes are so small that the pitch of the resulting notes is much lower than the position of the holes would suggest, so the discrepancy to the ear is not as great as to the eye. In other cases the length is misleading, for the holes are bored obliquely or holes are bored in the tube below the holes to be fingered, thereby raising and adjusting the pitch of the lowest note, as Mahillon shows in the Brussels catalogue (Nos. 830, 1039, 1117, 1119, and 1123) and Villoteau shows on his Plate c c, No. 1. This is a possible explanation of the superfluous holes in the flute on the statue from the ruins of Susa (Plate 2, fig. 1), if the figure be accepted as archæologically correct. In modern instruments, as is well known, the distant holes are controlled by covers at the ends of long levers.

The relation of the instruments of the resonator type to the hand is too obvious to need discussion; the objects must be of such size and shape as to be held by the hand or by two hands while the fingers are manipulated, and the holes must be conveniently located and small enough to be closed by the tips of the fingers, or in the Chinese *hiuen* also by the thumbs.

It is rather surprising to see how little the thumb is used in playing upon the instruments under consideration. Although from its anatomical structure the thumb has a peculiar independence in its movements, yet most of its services are rendered by cooperation with the other fingers; and the natural training of these, as in grasping, sewing, weaving, or the most delicate savage industries, appears likewise to call for their cooperation, not for independent action. It is only in playing instruments like the lyre and harp (whose tuning depends on principles outside the instrument, and so they do not belong to the present discussion) that one sees a grasping action requiring two or more fingers at once. But in the guitars, flutes, etc., under consideration, the thumb is constantly occupied in merely supporting the instrument, so any variation in the pitch of the sound can come only as the other fingers become independent in action. When we remember how difficult it is for a civilized piano-player or typewriter to-day to acquire a satisfactory independence in movement of all the fingers, especially of the third and fourth, and recall that the early instruction-books for the harpsichord required the use of but two fingers on each hand, we shall have a higher respect for the technique of primitive musicians, and shall not wonder that primitive wind instruments have so few holes. Presumably the index finger first gained independence, and then it marked a long advance when two fingers could act independently of one another. So the four-hole flute or resonator, requiring the action of two fingers from each hand, and giving a scale of five tones, is a monument commemorating an important stage both in the development of the hand and in the extension of musical resources.

VI. COMPOSITE INSTRUMENTS.

Each of the instruments thus far examined is capable of furnishing several notes of approximately constant pitch, but the general principle before us may be embodied in composite instruments, where each note has its own vibrating body; thus

1. Various forms of harps and dulcimers show strings of regularly decreasing length; here, of course, difference of tension may nullify the scale due to the lengths. One form is shown on Plate 8.

2. Pan's pipes are sometimes seen with regularly decreasing lengths; it is true that this regularity is not very common, but it is the only principle of scale building (except the Chinese cycle of fifths) yet recognizable in these primitive instruments. (Plate 9.)

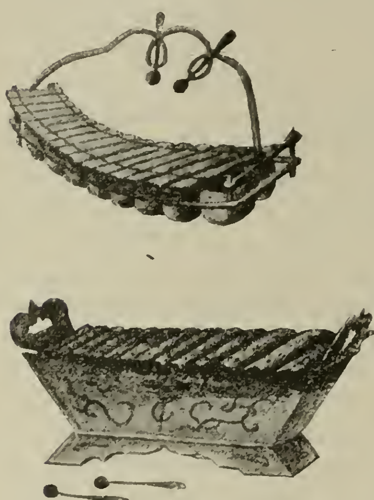


Fig. 8.
XYLOPHONES.
After Kraus.

3. Instruments of the bar type are found frequently in our orchestras and bands under various names, as *xylophone;* they are familiar in children's toys and are widely distributed in savage and half-civilized lands under the names of *marimba*, *balafong*, *harmonicon*, etc. (Plate 8 and fig. 8.) The law of the uniform bar is that the frequencies of vibration of a series of bars of the same material are proportional to the quotients of the thickness divided by the square of the length; the breadth is immaterial if it is uniform. So if one takes a series of *uniform* bars of the same thickness and regularly decreasing length he may obtain a series of ascending notes. Thus, let the first bar be 24 units long (for example 24 cm.), the successive bars decreasing by one unit; the eighth bar will be 17 units long, and the fifteenth bar 10 units; the series of frequencies would then be as the reciprocals of the squares of 24, 23, etc., so giving to the ear a series of increasing intervals; with these proportions bar No. 8 would give the Octave of the first, but bar No. 15 would give the Twelfth of bar No. 8. The simplicity of the rule, however, frequently disappears, either because of variations in the thickness, as when a savage splits a bamboo stem and then cuts his bars so that the shorter ones are also thinner, or because of the attachment of lumps of wax or clay to the bars to tune them to some other instrument; or because of the hollowing of the center, as is done by modern Japanese; so at present one can not affirm that this

theoretical principle of scale determination is certainly and consciously embodied in any instrument anywhere; but some instruments in the National Museum and some drawings in books make the assumption seem plausible, that the primitive type of this instrument is a series of bars, supported at points about one-fifth or one-fourth of their length from their ends, and decreasing in length by equal linear amounts.

It is evident that these composite instruments are of minor importance in this study; but in the light of the theoretical laws here suggested perhaps travelers may learn something of the intention of a savage who cuts his Pandean pipes or bars to form a musical instrument.

VII. CONCLUSIONS.

There have now been considered all the types of instruments in which several notes of different pitch are produced from the same vibrating body—whether string, column of air, or mass of air.

(1*a*.) There have been found examples from various parts of the world of the intentional location of the stopping points of a vibrating string at equal linear distances; since with all stringed instruments the fingering will cause a slight increase of tension, the equivalent length of the string is less than the actual length.

(1*b*.) There have been found numerous examples of wind instruments pierced with holes in one or two groups spaced at equal linear distances; since these holes are never sufficiently large to allow the air to flow through them with perfect freedom (unless in some Chinese flutes) the equivalent length of the vibrating column of air is greater than the actual distance from the mouthpiece to the hole.

(2.) There have been found instruments of the Marimba type with bars of regularly decreasing lengths.

(3.) There have been found many forms of instruments of the resonator type embodying a series of equal and similarly-located holes; in these, thickening the wall is equivalent acoustically to making the holes smaller; while locating the hole nearer the point where the vibrating air has its maximum change of density is equivalent to enlarging the hole.

Three simple laws give to the first approximation the scales of these several instruments, namely:

(1) The law of inverse lengths.

(2) The law of inverse squares of lengths.

(3) The law of the square roots of a series of numbers proportional to sums of diameters.

The first and second laws give scales whose intervals increase as the pitch rises; scales based on the third law have decreasing intervals. Some results are shown in a table in the appendix and graphically in Plate 10.

From these it is evident that whichever type of instrument one may take, there will be some intervals that very closely agree with intervals of our familiar scale. In a few cases this comes about because our scale is principally derived from the Greek theorists, who based their scales on proportional string-lengths; so, if the unit of equal distance on a simple guitar chances to be an aliquot part of the length of the string from the bridge to the nut, some of the resulting notes will belong to our scale. (However, the divisor must not have a prime factor greater than five.) But whatever the instrument, on any doctrine of chances, there will be some approximate coincidences; and these coincidences, as judged by the ear, will be found much closer and more numerous than when judged mathematically or graphically; for the training of modern musicians, as has often been recognized, not only allows but compels them to ignore deviations from their standard scale—deviations amounting sometimes to more than half a semitone. So one is forced to conclude that the recognition, even by a musically educated ear, of a series of notes as agreeing substantially with our diatonic scale or with any other known scale, does not afford any adequate ground for judging of the principles underlying the series; in fact, the failure to note the deviation may prevent the recognition of the underlying principle.

The type Costa Rican four-hole whistle is the most striking example of a series agreeing closely with notes of our scale, yet based on an absolutely different principle; for the mean computed deviation from the piano intervals is only one-eighth of a semitone.

Further, the whole discussion makes it evident that the people who made and used these instruments, or any single type of them, had not that idea of a scale which underlies all our thinking on the subject, namely: A series either of tones or of intervals recognized as a standard, independent of any particular instrument, but to which every instrument must conform. Modern Europeans for the sake of harmony have nearly banished all scales but one, and seldom know by what rules the instruments are tuned to furnish this. But for these people the instrument is the primary thing, and to it the rule is applied, while the scale is a result, or a secondary thing; and the same rule applied a hundred times may possibly give a hundred different scales. Naturally one does not expect to find much concerted music among people in this stage of development.

The various rules discussed above may be united in a generic one, namely:

The primary principle in the making of musical instruments that yield a scale is the repetition of elements similar to the eye; the size, number, and location of these elements being dependent on the size of the hand and the digital expertness of the performer.

This principle shows itself in the occasional equal spaces on the neck or table of a stringed instrument, and conspicuously in the series of holes on flutes and primitive oboes, while a sense of balance and symmetry added to the repetition appears in the two groups of holes on the flutes, etc., and especially in the resonators, and appears in a different way in the trapezoidal forms of dulcimers, Pan's pipes, and marimbas. The pitch-determining elements are therefore primarily decorative. In fact no one can examine any collection of primitive wind instruments, or drawings of them, without being struck by the way in which the holes often cooperate in the decoration; while they are not found interfering with the artistic design (see fig. 3, page 430; Plate 2, figs. 1 and 2; Plate 3, fig. 2).

Simple decoration involving only repetition and symmetrical placing or grouping of similar parts is not only found among living primitive peoples everywhere that musical instruments embodying a scale can be found, but is prehistoric. The prehistoric flutes are believed to come from the neolithic age, and the pottery from this age shows a multitude of geometrical designs, some of which are collected in Wilson's Plates 19 and 20. The paleolithic age has furnished few geometrical designs and no flutes or many-holed resonators. In applying such decoration to the hollow bones of animals or human enemies, to the hollow reeds that Lucretius says whistle in the wind, or to gourds and simple pottery, nothing can be more natural than sometimes to perforate the walls and to get a several-toned musical instrument as the result. So although no conclusions regarding the mental operations of prehistoric man can be absolutely certain, one feels a strong conviction that, as with immature minds among us, art appealed first to the eye and later to the ear; that beauty of material form incidentally furnished series of sounds that could be repeated, and could give to the ear and the mind the idea of the definite leaps or steps that Aristoxenus, countless ages afterward, called the characteristic of music. (Of course rhythm in movement and in sound are independent of the structure of an instrument.) Any influence that may have been exerted on the establishment of scales by the songs of birds, by the recognition of overtones in the sounds of the human voice, or by the production of harmonics on the horn must have been limited and trivial. The principle here presented is at any rate a *vera causa*, and explains facts hitherto unexplained; further, (1) it is extremely simple both in theory and practice; (2) it is flexible, allowing of multifarious results in practice; (3) it is suggested by prehistoric instruments, supported by the instruments of many living primitive peoples and repeatedly confirmed by its survival in several instruments of peoples in an advanced stage of musical culture.

It only remains to add, in order to prevent misunderstanding, that the principle here set forth never appears as the dominating one among peoples who are known to have had a theory of the scale. The Greek theoretical scales, diatonic and nondiatonic, are doubtless its direct descendants, though at present it is not known what the influence was that so transformed them and made them depend on ratios, not on difference of lengths. Possibly the theory of numbers bewitched musicians then as it has sometimes since, though the converse speculation is a plausible one—that the recognized musical ratios gave a mystical meaning to numbers. It is curious to note that Aristoxenus had somehow got far enough to complain that flutes distort most of the intervals (p. 42, Mb.), and if his lost treatise on boring flutes should be found it might throw light on this history. The Arab "step by step" method is apparently a late descendant of the equal linear divisions, appearing after men had learned to recognize the equality of intervals as well as of spaces. But the Chinese cycle of fifths must be explained and determined on entirely different physical principles, and the various European scales as defined by theorists or rendered by the best violinists or fixed by good tuners, when properly examined, reveal elements as diverse as the elements of our language or our population. The principle in question is therefore presented only as the simplest, earliest, and most primitive principle of scale-building.

APPENDIX.

The laws briefly stated on page 437 for the several kinds of instruments discussed in the paper may be expressed more accurately by the following formulæ:

Let N = number of complete vibrations per second.
l = length of string or column of air or bar.
a = diameter of mouth-hole of resonator, corrected for thickness of wall.
b = diameter of finger-holes of resonator, corrected for thickness of wall.
n = number of finger-holes opened on resonator.
t = thickness of bar.
K = constant, depending on material and units of measurement.

Assuming centimeter-gram-second units and ordinary temperatures,

$K^{i} = \sqrt{\text{Tension in dynes} \div \text{mass in grams per cm.}}$ = velocity; e. g., in piano strings 17,000 to 40,000 cm.-sec.; in violin strings from 13,000 for the covered string to 43,000 for the gut E-string; in weak primitive instruments probably much less.

K^{ii} = 34,000 cm.-sec., the velocity of sound in air.

K^{iii} = 520,000 cm.-sec. for iron bars; 340,000 to 520,000 for wood bars supported as usual in a xylophone.

K^{iv} = 5,500.

Then, corresponding with the brief laws,

(1a) For strings: $N = \frac{K^{i}}{2l-} = \frac{1}{2 \times l-} \sqrt{\text{tension} \div \text{linear density}}$.

(1b) For columns of air: $N = \frac{K^{ii}}{2l+} = \frac{17{,}000}{l+}$.

(2) For bars: $N = K^{iii} \frac{t}{l^2} = 340{,}000 \text{ to } 520{,}000 \frac{t}{l^2}$.

(3) For resonators: $N = K^{iv} \frac{\sqrt{a + \text{sum of } b}}{\sqrt{\text{volume}}} = \frac{5{,}500}{\sqrt{\text{volume}}} \sqrt{a\left(1 + n\frac{b}{a}\right)}$.

These constants are sufficiently accurate for the general purposes of the anthropologist and musician. But the results should be expressed in musical terms. The French standard pitch, now adopted by the Piano Makers' Association, gives A = 435 d. v., or C = 258.7 d. v., and the ratio for any interval of p piano semitones is $2^{\frac{p}{12}}$. In most cases it is much more convenient to have intervals than ratios; and incomparably the most convenient unit of intervals is the piano semitone, of which 12 by definition make an octave; these can readily be grouped by anyone with slight musical knowledge into larger intervals, Thirds, etc., and the musical value of any whole number of them can instantly be found on a well-tuned piano.

Since the reduction of ratios to intervals can not ordinarily be done without logarithms, a short table has been calculated and is appended by the use of which the reduction may be done by inspection in most practical cases. This table gives the logarithm of every whole number from 1 to 40, and the product of these by 40, less one three-hundredth, together with the successive differences; these are in semitones; for the factor is so chosen that when the logarithm of the ratio 2:1 is multiplied by it the product will be 12, which is the number of semitones corresponding to the ratio of the octave. Much more elaborate tables, but without the column of differences, have been published by Prony and by Ellis. In using the table it is well to remember that the average uncertainty in pitch of public performers in Berlin was found to be about one-tenth of a semitone.

As illustrations of the use of the table, find the successive intervals of the scale of the Hindu *Sitar*, the string being stopped successively at 36, 35, 34, . . 27; the corresponding differences in column 4 of the table are 0.49, .50, .52, ...63 E. S., the sum being 4.98 E. S., as required by Tagore's rule (p. 425 above). To complete the octave, the space 27 to 18 is to be divided into 13 equal parts; substitute for the ratio 27:18, or 3:2, 39:26, and use the table again; the differences are now 0.45, .46, ...65, the sum being 7.02 E. S., which added to 4.98 gives 12 E. S., or the octave.

If the law be that of the square roots, as with resonators, the table is to be used in precisely the same way, but the final results are to be divided by 2; for example, in the type resonator, calling the equivalent radius of the mouth hole 1.0, that of the finger holes is 0.6 (more accurately, 0.62); the series of terms will therefore be 1.0, 1.6, 2.2, 2.8, 3.4; multiply all by 10, and take the corresponding numbers from column 3 of the table; divide the differences by 2, and add the quotients to the fundamental pitch. The results are as follows:

	E. S.			
10	39.86			F
16	48.00	8.14	4.07	A + .07 E. S.
22	53.51	13.65	6.83	C − .17.
28	57.69	17.83	8.92	D − .08.
34	61.05	21.19	10.60	E − .40.

If 0.62 had been taken the results would have been slightly higher in pitch.

Plate 10 has been plotted to give directly the intervals of resonator scales for any number of open holes up to 5, and for ratios of radii between 0 and 1. The dotted line corresponds to the type resonator.

The table may also be used for bars; the only change is that the differences are to be doubled instead of halved. Thus, with a series of uniform bars whose lengths are 24, 23, etc., to 17, the compass will be $2 \times (55.02 - 49.05) = 11.94$ E. S., which is practically an octave, as stated on page 436.

Table for computing musical intervals.

N.	Log. N.	E. S.	Dif.	N.	Log. N.	E. S.	Dif.
1	0.0000	....	....	21	1.3222	52.70	0.84
2	.3010	12.00	12.00	22	.3424	53.51	.81
3	.4771	19.02	7.02	23	.3617	54.28	.77
4	.6021	24.00	4.98	24	.3802	55.02	.74
5	.6990	27.86	3.86	25	.3979	55.73	.71
6	.7782	31.02	3.16	26	.4150	56.41	.68
7	.8451	33.69	2.67	27	.4314	57.06	.65
8	.9031	36.00	2.31	28	.4472	57.69	.63
9	.9542	38.04	2.04	29	.4624	58.30	.61
10	1.0000	39.86	1.82	30	.4771	58.88	.58
11	.0414	41.51	1.65	31	.4914	59.45	.57
12	.0792	43.02	1.51	32	.5051	60.00	.55
13	.1139	44.41	1.39	33	.5185	60.53	.53
14	.1461	45.69	1.28	34	.5315	61.05	.52
15	.1761	46.88	1.19	35	.5441	61.55	.50
16	.2041	48.00	1.12	36	.5563	62.04	.49
17	.2304	49.05	1.05	37	.5682	62.52	.48
18	.2553	50.04	0.99	38	.5798	62.98	.46
19	.2788	50.98	0.94	39	.5911	63.43	.45
20	.3010	51.86	0.88	40	.6021	63.86	.43

EXPLANATION OF PLATE 1.

STRINGED INSTRUMENTS.

Fig. 1. Small Turkish Tamboura.
(Cat. No. 95312, U. S. N. M.)

Fig. 2. Medium Colascioni (Italian).
(Cat. No. 95307, U. S. N. M.)

Note.—The scale shown on this and most of the following plates is 20 centimeters long.

STRINGED INSTRUMENTS.

EXPLANATION OF PLATE 2.

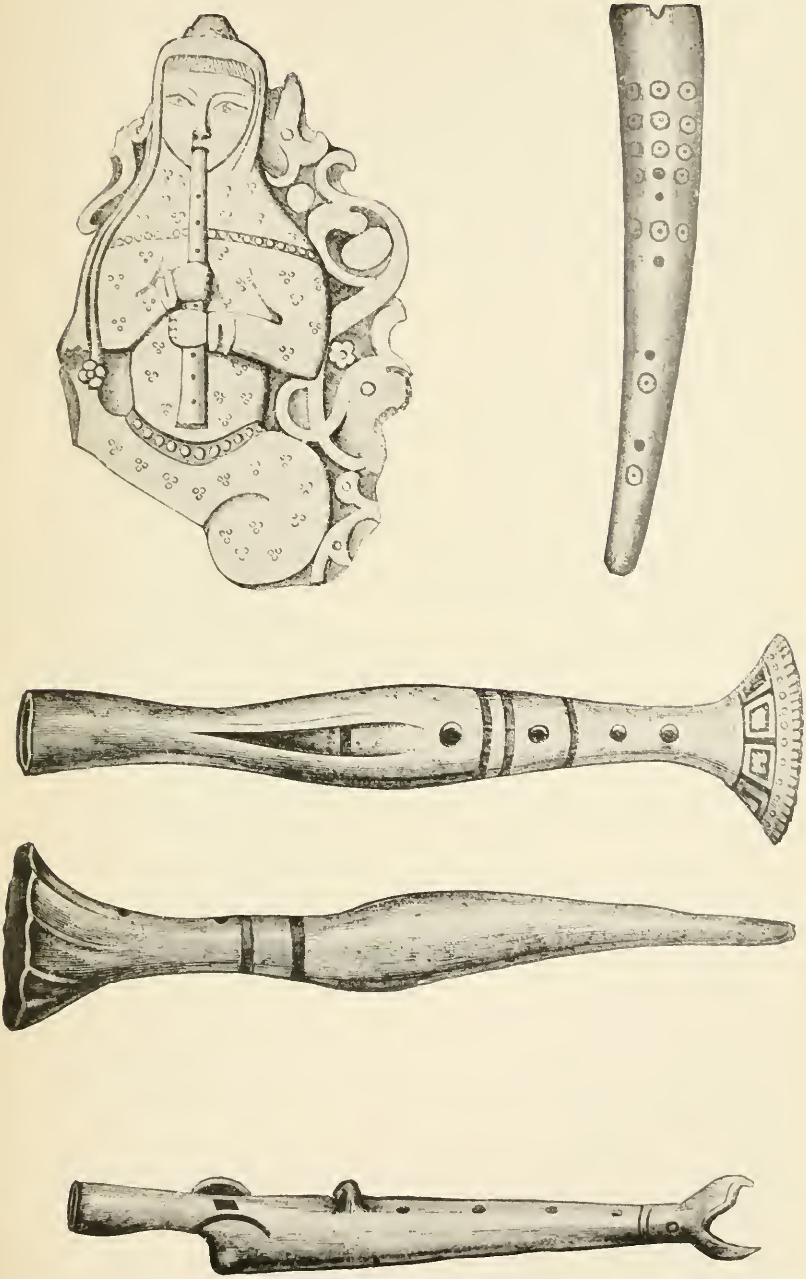
FLUTES WITH EQUAL-SPACED HOLES, TYPE A.

Fig. 1. PIPE FROM SUSA. Engel, Music of the Most Ancient Nations, p. 77.

Fig. 2. BONE FLUTE, about 6 inches long, disinterred at Truxillo, Peru. British Museum. Engel, Musical Instruments, p. 64.

Figs. 3, 4. AZTEC PIPES, called by Mexicans *pito;* usual form; scale, a, b, c♯, e, f♯. Engel, Musical Instruments, p. 62.

Fig. 5. AZTEC PIPE; unusual form. Engel, Musical Instruments, p. 62.



FLUTES WITH EQUAL-SPACED HOLES.

EXPLANATION OF PLATE 3.

FLUTES WITH EQUAL-SPACED HOLES, TYPE A.

Fig. 1. Double Flageolet. Mexico.
(Cat. No. 197173, U. S. N. M. Report 1896, fig. 250b.)

Fig. 2. Aztec Flageolet (*pito*). Mexico.
(Cat. No. 172819, U. S. N. M. Report 1896, fig. 252.)

Fig. 3. Stone Flageolet. Mexico.
(Cat. No. 98948, U. S. N. M.)

Fig. 4. Bone Flageolet. Costa Rica.
(Cat. No. 18108, U. S. N. M. Report 1896, fig. 273.)

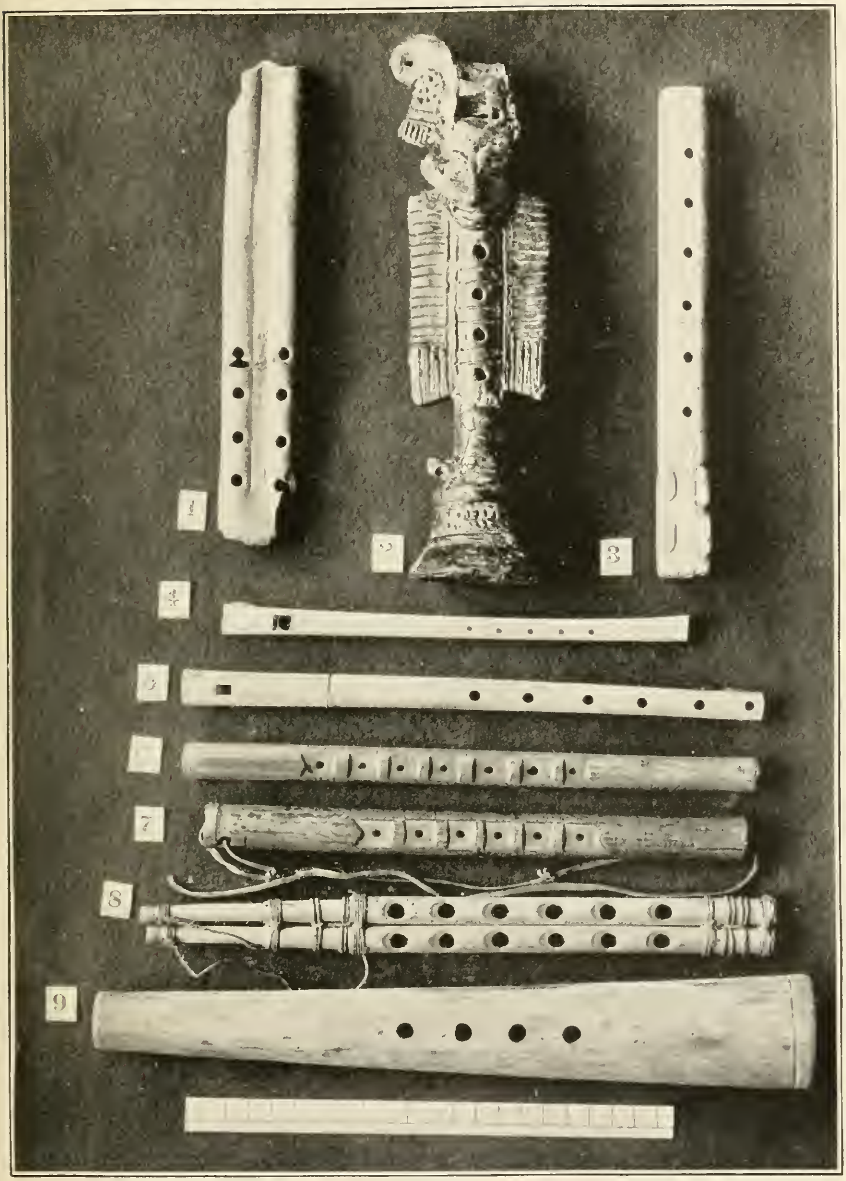
Fig. 5. Bone Flageolet. Amazon.
(Cat. No. 5719, U. S. N. M.)

Fig. 6. Bamboo Whistle. Thibet.
(Cat. No. 167165a, U. S. N. M. Report 1896, plate 69.)

Fig. 7. Bamboo Whistle. Thibet.
(Cat. No. 167165b, U. S. N. M. Report 1896, plate 69.)

Fig. 8. Shepherd's Pipe, with reed. Arabia.
(Cat. No. 93555, U. S. N. M.)

Fig. 9. Horn (*Soittotorvi*). Finland.
(Cat. No. 95686, U. S. N. M.)



FLUTES WITH EQUAL-SPACED HOLES.

EXPLANATION OF PLATE 4.

FLUTES WITH EQUAL-SPACED HOLES, TYPE A.

Fig. 1. Direct Flute. Peru.
(Cat. No. 95904, U. S. N. M.)

Fig. 2. Flute or Flageolet. Kiowa Indians.
(Cat. No. 153584, U. S. N. M.)

Fig. 3. Flute or Flageolet. Mohave Indians.
(Cat. No. 107535, U. S. N. M.)

Fig. 4. Flute or Flageolet. Dakota Indians.
(Cat. No. 23724, U. S. N. M.)

Fig. 5. Transverse Flute (*Ti-tzu*). China.
(Cat. No. 130446, U. S. N. M.)

Fig. 6. Transverse Flute (*Koma Fuye*). Japan.
(Cat. No. 93205, U. S. N. M.)

Fig. 7. Oboe (*Pee Chawar*). Siam.
(Cat. No. 27313, U. S. N. M.)

Fig. 8. Flageolet (*Sopilka*). Little Russia.
(Cat. No. 96466, U. S. N. M.)

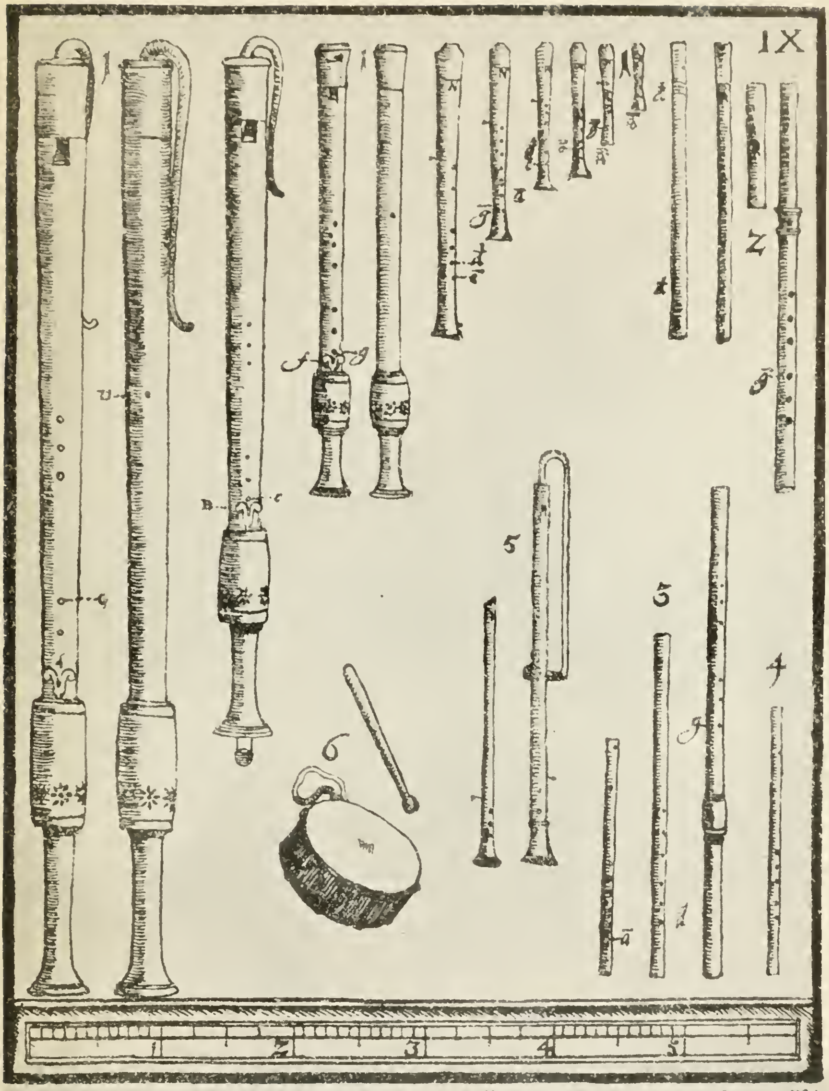
Fig. 9. Double Flageolet. Thibet.
(Cat. No. 95816, U. S. N. M.)

FLUTES WITH EQUAL-SPACED HOLES.

EXPLANATION OF PLATE 5.

FLUTES WITH HOLES IN TWO GROUPS, TYPE B.

From Prætorius's Syntagma Musicum of 1618, to show finger-holes grouped in two sets.



1 Blockflöten, ganz Stimmwerk. 2 Doltzflöt $\overline{d}$ g. 3 Querflöten, ganz Stimmwerk. 4 Schweitzer Pfeiff.
5 Stamentienbass und Discant 6 Klein Päuklin zu den Stamentien Pfeiffen zu gebrauchen

FLUTES WITH HOLES IN TWO GROUPS.

EXPLANATION OF PLATE 6.

FLUTES WITH HOLES IN TWO GROUPS, TYPE B.

Fig. 1. Flageolet (*Souling*). Java.
(Cat. No. 95669, U. S. N. M.)

Fig. 2. Direct Flute. Ceylon.
(Cat. No. 95727, U. S. N. M.)

Fig. 3. Direct Flute (*Manjairah*). Syria.
(Cat. No. 95150, U. S. N. M.)

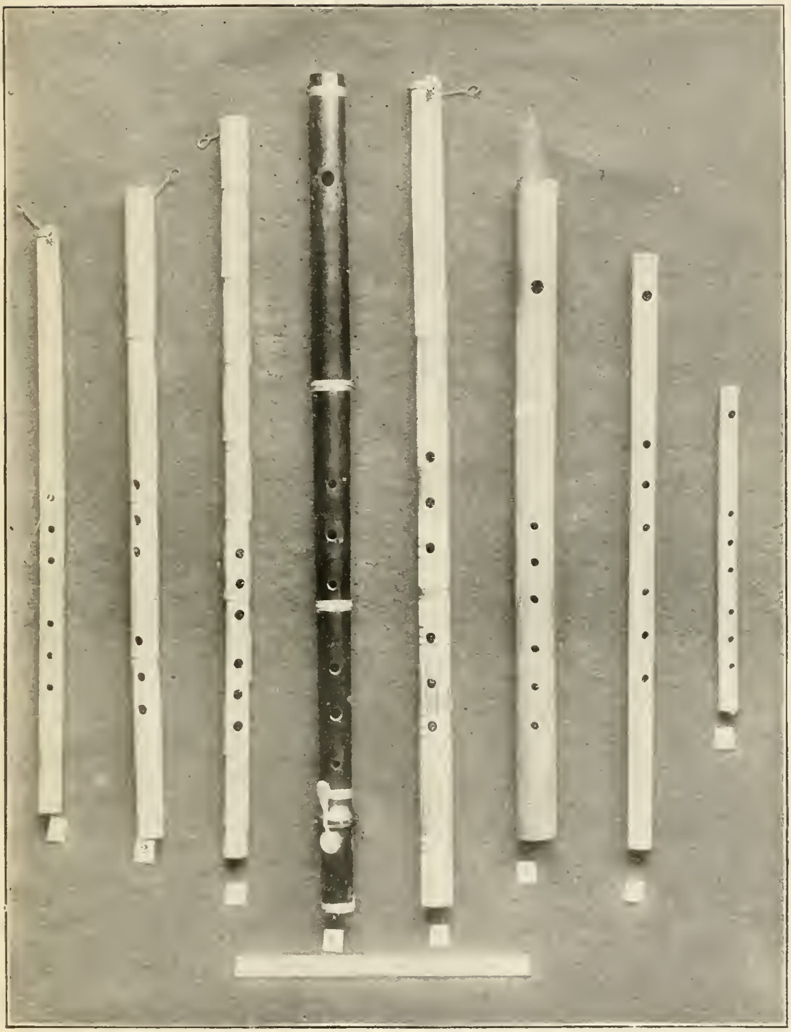
Fig. 4. German D Flute. New York.
(Cat. No. 55624, U. S. N. M.)

Fig. 5. Flageolet (*Souling*). Java.
(Cat. No. 95666, U. S. N. M.)

Fig. 6. Transverse Flute (*Murali*). Bengal.
(Cat. No. 92707, U. S. N. M.)

Fig. 7. Transverse Flute. Manila.
(Cat. No. 95061, U. S. N. M.)

Fig. 8. Transverse Flute. Manila.
(Cat. No. 95060, U. S. N. M.)



FLUTES WITH HOLES IN TWO GROUPS.

EXPLANATION OF PLATE 7.

CENTRAL AMERICAN RESONATORS OR WHISTLES.

Fig. 1. Costa Rica.
(Report U. S. Nat. Mus., 1896, p. 617. Scale: f, a, c, d, e. Cat. No. 59970, U. S. N. M.)

Fig. 2. Costa Rica.
(Report U. S. Nat. Mus., 1896, fig. 263. Scale: d, e, f♯, g, a. Cat. No. 59969, U. S. N. M.)

Fig. 3. Costa Rica.
(Report U. S. Nat. Mus., 1896, fig. 262. Scale: g♭, b♭, b, c, d♭, d, e♭, e, f. Cat. No. 28952, U. S. N. M.)

Fig. 4. Costa Rica.
(Report U. S. Nat. Mus., 1896, fig. 269. Scale: f, g, a, b♭, c. Cat. No. 28956, U. S. N. M.)

Fig. 5. Costa Rica.
(Report U. S. Nat. Mus., 1896, p. 617. Scale: d♭, f, g♭, a♭, b♭. Cat. No. 60045, U. S. N. M.)

Fig. 6. Panama, Chiriqui.
(Report U. S. Nat. Mus., 1896, figs. 304–5. Holmes, Report Bureau Ethnol., 1884–5, figs. 245–246. Scale: end closed, f, g, a♭, b♭; open, f♯, g♯, a♯, b. Cat. No. 109682, U. S. N. M.)

Fig. 7. Costa Rica.
(Report U. S. Nat. Mus., 1896, p. 614. Scale: g♭, b♭, c♭, d♭, e♭. Cat. No. 28954, U. S. N. M.)

Fig. 8. Costa Rica.
(Report U. S. Nat. Mus., 1896, fig. 270. Scale: a♭, b♭, b, c, d♭, d, e♭. Cat. No. 6423, U. S. N. M.)

CENTRAL AMERICAN RESONATORS, OR WHISTLES.

EXPLANATION OF PLATE 8.

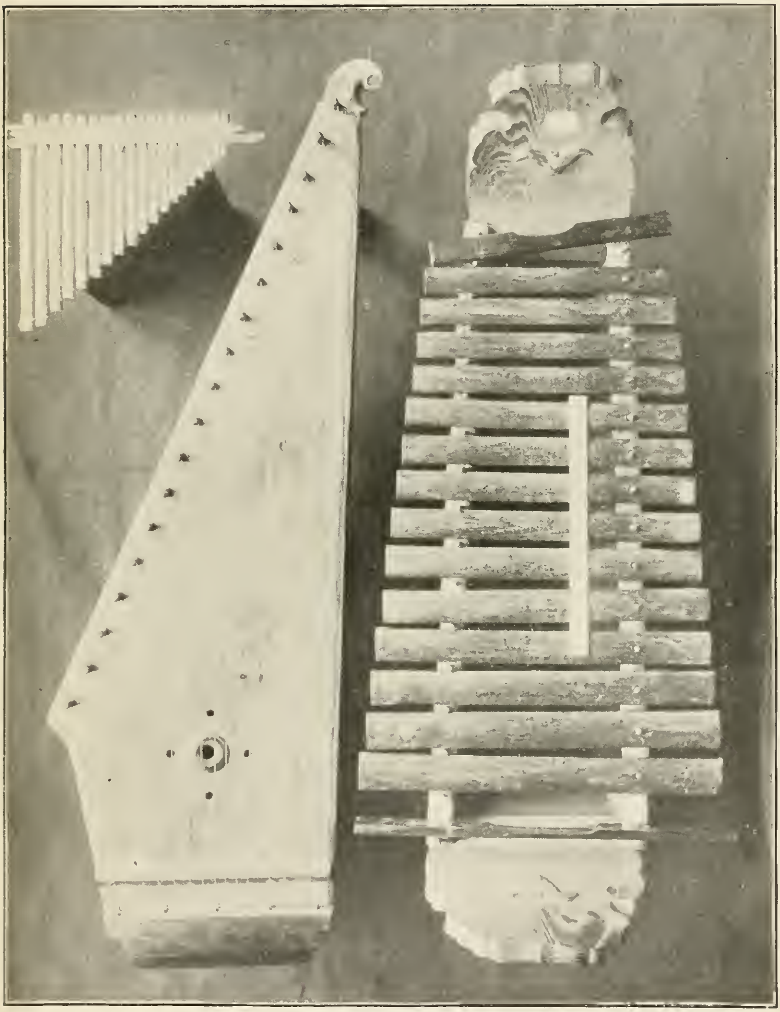
COMPOSITE INSTRUMENTS.

Fig. 1. PAN'S PIPES. Cairo, Egypt.
(Cat. No. 94653, U. S. N. M.)

Fig. 2. KANTELE. Finland.
(Cat. No. 95691, U. S. N. M.)

Fig. 3. MOKKIN. Japan. Two bars turned edgewise to show their form.
(Cat. No. 96841, U. S. N. M.)

The paper scale is 20 centimeters long.



COMPOSITE INSTRUMENTS.

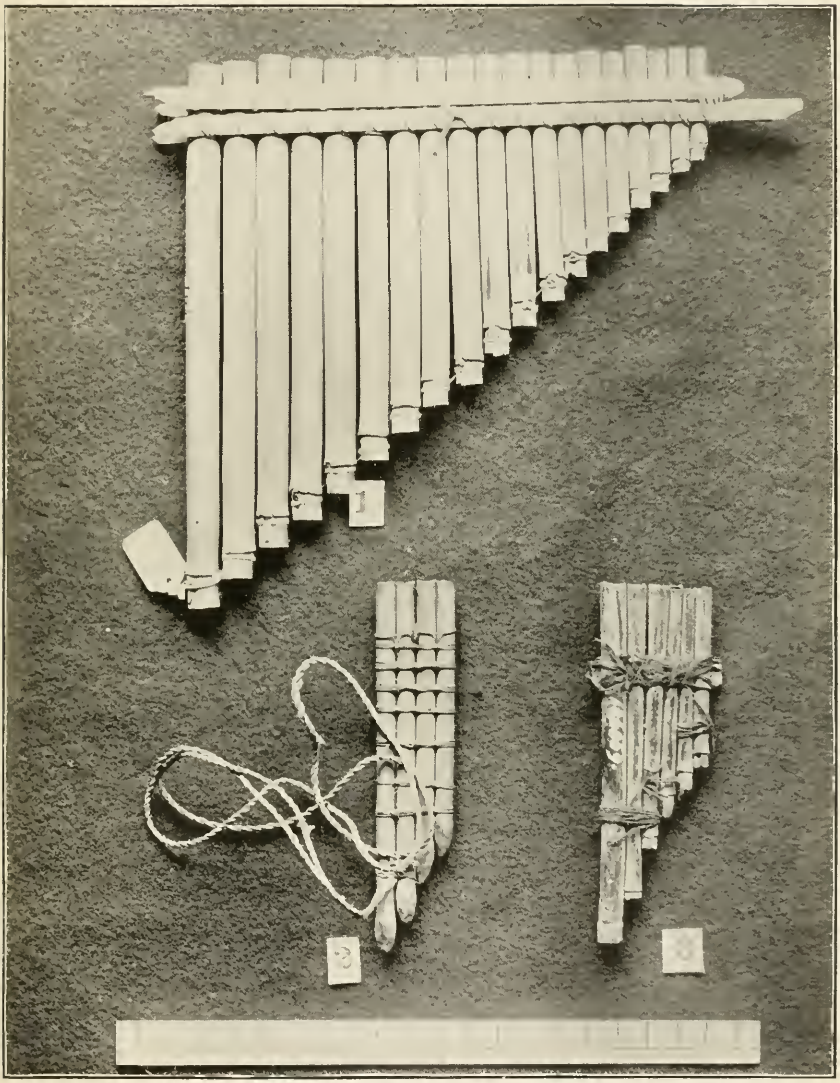
EXPLANATION OF PLATE 9.

PAN'S PIPES.

Fig. 1. Pan's Pipes (*Safafir*). Egypt.
(Cat. No. 94653, U. S. N. M.)

Fig. 2. Pan's Pipes. Fiji Archipelago.
(Report U. S. Nat. Mus., 1896, p. 559; Cat. No. 23942, U. S. N. M.)

Fig. 3. Pan's Pipes (*Huayra Puhura*). Peru, from an ancient grave.
(Cat. No. 136869, U. S. N. M.)



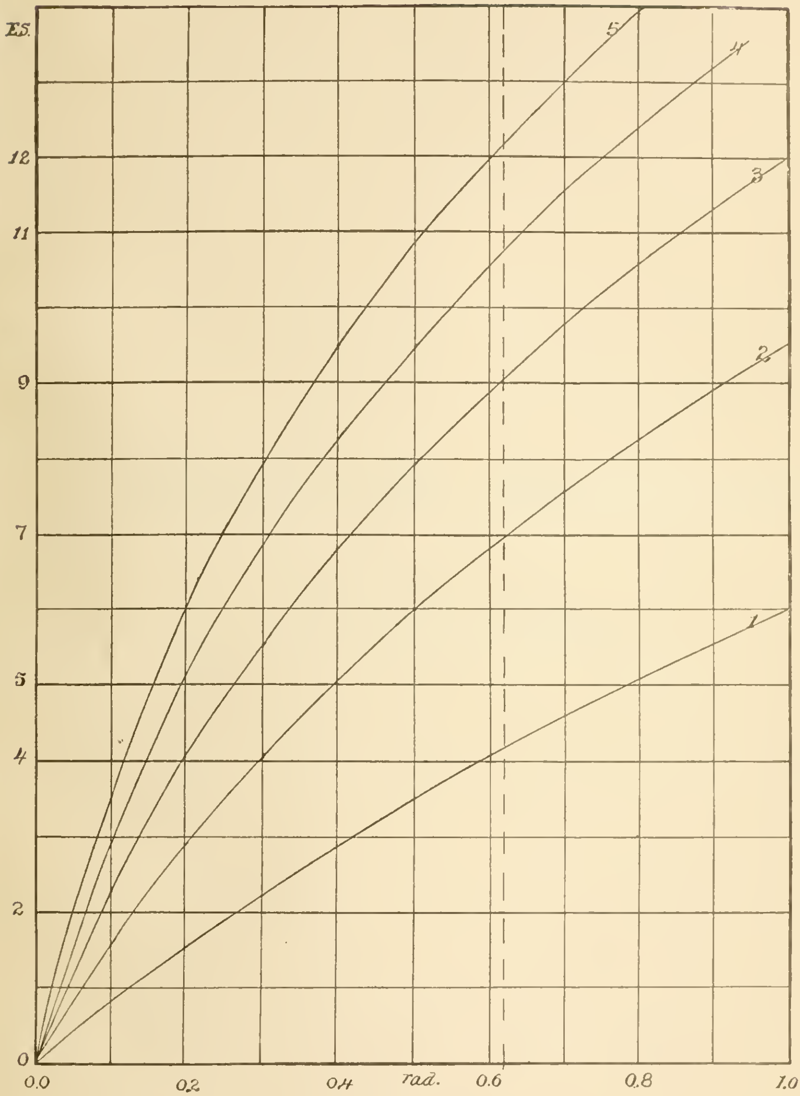
PAN'S PIPES.

EXPLANATION OF PLATE 10.

SCALES GIVEN BY RESONATORS.

The construction of this chart has been explained in the appendix. To use it, find in the base line the number which expresses the radius of the finger holes, that of the mouth hole being considered 1.0, and erect a perpendicular therefrom; the heights of the points of intersection with the successive curves, measured on the left-hand scale, give the pitch of the successive notes produced as the holes 1, 2, 3, etc., are opened, expressed in equally tempered semitones, E. S. The dotted line corresponds to the position on the chart of the type resonator. The chart shows clearly how the successive intervals become smaller as the number of open holes increases, and how the total compass is small if the finger holes are relatively small.

Use may be made of the chart for many ready calculations of intervals other than those due to equal differences, and by doubling the readings in E. S. the result may be applied to string ratios; e. g., find the interval corresponding to the ratio 5 : 4, or 1+0.25; the chart gives directly 1.9; the double of which is 3.8 E. S. The table in the appendix gives more accurately 3.86 E. S., showing that the just Third is 0.14 E. S. flatter than the piano Third.



SCALES GIVEN BY RESONATORS.

A COLLECTION OF HOPI CEREMONIAL PIGMENTS.

BY

WALTER HOUGH,

Assistant Curator, Division of Ethnology.

A COLLECTION OF HOPI CEREMONIAL PIGMENTS.

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Some years ago Mr. A. M. Stephen made for Dr. Washington Matthews, U. S. A., a collection of Hopi Indian ceremonial pigments, with notes on their preparation, derivation, and uses. These valuable notes from that most excellent observer were brought together by Dr. Matthews and presented to the International Folk-Lore Congress held at Chicago in 1893, and later were published under Mr. Stephen's name in the report of the congress, which appeared in 1898.[1]

Through the liberality of Dr. Matthews, the series of paints, comprising about twenty-five specimens, is now in the national collection. Determinations of the paints have been made by Mr. Wirt Tassin, assistant curator of the division of minerals. With the addition of the pigments secured from the Hopi, many years ago, by Maj. J. W. Powell and James Stevenson, together with those gathered among the Navajo by Dr. Matthews, this unique collection becomes of great importance and interest.

The Hopi are assiduous collectors. A catalogue of the substances brought to their pueblos from long distances would awaken surprise, and the diverse materials gleaned from a region so unpromising in appearance would increase the wonder. Every house is a museum of the environment, with specimens from the mineral, animal, and vegetal kingdoms, and every Hopi is a repository of knowledge as to the places where materials may be secured. Time and distance are little thought of when it comes to procuring the materials desired. For this reason the pigments and dyes, when compared with those employed by other American Indian tribes, are remarkable for their number as well as for the diversity of their origin. The colors range over the whole spectrum and furnish a number of shades and tints, as anyone may observe on looking through the large collections of Hopi objects

[1] The International Folk-Lore Congress of the World's Columbian Exposition, Chicago, July, 1893. Archives International Folk-Lore Association, I, pp. 260–265. Chicago, 1898.

in the United States National Museum, the Field Columbian Museum, and the Peabody Museum.

The region where the Hopi live is remarkable for its natural colors, which are displayed in marvelous profusion and brilliancy in the bad lands, known as the Painted Desert. The love of color might well arise from the tints of the native corn, on which the Hopi principally depend for nourishment. This corn presents a variety of beautiful colors, sufficient to represent the six regions, and for this purpose it is used in the ceremonies. The same observation applies to the multifarious varieties of Hopi beans.

The Hopi apparently do not discriminate indigo, blue, and green; at least, they do not have separate words to describe these colors. Violet is classed with the red; orange is not differentiated from yellow or red. Thus, as has been observed among primitive peoples, the Hopi recognize the primary colors and have given them names. Probably primitive man could see only the primary colors, a reasonable hypothesis from the survival of these terms, but in the present culture stage of the Hopi it must not be inferred that they lack practical knowledge of all the spectrum colors.

Abstract terms belong far above the Hopi plane of culture, hence it is found that the term for a color denotes some object having the color. Frequently the name of a pigment refers to the place of its origin or to the use to which it is to be put, or, if a compound, to the principal constituent.

While the Hopi appreciate color, their applications of it are crude and inartistic, the tendency being to barbaric gaudiness. It may be noted that in the Hopi dwellings almost no colors are applied for decoration, the band of red ocher sometimes painted on the walls of a room near the floor being a modern innovation. One remarks also that the Hopi costume is plain, the weaver producing only stuffs of white, dark blue, or brown, without patterns, except in belts and hair tapes, and in garments of a ceremonial character. The leather for moccasins may be dyed according to individual fancy, and in the brilliant shoulder scarfs of cotton print a riot of color is allowable, but the costume without these recent additions is sober and relieved only by ornaments of shell and turquoise.

Of articles in common use pottery shows two colors, a red and a dark brown, and baskets present several colors. These articles, however, are ceremonial in decoration and to a large extent as to use, and as they are buried with the dead it would seem that the symbolic ornamentation has some deeper meaning than that of mere ornament.

The use of pigments among the Hopi is then confined to that large element in Hopi life, ceremony, and colors are displayed in profusion on the paraphernalia of their complex religion.

The Hopi apply color with meaning, if not with art, and these meanings are many. The colors emblematic of the regions constantly occur in Hopi painting and present an interesting phase of their beliefs as set forth by Mr. Stephen.

The Hopi orientation bears no relation to north and south, but to the points on his horizon which mark the places of sunrise and sunset at the summer and winter solstices. He invariably begins his ceremonial circuit by pointing (1) to the place of sunset at summer solstice, then to (2) the place of sunset at winter solstice, then to (3) the sunrise at winter solstice, and (4) the summer solstice, next to (5) the above, and (6) the below.

The names of these directions and their emblematic colors are as follows:

1. Kwi-ni-wi; yellow, because the anthropomorphic deity who sits there is yellow, wearing a yellow cloud as a mask which covers his head and rests upon his shoulders; a multitude of yellow butterflies constantly flutter before the cloud, and yellow corn grows continually in that yellow land.

Similar phenomena are manifest at all the other directions, only of different colors, thus:

2. Té-vyüñ-a, Blue.
3. Tá-tyük-a, Red.
4. Hó-po-ko, White.
5. Omi, Black.
6. At-kya-mi, all colors, and here sits the deity regarded as the maker of all life germs. He sits upon a flowery mound on which grows all vegetation; he is speckled with all the colors, as also is his cloud mask, and before it flutter all the butterflies and all the sacred birds.[1]

The prayer offerings called Paho, of most of the ceremonies, are painted green, the color of vegetation, a frequent Hopi supplication being for abundant crops. One set of the Pahos of the Ninian Katcina ceremony are painted yellow, and are said to be a supplication for flowers. Red is the color of the warrior, who also rubs his face with powdered charcoal and sprinkles it with micaceous iron ore, when he desires to represent the Twin War-Gods.

The different ceremonies have prescribed uses of certain colors in costume, paraphernalia, and bodily decoration of the priests, and the "dolls" and other representations of the beings of the spirit world are painted in traditional colors.[2]

In passing, attention may be called to the ceremonial sand painting of the Hopi and Navajo, where the most beautiful effects are secured by allowing sand in slender streams of different colors to fall from the hand guiding it over the surface to form designs. The blending of the colored sands is soft and harmonious, and the result is a sand mosaic.[3]

With the poor tools and appliances in their reach the skill the

[1] A. M. Stephen, Pigments in Ceremonials of the Hopi, International Folk-Lore Congress, I, p. 261.

[2] Washington Matthews, The Mountain Chant, Fifth Annual Report of the Bureau of Ethology, p. 445.

[3] James Stevenson, Navajo Ceremonial of Hasjelti Dailjis, Eighth Annual Report of the Bureau of the Ethnology, p. 260.

Hopi display in applying pigments is remarkable. This art is altogether the province of the men, on whom the preparation of the elaborate paraphernalia falls. The accuracy of the drawing and, in many cases, the quality of the lines, are worthy of praise, and seem beyond the simple brush made of a narrow strip of yucca leaf. In fact, the skill displayed is little less than that observed in the Mexican codices, as the set of drawings of Hopi Katcinas prepared by a native for Dr. J. Walter Fewkes amply evidences.

The purity of the natural colors laid on by the Hopi artists gives their work a character like that of Egyptian paintings. It will be seen by examination that colors are laid on in mass usually to define forms and that the background is not intended to enter into the design. It is important to bear this in mind in the study of Hopi symbolism.

While some colors are applied dry and rubbed in as on feathers and the tanned leather of moccasins in the manner of the Plains tribes, the customary method is to use as a medium water or the fatty substance of squash, melon, piñon, or other seeds. The latter medium is procured by chewing the seeds and mixing the saliva with the paint. In a few cases the albumen from the eggs of the eagle is used as a medium. With these mediums the colors have little permanence, and the refurbishing of paraphernalia is usually required for each ceremony.

The Hopi artist applies his colors with a yucca brush or with the hand. The green paint, made by heating together piñon gum and powdered carbonate of copper, says Mr. Stephen, is rubbed down on a paint muller moistened with saliva charged with chewed squash seeds, then transferred to the mouth by means of a corn husk, and spurted over the surface of a mask.

Paint mortars of stone, sometimes a slightly concave stone and sometimes an elaborately worked-out utensil of good shape, are found in use among the Hopi. Paint vessels of pottery are found, though they are not so common as at Zuñi. Some of the massive paint materials are used as a muller on the slab, the paint being ground from the muller as needed, like India ink. Other paints are pulverized and washed with water, and some of the materials are soft enough to be used in the natural state or need very little manipulation.

Face paint, generally red, is carried in bits of skin pursed to form a bag. Face painting, except in ceremonies, is uncommon among the Hopi, and never employed at the East Mesa. At the Middle Mesa and Oraibi the practice is sometimes observed. Commonly one notices persons having patches of kaolin daubed on the skin, but no reason has been given for this custom.

From the processes described by Mr. Stephen in the following catalogue it will be seen that the Hopi exercise considerable skill in the preparation of a number of their colors, especially those of organic substances. In one case piñon gum is employed, as a medium like varnish, and in two cases lakes are produced by complicated processes involving the use of alum. The Hopi also know the value of alum as a mordant, this substance being derived from an impure alum-bearing clay.

CATALOGUE.

1. Ca kwa'pi ki, "green bread" (artificial), 175682.

Ca kwa'pi ki is thus made:

About ten ounces of piñon gum is put in an earthern pot and set on the fire, a very little water being poured in to keep it from burning and it is then allowed to roast. A large basin is set conveniently with about a gallon of water in it, and over this basin a yucca sieve is laid, and in the sieve a quantity of horse hair, or shredded yucca fiber. After the gum has melted and boiled for about ten minutes it is poured upon the hair lying in the sieve and allowed to strain through into the water, where it accumulates in a white mass. The operator then puts about three ounces of fragments of blue and green copper carbonate into a small muller and rubs them into a pulp, then pours a little water in the muller and rubs the pulp into a liquid. He then turns to the gum, which is stiff but still pliable, and after kneading and stretching it back and forth, doubling and twisting and pulling, it becomes soft and of glistening whiteness. After manipulating the gum for about a quarter of an hour, he folds it up compactly, dips it lightly in the blue-pulp liquid, and puts it back in the roasting pot, which has been filled with water, and sets it on the fire to boil. As the water heats, the gum melts, and just before it comes to a boil he pours in all the blue-pulp liquid, then, as the mixture boils he maintains a constant stirring with a long rod. He dips up some of the mass from time to time on the rod to examine its color, and the longer it boils the darker it grows, and after about twenty minutes he takes the jar off the fire, pours off the hot water and pours in some cold. He then takes the blue-green mass out, and works it around in his hands, forming a cake of about eight ounces.[1]

2. Kü tcatc'ka, "white clay," clay; Navajo hlej, or glec. 175683. This clay, which is valued by Hopi potters, is in general use as a ceremonial paint for the body.

3. Ko ho ni ni cü' ta. 175684. Probably hematite ground and worked up with water. The Hopi obtain this pigment from the Kohonini country in Cataract Canyon, 110 miles west of the reservation. The color is symbolic of the northwest region. Its use is most marked in the paraphernalia of the Snake Society.

4. Cüp na la, Si bibse, berries of sumac (*Rhus trilobata*). Artificial.

Cüp' na la—red paint, made as follows:

Three ears of dark purple corn are shelled and the kernels put in an earthen pot, in which are about three pints of water, and the pot is set on the fire to boil. About a quart of dried sumac berries are put in a basin, over which a yucca sieve is laid. The corn having boiled about three-quarters of an hour, the pot is taken from the fire and its contents poured upon the sieve, through which the purple-stained boiling water is strained upon the sumac berries. Some of the talc-like substance, called potato-clay [Tumin chuoka] is then produced, and the operator puts a piece about the size of a walnut in his mouth, chewing it a little to soften it. The berries and hot water having now cooled sufficiently, he spits out the clay into his hands which

[1] A. M. Stephen, Pigments in Ceremonials of the Hopi, p. 263.

are dipped among the berries, and these and the clay he rubs thoroughly between his hands in the water. He continues chewing bits of clay and spitting them among the berries, rubbing and squeezing them until by repeated tests upon the skin he obtains the desired tint, which is usually a hue of lake. The mixture is now ready for use, or it may be dried and used at a future time by again moistening with water.[1]

5. Ya la′ ha. 175686. Hematite, with clay. Face paint, in ceremonies. This is the sacred paint of the warrior fraternity. It is often found buried with the dead in the ancient ruins.

6. Pa l′a′te ka. Red ocherous, earthy, hematite. 175687.

7. O wa′k ta la′ si, "stone pollen." 175688. Yellow clay, resembling in color the pollen used in ceremonies. Dr. Fewkes has stated that the word for pollen, ta la si, means flower of the sun, symbolizing the belief that the light of the sun is sprinkled on the earth, fructifying it as with pollen.

8. Tü mi′n tcü′′ka, clay. 175689.

The name means sandy clay. It is collected under the mesas.

9. Ca′ kwa, "green." Copper carbonate, composed of malachite and azurite. 175690. The Hopi collect this paint 110 miles west of the reservation in Cataract Canyon. It is used for painting Pahos, masks, figurines, etc. Frequently found in graves in the ancient ruins.

10. Si uña. Glauber salt (mirabilite). 175691.

The name means "salt flower." Its use has not been ascertained.

11. Sikya′ pi ki, "yellow bread." 175692.

Sikyapiki, "bright yellow paint," is thus prepared by some old, expert priest.

A small fire is made at any convenient court nook, or on the roof of a house, and two or three flat stones set on edge around it support an earthen pot of about two gallons capacity, and about half a gallon of water is poured into it. The expert then puts in about two ounces of Sì-üña, an impure almogen [alunogen?], rubbing it to a powder between his fingers, and in the same way adds about the same quantity of tú-wák-ta, a very fine, white, calcareous sandstone. He stirs frequently with a gourd ladle, and as the mixture boils it foams violently, and having subsided, some more of the two substances is added, and then as much of the dried flowers of the *Bigelovia graveolens* as can be crowded into the vessel, and then enough water to fill it. The contents are allowed to boil for about half an hour, during which they are stirred as much as possible. A yucca sieve is placed over a large basin and the contents of the pot strained through it, the flowers being squeezed dry and thrown away, and there is thus obtained about two quarts of a dull, yellow liquid. The process just described is repeated and the infusion is poured back into the pot, and as it again comes to a boil more of the earthy ingredients are added in small quantities from time to time.

The tint of the liquid is tested on the skin occasionally; should it prove too pale, another vessel is put on the fire and another infusion obtained by the process first described, enough of which is added to the liquid in the first pot to bring it to the desired tint. Should the liquid be too dark, more of the mineral substances and water are added. The process occupies about four hours and the mixture has then boiled away to about a pint, of a bright yellow color and pasty consistency, which on drying forms a hard cake.[2]

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[1] A. M. Stephen, Pigments in Ceremonials of the Hopi, p. 263. [2] Idem, p. 262.

12. Katci'na sikyatc' ka. "Katcina yellow clay." Ferruginous clay. No organic matter, and therefore not an artificial compound. Probably ground with water. Of dull yellow color; used for personal adornment. 175693.

13. Wi' va vi. Arenaceous clay colored with carbonate of copper. 175694.

The paint is made by pulverizing a dull green sandstone. Mixed with water for use.

14. Kwu'' map o' wa, lignite. 175695.

Black is made from lignite coal, charcoal, soot, and corn smut. Used for different occasions.[1]

15. Tū wa'k ta. Carbonate of lime ground and mixed with clay. 175696.

16. Lü ku tak ti pu. Highly bituminous coal. Navajo, Pas jini. 175697.

Ground and used as black paint.

17. Sikya' to ho, "yellow stone." Ferruginous clay. 175698.

18. Tü' ma, "sand." White, fine-grained argillaceous sandstone. 175699.

The paint is made by crushing fine white sand rock.

19. Sikya' to ho, "yellow stone." Ferruginous clay. 175700.

20. Tca káp ta, sikya tc' ka. Ferruginous clay. 175701.

The name refers to a clay for making pottery.

21. Red paint. Red ocherous hematite. Navajo Indians. 175678.

22. Green paint. Carbonate of copper (malachite). Navajo Indians. 175681.

23. White paint, Glee. Arenaceous clay. Navajo Indians. 175680.

24. Black paint. A compound used only for painting sacred Kethawn Pahos, or plumed sticks. 175677.

The details of its origin or manufacture are not known. It consists of clay rich in oxides of manganese and iron with some organic matter. Dr. Matthews understood that the substance was found in the ground in this condition. Navajo Indians.

25. Yellow paint. Ferruginous clay. Navajo Indians. 175679.

26. Green paint, carbonate of copper (malachite). 71031.

27. Ca kwa' pi ki, with large proportion of pinon gum. 129075.

28. Same in buckskin bag. Collected by Maj. J. W. Powell. 22893.

29. "Five paints used in decorating masks and bodies for the *Te win ni* dance." 1, Kohonini cuta; 2, Shaqua, copper carbonate; 3, Shaquapik i; 4, Sikiyapiki; 5, Tuma, kaolin. 129074. Walpi. James Stevenson.

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[1] Pigments in Ceremonials of the Hopi, p. 264.

DESCRIPTIVE CATALOGUE OF THE COLLECTIONS OF GEMS IN THE UNITED STATES NATIONAL MUSEUM.

BY

WIRT TASSIN,

Assistant Curator, Division of Mineralogy.

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DESCRIPTIVE CATALOGUE OF THE COLLECTIONS OF GEMS IN THE UNITED STATES NATIONAL MUSEUM.

By Wirt Tassin,

Assistant Curator, Division of Mineralogy.

I. DEFINITION AND PROPERTIES OF GEM MINERALS.

A gem mineral may be defined as a mineral of any sort distinguished, especially when cut and polished, for its beauty, durability, or rarity.

The essentials, beauty and durability, are dependent upon the color, brilliancy, and hardness of the stone, and these in turn are dependent upon certain chemical and physical properties characteristic of any one kind of mineral as compared with all other kinds of minerals. A detailed description of all these properties is to be found in any textbook of mineralogy, so that a discussion of them here will be limited to those that will afford a more or less ready means of distinguishing one kind of gem from another or upon which their beauty largely depends. These several properties are:

Color.—The character of the color in any one kind of gem is not a constant, and may vary within rather wide limits. The garnet, for example, which popularly is supposed to be a blood or purplish red stone, varies through red of several shades to brown, black, green, yellow, and nearly white. The color depends upon the power of absorbing certain portions of light and reflecting others—that is, absorbing certain rays of the spectrum that pass through or fall upon its surface. Thus a gem appears red because it absorbs all other colors and reflects, or transmits chiefly the reds; a gem appears green because it reflects, or transmits chiefly green rays, absorbing all others. In all cases the color results from the constituents of the light which have not been absorbed. Those which reflect or transmit all the colors in the proportions in which they exist in the spectrum and absorb none are white; those which absorb all and reflect or transmit none are black. Between these two limits there is an infinite variety of hues, according to the greater or less extent to which substances reflect or transmit some colors and absorb others.

Among minerals the many varieties of color are classed, first, as metallic and nonmetallic, and all shades are referred to eight fundamental colors—white, gray, black, blue, green, yellow, red, and brown; second, according to peculiarities in the arrangement of color, as play of color, opalescence, iridescence, and asterism; third, as to difference in color shown for light transmitted in different directions through the stone. This case of color absorption is called pleochroism and is peculiar to certain minerals.

Diaphaneity.—The capacity of transmitting light materially affects the beauty and value of gems. There is a wide difference in the degree of this property possessed by most gems and the amount of light transmitted, or the degree of transparency is classed as transparent when the outline of an object seen through the stone is perfectly distinct; subtransparent when an object may be seen but its outline is indistinct; translucent when light is transmitted but objects are not seen; subtranslucent when merely the edges are translucent; opaque when no light is transmitted.

Luster.—This is that character depending upon the power and manner of reflecting light and is dependent upon the nature of the reflecting surface and the quantity or the intensity of the light reflected. The kinds of luster are described as metallic, the brilliant appearance seen upon the surface of polished metal; adamantine, the luster of the diamond; vitreous, having the luster of flint glass; resinous, having the appearance seen upon the surface of pine resin; waxy, the luster of beeswax; greasy, when resembling that of a freshly oiled surface; pearly, the luster of mother-of-pearl; silky, when having a sheen like that of silk. The degrees of intensity are splendent, shining, glistening, glimmering, and dull. There being no standard of description in regard to luster, these terms are loosely used and intermediate ones may be substituted in describing a particular kind of luster according to the judgment of the observer.

Refraction of light.—The familiar case of the apparent breaking of an oar where it enters the water is an illustration of the bending back or refraction of light. This phenomenon occurs in the majority of cases where a ray of light passes obliquely from one transparent medium to another. Part of the incident ray enters the medium and changes its direction, or is refracted.

For example, if in fig. 1 *ao* is a ray of light passing from air into water, its path will be changed after passing the surface at *o* and it will continue in the direction *ob*. Conversely, if a ray of light, *bo*, pass from the denser medium, water, at *o*, it will take the direction *oa*. Now, if *yox* is a perpendicular to the surface, *ww*, at *o*, it will be seen that the angle *aoy*, called the angle of incidence (*i*) of the ray, *ao*, is greater than the angle *box*, called the angle of refraction (*r*), and what is observed in this case is found to be universally true. Again, however great or small the angle of incidence may be, there is always a constant relation between it and the angle of refraction for two given substances. This constant relation is the ratio between the sines of the incident and refracted angle, and is called the *index of refraction.*

When a ray of light passes from one medium into another which is less refracting, as from water into air, the angle of incidence is less than the angle of refraction. Hence when light is propagated in a mass of water there is always a value of the angle of incidence such that the angle of refraction is a right angle, in which case the refracted ray emerges parallel to the surface of the water. This angle is called the critical angle, since for any greater angle the incident ray can not emerge, but undergoes an internal reflection, which is called total reflection because the incident light is entirely reflected. From water to air the critical angle is 48° 35′. In the example given, air and water, r = 48° 35′. Now, supposing the light to go from b to o, the line oc will coincide with the line of (the critical angle). If the value of r is increased, the ray will no longer pass from water into air, but undergoes total reflection at the surface o.

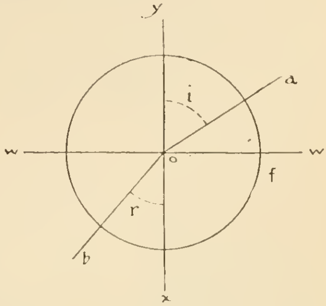


Fig. 1.

DIAGRAM TO ILLUSTRATE REFRACTION.

In total reflection there is no loss of light from absorption or transmission, and accordingly it produces the greatest brilliancy. The luster of transparent bodies bounded by plane surfaces, such as the luster of gems, arises mainly from total reflection. This luster is the more frequent and the more brilliant the smaller the limiting angle. The diamond, having the smallest value for its limiting angle, is the most brilliant of all gems.

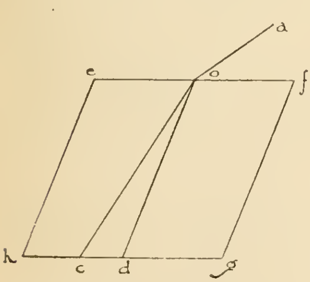


Fig. 2.

DIAGRAM TO ILLUSTRATE DOUBLE REFRACTION.

There are certain transparent substances which possess the power of splitting the refracted ray into two. The most familiar example of this is furnished by the mineral calcite. If $efgh$ (fig. 2) be a cleavage piece of calcite and a ray of light meets it at o, it will in passing through be divided into two rays, oc, od, one of which follows the ordinary law of refraction, the other a more complicated law. Similarly, a line seen through a piece of calcite ordinarily appears double. This phenomenon is called *double refraction.* The diamond, garnet, and all other minerals belonging to the isometric system are singly refracting. The ruby, topaz, and all minerals belonging to systems of crystallization other than the isometric are doubly refracting.

Dispersion of light.—When a ray of light passing from one medium to another is refracted, it may be decomposed into several kinds of light, separated more or less widely from each other and differently colored. A familiar example of this is seen when a beam of sunlight passes through a flint-glass prism and produces a band of colors in all the hues of the rainbow. This decomposition of light by refraction is called dispersion. Upon it depends that peculiar quality of "fire" or play of prismatic hues in gems, a marked characteristic in the diamond and zircon.

Polarization of light.—The light which passes through a doubly refracting crystal undergoes a peculiar change. A ray of light which has been once split by passing through a doubly refracting substance will not again be divided on passing through another doubly refracting substance, nor can it again be reflected at a certain angle, nor again traverse in a certain direction the substance in which it has suffered this change. Light which has acquired these properties is said to be polarized.

Pleochroism.—This is the variation in color observed in doubly refracting minerals when viewed in different directions. This property is conspicuous in the tourmaline, iolite, chrysoberyl, and epidote. The pleochroism of gems can best be observed with the aid of an instrument called the dichroscope.

This consists of an oblong rhombohedron of Iceland spar, at the extremities of which is cemented a glass prism of 18°. This is contained in a cylindrical metal case having a convex lens at one end and a square opening at the other. On looking through the lens the square opening appears double. When a pleochroic gem is examined in transmitted light with this instrument, the two squares on a revolution will be found to have different colors at certain intervals.

Phosphorescence.—The emission of light or phosphorescence may be produced in different ways; by rise of temperature, by mechanical effect, and by insolation—that is, by exposure to the direct action of sunlight. Phosphorescence is a property possessed by some gems, notably the diamond.

Hardness.—This is the degree of resistance the mineral offers to abrasion. It is usually referred to an arbitrary scale of ten minerals showing a regular gradation in hardness from 1, talc, the softest; 2, gypsum; 3, calcite; 4, fluorite; 5, apatite; 6, orthoclase; 7, quartz; 8, topaz; 9, corundum, to 10, diamond, the hardest. The scale is used as follows: Fragments of the minerals comprising the scale are applied in succession to the stone under examination. Should the test stone neither scratch nor be scratched by a particular unit in the scale, the hardness of the two are the same. Should the test piece scratch one and be scratched by the next number of the scale above it, its hardness is somewhere between the two units.

The property of hardness is an essential in gem stones, since upon it depend its capabilities of receiving and retaining a high degree of polish and of resisting wear from abrasion. It is also often an available method of identifying a gem. In testing cut stones, however, care must be taken not to disfigure them, and, if possible, the girdle, or the part hid by the mount, should be used as the test surface. Furthermore, the term "hardness" must not be confused with toughness or difficulty of breakage. A very hard stone may be a very brittle or fragile one. Hardness means simply liability or nonliability to scratch.

Specific gravity.—This is the density of a body compared with that of distilled water at a certain temperature (commonly at 60° F.).

The determination of specific gravity is in principle very simple. The substance is at first weighed in air, then in water; divide the weight in air by the loss of weight in water, and the quotient is the specific gravity. Thus if a gem weighs 5 grams in air and only 3 in water, it is evident that it has displaced 2 grams of water, and its specific gravity is 2.5.

In order to get absolute results, very delicate balances have to be used and many precautions taken, but for ordinary work such care is not necessary.

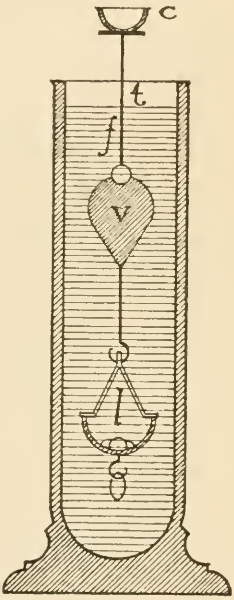


Fig. 3.
NICHOLSON HYDROMETER.

A very convenient specific-gravity apparatus that is sufficiently close for ordinary use is the Nicholson hydrometer (fig. 3). This consists of a float having a descending hook, to which is hung a pan to hold the substance weighed in water. A wire stem supports a cup on which the weights and the substance weighed in air are placed. A mark on the stem shows the point at which the whole apparatus will float in a vessel of water when a certain known weight (called the balance weight) is placed in the weight cup. The specimen under examination must not exceed in weight that of the balance weight, this being the limit of the apparatus. Suppose the limit to be 100 grams. Then to find the specific gravity of a substance, place it on the weight pan and add weights until the instrument sinks to the mark. The difference between the added weight and 100 is the weight of the specimen in air. Then place the specimen in the lower pan; as much more weight on the weight pan will now be required as corresponds to the weight of a bulk of water equal to that of the specimen. The difference of weight thus found will be the divisor of the weight of the specimen and the quotient will be the specific gravity. Thus:

The substance is placed in the weight cup.	
The limit of the apparatus is	100.00
Weight added to sink instrument to mark	22.50
Weight of specimen in air is then	77.50
Specimen placed in lower pan requires, to sink instrument to mark, the weight	35.50

Now, $35.50-22.50=13$, the weight of a like bulk of water. Then $77.50 \div 13=5.9615$, the specific gravity sought.

The specific gravity test is one of the most important and reliable means of identifying a gem, since it is practically a constant for all individuals of the same kind, while the difference between individuals of different kinds is often considerable. Thus:

Zircon	4.6	Topaz	3.65
Almandite	4.2	Diamond	3.52
Sapphire	4.0	Beryl	2.70

Further, if the specific gravities of two substances are known, by taking the specific gravity of their compound the relative weights of the components may be found. Thus, having the weight of a diamond and gold ring we can find the weight of the diamond.

Let A be the weight of the stone, a its specific gravity; B be the weight of the gold, b its specific gravity; C be the weight of the ring, c its specific gravity:

Then $A + B = C$ and $\frac{A}{a}+\frac{B}{b}=\frac{C}{c}$

From which we obtain $A = C\,\frac{(c-b)\,a}{(a-b)\,c}$

Electricity.—The electrical properties of minerals are distinguished by the following terms: Frictional electricity, pyroelectricity, and thermoelectricity. Of these we have to do only with frictional electricity, or the power of becoming electrified by friction, and as a result attracting or repelling certain substances. This property is especially noticeable in the topaz, tourmaline, and amber.

Cleavage.—This is that tendency of a mineral to break in the direction of minimum cohesion, and that direction is always parallel to some plane which occurs or may occur in the crystal. The cleavage is characterized, first, according to direction, that is, when parallel to certain faces or planes; second, according to the ease with which it may be obtained, as perfect, imperfect, interrupted, or difficult.

Fracture.—This is that surface obtained by breaking the mineral in a direction other than that of the cleavage. It may be designated as conchoidal, that is, breaking with cavities more or less deep; even, when the fracture approximates a plane surface; uneven, when the surface is irregular; hackly or splintery, when the surface is jagged.

Form.—The external form of a gem mineral may be described as: *A*—crystallized, *B*—crystalline, and *C*—amorphous.

A—Crystallized: When made up of geometrical solids, any individual polyhedral form of which is called a crystal. Crystals are bounded by plain surfaces called planes or faces, symmetrically arranged with reference to one or more imaginary diametral lines called axes.

Crystals, though their forms and modifications are of an idefinite number, are classified under six systems according to the number and character of their axes. The systems of crystallization and typical examples occurring under each are:

Isometric.
Examples: Cube, octahedron, and dodecahedron.
Tetragonal.
Examples: Square prism and square octahedron.
Hexagonal.
Examples: Hexagonal prisms, pyramids, and rhombohedrons.
Orthorhombic.
Examples: Right prism on a rhombic base and a rhombic octahedron.
Monoclinic.
Examples: Oblique prisms on a rectangular base and oblique octahedron on a rhombic base.
Triclinic.
Examples: Doubly oblique prism and doubly oblique octahedron or pyramid.

B—Crystalline: When the mass appears to be made up of closely compacted, minute crystals. The individuals composing crystalline masses may be: In columns or fibers, in which case the structure is columnar; in thin laminae, plates, or leaves, giving rise to a lamellar structure; in grains, producing a granular structure. Further, there are numerous irregular and accidental groupings of the individuals composing the mass, giving to it certain shapes, such as globular, botryoidal, reniform, dendritic, etc., which are too numerous to allow of a specification here. These indeterminate forms are grouped under the head of "imitative shapes."

C—Amorphous: Finally, the mass may be entirely destitute of crystalline structure or imitative shape and show neither external nor internal signs of crystallization. Such a mass is said to be amorphous.

II. DESCRIPTION OF MINERALS USED AS GEMS.

ALBITE.

AVENTURINE—MOONSTONE—PERISTERITE.

Albite occurs in opaque to transparent masses and in triclinic crystals having a cleavage in two directions, one of which is highly perfect. The mineral has a hardness of 6; a specific gravity of 2.62, and a vitreous luster, often pearly on a cleavage surface. Color white, also bluish, grayish, reddish, greenish, and green, occasionally having a bluish chatoyancy or play of color.

The use of this mineral for gem purposes is practically restricted to those kinds showing a bluish opalescence or play of colors, or an aventurine effect, or which give a moonstone effect when cut cabochon. Prominent among the kinds affording gem material are: *Peristerite*, a whitish adularia-like albite presenting a bluish chatoyancy, usually more or less mixed with pale green and yellow, the play of color resembling that on the neck of a pigeon; hence the name, from *περιοτεράά, pigeon*. *Aventurine*, a grayish white to reddish gray albite with internal fire-like reflections proceeding from minute disseminated occluded crystals. *Moonstone*, a transparent albite having a chatoyant reflection resembling that of a cat's eye, or an opaque pearly white albite having a bluish opalescence.

Albite is a constituent of many crystalline rocks and often replaces common feldspar as a constituent of granite, and is frequently a constituent of syenite and greenstone; in other instances it is associated with feldspar and dolomite. Some of the most common occurrences are in veins or cavities in granite or granitoid rocks, such veins being then frequently repositories of fine crystals of other gem minerals, such as beryl, tourmaline, smoky quartz, etc.

One hundred parts of albite contain: Silica, 68.7; alumina, 19.5; oda, 11.8.

AMBER.

SUCCINITE.

A fossil resin occurring in irregular masses without cleavage and having a conchoidal fracture. Color yellow, sometimes reddish, brownish, and whitish, often clouded, and occasionally fluorescent, exhibiting a peculiar blue or green tinge. Hardness 2 to 2.5; brittle. Specific gravity 1.05 to 1.09. Luster resinous to waxy. Transparent to opaque. Negatively electrified by friction. It burns readily with a rich yellow flame and aromatic odor; heated to 150° C. it begins to soften and finally melts at about 250° C., giving off dense white fumes having an irritating aromatic odor. It is soluble in alcohol.

Amber contains in 100 parts: Carbon, 78.96; hydrogen, 10.51; oxygen, 10.52.

ANDALUSITE.

CHIASTOLITE—MACLE.

Andalusite has but a limited use as a gem. It crystallizes in the orthorhombic system commonly in coarse prismatic forms, the prisms often nearly square; occurring also massive, columnar, radiated, and granular. The color varies from a reddish or greenish brown to olive green, flesh red, rose red, violet, and pearl gray; pleochroism strong in some colored varieties, green in one direction and hyacinth to rose-red in another. Luster, vitreous, often weak. Hardness, 7.5, somewhat greater than that of quartz; brittle. Specific gravity, 3.2; cleavage, prismatic and distinct: often perfect.

The variety chiastolite, or macle, varies in hardness from 5 to 7.5 due to the presence of impurities, which, in part, are arranged symmetrically about the axes of the crystal so as to give a tessellated appearance in cross section.

Andalusite contains: Silica, 37; alumina, 63.

ANHYDRITE.

VULPINITE.

Anhydrite, anhydrous sulphate of lime, has a hardness of 3.5, a specific gravity of 2.9, and a vitreous to pearly luster. Color, white, grayish, bluish, reddish; also brick red and blue. Anhydrite has been variously denominated muriacite, anhydrite, and tripe stone, according to its structure; the first, when crystallized in broad lamellae; the second, when granular, and the third, when composed of contorted plates. Vulpinite is a siliceous variety containing 8 per cent of silica and is the kind most used for ornamental purposes. The use of any of the varieties is limited. Anhydrite contains 41.2 parts of lime and 58.8 parts of sulphuric acid in 100.

APOPHYLLITE.

FISH-EYE STONE.

Apophyllite is occasionally cut for gem purposes.

The hardness of the mineral is below 5; its specific gravity is 2.33; its color varies from white to gray, occasionally tinged with green, pink, or yellow. It crystallizes in the tetragonal system, usually in octahedrons having their solid angles truncated. The faces thus formed have a decided pearly luster, the others vitreous. Apophyllite was so named in allusion to its tendency to exfoliate under the blowpipe. Its pearly luster, producing an effect like that of a fish's eye, gave rise to the name "fish-eye stone," or ichthyophthalmite.

Apophyllite occurs commonly as a secondary mineral in basalt and related rocks associated with datolite, pectolite, and the several zeolites. One hundred parts contain: Silica, 52.7; lime, 26; potash, 4.4; water, 16.7. There is also a variable proportion of fluorine present which probably bears no relation to the compound.

AXINITE.

Crystals of axinite are occasionally cut for ornamental use. Axinite crystallizes in the triclinic system, commonly in broad, acute-edged, wedge-shaped forms, occurring also massive. The hardness of the mineral is about 7, or near that of quartz, but it is so extremely brittle that it is fashioned only with difficulty. Luster, vitreous.

Transparent to subtranslucent. Specific gravity, 3.27. Color, clove brown, plum blue, violet, pearl gray, and honey yellow to greenish yellow. It is usually strongly pleochroic, pale olive-green specimens giving, with the dichroscope, olive-green and violet-blue images.

The composition of axinite in 100 parts is approximately: Silica, 43; boron trioxide, 5; alumina, 16; ferric oxide, 10; manganese oxide, 3; potash, 1; lime, 20; magnesia, 2.

AZURITE AND MALACHITE.

The use of the two carbonates of copper as gems is limited by their softness and opacity. Their hardness is 4; their specific gravity varies from 3.5 to 4, and they possess a vitreous to adamantine luster, occasionally silky. Malachite is a bright green in color, varying somewhat in tint and usually in veinings or markings. Azurite shows the various shades of azure passing into Berlin blue. Botryoidal masses of these carbonates occur in which the two minerals are in alternate concentric layers, giving rise to a very pleasing effect.

Malachite contains: Copper oxide, 71.9; carbon dioxide, 19.9; water, 8.2. Azurite contains: Copper oxide, 69.2; carbon dioxide, 25.6; water, 5.2. (Plate 1.)

BARITE.

Barite can hardly be regarded as a gem stone, its softness permitting rapid abrasion. Its hardness does not exceed 3.5; its specific gravity is 4.3 to 4.7, depending upon the amount of impurity present. Its color ranges between white, gray, blue, red, or brown; the colors occasionally banded or mottled. Luster vitreous, sometimes pearly.

One hundred parts contain: Baryta, 65.59; sulphuric acid, 34.33.

BERYL.

EMERALD—AQUAMARINE—GOSHENITE.

The beryl crystallizes in six-sided hexagonal prisms, usually long prismatic and often having the prism faces more or less deeply striated vertically. The specific gravity of the transparent flawless beryl is 2.73; usually 2.69 to 2.70. Hardness 7.5 to 8. Brittle. Cleavage indistinct. Fracture uneven to conchoidal. Luster vitreous, occasionally resinous. The colors of the beryl include emerald green passing into pale green, and pale blue, pale yellow, honey, wine, and citrine yellow, white, to a pale rose-red. The pleochroism is more or less distinct; occasionally strong, especially in the emerald which, when viewed across the prism with the dichroscope, shows two different shades of green.

Mineralogically the beryl includes the emerald, aquamarine, goshenite, and davidsonite. The general composition, fundamental crystalline form, hardness, and specific gravity of all the varieties are essentially the same, the difference being primarily one of color. The

Banded Nodules of Azurite and Malachite.

Morenci, Arizona.

Specimen No. 48567, U.S.N.M.

emerald includes the rich green colored kinds only. It is a highly prized gem when of a bright emerald green color, clear, and free from flaws.

The aquamarine includes those beryls showing clear shades of sky blue and sea green. Goshenite is a white or colorless variety from Goshen, Massachusetts. Davidsonite is a greenish yellow beryl from near Aberdeen, Scotland. Other varieties are: Aeroides, pale sky blue; hyacinthozontes, clear sapphire blue; améthiste basaltine, pale

Fig. 4.

EMERALD CRYSTAL.

Stony Point, Alexander County, North Carolina.

Weight, 8¾ ounces.

Specimen No. 83730, U.S.N.M.

violet or reddish; chrysolithus, pale yellowish green; golden beryl, clear bright yellow, and chrysoberyllus, greenish yellow to honey or wine yellow. All the varieties are somewhat brittle and contain in 100 parts: Silica, 66.8; alumina, 19.1; glucina, 14.1.

BERYLLONITE.

Beryllonite was first found loose among the disintegrated material of a granite vein at Stoneham, Maine, in 1886, and this is still the only locality known. It occurs in short prismatic to tabular and highly complex crystals having a hardness of 6 and a specific gravity of 2.84. The transparency and brilliancy of the stone resembles that of topaz.

One hundred parts contain: Phosphoric acid, 55.86; glucina, 19.84; soda, 23.72.

BROOKITE.

ARKANSITE.

Brookite does not readily admit of polish, and in consequence has little use as a gem. Its hardness is 5.5 to 6; specific gravity, 4.12 for brookite and 4.08 for arkansite. Brookite includes the hair brown, yellowish, reddish, or ruby red, transparent to translucent kinds having a metallic adamantine luster. Arkansite includes the brilliant, iron-black, opaque kinds.

Composition: Titanium, 60.98; oxygen, 39.02.

CARBONATE OF LIME.

PEARL—CORAL—MARBLE—CALCITE—ARAGONITE.

Carbonate of lime is most widely distributed in a variety of forms, the varieties depending upon differences in origin, crystallization and structural condition, presence of impurities, etc. With the exception of pearl and coral, the many forms find a use more for decorative purposes than for personal adornment.

Pearls are concretions, consisting essentially of carbonate of lime, found in the shells of certain mollusks. They are the result of an abnormal secretory process caused by an irritation of the mantle of the mollusk, resulting from the introduction into the shell of some foreign body, such as a grain of sand.

Pearls possess a luster peculiar to themselves, which is called pearly or nacreous. This luster may exist on the exterior surface only of the concretion, or the outer surface may be dull and dead in luster while an inner surface may be clear and lustrous. Their specific gravity is 2.5 to 2.7; their hardness 2.5 to 3.5. They may be of any shape, and in some instances of considerable size. In color they range from an opaque white, through pink, yellow, salmon, fawn, purple, red, green, brown, blue, black, passing through the several shades of these colors, or of almost any color; in addition they may be iridescent. In general, their color and luster will be that of the interior shell surface adjacent to which they are formed.

The beauty and value of pearls is dependent upon their color, texture or "skin," transparency or "water," luster, and form, the most valuable being those which are round or pear-shaped, slightly transparent, free from specks or blemishes, and possessing to the highest degree the characteristic luster.

Pearls are liable to deteriorate with age, contact with acids, gases, and vapors, and though various methods are in use for restoring them to their original beauty, they are by no means to be relied upon, so that care should be taken to preserve fine pearls by carefully wiping them after use with a clean, soft cloth and keeping them wrapped in a clean cloth in a closed box.

Although nearly all bivalves with nacreous shells occasionally yield pearls, practically all of the pearls of commerce are obtained from a few families only of mollusks, prominent among which are the Aviculidae, Unionidae, and Mytilidae. The pearl oyster of the Pacific and Indian oceans, which has yielded the bulk of the pearls of the world, belongs to the first of these groups. The unio, or fresh-water mussel, so abundant in the rivers and lakes of North America, belongs to the second.

Coral is essentially carbonate of lime produced by gelatinous marine animals called polyps. The coral-forming animals are very often, though wrongly, called coral insects, and the coral is not built up as bees build a comb, but grows, as do the bones of other animals, being produced or secreted by a peculiar layer of the skin. The small star-like pits on a branch of coral represent the places where the various members of the colony once grew.

Although coral is found abundantly in the seas of many parts of the globe, that adapted to purposes of ornament comes almost entirely from the African coast of the Mediterranean. The beds lie at a depth of 500 to 800 feet below the surface of the sea, and the coral is won by means of iron drags and nets. The coral varies in color from deep red through pink to green, brown, yellow, white, and black. The red coral, once the most valuable, is now worth far less than the rose-pink, while the white, yellow, and black corals are of very little value.

Coral is frequently imitated in horn, bone, and ivory; also by a composition made up of plaster of paris, gum, and coloring matter.

Marbles consist essentially of carbonate of lime, with more or less carbonate of magnesia. They are fine to coarse granular in structure, and exhibit various colors, as white, yellow, red, green, blue, etc., often clouded and giving a handsome effect when polished. *Statuary marble* is pure white and fine grained; the best is from Paros and Carrara, Italy. *Architectural marble* is both white and colored. The *Cipolin* is white, tinged with green. The *Siena* is yellow, veined or clouded with brownish red. The *Mandelato* is light red with white spots. The *Bardiglio* is gray with dark cloudings. *Verde-Antique* is clouded yellowish to bluish green. The *Portor* or *Egyptian marble* is black, veined with yellow. *Lumachelle* or *fire marble* is a dark brown shell marble with brilliant fire-like or chatoyant internal reflections. *Madreporic marble* contains corals. *Ruin marble* is a kind showing, when polished, figures bearing a resemblance to cities, castles, etc., in ruins. *Oolite* is a concretionary massive limestone made up of minute spherical grains resembling the roe of a fish, the name coming from ᾠόν, egg; *pisolite* differs from oolite in the larger size of its particles. *Stalactites* are pendent masses of limestone formed in caverns by the percolation of water, holding lime in solution, which on evaporation leaves the carbonate of lime. *Stalagmites* are of the same material, covering the floors of the cavern. Stalactites and stalagmites vary in diaphaneity from nearly transparent to opaque, and are frequently made up of layers of different colors, giving rise when polished to agate-like bandings. Stalagmites when fine grained and pure white are sometimes called *alabaster*. *Oriental onyx*, *Gibraltar stone*, *onyx marble*, and *Mexican onyx* have beautifully banded, mottled, or clouded structures, often showing wide ranges of color.

Calcite and aragonite consist essentially of carbonate of lime (lime 56, carbonic acid 44). They occur crystallized and massive, and vary in color from white through various shades of gray, red, green, yellow, brown, blue, and black. Calcite has a hardness of 3 and a specific gravity of 2.72 when pure. Aragonite has a hardness of 3.5 and a specific gravity of 2.93. Their use as gems is limited to fibrous kinds, called satin spar, and those specimens showing rich colors.

CANCRINITE.

Cancrinite is occasionally fine enough to be used as a gem. It crystallizes in six and twelve sided hexagonal prisms, also occurring massive. Luster, weak vitreous, inclining to greasy. Transparent to subtransparent. Color, yellow of several shades, also white, gray, greenish, bluish, or reddish. Hardness 5.5 to 6; specific gravity 2.44.

Cancrinite is found at Miask in the Urals; also in the Turkinsk Mountains in a coarse granite with zircon, calcite, and magnetite; and in crystals and massive at Litchfield, Maine, with sodalite and zircon. This locality affords bright orange yellow and pale yellow specimens; occasionally the yellow cancrinite is found penetrating the blue sodalite, forming, when polished, a very attractive stone.

One hundred parts of cancrinite contain: Silica, 38.7; carbon dioxide, 6.3; alumina, 29.3; lime, 4; soda, 17.8; water, 3.9.

CASSITERITE.

WOOD TIN—TOAD'S-EYE TIN.

Cassiterite, or tin stone, is used to a very limited extent for ornamental purposes. Its hardness is between 6 and 7; specific gravity 6.69; luster adamantine. Color, brown or black, occasionally gray, white, or yellow. The mineral occurs in tetragonal crystals and massive; often in reniform shapes having a fibrous structure. The variety known as wood tin occurs in reniform or botryoidal shapes made up of concentric layers or bandings having a fibrous structure and resembling dark wood. Toad's-eye tin is the same on a smaller scale. Cassiterite contains in 100 parts: Tin, 78.28; oxygen, 21.62.

CATLINITE.

PIPE STONE.

Catlinite, or pipe stone, is a compact clay slate of an ash gray to deep red color, or red with white and gray spots. It occurs in beds in Pipestone, especially at Coteau de Prairies, and in Cottonwood, Watonwan, Nicollet counties, Minnesota; at Flandeau and Sioux Falls, South Dakota; Sac County, Iowa; Barron County, Wisconsin, and elsewhere in the Upper Mississippi and Missouri country. Catlinite is worked into ornamental pipes, paper weights, ash trays, match boxes, and other trinkets.

CAT'S-EYE.

The term cat's-eye is applied to a number of minerals which, when cut cabochon, exhibit a peculiar opalescence characterized by a line, or ray, of light across the stone and resembling the contracted pupil of the eye of a cat. Among the minerals which, when fibrous or cut across the cleavage, will show the cat's-eye ray are: Beryl; chrysoberyl, especially the cymophane; corundum; crocidolite; dumortierite; quartz filled with acicular crystals or fibrous minerals, such as actinolite, byssolite, hornblende, etc.; hypersthene; enstatite; bronzite; aragonite; gypsum; labradorite; limonite; hematite, etc. Such gems may be opaque, translucent, or transparent, and may be of any color or colors.

CHONDRODITE.

The hardness, translucency, and range of color of this mineral render it suitable for use as one of the minor gems. It occurs in monoclinic crystals of a varied habit; also massive, compact, and in embedded grains. Its hardness is 6.5; brittle. Cleavage indistinct. Fracture conchoidal. Luster, vitreous. Specific gravity, 3.1 to 3.2. Color, light to dark yellow, honey yellow, garnet, hyacinth, and brownish red. Pleochroism occasionally distinct, especially in brownish-red crystals.

Chondrodite, from *χονδρος*, a grain, in allusion to its granular structure, occurs usually in embedded grains or granular masses in limestone. It is found abundantly at the Tilly Foster mine, Brewster, New York, in deep garnet-red crystals of great beauty.

One hundred parts contain approximately: Silica, 33.06; magnesia, 55.46; iron, 3.65; fluorine, 7.60.

CHRYSOBERYL.

ALEXANDRITE—CAT'S-EYE—CYMOPHANE.

The gems known as alexandrite, oriental chrysolite, and cymophane, or true cat's-eye, are varieties of chrysoberyl. The mineral crystallizes in the orthorhombic system, generally in tabular crystals, often twinned and frequently repeated, forming pseudo-hexagonal crystals with or without reentrant angles. The cleavage of the mineral is quite distinct in one direction. Fracture uneven. Its hardness is 8.5. Specific gravity 3.5 to 3.84. Luster, vitreous. The color ranges from asparagus green, grass green, emerald green, greenish white, yellowish green, golden yellow, to brown and intermediate hues; sometimes a raspberry or columbine red by transmitted light, and occasionally having a bluish opalescence internally.

Alexandrite is the emerald-green variety which by artificial light appears a columbine or raspberry red. The crystals have a specific gravity of 3.644.

Cymophane, or true cat's-eye, is of a greenish yellow color and exhibits a fine chatoyant effect, due to minute internal striations resulting from twinning, either of the crystal itself or of minute composite crystals of which the whole is made up.

The name *chrysoberyl* is from χρύσοσ, golden, and βήρυλλος, beryl. *Cymophane*, from κῦμα, wave, and φαίνω, to appear, alludes to its peculiar opalescence. *Alexandrite* is named after Alexander I of Russia.

Chrysoberyl of gem value has not as yet been found in the United States. The chief source of the supply is Minas Geraes, Brazil, and Ceylon. Alexandrite occurs chiefly in the Orenburg district, the Urals, Siberia.

CHRYSOCOLLA.

This mineral, when coated with or contained in quartz or chalcedony, is occasionally cut as a gem. Chrysocolla is a hydrated copper silicate having a mountain green, bluish green, passing into a sky blue, color.

COAL.

JET—CANNEL—ANTHRACITE—BROWN.

The most important of the mineral coals used for ornamental purposes is jet, a compact, soft, light coal of a lustrous velvet black color, susceptible of a high polish. It is the *Gagates* of Dioscorides and Pliny, a name derived from the river Gagas, in Syria, near the mouth of which it was early found. The finest specimens are now found in detached pieces in a clay near Whitby, Yorkshire, England.

Cannel coal has a dark grayish-black or brownish-black color; a fine, compact texture; a large conchoidal fracture, and receives a good polish. It burns readily, without melting, with a clear yellow flame, and has been used as a substitute for candles, whence its name. It is occasionally worked into inkstands, snuff boxes, breast pins, bracelets, and other similar articles.

Anthracite is harder than either jet or cannel coal; it is iron black in color; occasionally iridescent, and has a bright, often submetallic, luster, and a conchoidal fracture. Anthracite is sometimes made into beads and other round ornaments, trinkets, and charms. It is also made into candlesticks, paper weights, etc.

Brown coal is more recent in its origin than the Carboniferous period of geologists. It sometimes closely resembles ordinary bituminous, or soft coal. Other varieties have a brownish-black color, with more or less of the texture of wood remaining. Often the form and fiber of the original tree is retained. This variety is then called *lignite*. Brown coal in some of its varieties is occasionally made into paper weights, charms, and trinkets.

COBALTITE.

Cobaltite, when in groups or crusts of small, brilliant crystals, is occasionally cut into ovals or other shapes and used as ring stones, mountings for scarf pins, and other ornaments. Its color is pale steel gray, tarnishing to copper or flesh red. Its hardness is about 5.

One hundred parts contain: Cobalt, 35.5; arsenic, 45.2; sulphur, 19.3.

CORUNDUM.

RUBY—SAPPHIRE.

Corundum crystallizes in the hexagonal system in six-sided prisms and pyramids, the crystals often rough and rounded. Hardness 9. Brittle. Specific gravity about 4, the range being from 3.916 to 4.16. Luster, adamantine to vitreous; sometimes pearly on the basal plane and occasionally exhibiting a bright, opalescent, six-rayed star in the direction of the vertical axis. The color range includes nearly all the prismatic hues to colorless. Pleochroic in the strongly colored varieties. Occasionally phosphorescent, with a rich red color.

The transparent corundums rank among the most valuable of gem stones, and include two recognized varieties, the ruby and the sapphire. The red-colored corundums are called rubies. They vary in hue from a rose to a deep carmine, the same crystal occasionally exhibiting different colors, the most approved tint being a "pigeon's blood" red. The sapphire, in general, includes corundums of any color except the red. Specifically, the name is limited in its use to the blue-colored specimens, the approved tints being royal blue, velvet blue, and cornflower blue. The sapphire occasionally exhibits a different color effect by natural light from that seen by artificial light, and as a rule is less brilliant by the latter.

Corundums of other colors are named according to their hues: Oriental emerald, the green-colored kinds, varying in tint from a lively green, exceeding that of the emerald, to a sea or bluish green.

Oriental amethyst, purple or amethystine. Oriental topaz, yellow, rivaling the yellow diamond in brilliancy. Oriental hyacinth is hyacinthine in tint and is rare. Adamantine spar includes the hair-brown varieties.

The six-rayed star seen in many clouded corundums, especially when cut cabochon with the summits cutting the vertical axis of the prism, is due to numerous minute crystals or layers within the stone which reflect the incident light so as to produce the stellar effect. These rays are invariably white, though the specimen may be of any color, and may be best seen by artificial light. This chatoyancy, when marked, gives the asteria, or star stone, also known as the star ruby or

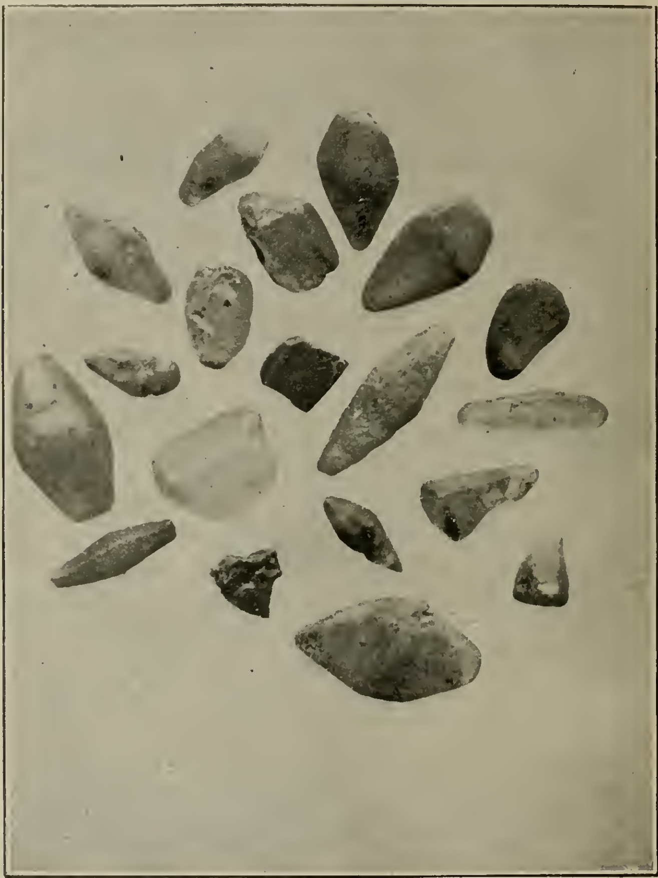


Fig. 5.

CORUNDUM CRYSTALS.

Ceylon.

Specimen No. 81441, U.S.N.M.

star sapphire, as the case may be. Should the gem assume a fibrous texture, the chatoyancy affords the "cat's-eye" ray.

Corundum is associated with crystalline rocks as granular limestone or dolomite, gneiss, granite, mica slate, and chlorite slate. The finest sapphires are usually obtained from the beds of rivers, either in modified hexagonal prisms or in rolled masses, accompanied by grains of magnetic iron ore, and several species of gems.

The best rubies come from the mines of Upper Burma, in an area about 30 miles square of which Mogok is the center. The rubies are found in place in crystalline limestone; occurring also in gem-bearing gravel and in the soil of the hillsides. A similar locality exists in the marble hills of Sagyin, 16 miles north of Mandalay. Ruby mines have also been worked at Jagdalak, near Kabul, Afghanistan. Individuals occur near Bilin in Bohemia and in the sands of the Expailly River in Auvergne. Blue sapphires are brought from Ceylon. Corundum occurs in the Carnatic, on the Malabar coast, in the territories of Ava, and elsewhere in the East; also near Canton, China. At St. Gotthard, it occurs of a red or blue tinge in dolomite, and near Mozzo in the Piedmont in white compact feldspar. Adamantine spar is met with in large, coarse, hexagonal pyramids on the Malabar coast and in Gellivara, Sweden.

The great corundum region of the United States extends from the Virginia line through North and South Carolina, across Georgia and into Alabama. Numerous localities are known in the crystalline rocks of the region, especially in Madison, Buncombe, Haywood, Jackson, Macon, and Clay counties, North Carolina. Quite recently rubies, rivaling those from Burma in color, have been found in the Cowee district of North Carolina. In variety of color the North Carolina corundum excels; it is gray, green, rose, ruby, emerald, sapphire to dark blue, violet, amethystine, brown, yellow of all shades, and colorless. Fine gem sapphires are found on bars in the Upper Missouri River near Helena, Montana. They are most abundant at Eldorado Bar, Frenchman's Bar, and Yogo Gulch, where they occur as pebbles more or less rolled. Corundum has been found in place in granite and trachyte rock in Fergus County, Montana. The Montana specimens rarely exceed one-fourth to one-half inch in length and range in color from light green, light blue, steel blue, bluish red, light red, and intermediate shades; frequently the colors mentioned will appear red or assume a reddish tinge by artificial light. They are usually dichroic and often blue in one direction and red in another.

CROCIDOLITE.

CAT'S-EYE—TIGER'S-EYE.

Crocidolite, from *κροκις*, woof, in allusion to its fibrous structure, is a fibrous, asbestus-like mineral, having a hardness of 4 and a specific gravity of 3.26. Its color varies from gold yellow to yellowish brown, indigo to greenish blue, leek green, and dull red. Crocidolite often contains a siliceous base, usually a ferruginous quartz, and when cut cabochon with a high summit and the longer diameter of the oval at right angles to the direction of the fibers of which the mineral is made up, will give the "cat's-eye" ray. The gem is also called "tiger's-eye." Crocidolite contains in 100 parts: Silica, 51; iron oxides, 34; soda, 7; magnesia, 2; water, 3.

The best specimens occur in Griqualand and the Orange River country, South Africa. These are essentially quartz, pseudomorphous after crocidolite, and have a hardness of about 7 and a specific gravity of 3.2. (Plate 2.)

DAMOURITE.

This mineral is one of the micas and usually results from the alteration of some other mineral. It is of little use as a gem. Practically, the only locality at which the mineral is so used is Stoneham, Maine, where a green and red damourite, altered from topaz, has been cut into trinkets.

DATOLITE.

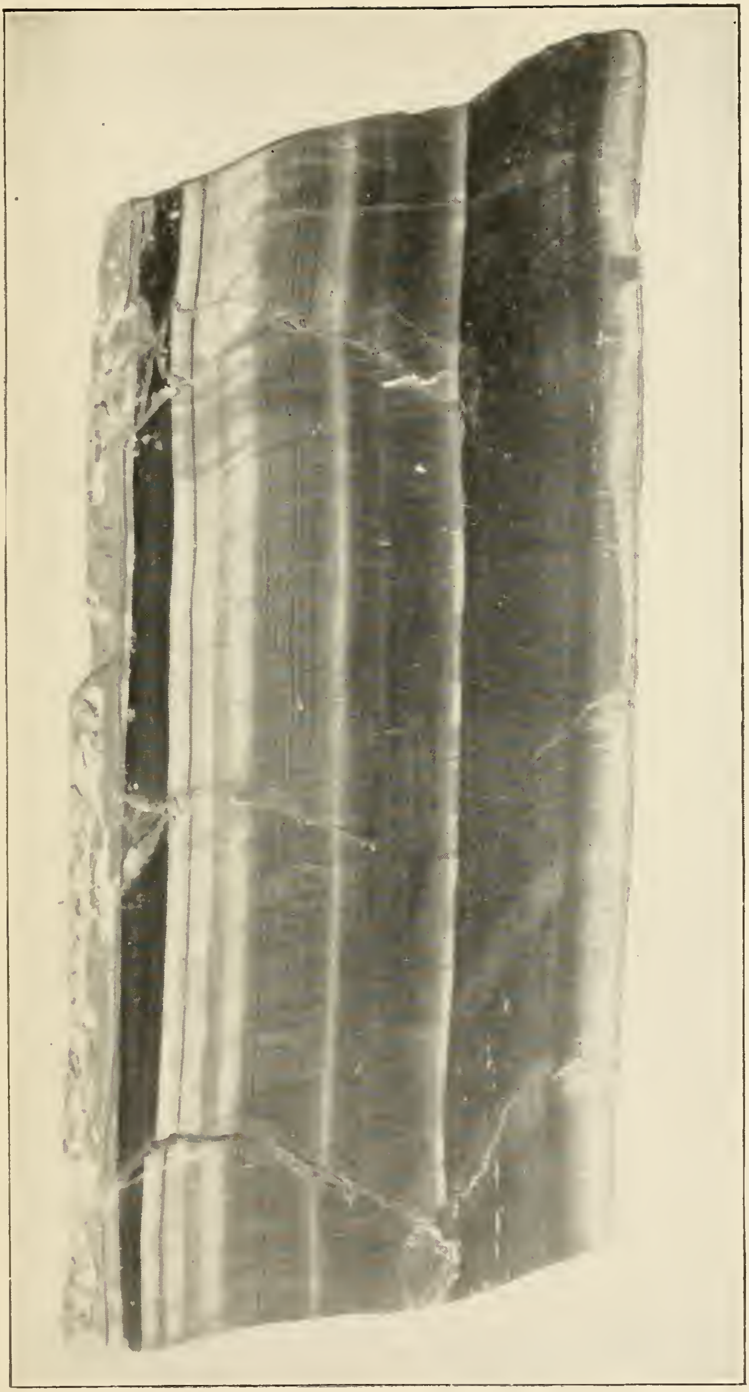
Datolite is another of the mineralogical gems. Its hardness is 5; specific gravity, 2.98; color, white, creamy, grayish, pale green, yellowish, reddish, or amethystine. It occurs in small, glassy crystals and massive, often having a radiating structure.

One hundred parts contain: Silica, 37.7; boric acid, 21.8; lime, 34.9; water, 5.6.

DIAMOND.

The diamond is the hardest of gems; is the only one that is combustible; is the most highly refractive, and surpasses all others in the property of dispersing light—that is, dividing light into colored rays, causing that peculiar flash of prismatic hues called its *fire*. The diamond crystallizes in the isometric system, usually in octahedrons, or combinations of octahedron, cube, dodecahedron, and tetrahedron, the crystals having their faces commonly curved. The cleavage of the diamond is highly perfect and parallel to the octahedral faces. The luster, especially of artificial faces, is peculiarly brilliant and is superior to that of any other gem. The remarkable brilliancy of the diamond results in part from the total reflection of light from its internal faces when the incident ray strikes it at an angle of a little more than 24 degrees. The stone also refracts light strongly. To the refractive and dispersive power of the diamond are due the flash of colors or fire, characteristic of the stone, the colorless specimens exhibiting it to the greatest degree, the colored to the least, or not at all.

The range of color of the diamond is extensive, including nearly all the prismatic hues. The whites, yellows, and browns, perhaps, afford the greatest number of shades and are the most numerous. Next to these, for colored specimens, the greens, including all shades, are most plentiful; the pure grass-green and emerald-colored stones are, however, very rare, as, indeed, are all the strongly colored specimens. Red stones of strong, rich, deep tints are extremely rare; so, too, are the garnet, hyacinth, rose-red, peach-blossom, and lilac colored speci-



CROCIDOLITE IN QUARTZ.

Griqualand West, South Africa.

Specimen No. 47105, U.S.N.M.

mens. Practically all of the blue stones known have been found in India, and their occurrence is as rare as the red. Cinnamon, brown, black, milky, and opalescent stones are occasionally met with. Pure colorless diamonds without a flaw or tint of any kind are more rare than is generally supposed.

The specific gravity of the diamond is 3.52; hardness, 10; crystallization, isometric; cleavage, octahedral and perfect; refraction simple, with an index of 2.439; a high dispersive power; luster, brilliant adamantine; is combustible though infusible; positively electric by friction; a nonconductor of electricity; is phosphorescent; does not polarize light, and consists essentially of carbon.

Three forms of the diamond are recognized: First, crystallized, the one employed in jewelry; second, crystalline, or imperfectly crystallized, having a hardness greater than that of the crystals and known as bort; this term is applied also to chips, diamond waste, and stones unsuited for cutting; third, an impure kind called carbonado; this is an opaque, steel gray to black, amorphous variety, without cleavage.

Diamonds and all other gems are rated by the carat. The term carat is derived from the name of certain small leguminous seeds which, when dry, are quite constant in weight. The brilliant, glossy, scarlet and black seed of *Abrus precatorius* weighs about 2 grains, and was early used in India for weighing gems. An English carat is equal to 3.1683+ grains, commonly reckoned as 3.17 grains troy, hence there are 151½ carats in an English troy ounce. Reckoning the value in the metric system, the weight of a standard carat will be 0.205 grams. The carat is subdivided into halves, quarters, eighths, sixteenths, thirty-seconds, and sixty-fourths. A quarter carat is called a grain. This is a "diamond" grain, not a troy grain, and is but 0.7925 of a true grain. In diamonds, perfectly white stones or decided tints of red, rose, green, or blue are most highly prized. Fine cinnamon, salmon, brown, black, or yellow stones are also much esteemed. When flawless and without tint of any kind, they are termed "first water." If they possess a steely-blue color they are called "blue white." It is impossible to estimate the value of a diamond by its weight. Color, brilliancy, cut, and general perfection of the stone are all to be considered. Of two stones, both flawless and weighing 10 carats, one may be worth $600 and the other $12,000. Off-colored or defective stones may sell at $40 to $75 a carat regardless of size, while the value of an ordinary good water stone increases in an increasing ratio with its weight up to about 20 carats, beyond which no rule holds good. Exceptionally perfect stones have no fixed value, the price depending upon the purity and brilliance of the stone.

Some diamonds are celebrated for their size, others for the interesting legends connected with them. Among the more interesting of these celebrated diamonds are the "Regent" or "Pitt" diamond, weighing $136\frac{14}{16}$ carats, the finest large diamond in the world. It was discovered in India in 1701, and weighed 410 carats in the rough. The finest blue diamond is the "Hope," an almost sapphire-blue stone weighing $44\frac{1}{4}$ carats, valued at £18,000. The "Dresden Green" is the finest green diamond, a pear-shaped $48\frac{1}{2}$ carat brilliant. The "Orloff" is a 193-carat stone in the scepter of the Emperor of Russia. The Russian treasury also contains the "Shah," an 86-carat stone. The "Koh-i-Nur" or "mountain of light," which weighed, when first brought to England, $186\frac{1}{16}$ carats, but was reduced by recutting in 1852 to $106\frac{1}{16}$ carats, is among the English crown jewels. The "Victoria," a Cape diamond weighing $457\frac{1}{2}$ carats in the rough and 180 carats cut, is valued at £200,000, and is perhaps the largest brilliant in the world. The largest diamond in America, and the finest yellow diamond in the world, is the "Tiffany" diamond, a flawless double-cut brilliant of a rich orange-yellow color. It was found in South Africa, weighs $125\frac{3}{8}$ carats, and is valued at $100,000.

For a full discussion and history of the more important stones above 100 carats in weight, as well as of many others, see Streeter's Great Diamonds of the World.

The diamond occurs in alluvial deposits of gravel, sand, or clay, associated with quartz, gold, platinum, zircon, rutile hematite, ilmenite, chrysoberyl, topaz, corundum, garnet, etc., the associated minerals being those common in granite rocks or granitic veins. It is found also in quartzose conglomerates, in peridotite veins in gneiss, and in an eruptive pegmatite.

Before the discovery of the Brazilian mines all diamonds were brought from India and Borneo. In India the diamond is met with at three principal localities. The first is in southern India, in the Madras Presidency, and embraces the districts of Kadapah, Bellary, Karnul, Kistna, and Godavari. This region includes the famous "Golconda" district, the name, however, being not that of a mine, but merely the general term for the market where diamonds were bought and sold. The second locality is farther north and includes a large tract between the Mahanadi and Godavari rivers; it embraces Sambalpur and Waigarh, 80 miles southeast of Nagpur as well as portions of the province of Chutia Nagpur. The third region is in Bundelkhand, in central India, the principal working being near the city of Panna. The Indian diamonds were obtained in part from alluvial deposits and in part from a quartzose conglomerate; at Panna this conglomerate appears to be largely made up of fragments of a lower sandstone which it has been suggested may represent the original matrix. The yield of the Indian mines, once so large, is at present very small.

Borneo produces only about 3,000 carats annually. The principal locality is in the basin of the Kapoeas River on the west side of the Ratoos Mountain near the town of Pontianak.

The diamond deposits of Brazil were discovered in 1728 and were at one time very productive, although the yield is at present small. Near Diamantina in Minas Geraes the diamonds are obtained in part from river washings and in part from prairie washings. The river deposits consist of rolled quartz pebbles, mixed with or united by a ferruginous clay which rests usually on talcose clays. The more common associated minerals are rutile, hematite, ilmenite, quartz, kyanite, tourmaline, gold, garnet, zircon, etc. In the prairie washings the diamonds occur in a conglomerate consisting of quartz fragments covered with a thin bed of sand or earth. This deposit affords the finest stones. Other Brazilian localities are those of Bagagem, at which place a 247½ carat stone was found, and at Abaethe, Minas Geraes. In Bahia diamonds are found at Lencães; along the river Cacholira, especially at Surua and Sinorca; they occur also on the Salobro and other branches of the Pardo River.

Derby,[1] in a recent paper on the occurrence of diamonds in Brazil, says that for the question of genesis the most significant of the Brazilian localities is that of Sao Joao de Chapada, near Diamantina. The diamonds occur here in thoroughly decomposed material, no fresh rock being found. He regards the various clays as representing a group of phyllites, of varied character, of principally, if not exclusively, clastic origin threaded with dikes of pegmatite, the clastic origin of the schists being indicated by the worn character of the zircons found in the clay derived from them. The diamond streaks appeared to Derby to contain distinct bands composed in part of quartz with plates of hematite, and these bands, he suggests, may be pegmatite dikes. The primary tourmaline and zircon and the secondary hematite and rutile found in the heavy residue after washing the clay are supposed to have originated in the pegmatite, the hematite, octahedrite, and rutile having formed from the original iron and titanium minerals now gone. The staurolite and kyanite, found in the heavy residue, are supposed to have come from the schists where they may have formed as a result of contact metamorphism induced by the intrusive pegmatyte. The diamonds have come from the schist along the borders of the pegmatite dikes and not from the dikes themselves; that is, he regards it possible that the diamond is a product of contact-metamorphism.

By far the greatest portion of diamonds now obtained come from South Africa, their discovery dating from 1867. The diamond workings are of two kinds, river diggings and dry diggings. The river diggings are in the gravel of the Vaal River from Potchefstroom down to its junction with the Orange River, and along the latter as far as Hopetown, the principal workings being along the Vaal between Klip

[1] Brazilian evidence on the genesis of the diamond, Journal of Geology, VI, 1898, pp. 121–146.

Drift and its junction with the Hart River. The dry diggings are chiefly in Griqualand-West, south of the Vaal River, on the border of the Orange Free State, about 640 miles northeast of Cape Town. There are here a number of limited areas approximately spherical or oval in form, with an average diameter of some 300 yards, the entire productive area being all within a circle having a radius of about 2 miles. These mines were originally worked as individual claims, but they are now all consolidated in one gigantic monopoly which practically controls the diamond output of the world. Some idea of the enormous output of the region may be gained from the statement that from

Fig. 6.

DIAMOND CRYSTALS.

Kimberly mines, South Africa.

Specimen No. 84799, U.S.N.M.

1867 to 1887 over 33,000,000 carats, or more than 6½ tons of diamonds have been taken out, valued in the rough at $225,000,000, and after cutting at $450,000,000.

At the Kimberly mines the diamantiferous area is inclosed in a wall of nearly horizontal black carboniferous shale. The upper portion of the deposit consists of a friable mass of pale yellow color, called the "yellow ground." Below the reach of atmospheric influences the rock is more firm and of a bluish green color; it is called the "blue ground." This consists essentially of a serpentinous breccia inclosing fragments of carbonaceous shale, bronzite, diallage, garnet, magnetite, etc. The diamonds are rather abundantly distributed through the mass, often to the amount of four to six to the cubic yard. These areas are believed to be volcanic pipes, and the occurrence of the diamonds is obviously connected with the igneous intrusive, either being formed by the action of heat upon the carbonaceous shales, or being brought up from underlying rocks.

In this connection De Launay[1] treats of the occurrence and origin of the Cape diamonds as follows: He describes the serpentine of the Kimberly mines as being derived from a peridotite determined as a picrite-porphyry. Mixed with the serpentine are abundant fragments of various rocks, so that many specimens are of the nature of a contact-breccia. The serpentine bodies occur as pipes extending downward in a nearly vertical direction to an unknown depth. In following the volcanic pipes down it has been proved that each one passes through several formations. At the surface the inclosing rocks are carbonaceous shales, and at one time it was believed that the crystallized carbon was primarily derived from these shales. Underlying these shales is a bed of diabase. The serpentine at this horizon still contained diamonds. Below the diabase horizon are quartzites, through which the miners are now engaged in working. According to De Launay, the inclosing terranes have had no influence on either the quantity or quality of the diamonds. He therefore holds that the diamonds have come from below with the peridotite-breccia and that the diamonds did not originate in the Upper Carbonaceous shales. He believes that since the cavities which contain the serpentine pipes are in the nature of volcanic chimneys, water, penetrating to the contact of a molten metallic bath charged with various carburets, caused the sudden formation of carburets of hydrogen, and by their explosion the opening of the volcanic chimneys. The water produced the scorification of the molten peridotite magma, and by the compression thus exercised on the carbon, the crystallization of the diamonds. Finally water accompanied the eruption of the peridotite and caused its serpentinization.

Diamonds are mined in the Urals, where they were discovered in 1829. They occur in the gold washings of the detritus along the Adolfskoi Creek, near Bisersk, and elsewhere along the western declivity of the Uralian range. In Australia they are found in the alluvial of the Cudgegong River, near Mudgee, and in the valley of the Horton River, in the Bingera district of New South Wales.

A few crystals have been occasionally met with in the United States in Rutherford, Franklin, Mitchell, and McDowell counties, North Carolina; in Hall County, Georgia; in Kentucky, Ohio, Wisconsin, Colorado, and Idaho, and in the placers of Eldorado, Amador, Nevada,

[1] Les Diamants du Cap, Paris, 1897.

Butte, Trinity, and Del Norte counties, California. In 1856 the Dewey diamond, weighing when cut 11½ carats, was found at Manchester, near Richmond, Virginia.

DIASPORE.

The smallness of the crystals, together with their brittleness, makes this mineral of little use as a gem. Its hardness is 6.5 to 7. Specific gravity, 3.3 to 3.5. Luster, brilliant; pearly on cleavage face. Color, grayish white, greenish gray, hair brown, topaz to fawn yellow, and colorless; occasionally violet blue in one direction, plum blue in another, and pale asparagus green in a third. Diaspore occurs foliated and massive and in orthorhombic prismatic crystals; usually small, thin, and flattened. The mineral is commonly found with corundum or emery in dolomite, chlorite schist, and other crystalline rocks. Perhaps the finest diaspores are those found near Unionville, Chester County, Pennsylvania. At this locality crystals have been found measuring from ½ to 1½ inches in length and ¼ inch in thickness.

One hundred parts contain: Alumina, 85.1; water, 14.9.

DIOPSIDE.

Diopside is occasionally cut as a gem. It is a variety of pyroxene occurring in monoclinic crystals of a prismatic habit. Its hardness is about 6. Specific gravity, 3.2 to 3.38. Luster, vitreous. Color, white, of several shades, pale green to dark green and nearly black. A variety containing chromium is often of a fine bright-green color.

Pyroxene is a common mineral in crystalline limestone and dolomite, serpentine, and eruptive rocks; occurs also in granitic rocks and metamorphic schists. The variety diopside occurs commonly in limestones and serpentines. A famous locality is on the Mussa Alp, in the Piedmont, where it occurs in veins, traversing serpentine, associated with garnet. A similar locality is at Traversella, in the Tyrol. Fine gem diopside occurs also at Dekalb, New York.

One hundred parts contain: Silica, 55.6; lime, 25.9; magnesia, 18.5. Iron is usually present in small amounts, and chromium is occasionally observed.

DIOPTASE.

ACHIRITE—CONGO EMERALD.

Dioptase is a silicate of copper crystallizing, commonly in prismatic forms, in the rhombohedral division of the hexagonal system. Its hardness is 5; brittle. Specific gravity, 3.28 to 3.35. Luster, vitreous. Color, rich emerald green. Transparent to subtranslucent. Double refraction, strong. Cleavage, rhombohedral and perfect. Pyroelectric.

Dioptase is limited in its use as a gem by its softness and brittleness. It occurs in druses and crystalline aggregates on quartz in seams of a compact limestone near Altyn-Tube, in the Kirghese Steppes, whence it was first brought by a Bucharian merchant, Achir Mahmed, after whom it was called *Achirite*. Fine crystals are found at Mindouli, near Comba, the French Congo, whence the name *Congo emerald*. Brilliant crystals are found at the copper mines near Clifton, Graham County, Arizona.

One hundred parts contain: Copper oxide, 50.4; silica, 38.2; water, 11.4.

DUMORTIERITE.

Dumortierite occurs commonly in fibrous to columnar aggregates and massive; rarely in distinct orthorhombic crystals. Luster, vitreous. Hardness, 7. Specific gravity, 3.26. Color, strong smalt blue to greenish blue; strongly pleochroic, being colorless, reddish violet, and deep ultramarine in the several directions. The fibrous kinds, when cut cabochon with sufficiently high summits, will often afford the "cat's-eye" ray. In composition the mineral is essentially a basic aluminum silicate, containing in 100 parts: Silica, 30.6; alumina, 69.4.

ENSTATITE.

BRONZITE—HYPERSTHENE.

Enstatite, bronzite, and hypersthene are orthorhombic pyroxenes occurring commonly crystalline, massive, fibrous, lamellar, or foliated. Their hardness does not exceed 6; their specific gravity, 3.5, and their colors include the various shades of green, gray, brown, white, and black. When cut cabochon across the fibers they will all afford the "cat's-eye" ray.

Enstatite is yellowish, grayish, or greenish white; has a vitreous to pearly luster; a specific gravity of 3.10 to 3.13; a hardness of 5.5, and is somewhat brittle. In composition it is essentially a magnesian silicate containing in 100 parts: Silica, 60; magnesia, 40.

Bronzite is grayish to olive green and brown in color; has an adamantine pearly to a metalloidal or bronze-like luster; a specific gravity of 3.1 to 3.3, and a hardness of 5.5. In composition it is an enstatite, having its magnesium in part replaced by iron. Bronzite and enstatite are common constituents of peridotites and the serpentines derived from them; occurring also in the crystalline schists.

Hypersthene is dark brownish green, grayish black, greenish black, and pinchbeck brown, occasionally marked by a play of color resulting from included labradorite. Luster, pearly on cleavage face and frequently exhibiting a peculiar metalloidal effect; hardness, 6; specific gravity, 3.4 to 3.5.

Hypersthene, associated with labradorite, is common in certain granular eruptive rocks, as noryte and gabbro. In composition it is analogous to an enstatite in which the magnesium has in part been replaced by iron, often in the proportion of 1:1.

EPIDOTE.

THULITE.

Epidote occurs in monoclinic crystals, commonly prismatic and in fibrous to granular masses having a hardness of 6 to 7, a specific gravity of 3.2 to 5, and a vitreous luster, inclining to pearly or resinous on certain faces. Ordinarily the color is a peculiar yellowish green, seldom seen in other minerals; from this it may pass into light and dark shades, black on one side and brown on the other; red, yellow, gray, and colorless varieties also occur. Epidote is doubly refracting and strongly pleochroic, showing a green, a brown, and a yellow as viewed in the several directions.

Thulite is a closely related mineral occurring in orthorhombic forms and in columnar to compact masses, having a specific gravity of 3.124 and a hardness of about 6.5. Its color varies from a peach-blossom red to rose red; strongly pleochroic, showing a light rose, a deep rose, and a yellow color in the different directions.

Epidote is common in many crystalline rocks, as syenite, gneiss, schist, and serpentine. It is sometimes found in geodes in trap, and also in sandstone adjoining trap dikes, as a result of contact metamorphism. It occasionally forms with quartz an epidote rock, and is sometimes found in nodules in the different quartz rocks or altered sandstones.

One hundred parts contain, approximately: Silica, 38; alumina, 22; ferric oxide, 15; lime, 23; water, 2.

EUCLASE.

Euclase, named by Hauy from εὐ, easily, and κλὰω, to break, though susceptible of a high polish, is rarely used as a gem stone because of its brittleness. It varies in color from pale mountain green to indigo blue and white. Its hardness is 7.5, and its specific gravity about 3.1. The mineral crystallizes in the monoclinic system and exhibits trichroism.

One hundred parts contain, approximately: Silica, 41.2; alumina, 35.2; glucina, 17.4; water, 6.2.

Euclase occurs in the mining district of Villa Rica, Minas Geraes, Brazil, associated with topaz in a chloritic schist. It is found also in the auriferous sands of the Orenburg district of the southern Urals, associated with topaz, corundum, kyanite, rutile, etc.

FLUORITE.

CHLOROPHANE.

Fluorite crystallizes in the isometric system, commonly in cubes; occurring also massive and granular, coarse or fine. The mineral has a perfect octahedral cleavage; a conchoidal to splintery fracture; is brittle; has a hardness of 4, a specific gravity of 3.18, and a highly vitreous luster. The color range is extensive, including white, yellow, green, violet, sky and amethystine blue, brown, wine yellow, rose red, crimson, and pink. It sometimes presents a bluish fluorescence, and is phosphorescent when heated gently. This is especially characteristic of the variety chlorophane, or cobra stone, which emits a bright emerald-green light on a comparatively low rise of temperature.

Fluorite, though too soft for continuous wear, is occasionally cut as a gem, chiefly for collectors' use, and a massive variety occurring in the north of England is not infrequently worked up into trinkets, paper weights, vases, and other ornaments.

Fluorite occurs in veins and beds in gneiss, mica slate, clay slate, limestone, and sandstone.

One hundred parts contain: Calcium, 51.3; fluorine, 48.7.

GADOLINITE.

Gadolinite, a complex silicate of yttrium and other earths, occurs usually massive, rarely in monoclinic crystals. Its hardness is 6.5; specific gravity, 4.35; color, black, of several shades. The mineral affords velvety black, opaque gems and is cut for collectors' use only.

GARNET.

The garnet includes several varieties, which are distinguishable by their differences in composition and in part by their colors. The mineral crystallizes in the isometric system, commonly in dodecahedrons and trisoctahedrons and derived forms. It is singly refracting and monochroic; has a vitreous to resinous luster, and varies in hardness and specific gravity, according to the variety, from 6.5 to 7.5 and 3.15 to 4.3, respectively.

In composition garnet is a silicate of different bases—alumina, lime, magnesia, chrome, iron, manganese, and titanium. There are three prominent groups, with several subdivisions under each, many of these passing into each other. They are:

I. Aluminum garnet:
- Grossularite—Lime-aluminum garnet.
- Pyrope—Magnesium-aluminum garnet.
- Almandite—Iron-aluminum garnet.
- Spessartite—Manganese-aluminum garnet.

II. Iron garnet:
- Andradite—Lime-iron garnet.

III. Chromium garnet:
- Ouvarovite—Lime-chrome garnet.

The lime-aluminum garnet has a hardness of 7, a specific gravity of 3.55 to 3.66, and its color range includes white, pale green, amber, honey, wine, and brownish yellow, cinnamon brown, and pale rose red. The several varieties are: *Essonite*, *cinnamon stone*, or *hyacinth*. The kind of this variety more commonly used as a gem includes the clear cinnamon brown to a deep gold tinged with brown specimens. Its hardness is 7 and its specific gravity 3.6. *Grossularite*, the pale green, yellow to nearly white, pale pink, reddish orange, and brown kinds. *Romanzovite* is brown. *Wiluite* is yellowish green to greenish white in color. *Topazolite* is topaz to citrine yellow. *Succinite* is an amber-colored kind.

The principal magnesian garnet is the *pyrope*, meaning "fire-like," a deep blood red to nearly black stone, prized as a gem. It is among the hardest of the garnets, ranking 7.5 in the scale. Its specific gravity lies between 3.7 and 3.8. (Fig. 7.)

The *almandite*, or *carbuncle*, and *rhodolite* are iron-aluminum garnets. Almandite varies in color from cherry red, blood red to deep

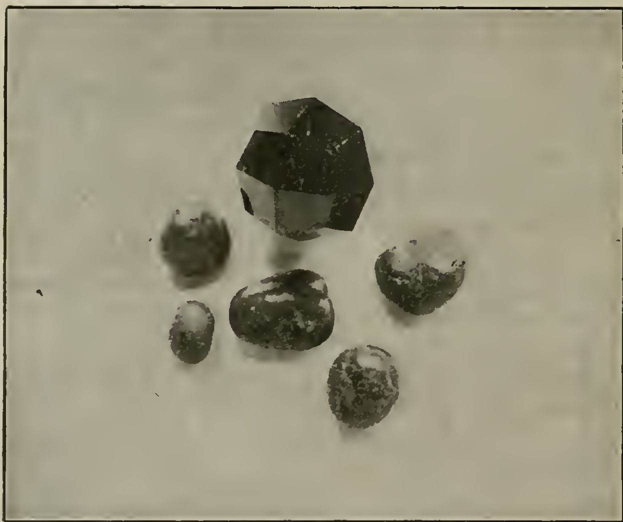


Fig. 7.

GARNET CRYSTAL AND PEBBLES OF PYROPE.

Specimen No. 82575, U.S.N.M.

red of several tints, occasionally assuming an orange hue by artificial light. The color of the rhodolite lies between a violet purple and a brownish red. These varieties have a hardness of about 7.5, with a specific gravity seldom less than 4, and occasionally as high as 4.3. Both are prized as gems.

Spessartite is a manganese aluminum garnet, varying in specific gravity from 3.7 to 4.3, and has a hardness of about 7. The color varies from a reddish brown, dark hyacinth red, sometimes with a tinge of violet, to orange red. It often affords fine gems.

The calcium-iron garnet varies in specific gravity between 3.6 and 4 and in hardness from 5 to 7. The group includes a number of varieties, varying widely in color and other respects, the more important of which are: *Andradite*, a yellow or orange-brown variety. *Demantoid* or *Uralian emerald*, a grass-green, emerald-green, or brownish-green stone having a brilliant luster, and when cut exhibiting considerable fire, especially by artificial light. It is somewhat soft, having a hardness of about 5. *Colophonite* is a brownish-black garnet, characterized by a resinous luster. *Melanite* is a black to yellow-brown kind.

The lime-chrome garnet, *ouvarovite*, is almost invariably a fine emerald green, and is harder than any of the other varieties, ranking nearly 8 in the scale.

In the trade the lighter-colored clear garnets are often called *hyacinth*. The yellowish is the *jacinta;* a yellowish-red, the *guarnaccino* or *vermeille;* the red with a tinge of violet, *rubino-di-rocca* or *grenat syriam*. The deep clear red is the true precious garnet and is often called *carbuncle*.

Garnet is common in mica schist, hornblende and chlorite schist, gneiss, syenitic gneiss, and granite, occurring also in limestone, serpentine, and volcanic rocks. The garnet of granite, gneiss, mica schist, and similar rocks is commonly almandite. Grossularite is common in limestones and crystalline schists. Pyrope belongs especially to peridotites and the serpentines derived from them; occurs also in basalts. Spessartite occurs in granitic rocks, in quartzite, in certain schists, and in some rhyolytes. Iron garnets are common in eruptive rocks, occurring also as a product of contact metamorphism. Demantoid occurs in serpentine. The chrome garnets belong particularly with the chromite in serpentine; found also in granular limestone.

GÖTHITE.

A hydrated oxide of iron, which, when occurring in acicular crystals in limpid quartz, is often cut into gems. The color of the göthite is yellowish, reddish, and blackish brown.

GOLD.

Gold, in crystals, filiform, reticulated, and arborescent shapes, or in nuggets, is frequently worn as a jewel. Gold penetrating white, black, rose, and amethystine quartz is worked into jewelry of all sorts, the designs often being elaborate.

GYPSUM.

ALABASTER—SATIN SPAR—SELENITE.

Gypsum occurs in monoclinic crystals and massive. It has a hardness of 2, a specific gravity of 2.3, and is usually white in color, sometimes gray, flesh red, honey, and ocher yellow, blue, brown, and black. Three varieties are recognized. 1. *Selenite*, occurring either in distinct crystals or broad folia, which are transparent throughout. It is not used as a gem. 2. *Satin spar*, a fine fibrous variety having the pearly opalescence of moonstone and affording the "cat's-eye" ray when cut cabochon. Though soft, it is frequently worked up into beads, pins, and other ornaments. 3. *Alabaster*, a fine-grained, white or delicately clouded variety. It is worked up into carvings, statuettes, and other ornamental objects.

Gypsum often forms extensive beds in connection with various stratified rocks, especially limestones and marlytes; found also in crystalline rocks, about the fumaroles of volcanoes, and is deposited on the evaporation of sea water and brines, in which it exists in solution.

One hundred parts contain: Sulphuric acid, 46.51; lime, 32.56; water, 20.93.

HEMATITE—CHROMIC IRON—ILMENITE.

The compact, fibrous kinds of hematite are cut into beads, intaglios, charms, and other ornaments. The color is iron black to steel gray; luster metallic and opalescent; hardness 6; specific gravity 4.5 to 5.3. One hundred parts contain: Iron, 70; oxygen, 30.

Chromic iron and ilmenite have a use similar to that of hematite. The hardness, specific gravity, and color of both are also near that of hematite. Chromic iron contains: Iron, 38; chrome, 62. Ilmenite consists essentially of the oxides of iron and titanium in varying proportions.

HORNBLENDE.

The use of hornblende as a gem is limited to those specimens found penetrating liquid quartz. As such, especially when the hornblende is in delicate acicular crystals, interlaced and penetrating the quartz in every direction, it affords very beautiful gems.

IOLITE.

DICHROITE—SAPHIR D'EAU—WATER SAPPHIRE.

Iolite, called also dichroite and saphir d'eau, or water sapphire, is occasionally used as a gem. It occurs in orthorhombic crystals of a prismatic habit, and massive, compact. The hardness is greater than that of quartz; its specific gravity is 2.60 to 2.66, and its luster vitreous. The colors are the various shades of blue, commonly a smoky blue, either light or dark. Its pleochroism is strongly marked, the crystals presenting different shades of blue, bluish white, and yellowish gray, according to the direction in which they are viewed; hence the name dichroite, meaning two colored.

Iolite occurs in granite, gneiss, chloritic and talcose schists, and allied rocks; also in igneous rocks, and as a contact mineral in connection with eruptive dikes, as in slates adjoining granite. The saphir d'eau occurs in small rolled masses of a strong blue color in the alluvial deposits of Ceylon. The mineral alters readily on exposure, so that it is most commonly found in an altered condition or inclosed in altered iolite.

One hundred parts contain: Silica, 49.6; alumina, 33.8; magnesia, 8.7; oxide of iron, 7.9.

ILVAITE.

Ilvaite has little value as a gem, but is occasionally used for the letter I in sentimental jewelry. It is iron black in color; has a hardness of 6; a specific gravity of 3.99, and a submetallic luster. The mineral crystallizes in the orthorhombic system, commonly in prisms, also occurring columnar or compact massive.

One hundred parts contain: Silica, 29.3; oxides of iron, 54.8; lime, 13.7; water, 2.2.

ISOPYRE.

Occurs in compact masses with cleavage. Its color is grayish or velvet black to dark green, occasionally spotted red like heliotrope and then used as a gem. Its hardness is 6 to 6.5; specific gravity, 2.912; luster, vitreous, and is translucent to opaque. Isopyre occurs in a quartzose granite near Penzance, Cornwall, England, and in a breccia near Edinburgh, Scotland.

The mineral contains in 100 parts: Silica, 47.09; alumina, 13.91; iron, 20.07; lime, 15.43; copper, 1.94.

JADE.

Jade, as commonly used, is a generic term including various mineral substances, as chloro-melanite or jadeite, nephrite, saussurite, pseudonephrite, of tough, compact texture, and ranging in color from cream white to dark green and nearly black. The Asiatic jade is usually pale green or bluish white, while that of New Zealand is dark green.

The term jade includes properly two minerals only—*nephrite* and *jadeite*. The one is a tough, compact, fine-grained tremolite, a variety of amphibole, having a hardness of 6 to 6.5 and a specific gravity of 2.96 to 3.1. The other is a tough, fibrous foliated to closely compact mineral grouped with the pyroxenes. Its hardness is 6.5 to 7 and its specific gravity 3.33 to 3.35.

The lack of brilliancy in jade makes it of little value as an article of jewelry, but its great toughness renders it eminently suitable for ornamental vases and other carved work displaying delicacy of workmanship.

KYANITE.

DISTHENE.

Kyanite, when transparent and of a good color, is employed as a gem. The name is from κυανος, blue, though the mineral affords examples of other colors, such as white, gray, green, and black. Disthene is from δις, twice, and σθενος, strong, alluding to its unequal hardness and electrical properties in two different directions.

The mineral occurs commonly in long-bladed triclinic crystals and in bladed to subfibrous masses. Hardness, 5 to 7, depending upon the direction and crystal face upon which the test is made. Specific gravity, 3.56 to 3.67. Luster, vitreous. The color is commonly pale blue, often a deeper hue along the center of the blades, also white, gray, green, and black; pleochroism strong in colored kinds.

Kyanite occurs principally in gneiss and muscovite and paragonite schist.

One hundred parts contain: Silica, 37; alumina, 63.

LABRADORITE.

Labradorite is one of the feldspars occurring in triclinic crystals and cleavable to granular masses. Its hardness is 6; specific gravity, 2.72: luster, vitreous, passing into pearly, translucent to subtranslucent; color, gray, brown, or greenish, sometimes colorless and glassy. Owing chiefly to a peculiarity in its intimate structure, labradorite, especially of the cleavable kinds, often shows a magnificent play of colors, in which blue and green predominate, while yellow, red, pearl gray, orange, puce, amber, and peach blossom hues are apparent, together with a golden and copper schiller. The mineral takes a high polish, and, because of its chatoyant reflections, is often very beautiful.

Labradorite is an essential constituent of various rocks, especially the basic kinds, and is usually associated with some member of the pyroxene or amphibole groups. Labradoritic massive rocks are most common among the Archaean formations. It was brought first from the coast of Labrador, hence the name.

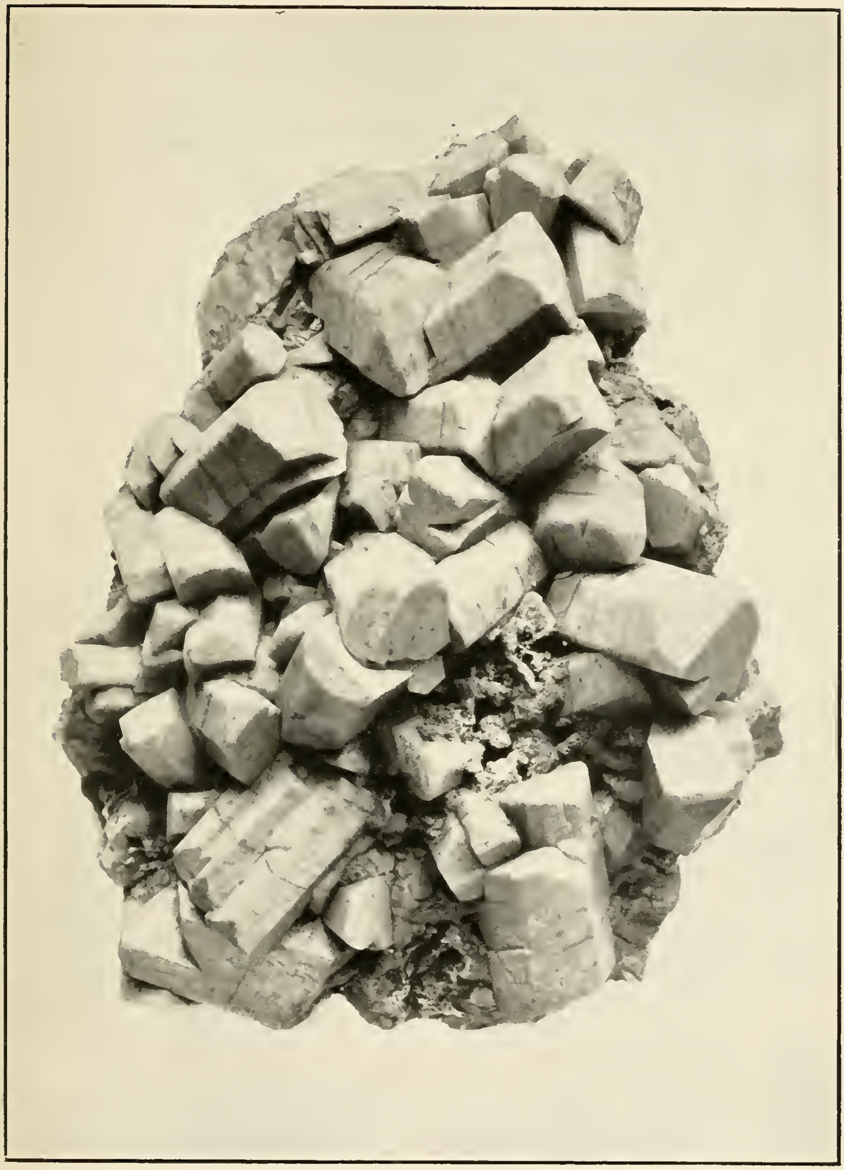
One hundred parts contain: Silica, 53.1; alumina, 30.1; lime, 12.3; soda, 4.5.

LAPIS-LAZULI.

Lapis-lazuli, long thought to be a simple mineral, consists of a mixture of a bluish substance (lazurite) with granular calcite, scapolite, diopside, amphibole mica, pyrite, etc. The richly colored kinds are highly esteemed for costly vases, mosaics, and other ornamental work. Color, rich Berlin or azure blue, violet blue, and greenish blue; occasionally containing a colorless substance and frequently including brass yellow specks of pyrite; these are often so numerous as to produce a spangled appearance. Its hardness is 5.5; specific gravity about 2.4; luster, vitreous; translucent.

Lapis-lazuli occurs commonly massive in limestone and in a granitic rock.

In composition it carries in 100 parts: Silica, 31.7; alumina, 26.9; soda, 27.3; sulphur 16.



AMAZON STONE.

Pikes Peak, Colorado.

Specimen No. 81813, U.S.N.M.

LEPIDOLITE.

Lithia mica is used to some extent for ornaments, such as ash trays, dishes, vases, paper weights, etc. The colors range from rose pink through a variety of shades of violet gray to yellowish and whitish. It occurs in granular masses made up of foliated scales. Hardness about 4; specific gravity, 2.84 to 3.

MAGNETITE.

LODESTONE.

Lodestone, a magnetite that possesses polarity, is worked up into charms and worn solely for the mystic properties it is supposed to possess. Color, iron black; luster, metallic; hardness, 6.4; specific gravity, 5. Brittle, opaque, strongly magnetic, and possessing polarity.

Composition: Iron, 72.4; oxygen, 27.6.

MICROCLINE.

AMAZONSTONE—AVENTURINE.

Microcline, one of the feldspars, occurs massive and in triclinic crystals, resembling those of orthoclase, common feldspar, in habit. Its hardness is 6.5; specific gravity, 2.54; cleavage perfect and in two directions; luster, vitreous; translucent to opaque, and varying in color from white to pale cream yellow, red, and green.

Two recognized varieties are used either as gems or ornamental stones. 1. *Amazonstone*, a green-colored microcline. Its color range includes the several shades of green, from the palest and most delicate to a strong, deep, verdigris green. (Plate 3.) 2. *Aventurine*, consisting of interlaminated albite and microcline, and often including disseminated scales of hematite or göthite, giving rise to internal yellowish or reddish reflections.

Microcline contains in 100 parts: Silica, 64.7; alumina, 18.4; potash, 16.9.

MICROLITE.

Occasionally crystals of microlite are found that are sufficiently transparent to afford gems ranging in color from cinnamon brown to orange red and spinel yellow. The hardness of the mineral is 5.5; specific gravity, 5.65 to 6.13, greater than that of any other known gem, luster, resinous to vitreous, transparent to translucent and opaque.

In composition it is essentially a tantalate of lime.

NATROLITE.

Natrolite is occasionally used for the letter N in sentimental jewelry and as a collectors' gem. The mineral occurs in groups of slender, prismatic, orthorhombic crystals, in fibrous, radiated, and divergent masses, in amygdules having a fibrous structure, and in compact masses. Its hardness is 5.5; specific gravity, 2.2; luster, vitreous, sometimes inclining to pearly or silky in the fibrous kinds; color, white to grayish, yellowish, reddish, and red.

Natrolite occurs in cavities in amygdaloidal basalt and related igneous rocks, and in seams in granite, gneiss, and syenite.

One hundred parts contain: Silica, 47.4; alumina, 26.8; soda, 16.3; water, 9.5.

OBSIDIAN.

Obsidian is compact volcanic glass. Its specific gravity is 2.25 to 2.8. The hardness is somewhat less than that of ordinary feldspar. The prevalent color of the material is black, but some of it is mottled and streaked with brownish red or various shades of brown; sometimes in reddish-brown spherules in a gray matrix; also green of several shades to light and dark yellow. Certain fibrous specimens will afford the cat's-eye ray.

The kinds used as gems are known as: *Moldavite* or *bottle stone*, a green-colored obsidian; *marekanite* or *mountain mahogany*, a red colored or banded black and brown variety, and *Iceland agate*, *pearlylite*, and *sphaerulite*.

OLIVINE.

CHRYSOLITE—PERIDOT—HYALOSIDERITE.

Olivine crystallizes in the orthorhombic system; also occurring massive; compact or granular; commonly in embedded grains. Its hardness is 6.5 to 7. Specific gravity, 3.33 to 3.44. Cleavage distinct. Fracture, conchoidal. Brittle. Luster, vitreous. Color, commonly olive green, sometimes brownish, grayish red, and occasionally black. Double refraction, strong. Dichroism occasionally marked, the peridot giving a straw-yellow and a green image.

The kinds used as gems are known as: *Chrysolite*, yellowish green; *peridot* or *evening emerald*, having an olive pistachio, or leek-green color, of a quieter hue than that of the emerald, the approved tint being similar to that seen on looking through a delicate green leaf, and *hyalosiderite*, called also *Job's tears*, a highly ferruginous variety having a specific gravity as high as 3.57 and a rich olive-green color.

Olivine is a common constituent of some eruptive rocks; not uncommon in granular limestone and dolomite; occurring also in certain schists and in ore deposits.

The percentage composition of olivine, though the iron oxide may be more or less replaced by magnesia, is, approximately: Silica, 41; magnesia, 50; iron oxide, 9.

OCTAHEDRITE.

ANATASE.

Octahedrite crystallizes in the tetragonal system, commonly on octahedra. Its hardness is nearly 6, its specific gravity 4.86, and its color includes the several shades of brown, passing into deep blue or black; sometimes greenish yellow to pale green. Fine blue crystals of this mineral from Brazil are so remarkably brilliant as to be mistaken for diamonds.

One hundred parts of octahedrite contain: Titanium, 60; oxygen, 40.

ODONTOLITE.

BONE TURQUOISE—FOSSIL TURQUOISE.

Odontolite is a fossil ivory or bone, colored sky blue or green by phosphate of iron. It resembles the turquoise in color, but may readily be identified by its bony structure.

OLIGOCLASE.

HELIOLITE—SUNSTONE.

Oligoclase, one of the feldspars, occurs massive and in triclinic forms crystals somewhat rare. Its cleavage is perfect in one direction, less so in another. Fracture uneven. Hardness, 6. Specific gravity, 2.65 to 2.67. Luster, vitreous to somewhat pearly. Color, grayish, reddish, greenish, and white to colorless, occasionally having a play of color. Aventurine kinds, called either *sunstone* or *heliolite*, are of a grayish white to reddish gray color, with internal yellowish or reddish reflections proceeding from disseminated crystals or flakes of iron oxide.

Fine transparent oligoclase, affording brilliant gems having a moonstone effect, is found near Bakersville, North Carolina. The best sunstone is from Christiana fiord, Norway. The same region also affords specimens having a magnificent play of color, in which grayish blue, orange, and gray, with coppery reflections, are seen.

Oligoclase occurs in granitic, syenitic, and dioritic rocks.

One hundred parts contain, approximately: Silica, 62.3; alumina, 23.5; soda, 14.2.

OPAL.

The opal occurs in amorphous masses; sometimes in reniform, stalactitic, and tuberose shapes, and encrusting. Its hardness is about 6.5, occasionally as low as 5.5. The specific gravity varies from 1.9 to 2.3, commonly 2.1. Luster, vitreous, frequently subvitreous, often inclining to resinous, and occasionally to pearly. Color, white, yellow, red, brown, green, gray (the dark color arising from foreign admixtures); sometimes having a brilliant play of colors by reflected and refracted light. This play of colors is not due to the presence of colored substances as constituents of the mineral, but to a physical condition of the specimen resulting from a multitude of fissures, the sides of which are minutely striated, and which cause a diffraction and decomposition of the light which falls upon them. The size of these striations and fissures influence the color and its distribution within the mineral; occasionally the patches of color are of a uniform size; again, they may be irregular. Certain specimens may show a predominance of one set of colors, as red and orange; others may show chiefly green and blue tints.

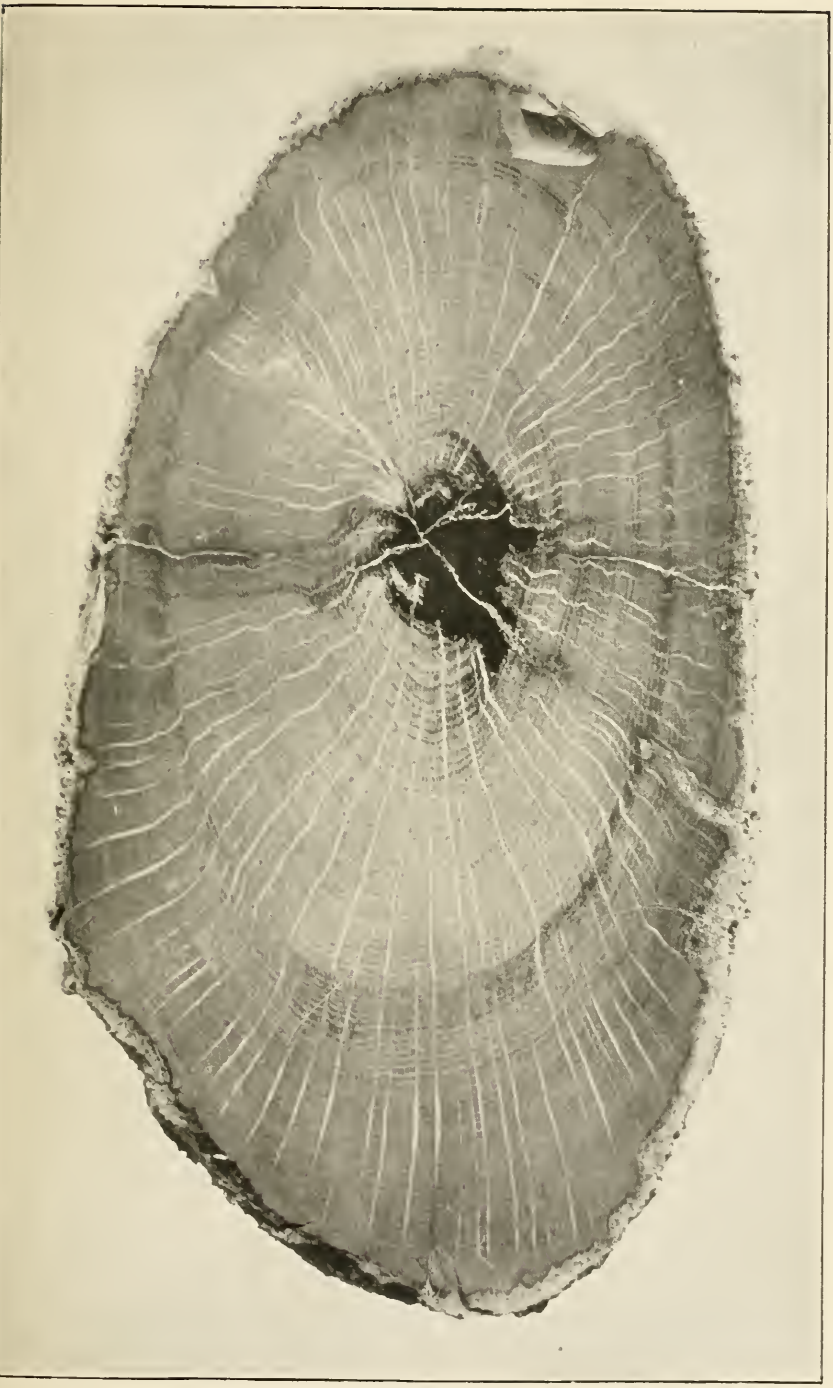
There are many varieties of the opal to which specific names have been given. The *precious opal* exhibits a play of delicate colors, reflecting now one hue and then another. The *harlequin opal* presents a variegated play of colors on a reddish ground and resembles the fire opal. The *fire opal* presents hyacinth red to honey yellow colors, with fire-like reflections, somewhat irised on turning. *Girasol* is a bluish white translucent kind, presenting reddish reflections in a strong light. *Lechosos opal* is a name applied to those kinds showing deep green flashes of color. *Hydrophane* is a whitish or light colored opaque kind which becomes transparent when immersed in water. *Cacholong* is an opaque porcelain, bluish, yellowish, or reddish white variety. *Opal agate* is agate-like in structure. *Jasp opal* contains several per cent of iron, and is the analogue in opal of jasper in quartz. *Wood opal* is wood silicified by opal; sometimes called *lithoxyle* when showing a woody structure. (Plate 4.) *Hyalite*, or *Müller's glass*, is either colorless and pellucid like glass, or a translucent bluish white. *Moss opal* contains moss-like inclusions of manganese oxide and is the analogue in opal of the moss agate in quartz. *Tabasheer* is an amorphous opal-like silica deposited within the joints of bamboo; it absorbs water and becomes transparent like hydrophane.

The opal occurs filling seams, cavities, and fissures in igneous rocks, etc. It occurs also embedded in limestone and argillaceous beds. It consists essentially of silica in the soluble or gelatinizing condition, but often combined with insoluble silica, and is more or less hydrous.

ORTHOCLASE.

ADULARIA—AVENTURINE—MOONSTONE—PERTHITE.

Orthoclase, common feldspar, occurs in monoclinic crystals, often prismatic in habit, and massive, coarsely cleavage to compact, and flint-like or jasper-like. Cleavage perfect in one direction, less so in another. Hardness, 6. Specific gravity, 2.4 to 2.6. Luster, vitreous, sometimes inclining to pearly on the face of a perfect cleavage, and



OPALIZED WOOD.
Clover Creek, Lincoln County, Idaho.
Specimen No. 82581, U.S.N.M.

occasionally having a satin-like effect or schiller. Color, white; often gray, reddish white, flesh red, greenish white, and occasionally green. Transparent to translucent.

The difference in color, luster, and other physical properties has given rise to distinct names for several varieties of this mineral, the more important of which for use as gems are: *Adularia*, a transparent or translucent variety differing from ordinary orthoclase in presenting, when polished, chatoyant or pearly reflections. The kinds exhibiting this chatoyancy to the greatest degree are known as *moonstones*, and have, as a rule, a specific gravity of 2.58. *Aventurine* is less pellucid and has reddish and yellow internal reflections arising from minute scales of occluded minerals.' *Sunstone* is a similar variety. *Cassinite* is a bluish-green kind, having a pearly luster and more or less of an aventurine character. *Leelite* has a deep flesh-red color, with a waxy luster. *Perthite* is a flesh-red feldspar, consisting of interlaminated orthoclase and albite, and which often affords bright aventurine reflections. *Variolite* is a dark-green variety containing lighter globular particles; it was so called in allusion to its supposed power in preventing and curing smallpox.

Orthoclase in its several varieties belongs especially to the crystalline rocks, occurring as an essential constituent in granite, gneiss, syenite, porphyry, etc.

One hundred parts contain: Silica, 64.8; alumina, 18.4.

PEGMATITE.

GRAPHIC GRANITE.

Pegmatite consists of feldspar and quartz, in which the quartz, arranged in parallel positions, is so distributed through the feldspar as to appear like oriental characters.

PHENACITE.

Phenacite crystallizes in the hexagonal system; has a hardness of 8; a specific gravity of 2.96; it is colorless, often clouded or milky; also straw and wine yellow and cinnamon colored. The clouded kinds are dichroic. The colorless transparent kinds exhibit considerable "fire," especially by artificial light, and may easily be mistaken for the diamond, hence the name, from Φέναξ, a deceiver.

One hundred parts contain: Silica, 54.3; glucina, 45.7.

PORPHYRY.

The term porphyry, as here used, applies to that class of rocks in which the mass of the rock, or groundmass, is so compact and dense as to appear practically noncrystalline, and in which are embedded large, scattering, more or less perfectly formed crystals, usually of quartz or feldspar. These crystals being of a different color from the groundmass stand out in marked contrast. The porphyries are, as a rule, hard, tough, and without rift or grain. They may be of several shades of color, as green with splashes of white, or a paler green or red with white specks, etc. Near Charlotte, North Carolina, there occurs a cream-colored quartz porphyry which is penetrated by long parallel streaks of a dead-black color. The stone, when cut across the streaks, has a spotted appearance (hence the name *Leopardite*); cut parallel with the streaks it gives a dentritic or moss-like effect.

Porphyry finds a use more as an ornamental stone than as a stone for personal adornment.

PREHNITE.

CHLORASTROLITE—ZONOCHLORITE.

Prehnite occurs more commonly massive, usually in reniform, botryoidal, globular, and stalactitic shapes. Hardness, 6.5; specific gravity, 2.8 to 2.95; luster, vitreous, occasionally pearly on certain surfaces. Color, light green of several shades, passing into white and gray, the color often fading on exposure. When cut and polished the darker kinds resemble chrysoprase in color and luster.

Chlorastrolite, from chloros (green), aster (star), and lithos (stone), is an impure variety of prehnite, occurring in small rounded pebbles obtained from the trap on the shores of Isle Royale, Lake Superior. It is opaque, of a mottled green color, somewhat chatoyant on the rounded sides, and receives a high polish.

Zonochlorite occurs on a small island off Neepigon Bay, Lake Superior. Its green color and banded appearance has given it its name from zona, a band; chloros, green; and lithos, stone.

Prehnite occurs as a secondary mineral in veins and cavities in the more basic eruptive rocks as basalt and diabase; less often in the crystalline rocks, granite, gneiss, and syenite.

One hundred parts contain: Silica, 43.8; alumina, 24.8; lime, 27.1; water, 4.3.

PYRITE AND MARCASITE.

Pyrite and marcasite are occasionally cut into squares, ovals, and other shapes for use as settings for rings, scarf pins, trinkets, etc. The two minerals contain the same elements in the same proportions—iron 46.7 and sulphur 53.3 parts per 100—but differ in their physical properties. Pyrite has a hardness of 6.5; specific gravity, 5.2; crystalline form, isometric; color, brass yellow, and is the kind more commonly used for ornaments. Marcasite has a hardness of 6; specific gravity, 4.8; crystalline form, orthorhombic; color, pale or grayish yellow. During the eighteenth century both pyrite and marcasite were cut into facetted forms and extensively used for jewelry.

QUARTZ.

Quartz crystallizes in the hexagonal system, the most common form being a six-sided prism, generally striated horizontally. The crystals are often highly modified; some appear to have each alternate plane of the prism suppressed; some have the prism with pyramids at each end; others have the two pyramids only; still others have the edges and angles replaced by new planes. It occurs also in stalactitic, mam-

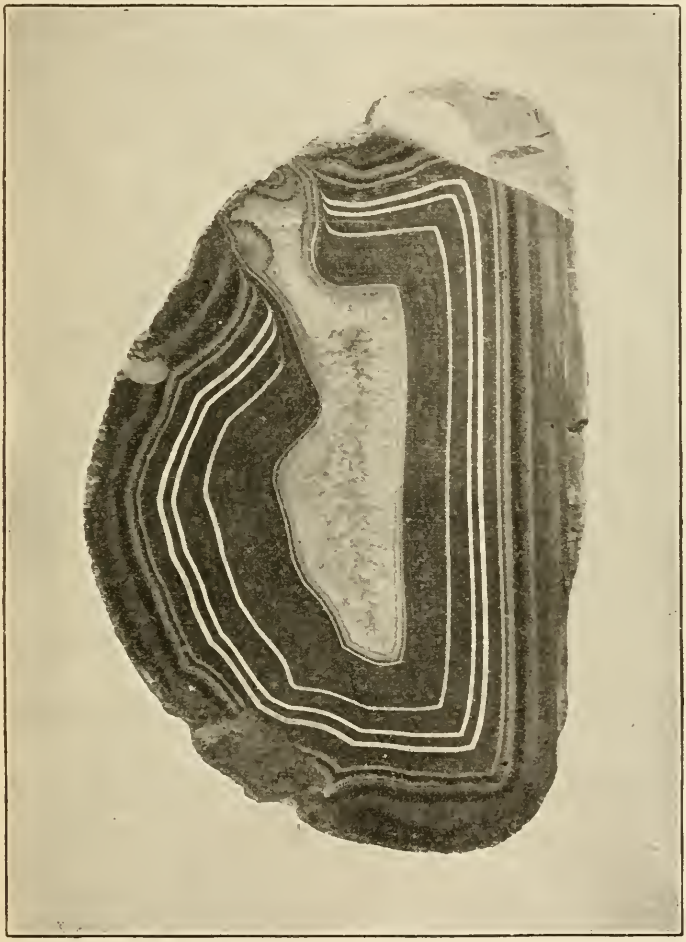


Fig. 8. AGATE. Brazil. Specimen No. 44918, U.S.N.M.

millary, and other imitative shapes, and massive, either impalpable, fine, or coarse granular. Hardness, 7; specific gravity, 2.5 to 2.8, depending upon the amount of impurity present, the purest kinds 2.65. Luster, vitreous, sometimes inclining to resinous, and varying in degree from splendent to dull. Colorless when pure; often various shades of yellow, red, brown, green, blue, and black. Quartz is doubly refractive and the colored kinds are dichroic. (Plate 5.)

Quartz includes a larger number of kinds of gems among its varieties than any other mineral. The varieties arise from differences in color, mode of formation, or crystallization. These varieties, though differing widely in appearance and passing under a variety of names, are chemically all of one substance. The following is a list of the kinds commonly recognized:

Agate.—A variegated chalcedonic quartz, the colors in clouds, spots, bends, or layers. The bands or layers may be either parallel or concen-

Fig. 9.

AGATIZED WOOD.

Chalcedony Park, Arizona.

Specimen No. 82485, U.S.N.M.

tric, and either in straight, circular, or zigzag forms. Banded agates may be called *fortification*, *banded*, or *eye agates*, according to the arrangement of the layers. (See fig. 8.)

Agatized wood.—Wood silicified by silica and usually having the structure of the original material. The western part of the United States affords some remarkable specimens of this material. In Apache County, Arizona, there is a silicified forest in which trunks 150 feet

CRYSTALS OF QUARTZ.

Dauphiny, France.

Specimen No. 8218, U.S.N.M.

long and 3 feet in diameter are not uncommon. The locality affords perhaps the finest specimens known for warmth and combination of colors, in which red predominates. (Fig. 9.)

Amethyst.—A clear purple or bluish violet quartz. The color of the amethyst is often irregularly diffused, the deep purple fading into pink and white. (See fig. 10.)

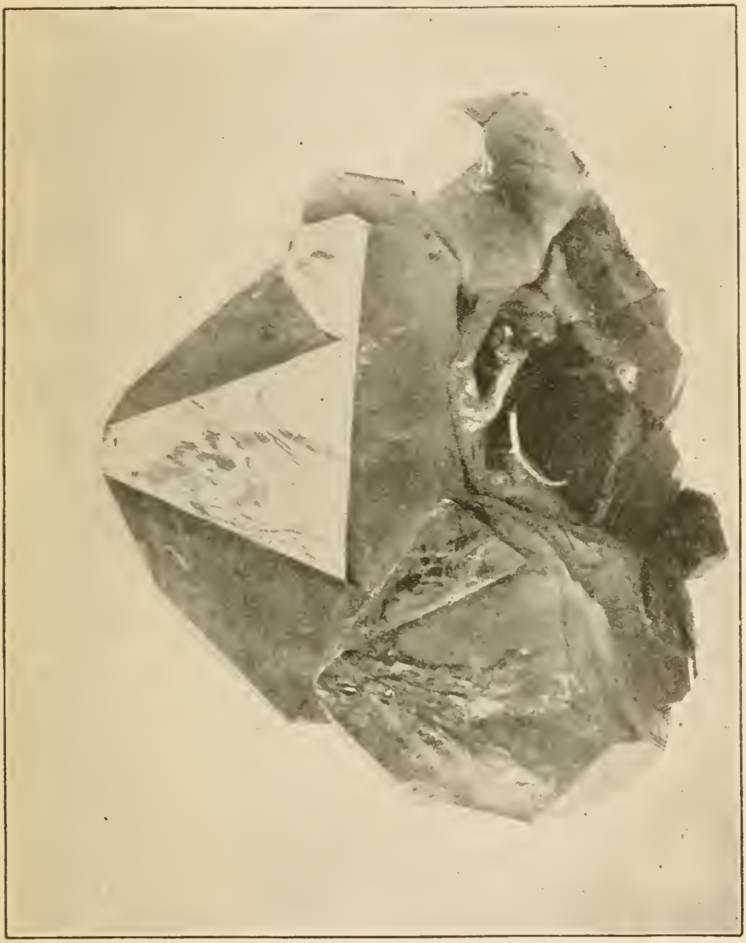


Fig. 10.
AMETHYST CRYSTALS.
Upper Providence, Pennsylvania.
Specimen No. 83676, U.S.N.M.

Asteriated or star quartz.—Contains impurities or opacity so arranged that when cut cabochon across the prism it exhibits asterism.

Aventurine quartz is minutely spangled throughout the mass with yellow scales. It is transparent to opaque, and of a gray, brown, reddish-brown, or yellow color.

Basanite, lydian stone, or touchstone.—A velvet-black siliceous quartz or flinty jasper.

Beekite.—Silicified corals, shells, or limestones, resembling chalcedony.

Bloodstone or heliotrope.—A translucent to opaque jasper of a deep-green color interspersed with red spots.

Cairngorm, smoky quartz, or morion.—Having a smoky gray, yellow, yellowish-brown, and brown color. The crystals are often pellucid, but occasionally the color is so deep as to render them nearly opaque.

Carnelian.—A reddish variety of chalcedony passing into grayish red, yellow, and brown; translucent, like horn. The carnelian takes a fine polish and is often of a clear bright tint. The colors are commonly heightened by exposure to the sun or by heat. (Plate 6.)

Cat's-eye.—Translucent quartz exhibiting opalescence or chatoyancy when cut cabochon, an effect due to inclusions of fibrous minerals, such as hornblende, asbestus, actinolite, and crocidolite. The color is commonly light greenish gray; sometimes yellow, red, or brownish.

Chalcedony.—Translucent, subtranslucent, or opaque, usually having a waxy luster and a white, yellow, brown, or bluish color. It occurs massive in imitative shapes.

Chrysoprase.—An apple, leek-green, bluish, or yellowish translucent chalcedony.

Citrine quartz, false, Saxon, Scotch, or Spanish topaz.—A light-yellow, brown, or greenish-yellow, pellucid quartz.

Ferruginous quartz, rubasse, Ancona ruby, or Mont Blanc ruby, is opaque-red, brownish-red, or ocher-yellow crystallized quartz.

Flint.—A more or less opaque chalcedonic quartz, usually gray, smoke brown, and brownish black. Breaks with a conchoidal fracture and a sharp cutting edge.

Hornstone closely resembles flint, but has a more splintery fracture.

Hyaline is an opalescent white quartz.

Jasper.—An impure massive quartz or chalcedonic rock, presenting little beauty until polished. Color, dull red, yellow, brown, or green, sometimes blue or black. When the colors are banded it is called *riband jasper.* If zoned with colors, yellow, red, brown, or black, it is called *Egyptian jasper.* Jasper takes a high polish, and is extensively used in the manufacture of mosaics, vases, snuff and match boxes, knife handles, etc.

Milky quartz is a massive, vitreous variety, having a milk-white color. It is occasionally opalescent, and sometimes has a greasy luster.

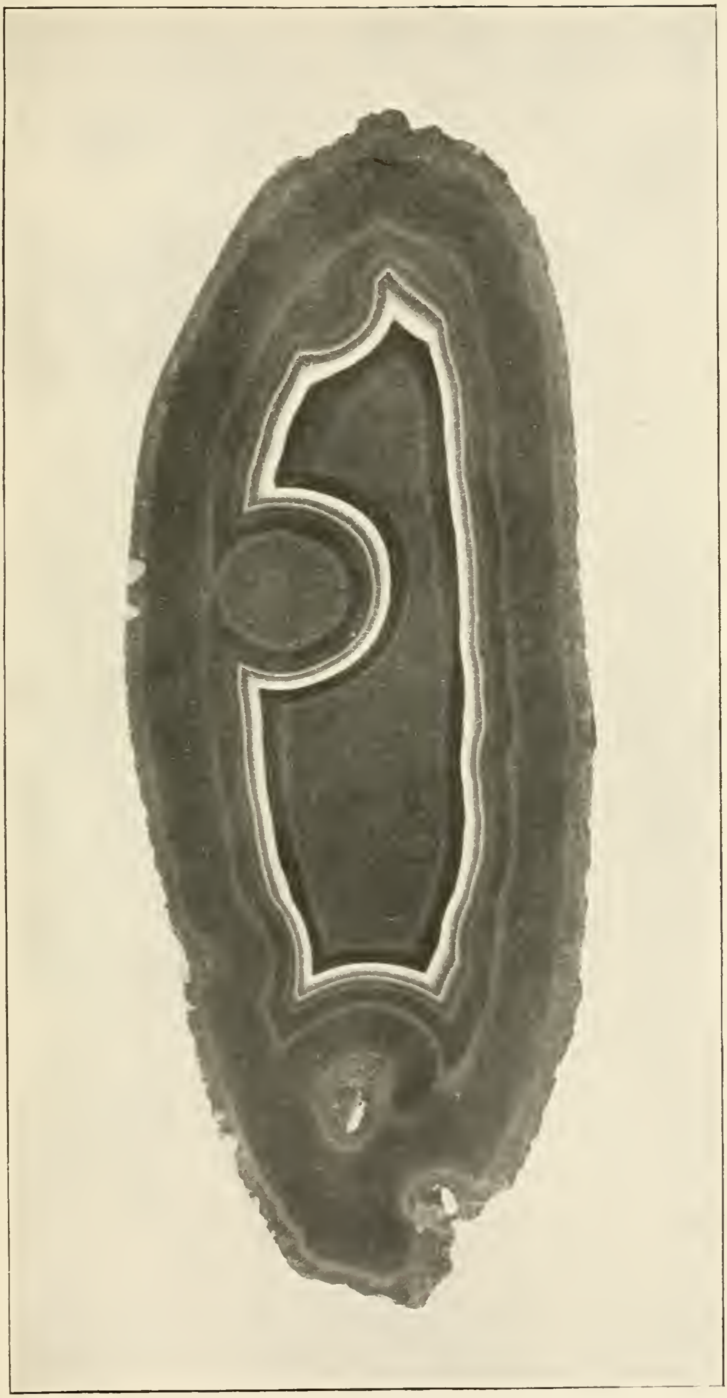
Moss agate or mocha stone is a chalcedony, containing dendritic or moss-like markings.

Onyx.—Like agate, but the colors are arranged in horizontal planes or layers, so that it can be used in cutting cameos. When the layers consist of reddish and white chalcedony the stone is called *sardonyx.*

Plasma.—A more or less translucent chalcedony, having a leaf-green color.

Prase.—A leek or olive green, somewhat spotted, massive quartz.

Rock crystal.—Transparent and colorless; includes the pure crystals of quartz.



CARNELIAN AGATE.

Uruguay.

Specimen No. 61770, U.S.N.M.

Rose quartz.—Rose to pale pink, more or less transparent, and usually massive. Luster, vitreous, occasionally greasy, and sometimes opalescent. Rose quartz is liable to lose its color on exposure to light.

Sagenitic quartz.—Quartz penetrated with acicular crystals of other minerals, as rutile (*Venus hair stone* or *flèche d'amour*) hornblende, tremolite, actinolite (*Thetis'-hair stone*), göthite, tourmaline, etc. (Plate 7.) Chlorite in quartz is common, and advantage is often taken of its

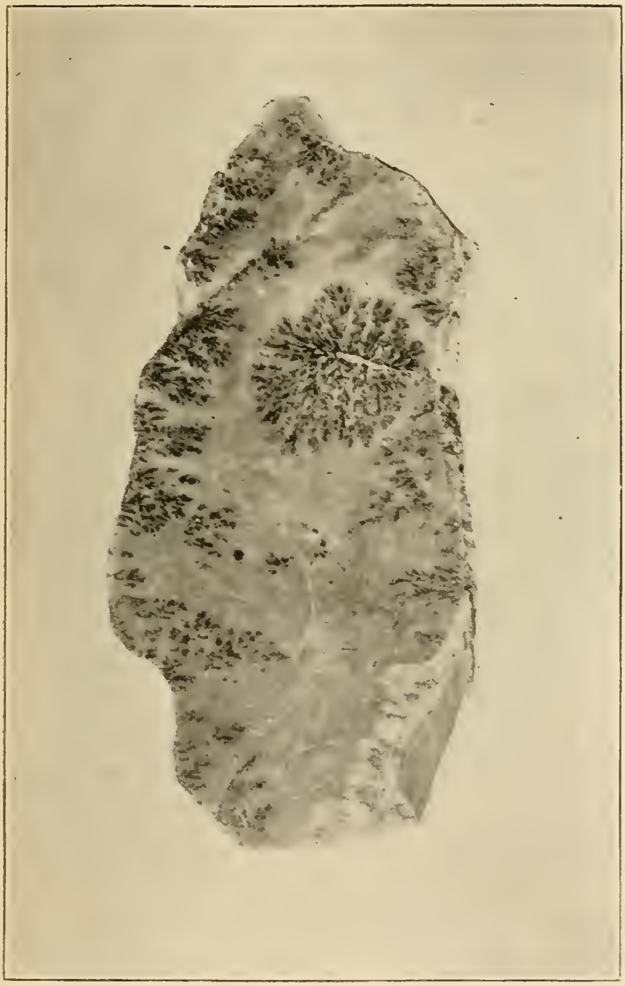


Fig. 11.
MOSS AGATE.
Sheridan, Kansas.
Specimen No. 49261, U.S.N.M.

presence in working up the specimen. Gold, silver, copper, etc., are frequent inclusions, and such specimens are largely used in jewelry. Often the included mineral is so abundant that the quartz is present only as a cementing material. An example of this is seen in the *crocidolite quartz* or *tiger-eye*.

Sapphirine or siderite.—A translucent, indigo, Berlin, or pale grayish blue, vitreous quartz.

Sard.—A translucent, red, brownish red, blood red, golden or amber colored chalcedony. Quartz crystals are occasionally met with which are irridescent within, an effect due to fractures and cavities in the interior. Such crystals are cut and sold under the name of *iris*. The irised effect is frequently produced by artificial means, usually by heating and then suddenly cooling the specimen.

Quartz is widespread in its occurrence, being found in some of its varieties in nearly every rock stratum. The varieties consist essentially of either amorphous or crystalline silica in various forms, associated with various coloring compounds, such as those containing iron, manganese, or nickel.

RHODONITE.

FOWLERITE.

Rhodonite has a hardness of 6.5, a specific gravity of 3.6, and a vitreous luster. The kinds used as ornamental stones are a fine rose to flesh red, often streaked with black. Though somewhat soft, the mineral is nearly as tough as jade. The variety known as fowlerite occurs in fine flesh-red crystals, some of them over 4 inches thick, at Franklin, Sussex County, New Jersey.

Rhodonite contains: Silica, 45.9; manganese oxide, 54.1.

RUTILE.

NIGRINE.

Rutile occurs crystallized and massive. The crystals are frequently acicular; often geniculated, and usually have their vertical planes striated. Hardness, 6 to 6.5; specific gravity, 4.25; luster, metallic adamantine; color, reddish brown passing into red, black, yellowish, violet, blue, and occasionally green. The black variety, nigrine, more closely approaches the black diamond in appearance than any other gem. The reds have the tone and color of the garnet; acicular crystals penetrating limpid quartz when cut affords the *Venus hair stone*, *flêche d'amour*, or *love's arrows*. Rutile occurs in granite, gneiss, mica, slate, and syenitic rocks, occasionally in granular limestones.

One hundred parts contain: Titanium, 60.98; oxygen, 39.02.

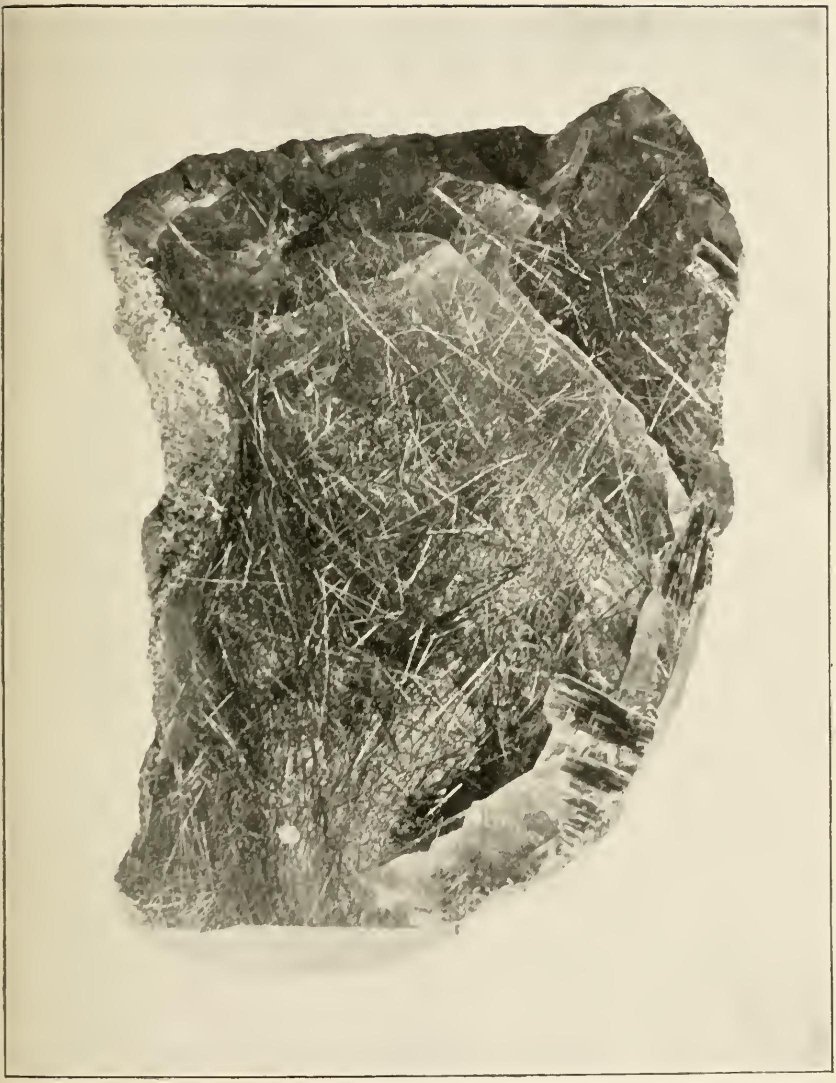
SAMARSKITE.

This mineral is occasionally cut as a collector's gem. Its color is velvety black; luster, submetallic and shining; hardness, 5.5; specific gravity, 5.68; color, opaque.

SCAPOLITE.

WERNERITE—WILSONITE.

Scapolite occurs in tetragonal crystals and massive; luster, vitreous to pearly, occasionally resinous; color, white, gray, blue, green, and red, usually of faint shades; hardness, nearly 6; specific gravity, 2.7.



RUTILE IN QUARTZ (VENUS' HAIR STONE).

Alexander County, North Carolina.

Specimen No. 17620, U.S.N.M.

The variety wilsonite is of a rich purplish-red color and takes a good polish. Scapolite is usually found in crystalline rocks and in granular limestone, more commonly near granite contacts.

SERPENTINE.

Serpentine admits of a high polish and is often employed as a material for ornaments, vases, etc. Its hardness is about 4; specific gravity, 2.5; luster, resinous to greasy; color, dark green, and blackish green to oil and siskin green, yellow, and white; frequently clouded with green of various shades and occasionally mottled with red. *Bowenite* is a cream-colored variety resembling nephrite and having a hardness of 5. *Williamsite* is of a rich blackish oil-green color, often having chromic iron disseminated through it, giving it a mottled appearance. *Verde antique* is a serpentinous rock used as a marble. It is clouded with green of various shades and is extensively used for indoor ornamental work.

Serpentine often constitutes rock masses, and as such is the result of the alteration of an igneous rock composed largely of magnesian silicates.

One hundred parts of the mineral contain: Silica, 43.64; magnesia, 43.35; water, 13.01.

SMITHSONITE.

Smithsonite has a hardness of 5, a specific gravity of 4.45, and a vitreous to pearly luster. Color, white, often grayish, greenish, and brownish white; sometimes green, blue, orange yellow, brown, and pink. The rich-colored kinds are occasionally cut for cabinet gems.

Smithsonite is found in beds and veins associated with other zinc minerals, galena, copper, and iron, usually in calcareous rocks.

One hundred parts contain: Oxide of zinc, 64.81; carbonic acid, 35.19.

SODALITE.

The fine blue-colored varieties of sodalite are cut cabochon for gem purposes. Hardness, 6; specific gravity, 2.29; luster, vitreous, inclining to greasy. Sodalite is met with in mica-slate, granite, gneiss, and certain eruptive rocks.

One hundred parts contain: Silica, 37.2; soda, 19.1; chlorine, 7.3.

SPINEL.

ALMANDINE—BALAS-RUBY—RUBICELLE—SAPPHIRINE—PLEONAST.

Spinel crystallizes in the isometric system, commonly in octahedrons. Its hardness is 8; specific gravity about 3.65; luster, vitreous. Color, red of various shades, passing into blue, green, yellow, brown, black, and occasionally nearly white. The mineral affords a wider range of color than any other gem. Following the order of the prismatic hues there are red, orange, yellow, green, blue, indigo, and violet colored spinels; and also there are those showing a whole series of intermediate hues such as pink, heliotrope, lavender, lilac, purple, fawn, corn color, etc. The transparent, lively, red-colored spinels are called *spinel rubies*, and may readily be taken for the true ruby, though its small refractive and dispersive power together with the absence of pleochroism render it less brilliant than and lacking the fire of the red corundums. The rose-red to pink-colored kinds are called *balas ruby;* the yellow or orange-red spinels are known as *rubicelle;* the violet and purple ones as *almandine;* the pale to sapphire-blue kinds as *sapphirine;* the blacks as *pleonast*

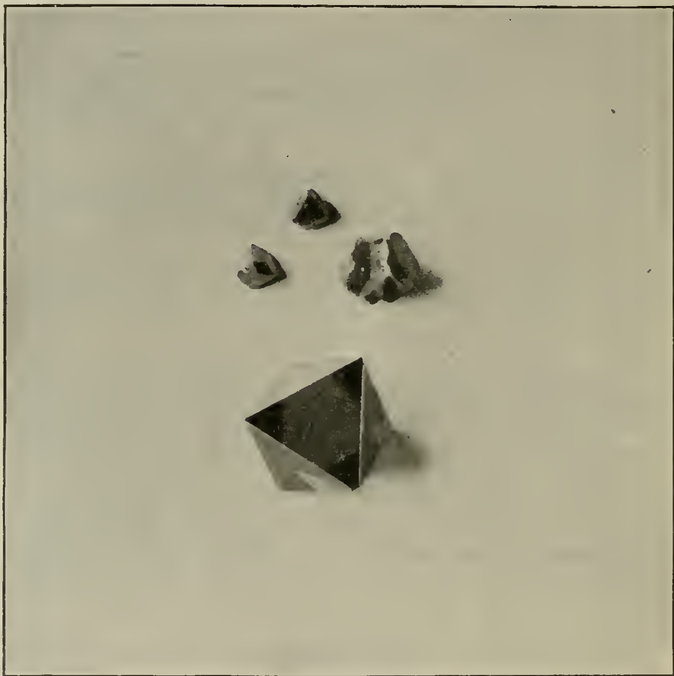


Fig. 12.
SPINEL CRYSTALS.
Kandy, Ceylon.
Specimen No. 49163, U.S.N.M.

Spinel occurs embedded in granular limestone, and with calcite in serpentine, gneiss, and allied rocks; occurring also in cavities in the ejected masses of certain volcanoes. Found also as rolled pebbles in certain alluvials, such as those of Ceylon and Burma, where it occurs in water-worn masses of fine colors in the channels of streams along with quartz, garnet, tourmaline, sapphire, zircon, and other gem minerals. Spinel ruby is frequently found along with the ruby corundum in the crystalline limestone of the ruby mines of Burma. Most of the gem spinel comes from Ceylon, Burma, Siam, India, and other

Eastern countries. Small crystals of good color are found in the gem-bearing gravel of Expailly, France. The old lavas of Monte Somma, Italy, afford small black crystals of great brilliancy. A pale blue to pearl gray kind is found in the limestone near Aker, Sweden. From Amity, New York, to Andover, New Jersey, a distance of about 30 miles, is a region of granular limestone and serpentine in which localities of spinel abound, the crystals sometimes being fine enough to afford green, black, brown, and, less commonly, red gems. The localities near Franklin, New Jersey, afford crystals of various shades of black, blue, green, and red, which will occasionally afford small gems.

Spinel, when pure, contains essentially 28 parts of magnesia and 72 parts of alumina per 100; the magnesia, however, may be, and often is replaced by oxides of iron, zinc, manganese, or lime. These replacements give rise to several varieties known as automolite and gahnite, zinc spinels, having a dark green to black color and a specific gravity of 4.1 to 4.9. Ceylonite, an iron magnesia spinel, usually black in color, and having a density of 3.57. Chlorospinel, a magnesia, iron, and alumina spinel, having a grass-green color and a specific gravity of 3.59. Dysluite, a zinc, manganese, and iron spinel, having a yellowish or grayish brown color with a specific gravity of 4.55. Hercynite, an iron spinel, having a specific gravity of 3.9.

SPODUMENE.

HIDDENITE—LITHIA EMERALD.

Transparent spodumene affords gems varying in color from green of several shades, straw yellow to yellowish white, faint reddish to amethystine, and colorless. The mineral occurs in monoclinic crystals of a prismatic habit and in cleavable masses. Its hardness is 6.5 to 7. Specific gravity, 3.13. Cleavage, prismatic and perfect. Fracture, uneven; brittle. Luster, vitreous; somewhat pearly on cleavage surfaces.

Hiddenite, or lithia emerald, is a variety of spodumene varying in color from a yellowish green to a deep emerald green tinged with yellow, the colors of the crystal usually being yellow at one extremity and a more or less deep green at the other. The deeper colored kinds afford a gem resembling the emerald but having a greater variety of color because of its strong pleochroism. The mineral occurs in slender prismatic crystals one-half inch to 2 inches in length, affording small gems only, the largest being under 3 carats in weight. Hiddenite is at present known from but one locality, Stony Point, Alexander County, North Carolina, where it is found in metamorphic rocks, generally gneiss or mica schist, in veins of kaolin. The associated minerals are quartz, mica, rutile, beryl, and feldspar.

Most of the gem spodumene proper comes from the province of

Minas Geraes, Brazil, where it occurs rather abundantly in crystals closely resembling chrysoberyl in color.

Spodumene contains in 100 parts: Silica, 64.5; alumina, 29.3; lithia, 6.2.

STAUROLITE.

FAIRY STONE.

Staurolite is occasionally used as a gem. It occurs in orthorhombic crystals of a prismatic habit, often cruciform from twinning. Color, dark reddish brown to brownish black. Hardness, 7.5; specific gravity, 3.7. The transparent kinds when cut resemble garnets. From their resemblance to a cross, the twinned forms are used to quite an extent as ornaments and charms, a use based to a certain degree upon the belief that they fell from heaven. Staurolite occurs commonly embedded in schist and gneiss.

One hundred parts contain: Silica, 29.3; alumina, 53.5; peroxide of iron, 17.2..

THOMSONITE.

LINTONITE.

The thomsonite, and a variety, lintonite, occurring as amygdules in the basalt and as rolled pebbles on the beaches of Lake Superior, find a limited use as gem minerals. The pebbles vary in size from that of a pea to a hickory nut, and are often made up of a series of concentric layers of various shades of color, flesh red and other reds, green, yellow, and white; affording, when polished, an attractive ornament resembling the eye agate. Hardness, 5.5; specific gravity, 2.4; luster, vitreous, inclining to pearly.

One hundred parts contain: Silica, 37.4; alumina, 31.8; lime, 13; soda, 4.8; water, 13.

TITANITE.

SPHENE.

Titanite, or sphene, is employed to some extent as a gem mineral. Its hardness is 5.5; specific gravity, 3.5; luster, vitreous; color, brown, gray, yellow, green, and black; possessing strong refractive and dispersive powers on light. The transparent and colorless, greenish or yellowish kinds when cut show a great deal of fire and present an appearance approaching that of the fire opal.

One hundred parts contain: Silica, 30.45; titanic oxide, 41.33; lime, 28.22.

TOPAZ.

Topaz crystallizes in the orthorhombic system, occurring commonly in prismatic forms having the prism faces more or less striated vertically; also occurring massive. The mineral has a highly perfect basal cleavage, i. e., transverse to the length of the prism; a hardness of 8;

TOPAZ WITH SMOKY QUARTZ.

Specimen No. 81242, U.S.N.M.

a specific gravity of 3.5 to 3.65; becomes strongly electric by friction, heat, or pressure, remaining in that condition for some time, a characteristic so marked as to afford a valuable means for its discrimination; a vitreous luster; a strong double refraction; and, in colored kinds, a marked pleochroism.

The colors of the topaz include wine, amber, honey, and straw-yellow, pale blue to pale green of several shades, grayish, reddish, and white. Colorless specimens, especially the rolled pebbles, are peculiarly limpid, hence the name *gouttes d'eau.* (Fig. 13.) The best colorless topazes have considerable fire, and, when properly cut, exhibit brilliant reflec-

Fig. 13.

TOPAZ PEBBLES [GOUTTES D' EAU].

Mitchell River, New South Wales.

Specimen No. 83782, U.S.N.M.

tions of white light, approximating that of the diamond. The rose-pink topaz is probably not known in nature, the delicate tint being commonly obtained by heating the yellow or brown colored kinds. The process of "pinking" is quite simple. The selected stone is packed in magnesia, asbestus, or lime, and carefully heated to a low red heat, care being taken that the temperature is raised gradually; the stone is then allowed to slowly cool. If the temperature reached has been sufficiently high, the desired rose-petal tint is obtained; if not high enough, a salmon tint; if too high or too long continued, the color is lost completely.

There are several distinct minerals which are commonly called topaz, the yellow sapphire known as the "oriental topaz," the topaz proper, and certain colored kinds of quartz, known as "Saxon," "Scotch," "Spanish," "smoky," and "false topaz." These stones vary rather widely in hardness and specific gravity, which, together with the power of developing frictional electricity (possessed by the true topaz) furnishes a ready means for their discrimination. Thus:

Name.	Hardness.	Specific gravity.
Oriental topaz	9	4.01
True topaz	8	3.53
Scotch topaz, etc	7	2.65

Topaz occurs in gneiss or granite, associated with tourmaline, mica, beryl, etc., and occasionally with apatite, fluorite, and cassiterite; occurring also in certain talcose rocks, in mica slate, in rhyolite, and in alluvial deposits and drift.

In composition the mineral is a fluo-silicate of alumina, containing in 100 parts: Silicon, 15.5; aluminum, 30.2; oxygen, 36.8; fluorine, 17.5.

TOURMALINE.

ACHROITE—APHRIZITE—INDICOLITE—RUBELLITE.

The tourmaline crystallizes in the rhombohedral division of the hexagonal system. The crystals are commonly prismatic in habit, and often slender to acicular. The prismatic faces are strongly striated longitudinally, giving a rounded, barrel-shaped, or triangular appearance to the crystal. The crystals are sometimes isolated, but occur more commonly in parallel and radiating groups. The mineral also occurs massive, compact, or in parallel to divergent, columnar shapes. Hardness, 7 to 7.5; specific gravity, 2.94 to 3.3; luster, vitreous; transparent to opaque, and unlike in transparency across the prism and in the line of the axis; becomes electric by friction. Color, black, brown, blue, green, red, and white; some specimens red internally, and green externally; others red at one extremity and green, blue, or black with intermediate shades at the other; dichroism marked.

The question of color is of interest. Some specimens are of one color only; others are green at one extremity and red at the other; some are green, then yellow, red, and finally green; others are crimson, tipped with black, or dark green passing into blue. A crystal may be white at the termination, then green of varying shades, pink and colorless, and in cross section dark blue or red at the center, surrounded by concentric layers of white, pink, and green. Another specimen may be red internally, passing into a lighter hue and finally

SIBERIAN TOPAZ.

Specimen No. 81244. U.S.N.M.

green; or it may be blue or black internally, then red, and then green externally. In some specimens the different colors pass imperceptibly into one another; in others the line of demarcation is well defined.

The colorless tourmalines are called *Achroite;* to the black the names *Aphrizite* and *Schorl* are applied; the blues, either pale, indigo, or blackish blue, are called *Indicolite;* this also includes the kinds known as *Brazilian sapphire* having a transparent Berlin-blue color; the red tourmalines, varying from a fine ruby red to violet red (*siberite*) and pale rose red or pink, are called *Rubellite.*

The optical structure of the tourmaline is unique. When a crystal is viewed along the direction of its vertical axis it is less transparent and of different color than when viewed across that axis. For instance, a crystal viewed through the side is a transparent green, but when viewed through the end of the prism it may be either opaque or yellow green.

The marked pleochroism of the colored tourmalines influences to a great degree the appearance of the fashioned stone. For example, if a green-colored specimen is cut so that the table is parallel with the vertical axis of the crystal, the gem will exhibit a play and interchange of colors of two shades of green; if, however, the specimen is so cut that the table of the fashioned stone is perpendicular to the vertical axis, the gem will appear more or less opaque and dark colored, and will exhibit its transparency and green coloring only when viewed across the girdle. Care should be taken, therefore, in fashioning the tourmaline that the table is parallel with the vertical axis of the crystal; further, the facets of the crown should be large and well-developed in order to exhibit to the utmost the differences of color for light transmitted in different directions as the gem is viewed from different positions.

In composition the tourmalines are very complex boro-silicates of aluminum, magnesium, iron, or alkalies, falling under four types: Lithia tourmalines, iron tourmalines, magnesia-iron tourmalines, and magnesia tourmalines.

The geological occurrence of the four types of tourmaline is of interest. The lithia group—which is often beautifully colored and affords the best gem material—is associated with soda and potash feldspar in pegmatite veins along with lepidolite and muscovite. The iron and the magnesia-iron groups, which are commonly black or brownish black, occur in granites, gneisses, schists, and also to a certain extent in pegmatites along with the lithia group. The magnesia group—commonly brown in color—occur chiefly in crystalline magnesian limestones associated with mica, pyroxene, scapolite, etc.

Tourmaline is usually found in granite, gneiss, or mica slate. It occurs also in dolomite or granular limestone, and in certain contact rocks near dikes of igneous rocks; also in rolled pebbles in alluvial deposits.

In the United States magnificent colored tourmalines have been found in Maine at Auburn, Hebron, Norway, Andover, Rumford, Standish, and Paris. The more famous locality is at Mount Mica, near Paris. It was discovered in 1820 and is still yielding fine specimens of red, green, and parti-colored tourmalines; some crystals are over an inch in diameter, transparent ruby red within, surrounded by green, or red at one extremity and green at the other. One blue crystal found was nine inches long. The locality affords all of the colored varieties, achroite, aphrizite, indicolite, and rubellite. Red and green tourmalines are found at Chesterfield, Massachusetts, in a granite vein with albite, uraninite, and pyrochlore; the crystals small and curved, nearly opaque, and fragile; the green crystals, often with distinct prisms of red color inside, are found at this locality. At Goshen, Massachusetts, similar varieties occur, and the blue is met with in great perfection. At Haddam, Connecticut, in crystals in mica-slate with anthophyllite, also in granite with iolite, and also at the gneiss quarries, on the east side of the river. At Haddam Neck, in fine green, and parti-colored crystals affording magnificent gems. Near Gouverneur, New York, light and dark brown crystals, often highly modified. Good crystals are found in Pennsylvania at Newlin, Chester County, at London Grove, and Unionville. Fine stellate and divergent rubellites in lepidolite are found in San Bernardino County, California. In Canada magnificent greenish-yellow crystals occur in the limestone at Great Calumet Island; amber-colored ones at Fitzroy, Ontario; transparent brown at Hunterstown, Quebec; black at Bathurst and Elmsley, Ontario, and St. Jerome, Quebec. Small brilliant crystals found in decomposed feldspar, at Andreasberg in the Hartz, are of the Aphrizite variety. Rubellite and green tourmaline occur near Ekaterinburg in Siberia. The island of Elba yields pink, red, white, green, black, and parti-colored crystals. Brazil affords a large proportion of the specimens used for gems, and has been one of the great sources of supply for more than two hundred years. Ceylon, India, and Burma produce good gem material, the latter locality affording some magnificent rubellites, rivaling the ruby in color.

TURQUOISE.

CALLAINITE—TURKIS.

Turquoise occurs massive, reniform stalactitic or encrusting; in thin seams and disseminated grains; and in rolled masses. The hardness of the mineral is 6. Specific gravity about 2.75. Cleavage, none. Fracture, small conchoidal; rather brittle. Luster, somewhat waxy. Color, sky-blue, bluish green, apple-green, and greenish gray; the color is liable to change, a fine blue stone becoming a verdigris or sickly green.

Turquoise of poor color is frequently given the approved robin's-egg or peculiar bluish green tint by artificial means. Many of these sophistications can be detected by washing the stone in strong ammonia water, which will attack the coloring matter. The reagent does not affect the color of the true Persian turquoise, although soap and water does, so that the hands should never be washed with a turquoise on them.

The best specimens, which generally do not lose their color easily, come from the vicinity of Nishâpûr, Persia, where they occur in narrow seams and irregular patches in the brecciated portions of a porphyritic trachyte and the surrounding clay slate. Inferior specimens are found in Asia Minor, Turkestan, and the Kirghiz Steppes. In the United States, turquoise is found in a trachytic rock in the Los Cerillos Mountains, near Santa Fe; the locality was early worked by the Indians and has lately afforded some fine gems. Other occurrences are at Turquoise Mountain, Cochise County, and Mineral Park, Mojave County, Arizona; near Columbus, Nevada; at the Holy Cross Mountain, Colorado, and in Fresno and San Bernardino counties, California.

Chemically, the turquoise is a hydrous phosphate of aluminum and copper and contains in 100 parts: Phosphoric acid, 30.9; alumina, 44.50; oxide of copper, 3.75; water, 19.

VARISCITE.

UTAHITE.

The compact massive kinds of variscite are occasionally cut for use as a gem. The color of the mineral is a rich green of several shades, bright green, emerald, and bluish green. Hardness, 4; specific gravity, 2.6. It takes a high polish, and its strong rich colors would make it an attractive ornamental stone were it not so soft. The best variscite is found in compact nodular masses, locally called *utahite*, near Lewiston, Cedar Valley, Tooele County, Utah.

Variscite contains in 100 parts: Phosphorous pentoxide, 44.9; alumina, 32.3; water 22.8.

VESUVIANITE.

CYPRINE—IDOCRASE.

Vesuvianite occurs in tetragonal crystals commonly of a prismatic habit and massive, either columnar or granular. Hardness, 6.5; specific gravity, 3.349 to 3.45. Luster, vitreous, often inclining to resinous. Color, brown to green, the latter frequently bright and clear and appearing of a different color when viewed across the lateral axis of the prism; occasionally sulphur-yellow, wine-yellow, pale blue, and black.

Vesuvanite was first found in the ancient Vesuvian lavas, and in the dolomite of Monte Somma. It occurs rather abundantly in granular limestone, serpentine, chlorite schist, gneiss, etc., frequently as a result of contact metamorphism. Its common associates are garnet, diopside, epidote, wollastonite, and titanite.

The name *vesuvianite* is from the first known locality. *Idocrase* is from ειδος, *I see*, and κρασις, *mixture*, in allusion to the resemblance between its form and those of other minerals. *Cyprine* is the name applied to a pale blue kind occurring near Tellemarken, Norway.

One hundred parts of vesuvianite contain approximately: Silica, 39.6; alumina, 22.5; lime, 32.6; iron, 5.3.

WILLEMITE.

Anhydrous silicate of zinc has a hardness of 5.5; a specific gravity of 3.9; and a vitreo-resinous luster. Sufficiently transparent specimens affording fair cabinet gems have been found at Franklin, Sussex County, New Jersey. The color varies from golden or greenish yellow, near that of chrysoberyl, to a canary-yellow. The mineral is commonly opaque and of a brown, apple-green, or flesh-red color, and at Franklin is usually mixed with zincite and franklinite.

ZIRCON.

HYACINTH—JACINTH—JARGON.

Zircon crystallizes in the tetragonal system, occurring commonly in square prisms; also in irregular forms and grains. Its hardness is 7.5; specific gravity, commonly 4.7, sometimes as low as 4.2, or as high as 4.86; luster, adamantine; double refraction, strong. Its range of color includes green, red, brown, blue, yellow, all presenting many gradations of hue, to colorless. Its "fire" is second only to that of the diamond, and this, together with its brilliant luster and range of rich and delicate tones of color, makes it an attractive gem.

The zircon includes the gems known as *hyacinth*, or *jacinth and jargon* or *jargoon*. The hyacinth includes the reddish, brownish, and orange-red specimens; the jargon the yellowish, smoky, and colorless kinds.

Zircon occurs in crystalline rocks such as granular limestone in gneiss, granite, and syenite; in chlorite and other schists, and in alluvial deposits derived from them.

Chemically it contains in 100 parts: Zirconia, 67.2; silica, 32.8.

III. COMPARATIVE TABLES OF THE COLORS AND DISTINGUISHING CHARACTERS OF THE BETTER-KNOWN GEMS.

I.—LIMPID OR COLORLESS STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon (jargoon).	4.44 –4.8	7.5. Will just scratch quartz.	Double. 1.990.	0.044	Distinguished from diamond, which it resembles, by its hardness and specific gravity and by the fact that strong hydrochloric acid dropped upon a polished face will, upon removal, have destroyed or dulled its brilliancy. The acid is without effect on the diamond. The zircon acquires + electricity by friction.
Sapphire	3.916–4.27	9. Scratched by diamond; will scratch all others of the class.	Double, but not strong. 1.765.	.026	Distinguished by its hardness and specific gravity. Becomes electrified by friction.
Spinel	3.5 –3.8	8. Scratched by sapphire; will scratch quartz easily.	Single. 1.755 to 1.810.	.040	Distinguished from other members of the group, except topaz, by its specific gravity and hardness, and from topaz by not possessing pyroelectricity.
Topaz	3.54 –3.6	8. Scratched by sapphire; will scratch quartz easily.	Double. 1.635.	.025	Becomes electrified by friction and heat. Distinguished from all stones in the group, except spinel, by its specific gravity and hardness, and from spinel by its electrical properties.
Diamond	3.48 –3.52	10. Scratches all other stones.	Single. 2.455..	.38	Readily distinguished by its hardness.
Tourmaline	2.99 –3.22	7–7.5. Will barely scratch quartz.	Double. 1.625.	.028	Becomes + and – electrified by heat or friction; one portion of a crystal attracts and another repels light bodies.
Beryl	2.73 –2.76	7.5–8. Specimens vary. Scratched by spinel; scratches quartz.	Double; weak. 1.585.	.026	Specimens may become electrified by friction.
Quartz (rock crystal).	2.55 –2.7	7. Scratches glass	Double. 1.549.	.026	

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

II.—YELLOW STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon (jacinth).	4.44–4.8	7.5. Harder than quartz.	Double, strongly so. 1.990.	0 044	Distinguished from quartz in that its luster is dulled by strong hydrochloric acid; also by its higher specific gravity, and from all others of the group by hardness and specific gravity.
Sapphire (oriental topaz).	3.97–4.27	9. Scratches all other stones of the group except diamond.	Double. 1.765.	.026	Distinguished by its hardness and specific gravity. Becomes electrified by friction.
Garnet (topazolite or grossularite, also essonite or cinnamon stone).	3.5 –4.3	6.5–7.5. Varies, but majority of specimens will scratch quartz slightly.	Single. 1.759..	.033	
Chrysoberyl (oriental chrysolite).	3.5 –3.89	8.5. Scratched by sapphire; scratches all others except diamond.	Double. 1.760.	.033	The yellow is tinged with green. Acquires electricity by friction. Distinguished by its hardness, specific gravity and peculiar yellow color.
Spinel	3.5 –3.8	8. Scratched by diamond, sapphire; scratches quartz.	Single. 1.755 to 1.810.	.40	Distinguished by its specific gravity and hardness. Does not become electrified by friction.
Topaz	3.54–3.6	....do	Double. 1.635.	.025	Distinguished from spinel by its electrical properties, and from other stones by its hardness and specific gravity.
Diamond	3.48–3.52	10	Single. 2.455..	.38	Readily distinguished by its hardness.
Olivine (chrysolite).	3.33–3.5	6–7. Scratched by quartz.	Double. 1.660.	.033	The yellow is tinged with green. Distinguished by its hardness and specific gravity.
Tourmaline	2.99–3.22	7–7.5. But little harder than quartz.	Double. 1.625.	.028	Becomes electrified by friction; one extremity of crystal +, other –.
Beryl	2.73–2.76	7.5–8. Specimens vary.	Double; weak. 1.585.	.026	
Quartz (citrine or Scotch, Spanish, Saxon, or false topaz).	2.55–2.7	7	Double. 1.549.	.026	

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

III.—BROWN STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon (jacinth)	4.44–4.8	7.5	Double. 1.990	0.044	See previous tables.
Sapphire (adamantine spar).	3.97–4.27	9. Scratched by diamond.	Double. 1.765	.026	Distinguished by its hardness and specific gravity.
Chrysoberyl	3.5 –3.89	8.5	Double. 1.760	.033	Distinguished by its hardness and specific gravity. Becomes electrified by friction.
Garnet (essonite or cinnamon stone).	3.5 –4.3	7.5. Varies, but as a rule will scratch quartz.	Single. 1.759	.033	
Diamond	3.48–3.52	10	Single. 2.487	.38	
Tourmaline	2.99–3.22	7–7.5. But little harder than quartz.	Double. 1.625	.028	Becomes + and – electrified by heat or friction.
Quartz (cairngorm).	2.55–2.7	7. Scratches glass.	Double. 1.549	.026	

IV.—RED AND FLAME-COLORED STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon (hyacinth).	4.44–4.8	7.5. Scratched by diamond, ruby, etc.; will just scratch quartz.	Double. 1.990.	0.044	Distinguished from ruby and red diamond by its hardness and specific gravity.
Ruby	3.97–4.27	9. Scratches all others except diamond.	Double. 1.765.	.026	Distinguished by its hardness and specific gravity. Becomes electrified by friction, a property wanting in the spinel, with which it is frequently confused.
Garnet (pyrope, rhodolite, almandite, essonite).	3.5 –4.5 Usually 4.	7–7.5. Varies, but as a rule will scratch quartz.	Single. 1.759	.033	Distinguished by its specific gravity and hardness.
Spinel (Balas ruby, rubicelle, spinel ruby).	3.5 –3.9	8. Scratched by sapphire; scratches zircon, garnet, tourmaline, etc.	Single. 1.755 to 1.810.	.040	Distinguished from ruby by not becoming electrified by friction, and from it and all others of the group by its hardness and specific gravity.
Diamond (rare)	3.48–3.52	10. Hardest of stones.	Single. 2.455	.38	Readily distinguished by its hardness.
Tourmaline (rubellite).	2.99–3.22	7–7.5. But little harder than quartz.	Double. 1.625.	.028	Becomes electrified by friction; one extremity of the crystal +, the other –.

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

V.—PINK STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Sapphire (ruby).	3.97–4.27	9. Scratched by diamond; will scratch all others.	Double, 1.765.	0.026	Distinguished by its hardness and specific gravity.
Garnet (grossularite).	3.5 –4.3	6.5–7.5. Varies; but the majority of the specimens will scratch quartz.	Single. 1.759.	.033	
Chrysoberyl	3.5 –3.89	8.5. Scratched by diamond and sapphire.	Double. 1.760.	.033	
Spinel (rubicelle).	3.5 –3.8	8. Scratched by diamond and sapphire.	Single. 1.755 to 1.810.	.40	Distinguished by its hardness and specific gravity. Does not become electrified by friction.
Topaz	3.54–3.6	8. Scratches quartz.	Double. 1.635.	.025	The pink color is usually produced artificially by heating yellow stones.
Diamond	3.48–3.52	10	Single. 2.455.	.38	Readily distinguished by its hardness.
Tourmaline (rubellite).	2.99–3.22	7–7.75. But little harder than quartz.	Double. 1.625.	.028	
Beryl (rare)	2.73–2.76	7.5–8. Specimens vary.	Double, weak. 1.585.	.026	

VI.—REDDISH YELLOW OR ORANGE COLORED STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon (jacinth).	4.44–4.48	7.5	Double. 1.990.	0.044	Distinguished by its hardness and specific gravity. See ante.
Sapphire (oriental topaz).	3.97–4.27	9. Scratched by diamond only.	Double. 1.765.	.026	Distinguished by its hardness and specific gravity.
Garnet (spessartite and essonite).	3.5 –4.3	6.5–7.5. Varies	Single. 1.759.	.033	
Chrysoberyl	3.5 –3.89	8.5. Scratched by diamond and sapphire.	Double. 1.760.	.033	Distinguished by its hardness and specific gravity.
Spinel (rubicelle).	3.5 –3.8	8	Single. 1.755–1.810.	.40	Does not become electrified by friction.
Topaz	3.54–3.6	8	Double. 1.635.	.025	Distinguished from spinel by becoming electrified by friction.
Diamond	3.48–3.52	10	Single. 2.455.	.38	
Tourmaline	2.99–3.22	7–7.5. But little harder than quartz.	Double. 1.625.	.028	See previous tables.

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

VII.—GREEN STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Zircon	4.44–4.8	7.5 Harder than quartz.	Double. 1.990	0.044	See previous tables.
Sapphire (oriental emerald).	3.97–4.27	9	Double. 1.765	.026	Do.
Garnet (demantoid and ouvarovite).	3.5 –4.3	6.5–7.5. Varies, but as a rule will scratch quartz.	Single. 1.759	.033	Distinguished from emerald, olivine, and dioptase by its specific gravity, hardness, and optical characters.
Chrysoberyl (alexandrite).	3.5 –3.89	8.5. Nearly as hard as sapphire; harder than beryl, topaz, garnet, etc.	Double. 1.760	.033	Characterized by exhibiting a columbine red or reddish color by transmitted light.
Spinel	3.5 –3.8	8	Single. 1.755–1.810.	.40	See previous tables.
Topaz	3.54–3.6	8	Double. 1.635.	.025	Do.
Diamond	3.48–3.52	10	Single. 2.455	.38	Rare.
Olivine (peridot)	3.33–3.5	6–7	Double. 1.660.	.033	Color, olive green; distinguished from beryl by its hardness and specific gravity. Acquires electricity by friction.
Tourmaline (Brazilian emerald)	2.99–3.22	7–7.5	Double. 1.625.	.028	See previous tables.
Beryl (emerald and aquamarine).	2.73–2.76	7.5–8. Specimens vary.	Double. 1.585.	.026	Do.
Quartz (chrysoprase, plasma, prase, and jasper).	2.55–2.7	7	Double. 1.549.	.026	For the colors of the several varieties see under Quartz.
Turquoise	2.62–3	6. May or may not scratch glass. Scratched by quartz.	....	....	Can readily be distinguished by its earthy, compact appearance and specific gravity.

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

VIII.—BLUE STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Sapphire	3.97–4.27	9	Double. 1.765.	0.026	See previous tables.
Spinel	3.5 –3.8	8	Single. 1.755–1.810.	.40	Do.
Topaz	3.54–3.6	8	Double. 1.635.	.025	Do.
Diamond	3.48–3.52	10	Single. 2.455.	.38	Rare.
Tourmaline (indicolite).	2.99–3.22	7–7.5	Double. 1.625.	.028	See previous tables.
Beryl (aquamarine).	2.73–2.76	7.5–8. Specimens vary.	Double. 1.585.	.026	Do.
Iolite (water sapphire, dichroite).	2.60–2.65	7–7.5	Double. α=1.537; β=1.542; γ=1.543.	Feeble	The chief distinguishing character of this stone is that it possesses a double color, i. e., it is a fine blue or a yellow to smoke gray as it is viewed in the direction of its base or the planes of the prism, which is its crystalline form.
Turquoise	2.62–3	6			

IX.—VIOLET OR AMETHYSTINE STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Sapphire (oriental amethyst).	3.97–4.27	9	Double. 1.765.	0.026	See previous tables.
Garnet	3.5 –4.3	6.5–7.5. Varies, but in general is above 7.	Single. 1.759.	.033	Do.
Spinel	3.5 –3.8	8	Single. 1.755–1.810.	.040	Do.
Diamond	3.48–3.52	10	Single. 2.455.	.38	Do.
Tourmaline	2.99–3.22	7–7.5	Double. 1.625.	.028	Do.
Quartz (amethyst).	2.55–2.7	7	Double. 1.549.	.026	Do.

X.—BLACK-COLORED STONES.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Sapphire	3.96–4.27	9	Double. 1.765.	0.026	See previous tables.
Garnet (schorlomite).	3.5 –4.3	6.5–7.5. Varies, but in general will scratch quartz.	Single. 1.759.	.033	Do.
Spinel	3.5 –3.8	8	Single. 1.755–1.81.	.040	Do.
Diamond	3.48–3.52	10	Single. 2.455.	.38	Do.
Tourmaline	2.99–3.22	7–7.5	Double. 1.625.	.028	Do.
Quartz (morion).	2.55–2.77	7	Double. 1.549.	.026	Do.

III.—*Comparative tables of the colors and distinguishing characters of the better-known gems*—Continued.

XI.—GEMS POSSESSING A PLAY OF COLOR OR EXHIBITING A CHATOYANT OR OPALESCENT EFFECT.

[No attention is here paid to the ground or body color of the gem, but only to the play of color, chatoyancy, and opalescence. These effects may be of several kinds. In some, as in the opal and labradorite, there may be a variety of hues of color, which change as the gem is viewed from different positions; in others there may be a reflection having the appearance of a white six-rayed star on the body or ground color of the gem, as in the sapphire; or the reflection may have the appearance of a point or mass of pearly light, which sometimes appears to occupy the whole of the stone, and which varies according to the inclination given to the gem. The moonstone is an example of this class.]

(*a*) GEMS HAVING A PLAY OF COLOR OR IRIDESCENCE.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Opal	1.9 –2.3 Commonly 2.1.	5.5–6.5. Varies, but in general will scratch glass slightly.			
Labradorite	2.72	6. Scratches glass slightly.			
Oligoclase (heliolite sunstone.)	2.72	do			
Albite (peristerite).	2.62	do			

(*b*) GEMS HAVING STAR-LIKE REFLECTIONS, ASTERIA.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Corundum (star ruby, star sapphire, asteria).	3.16–4.27	9	Double		
Garnet	3.5 –4.3	6.5–7.5	Single		
Tourmaline	2.99–3.22	7–7.5	Double		

(*c*) GEMS HAVING CHATOYANT REFLECTIONS.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Chrysoberyl (cymophane).	3.5 –3.89	8.5	Double		
Beryl	2.73–2.76	7.5–8	do		
Quartz (cat's-eye)	2.35–2.7	7			
Orthoclase (moonstone).	2.4 –2.6	6			
Albite (moonstone).	2.62	6			

XII.—GEMS HAVING A NACREOUS LUSTER.

Name.	Specific gravity.	Hardness.	Refraction and refractive index.	Dispersion.	Remarks.
Pearl	2.5–2.7	2.5–3.5			
Apophyllite (Ichthyopthalmite, fish-eye-stone).	2.33	4.5–5			

IV. INDEX OF NAMES OF GEMS.

Pearl, see Carbonate of lime.
Pearlyte, see Obsidian.
Pegmatite.
Peridot, see Olivine.
Peristerite, see Albite.
Perthite, see Orthoclase.
Phantom quartz, see Quartz.
Phenacite.
Pipestone, see Catlinite.
Pisolite, see Calcite.
Plasma, see Quartz.
Pleonast, see Spinel.
Porphyry.
Prase, see Quartz.
Prehnite.
Pseudonephrite, see Jade.
Pyrite.
Pyrope, see Garnet.
Quartz.
Rhodolite, see Garnet.
Rhodonite.
Ribband jasper, see Qnartz.
Rock crystal, see Quartz.
Romanzovite, see Garnet.
Rose quartz, see Quartz.
Rubasse, see Quartz.
Rubellite, see Tourmaline.
Rubicelle, see Spinel.
Rubino-di-rocca, see Garnet.
Ruby, see Corundum.
Rutile.
Sagenite, see Quartz.
St. Stephen's stone, see, Quartz.
Samarskite.
Saphir d'eau, see Iolite.
Sapphire, see Corundum.
Sapphire, see Quartz.
Sard, see Quartz.
Sardonyx, see Quartz.
Satin spar, see Carbonate of lime.
Satin spar, see Gypsum.
Saussurite, see Jade.
Saxon topaz, see Quartz.
Scapolite.
Schorl, see Tourmaline.
Scotch topaz, see Quartz.
Serpentine.
Siderite, see Quartz.
Silicified wood, see Opal.
Silicified wood, see Quartz.
Smithsonite.
Smoky quartz, see Quartz.
Sodalite.
Spanish topaz, see Quartz.
Spessartite, see Garnet.
Sphaerulite, see Obsidian.
Sphene, see Titanite.
Spinel.
Spodumene.
Stalagmite, see Carbonate of lime.
Star qnartz, see Quartz.
Star ruby, see Corundum.
Star sapphire, see Corundum.
Staurolite.
Succinite, see Amber.
Sunstone, see Oligoclase.
Sunstone, see Orthoclase.
Tabasheer, see Opal.
Thetis'-hair stone, see Quartz.
Thomsonite.
Thulite, see Epidote.
Tiger-eye, see Crocidolite.
Titanite.
Toad's-eye stone, see Cassiterite.
Topaz.
Topaz (false), see Quartz.
Topaz (oriental), see Corundum.
Topaz (Saxon), see Quartz.
Topaz (Scotch), see Quartz.
Topaz (smoky), see Quartz.
Topaz (Spanish), see Quartz.
Topazolite, see Garnet.
Touchstone, see Quartz.
Tourmaline.
Turkis, see Turquois.
Turquois.
Turquois (bone), see Odontolite.
Turquois (fossil), see Odontolite.
Uralian emerald, see Garnet.
Utahite, see Variscite.
Variolite, see Orthoclase.
Variscite.
Venus'-hair stone, see Quartz.
Verde antique, see Serpentine.
Vesuvianite.
Volcanic glass, see Obsidian.
Vulpinite, see Anhydrite.
Water sapphire, see Iolite.
Wernerite, see Scapolite.
Willemite.
Wilsonite, see Scapolite.
Wiluite, see Garnet.
Wolf's-eye stone, see Crocidolite.
Wood tin, see Cassiterite.
Zircon.
Zonochlorite, see Prehnite.

V. THE CUTTING OF GEM STONES.

The cutting of gem stones is necessary for the complete development of those properties upon which their beauty largely depends. Rarely does the gem stone, as found in nature, present those qualities which make it attractive to the eye. In its natural state it is often opaque, dull, or flawed, and even if transparent and flawless its form is rarely adapted to the display of those characters which distinguish the fashioned stone. Occasionally a gem stone may, without artificial treatment, show to a sufficient degree those qualities which give it rank; but such cases are rare, and in order that its inherent beauty may be developed to the maximum it should be cut and polished.

The several styles of cut may all be brought under one or the other of the following heads: I. Those bounded by plane surfaces only. II. Those bounded by curved surfaces only. III. Those bounded by both curved and plane surfaces. The several examples under the above heads may be tabulated thus:

I. Bounded by plane surfaces:
- Brilliant cut.
- Double brilliant or Lisbon cut.
- Half brilliant or single cut.
- Trap or split brilliant cut.
- Portuguese cut.
- Star cut.
- Rose cut, or briolette.
- Step brilliant or mixed cut.
- Table cut.

II. Bounded by curved surfaces:
- Double cabochon cut.
- Single cabochon cut.
- Hollow cabochon cut.

III. Bounded by curved and plane surfaces—mixed cabochon cut.

BRILLIANT CUT.

The brilliant cut may be described as two truncated pyramids, placed base to base. The upper pyramid is called the *crown*, and is so truncated as to give a large plane surface; the lower one, called the *pavilion*, terminates almost in a point. The line of union of the two pyramids is called the *girdle*, and is the widest part of the stone. This fashion of cut, though occasionally modified as to the size, mutual proportions, and even the number of facets, requires, when perfect, 58 facets. The uppermost facet is called the *crown*, and is formed by removing one-third of the thickness of the fundamental octahedron; the lowermost facet is called the *culet*, or *collet*, and is formed by removing one-eighteenth of the thickness of the stone (*a* and *b*, in text fig. 14). The triangular facets touching the table (s in *c*, fig. 14) are called *star facets;* those touching the girdle fall into two groups, *skill facets* (E in *c*) and skew facets (D in *c*). The corner facets touching the table and girdle on the crown (B in *c*), and the culet and girdle on the pavilion (Q in *d*) are called *quoins*. The facets between the quoins, and touching the table and girdle when on the crown, and the culet and girdle when on the pavilion, are called, respectively, *bezel*

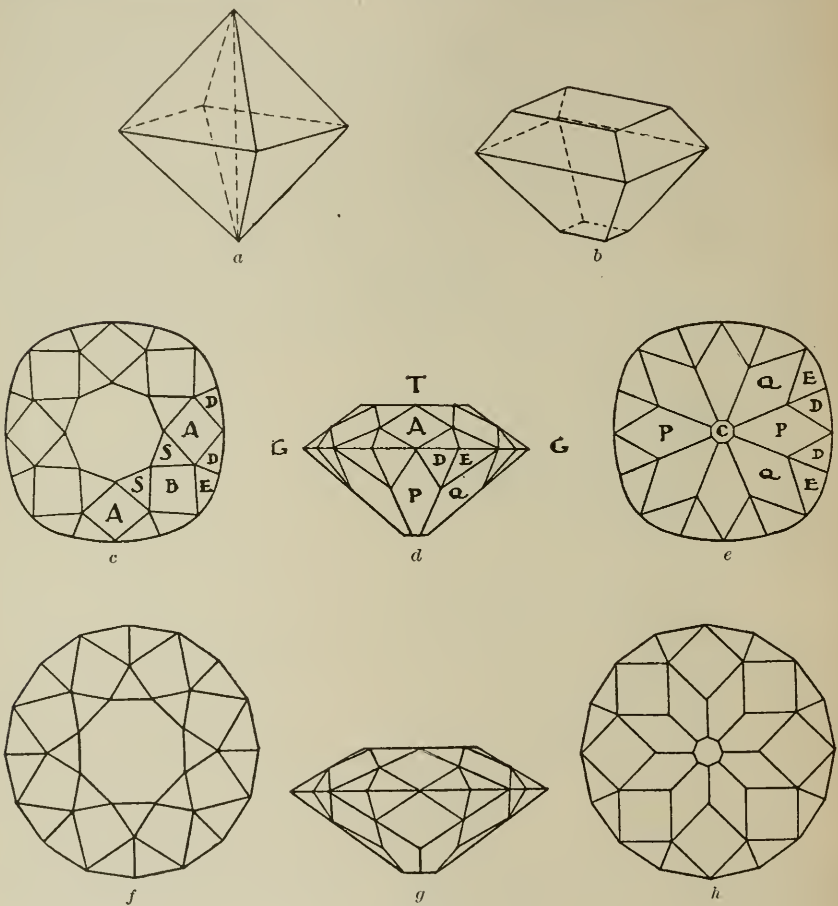


Fig. 14.

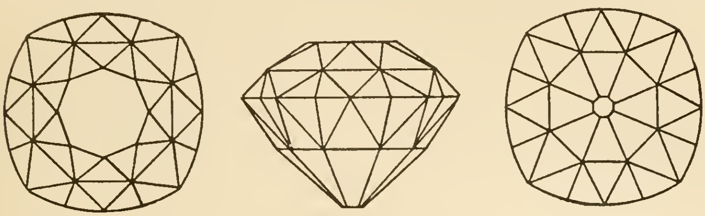
THE BRILLIANT.

a and *b*, manner in which the brilliant is derived from the fundamental form; *c*, *d*, and *e*, top, side, and back view of brilliant with 58 facets; *f*, *g*, and *h*, top, side, and back view of modified brilliant with 66 facets.

facets (A in *c*) and *pavilion* facets (P in *d*). The total number of facets are distributed as follows: 1 table, 16 skill facets, 16 skew facets, 8 star facets, 8 quoins, 4 bezel facets, 4 pavilion facets, and 1 culet, as shown in *c*, *d*, and *e* of the text figures, representing the top, side, and bottom views of a brilliant with 58 facets. Occasionally the cut is modified by cutting extra facets around the culet, making 66 in all.

The brilliant cut is especially applied to the diamond, and when perfect should be of the following proportions: From the table to the girdle, one-third, and from the girdle to the culet two-thirds of the total. The diameter of the table should be four-ninths of the breadth of the stone. When applied to other stones these proportions are more or less modified to suit their individual optical constants.

DOUBLE BRILLIANT CUT.



a *b* *c*

Fig. 15.

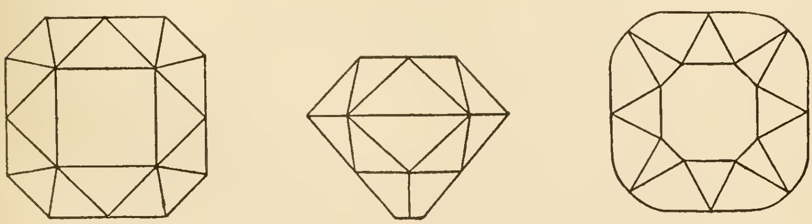
THE DOUBLE BRILLIANT.

Top (*a*), side (*b*), and back (*c*) view.

The double brilliant, or Lisbon cut, is a form with two rows of lozenge-shaped facets, and three rows of triangular-shaped facets, 74 in all. The figure shows top (*a*), side (*b*), and bottom (*c*) views of this fashion.

HALF BRILLIANT CUT.

The half brilliant, single, or old English cut is the simplest form of the brilliant, and is generally employed for stones too small to admit



a *b* *c*

Fig. 16.

THE HALF BRILLIANT.

Top (*a*) and side (*b*) view of the half brilliant. In *c* the top is cut in the form of a star, then called English single-cut.

of numerous facets. The figure shows top (*a*) and side (*b*) views of this style of cut. Occasionally the top is cut so as to form a star (*c* in fig. 16) and then called English single-cut.

TRAP BRILLIANT CUT.

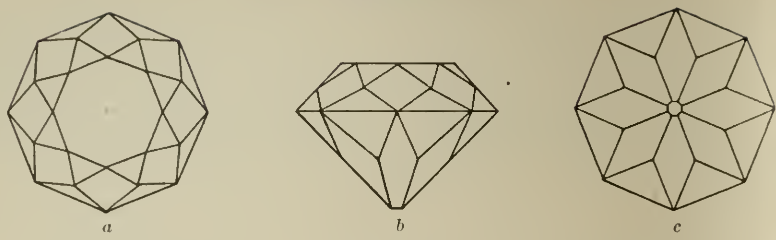


Fig. 17.

THE TRAP BRILLIANT.

Top (*a*), side (*b*), and back (*c*) view.

The trap brilliant, or split brilliant, differs from the full brilliant in having the foundation squares divided horizontally into two triangular facets, making 42 in all.

PORTUGUESE CUT.

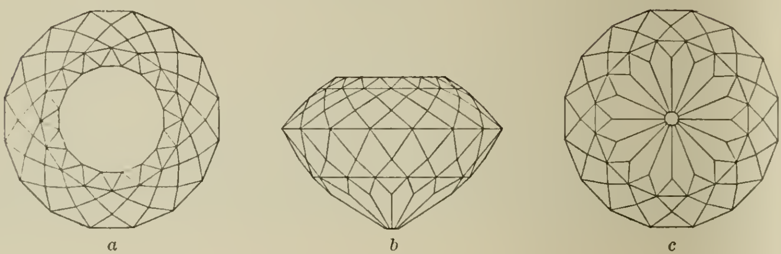


Fig. 18.

THE PORTUGUESE CUT.

Top (*a*), side (*b*), and back (*c*) view.

The figures show the top, side, and bottom views of the Portuguese cut, which has two rows of rhomboidal and three rows of triangular facets above and below the girdle.

STAR CUT.

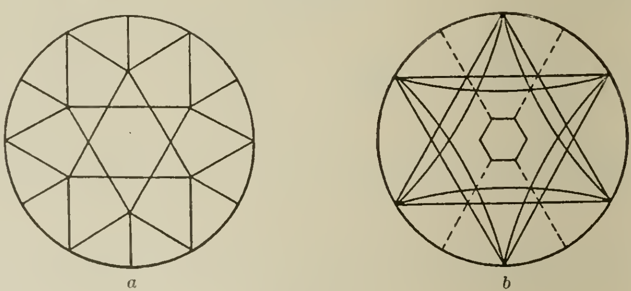


Fig. 19.

THE STAR CUT.

Front (*a*) and back (*b*) view.

The figures show the front and back views of the star cut. The table is hexagonal in shape, and is one-fourth of the diameter of the stone; from the table spring six equilateral triangles, whose apices touch the girdle, and these triangles, by the prolongation of their points, form a star.

ROSE CUT.

The rose cut differs from the brilliant cut in that the crown consists of triangular or star facets, whose apices meet at the point or crown of the rose. The base lines of these star facets form the base lines for a row of skill facets whose apices touch the girdle, leaving spaces

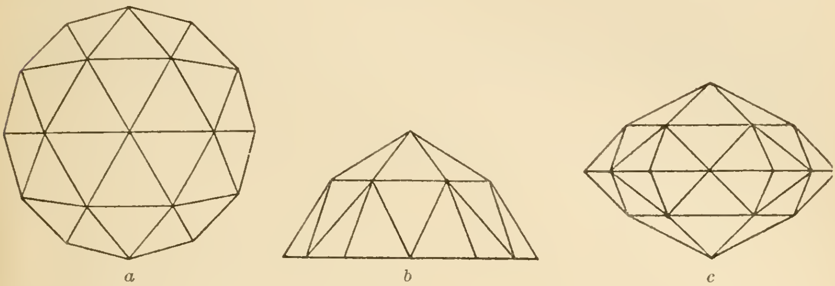


Fig. 20.

THE ROSE CUT.

a and *b*, top and side view; *c*, side view of a double rose.

which are each cut into two facets. The base may be flat or the bottom may be cut like the crown, making a double rose or briolette cut. The shape of a rose-cut stone may be circular, oval, or indeed any other that the rough gem may permit.

TRAP OR STEP CUT.

In the trap or step cut the facets run longitudinally around the stone from the table to the girdle and from the girdle to the culet. There are usually but two or three sets of step facets from the table

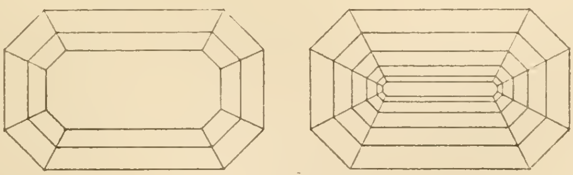


Fig. 21.

UPPER AND UNDER SIDE OF TRAP CUT.

to the girdle, while the number of steps from the girdle to the culet depends upon the thickness and color of the stone. The fashion is best adapted to emeralds and other colored stones.

STEP BRILLIANT OR MIXED CUT.

Fig. 22.

THE STEP BRILLIANT CUT.

Here the form from culet to girdle is the same as that of the trap cut, while from the girdle to the table the stone is brilliant cut, or the opposite.

TABLE CUT.

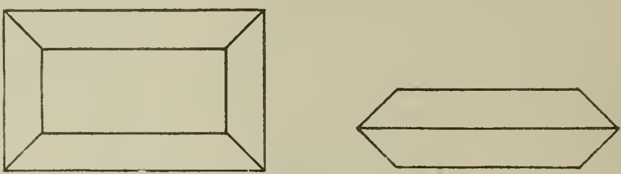


Fig. 23.

TOP AND SIDE VIEW OF TABLE CUT.

The table cut consists simply of a greatly developed table and culet meeting the girdle with beveled edges. Occasionally the 8 edge facets are replaced by a border of 16 or more facets.

CABOCHON CUT.

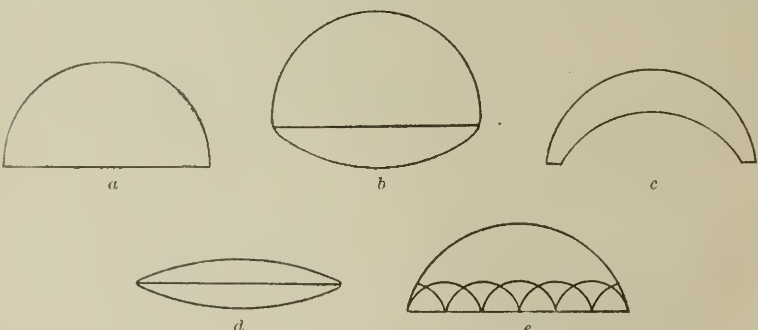


Fig. 24.

THE CABOCHON CUT.

a, the single cabochon; *b*, the double cabochon; *c*, the hollow cabochon; *d*, flat or tallow-top cabochon; *e*, mixed cabochon.

The cabochon cut is usually applied to opaque, translucent, deep colored, or chatoyant stones. The double cabochon is usually cut with a smaller curvature on the base than on the crown. The single cabochon is a characteristic cut for the turquoise. The hollow cabochon is adapted to very deep colored transparent stones. The mixed cabochon has either the edge or side faceted, or both. In all of the cabochon cuts the arches may be of a varying degree of flatness, depending upon the nature of the stone.

VI. IMITATIONS, SOPHISTICATIONS, AND ARTIFICIAL FORMATION OF GEMS.

Practically all of the gem stones have been and are successfully imitated. Deceptions are practiced by means of imitations, pure and simple; or by combining a genuine stone with an imitation, or an inferior one with a superior; by substituting one stone for another; or by intensifying, improving, or changing the color of a stone.

The basis of most imitation gems is a lead glass of great brilliancy called paste or strass. Its composition varies considerably, but a typical mixture is the following:

Pure powdered quartz	38.2
Red lead	53.3
Potassium carbonate	7.8

The materials are carefully powdered, mixed, and heated in a crucible. The temperature is gradually raised to fusion and carefully kept at that point for about thirty hours, after which it is very slowly lowered. The value of the product depends entirely on the intimacy of the previous admixture, the regularity of temperature, the duration of fusion, and the slowness of cooling.

Imitation diamonds are cut from the uncolored paste, but for the imitation of colored gems the desired color is imparted by the solution of certain metallic oxides and other substances in the paste, some of the more typical mixtures being given in the following table:[1]

	Strass.	Glass of antimony.	Purple of cassius.	Gold.	Cobalt oxide.	Copper oxide.	Chrome oxide.	Manganese oxide.	Iron oxide.	Uranium trioxide.
Ruby	1,000	40	1	1	....	....	....	....	....	....
	1,000	....	Trace.	....	....	....	....	5	....	....
	1,000	....	....	....	....	....	....	25	....	....
Sapphire	1,000	....	....	....	14	....	....	....	....	....
	1,000	....	....	....	25	....	....	....	....	....
Topaz	1,000	40	1	....	....	....	....	....	....	....
	1,000	....	....	....	....	....	....	....	....	16
Emerald	1,000	....	....	....	....	8	0.2	....	....	....
	1,000	....	....	....	....	8	0.53	....	....	....
Amethyst	1,000	....	....	....	25	....	....	....	....	....
	1,000	8	0.2	....	5	....	....	....	....	....
	1,000	....	2	....	5	....	....	8	....	....
Garnet	1,000	....	1 to 8	....	....	....	....	....	....	....
	1,000	500	4	....	....	....	....	4	....	....
Aquamarine	1,000	7	....	....	0.4	....	....	....	....	....

[1] Thorpe's Dictionary of Applied Chemistry, II, p. 222.

These proportions admit of considerable variation. For example, borate and chloride of silver are added to produce topaz yellow; or the first mixture given for topaz is, after fusion, mixed with 8 parts of strass and re-fused for thirty hours and used as a ruby glass. The ruby composition is colorless and only acquires its color upon re-fusion, the depth of color being varied by the addition of compounds of tin.

These imitations can, as a rule, be readily detected. They are deficient in hardness and yield readily to the file. Further, they are liable to tarnish in impure air, are not pleochroic as the majority of colored gems are, and under the magnifying glass they show the many lines, striæ, and bubbles characteristic of fused glassy masses. Finally they differ in specific gravity from the gems they represent.

Instead of a purely imitative preparation being used, what is known as a "doublet" may be constructed. The doublet is made up of the table and crown of a genuine stone, usually somewhat off-colored, cemented to a pavilion made of a paste having the approved color, thus giving the valueless crown the appearance of a fine stone. The doublet usually betrays itself by the softness of its pavilion. To avoid this the "triplet" has been devised. This consists of a crown and pavilion made usually from a pale or off-colored stone with a thin layer of colored glass at the girdle. Here the hardness test will be found wanting and the magnifying glass and specific gravity test must be used. The glass usually distinguishes the composite nature of the triplet, and if soaked in alcohol, carbon bisulphide, or ether, the fraud will usually betray itself by falling to pieces.

The manufacture of imitation pearls by coating the inner surfaces of glass beads with a preparation made from the scales of certain fishes is extensively carried on as a home industry in the glass-making centers of Europe. The manufacture of the fish-scale extract, as carried on in Thuringia, is substantially as follows: Four to five pounds of bleak scales (obtained from the Baltic) are washed in fresh water to remove dirt; they are then churned for about two hours in six quarts of cold fresh water and the whole subjected to pressure in a linen bag. The silvery, lustrous runnings are caught and set aside and the operation repeated until the scales have lost their silvery appearance. The runnings, to which a little ammonia has been added, are put aside to clarify, care being taken to prevent putrefaction. The sediment is washed repeatedly with fresh water and left to settle. When the washings are quite clear, the lustrous sediment is bottled with its own volume of alcohol, shaken, and allowed to settle. The alcohol is then decanted off and the operation repeated until the sediment has lost its water and has the consistency of butter. For use, the preparation is mixed, in small quantities, with a hot aqueous solution of gelatin to which a small amount of alcohol has been added. Colored pearls are made from it by the addition of the desired coal-tar dyestuff.

Sophistications include substitutes pure and simple, such as substituting quartz, white topaz, zircon, or other colorless stones for the diamond, and so on. Or the stone may be treated with chemicals or heat to heighten or change its color. Topaz, sapphire, and other stones may have their color removed or their brilliancy increased by heating. The color of the wine-yellow Brazilian topaz is changed to a rose pink by heat; an off colored or spotted diamond is made to appear whiter and more brilliant by the same means. The color of the cairngorm, citrine quartz, and other stones is altered and improved in a similar manner. The color of the turquoise is deepened and its permanency increased by treating it with solutions of certain chemicals. The colors of agates, chalcedony, chrysoprase, etc., may be changed or improved with the aid of dyes and chemicals, and in a similar manner imitation moss agates may be manufactured from colorless chalcedony. An off colored diamond may be given a wash of aniline blue, and the result is apparently a stone of good water as long as the wash remains. The interior of a setting may be backed, painted, or enameled; in fact, there are a hundred or more methods by means of which a tint is improved or given a beauty and depth not inherent in the specimen.

A sharp distinction is to be drawn between the imitation of a gem stone and its formation by artificial methods. The imitation gem only simulates the natural substance; the artificial gem is identical with it in all its chemical and physical properties. Until recently the laboratory gem was hardly more than a curiosity, though its synthesis has undoubtedly been of value from a theoretical standpoint. Examples of this class are to be found in the diamond as produced by Moissan in the electric furnace and the synthesis of spinel and chrysoberyl by Ebelmen from mixtures of alumina and glucina, respectively, using boric acid at very high temperatures as a solvent. Hydrofluoric acid and silicon fluoride have also been used to induce combination between silica and other oxides. In this manner topaz, a complex fluo-silicate, has been made by the action of fluoride of silicon upon alumina.

The minerals thus formed have usually been very small and of no commercial value. Quite recently, however, rubies have been produced by the fusion of alumina with traces of chromium oxide in the electric furnace, and the art has progressed to such an extent that the product is now on the market for sale as watch jewels. The electric furnace has also produced another product which, while strictly speaking, not a synthetic gem, yet is essentially an artificial one. Imperfect rubies, chips, and small stones are fused in the furnace together with the addition of a small amount of coloring oxide such as chromium. The fused product is then cut and polished, and the result is a ruby of good color and fairly large size. Emeralds and other colored stones have been made in the same way, and so promising has the industry become that the courts have been called in to decide what constitutes a ruby. Their decision was in substance that the word ruby could be applied only to the red-colored corundum, anhydrous oxide of aluminum occurring ready formed in nature.

VII. GEMS OF THE BIBLE.

The Bible contains three lists of gems. The first of these is an account of the jewels on the *ephod* of Aaron. The *ephod* is described as having a front part and a back part fastened at each shoulder with an onyx mounted in gold and engraved with the names of the children of Israel, six on each stone, to memorialize the Lord of the promise made to them. [Exodus xxviii, 6, 12, 29.] The breastplate was made of the same material as the *ephod*, and folded so as to form a kind of a pouch in which the Urim and Thummin were placed. [Exodus xxxix, 9.] The external part of this gorget, or "breastplate of judgment" was set with four rows of gems, three in each row, each stone set in a golden socket and having engraved upon it the name of one of the twelve tribes of Israel. [Exodus xxviii, 17–20.]

The following lists taken from Biblical antiquities by Adler and Casanowicz[1] give the names of these stones in the original and in the Septuagint, together with the meaning adopted by most authorities, the rendering of the Revised Version, both in text and margin being added in parentheses:

1. *Odem* (*sardion*), carnelian (sardius, ruby).	2. *Pitdah* (*topazion*), topaz or peridot.	3. *Bareketh* (*smaragdos*), smaragd or emerald (carbuncle emerald).
4. *Nofek* (*anthrax*), carbuncle, probably the Indian ruby (emerald, carbuncle).	5. *Sappir* (*sapfeiros*), sapphire or lapis lazuli (sapphire).	6. *Yahalom* (*iaspis*), onyx, a kind of chalcedon (diamond, sardonyx).
7. *Leshem* (*ligyrion*), jacinth, others, sapphire (jacinth, amber).	8. *Shebo* (*achates*), agate.	9. *Achlamah* (*amethystos*), amethyst.
10. *Tarshish* (*chrysolithos*), chrysolite, others, topaz, (beryl, chalcedony).	11. *Shoham* (*beryllion*), beryl (onyx, beryl).	12. *Yashpeh* (*onychion*), jasper.

In many instances the equivalent of the Biblical names of gems is uncertain in the nomenclature of modern mineralogy, and as a consequence there are several distinct lists of names given for the stones in the breastplate. In the Division of Oriental Religions in the U. S. National Museum is a very old silver breastplate employed as an ornament for the manuscript copy of the Torah, or Pentateuch, used in an ancient synagogue. The twelve stones, with the names of the twelve tribes, according to it are as follows: Garnet, Levi; diamond, Zebulon; amethyst, Gad; jasper, Benjamin; chrysolite, Simeon; sapphire,

[1] Report of the U. S. National Museum, 1896, p. 943.

Issachar; agate, Naphthali; onyx, Joseph; sard, Reuben; emerald, Judah; topaz, Dan; beryl, Asher.

The second list is that given in the description of the ornaments of the Prince of Tyrus [Ezekiel xxviii, 13]:

1. *Odem.*	2. *Pitdah.*	3. *Yahalom.*
4. *Tarshish.*	5. *Shoham.*	6. *Yashpeh.*
7. *Sappir.*	8. *Nofek.*	9. *Bareketh.*

The third list is that given in the description of the Heavenly City. [Revelations xxi, 19, 20.] As in the preceding list, the word used in the original or Septuagint is followed by the rendering given by most authorities, that of the Revised Version in parentheses:

1. *Iaspis*, jasper.	2. *Sapfeiros*, sapphire or lapis lazuli.	3. *Chalkedon*, chalcedony.
4. *Smaragdos*, smaragd (emerald).	5. *Sardonyx*, sardonyx.	6. *Sardios*, sardius.
7. *Chrysolithos*, chrysolite.	8. *Beryllos*, beryl.	9. *Topazion*, topaz.
10. *Chrysoprasos*, chrysoprase.	11. *Hyakinthos*, jacinth (sapphire).	12. *Amethystos*, amethyst.

In addition to the gems enumerated in these lists, there is mentioned the diamond by the Hebrew name of *shamir* [Jeremiah xvii, 1; Ezekiel iii, 9; Zechariah vii, 12]; amber, Hebrew *hashmal* (margin of Revised Version gives *electrum*) [Ezekiel i, 4.], and crystal (quartz) Hebrew *gerah* and *gabish* [Ezekiel i, 22; Job xxviii, 18; Revelation iv, 6].

The complete list of gems mentioned being as follows:

Agate (Hebrew *shebo*).—One of the stones in the breastplate of judgment, Exodus xxviii, 19.

Amber (Hebrew *hashmal*).—Ezekiel i, 4. Some render the Hebrew *leshem* as amber, thus making it one of the gems in the breastplate, Exodus xxvii, 19.

Amethyst (Hebrew *ahlamah*).—One of the stones in the breastplate, Exodus xxviii, 19. In Revelation xxi, 20, it is mentioned as garnishing the twelfth foundation of the heavenly Jerusalem.

Beryl (Hebrew *shoham*).—One of the stones in the breastplate, Exodus xxviii, 20. Mentioned as one of the ornaments of the King of Tyre, Ezekiel xxviii, 13. In Revelation it is spoken of as adorning the eighth foundation of the Holy City.

Carbuncle (Hebrew *nofek*).—One of the stones in the breastplate, Exodus xxviii, 18; see also Ezekiel xxviii, 13. The word *nofek* has been rendered ruby.

Carnelian, perhaps the Hebrew *odem* of the breastplate, Exodus xxviii, 17, and the sardius in Revelation xxi, 20. In Revelation iv, 3, of the revised version is the rendering sardius. In the Authorized Version the reading is: "And he that sat was to look upon like a jasper and a *sardine* stone." In the Vulgate: "Et qui redebat similis erat aspectui lapidis jaspidis et sardinis." The Textus receptus (Greek) is: "*Καὶ ὁ καθήμενος ἦν ὅμοιος ὁράσει λίθῳ ἰάσπιδι καὶ σαρδίνῳ.*" All other editions have for the last word, "*σαρδίῳ.*" It is evident that the Vulgate and the Authorized Verson simply followed the Textus receptus, and that the correct rendering is "sardius" and not "sardine stone."

Chalcedony.—The Hebrew *tarshish*, Exodus xxviii, 20, has been rendered chalcedony. In Revelation xxi, 19, it is enumerated in the description of the foundation of the New Jerusalem.

Chrysolite.—See Revelation xxi, 20. The Hebrew *tarshish*, Exodus xxviii, 20, has been rendered chrysolite.

Chrysoprase.—One of the stones in the foundation of the Heavenly City, Revelation xxi, 20.

Diamond, Hebrew *shamir.*—See Jeremiah xvii, 1; Ezekiel iii, 9; and Zechariah vii, 12, where it is spoken of as an object of extreme hardness. In the Authorized Version the Hebrew *yahalom*, Exodus xxviii, 18, is rendered diamond.

Emerald, Hebrew *bareketh.*—One of the stones in the breastplate; also see Revelation iv, 3.

Jacinth, Hebrew *leshem.*—A stone in the breastplate, Exodus xxviii, 19. The eleventh foundation of the Heavenly Jerusalem, Revelation xxi, 20.

Jasper, Hebrew *yashpeh.*—A stone in the breastplate, Exodus xxviii, 20. Mentioned as adorning the Prince of Tyrus, Ezekiel xxviii, 13. One of the stones enumerated in the description of the Heavenly City, Revelation xxi, 19.

Onyx, Hebrew *shoham.*—One of the stones in the breastplate, Exodus xxviii, 20; see also Genesis, ii, 12; and Ezekiel xxviii, 13. According to certain renderings the *shoham* is beryl. *Shohams* set in gold were put on each of the two shoulder straps of the *ephod* of the high priest, and the two were engraved with the names of the twelve tribes, six on each, Exodus xxviii, 12.

Ruby, Hebrew *nofek* or *odem.*—One of the gems in the breastplate, Exodus xxviii, 17; see also Ezekiel xxvii, 13.

Sapphire, Hebrew *sappir.*—One of the stones in the breastplate, Exodus xxviii, 18; also mentioned in Ezekiel xxviii, 13, and Revelation xxi, 19. Some authorities render *sappir* as lapis lazuli, and not sapphire.

Sardonyx, Hebrew *yahalom.*—One of the stones in the breastplate, Exodus xxviii, 18.

Topaz, Hebrew *pitdah.*—One of the stones in the breastplate, Exodus xxviii, 17; also mentioned in Ezekiel xxviii, 13, and in Revelation xxi, 20.

Pearl.—It is thought that pearl is meant by the Hebrew *peninim*, a word often employed in the Old Testament as a figure of something valuable and precious; see Proverbs iii, 5; xxxi, 10, and Job xxviii, 18. Jesus uses the pearl for the same purpose in Matthew vii, 6, and xiii, 45.

VIII. MYSTICAL PROPERTIES OF GEMS.

Man has endowed gems with talismanic, curative, and supernatural powers. Certain gems preserved him from incubi, vampires, and kindred terrors; others preserved him from the powers of sorcery or conferred the powers of witchcraft; by their aid he controlled the spirits of evil or was protected from their malign influence. With a suitable gem he could foretell the future, review the past, or conjure up pictures of events taking place at a distance. Protected by their mystic influences he feared neither plague nor poison, while his belief in the marvelous efficacy of their curative powers gave them a place among his most potent remedies.

The virtues of gems were diverse. Some procured the favor of the great; others rendered their possessors amiable, wise, strong, and brave; some protected him from fire, lightning, and tempests; others from danger and disease: some were preferred as talismans and charms; others were used as drugs, either alone or with electuaries, and with or without prayers, incantations, or other prescribed formulas.

Certain gems brought good or evil through the planetary influence of certain days. All yellow gems were appropriate for Sunday wear through the name giver, the sun. On Monday, the moon day, all white stones, except the diamond, were to be worn. Tuesday, the day of Mars, claimed garnets, rubies, and all red stones. Wednesday demanded blue stones. Thor's day, or Thursday, required amethysts and other stones of a sanguine tint. Friday, the day of Venus, had for its gem the emerald. Saturn's day claimed the diamond.

A particular stone was potent for good during a particular month, and, under the proper astrological control, was supposed to have a mystical influence over the twelve parts of the human anatomy. Such a gem was the more potent if the natal day of the wearer corresponded with its particular sign, and when worn as a birth or month stone was supposed to attract at all times propitious influences and avert malign effects. The more important stones, their zodiacal control, and most potent periods of influence are:

Stone.	Zodiacal control.	Period.
Garnet	Aquarius	Jan. 21 to Feb. 21.
Amethyst	Pisces	Feb. 21 to Mar. 21.
Bloodstone	Aries	Mar. 21 to Apr. 20.
Sapphire	Taurus	Apr. 20 to May 21.
Agate	Gemini	May 21 to June 21.
Emerald	Cancer	June 21 to July 22.
Onyx	Leo	July 22 to Aug. 22.
Carnelian	Virgo	Aug. 22 to Sept. 22.
Chrysolite	Libra	Sept. 22 to Oct. 23.
Aquamarine	Scorpio	Oct. 23 to Nov. 21.
Topaz	Sagittarius	Nov. 21 to Dec. 21.
Ruby	Capricorn	Dec. 21 to Jan. 21.

A closely related idea is found in the twelve stones which, according to the Jewish cabalists, when engraved each with an anagram of the name of God were supposed to have a mystical power over, and a prophetical relation to, the twelve angels. Thus:

Ruby	Malchediel.
Topaz	Asmodel.
Carbuncle	Ambriel.
Emerald	Muriel.
Sapphire	Herchel.
Diamond	Humatiel.
Jacinth	Zuriel.
Agate	Barbiel.
Amethyst	Adnachiel.
Beryl	Humiel.
Onyx	Gabriel.
Jasper	Barchiel.

These stones also had reference to the twelve tribes of Israel, the twelve parts of the human body, twelve hierarchies of devils, etc. By their aid a system of prognostication was practiced, based upon the change of hue or brilliancy of the stone, so that the cabalist was enabled to foretell future events.

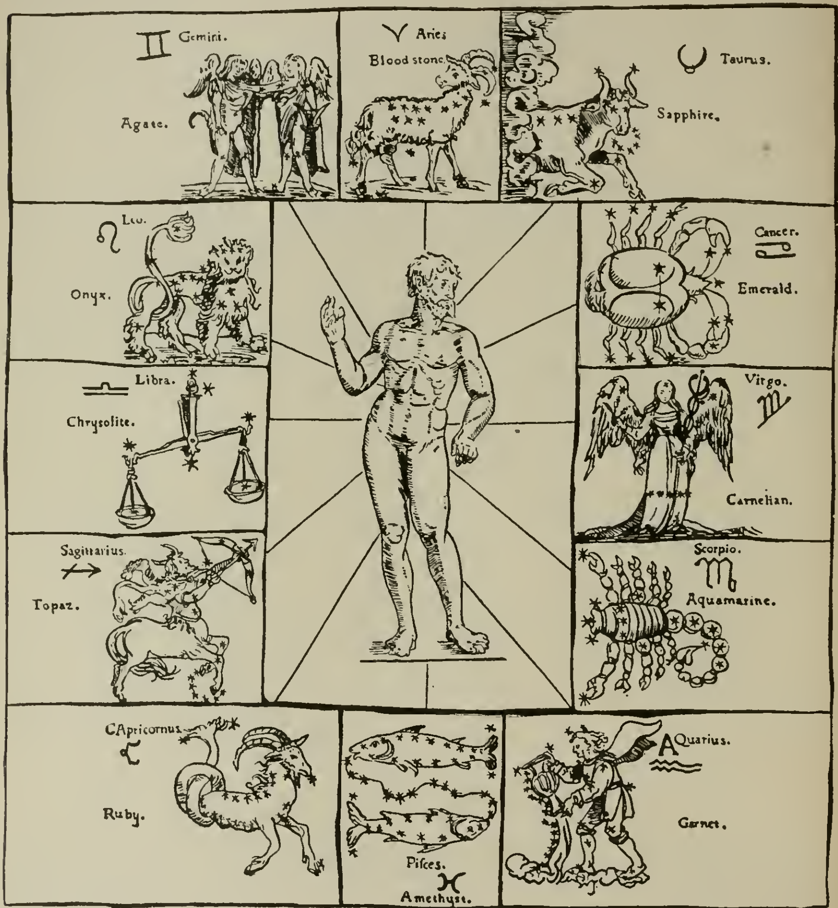


Fig. 25.

THE ZODIACAL STONES WITH THEIR SIGNS [AFTER AN OLD PRINT].

The Twelve Apostles were represented, symbolically, by precious stones: Jasper, St. Peter; sapphire, St. Andrew; chalcedony, St. James; emerald, St. John; sardonyx, St. Philip; carnelian, St. Matthew; beryl, St. Thomas; chrysoprase, St. Thaddeus; topaz, St. James the Less; hyacinth, St. Simeon; amethyst, St. Matthias.

The superstitions connected with the twelve stones have persisted, in one form or another, from the times of the Magii to the present, and the belief in their virtues can still be traced in the wearing of "birthstones."

By those who are in January born
No gem save *garnets* should be worn;
They will insure you constancy,
True friendship and fidelity.

The February born will find,
Sincerity and peace of mind—
Freedom from passion and from care,
If they the *amethyst* will wear.

Who on this world of ours their eyes
In March first open, shall be wise,
In days of peril firm and brave,
And wear a *bloodstone* to their grave.

Those who in April date their years,
Diamonds should wear, lest bitter tears
For vain repentance flow. This stone
Emblem of innocence is known.

Who first behold the light of day
In spring's sweet flowery month of May,
And wears an *emerald* all her life,
Shall be a loved and happy wife.

Who comes with summer to this earth,
And owes to June her day of birth,
With ring of *agate* on her hand,
Can health, wealth, and peace command.

The glowing *ruby* should adorn
Those who in warm July are born;
Thus will they be exempt and free
From love's doubts and anxiety.

Wear a *sardonyx*, or for thee
No conjugal felicity;
The August born without this stone
'Tis said must live unloved alone.

A maiden born when autumn's leaves
Are rustling in September's breeze,
A *sapphire* on her brow should bind,
'Twill cure diseases of the mind.

October's child is born for woe,
And life's vicissitudes must know;
But lay an *opal* on her breast,
And hope will lull the woes to rest.

Who first comes to this world below,
With dull November's fog and snow,
Should prize the *topaz* amber hue,
Emblem of friends and lovers true.

If cold December gave you birth,
The month of snow and ice and mirth,
Place on your hand a *turquoise* blue—
Success will bless you if you do.

In the *Sympathia Septem Metallorum ac Septem Selectorum Lapidum ad Planetas* is a list of stones recorded as being in sympathy with the planets, and as such were possessed of astrological and medicinal properties which, under the proper sign, rendered them of service to men. Thus—

[♄] Saturn..... Turquoise, sapphire.
[♃] Jupiter .... Carnelian, topaz, amethyst.
[♂] Mars ...... Jasper, emerald.
[♀] Venus..... Emerald, amethyst, topaz.
[☿] Mercury... Crystal, agate, emerald.
[☽] Moon ..... Moonstone, topaz, and all white stones.
[☉] Sun .... Diamond, ruby.

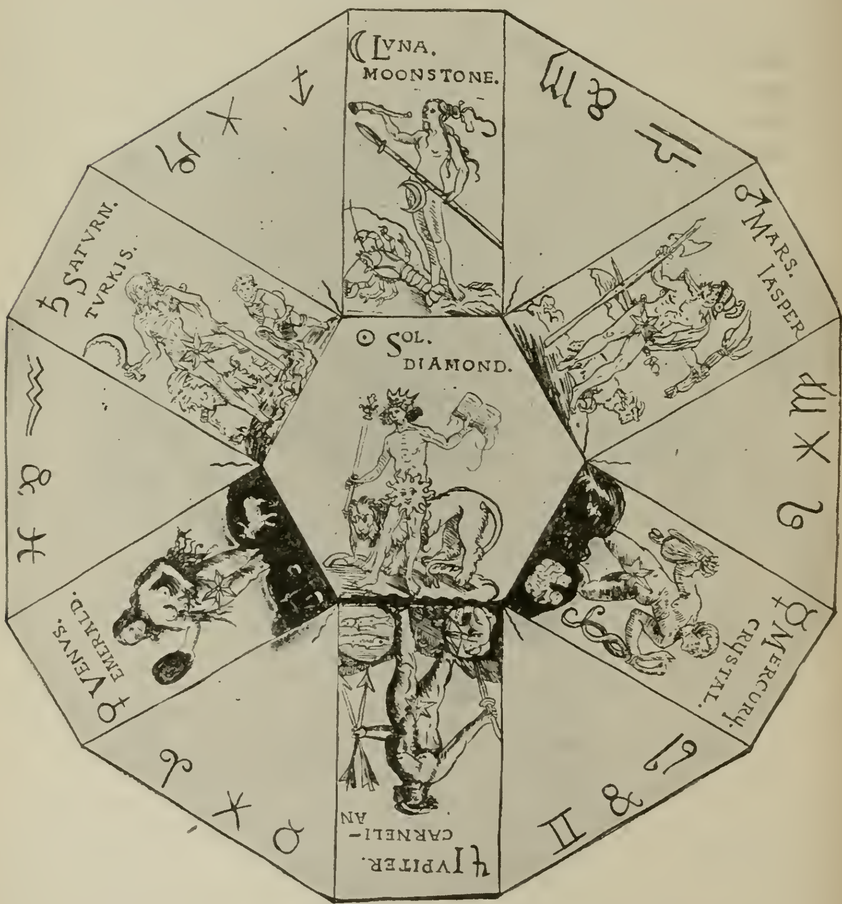


Fig. 26.

THE FIGURES OF THE PLANETS WITH THEIR SIGNIFICANT STONES [AFTER AN OLD PRINT].

The Hindu propitiated hostile stars by the bestowal of gems. If the sun was hostile, a pure ruby; the moon, a good pearl; if *sani*, a star affecting to a powerful degree the destinies of men, a sapphire. He also averted the evil effects of adverse astral influences by wearing certain stones. If the sun was adverse, the cat's-eye; if the moon, the sapphire, etc.

The mystic ascribed a certain significance both to the gem and to its various colors. For example, white was the emblem of light, purity, faith, innocence, joy, and life; worn by women it was emblematic of chastity; by the ruler, of humility and integrity. Red signified pure love and wisdom; in another sense it signified passion, love of evil, hatred, etc. Blue was indicative of truth constancy, and fidelity. Yellow in one sense was symbolical of marriage and faithfulness; in another sense of inconstancy, jealousy, and deceit. Green was the color of hope, especially that of immortality. Amethystine signified love, truth, passion, suffering, and hopefulness, and among the Rosicrucians was symbolical of the divine male sacrifice.

Stones of all sorts were engraved with the figure of a cockatrice, which, under the proper planetary influence, were preservatives against the evil eye. The names of Jesus, Mary, and Joseph were engraved on stones, chiefly amethyst, onyx, and bloodstone, which were worn as preventives of contagious diseases, the larger the stone, the greater its efficacy. Gems were also supposed to indicate the state of health of the donor or wearer. If the stone became dull, opaque, or colorless it was thought to be significant of danger and death. In a similar manner they lost or changed color in contact with poisons.

Dreaming of gems was usually fraught with good, while seeing or handling them on the eve of a journey, or at certain phases of the moon, was regarded as auspicious.

Supernatural influences have been attributed to gems which still pass current. For example, an onyx ring, supposed to be the espousal ring of Mary and Joseph, exhibited in the Duomo of Perugia, is thought to be efficacious in the cure of every disorder. Amber is still used as a prophylactic and curative for goiter, croup, and diseases of the throat. The opal is thought by many to bring ill luck to the wearer. The coral is still believed to be a charm against diseases of childhood, and is extensively worn in Italy as a protection against the "evil eye." Pearls are dreaded by some and favored by others. No French bride will wear them on her wedding day, since they would bring tears to her married life. In the East the believers are dogmatic in their faith and it is heresy to assert that the use of gems has no practical influence over body or mind.

It is impossible here to do more than hint at the many beliefs concerning gems which were or are current, and the following notes merely suggest a few of the more prevalent beliefs on this subject.

Agate.— Emblematic of health and wealth. An enemy to all venomous things; assuages thirst when held in the mouth; gives victory to its wearer; repels storms; sharpens the sight; preserves and increases strength, and renders its wearer gracious and eloquent. (Camillus Leonardus, Speculum Lapidum, 1502.) Efficacious as an amulet against scrofula and skin diseases. (Albertus Magnus, De Vertutibus Herbarium, Lapidum, Animalum, etc.) Various properties are attributed to it by Mohammedan authorities. It cured insanity when administered with water or with the juice of the fruit *Sheu* (an apple?); a remedy for hemorrhage in the genital organs or in the rectum; for the spitting of blood; for the unusual discharge of the menstrual fluid. In conjunction with other medicines it cured hard boils and porous ulcers, gravel, spleen, and kidney troubles. It prevented bleeding of the gums and rendered them hard when applied to the parts as a calcined powder.

Agates having the reddishness of the water after washing raw flesh in the shape of finger rings prevent bleeding of all kinds. The wearer strikes terror to the heart of his enemies, obtains his heart's wishes from the gods, and becomes free from pain in the breast.

The *Akik* (agate) confers upon the wearer all the blessings that the use of the turquoise does. Its internal use may do harm to the stomach, but this can be avoided by mixing it with *Katira*, or, in its absence, with the *Basud* stone. (Views of Arabic and Persian writers on gems and stones.)

If taken internally, the agate drives away fear, increases the power of digestion, cures insanity and monomania of that kind which creates the impression of being beaten and abused by others. If worn, it cures stricture and the vomiting of blood coming fro n the chest; worn on the neck, it cures the spitting of blood issuing from the lungs at the time of coughing. Calcined, powdered, and administered with white wine in doses weighing 16 barleycorns, it cured the gravel. If tied about the thighs of a woman under painful labor, it helps to a speedy and easy delivery. The weight of the stone here prescribed should be about 120 barleycorns. (Ben Adloulah.)

The eye-agate vas considered efficacious as an amulet in cases of scrofula and other skin diseases. In great repute to-day in Syria as a curative for "Aleppo" sores.

Pierre de Boniface, writing in 1315, said:

The agate of India or Crete renders its possessor eloquent and prudent, amiable and agreeable.

Ben Jonson, in the Alchymist, speaking of the medicinal properties of gems, wrote:

My meat shall come in Indian shells, dishes of agate set in gold, and studded with emeralds, sapphires, hyacinths, and rubies. The tongues of carps, dormice, and camel's heels boiled in the spirit of Sol, and dissolv'd pearl, apicus diet 'gainst the epilepsy. And I will eat these broths with spoons of amber, headed with diamond and carbuncle.

Dioscorides, in his Materia Medica, recommends the use of the agate as a preventive of contagion.

Alabaster.—According to Leonardus, it is the best for vessels to hold unguents, which are preserved in them without spoiling. Dioscorides and many other doctors account it good in physicks. He who carries it will prove victorious in suits at law.

Amber.—Supposed to be "generated out of the urine of the lynx, and is hardened by time: that voided by the male, brown: by the female, saffron, inclining to a darkness." Amber assuaged pain in the stomach, cured jaundice, flux, and king's evil.

It naturally restrains the flux of the belly; is an efficacious remedy for all disorders in the throat (a belief still prevalent). It is good against poison. If laid on the breast of a wife when she is asleep, it makes her confess all her evil deeds. Being taken inwardly it provokes urine, brings down the menses, and facilitated a birth. It fastens teeth that are loosen'd, and by the smoke of it poisonous insects are driven away. (Camillus Leonardus, Speculum Lapidum. 1502.)

When buried in a moist soil it was supposed to generate a fungus, which was administered to those troubled with the gravel. It cured fits, dysentery, scrofula, and jaundice. Used as an amulet it charmed away toothache, asthma, croup, and diseases of the throat; supposed to be efficacious as a curative and prophylactic if rubbed on the parts or taken internally, after dissolving in white wine. (Dissertatio medica de Succino, 1682.) These beliefs are still current.

Thomas Nicols states that the—

white odoriferous amber is esteemed the best for physic use, and thought to be of great power and force against many diseases, as against the *vertigo* and *asthmatic paroxysmes*, against *catharres* and *arthriticall* pains, against diseases of the stomach, and to free it from sluffings and putrefactions, and against diseases of the heart, against plagues, venoms, and contagions. It is used either in powder, or in oil, or in troches, either in distempers of men or of women, either married or unmarried, either with child or without, or in the distempers of children. [Arcula Gemmea, 1653.]

Olaus Worm, of Copenhagen, writing in 1640, says that amber was received as a panacea; a sovereign remedy for toothache, asthma, and dropsy.

In the work "De Proprietatibus Rerum," by Bartholomaeus Glanvilla, amber is reported to possess the property of driving away adders and of being contrary to friends.

The Shah of Persia is said to wear an amulet of amber reported to have fallen from heaven, and which has the property of rendering him invulnerable.

Amber is used to-day in Lombardy and the Piedmont as a cure for goitre, a belief that dates back to the time of Pliny.

Amethyst.—Emblematic of sincerity.

As an amulet it dispelled sleep, sharpened the intellect, prevented intoxication, gave victory to soldiers, and protected its wearer from sorcery. (Leonardus.)

"The amethyst banishes the desire for drink and promotes chastity." (Art Magic; or Mundane, Submundane, and Supermundane Spiritism.)

Lost its color in contact with and was an antidote for all poisons. (Albertus Magnus.)

According to Pliny, the amethyst was an antidote to drunkenness, and it takes its name from this property. Moreover, if the name of the moon or sun be engraved on it and it be thus hung about the neck from the hair of a baboon or the feathers of a swallow, it is a charm against witchcraft. It is also serviceable to persons having petitions to make to princes. With the assistance of a spell or incantation, it kept off hailstorms and flights of locusts.

Porta, in his treatise on magic, says that the amethyst neutralizes magic incantations.

The Puranas hold that the amethyst "gives strength and cures morbid heat and fistula."

Beryl.—Used with incantations to foretell the future and review the past; was efficacious in detecting thieves, forewarned death, and was supposed to have power over and to be the abode of evil spirits that could be made to work the wearer's will by means of suitable incantations. It rendered its owner cheerful, preserved and increased conjugal love, cured diseases of the throat and jaws and disorders "proceeding from the humidity of the head, and is a preservative against them." (Camillus Leonardus, Speculum Lapidum. 1502.)

According to Freeman, who wrote in 1701—

> The beryl disturbs devils beyond all others. If it be thrown in water with the words of its charm sung, it shews various images of devils and gives answers to those that question it. Being held in the mouth, a man may call a devil out of hell and receive satisfaction to such questions as he may ask.

Browning, in one of his poems, makes use of this belief.

The beryl was largely used for divination in 1600. The method was as follows: A bowl was filled with water and the ring suspended in it. The answer to the question propounded was spelled out by the ring striking the sides of the vessel. A modification of this, and one still in use, was to mark the edges of the bowl with the letters of the alphabet; the stopping of the ring at certain letters composed the answer. Still another method, and one said to have been used by Napier, was to throw a sphere cut from the stone into a bowl of water. The character of the circles formed announced whether the presiding demon was favorable or not. If favorable, the information desired was pictured on the surface of the bowl.

Prior to the seventeenth century the beryl was in some repute as a curative. Mixed with an equal weight of silver, its powder, taken internally, was thought to cure leprosy. Water in which the stone had stood was good for the eyes, and, taken internally, it dispelled flatulency and cured indisposition of the liver.

Nicols, in the "Arcula Gemmea," published in 1653, said:

> Wurtzung, in his general practise, saith that the beryll is used in all distempers of the heart. But take this caution by the way: Beware of the use of gemms (unless you are sure they be true) in physick, by reason they are so frequently adulterated.

Bloodstone.—Symbolical of wisdom, firmness, and courage.

Used with the proper incantations, its owner was enabled to foretell the future, and if rubbed with the juice of the heliotrope, it rendered its wearer invisible. The stone brought safety and long life to its possessor, stopped the flow of blood, and was an antidote for poisons. (Camillus Leonardus, Speculum Lapidum. 1502.)

Albertus Magnus taught that it cured dyspepsia, strengthened the stomach, and, if "washed according to medicinal art," was a styptic. Mixed with honey or the white of an egg, its powder was held by him to be an excellent remedy for hard tumors, while its dust would cure proud flesh and running sores.

Pliny and Leonardus mention that if placed in a basin of water containing the juice of the heliotrope and set in the sun, the water will appear red and the sun bloody. After a time the water will apparently boil and overflow the basin. Taken out of the water, the sun and solar eclipses could then be viewed in the water as in a mirror.

In a "Booke of the Thinges that are brought from the West Indies," published in 1574, the statement is made—

> They doo bring from the New Spain a stone of great virtue, called the stone of the blood. The Bloodstone is a kind of jasper of divers colours, somewhat dark, full of sprinkles like to blood, being of colour red, of the which stones the Indians dooth make certayne Hartes, both great and small. The use thereof both there and here is for all fluxe of bloode, and of wounds. The stone must be wet in cold water, and the sick man must take him in his right hand and from time to time wet him in cold water. And as touching the Indians, they have it for certayne that touching the same stone in some part where the blood runneth, that it doth restrain.

The bishop of Rennes, in the eleventh century, writing on the talismanic efficacy of stones, asserts that the bloodstone endows its bearer with the gift of prophecy and renders him proof against poison.

During the Middle Ages the belief was prevalent in Europe that the stone had its origin in a dark-green jasper which happened to lie at the foot of the cross at the time of the crucifixion, and upon which the blood of Christ fell, hence the red spots.

Carnelian.—According to Epiphanius, it cured tumors and all wounds made by iron.

It preserved the strength, prevented hoarseness, and cleared the voice. (Camillus Leonardus.)

It cheered the soul, banished fear and enchantments, and preserved harmony. (Albertus Magnus.)

According to the work by Giov. B. Porta, the wearing of a carnelian insured victory in all contests save those of love.

As an amulet and as a powder it was supposed to be a sovereign remedy for hemorrhage. De Laet, in 1647, has described from a personal experience its power in stopping bleeding at the nose, and advises the wearing of rings cut entirely from the stone for this purpose. The belief in its efficacy in such cases still persists.

Cat's-eye.—The cat's-eye cheers the mind, cures pallor, brings on a safe delivery in case of protracted labor, especially if tied in the hair of a patient. Applied locally, it causes infants suffering from the croup to bring up phlegm.

Applied as an ointment to the eyes, it cures lachryma. Calcined, the powder applied to sores heals them, and will cause new flesh to appear in the place of proud flesh. (Ben Adoulah.)

According to the Mani-Málá, "the cat's-eye is warm, sour, and curative of cold, chronic derangements of the spleen, and colic, and is generally auspicious when worn." The same authority says that the perfect cat's-eyes, which are "heavy, deliciously cool, flawless, smooth, and otherwise faultless," are considered very lucky, while those that are defective bring about loss of friends, ruin, and wasting of the body.

The Hindus group the cat's-eye in four castes, according to their quality, all of which are replete with lucky signs.

The Persians held that the stone ground to a fine powder, mixed with water, and then dried in the sun, and the operation repeated until the powder soaks up four times as much water as was first put in, would cure dropsy and inflammation of the navel if applied locally.

The Assyrians dedicated the stone to the god *Belus*, and ornaments containing it would, after the proper religious ceremony, render its wearer invisible to his enemies.

Chalcedony.—Prevented and cured melancholy. Worn as an amulet and in contact with the hairs of an ass, it was a preventive of danger during tempests and sinister events. (Camillus Leonardus, Speculum Lapidum. 1502.)

Reported to drive away evil spirits, a preventive of melancholy and sadness, and would bring victory to its wearer. (Andrea Baccius, Armot. Super. 6, c. de Natur. gem.)

Chrysoberyl.—As an amulet it dispelled evil dreams, fear, and melancholy; in addition, it possessed the properties of the beryl. (The Mirror of Stones. 1750.)

The oriental chrysolite (chrysoberyl) dispelled pestilential vapors and infectious airs. Taken internally, it alleviated asthma. (Rulandus, Medicina Practica. 1564.)

It was said to cool boiling water when immersed in it, soften anger, lose its luster on contact with poison, and induce its wearer to repent of the faults he had committed. (Porta, Magiæ Naturalis. 1561.)

According to the Mani-Málá, the chrysoberyl, when set in gold and worn about the neck or hand, removes disease and vicious habits, and increases family, life, and happiness.

Chrysolite.—Cardanus, in his "de subtilitate," says that he cured one C. Palavicinus of a fever and another person of the "falling sickness" by the administration of powered chrysolite with wine.

The powder was prescribed as a remedy for asthma. Held under the tongue, it assuaged thirst in fever. (Arcula Gemmea. 1653.)

Chrysoprase.—Preserved the sight, banished covetousness, and rendered its wearer cheerful. (Mirror of Stones. 1750.)

Worn as an amulet, it assuaged the pains of gout. (Arcula Gemmea. 1653.)

Bound around the arm, it was supposed to become a diuretic, to expel gravel, and prevent the generation of the stone. (Rulandus, Medicina Practica. 1564.)

Citrini.—The citrini (yellow corundum) protected the wearer from danger while traveling, secured him from pestilential vapors, and procured him every courtesy. (Arcula Gemmea. 1653.)

Coral.—In the "Arcula Gemmea" is a rather interesting account of the coral, as follows:

> This is a bud of maritime beauty, and the delight of children, the best of nature's buds, as somewhat furthering the springtide of their growth. The corall is a plant of nature's setting in the sea, which, though being covered with the waters of the sea, it bee green and soft, yet so soon as it is elevated above the waves and discovered in the region of the aire it altereth its colour and changeth its nature: its colour from green to a very noble and beautifull red; its softnesse into the compacted firmness and solidnesse of a stone, beautifull and lasting; by the operation of the aire encompassing its sometimes soft and flaccid substance. It is (under the waters of a brinish sea) a thriving, growing plant, sprung by nature with the ornament of many pretty branches, which is no sooner violently forc'd from the place of its growth and brought to light above the overflowing of the waters, but it blushes at the injurious hand that offereth violence to its secret, silent, tender, spreading growth.

Ovid, the Roman poet, accounts for the origin of the coral in the "Metamorphoses" in the following manner:

Perseus, having cut off the head of the Medusa, placed it upon some twigs and leaves near the seashore. The twigs were turned to stone on contact with the head, were scattered far and wide beneath the sea by sea nymphs, and thus became the seeds of coral.

The coral was thought to be of greater beauty when worn by a man than by a woman. By its change of color it was thought to forewarn the approach of disease; and should the wearer become dangerously sick, the gem became spotted. Worn as an amulet, it drove away fear, kept men from the influence of sorcery and evil spirits. It was a protection against poison, plague, and storm. (Arcula Gemmea. 1653.)

It secured women from *incubus* and men *succubus* and hindered the delusions of the devil. [Dioscorides, De Materia Medica.]

Coral was administered, according to the following prescription, for vomiting, purging, and colic:

TABELLÆ CORALLATÆ.

℞. Corallorum rubeorum præparatorum, ℥ii; margaritar præparator, ℥i; boli armeni, ʒß; ligni aloes, ℈i. Sacch. albissimi dissoluti in aqua rosaru cinnamomi tenuioris quantum sufficit; fiat confectio in tabellis. [Arcula Gemmea. 1653.]

According to the "Medicina Practica" of Rulandus, written in 1564, a half a drachm of powdered coral was given as a cardiac stimulant;

and in all contagious diseases, fevers, and poisonings the "tinctura corallorum" and the "sal corallorum" were equally efficacious.

Stopped every flux of blood; drove away ghosts, illusions, and dreams; was a protection against lightning, wind, tempest, and attacks of wild beasts. (Methrodorus.)

It gave relief to pains in the stomach and heart and strengthened those organs. It made sound diseased gums, and cleansed putrid sores. The powder, taken with wine, was given for the gravel. If hung on fruit-bearing trees, it insured fertility and protected them from hail and blighting winds. A kind known as *Grogius* had the power of stopping thunder and lightning. [Leonardus, Speculum Lapidum. 1502.]

Before the time of Pliny coral was held in great esteem, but during his period it was apparently not so highly appreciated, since he remarks "that formerly it was deemed a most excellent antidote for poison." During the Middle Ages, however, it was in great repute throughout Europe both as a drug and as an amulet. It was at that time deemed a powerful astringent, and in demand as a talisman against witchcraft, poison, epilepsy, etc.

Boetius de Boot, writing in 1636, says that he was cured of a dangerous pestilential fever by taking 6 drops of tincture of coral. A. de Villenevee prescribed 10 grains of coral for infants in order to preserve them from epilepsy or any other fit through life. It is still in repute as a preservative against children's diseases and is not infrequently worn suspended from the neck for this purpose. In India it is occasionally given to children in the hope of ridding them of the hives and kindred itches.

According to the Mani-Málá a deep red coral was worn as an immediate cure for poisoning. Kar, an oriental sage, says that any man who wears an ugly discolored and rough coral courts death.

Sanskrit medical science taught that coral is sour, sweet, a specific for cold and biliousness, nutritious, and grace imparting; and the wearing of it very beneficial to women.

According to the Arabic and Persian writers, as given by Tagore in his Treatise on Gems, a dose of coral was considered to be a good astringent, a remedy for all bleedings, and an antidote for all poisons. Worn over the parts it cured all stomach complaints; worn around the neck it stopped crying in infants and protected them from fear and sudden starts while asleep. In Afghanistan the coral mixed with gold dust is given as a tonic. In Egypt it is used according to the following receipt:

Cut open a lemon and put a piece of coral inside, cover the opening with a paste of clay, and place the whole under a fire for some time until it gets white from burning; remove it and after grinding the stone use it as an ointment for the eyes. Mixed with electuaries and taken internally it will give great physical strength.

Porta, in his Magiae Naturalis, says that the coral will arrest the flow of blood and keep off evil spirits. This belief still persists in Italy where a hand holding a branch of coral is not infrequently worn as a protection against the evil eye.

Diamond.—This stone being of all gems the purest, hardest, and most brilliant, was considered to be the most powerful in spiritual influences and was consecrated to all that was holy and heavenly.

It was symbolical of constancy, purity, and innocence, and hence early used in betrothal rings. It softened anger, strengthened love, and was considered an infallible test of conjugal fidelity. To the ancients the diamond represented inexorable justice and unchangeable fate, hence the judges of Hades were described as having hearts and bosoms of adamant.

According to the Talmud, a certain gem, supposed to have been the diamond, worn in the girdle of the high priest, if brought in contact with an accused man became dark and dim if the suspect was guilty; if innocent the stone shone with increased brilliancy.

In Europe as late as 1700 the diamond was thought to be the most potent talisman against poison, pestilence, witchcraft, etc. It was esteemed a safeguard to virtue; was used as a preventive of and a cure for lunacy. It was supposed to drive away lemures, incubi, and kindred terrors; and was considered a preservative against lightning. The gem was supposed to possess sex, and Boetius de Boot mentions two such diamonds which by their union produced others and thus left a numerous progeny.

Sir John Mandeville also bears witness to the procreative powers of diamonds:

They grow together, male and female, and are nourished by the dew of heaven; and they engender commonly, and bring forth small children that multiply and grow all the year. I have oftentimes tried the experiment, that if a man keep them with a little of the rock, and wet them with May dew often, they shall grow every year and the small will grow great.

Speaking further concerning the diamond, Mandeville held that in order to secure the greatest good from a diamond it should be worn on the left side.

For it is of greater virtue than on the right side; for the strength of their growing is toward the north, that is the left side of the world, and the left part of a man is when he turns his face toward the east. He who so carries the diamond upon him, it gives him hardness and manhood, and it keeps the limbs of his body whole. It gives him victory over his enemies, if his cause is just; and it keeps him that bears it in good wit; and it keeps him from strife and riot; from sorrows and enchantments; and from phantasies and illusions of wicked spirits. It makes a man stronger and firmer against his enemies; and heals him that is a lunatic, and those whom the fiend pursues or torments. And if venom or poison be brought in presence of the diamond, anon it begins to grow moist and sweat. Nevertheless, it happens often that the good diamond loses its virtue by sin, and for incontinence of him who bears it; and then it is needful to make it recover its virtue again, or else it is of little value.

Pierre de Boniface, a fourteenth century alchemist, taught that one of the virtues of the diamond was to render its wearer invisible and invincible.

In this connection the Shah of Persia is the possessor of a diamond set in a scimitar which is believed to render him invincible so long as he has it by him. The shah also has a five-pointed star of diamonds which is thought to make conspirators instantly confess their crimes when in its presence.

A diamond ring was given to Mary Queen of Scots, by Ruthven, as a talisman against danger and poison. The queen also possessed two other diamonds—"one medicinable and against poison," the other "medicinable for the collicke."

According to the Puranas, the diamond varies in the preponderance of one or the other of the five primal elements—

Earth, water, sky, energy, and air. The "airy" sort gives heart and gracefulness, the "skyey" diamonds bring about the possession of all kinds of wealth. The ownership and use of those kinds in which energy predominates adds to puissance, heroism, and hope. Those diamonds which are white like the jessamine flower, white clouds, or the moon, and are possessed of six or eight corners, sharp ridged, that have originated from water, and that shine in the darkness, lead to the instant cure of snake bites, and prove efficacious in neutralizing the effects of other poisons, and prove a panacea as soon as worn.

Like men, diamonds are divided into castes, Brahmins, Vaisya, Kshatriyas, and Súdras. The wearing of superior Brahmin diamonds gives favor in the eyes of the gods. The better sort of the Kshatriya class bring about uniform success, accession of power, and destruction of foes. The best stones of the Vaisya class are productive of fame, wisdom, and skill in the fine arts. The higher order of the Súdra caste induce benevolence in their owner and make him hale and wealthy.

As the promiscuous intercourse of one caste with another gives rise to mixed castes among men, so it is with diamonds. These mixed castes give rise to impurities and flaws in the stones, and which, according to their nature and kind, are fraught with grave trouble to man. Such diamonds cause: Unchastity; brings destruction; renders man apprehensive of snake bites; creates fear; leads to ruin, loss of family dignity, and death. Such stones are dangerous to pregnant women and contact with them may lead to abortion.

A shapeless diamond is fraught with danger; a dirty diamond with grief; a rough diamond with unhappiness, and a black diamond with various troubles. A three-cornered diamond gives rise to quarrels; a four-cornered diamond occasions various fears; a five-cornered one brings death; but a six-cornered stone is productive of good.

Since the use of impure diamonds leads to danger, causes swelling in wounds, faintness, leprosy, pleurisy, jaundice, etc., it is highly advisable to refine and purify the stone before using it medicinally.

The process is as follows: On some auspicious day dip the diamond in the juice of *Kantakari* (solarium jaquiri) and then burn it in a fire made of dried cow or buffalo dung. The burning should be carried on for a whole night. In the morning the diamond should be put under horse's urine and again burnt. These operations are continued for seven days. The stone is then immersed in a gruel made of various leguminous seeds to which assafoedita and rock salt have been added and heated repeatedly twenty and one times. By this means the diamond is purified and reduced to ashes. The taking of a diamond so treated gives longevity, strength, energy, beauty, develops the parts, and effects a cure for every distemper. (Mani-Málá.)

The Brahmin diamond is useful in chemical operations, and brings about the acquisition of power, friends, wealth, position, and good luck to one's family. A Kshatriya diamond wards off old age and premature death; a Vaisya one crowns every endeavor with success; while a Súdra one is a panacea.

The Hindu held that the diamond was masculine, feminine, or neuter according to its marking and appearance. The masculine kinds were considered the best, and were useful in medicine. The feminine diamond was auspicious to women; but the neuter diamond was destructive of vigor and brought weakness and disappointment; as a medicine it was administered for impotency.

According to the views of Arabian and Persian authorities the diamond, if worn, imparted health and dispelled fear. Tied around the thighs of a woman about to be confined it brought on a safe and speedy delivery and assuaged the pain of labor. Cut into a hexagon and worn on the arm it cured epilepsy. Combined with other ingredients and used as a dentifrice it rendered the teeth bright and hard; its use in this manner was attended with risks, for on too long a contact with the teeth it caused them to fall out; while the presence of a single particle in the stomach was liable to produce death. It was a fatal poison if taken internally without electuaries; and

> if by accident one takes a quantity of it his life should not be considered safe until he is made to vomit it out by means of drinking a quantity of fresh cow's milk or some heated clarified butter, or by any other means, such as applying the fingers to the inside of the throat. The soup of some fatty flesh is then to be given to the patient to complete the recovery. (Tagore, Treatise on Gems.)

The Burmese call the diamond and arsenic by the same name, *chein*, on the ground that they are both fatal poisons.

This idea was not unknown in Europe, for we find the diamond listed as one of the poisons given to Sir Thomas Overbury when a prisoner in the Tower; while Benvenuto Cellini, the famous goldsmith, writing about 1560, relates how his life was preserved by the roguery of an apothecary, who, being employed to pulverize a diamond intended to be mixed in a salad for Cellini with the intention of poisoning him, substituted a beryl as cheaper, thus saving the life of Cellini.

According to Sanskrit medicine the diamond combined all the six tastes, cured every disease, brought health and strength, and was very useful in chemical operations. (Mani-Málá.)

In Egypt the diamond, when set in gold, gives health and wealth to its wearer.

According to Porta, in his Magiae Naturalis, the diamond contends against sleeplessness, enchantments, and turns away wrath.

Rabbi Benoni, a fourteenth century mystic, held that the diamond was capable of producing somnambulism, and when used as a talisman with lodestone and sapphire it would attract such powerful planetary influences as to render its wearer almost invincible.

In Art Magic; or Mundane, Submundane, and Supermundane Spiritism, it is stated that the diamond is the most powerful of all stones to promote spiritual ecstacy.

Emerald.—Emblematic of happiness. As an amulet it was a preserver of chastity, and betrayed or punished its violation by flying into pieces or losing color. It preserved women in childbirth and eased the pains of labor; water in which the stone had stood hastened the afterbirth. (Leonardus.) Applied to the lips it stopped hemorrhage. When hung around the neck it prevented epileptic attacks. (Albertus Magnus.)

Dedicated to Mercury.

Much used by astrologers for the purposes of divination. (Cardanus, De Lapidibus Preciosis.)

Albertus Magnus cites the case of a certain King of Hungary who, while wearing an emerald, had knowledge of his wife, upon which the stone broke in three parts.

> There is such an enmity betwixt it and illegitimate venery, or the uncleanness of the flesh, as that if it do but touch the skin of an adulterer it will break, and that it doth bridle the reins of lasciviousness and much temper it. (Arcula Gemmea.)

Avenzoar held that it was an antidote for poisons, and that six grains of its powder taken in water made an excellent cordial.

Mundella, a sixteenth century physician, calls attention to the purchase of a fine emerald by Franciscus Maria, Prince of Urbine, for use as a remedy in the treatment of a disorder which he was troubled with. (Arcula Gemmea.)

Ahmed Ben Abdalaziz, in his Treatise on Jewels, says that if a serpent fix his eyes on the luster of emeralds he immediately becomes blind. Thus Moore in "Lalla Rookh:"

> Blinded like serpents when they gaze
> Upon the emerald's virgin blaze.

The Shah of Persia has a small casket of gold studded with emeralds, said to have been blessed by Mahomet, which has the property of rendering the royal wearer invisible so long as he remains celibate.

The San Greal was a chalice made from a single emerald, and which possessed the power of preserving chastity, prolonging life, curing wounds and disease, and other wonderful properties. The Holy Grail was used at the Last Supper, and in it were caught the last drops of the blood of Christ as he was taken from the cross. In the legends and poetry of the middle ages are many notices of the Greal. A subject revived by Tennyson.

The Romans used it to rest, strengthen, and preserve the eyes, a practice which persisted through the Middle Ages, during which period water in which the stone had stood was used as a specific for ophthalmia.

Boetius de Boot gives directions for its treatment for use as a drug as follows:

Pound the emerald in an iron mortar, sift the powder through the muslin, then cover it with *spiritus urinæ;* the spirit must be distilled off, leaving the powder of a gray color, but which will communicate that of the emerald to the spirits of wine.

This taken internally was considered a powerful remedy for many diseases such as dysentery, epilepsy, venomous bites, fevers, etc.

According to Sanskrit medicine—

The emerald is cool, good in poisoning, sweet, and purgative, helps digestion, cures biliousness, removes disrelish, is nutritious, and wards off spectral influences. (Tagore, Treatise on Gems.)

The Hindu authorities held that the perfect emerald was an infallible remedy for all cases of poisoning; cleansed men from sin, brought about success in war, and rendered successful the rites performed according to the Atharva-Veda. The defective emerald lead to sickness, injury, loss of male children, and rendered one liable to bites. (Mani-Málá.)

The Persian and Arabian sages taught that, whether worn or taken as a medicine, the emerald—

bestows contentment of mind, quickens the pulse, gives nourishment to the soul, heart, brains, and stomach, cures epilepsy, removes all bodily pain, stops the vomiting and purging of blood, is an antidote to poison, allays unnatural thirst, ana is a panacea for jaundice, liver troubles, stricture, gravel, and leprosy.

If administered in doses weighing 8 wheat corns to a patient suffering from poison, it neutralizes its action, provided it be taken soon enough. To prevent vomiting of blood, the dose of the emerald should be the weight of 4 barleycorns. The powder applied to the eyes, brings out all impurities therein and stops the flow of fluid substances. When set in a gold ring and worn on the forefinger or thumb, it is a prophylactic against cholera. The ashes of burnt emerald heals ulcers if applied locally.

According to the Rosicrucians, if at the time when Sol enters Libra an emerald be set in a gold ring of the same weight and worn on the finger, its wearer would attain his cherished object and could detect the presence of poisons by the sweating of the stone.

The possessor of an emerald would never become poor.

If a serpent looked at this stone, he was struck with blindness.

The Egyptians held that the best test for a genuine emerald was that a serpent immediately fell to licking it as soon as it came across it.

The Aztecs administered its powder as a remedy for venereal diseases.

Garnet.—Emblematic of constancy. Its virtue was to dispel "poisonous and infectious airs" (Leonardus). During the Middle Ages it was considered to possess the same marvelous and medicinal properties as the ruby, though to a less degree. It gave and preserved health, drove away vain thoughts, and reconciled differences between friends.

Suspended from the neck, it kept off plague and thunder, strengthened the heart, and increased riches and honors. (Giov. B. Porta. Magiae Naturalis. 1561.)

According to the Puranas—

> A garnet which is colored like the conch, the lotus, the black bee, or the sun, and which is strung on a thread, is sound and auspicious, and heralds good fortune. A garnet which is colored like the crow, the horse, the ass, the jackal, the bull, or the blood-stained beak of a vulture holding a piece of flesh, brings on death.

Jacinth.—Procured sleep, riches, honor, and wisdom. A preservative against pestilence and foes. (Leonardus, Speculum Lapidum. 1502.)

Cardanus, in De Lapidibus preciosis, says that he was in the habit of carrying a jacinth about him for the purpose of inducing sleep, which he says "it did seem somewhat to confer, but not much."

Nicols, quoting Cardanus, says that jacinth procured sleep, cheered the heart, drove away plagues, brought protection from thunder, and increased wisdom and honor when worn on the finger or about the neck as an amulet. (Arcula Gemmea. 1653.)

Jade.—Worn as an amulet or administered internally, it was a curative of diseases of the kidney and loins.

Wecker, in the Antidotæ speciale de Lapidibus minus preciosis Alterantibus, says that a nobleman, well known to him, had a fine "nephritick stone," which he wore on his arm—

> by the power of which he voided a very great quantity of gravel, so great as that he feared lest he should suffer harm by so large an expulsion of it in so short a time.

Porta, in the Magiæ Naturalis, says:—It alleviates the pain of the kidneys, expels gravels from the bladder, and when worn as a charm is a preservative against venomous things.

Jasper.—Was a charm against scorpions and spiders. (Boot, Gemmarum et Lapidarum Historia. 1690.)

Checked the flow of blood; strengthened the chest, lungs, and stomach; cured fevers and dropsy; cleared the sight, and prevented conception. (Leonardus, Speculum Lapidum. 1502.)

In the list of valuables left by George, Earl Marischal, who died in 1620, is "ane jaspe stone for steming of bluid."

Mottled jasper, suitably engraved, was believed to prevent its wearer from death by drowning and to render him free from injury while on the water. (Arcula Gemmea. 1653.)

Burton, in the Anatomy of Melancholy, says: "If hung about the neck, or taken in drink, it much resisteth sorrow."

Nonus, a physician of the Middle Ages, reported of it that it cured epilepsy.

Galen asserted that a green jasper, worn as an amulet suspended from the neck so that it was above the navel, would cure dyspepsia and strengthen the stomach.

Jet.—Cardanus (de substilitate, lib. 5) says that—

the wearing of this stone doth secure men from nocturnal fears, from incubus or succubus, or the nightmare, and from evil spirits; and that being drunk will show whether a maid hath her virginity or no.

Believed to dissolve spells and enchantments. "If burned as incense, its smoke drives away devils and relieves the dropsical." (Boetius, De Gagate.)

Bruised in water and given to a gravid animal, it brings forward the foetus. Its powder cures epilepsy and fastens loose teeth. Mixed with the marrow of a stag and taken internally, it cures snake bites. (Speculum Lapidum. 1502.)

Used as a perfume, it prevented irregularity in female periods. (Wurtz, Tab. gener. prac.)

Lapis-lazuli.—Believed to cure melancholia. (Speculum Lapidum.)

Dioscorides, in De Materia Medica, suggests its use as a cure for melancholy, and states that it is a good purgative.

Cardanus advises its use in pectoral diseases of children and in epilepsy. The dose to be five grains. (De Subtilitate.)

Boetius (Tract. de Lapidibus et Gemmis) states that it is a good purgative. Unwashed, it purges by vomiting; washed, it purges by stool. Used for this purpose to-day in India, Chile, and Peru.

A. Mussa Brassavolus (Lib. de Med. purgant.) used it as a purgative according to the following prescription:

℞. Lapidis lazuli praeparati, ʒj. Camphoræ, anisi, cinnamomi, zinziberis, mastiches ana, gr. 6. Misce, cum succo salviæ vel diacatholico fiant pilulæ quinq. Dosis est à ℈ij ad ʒj, aut in pilulis, aut in pulvere, aut in jure, aut in aqua Boraginis, aut in conserva Boraginis, aut in vino cretico.

According to Sanskrit medical science lapis-lazuli is cooling, and a curative of biliousness. (Mani-Málá.)

Lodestone.—Orpheus, in the Hymni et de Lapidibus, says:

It will confer strength, banish disease, and when worn constantly about the person ward off epidemics and plagues. Sitting before it and fixing the eyes earnestly upon it one has but to ask the gods for light on any subject, and the answer will come breathing out through the stone. The soul will hear it and the senses discover it clearly.

In great repute in Europe during the fifteenth, sixteenth, and seventeenth centuries for its numerous virtues as an amulet and drug. Carried about the person it cured cramp and gout; held in the hand during the hour of travail it shortened the time and eased the pains of labor. Bruised and taken with honey, it was used as a purgative; also cured dropsy. The same dose applied locally afforded relief from wounds made by poisoned iron. Taken internally with the juice of fennel it cured disorders of the spleen; applied as an ointment it prevented baldness. A dram of the stone mixed with the fat of a serpent and the juice of nettles caused insanity. The powder thrown over a household fire caused the inmates to flee in a panic, an artifice, according to the popular belief, made use of by thieves. (The Mirror of Stones. 1750.)

It is good against the headache, convulsions, and poisons; and that it causeth easy delivery, and procureth love 'twixt man and wife, and preserveth peace and concord amongst friends, and that it driveth away fears and increases wisdom. Galen and Dioscorides say it. (Arcula Gemmea. 1653.)

Lodestone is in repute to-day as a preventive and cure for cramps, colic, and rheumatism. Among the American negroes it is used as a voodoo stone, and is thought to be a love charm; to possess phallic properties; to increase the strength of the body, and to cure lumbago, rheumatism, and hernia.

Malachite.—Thought to increase the strength and growth of children and ward from them all dangers and infirmities. (Pliny, Nat. Hist.; Solinus, Polyhist., C. 36; Baccius de Nat. gem., C. 29.)

It strengthened the stomach; preserved children from hurt and convulsions. (Arcula Gemmea.)

Boetius states that six grains taken internally acts as an excellent purgative. It will cure "cardialgia" and colic. (Tract. de Lapidibus et Gemmis.)

Held to be a powerful local anæsthetic, for "being taken in drink or bruised in vinegar and applied to the members that are to be cut off and burnt, it makes them so insensible that they feel scarce any pain." (Speculum Lapidum.)

Moonstone.—According to Pliny, "the image of the moon contained therein daily waxes or wanes according to the period of the lunar motion."

During the period of the increase of the moon it was a potent love charm; during the period of decrease it enabled its wearer to foretell the future. Carried in the mouth it became an aid to the memory. As a powder and amulet it was prescribed in cases of epilepsy. (Camillus Leonardus.) It is still used for this purpose among the Basques. (Crevecœur.)

Onyx.—Its origin, according to the Greek legend, was due to Cupid cutting the nails of the sleeping Venus with his arrow; these falling into the Indus were changed to onyx.

The stone was thought to be a powerful aphrodisiac; to increase spittle in children; hasten a birth; give rise to nightmare, and stir up strife. Used as an eyestone "it enters of its own accord, and if it found anything within that is noxious, it drives it out and tempers the hurtful and contrary humors." (Camillus Leonardus, Speculum Lapidum. 1502.)

The belief in its causing nightmare and strife was widespread. This belief was explained by Benoni on the assumption that "in the onyx is a demon imprisoned in the stone who wakes only of a night, causing terror and disturbance to sleepers who wear it."

Among the Persians the onyx is to-day administered as a drug for the cure of epilepsy.

Opal.—Symbolical of hope.

The gem was in great repute as an eyestone, and was used in all diseases of the eye. It partook of all the virtues of those stones whose colors it showed. (Camillus Leonardus, Speculum Lapidum. 1502.)

It stimulated the heart; preserves from contagious and infectious airs; drives away despondency; prevents fainting, heart disease, and malignant affections. (Giov. B. Porta, Magiae Naturalis. 1561.)

The opal was supposed to indicate the state of health of its wearer by change of color, losing its brilliancy if the wearer was ill, and vice versa.

The idea that the opal is unlucky is based on a teutonic superstition, and is comparatively modern. Mention of its supposed evil qualities is made in a work entitled Art Magic; Mundane, Submundane, and Supermundane Spiritism, in which the opal is credited with being fatal to love and sowing discord between giver and receiver.

Pearl.—Emblematic of purity, beauty, and nobility.

Pliny states that pearls were supposed to be generated by a celestial dew falling on the shellfish, which, in the early mornings of certain seasons, left the bottom of the sea to draw in the air containing the dew from which the pearls were derived, the size and quality of the pearl depending upon the size of the dewdrop and the purity of the air. Cloudy weather spoiled the color, lightning stopped the growth, and thunder ruined the gem.

According to the ancient Hindu authorities, pearls were held to originate in elephants, clouds, boars, conch shells, fishes, frogs, oysters, and bamboos. Of these, the oysters were the most productive. The pearls were formed by rain drops falling into the open shell of the mollusk, the finest gems being found during the period when the sun rested on arcturus, the fifteenth lunar asterism.

In the Orient the pearl was and is extensively used as a medicine for syncope, hemorrhage, stomach troubles, etc. In China large quantities of seed pearls are made into an electuary, and taken to restore manly vigor and as a stimulant.

According to Sanskrit medical science, the pearl is "sweet in taste, very cool, and a specific for eye diseases, cures poisoning and atrophy, and brings strength to weak limbs." (Mani-Málá.)

The Arabian and Persian sages held that the use of pearls was conducive to contentment of body and soul; cured insanity and all mental diseases; all diseases of the heart, stomach, and bowels; piles, stricture, and excessive and insufficient menstruation. It was an antidote for poison, stopped bleeding from cuts, and cured leprosy and skin diseases.

Rambam recommends the use of the burnt powder as an ointment in the treatment of ulcers and diseases of the eye, such as conjunctivitis, cataract, etc. The burnt powder taken internally cured vomiting of blood and purging.

According to Egyptian medicine, pearl powder taken with electuaries strengthened the body and added luster to the eyes.

The Hindu authorities recognized four shades as belonging to pearls—yellow, honey, white, and blue. The first brings wealth, the second fosters understanding, the third brings fame, and the fourth good luck. If defective, according to the kind and degree, the pearl brought on leprosy, loss of male issue, loss of fortune, disgrace, slothfulness, insanity, and death. (Mani-Málá.)

According to Art Magic; or Mundane, Submundane, and Supermundane Spiritism, the wearing of pearls brought one en rapport with spirits and promoted chastity.

In Bengal bracelets of pearl are worn by virgins to preserve their virtue.

In Europe as late as the seventeenth century decoctions containing pearls were thought to be powerful mental stimulants and a cure for insanity. A decoction of pearl powder and distilled water was one of the remedies given to the insane Charles, King of Spain.

Leonardus states that pearls boiled in meat would cure the quartan ague; powdered and taken with milk, they healed ulcers and cleared the voice; they comforted the heart, gave relief in cramps and colic, cured epilepsy and dysentery; taken with sugar, they were of assistance in the cure of pestilential fevers, and that they rendered their wearers virtuous.

According to Nicols (Arcula Gemmea), pearls were—

> good against syncopes, and cardiacall passions, that they do comfort the spirits, stop the fluxes of bloud, cure lienteries and diarrheas, and that they are good for the sight.

Prase.—Supposed to possess all the properties of the emerald, but to a less degree. Lost its color on contact with poison or venom, but recovered it again on being washed. Reported to be an excellent cordial and cardiac stimulant. Applied to the eyes, it strengthened the sight. (Arcula Gemmea. 1653.)

Benoni states that the powder mixed with the milk of a ewe that has had but one lamb will, if applied locally, cure the gout; taken internally, it was a deadly poison.

Quartz.—The powder mixed with wine was given for dysentery in the north of England during the twelfth century. A crystal held against the tongue assuaged thirst. (Leonardus, Speculum Lapidum.)

Applied locally to-day in the mountains of Georgia for faintness, headaches, and bleeding at the nose. Used in parts of Virginia to cure styes; the sty is rubbed with the crystal three times a day for three days. In northern New York a so-called "vital ore," consisting entirely of quartz sand, is sold as a veritable panacea, curing sore eyes, piles, carbuncles, indigestion, sore throat, giddiness, and blood-poisoning.

In the Middle Ages the clear, transparent quartz was believed to betray the presence of poison, either by becoming opaque or breaking. The powder, mixed with wine, was given in dysentery; held in the mouth, it assuaged thirst, cured headaches and faintness; powdered and taken with wine and honey, it filled the breasts of nursing women with milk. (Leonardus.)

Orpheus recommended its use as a medicine for diseases of the kidneys.

Andrea Bacci, writing in 1605, says:

> It is used either in powder, or the salt of it, or the oil of it, against all obstructions of the bowels, against gouts, swoonings, and all cephalic diseases.

A drachm of the powder taken with oil of sweet almonds cures those that have taken sublimate. (Arcula Gemmea. 1653.)

Quartz balls were and are used by mystics, astrologers, and diviners to foretell the future, review the past, and conjure up distant scenes. The famous "show-stone" of Dr. Dee, a sphere three inches in diameter, was made of quartz. It is interesting to note that while the modern mystic and the mystic of the Middle Ages differ somewhat in their methods, each have the same end in view, and each have produced witnesses to show that they attained that end. The methods used to induce a vision as practiced by the mystic of the Middle Ages are as follows: The crystal, according to Scot, in his "Discovery of Witchcraft," when "charged" with the name of St. Helen written on the stone with olive oil while the operator faced the east, and held in the hands of an innocent child born in wedlock, would, upon the recital of a prayer to the saint, become an oracle and answer any question put to it.

In an eighteenth century manuscript is the following statement—

> Take a christall stone or glasse, most clear, without a craise, and wrape about it a pece of harte's lether, saying, "In the name of the Holy Trinity, and of the hey Deity Amen." Then holde the cristalle in the beam where the ☉ is most bright, at the hottest of the day, and say there con (jurations) subscribed, and by and by you shall sie the spirit peradventer, appeiring himselfe.

The spirit is then to be "charged," upon which he will point out the whereabouts of stolen property; the location of buried treasure; give information concerning relatives, friends, or enemies, or such other information as may be desired.

According to Hindu authorities the quartz is—

> cool and cooling, cures hemorrhage from the nose and mouth, and when worn removes baneful astral influences.
>
> The crystal gives strength and cures biliousness, morbid heat, and fistula. A specific for consumption, leprosy, and poisoning. It may enter into medicines as a substitute for diamonds. (Mani-Málá.)

A good rock crystal is an infallible remedy in all cases of poisoning. Wild animals like the leopard, the elephant, the lion, and the tiger, can not approach this gem. It neutralizes snake, rat, and scorpion poisons, and the wearer need never fear drowning, fire, or a thief. A moss-colored, clouded, rough, yellow, dull, dirty, and discolored rock crystal the authorities shun from a distance. (Tagore, a Treatise on Gems.)

Ruby.—Emblematic of love.

A sovereign remedy and amulet against plague, poison, evil thoughts, nightmare, and diverted the mind from sadness and sensuality. (Leonardus, Speculum Lapidum.

It forewarned the wearer of the approach of any misfortune by loss of color. In this connection Wolfgang Gabelchover gives his experience:

On December 5, 1600, as I was travelling from Studtgard in company with my beloved wife, Catherine Adelmann, of pious memory, I observed most distinctly during the journey that a very fine ruby, her gift, which I wore set in a ring upon my finger, had lost almost all its splendid color, and had put on dullness in place of brilliancy and darkness in place of light; which blackness and opacity lasted not for one or two days only, but for several. * * * Whereupon I warned my wife that some grievous mishap was impending over either her or myself, as I foreboded from the change of color in my ruby. Nor was I wrong in my anticipation, inasmuch as within a few days she was taken with a fatal sickness that never left her till the day of her death. And truly, after her decease, its former brilliant color returned spontaneously to my ruby.

Arabian and Persian writers taught that the wearer of the ruby obtained peace of mind and strength of brain.

A *durm* dose of it, taken internally, cures epilepsy, insanity, cholera, and the spitting of blood; causes free circulation of blood throughout the system, and prevents uneasiness of mind. It cures all kinds of poisonings from snake bite or from administration of poison by enemies. It frees the atmosphere from the pollution engendered by cholera. It purifies the blood and brings back to its normal state the fatally quick action of the pulse. The wearer of the ruby in the form of a finger ring obtains from the deity all the desires of his heart and becomes proof against thunder stroke and cholera. Worn over the eyes or applied to them as an ointment it cures all complaints of the vision; over the mouth it takes away the bad smell of it, allays thirst, and gives constant satisfaction to the mind. It brings honor to the wearer. The dose for internal use is from 1 kirat (4 barleycorns) to 1 dang (16 barleycorns). (See the work Karabadin Kabir, as cited by Tagore in his Treatise on Gems.)

The ruby enters into the Chinese pharmacopœia as an ingredient in the "five precious fragments," supposed to consist of ruby, topaz, emerald, sapphire, and hyacinth.

The Hindu writers held that those rubies—

which are flawless and of approved color are auspicious, produce health, wealth, wisdom, and happiness. If flawed or offcolored they bring humiliation, loss of friends, liability to wounds, loss of wealth, and lightning stroke; are fatal to domestic animals, and are inimical to life, wealth, and fame.

The man who treasures a ruby furnished with every perfection, and which when cast in a quantity of milk a hundred times its bulk, makes the white mass one entire sheet of red, or sends out a red flame, is as meritorious as the celebration of the *Aswamedha jajna*.[1] Such a stone leads to wealth, success, happiness, and long life. (Mani-Málá.)

Sapphire.—Emblematic of wisdom. If placed on the heart it bestows strength and energy. St. Jerome states that the sapphire procures royal favors, softens anger, frees people from enchantment, obtains release from captivity, and prevents evil and impure thoughts.

Because of its extreme coldness it was thought to preserve the chastity of its wearer, hence especially suited for ecclesiastical rings.

Worn in a ring or in any other manner it is able to quench concupiscence, and for this reason it is proper to be worn by the priesthood and by all persons vowed to perpetual chastity. It is said to grow dull if worn by an adulterous or lascivious person.

It rendered its wearer chaste, virtuous, pious, devout, wise, amiable, and pacific. It cured boils, carbuncles, and headaches, rested and refreshed the body, and gave a color to the cheeks. Taken with milk it cured cramps. (Leonardus, Speculum Lapidum. 1502.)

Soaked in vinegar its vinegar extract was administered in fevers; powdered and soaked in vinegar for one phase of the moon, it was given to insure continency and conjugal love. (Galen.)

Placed on the heart it cured fever; on the forehead it stopped bleeding at the nose. The powder taken with milk was a remedy for fevers, plague, and poison. (Albertus Magnus.)

The powdered sapphire used as an ointment cured inflammation and irritation of the eyes; it was also thought to be able to draw out any foreign substance that might be present in them. (Canones Medicinæ.)

According to Giov. Porta the sapphire was of great service in necromancy and the magic arts, and a deadly enemy to all venomous reptiles and insects. (Magiae Naturalis. 1561.)

The Hindus regarded the stone as unlucky and as a bringer of misfortune. Thus—

A sapphire, the surface of which wears a mica-like sheen, * * * brings about loss of wealth and life. That mark in a sapphire which at first sight looks like a rift, * * * renders one liable to bites. That sapphire which is parti-colored causes loss of family dignity. The sapphire which contains dirt produces a variety of skin diseases like itching. That which contains gritty fragments is destructive; that which is rough causes banishment. (Mani-Málá.)

The same authority says, however, "that sapphire which when placed in a pot of milk darkens it all through, increases wealth, and is conducive to fame and increase of family," while "a flawless, sterling sapphire brings its wearer strength, fame, and length of days," and "the man who wears a sapphire of spotless chastity finds favor with *Narayana*,[2] and acquires longevity, family dignity, fame, understanding, and wealth."

[1] The Horse Sacrifice, a celebrated ceremony, the antiquity of which dates back to the Vedic period.

[2] The preserver of the Hindu Triad.

According to the Sanskrit medical science the sapphire is bitter, warm, and good in cold and biliousness, and when worn alleviates the rage of *Sani*.[1]

In Egypt the sapphire is taken with *majoom* (electuaries) to add strength to the body. (Tagore, Treatise on Gems.)

The Buddhists esteem the sapphire above all gems, claiming that it produced tranquillity of mind, and when worn by one wholly pure and devoted to God insures protection against disease, danger, and venomous reptiles.

The saphire is of a cold and drie faculty, even as are most pretious stones; it is reported of it that it is good against feverish distempers, hence this old distick.

Corporis ardorem refrigerat interiorem
Sapphirus, & cypriæ languida vota facit.

The best of these are very comfortable to the eyes if they be often looked on. (Arcula Gemmea. 1653.)

It is reported of it that if it be worn by an adulterer, by loosing its splendor it will discover his adultery. (Cardanus, De Lapidibus preciosis.)

The sapphire is of so contrary a nature to poisons that if placed in a glass with a spider the insect will quickly die. (Arcula Gemmea. 1653.)

St. Jerome wrote that the sapphire conciliates to its wearer the condescension of princes, quells his enemies, disperses sorcery, sets free the captive, and may even assuage the wrath of God.

In the inventory of the jewels of Charles V, mention is made of a "bluestone with two clasps of gold, good for the gout."

In the church of Old St. Paul's, London, was a famous sapphire which was supposed to cure the infirmities of the eyes of all those thus afflicted who might resort to it.

The modern mystic holds it capable of attracting powerful planetary influences, and nearly equal to the diamond and quartz in inducing visions. (Art Magic; or Mundane, Submundane, and Supermundane Spiritism.)

The star sapphire was and is still reputed to be a potent love charm. The powder of this gem was taken as an aphrodisiac during the Middle Ages. Star sapphire as a powder was given for vertigo in the low countries as late as 1810.

Sard.—Said to possess sex.

The males shine brighter than the females; for the females are the fattest and glitter more obscurely. (Leonardus, Speculum Lapidum.)

The sard nullified the evil effects of the onyx when worn with it; sharpened the wit; gave cheerfulness, and prevented dysentery. (Albertus Magnus, Leonardus, and De Boot.)

Epiphanius, writing in 1565, says that the sard conferred upon its wearer a cheerful heart, courage, and presence, and protected him from witchcraft and noxious humors.

[1] One of the stars influencing the destinies of men.

Baccius in his Annotations says that powdered sard taken in spirits stops the menses and prevents miscarriage.

Sardonyx.—Symbolical of conjugal bliss. It rendered its possessor virtuous, cheerful, and agreeable. (Leonardus, Speculum Lapidum, 1502.)

Spinel.—Reconciled differences between friends; gave health and strength to the body; cured disorders of the liver; restrained passion and fiery wrath; and was a preservative from lightning. (Leonardus.)

Powdered and taken with water Arnobis used it as a remedy for diseases of the eye. (Dissertatio Medica.)

Boetius held that the wearing of a balas ruby (spinel) restrained fury, wrath, and lust.

In the Arcula Gemmea, written in 1653, the author, Nicols, says:

Rulandus reporteth this of it. That if the four corners of a house, arbor, or vineyard be covered with this stone it will preserve it from lightning, tempests, and worms.

According to Arabian and Persian medicine, the wearing of the spinel gives contentment, prevents the spitting of blood, cures piles, and all diseases caused by the increase of phlegm. The dose for internal use is from 1 *kirat* (4 barleycorns) to 1 *dang* (16 barleycorns). Applied as an ointment to the eyes the stone adds to their luster.

According to an Arabic work, entitled Azaabul beldan, as cited by Tagore:

The sea cows get spinel stones from the Kokaf Mountains and put them on the ground when they come grazing toward Ceylon. The stone gatherers, who remain concealed all about, then come out in stealthy steps, carefully throw lumps of clay over the stones left, and then retire. When after grazing these animals go back to the sea, disappointed at not finding the stones and fretting and fuming with rage, those people came back and took away the precious stones.

Staurolite.—In Brittany, France, a superstitious reverence is attached to the cruciform crystals of this stone, based on a belief that they fell from heaven.

In Virginia and the Carolinas the staurolite, locally known as fairy stone, is worn as a lucky charm and is believed to bring good fortune and ward off danger and disease.

Sunstone.—According to Sanskrit authorities—

the sunstone is warm, flawless, and good in cold and defective oxidation, and sacred; it is an *elixir vitæ*, and is the delight of the Sun. (Mani-Málá.)

Topaz.—Symbolical of friendship.

It cooled boiling water on being immersed in it; became opaque on contact with poisons; restrained anger and desire; cured insanity; checked the flow of blood; cleansed hemorrhoids, and averted sudden death. (Camillus Leonardus, Speculum Lapidum.)

Benoni states that the topaz is favorable for all hemorrhages, and imparts strength and good digestion. Powdered and taken in wine it cured asthma and insomnia. (Dissertatio Medica.)

Rubbed on a hone the topaz gave a milky juice in quantities, and yet lost none of its original weight. The juice was taken internally in cases of dropsy, and certain poisonings. Used as an ointment it was in repute as a curative for diseases of the eye. (Epiphanius.)

Worn as an amulet, so says Porta, it drove away sadness and nightmare; strengthened the intellect and bestowed courage. Mounted in gold and hung around the neck it dispelled enchantments; worn on the left hand it preserved its wearer from sensuality.

In the Honest Jeweller, written in the seventeenth century, the statement is made that—

the virtue and strength of the topaz is said to increase and decrease with the moon, and consist in the fact that when thrown into boiling water, it at once deprives it of its heat.

According to the Sanskrit authorities, the—

topaz is sour, cool, and curative of abnormal oxidation, gives an appetite, and brings fame and wisdom.

The Hindu sages held that the medicinal properties of the topaz were similar to those of the coral, and in addition it prevented and cured sterility. (Mani-Málá.)

Like the ruby, the topaz was supposed to possess the power of emitting light to a great degree. A topaz given by the wife of Theoderic, count of Holland, to Adelbert, gave out so brilliant a light in the chapel where it was kept that prayers could be read by it.

Turquoise.—Emblematic of success. Highly valued by all orientals and worn by them to insure health and success. Supposed to preserve the wearer from injury through accidents. In the presence of poisons the stone sweated profusely, a property thought to be characteristic of many of the noble gems. Its color paled as its owner sickened and was lost entirely on his death, to be recovered only on its becoming the property of a healthy person.

The turquoise, according to Arabian and Persian authorities, as cited in the Mani-Málá, cured all diseases of the head and heart. A sovereign remedy for hernia, swellings, flatulence, dyspepsia, insanity, and cancerous sores. Whether taken alone, mixed with honey or with other drugs, it cures epilepsy, spleen, and stricture. In cases of poisoning or snake bite, it was given with wine. Aristotle advises a similar dose for the same purpose. Applied as an ointment to the eyes, it increased their luster, restored the vision, and prevented the fall of fluids therefrom. Worn as an amulet, the turquoise brought happiness, dispelled fear, and rendered its wearer safe from drowning, lightning stroke, and snake bite. Seen after looking at the moon on the first day after the new moon, it brought good luck.

In Egypt cure of a cataract is believed to be effected by the local application of a turquoise set in a silver ring and dipped in water, the application being accompanied by the chanting of the name of God.

Variolite.—Supposed to be a preventive and cure for variola (smallpox). (Castellani, History of Gems.)

Water sapphire or iolite.—A woman possessing a ring set with this stone as a signet and on which was cut one-half of a fish, a mirror, a branch, and a nude female, procured any desire.

Zircon.—Supposed to bring riches, honor, and wisdom; a charm against plague and evil spirits; and afforded its wearer protection against thunderbolts. (Europe During the Middle Ages.).

According to the Mani-Málá—

> The wearing of a weighty, lustrous, white, cool, tender, very old, and transparent gomeda (zircon) leads to prosperity. A light, discolored, exceedingly rough, delusion creating, and cool, yet dirty, gomeda blights happiness and saps the foundations of energy.

The same treatise, speaking of its medicinal value, says:

> The zircon is sour, heating, and curative of unhealthy oxidation, sharpens the appetite, helps digestion, and takes away sin.

In conclusion, it would be expected to find the belief in the marvelous and medicinal properties of gems prevalent during the age of faith, while during the age of reason and inquiry it seems somewhat childish that they should still continue to exist. In India, the land of occultism, the mystics still pursue their researches after the occult virtues of precious stones. The modern Western spiritualist endeavors to discover and apply the occult knowledge of the East. He still believes in and teaches the virtues of gems, and is emphatic in his opinion that certain gems facilitate the rapport of a certain class of spirits with the wearers of those gems.

Swedenborg, the Swedish mystic, in his spirit revelations to L. A. Cahagnet, as cited in his Magie Magnetique (Paris, 1838), gives numerous categorical answers to questions asked by the medium concerning the spiritual and material powers of certain precious stones.

In Paris a school has been established which has for its object the study of the magnetic emanations, radiance, and crystals. In Nice a Dr. de Lignieres has issued a prospectus of a work of 644 pages that seriously considers the medicinal properties and virtues of precious stones.

IX. CATALOGUE OF THE ISAAC LEA COLLECTION OF GEMS.

PREFATORY NOTE.

The exhibit of gems made by the United States National Museum at the New Orleans and Cincinnati expositions in 1884 and 1885 marked the beginning of what is now one of the most complete public collections of gems in the United States. From 1886 to 1890 the growth of the collection, through gift or purchase, was steady, though slow. In 1891 the museum purchased, for exhibition at the World's Columbian Exposition at Chicago, the greater part of a collection of gems belonging to the estate of Dr. Joseph Leidy, of Philadelphia, and which was incorporated with the museum collections proper at the close of the exposition. In 1894 it became the possessor, under the provisions of the will of Mrs. Francis Lea Chamberlain, of a valuable collection of 1,316 gems formerly belonging to her father, Dr. Isaac Lea, of Philadelphia. This collection, known as the "Isaac Lea Collection of Gems," has, since that time, been steadily increased by contributions from Dr. L. T. Chamberlain. A notable accession of gems and gem minerals, chiefly from the United States, was received from Dr. Chamberlain in 1896. This, added to the original "Lea Collection," made it so large that it was decided to incorporate with it all of the gem material belonging to the museum, distinguishing those specimens obtained by gift or deposit, other than the Lea material, by a special label. In 1897 Dr. Chamberlain was appointed honorary custodian of the collection, and largely through his efforts the collection now contains a fine series of gems native to the United States, including nearly every variety and representing the majority of the gem localities.

In the catalogue is given the name, locality, description, and catalogue numbers of each specimen, and, when donated or deposited, the name of the parties from whom it was received. As all the stones were weighed in grams, the weights are given in carats and decimals of carats, instead of the more cumbersome fractions. The carat is equal to 0.205 gram; its fractions are known as fourths, eighths, sixteenths, thirty-seconds, and sixty-fourths.

CATALOGUE.

Adularia, see Orthoclase.

Agalmatolite. China. A small greenish-gray snuff bottle. Cat. Nos. b–899; 83553.

Agalmatolite. China. A carving representing a bird and a tree. Cat. Nos. b–900; 51515.

Agalmatolite. China. A carving representing a group of five baboons. Cat. Nos. b–902; 51515.

Agalmatolite. China. Two carved images. Cat. Nos. b–903, 904; 81803.

Agalmatolite. China. Two carvings. Cat. Nos. b–905, 906; 84236.

Agalmatolite. Japan. A carved platter brought to Holland by Dutch merchants early in the seventeenth century. Cat. Nos. b–907; 46057. Deposited by G. Browne Goode.

Agate, see Quartz.

Agatized wood, see Quartz.

Albite, var. moonstone. Amelia Court-House, Virginia. Colorless. Double cabochon cut; 18 by 14 by 10 mm. Cat. Nos. c–285; 50329.

Albite, var. moonstone. Amelia Court-House, Virginia. Colorless. Cabochon cut, elliptical girdle. Four stones varying in size from 10 by 8 by 4 mm. to 16 by 11 by 5.5 mm. Cat. Nos. c–286–9; 47846.

Albite, var. moonstone. Amelia Court-House, Virginia. White, opaque, with fine change of color. Single cabochon cut; elliptical girdle; size, 30 by 16 by 8 mm. Cat. Nos. c–290; 84184.

Albite, var. moonstone. Amelia Court-House, Virginia. White, opaque, with change of color. Double cabochon cut; elliptical girdle; size, 14 by 8 by 6 mm. Cat. Nos. c–291; 84184.

Albite, var. moonstone. Amelia Court-House, Virginia. White, opaque, with change of color. Single cabochon cut; elliptical girdle; size, 46 by 30 by 8 mm. Cat. Nos. c–292; 84184.

Albite, var. moonstone. Amelia Court-House, Virginia. White, opaque, with change of color. Single cabochon cut; elliptical girdle; size, 37 by 25 by 9 mm. Cat. Nos. c–293; 84184.

Alexandrite, see Chrysoberyl.

Almandite, see Garnet.

Amazon stone, see Microcline.

Amber. Coast of the Baltic. Color, wax yellow. A carved bottle 6.5 cm. high. Cat. Nos. c–72; 51338.

Amber. Coast of the Baltic. Color, yellow. Pair of cuff butttons. Cat. Nos. c–91–2; 84246.

Amber. Coast of the Baltic. A breastpin of 3 beads and a pendant. Cat. Nos. c–93; 84247.

Amber. Coast of the Baltic. Necklace of 50 beads on a silk cord. Cat. Nos. c–94; 84248.

Amber. Burmah. Color, resin yellow. A heart-shaped charm. Cat. Nos. c–95; 50259.

Amber. Burmah. Color, resin brown. A mass of amber having one side polished. Cat. Nos. c–96; 50259.

Amethyst, see Quartz.

Andalusite. Brazil. Color, dark green. Brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1 carat. Cat. Nos. a–566; 50326.

Andalusite. Brazil. Color, brownish green. Step-brilliant cut; square girdle. Size, 6 by 3.5 mm.; weight, 0.70 carat. Cat. Nos. a–567; 50371.

Andalusite. Brazil. Color, brownish green. Step-brilliant cut; rectangular girdle, size 11 by 6 by 3 mm.; weight, 1.35 carats. Cat. Nos. a–568; 84105.

Andalusite. Brazil. Brownish green. Step cut; rectangular girdle. Size, 10 by 4.5 by 2 mm.; weight 0.81 carat. Cat. Nos. a–569; 84105.

Aquamarine, see Beryl.

Aragonite. Colusa County, California. Single cabochon cut. Color, brown. Size, 27 by 14 by 7 mm. Cat. Nos. a–597; 84114.

Aragonite. Colusa County, California. Color, brown. A polished slab. Cat. Nos. b–840; 48540.

Aventurine, see Quartz.

Axinite. Dauphiny, France. Color, violet brown. Step-brilliant cut; square girdle. Sizes, 7.5 by 7 by 4.5 mm.; weight, 1.55 carats. Cat. Nos. a–581; 84109.

Beekite, see Quartz.

Beryl. Fitchburg, Massachusetts. Color, yellowish green. Brilliant cut. Size, 6.5 by 5 by 4 mm.; weight, 0.74 carat. Cat. Nos. 787; 50301.

Beryl. Litchfield County, Connecticut. Color, brownish yellow. Brilliant cut; circular girdle. Size, 6.5 by 5 mm.; weight, 0.96 carat. Cat. Nos. 784; 47568. Gift of the New England Mining Company, through J. F. Barse.

Beryl. Litchfield County, Connecticut. Color, greenish yellow. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.06 carats. Cat. Nos. 782; 47568. Gift of the New England Mining Company, through J. F. Barse.

Beryl. Litchfield County, Connecticut. Color, citrine. Brilliant cut; circular girdle. Size, 7.5 by 6 mm.; weight, 1.43 carats. Cat. Nos. 780; 47568. Gift of the New England Mining Company, through J. F. Barse.

Beryl. Avondale, Pennsylvania. Color, citrine. Step-brilliant cut; square girdle. Size, 10 by 10 by 7 mm.; weight, 3.19 carats. Cat. Nos. 792; 50299.

Beryl. Avondale, Pennsylvania. Color, yellow green. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 4 mm.; weight, 2.07 carats. Cat. Nos. 793; 50299.

Beryl. Ray's mine, North Carolina. Colorless. Brilliant cut; square girdle. Size, 8 by 8 by 6 mm.; weight, 1.64 carats. Cat. Nos. 759; 47840.

Beryl. Ray's mine, North Carolina. Colorless. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.35 carats. Cat. Nos. 760; 47840.

Beryl. Ray's mine, North Carolina. Colorless. Brilliant cut; circular girdle. Size, 7 by 7 by 5 mm.; weight, 1.12 carats. Cat. Nos. 761; 47840.

Beryl. Ray's mine, North Carolina. Colorless. Brilliant cut; circular girdle. Size, 7 by 7 by 5 mm.; weight, 1.14 carats. Cat. Nos. 703; 47840.

Beryl. Ray's mine, North Carolina. Colorless. Brilliant cut; square girdle. Size, 7 by 7 by 5 mm.; weight, 1.08 carats. Cat. Nos. 764; 47840.

Beryl. Brazil. Colorless. Brilliant cut; circular girdle. Size, 13 by 6 mm.; weight, 4.55 carats. Cat. Nos. 738; 50296.

Beryl. Brazil. Colorless. Step-brilliant cut; elliptical girdle. Size, 9 by 5.5 by 3.5 mm.; weight, 0.87 carat. Cat. Nos. 740; 50296.

Beryl. Brazil. Color, yellowish green. Step-brilliant cut; oval girdle. Size, 9 by 6 by 3 mm.; weight, 1.23 carats. Cat. Nos. 743; 82843. The Lea Collection.

Beryl. Alabashka, the Urals. Color, yellowish green. Table cut. Size, 31 by 16 by 6.5 mm.; weight, 20.94 carats. Cat. Nos. 713; 50293.

Beryl. Alabashka, the Urals. Color, yellow. Step-brilliant cut; rectangular girdle. Size, 18 by 14 by 10 mm.; weight, 17.04 carats. Cat. Nos. 714; 50294.

Beryl. Alabashka, the Urals. Color, yellow. Table cut. Size, 16 by 13 by 7 mm.; weight, 9.04 carats. Cat. Nos. 715; 50294.

Beryl. Alabashka, the Urals. Color, yellow. Step-brilliant cut; rectangular girdle. Size, 12 by 9 by 5 mm.; weight, 3.03 carats. Cat. Nos. 716; 50294.

Beryl. Alabashka, the Urals. Color, yellow. Brilliant cut; rectangular girdle. Size, 8 by 7 by 6 mm.; weight, 1.69 carats. Cat. Nos. 717; 50294.

Beryl. Alabashka, the Urals. Color, greenish yellow. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 6 mm.; weight, 3.05 carats. Cat. Nos. 718; 84050.

Beryl. Alabashka, the Urals. Color, yellow. Brilliant cut; circular girdle. Size, 8 by 8 by 5 mm.; weight, 1.28 carats. Cat. Nos. 719; 84050.

Beryl, var. aquamarine. Stoneham, Maine. Color, aquamarine blue. Brilliant cut; elliptical girdle. Size, 10 by 9 by 7 mm.; weight, 3.06 carats. A beautiful flawless gem. Cat. Nos. 789; 84065.

Beryl, var. aquamarine. Stoneham, Maine. Color, aquamarine green. Brilliant cut; rectangular girdle. Size, 7 by 6 by 5 mm.; weight, 1.02 carats. Cat. Nos. 790; 84065.

Beryl, var. aquamarine. Paris, Maine. Brilliant cut; rectangular girdle. Size, 7 by 5.5 by 5 mm.; weight, 0.96 carat. Cat. Nos. 791; 50300.

Beryl, var. aquamarine. Royalston, Massachusetts. Color, deep bluish green. Brilliant cut. Size, 14 by 13 by 9 mm; weight, 8.16 carats. Cat. Nos. 785; 84064.

Beryl, var. aquamarine. Fitchburg, Massachusetts. Color, faint green. Trap cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 0.86 carat. Cat. Nos. 786; 50301.

Beryl, var. aquamarine. Fitchburg, Massachusetts. Color, faint yellowish green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.72 carat. Cat. Nos. 788; 50301.

Beryl, var. aquamarine. Portland, Connecticut. Color, deep bluish green. Brilliant cut; rectangular girdle. Size, 17 by 15 by 10 mm.; weight, 13.91 carats. Perhaps the finest specimen ever found at the locality. Cat. Nos. 779; 84063.

Beryl, var. aquamarine. Litchfield County, Connecticut. Color, aquamarine green. Brilliant cut. Size, 8 by 6 mm.; weight, 1.44 carats. Cat. Nos. 781; 47568. Gift of the New England Mining Company, through J. F. Barse.

Beryl, var. aquamarine. Litchfield County, Connecticut. Color, pale aquamarine green. Brilliant cut. Size, 7 by 5 mm.; weight, 1.09 carats. Cat. Nos. 783; 47568. Gift of the New England Mining Company, through J. F. Barse.

Beryl, var. aquamarine. Asheville, North Carolina. Bluish green. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 7 mm.; weight, 2.79 carats. Cat. Nos. 777; 50298.

Beryl, var. aquamarine. Mitchell's Peak, North Carolina. Color, deep greenish blue. Step-brilliant cut; rectangular girdle. Size, 14 by 12 by 10 mm.; weight, 9.32 carats. A superb gem. Cat. Nos. 776; 83729. The Lea Collection, through Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Mitchell County, North Carolina. Color, blue; opaque. Single cabochon cut. Size, 17 by 10 by 6 mm.; weight, 7.24 carats. Cat. Nos. 778; 81309. Gift of J. K. Bruner.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 13 by 9 mm.; weight, 7.43 carats. Cat. Nos. 746; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 11 by 8 mm.; weight, 5 carats. Cat. Nos. 747; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 9 by 6.5 mm.; weight, 2.80 carats. Cat. Nos. 748; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 1.98 carats. Cat. Nos. 749; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 1.48 carats. Cat. Nos. 750; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.09 carats. Cat. Nos. 751; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.01 carats. Cat. Nos. 752; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 6 by 4.5 mm.; weight, 0.85 carat. Cat. Nos. 753; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.70 carat. Cat. Nos. 754; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.64 carat. Cat. Nos. 755; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, bluish green. Brilliant cut; circular girdle. Size, 5 by 3 mm.; weight, 0.39 carat. Cat. Nos. 756; 83731. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. aquamarine. Near Ray mine, North Carolina. Color, pale bluish green. Brilliant cut. Size, 9 by 5 mm.; weight, 1.98 carats. Cat. Nos. 757; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, pale greenish yellow. Brilliant cut; square girdle. Size, 8 by 8 by 6 mm.; weight, 1.78 carats. Cat. Nos. 758; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, pale bluish green. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.28 carats. Cat. Nos. 762; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, faint green. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.03 carats. Cat. Nos. 765; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, pale bluish green. Brilliant cut; circular girdle. Size, 6.5 by 5 mm.; weight, 0.97 carat. Cat. Nos. 766; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, pale bluish green. Brilliant cut; circular girdle. Size, 6 by 5 mm.; weight, 0.85 carat. Cat. Nos. 767; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, faint green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.70 carat. Cat. Nos. 768; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, pale green. Three stones. Brilliant cut; circular girdle. Total weight, 1.40 carats. Cat. Nos. 769–771; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Three small stones; brilliant cut. Total weight, 0.62 carat. Cat. Nos. 772–774; 47840.

Beryl, var. aquamarine. Ray's mine, North Carolina. Color, sea green. Brilliant cut; circular girdle. Size, 12 by 8 mm.; weight, 6.28 carats. Cat. Nos. 775; 50297.

Beryl, var. aquamarine. Brazil. Color, faint sea green. Step-brilliant cut; elliptical girdle. Size, 15 by 12.5 by 7 mm.; weight, 7.68 carats. Cat. Nos. 737; 50296.

Beryl, var. aquamarine. Brazil. Color, bluish green. Step-brilliant cut; elliptical girdle. Size 10 by 7 by 4 mm.; weight, 1.80 carats. Cat. Nos. 739; 50296.

Beryl, var. aquamarine. Brazil. Color faint green. Step-brilliant; oval girdle. Size, 20 by 10 by 5 mm.; weight, 4.52 carats. Cat. Nos. 741; 82843. The Lea Collection.

Beryl, var. aquamarine. Brazil. Color, bluish green. Step-brilliant cut; oval girdle. Size, 17 by 9 by 4 mm.; weight, 2.97 carats. Cat. Nos. 742; 82843. The Lea Collection.

Beryl, var. aquamarine. Brazil. Color, pale green. Step-brilliant cut; oval girdle. Size, 8 by 5 by 3 mm.; weight, 0.55 carat. Cat. Nos. 744; 82843. The Lea Collection.

Beryl, var. aquamarine. Mourne Mountain, Ireland. Color, bluish green. Brilliant cut; circular girdle. Size 8 by 8 by 6 mm.; weight, 1.72 carats. Cat. Nos. 745; 84061.

Beryl, var. aquamarine. Siberia. Color sea green. Rose cut; elliptical girdle. Size, 27 by 23 by 13 mm.; weight, 39.42 carats. Cat. Nos. 693; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Rose cut; elliptical girdle. Size, 26 by 17 by 9 mm.; weight, 21.94 carats. Cat. Nos. 694; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Table cut. Size, 37 by 12 by 9 mm.; weight, 28.89 carats. Cat. Nos. 695; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 19 by 16 by 7 mm.; weight, 12 carats. Cat. Nos. 696; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Table cut. Size, 14 by 14 by 7 mm.; weight, 6.79 carats. Cat. Nos. 697; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 16 by 13 by 7 mm.; weight, 8.44 carats. Cat. Nos. 698; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step cut; rectangular girdle. Size, 19 by 8 by 6 mm.; weight, 6.22 carats. Cat. Nos. 699; 50303.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 14 by 12.5 by 6.5 mm.; weight, 8.03 carats. Cat. Nos. 700; 50295.

Beryl, var. aquamarine. Siberia. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 16 by 11 by 5 mm.; weight, 4.43 carats. Cat. Nos. 701; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 17 by 9 by 5 mm.; weight, 4.79 carats. Cat. Nos. 702; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 17 by 8 by 5 mm.; weight, 4.61 carats. Cat. Nos. 703; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; octagonal girdle. Size, 13 by 13 by 5 mm.; weight, 4.48 carats. Cat. Nos. 704; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 12 by 9 by 5.5 mm.; weight, 3.87 carats. Cat. Nos. 705; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 11 by 9 by 5 mm.; weight, 2.40 carats. Cat. Nos. 706; 50295.

Beryl, var. aquamarine, Siberia. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 10 by 9 by 5.5 mm.; weight, 2.88 carats. Cat. Nos. 707; 50295.

Beryl, var. aquamarine. Siberia. Color, sea green. Step-brilliant cut; elliptical girdle. Size, 11 by 8 by 5 mm.; weight, 2 carats. Cat. Nos. 708; 50295.

Beryl, var. aquamarine. Siberia. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 29 by 22 by 9 mm.; weight, 46.77 carats. Cat. Nos. 709; 82839. The Lea Collection.

Beryl, var. aquamarine. Siberia. Color, sea green. Step-brilliant cut; elliptical girdle. Size, 16 by 12 by 7 mm.; weight, 10 carats. Cat. Nos. 710; 82839. The Lea Collection.

Beryl, var. aquamarine. Siberia. Color, greenish blue. Rose cut; elliptical girdle. Size, 12 by 8 by 6 mm.; weight, 3.20 carats. Cat. Nos. 711; 82839. The Lea Collection.

Beryl, var. aquamarine. Siberia. Color, pale green. Step-brilliant cut; octagonal girdle. Size, 9 by 9 by 5 mm.; weight, 1.90 carats. Cat. Nos. 712; 82839. The Lea Collection.

Beryl, var. aquamarine. Ceylon. Color, pale bluish green. Step-brilliant cut; elliptical girdle. Size, 17 by 13 by 7 mm., weight, 7.52 carats. Cat. Nos. 732; 82840. The Lea Collection.

Beryl, var. aquamarine. Ceylon. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 10 by 7 by 5 mm.; weight, 1.53 carats. Cat. Nos. 733; 82840. The Lea Collection.

Beryl, var. aquamarine. Ceylon. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 8 by 6 by 4 mm.; weight, 0.98 carat. Cat. Nos. 734; 82840. The Lea Collection.

Beryl, var. aquamarine. Ceylon. Color, pale green. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 4 mm.; weight, 1 carat. Cat. Nos. 735; 82840. The Lea Collection.

Beryl, var. aquamarine. Ceylon. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 8 by 6 by 4 mm.; weight, 1.02 carats. Cat. Nos. 736; 82840. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 12.5 by 10 by 6 mm.; weight, 3.90 carats. Cat. Nos. 720; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 12 by 9 by 3 mm.; weight, 3.28 carats. Cat. Nos. 721; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 10 by 7 by 4 mm.; weight, 1.74 carats. Cat. Nos. 722; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 9 by 7 by 3.5 mm.; weight, 1.15 carats. Cat. Nos. 723; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size 9 by 7 by 4 mm.; weight, 1.22 carats. Cat. Nos. 724; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, pale green. Step-brilliant cut; elliptical girdle. Size, 10 by 6 by 3 mm.; weight, 0.88 carat. Cat. Nos. 725; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, sea green. Brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 1.13 carats. Cat. Nos. 726; 82844. The Lea Collection.

Beryl, var. aquamarine. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 9 by 7 by 4 mm.; weight, 1.93 carats. Cat. Nos. 727; 84060.

Beryl, var. aquamarine. Color, sea green. Brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 1.23 carats. Cat. Nos. 728; 84060.

Beryl, var. aquamarine. Color, pale green. Brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 0.81 carat. Cat. Nos. 729; 84060.

Beryl, var. aquamarine. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 7 by 5 by 3 mm.; weight, 0.90 carat. Cat. Nos. 730; 84060.

Beryl, var. aquamarine. Color, bluish green. Step-brilliant cut; elliptical girdle Size, 6 by 4 by 2 mm.; weight, 0.25 carats. Cat. Nos. 731; d–4060.

Beryl, var. emerald. Stonypoint, Alexander County, North Carolina. Color, emerald green. Trap cut. One lot of 26 small emeralds having an average size of 4 by 3.5 by 3 mm. Cat. Nos. 801 to 826; 83127. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. emerald. Stonypoint, Alexander County, North Carolina. Color, emerald green. A crystal 7.6 by 4.2 cm.; weight, 8 oz. 3 dwts., the largest ever found in the United States. It is doubly terminated by base. Cat. Nos. b–865; 83730. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. emerald. Stonypoint, Alexander County, North Carolina. Three crystals. Cat. Nos. b–866–868; 83727. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. emerald. Muso, U. S. of Colombia. A crystal of emerald in a calcite geode. Cat. Nos. b–869; 83848. The Lea Collection; gift of Dr. L. T. Chamberlain.

Beryl, var. emerald. Color, emerald green. Table cut. Size, 8 by 6 by 4 mm.; weight, 1.37 carats. Cat. Nos. 794; 50302.

Beryl, var. emerald. Step-brilliant cut; rectangular girdle. Size, 6.5 by 6 by 3 mm.; weight, 0.68 carat. Cat. Nos. 795; 50302.

Beryl, var. emerald. Trap cut; rectangular girdle. Size, 6 by 5 by 3 mm.; weight, 0.50 carat. Cat. Nos. 796; 50302.

Beryl, var. emerald. A polished pebble. Weight, 4.72 carats. Cat. Nos. 797; 84066.

Beryl, var. emerald. Step-brilliant cut. Three small stones having a weight of 0.40 carat. Cat. Nos. 798–800; 84066.

Beryl, var. emerald. Step-brilliant cut. An emerald doublet set in a gold ring. Cat. Nos. 827; 82842. The Lea Collection.

Beryl, var. emerald. Step cut. An "off-color" stone set in a gold ring. Cat. Nos. 828; 84067.

Beryl, var. emerald. Step cut. Set in a gold ring with 4 diamond chips, one of which is missing. Cat. Nos. 829; 84068.

Beryllonite. Stoneham, Maine. Colorless Brilliant cut; square girdle. Size, 11 by 11 by 8 mm.; weight, 4.88 carats. Cat. Nos. c–423; 51130.

Beryllonite. Stoneham, Maine. Colorless. Step-brilliant cut; square girdle. Size, 10 by 10 by 7 mm.; weight, 3.76 carats. Cat. Nos. c–424; 50334.

Beryllonite. Stoneham, Maine. Colorless. Brilliant cut. Size, 9 by 9 by 7.5 mm.; weight, 3.25 carats. Cat. Nos. c–425; 48449.

Bloodstone, see Quartz.

Bowenite, see Serpentine.

Carbonate of lime. Fossil coral. Petosky, Michigan. A polished block 5.7 by 3.9 by 2 cm. Cat. Nos. b–915; 48325. Gift of E. F. Boss.

Carbonate of lime. Fossil coral. Iowa. Two paper weights. Cat. Nos. b–916; 50394 and b–917; 84238.

Carbonate of lime. Limestone. Japan. A veined black and white limestone carved. The artist has cleverly taken advantage of the colors in the stone and produced a black dragon with Fusi Yama in the distance. Cat. Nos. b–918; 51722.

Carbonate of lime. Lumachelle, or fire marble. Carinthia, Austria. A slab, one of the best of its kind, of highly fossiliferous limestone, in which the original color of the fossils has been so deepened and intensified that it rivals the finest of fire opal. Cat. Nos. b–919; 45015.

Carbonate of lime. Brecciated marble. Japan. Eleven balls averaging 8 cm. in diameter. Cat. Nos. b–922; 84471. Gift of O. C. Marsh.

Carbonate of lime. Onyx. Siskiyou County, California. Two paper weights. Cat. Nos. b–913–4; 47356. Gift of J. S. Diller.

Carbonate of lime. Stalagmite. Rock of Gibraltar, Europe. A mounted cannon. Cat. Nos. b–921; 46005.

Carnelian, see Quartz.

Cassiterite. Chesterfield County, South Carolina. Color, yellow tinged with green. Brilliant-cut stone mounted as a scarf pin. Cat. Nos. a–623; 84170. Deposited by T. M. Chatard.

Catlinite. Couteau du Prairie, Pipestone County, Minnesota. An Indian pipe. Cat. Nos. b–864; 50384.

Catlinite. Couteau du Prairie, Pipestone County, Minnesota. Carving of Indian chief's head cut by Patrick. Cat. Nos. b–863; 45112. Gift of J. F. Boughter.

Cat's-eye, see Chrysoberyl or Quartz.

Chalcedony, see Quartz.

Chlorastrolite, see Prehnite.

Chromic iron. Thetford, Canada. One lot of 5 unbored beads. Cat. Nos. c–248–252; 83343. The Lea collection; gift of Dr. L. T. Chamberlain.

Chrysoberyl. Brazil. Color, greenish yellow. Brilliant cut; square girdle. Size, 11 by 11 by 7.5 cm.; weight, 6.7 carats. Cat. Nos. 640; 60327.

Chrysoberyl. Brazil. Color, greenish yellow. Brilliant cut. Size, 10 by 7 by 5 mm.; weight, 2.44 carats. Cat. Nos. 641; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Step-brilliant cut. Size, 8 by 7 by 4 mm.; weight, 1.80 carats. Cat. Nos. 642; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Table cut. Size, 7 by 5 by 3 mm.; weight, 0.97 carat. Cat. Nos. 643; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Step-brilliant cut. Size, 7.5 by 6 by 3 mm.; weight, 0.94 carat. Cat. Nos. 644; 50327.

Chrysoberyl. Brazil. Color, pale yellowish green. Table cut. Size, 5.5 by 3 mm.; weight, 0.72 carat. Cat. Nos. 645; 50327.

Chrysoberyl. Brazil. Color, pale yellow. Step-brilliant cut. Size, 6 by 5 by 2 mm.; weight, 0.45 carat. Cat. Nos. 646; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Step-brilliant cut. Size, 5 by 5 by 3 mm.; weight, 0.48 carat. Cat. Nos. 647; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Step-brilliant cut; pentagonal girdle. Size, 5 by 5 by 3 mm.; weight, 0.47 carat. Cat. Nos. 648; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. Step-brilliant cut. Weight, 2.53 carats. A lot of 13 small stones. Cat. Nos. 649; 50327.

Chrysoberyl. Brazil. Color, greenish yellow. A lot of 26 small cut stones. Weight, 2.71 carats. Cat. Nos. 662; 82823. The Lea Collection.

Chrysoberyl. Ceylon. Color, dark green. Brilliant cut. Size, 10 by 9 by 7 mm.; weight, 5 carats. Cat. Nos. 634; 50098.

Chrysoberyl. Ceylon Color, dark greenish brown. Step-brilliant cut. Size, 8 by 7 by 6 mm.; weight, 3.01 carats. Cat. Nos. 635; 50098.

Chrysoberyl. Ceylon. Color, brownish green. Step-brilliant cut. Size, 12 by 10 by 4 mm.; weight, 3.81 carats. Cat. Nos. 636; 82823. The Lea Collection.

Chrysoberyl. Ceylon. Color, yellowish green. Step-brilliant cut. Size, 7 by 6 by 5 mm.; weight, 1.86 carats. Cat. Nos. 637; 82822. The Lea Collection.

Chrysoberyl. Ceylon. Color, brown. Step-brilliant cut. Size, 8 by 6 by 9 mm.; weight, 4.15 carats. Cat. Nos. 638; 84048.

Chrysoberyl. Ceylon. Color, brown. Rose cut; circular girdle. Size, 6.5 by 4 mm.; weight, 1.13 carats. Cat. Nos. 639; 84048.

Chrysoberyl, var. alexandrite. The Urals. Color, emerald green. Step cut. Size, 6.5 by 5.5 by 3.5 mm.; weight, 1.07 carats. Cat. Nos. 688; 82821. The Lea Collection.

Chrysoberyl, var alexandrite. The Urals. Color, emerald green. Step-brilliant cut. Size, 6 by 5 by 2 mm.; weight, 0.37 carat. Cat. Nos. 689; 82821. The Lea Collection.

Chrysoberyl, var. alexandrite. The Urals. Color, emerald green. Trap cut. Size, 5 by 4 by 3 mm.; weight, 0.42 carat. Cat. Nos. 690; 82821. The Lea Collection.

Chrysoberyl, var. alexandrite. The Urals. Color, emerald green. Step-brilliant cut. Size, 8 by 7 by 4 mm.; weight, 2.19 carats. Cat. Nos. 691; 84049.

Chrysoberyl, var. cat's-eye. Siam. Cabochon cut; 17 cat's-eyes and 16 diamond chips mounted in a heavy gold tower ring of Oriental workmanship. Cat. Nos. 692; 82847.

Chrysolite. Arizona. Color, bottle green. Brilliant cut; square girdle. Size, 9 by 6 mm.; weight, 2.67 carats. Cat. Nos. a–557; 82818. The Lea Collection.

Chrysolite. Near Fort Wingate, Arizona. Color, bottle green. Brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 1.61 carats. Cat. Nos. a–558; 50101.

Chrysolite. Near Fort Wingate, Arizona. Color, dark green. Brilliant cut; circular girdle. Size, 8 by 5 mm.; weight, 1.44 carats. Cat. Nos. a–559; 50101.

Chrysolite. Near Fort Wingate, Arizona. Color, dark green. Brilliant cut; circular girdle. Size, 7.5 by 5.5 mm.; weight, 1.52 carats. Cat. Nos. a–560; 50101.

Chrysolite. Near Fort Wingate, Arizona. Color, dark green. Size, 7.5 by 5 mm.; weight, 1.20 carats. Cat. Nos. a–561; 50101.

Chrysolite. Near Fort Wingate, New Mexico. Color, dark green. Brilliant cut. Size, 8 by 5 mm.; weight, 1.38 carats. Cat. Nos. a–562; 50101.

Chrysolite. Near Fort Wingate, New Mexico. Color, green. Step-brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1.06 carats. Cat. Nos. a–563; 50101.

Chrysolite. The Levant. Color, yellowish green. Step cut. Size, 15 by 12 by 6 mm.; weight, 8.64 carats. Cat. Nos. a–553; 50331.

Chrysolite. The Levant. Color, bottle green. Step cut; rectangular girdle. Size, 20 by 16 by 7 mm.; weight, 18.06 carats. Cat. Nos. a–554; 84102.

Chrysolite. Ceylon. Color, yellowish brown. Step-brilliant cut; rectangular girdle. Size, 14 by 9 by 8 mm.; weight, 8.27 carats. Cat. Nos. a–555; 82915. The Lea Collection.

Chrysolite. Ceylon. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 5.5 by 5 by 3 mm.; weight, 0.42 carats. Cat. Nos. a–556; 82915. The Lea Collection.

Chrysoprase, see Quartz.

Corundum, var. ruby. Corundum Hill, Macon County, North Carolina. Color, blood red. Step-brilliant cut; rectangular girdle. Size, 9 by 5 by 4 mm.; weight, 1.49 carats. Cat. Nos. 194; 50289.

Corundum, var. ruby. Corundum Hill, Macon County, North Carolina. Color, blood red. Step-brilliant cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 0.87 carats. Cat. Nos. 195; 50289.

Corundum, var. ruby. Corundum Hill, Macon County, North Carolina. Color, blood red. Step-brilliant cut; square girdle. Size, 4 by 4 by 2.5 mm; weight, 0.33 carats. Cat. Nos. 196; 50289.

Corundum, var. ruby. Ceylon. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 11 by 7 by 6.5 mm.; weight, 4.09 carats. Cat. Nos. 197; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, deep rose red. Rose cut; heart-shaped girdle. Size, 13 by 10 by 7 mm.; weight, 6.67 carats. Cat. Nos. 198; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; square girdle. Size, 5 by 5 by 4 mm.; weight, 0.80 carats. Cat. Nos. 200; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; square girdle. Size, 6 by 6 by 3 mm.; weight, 0.86 carats. Cat. Nos. 201; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 6.5 by 6 by 5 mm.; weight, 1.23 carats. Cat. Nos. 202; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; oval girdle. Size, 7.5 by 6 by 3 mm.; weight, 0.72 carats. Cat. Nos. 203; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 4 mm.; weight, 0.80 carats. Cat. Nos. 205; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; circular girdle. Size, 5.5 by 3 mm.; weight, 0.61 carats. Cat. Nos. 206; 82887. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 3 mm.; weight, 0.61 carats. Cat. Nos. 207; 82877. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, blood red. Step-brilliant cut; rectangular girdle. Size, 5.5 by 4.5 by 3 mm.; weight, 0.62 carats. Cat. Nos. 208; 82877. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, bright red. Brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 0.69 carats. Cat. Nos. 209; 82877. The Lea Collection.

Corundum, var. ruby. Ceylon. Color, red, of several shades. 245 small rubies, having a total weight of 21.32 carats. Cat. Nos. 219–464; 82877. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, milky red. Cabochon cut; circular girdle. Size, 7 by 5 mm.; weight, 2.47 carats. Cat. Nos. 199; 82877. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, blood red. Cabochon cut; elliptical girdle. Size, 7 by 6 by 4 mm.; weight, 1.25 carats. Cat. Nos. 204; 82877. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, red. Cabochon cut; circular girdle. Size, 11 by 9 mm.; weight, 9.10 carats. Cat. Nos. 210; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, red. Cabochon cut; circular girdle. Size, 7 by 4 mm.; weight, 1.27 carats. Cat. Nos. 211; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, grayish red. Cabochon cut; circular girdle. Size, 6.5 by 5 mm.; weight, 1.55 carats. Cat. Nos. 212; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, violet red. Cabochon cut; circular girdle. Size, 6 by 6 mm.; weight, 2.30 carats. Cat. Nos. 213; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, milky red. Cabochon cut; circular girdle. Size, 6 by 5 mm.; weight, 1.33 carats. Cat. Nos. 214; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Ceylon. Color, grayish red. Cabochon cut; circular girdle. Size, 6 by 5 mm.; weight, 1.13 carats. Cat. Nos. 215; 82886. The Lea Collection.

Corundum, var. ruby. Asteria. Color, blood red. Cabochon cut; circular girdle. Size, 7 by 4 mm.; weight, 1.53 carats. Cat. Nos. 216; 50264.

Corundum, var. ruby. Asteria. Color, blood red. Cabochon cut; circular girdle. Size, 7 by 7 by 3 mm.; weight, 1.04 carats. Cat. Nos. 217; 50264.

Corundum, var. ruby. Color, blood red. Brilliant cut; square girdle. Size, 5.5 by 5.5 by 4 mm.; weight, 1 carat. Mounted in ring. Cat. Nos. 218; 82888. The Lea Collection.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, dark greenish blue. Step-brilliant cut; rectangular girdle. Size, 11 by 8 by 6 mm.; weight, 3.56 carats. Cat. Nos. 162; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 9 by 7 by 5 mm.; weight, 1.87 carats. Cat. Nos. 163; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, pale greenish yellow. Step-brilliant cut; rectangular girdle. Size, 6 by 4 by 3 mm.; weight, 0.74 carats. Cat. Nos. 164; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 6.5 by 5 by 4 mm.; weight, 1 carat. Cat. Nos. 165; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, prussian blue, with a green play of color. Step-brilliant cut; rectangular girdle. Size, 5.5 by 4 by 4 mm.; weight, 0.76 carats. Cat. Nos. 166; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, pale yellowish green. Step-brilliant cut; rectangular girdle. Size, 6 by 3.5 by 2 mm.; weight, 0.42 carats. Cat. Nos. 167; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, pale bluish green. Step-brilliant cut; rectangular girdle. Size, 5 by 3.5 by 3 mm.; weight, 0.35 carat. Cat. Nos. 168; 50289.

Corundum, var. sapphire. Corundum Hill, Macon County, North Carolina. Color, blue. Step-brilliant cut; oval girdle. Size, 8 by 6 by 3 mm.; weight, 0.94 carat. Cat. Nos. 169; 47314. Gift of Clarence S. Bement.

Corundum, var. sapphire. Montana. Color, pale green. Table cut; rectangular girdle. Size, 9 by 6 by 5 mm.; weight, 2.43 carats. Cat. Nos. 156; 50290.

Corundum, var. sapphire. Montana. Color, bluish green. Step-brilliant cut; square girdle. Size, 5.5 by 5.5 by 4 mm.; weight, 0.80 carat. Cat. Nos. 157; 47315. Gift of Clarence S. Bement.

Corundum, var. sapphire. Montana. Color, greenish blue. Brilliant cut; square girdle. Size, 6 by 6 by 5 mm.; weight, 1.12 carats. Cat. Nos. 158; 84042.

Corundum, var. sapphire. Montana. Color, wine yellow. Brilliant cut; square girdle. Size, 6 by 5.5 by 3 mm.; weight, 0.70 carat. Cat. Nos, 159; 84042.

Corundum, var. sapphire. Montana. Color, bluish green. Brilliant cut; circular girdle. Size, 5 by 5 by 4 mm.; weight, 0.70 carat. Cat. Nos. 160; 84042.

Corundum, var. sapphire. Montana. Color, straw yellow. Brilliant cut; square girdle. Size, 4 by 4 by 2 mm.; weight, 0.26 carat. Cat. Nos. 161; 84042.

Corundum, var. sapphire. Montana. Twenty-one stones selected to show variations in color and varying in weight from 1 to 3.5 carats. Cat. Nos. c. 457; 84478. The Lea Collection; gift of Dr. L. T. Chamberlain.

Corundum, var. sapphire. Yogo gulch, Fergus County, Montana. Color, royal blue. Step-brilliant cut. Weight, 3.5 carats. Cat. Nos. c. 458; 84482. The Lea Collection; gift of Dr. L. T. Chamberlain.

Corundum, var. sapphire. The Urals, Siberia. Color, deep blue. Step-brilliant cut; elliptical girdle. Size, 7 by 6 by 4 mm.; weight, 1.16 carats. Cat. Nos. 170; 50291.

Corundum, var. sapphire. Ceylon. Color, strongly dichroic—c=prussian blue; a=sky blue. Step-brilliant cut; elliptical girdle. Size, 18 by 12 by 15 mm.; weight, 28.06 carats. Cat. Nos. 1; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; rectangular girdle. Size, 12 by 10 by 7 mm.; weight, 7.41 carats. Cat. Nos. 2; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sea green. Step-brilliant cut; rectangular girdle. Size, 12.5 by 11 by 8.5 mm.; weight, 7.145 carats. Cat. Nos. 3; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; elliptical girdle. Size, 14 by 10 by 4.5 mm.; weight, 6.434 carats. Cat. Nos. 4; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; rectangular girdle. Size, 14 by 10 by 9 mm.; weight, 10.51 carats. Cat. Nos. 5; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, bluish gray. Step-brilliant cut; rectangular girdle. Size, 17 by 13.5 by 10 mm.; weight, 21 carats. Cat. Nos. 6; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; square girdle. Size, 12 by 13 by 8.5 mm.; weight, 11.05 carats. Cat. Nos. 7; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lavender blue. Step-brilliant cut; circular girdle. Size, 10 by 10 by 7 mm.; weight, 5.35 carats. Cat. Nos. 8; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale bluish green. Step-brilliant cut; rectangular girdle. Size, 13 by 10 by 6 mm.; weight, 4.16 carats. Cat. Nos. 9; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step-brilliant cut; square girdle. Size, 12 by 11 by 6 mm.; weight, 6.76 carats. Cat. Nos. 10; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, violet blue. Step-brilliant cut; elliptical girdle. Size, 13 by 8 by 13 mm.; weight, 12.89 carats. Cat. Nos. 11; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, blue. Step-brilliant cut; elliptical girdle. Size, 5 by 4.5 by 3 mm.; weight, 0.57 carats. Cat. Nos. 12; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step-brilliant cut; elliptical girdle. Size, 11 by 9 by 7 mm.; weight, 5.12 carats. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pink. Step-brilliant cut; elliptical girdle. Size, 10 by 7.5 by 6 mm.; weight, 3.41 carats. Cat. Nos. 14; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; square girdle. Size, 10.5 by 10 by 5 mm.; weight, 3.96 carats. Cat. Nos. 15; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale pink. Step-brilliant cut; elliptical girdle. Size, 9 by 7.5 by 5 mm.; weight, 2.68 carats. Cat. Nos. 16; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 4.5 mm.; weight, 2.58 carats. Cat. Nos. 17; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, wine yellow. Step-brilliant cut; elliptical girdle. Size, 9.5 by 7.5 by 5 mm.; weight, 3.22 carats. Cat. Nos. 18; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; circular girdle. Size, 9 by 8 by 5 mm.; weight, 2.74 carats. Cat. Nos. 19; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; oval girdle. Size, 8 by 7 by 6 mm.; weight, 2.89 carats. Cat. Nos. 20; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, violet. Step-brilliant cut; circular girdle. Size, 8 by 8 by 5.5 mm.; weight, 2.35 carats. Cat. Nos. 21; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light bluish green. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 5 mm.; weight, 3.19 carats. Cat. Nos. 22; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; elliptical girdle Size, 9 by 7 by 4 mm.; weight, 2.10 carats. Cat. Nos. 23; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; oval girdle. Size, 10.5 by 8 by 6 mm.; weight, 4.41 carats. Cat. Nos. 24; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, milk white. Cabochon cut; elliptical girdle. Size, 12.5 by 7 by 5 mm.; weight, 3.48 carats. Cat. Nos. 25; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light violet. Step-brilliant cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.86 carats. Cat. Nos. 26; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale violet. Step-brilliant cut; rectangular girdle. Size, 9 by 7 by 6 mm.; weight, 3.51 carats. Cat. Nos. 27; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step-brilliant cut; circular girdle. Size, 7 by 7 by 6 mm.; weight, 1.74 carats. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale greenish yellow. Step-brilliant cut; elliptical girdle. Size, 9 by 8 by 5 mm.; weight, 2.28 carats. Cat. Nos. 29; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; rectangular girdle. Size, 10 by 7 by 5 mm.; weight, 2.97 carats. Cat. Nos. 31; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step cut; square girdle. Size, 7 by 7 by 7 mm.; weight, 2.89 carats. Cat. Nos. 32; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; rectangular girdle. Size, 10 by 7 by 6 mm.; weight, 3.19 carats. Cat. Nos. 33; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, grayish blue. Step-brilliant cut; rectangular girdle. Size, 7.25 by 6.5 by 6 mm.; weight, 2.38 carats. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 9 by 7.5 by 4.5 mm.; weight, 2.31 carats. Cat. Nos. 35; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; square girdle. Size, 5.5 by 5.5 by 3.25 mm.; weight, 0.73 carats. Cat. Nos. 36; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.62 carats. Cat. Nos. 37; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; circular girdle. Size, 8 by 7 by 5 mm.; weight, 1.87 carats. Cat. Nos. 38; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 7 by 5.5 by 4.5 mm.; weight, 1.42 carats. Cat. Nos. 39; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, bluish gray. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 6 mm.; weight, 1.45 carats. Cat. Nos. 40; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lilac. Step-brilliant cut; elliptical girdle. Size, 8 by 6 by 4 mm.; weight, 1.36 carats. Cat. Nos. 41; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, wine yellow. Step-brilliant cut; elliptical girdle. Size, 8 by 4 by 6 mm.; weight, 1.48 carats. Cat. Nos. 42; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; unsymmetrical girdle. Size, 7.5 by 7.5 by 4.75 mm.; weight, 1.93 carats. Cat. Nos. 43; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step-brilliant cut; square girdle. Size, 7 by 6.5 by 4 mm.; weight, 1.31 carats. Cat. Nos. 44; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 1 carat. Cat. Nos. 45; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; elliptical girdle. Size, 8 by 6 by 4 mm.; weight, 1.74 carats. Cat. Nos. 46; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, blue. Step-brilliant cut; elliptical girdle. Size, 8 by 6 by 3.5 mm.; weight, 1.57 carats. Cat. Nos. 47; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; oval girdle. Size, 7.5 by 5 by 4 mm.; weight, 1.24 carats. Cat. Nos. 48; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; rectangular girdle. Size, 8 by 5 by 5 mm.; weight, 1.53 carats. Cat. Nos. 49; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight 1.33 carats. Cat. Nos. 50; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; oval girdle. Size, 5.5 by 4 by 4 mm.; weight, 0.70 carat. Cat. Nos. 51; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 1.16 carats. Cat. Nos. 52; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lilac. Step-brilliant cut; rectangular girdle. Size, 8 by 7 by 2 mm.; weight, 0.80 carat. Cat. Nos. 53; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, wine yellow. Step-brilliant cut; elliptical girdle. Size 7 by 6 by 4 mm.; weight, 1.23 carats. Cat. Nos. 54; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, violet. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 4 mm.; weight, 1.20 carats. Cat. Nos. 55; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, bluish white. Step-brilliant cut; circular girdle. Size, 6.5 by 6.5 by 4 mm.; weight, 1.13 carats. Cat. Nos. 56; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lavender blue. Step cut; square girdle. Size, 6 by 6 by 5 mm.; weight, 1.58 carats. Cat. Nos. 57; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, claret. Step-brilliant cut; rectangular girdle. Size, 7 by 5.5 by 5 mm.; weight, 1.42 carats. Cat. Nos. 58; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 6.5 by 5 by 4.5 mm.; weight, 1.08 carats. Cat. Nos. 59; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light blue. Step-brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 1.38 carats. Cat. Nos. 60; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; elliptical girdle. Size, 7 by 6 by 3.5 mm.; weight, 1 carat. Cat. Nos. 61; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, straw yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 1 carat. Cat. Nos. 62; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue blotches. Step-brilliant cut; elliptical girdle. Size, 7 by 5.5 by 4 mm.; weight, 1.19 carats. Cat. Nos. 63; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, blue. Step-brilliant cut; circular girdle. Size, 7 by 7 by 4 mm.; weight, 1.50 carats. Cat. Nos. 64; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless. Step-brilliant cut; square girdle. Size, 6 by 6 by 3 mm.; weight, 1 carat. Cat. Nos. 65; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, blue. Step cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 1.22 carats. Cat. Nos. 66; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3 mm.; weight, 1 carat. Cat. Nos. 67; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, deep blue. Step-brilliant cut; rectangular girdle. Size, 6 by 6 by 4 mm.; weight, 1 carat. Cat. Nos. 68; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, grayish pink. Step cut; square girdle. Size, 4 by 4 by 2.5 mm.; weight, 0.50 carat. Cat. Nos. 69; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, amethystine. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 4 mm.; weight, 0.94 carat. Cat. Nos. 70; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, deep violet blue. Step-brilliant cut; oval girdle. Size, 6.5 by 5 by 3.5 mm.; weight, 0.90 carat. Cat. Nos. 71; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; rectangular girdle. Size, 6 by 4.5 by 5 mm.; weight, 1.12 carats. Cat. Nos. 72; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue streaks. Step-brilliant cut; rectangular girdle. Size, 6.5 by 5 by 4 mm.; weight, 0.83 carat. Cat. Nos. 73; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, blotched with blue. Step-brilliant cut. Size, 7 by 6 by 4 mm.; weight, 1.32 carats. Cat. Nos. 74; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with bluish streaks. Step-brilliant cut; oval girdle. Size, 6 by 6 by 5 mm.; weight, 1.40 carats. Cat. Nos. 75; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 5 mm.; weight, 1.15 carats. Cat. Nos. 76; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue streaks. Step-brilliant cut; elliptical girdle. Size, 6.5 by 5 by 5 mm.; weight, 1.24 carats. Cat. Nos. 77; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 7 by 5 by 5 mm.; weight, 1.26 carats. Cat. Nos. 78; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 1.08 carats. Cat. Nos. 79; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lilac. Step-brilliant cut; rectangular girdle. Size, 6.5 by 5 by 4 mm.; weight, 1.05 carats. Cat. Nos. 80; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light blue. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 3.5 mm.; weight, 0.77 carats. Cat. Nos. 81; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue blotches. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 5 mm.; weight, 0.93 carat. Cat. Nos. 82; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 3.5 mm.; weight, 0.75 carat. Cat. Nos. 83; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 7 by 5 by 4 mm.; weight, 1.01 carats. Cat. Nos. 84; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue streaks. Step-brilliant cut; elliptical girdle. Size, 6.5 by 5 by 3.5 mm.; weight, 0.87 carat. Cat. Nos. 85; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smoky blue. Step-brilliant cut; elliptical girdle. Size, 5.75 by 5 by 3 mm.; weight, 0.66 carat. Cat. Nos. 86; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue streaks. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 5 mm.; weight, 0.93 carat. Cat. Nos. 87; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; elliptical girdle. Size, 7 by 5 by 3 mm.; weight, 0.86 carat. Cat. Nos. 88; 83895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3 mm.; weight, 0.75 carat. Cat. Nos. 89; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; elliptical girdle. Size, 6.5 by 5 by 4 mm.; weight, 0.95 carat. Cat. Nos. 90; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 3.25 mm.; weight, 0.66 carat. Cat. Nos. 91; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; oval girdle. Size, 6.5 by 5 by 3 mm.; weight, 0.79 carat. Cat. Nos. 92; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 3 mm.; weight, 0.62 carat. Cat. Nos. 93; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 0.70 carat. Cat. Nos. 94; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 0.70 carat. Cat. Nos. 95; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 5.5 by 4.5 by 3.5 mm.; weight, 0.64 carat. Cat. Nos. 96; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light blue. Step-brilliant cut; circular girdle. Size, 5 by 5 by 4 mm.; weight, 0.72 carat. Cat. Nos. 97; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, lemon yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3 mm.; weight, 0.72 carat. Cat. Nos. 98; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, with blue blotches. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3.5 mm.; weight, 0.73 carat. Cat. Nos. 99; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale wine yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 3 mm.; weight, 0.63 carat. Cat. Nos. 100; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless, blotched with blue. Step-brilliant cut; circular girdle. Size, 5 by 5 by 5 mm.; weight, 0.83 carat. Cat. Nos. 101; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, sky blue. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 4 mm.; weight, 0.87 carat. Cat. Nos. 102; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, light blue. Step-brilliant cut; elliptical girdle. Size, 6 by 4.5 by 3 mm.; weight, 0.56 carat. Cat. Nos. 103; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smoky blue. Step-brilliant cut; rectangular girdle. Size, 5.5 by 4 by 3 mm.; weight, 0.54 carat. Cat. Nos. 104; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, violet blue. Step-brilliant cut; circular girdle. Size, 6 by 5 by 4 mm.; weight, 0.71 carat. Cat. Nos. 105; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, smalt blue. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3 mm.; weight, 0.70 carat. Cat. Nos. 106; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, prussian blue. Step-brilliant cut; oval girdle. Size, 5.5 by 5 by 3 mm.; weight, 0.55 carat. Cat. Nos. 107; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 6 by 4 by 4.5 mm.; weight, 0.68 carat. Cat. Nos. 108; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, bluish. Step-brilliant cut; circular girdle. Size, 6 by 5 by 4 mm.; weight, 0.75 carat. Cat. Nos. 109; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, deep blue. Step-brilliant cut; elliptical girdle. Size, 5 by 4.5 by 3.5 mm.; weight, 0.55 carat. Cat. Nos. 110; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, wine yellow. Step-brilliant cut; rectangular girdle. Size, 5 by 4 by 3 mm.; weight, 0.45 carat. Cat. Nos. 111; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, pale green. Step-brilliant cut; elliptical girdle. Size 4 by 4 by 3 mm.; weight, 0.39 carat. Cat. Nos. 112; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Colorless. Step-brilliant cut; elliptical girdle. Size, 5 by 4 by 2 mm.; weight, 0.22 carat. Cat. Nos. 113; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Blue of various shades. Step-brilliant cut. 16 small gems, less than one-half carat each. Total weight, 7.51 carats. Cat. Nos. 114–129; 82895. The Lea Collection.

Corundum, var. sapphire. Ceylon. Color, violet. Step-brilliant cut; rectangular girdle. Size, 8.5 by 6 by 4 mm.; weight, 1.41 carats. Cat. Nos. 130; 50274.

Corundum, var. sapphire. Ceylon. Color, deep bluish green. Step-brilliant cut; circular girdle. Size, 7 by 7 by 3.5 mm.; weight, 0.84 carat. Cat. Nos. 131; 50274.

Corundum, var. sapphire. Ceylon. Color, deep bluish green. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3.5 mm.; weight, 0.64 carat. Cat. Nos. 132; 50274.

Corundum, var. sapphire. Ceylon. Color, greenish blue. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 3.5 mm.; weight, 0.71 carat. Cat. Nos. 133; 50274.

Corundum, var. sapphire. Ceylon. Color, greenish yellow. Brilliant cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 0.86 carat. Cat. Nos. 134; 47313. Gift of C. S. Bement.

Corundum, var. sapphire. Ceylon. Color, amethyst. Brilliant cut; circular girdle. Size, 5 by 5 by 4 mm.; weight, 0.48 carat. Cat. Nos. 135; 47312. Gift of C. S. Bement.

Corundum, var. sapphire. Ceylon. Color, blue. Step-brilliant cut. Twenty small gems; average size, 3 by 3 by 2 mm. Total weight, 5.10 carats. Cat. Nos. 136–155; 84041.

Corundum, var. sapphire. (Asteria.) Ellijay, Macon County, Georgia. Color, bronze. Cabochon cut; circular girdle. Size, 14 by 7 mm.; weight, 10.42 carats. Cat. Nos. 191; 84043.

Corundum, var. sapphire. (Asteria.) Ellijay, Macon County, Georgia. Color, bronze. Cabochon cut; circular girdle. Size, 10 by 5.5 mm.; weight, 4.55 carats. Cat. Nos. 192; 84043.

Corundum, var. sapphire. (Asteria.) Ellijay, Macon County, Georgia. Color, bronze. Cabochon cut; elliptical girdle. Size, 11 by 8 by 4 mm.; weight, 3.35 carats. Cat. Nos. 193; 84043.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, gray (banded). Cabochon cut; circular girdle. Size, 25 by 10 mm.; weight, 50.50 carats. Cat. Nos. 171; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, blue. Cabochon cut; circular girdle. Size, 24 by 14 mm.; weight, 67.10 carats. Cat. Nos. 172; 83893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, violet. Cabochon cut; circular girdle. Size, 22 by 13 mm.; weight, 49.12 carats. Cat. Nos. 173; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, light blue. Cabochon cut; circular girdle. Size, 24 by 8 mm.; weight, 38.79 carats. Cat. Nos. 174; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, sky blue. Cabochon cut; circular girdle. Size, 18 by 10 mm.; weight, 27.61 carats. Cat. Nos. 175; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, gray. Cabochon cut; circular girdle. Size, 14 by 10 mm.; weight, 14.93 carats. Cat. Nos. 176; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, bluish gray. Cabochon cut; circular girdle. Size, 8 by 5 mm.; weight, 2.30 carats. Cat. Nos. 177; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, milk white. Cabochon cut; circular girdle. Size, 11 by 6.5 mm.; weight, 6.23 carats. Cat. Nos. 178; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, sky blue. Cabochon cut; circular girdle. Size, 11 by 8 mm.; weight, 7.34 carats. Cat. Nos. 179; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, light blue. Cabochon cut; elliptical girdle. Size, 11 by 9 by 6 mm.; weight, 5.35 carats. Cat. Nos. 180; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, dark blue. Cabochon cut; circular girdle. Size, 9 by 6 mm.; weight, 4 carats. Cat. Nos. 181; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, lead gray. Cabochon cut; circular girdle. Size, 8 by 7 by 7 mm.; weight, 2.24 carats. Cat. Nos. 182; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, milk white. Cabochon cut; circular girdle. Size, 9 by 5 mm.; weight, 2.94 carats. Cat. Nos. 183; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, bluish gray. Cabochon cut; circular girdle. Size, 6 by 6 mm.; weight, 1.62 carats. Cat. Nos. 184; 82893. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, milky white. Cabochon cut; circular girdle. Size, 11 by 9.5 mm.; weight, 10 carats. Cat. Nos. 185; 50292.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, light violet. Cabochon cut; circular girdle. Size, 10 by 7 mm.; weight, 4.86 carats. Cat. Nos. 186; 50292.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, bluish gray. Cabochon cut; circular girdle. Size, 9 by 7 mm.; weight, 4.37 carats. Cat. Nos. 187; 50292.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, bluish white. Cabochon cut. Size, 9 by 9 by 6 mm.; weight, 4.74 carats. Cat. Nos. 188; 82892. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, bluish white. Cabochon cut. Size, 9 by 9 by 6 mm.; weight, 4.74 carats. Cat. Nos. 188; 82892. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, gray. Cabochon cut. Size, 5 by 5 by 3 mm.; weight, 0.97 carat. Cat. Nos. 189; 82892. The Lea Collection.

Corundum, var. sapphire. (Asteria.) Ceylon. Color, grayish blue. Cabochon cut. Size, 7 by 5 mm.; weight, 2.23 carats. Cat. Nos. 190; 84044. The Lea Collection.

Crocidolite. Griqua Land, South Africa. Color, brown. Cabochon cut; elliptical girdle. Size, 44 by 33 by 5 mm. Cat. Nos. b–944; 47583. Gift of Geo. F. Kunz.

Crocidolite. Griqua Land, South Africa. Color, brown. Cabochon cut; elliptical girdle. Size, 24 by 17 by 5 mm. Cat. Nos. b–945–946; 82806. The Lea Collection.

Crocidolite. Griqua Land, South Africa. Color, brown. Cabochon cut; elliptical girdle. Size, 12 by 6 by 4 mm. Cat. Nos. b–947; 47345.

Crocidolite. Griqua Land, South Africa. Twelve beads and other cut pieces. Cat. Nos. b–948–959; 84242.

Crocidolite. Griqua Land, South Africa. Color, brown. Size, 5.5 cm. Cat. Nos. b–960; 83530. The Lea Collection; gift of Dr. L. T. Chamberlain.

Crocidolite. Griqua Land, Orange River, South Africa. Cut slab. Cat. Nos. b–961; 81433.

Crocidolite. Griqua Land, South Africa. Three slabs. Cat. Nos. b–962–964; 51733.

Crocidolite. Griqua Land, South Africa. Color, dark bluish black. A rectangular block. Cat. Nos. b–965; 84243.

Crocidolite. Griqua Land, South Africa. Cut into dish. Cat. Nos. b–966; 84243.

Crocidolite. Griqua Land, South Africa. Color, brown. A thin slab. Cat. Nos. b–967; 84243.

Crocidolite. Eland Island, South Africa. Color, dark gray. A slab. Cat. Nos. b–968; 45047.

Cyanite. Spruce Pine, Mitchell County, North Carolina. Color, blue. Step-brilliant cut; rectangular girdle. Size, 12 by 7 by 5 mm.; weight, 3.63 carats. Cat. Nos. a–564; 47860. Gift of D. A. Bowman.

Cyanite. Russia. Color, blue. Step-brilliant cut; rectangular girdle. Size, 7 by 4 by 2 mm.; weight, 0.56 carat. Cat. Nos. a–565; 84103.

Demantoid, see Garnet.

Diamond. Cabin Fork Creek, near Montpelier, Kentucky. Color, yellow. Natural faces of crystal polished. Size, 8 by 4 by 3 mm.; weight, 0.75 carats. Cat. Nos. 465; 83723. The Lea Collection; gift of Dr. L. T. Chamberlain.

Diamond. South Africa. Colorless. Brilliant cut; rectangular girdle. Size, 6 by 5 by 4 mm.; weight, 0.90 carat. Cat. Nos. 466; 84045.

Diamond. South Africa. Colorless. Partly cut. Size, 5 by 5 by 5 mm.; weight, 1.63 carats. Cat. Nos. 467; 84046.

Diamond. South Africa. Six small, variously colored stones: 1 pink, 1 green, 1 brown, 1 milk white, 1 yellow, 1 yellow green. Brilliant cut. Total weight, 0.95 carat. Cat. Nos. 468–473; 82902. The Lea Collection.

Diamond. India. Colorless, very clear. Brilliant cut. 122 small stones. Total weight, 18.32 carats. Cat. Nos. 474–595; 47351. Gift of the Imaun of Muscat.

Diopside, see Pyroxene.

Emerald, see Beryl.

Epidote. Tyrol. Color, dark brown. Step-brilliant cut; rectangular girdle. Size, 14 by 8 by 3 mm.; weight, 3.82 carats. Cat. Nos. a–579; 84108.

Epidote. Tyrol. Color, dark green. Step-brilliant cut; rectangular girdle. Size, 8 by 4.5 by 2 mm.; weight, 0.72 carat. Cat. Nos. a–580; 50324.

Essonite, see Garnet.

Euclase. Brazil. Color, pale green. Step-brilliant cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.03 carats. Cat. Nos. 832; 84070.

Flint, see Quartz.

Fluorite. Amelia Court-House, Virginia. Color, smoky brown. Step-brilliant cut; rectangular girdle. Size, 11 by 9 by 7 mm.; weight, 4.92 carats. Cat. Nos. a–607; 50330.

Fluorite. England. Two trays. Average size, 8.6 cm. diameter. Cat. Nos. b–896–897; 46964.

Fluorite. England. Color, dark purple. Cup on black marble base. Cat. Nos. b–898; 84235.

Fossil Coral, see Carbonate of lime.

Gadolinite. Near Burnett, Llano County, Texas. Color, black; opaque. Brilliant cut; circular girdle. Size 13 by 8 mm.; weight, 8.35 carats. Cat. Nos. a–587; 83743. The Lea Collection; gift of L. T. Chamberlain.

Garnet, var. almandite. Green Creek, Delaware County, Pennsylvania. Color, dark red. Cabochon cut; circular girdle. Size, 9 by 5 mm.; weight, 4.24 carats. Cat. Nos. a–25; 50310.

Garnet, var. almandite. Green Creek, Delaware County, Pennsylvania. Color, dark cherry red. Cabochon cut; elliptical girdle. Size, 12 by 8 by 4 mm.; weight, 3.56 carats. Cat. Nos. a–26; 50310.

Garnet, var. almandite. Macon County, North Carolina. Color, cherry red. Cabochon cut; pear shaped. Size, 14 by 10 by 6 mm.; weight, 5.53 carats. Cat. Nos. a–27; 82881. The Lea Collection.

Garnet, var. almandite. Macon County, North Carolina. Color, brownish red. Cabochon cut; elliptical girdle. Size, 8.5 by 7 by 4 mm.; weight, 2.10 carats. Cat. Nos. a–28; 82881. The Lea Collection.

Garnet, var. almandite. North Carolina. Color, light violet. Step-brilliant cut; rectangular girdle. Size, 7.5 by 6 by 4 mm.; weight, 1.54 carats. Cat. Nos. a–29; 50102.

Garnet, var. almandite. Fort Defiance, Arizona. Color, dark violet red. Brilliant cut; circular girdle. Size, 10 by 5 mm.; weight, 3 30 carats. Cat. Nos. a–30; 50109.

Garnet, var. almandite. Fort Defiance, Arizona. Color, dark violet red. Step-brilliant cut; rectangular girdle. Size, 8 by 7 by 4 mm.; weight, 1.63 carats. Cat. Nos. a–31; 50277.

Garnet, var. almandite. Fort Defiance, Arizona. Color, deep violet red. Brilliant cut; 2 circular, 1 rectangular girdle. Size, 6 by 6 by 4 mm.; weight, 2.62 carats. Cat. Nos. a–32–34; 84084.

Garnet, var. almandite. New Mexico. Color, violet red. Brilliant cut. Size, 8 by 8 by 4 to 5 by 5 by 4 mm. Seven gems; total weight, 6.70 carats. Cat. Nos. a–35–41; 82878.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; elliptical girdle. Size, 24 by 13 by 7 mm.; weight, 22.66 carats. Cat. Nos. 968; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; elliptical girdle. Size, 25 by 13 by 7 mm.; weight, 23.82 carats. Cat. Nos. 969; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; pear-shaped girdle. Size, 23 by 13 by 7 mm.; 20.85 carats. Cat. Nos. 970; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; elliptical girdle. Size, 18 by 12 by 6.5 mm.; weight, 14.92 carats. Cat. Nos. 971; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, brownish red. Rose cut; elliptical girdle. Size, 15 by 13 by 6 mm.; weight 8.90 carats. Cat. Nos. 972; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; elliptical girdle. Size, 15 by 12 by 6 mm.; weight, 10.53 carats. Cat. Nos. 973; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, brownish red. Rose cut; circular girdle. Size, 13 by 5 mm.; weight, 5.94 carats. Cat. Nos. 974; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, brownish red. Rose cut; square girdle. Size, 11 by 7 mm.; weight, 6.30 carats. Cat. Nos. 975; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut; elliptical girdle. Size, 12 by 9 by 6 mm.; weight, 6.36 carats. Cat. Nos. 976; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, brownish red. Step-brilliant cut; pear-shaped girdle. Size, 13 by 10 by 4 mm.; weight, 3.26 carats. Cat. Nos. 977; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Step-brilliant cut; oval girdle. Size, 10 by 7.5 by 4 mm.; weight, 2.67 carats. Cat. Nos. 978; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 11 by 8.5 by 4 mm.; weight, 2.55 carats. Cat. Nos. 979; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, brownish red. Step cut; square girdle. Size, 7 by 7 by 3 mm.; weight, 1.59 carats. Cat. Nos. 980; 82877. The Lea Collection.

Garnet, var. almandite. Bohemia. Color, violet red. Cabochon cut. Thirteen gems. Size, 12 by 10 by 3 to 6 by 5 by 2.5 mm.; total weight, 22.52 carats. Cat. Nos. 981–993; 82877. The Lea Collection.

Garnet, var. almandite. Tyrol. Color, brownish red. Cabochon cut; circular girdle. Size, 11 by 5 mm.; weight, 4.28 carats. Cat. Nos. 994; 84083.

Garnet, var. almandite. Tyrol. Color, brownish red. Rose cut; pear-shaped girdle. Size, 15 by 8 by 4 mm.; weight, 3.80 carats. Cat. Nos. 995; 84083.

Garnet, var. almandite. Tyrol. Color, brownish red. Rose cut. Four gems, average size, 6 by 5 by 3 mm.; total weight, 3.94 carats. Cat. Nos. 996–999; 84083.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 31 by 27 by 9 mm.; weight, 56.06 carats. Cat. Nos. 833; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 20 by 8 mm.; weight, 23.74 carats. Cat. Nos. 834; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; rectangular girdle. Size, 19 by 17 by 10 mm.; weight, 23.40 carats. Cat. Nos. 835; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 21 by 17 by 7 mm.; weight, 14.15 carats. Cat. Nos. 836; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 10 by 17 by 6 mm.; weight, 11.75 carats. Cat. Nos. 837; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 18 by 17 by 7 mm.; weight, 19.34 carats. Cat. Nos. 838; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 18 by 15 by 6 mm.; weight, 13.29 carats. Cat. Nos. 839; 50316.

Garnet, var. almandite. India. Color, violet red. Brilliant cut; elliptical girdle. Size, 15 by 13 by 7 mm.; weight, 12.50 carats. Cat. Nos. 840; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 15 by 7 mm.; weight, 14.03 carats. Cat. Nos. 841; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 16 by 14 by 7 mm.; weight, 10.69 carats. Cat. Nos. 842; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 15 by 7 mm.; weight, 8.94 carats. Cat. Nos. 843; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 15.5 by 14 by 5 mm.; weight, 9.63 carats. Cat. Nos. 844; 50316.

Garnet, var. almandite. India. Color, violet red. Rose cut. Size, 15 by 14 by 7 mm.; weight 12.14 carats. Cat. Nos. 845; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; heart girdle. Size, 17 by 12 by 5 mm.; weight, 8.92 carats. Cat. Nos. 846; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 15 by 13 by 6 mm.; weight, 9.84 carats. Cat. Nos. 847; 50316.

Garnet, var. almandite. India. Color, violet red. Rose cut; oval girdle. Size, 14 by 13 by 5 mm.; weight, 9.47 carats. Cat. Nos. 848; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 13 by 4.5 mm.; weight, 5.38 carats. Cat Nos. 849; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 12 by 4 mm.; weight, 4.84 carats. Cat. Nos. 850; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 12 by 4 mm.; weight, 4.39 carats. Cat. Nos. 851; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 11 by 3 mm.; weight, 3.13 carats. Cat. Nos. 852; 50316.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 14 by 13 by 6 mm.; weight, 8.82 carats. Cat. Nos. 853; 50313.

Garnet, var. almandite. India. Color, brownish red. Rose; heart-shaped girdle. Size, 16 by 13 by 5 mm.; weight, 9.14 carats. Cat. Nos. 854; 50313.

Garnet, var. almandite. India. Color, brownish red. Brilliant cut; rectangular girdle. Size, 13 by 12 by 8 mm.; weight, 10.77 carats. Cat. Nos. 855; 50313.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 11 by 5.5 mm.; weight, 6.30 carats. Cat. Nos. 856; 50313.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 11 by 9 by 3 mm.; weight, 2.90 carats. Cat. Nos. 857; 50313.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 12 by 9 by 3.5 mm.; weight, 3.11 carats. Cat. Nos. 858; 50313.

Garnet, var. almandite. India. Color, deep red. Step cut; rectangular girdle. Size, 13 by 10 by 5 mm.; weight, 5.22 carats. Cat. Nos. 859; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 12 by 7 by 4 mm.; weight, 2.92 carats. Cat. Nos. 860; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 11 by 8.5 by 4 mm.; weight, 2.57 carats. Cat. Nos. 861; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; square girdle. Size, 9 by 9 by 4 mm.; weight, 2.66 carats. Cat. Nos. 862; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; elliptical girdle. Size, 10.5 by 9 by 4.5 mm. Cat. Nos. 863; 50312.

Garnet, var. almandite. India. Color, violet red. Brilliant cut; rectangular girdle. Size, 11 by 8 by 3 mm.; weight, 2.25 carats. Cat. Nos. 864; 50312.

Garnet, var. almandite. India. Color, brownish red. Step cut; rectangular girdle. Size, 9 by 8 by 4 mm.; weight, 3 carats. Cat. Nos. 865; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 10 by 8 by 3.5 mm.; weight, 2.41 carats. Cat. Nos. 866; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 10 by 7 by 4 mm.; weight, 2.40 carats. Cat. Nos. 867; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 10 by 8 by 4 mm.; weight, 2.02 carats. Cat. Nos. 868; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 9 by 7.5 by 4 mm.; weight, 1.65 carats. Cat. Nos. 869; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 8 by 6.5 by 3 mm.; weight, 1.42 carats. Cat. Nos. 870; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 7.5 by 6.5 by 2.5 mm.; weight, 1.24 carats. Cat. Nos. 871; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 8 by 7 by 3 mm.; weight 1.30 carats. Cat. Nos. 872; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 8 by 7 by 3 mm.; weight, 1.20 carats. Cat. Nos. 873; 50312.

Garnet, var. almandite. India. Color, violet red. Step cut; rectangular girdle. Size, 8 by 6 by 3 mm.; weight, 1.18 carats. Cat. Nos. 874; 50312.

Garnet, var. almandite. India. Color, violet red. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 3 mm.; weight 1.33 carats. Cat. Nos. 875; 50312.

Garnet, var. almandite. India. Color, violet red. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 3 mm.; weight, 1.21 carats. Cat. Nos. 876; 50312.

Garnet, var. almandite. India. Color, violet red. Step-brilliant cut; rectangular girdle. Size, 7.5 by 6 by 4 mm.; weight, 1.16 carats. Cat. Nos. 877; 50312.

Garnet, var. almandite. India. Color, violet red. Rose cut; elliptical girdle. Size, 18 by 15 by 5 mm.; weight, 6.66 carats. Cat. Nos. 878; 48486.

Garnet, var. almandite. India. Color, brownish red. Half-rose cut; pear-shaped girdle. Size, 21 by 11 by 5 mm.; weight, 8.10 carats. Cat. Nos. 879; 48486.

Garnet, var. almandite. India. Color, brownish red. Half-rose cut; pear-shaped girdle. Size, 20 by 10 by 5 mm.; weight, 6.94 carats. Cat. Nos. 880; 48486.

Garnet, var. almandite. India. Color, brownish red. Rose cut; elliptical girdle. Size, 14 by 11 by 4 mm.; weight, 4.46 carats. Cat. Nos. 881; 48486.

Garnet, var. almandite. India. Color, brownish red. Rose cut; circular girdle. Size, 13 by 5 mm.; weight, 4.65 carats. Cat. Nos. 882; 48486.

Garnet, var. almandite. India. Color, violet red. Step-brilliant cut; pear-shaped girdles. Thirty-four gems, average size 10 by 8 by 2.5 mm.; total weight, 40 carats. Cat. Nos. 883–916; 50311.

Garnet, var. almandite. Madras, India. Color, violet red. Cabochon cut; elliptical girdle. Size, 19 by 11 by 9 mm.; weight, 20.04 carats. Cat. Nos. 917; 50318.

Garnet, var. almandite. Madras, India. Color, violet red. Cabochon cut; ellipsoidal girdle. Size, 23 by 9 by 5.5 mm.; weight, 10.75 carats. Cat. Nos. 918; 50318.

Garnet, var. almandite. Ceylon. Color, violet red. Cabochon cut. Size, 16 by 10 by 7 mm.; weight, 9.78 carats. Cat. Nos. 919; 51181.

Garnet, var. almandite. Ceylon. Color, violet red. Cabochon cut. Size, 17 by 9 by 6 mm.; weight, 10.15 carats. Cat. Nos. 920; 51181.

Garnet, var. almandite. Ceylon. Color, violet red. Cabochon cut; oval girdle. Size, 15 by 9 by 6 mm.; weight, 8.74 carats. Cat. Nos. 921; 51181.

Garnet, var. almandite. Ceylon. Color, violet red. Cabochon cut. Size, 16.5 by 8 by 6 mm.; weight, 7.81 carats. Cat. Nos. 922; 51181.

Garnet, var. almandite. Ceylon. Color, violet red. Twelve stones variously cut. Sizes, 9 by 7 by 2 to 5 by 5 by 2.5 mm.; total weight, 11.23 carats. Cat. Nos. 923–934; 82882.

Garnet, var. almandite. China. Color, deep red. Cabochon cut; elliptical girdle. Size, 23 by 15 by 8 mm.; weight, 18.94 carats. Cat. Nos. a–1; 46008. Gift of Dr. J. L. Holmes.

Garnet, var. almandite. Japan. Color, violet red. Rose and step-brilliant cut. Five gems; average size, 10 by 5 by 3 mm.; total weight, 9.20 carats. Cat. Nos. a–2–6; 50317.

Garnet, var. almandite. Japan. Color, violet red. Eighteen variously cut gems; average size, 8 by 6 by 4 mm.; total weight, 28.61 carats. Cat. Nos. a–7–24; 82880. The Lea Collection.

Garnet, var. almandite. Color, violet red. Cabochon cut; elliptical girdle. Size, 18 by 13 by 6 mm.; weight, 12.92 carats. Cat. Nos. 935; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 20 by 8 by 5 mm.; weight, 5.83 carats. Cat. Nos. 936; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Brilliant cut; elliptical girdle. Size, 17 by 7 by 3.5 mm.; weight, 2.54 carats. Cat. Nos. 937; 82876. The Lea Collection.

Garnet, var. almandite. Color, brownish red. Cabochon cut; elliptical girdle. Size, 12 by 10 by 3 mm.; weight, 4.36 carats. Cat. Nos. 938; 82876. The Lea Collection.

Garnet, var. almandite. Color, brownish red. Step cut; rectangular girdle. Size, 11 by 8 by 2.5 mm.; weight, 2.03 carats. Cat. Nos. 939; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 9 by 7 by 3.3 mm.; weight, 1.57 carats. Cat. Nos. 940; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 9 by 7 by 3.5 mm.; weight, 1.74 carats. Cat. Nos. 941; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 8 by 6.5 by 3 mm.; weight, 1.22 carats. Cat. Nos. 942; 82876. The Lea Collection.

Garnet, var. almandite. Color, brownish red. Step-brilliant cut; rectangular girdle. Size, 6.5 by 6 by 3.5 mm.; weight, 1.15 carats. Cat. Nos. 943; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Twenty-one gems variously cut. Various sizes; total weight, 15.07 carats. Cat. Nos. 944–964; 82876. The Lea Collection.

Garnet, var. almandite. Color, violet red. Step-brilliant cut; elliptical girdle. Size, 12 by 8 by 5 mm.; weight, 3.58 carats. Cat. Nos. 965; 50273.

Garnet, var. almandite. Color, violet red. Cabochon cut; circular girdle. Size, 8 by 3 mm.; weight, 1.64 carats. Cat. Nos. 966; 50273.

Garnet, var. almandite. Color, violet red. Cabochon cut; circular girdle. Size, 7 by 2 mm.; weight, 1.16 carats. Cat. Nos. 967; 50273.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 10 by 5 mm.; weight, 3 carats. Cat. Nos. a–100; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 8 by 5 mm.; weight, 2.04 carats. Cat. Nos. a–101; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, blood red. Brilliant cut; circular girdle. Size, 7.5 by 4 mm.; weight, 1.41 carats. Cat. Nos. a–102; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 1.30 carats. Cat. Nos. a–103; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 7 by 4 mm.; weight, 1.31 carats. Cat. Nos. a–104; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, blood red. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.44 carats. Cat. Nos. a–105; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, blood red. Brilliant cut; circular girdle. Size, 7 by 4.5 mm.; weight, 1.40 carats. Cat. Nos. a–106; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 7 by 4 mm.; weight, 1.06 carats. Cat. Nos. a–107; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, brownish red. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 1.02 carats. Cat. Nos. a–108; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 7 by 4 mm.; weight, 1.04 carats. Cat. Nos. a–109; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 7 by 4 mm.; weight, 1.03 carats. Cat. Nos. a–110; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 7 by 6 by 4 mm.; weight, 0.96 carat. Cat. Nos. a–111; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 6 by 4 mm.: weight, 0.90 carat. Cat. Nos. a–112; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, violet red. Brilliant cut; circular girdle. Size, 6 by 3.5 mm.; weight, 0.81 carat. Cat. Nos. a–113; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, blood red. Brilliant cut; circular girdle. Size, 6 by 3.5 mm.; weight, 0.70 carat. Cat. Nos. a–114; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, deep violet red. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.72 carat. Cat. Nos. a–115; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Macon County, North Carolina. Color, brownish red. Brilliant cut; circular girdle. Size, 5 by 3.5 mm.; weight, 0.55 carat. Cat. Nos. a–116; 83733. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. pyrope. Bilin, Bohemia. Color, blood red. Half rose cut. 51 small gems; average size, 4 by 4 by 4 mm.; total weight, 12.26 carats. Cat. Nos. a–42–92; 50315.

Garnet, var. pyrope. Bohemia. Necklace of blood-red garnets; 103 rose cut and 2 cabochon cut. Cat. Nos. a–93; 83534. The Lea Collection.

Garnet, var. pyrope. Cape Colony, Africa. Six gems. Color, deep red. Brilliant cut; circular girdle. Average size, 5 by 3 mm.; total weight, 2.29 carats. Cat. Nos. a–94–99; 84085.

Garnet, var. rhodolite. North Carolina. Color, between almandine and blood red. Step-brilliant cut. Two gems; total weight, 3.05 carats. Cat. Nos. c–460; 84479. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 21 by 13 mm.; weight, 39.13 carats. Cat. Nos. a–147; 51985.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 11.5 by 8 mm.; weight, 7.26 carats. Cat. Nos. a–148; 51985.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 8 by 5.5 mm.; weight, 2.38 carats. Cat. Nos. a-149; 51985.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 2.60 carats. Cat. Nos. a–150; 51985.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 1.10 carats. Cat. Nos. a–151; 51985.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Brilliant cut; circular girdle. Size, 14 by 8 mm.; weight, 11.51 carats. Cat. Nos. a–152; 50266.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Step-brilliant cut; rectangular girdle. Size, 12 by 10 by 7 mm.; weight, 8.89 carats. Cat. Nos. a–153; 51572. Gift of Ira R. Allen.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Step-brilliant cut; rectangular girdle. Size, 12 by 11 by 8 mm.; weight, 9.32 carats. Cat. Nos. a–154; 51572. Gift of Ira R. Allen.

Garnet, var. spessartite. Amelia Court-House, Virginia. Color, bright cinnamon. Cabochon cut; circular girdle. Size, 11 by 5.5 mm.; weight, 5.65 carats. Cat. Nos. a–155; 83348. The Lea Collection; gift of Dr. L. T. Chamberlain.

Garnet, var. essonite. Ceylon. Color, light brownish red or cinnamon brown. Step-brilliant cut; elliptical girdle. Size, 14 by 11 by 6 mm.; weight, 5.54 carats. Cat. Nos. a–117; 50319.

Garnet, var. essonite. Ceylon. Color, cinnamon brown. Step-brilliant cut; square girdle. Size, 12 by 11 by 5 mm.; weight, 5.57 carats. Cat. Nos. a–118; 50319.

Garnet, var. essonite. Ceylon. Color, cinnamon brown. Step-brilliant cut; elliptical girdle. Size, 30 by 24 by 12 mm.; weight, 62.60 carats. Cat. Nos. a–119; 82884. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon. Brilliant cut; rectangular girdle. Size, 11 by 10 by 5.5 mm.; weight, 3.80 carats. Cat. Nos. a–120; 82884. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon brown. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 5 mm.; weight, 3.62 carats. Cat. Nos. a–121; 82884. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon. Step-brilliant cut; square girdle. Size, 6 by 6 by 3 mm.; weight, 0.82 carat. Cat. Nos. a–122; 82844. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon. Brilliant cut; elliptical girdle. Size, 7 by 6 by 3 mm.; weight, 0.80 carat. Cat. Nos. a–123; 82884. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon. Step-brilliant cut; elliptical girdle. Size, 6.5 by 5 by 3 mm.; weight, 0.80 carat. Cat. Nos. a–124; 82844. The Lea Collection.

Garnet, var. essonite. Ceylon. Color, cinnamon. Step-brilliant cut. Eleven small gems; total weight, 3.53 carats. Cat. Nos. a–125–135; 82844. The Lea Collection.

Garnet, var. essonite. Locality unknown. Color, cinnamon. Step-brilliant cut; elliptical girdle. Size, 15 by 10 by 5 mm.; weight, 4.90 carats. Cat. Nos. a–136; 84086.

Garnet, var. grossularite. Hull, Canada. Color, pale yellow. Brilliant cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.21 carats. Cat. Nos. a–137; 50314.

Garnet, var. grossularite. Hull, Canada. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 6 by 5 by 3 mm.; weight, 0.59 carat. Cat. Nos. a–138; 50314.

Garnet, var. grossularite. Xalostoc, Morelos, Mexico. Color, deep rose. Step-brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1.17 carats. Cat. Nos. a–139; 50108.

Garnet, var. grossularite. Xalostoc, Morelos, Mexico. Color, deep rose. Step-brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.86 carat. Cat. Nos. a–140; 50108.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, grass green. Brilliant cut; square girdle. Size, 9 by 8.5 by 4 mm.; weight, 2.20 carats. Cat. Nos. a–141; 50309.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, brownish green. Brilliant cut; circular girdle. Size, 8.5 by 6 mm.; weight, 3.03 carats. Cat. Nos. a–142; 50309.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, grass green. Step-brilliant cut; rectangular girdle. Size, 7 by 5.5 by 3.5 mm.; weight, 0.99 carat. Cat. Nos. a–143; 84087.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, grass green. Brilliant cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 0.98 carats. Cat. Nos. a–144; 84087.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, grass green. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 1.03 carats. Cat. Nos. a–145; 84087.

Garnet, var. demantoid. Nizhni-Tagilsk, Urals. Color, light green. Brilliant cut; square girdle. Size, 5 by 5 by 2.5 mm.; weight, 0.33 carats. Cat. Nos. a–146; 84087.

Garnet rock. Xalostoc, Morelos, Mexico. Slab of garnet, with vesuvianite in calcite. Cat. Nos. b–853; 51732.

Gold. California. Gold nugget mounted as a breastpin. Cat. Nos. a–608; 83529. The Lea Collection.

Graphic granite. Hitteroe, Norway. Tabular piece of pegmatite mounted in silver as breastpin. Cabochon cut. Cat. Nos. a–609; 47392. Gift of Mrs. Spencer F. Baird.

Graphic granite. Siberia. Ash tray. Cat. Nos. b–836; 50395.

Grossularite, see Garnet.

Gypsum, var. satinspar. Puebla, Mexico. Color, white. Large rectangular block. Cat. Nos. b–873; 47662. Gift of Mexican Geographical Expl. Commission.

Gypsum, var. satinspar. Bridgeford, England. Color, white. Two necklaces, each containing 63 beads. Cat. Nos. a–611–612; 84167.

Gypsum, var. satinspar. Bridgeford, England. Egg-shaped ornament of satinspar. Size, 9.5 cm. long. Cat. Nos. b–874; 84230.

Gypsum, var. satinspar. England. Color, white. Cabochon cut; elliptical girdle. Size, 29 by 18 by 12 mm. Cat. Nos. a–610; 51444.

Hematite. England. Color, black. Tabular cut; rectangular girdle. Size, 18 by 15 by 3 mm. Cat. Nos. a–614–615; 48475.

Hematite. England. Color, black. Tabular cut; rectangular girdle. Size, 16 by 11 by 3 mm. Cat. Nos. a–616; 84168.

Hematite. England. Color, black. Necklace of 49 beads, largest 12 mm., smallest 8 mm. diam. Cat. Nos. a–617; 50254.

Huntilite in calcite. Silver Islet, Lake Superior. Rectangular disks. Size, 20 by 15 by 4 mm. Cat. Nos. a–623–624; 47845.

Hypersthene. Fredericksbarn, Norway. Color, blackish gray. Slab. Cat. Nos. b–852; 51940.

Hypersthene. Norway. Color, dark bronze. Cabochon cut; elliptical girdle. Size, 22 by 16 by 5 mm. Cat. Nos. c–422.

Iolite. Bodenmais, Bavaria. Color, blue; dichroic. Table cut. Size, 11 by 9 by 6 mm.; weight, 7.27 carats. Cat. Nos. a–586; 84111.

Iolite. Ceylon. Color, light blue. Step-brilliant cut; rectangular girdle. Size, 14 by 12 by 4 mm.; weight, 6.60 carats. Cat. Nos. a–584; 82819. The Lea Collection.

Iolite. Ceylon. Color, blue. Step cut; rectangular girdle. Size, 9 by 7.5 by 3 mm.; weight, 1.34 carats. Cat. Nos. a–585; 84110.

Jade. Alaska. Color, olive green. Two cabrets, 9 and 5 cm. long, respectively. Cat. Nos. a–680–681; 45937.

Jade. China. Color, greenish. Disk with flower. Size, 5½ cm. diameter. Cat. Nos. a-667; 51448.
Jade. China. Color, greenish. Vase. Size, 22½ cm. long. Cat. Nos. a-668; 45019.
Jade. China. Color, greenish gray. A carved ornament. Size, 5½ cm. in diameter. Cat. Nos. a-669; 84176.
Jade. China. Color, greenish gray. A carved ornament. Size, 10 by 2 cm. Cat. Nos. a-670; 84177.
Jade. China. Color, greenish gray. A carved ornament. Cat. Nos. a-671; 84178.
Jade. China. Color, light greenish. A carved ornament. Cat. Nos. a-672; 84179.
Jade. China. Color, light green. Carved inkstand on base of teak. Cat. Nos. b-871; 84228.
Jade. China. Small carved vase on base of teak. Cat. Nos. b-872; 84229.
Jade. Japan. Color, light green. Ring. Size, 7 cm. diameter outside; 5.2 inside. Cat. Nos. a-673; 84180.
Jade. New Zealand. Color, dark green. Three cameos; rectangular. Size, 15 by 12 mm. Cat. Nos. a-674-676; 51129.
Jade. New Zealand. Color, green. Slab. Cat. Nos. b-870; 50392.
Jade. New Zealand. Color, dark green. A watch charm, 28 by 19 by 6 mm., and two pendants, 6.4 and 5.5 cm. long. Cat. Nos. a-677-679; 50392.
Jasper, see Quartz.
Jet. Whitby, England. Color, black. Slab. Cat. Nos. b-856; 84225.
Jet. Whitby, England. Color, black. Cat. Nos. b-857; 50391.
Labradorite. Labrador. Polished slab. Cat. Nos. b-843-844; 81285.
Labradorite. Labrador. Two slabs; polished. Cat. Nos. b-845-846; 45011.
Labradorite. Labrador. Medallion. Size, 10.5 by 7.5 cm. Cat. Nos. b-847; 47852.
Labradorite. Labrador. Polished slab. Cat. Nos. b-848; 51962.
Labradorite. Labrador. Pyramidal-shaped ornament, 10 cm. high. Cat. Nos. b-849; 84223.
Labradorite. Labrador. Color, dark gray. Two knob-shaped pieces. Cat. Nos. c-253-254; 82852. The Lea Collection.
Labradorite. Labrador. Color, dark gray. Cabochon cut; circular girdle. Size, 20 by 6 mm. Cat. Nos. c-255; 82852. The Lea Collection.
Labradorite. Labrador. Color, dark gray. Circular disk. Size, 22 by 4 mm. Cat. Nos. c-256; 46830.
Labradorite. Labrador. Color, dark gray. Cabochon, intaglio; rectangular girdle. Size, 25 by 17 by 6 mm. Cat. Nos. c-257; 50071.
Labradorite. Labrador. Color, dark gray. Cabochon cut; rectangular girdle. Size, 24 by 15 by 5 mm. Cat. Nos. c-258; 50256.
Labradorite. Labrador. Color, dark gray. Cabochon cut; elliptical girdle. Size, 28 by 13 by 6 mm. Cat. Nos. c-259; 84164.
Labradorite. Labrador. Color, dark gray. A watch charm. Size, 12 mm. diameter. Cat. Nos. c-260; 84164.
Labradorite. Labrador. Color, grayish brown. Double Cabochon cut. Cat. Nos. c-261; 14346.
Lapis lazuli. Andes Mountains, Chile. Color, blue. Slab. Cat. Nos. b-875; 84231.
Lapis lazuli. Andes Mountains, Chile. Color, blue. Slab. Cat. Nos. b-878; 44474.
Lapis lazuli. Persia. Color, prussian blue. Cabochon cut; elliptical girdle. Size, 30 by 27 by 6 mm. Cat. Nos. a-622; 50432.
Lapis lazuli. Persia. Color, dark blue. Slab. Cat. Nos. b-877; 50432.
Lapis lazuli. Color, blue. Size, 8 cm. Cat. Nos. b-876; 84232.
Lepidolite. Rosena, Moravia. Color, purplish red. An ash tray. Size, 9 by 4.7 by 1.3 cm. Cat. Nos. b-842; 51446.
Limestone, see Carbonate of lime.
Malachite. Morenci, Arizona. Color, green. Cat. Nos. b-883; 50268.

Malachite. Morenci, Arizona. Small geode. Cat. Nos. b–884; 50113.

Malachite. Morenci, Arizona. Color, green. Cube, with truncated edges. Size, 5 cm. diameter. Cat. Nos. b–885; 50267.

Malachite. Morenci, Arizona. Color, dark green. Slab. Cat. Nos. b–886; 82488.

Malachite. Morenci, Arizona. Polished to show banded structure. Cat. Nos. b–887; 50112.

Malachite. Morenci, Arizona. Color, blue and green. Polished slabs. Cat. Nos. b–888–890; 84234.

Malachite. Siberia. Color, bright green, banded. Tabular cut; elliptical girdle. Size, 40 by 32 by 4 mm. Cat. Nos. a–618; 51139.

Malachite. Siberia. Color, dark green, with light green concentric rings. Size, 31 by 4 mm. Cat. Nos. a–619; 51139.

Malachite. Siberia. Color, bright green, with brown bands. Cabochon cut; circular girdle. Size, 34 by 6 mm. Cat. Nos. a–620; 82904.

Malachite. Siberia. Color, dark green, banded. Cabochon cut; elliptical girdle. Size, 33 by 26 by 5 mm. Cat. Nos. a–621; 84169.

Malachite. Ural Mountains, Siberia. Color, deep green. Large Botryoidal mass. Cat. Nos. b–891; 45088.

Malachite. Siberia. Color, green. Polished piece. Cat. Nos. b–892; 45032.

Malachite. Ural Mountains, Siberia. Color, green. Composite slab mounted on slate. Cat. Nos. b–893; 51483.

Malachite. Australia. Color, green. Polished piece. Cat. Nos. b–894; 81284.

Malachite. Bembe, West Africa. Color, green. Polished slab. Cat. Nos. b–895; 49239. Gift of Mrs. Mary I. Stroud.

Marble, see Carbonate of lime.

Microcline, var. amazonstone. Media, Delaware County, Pennsylvania. Color, green, with flesh bands. Elliptical disk. Size, 17 by 11 by 3 mm. Cat. Nos. a–688; 48921. Gift of Dr. Robert H. Lamborn.

Microcline, var. amazonstone. Mineral Hill, Delaware County, Pennsylvania. Color, green, with flesh-colored veins. Cabochon cut; elliptical girdle. Size, 45 by 34 by 12 mm. Cat. Nos. a–698; 49718. The Lea Collection.

Microcline, var. amazonstone. Amelia Court-House, Virginia. Color, green. Cabochon cut; elliptical girdle. Size, 48 by 34 by 9 mm. Cat. Nos. a–697; 48721.

Microcline, var. amazonstone. Amelia Court-House, Virginia. Color, light green. Small tray. Cat. Nos. b–835; 84221.

Microcline, var. amazonstone. Amelia Court-House, Virginia. Color, green. Two balls. Size, 40 mm. and 37 mm. diameter. Cat. Nos. c–451–452; 84261. The Lea Collection; gift of Dr. L. T. Chamberlain.

Microcline, var. amazonstone. Pike's Peak, Colorado. Color, green. Cabochon cut; elliptical girdle. Size, 28 by 22 by 8 mm. Cat. Nos. a–696; 50383.

Microcline, var. amazonstone. Siberia. Color, green. Cabochon cut; elliptical girdle. Three gems. Sizes, 17 by 13 by 4 mm., 22 by 17 by 4 mm., 15 by 11 by 5 mm. Cat. Nos. a–700–702; 50382.

Microcline, var. amazonstone. Siberia. Color, green. Cabochon cut; elliptical girdle. Size, 18 by 13 by 3 mm. Cat. Nos. a–703; 82861. The Lea Collection.

Microcline, var. amazonstone. Siberia. Color, green. Rectangular slab. Size, 72 by 40 by 4 mm. Cat. Nos. a–704; 51445. Gift of C. S. Bement.

Microcline, var. amazonstone. Color, green. Cabochon cut; elliptical girdle. Size, 33 by 24 by 10 mm. Cat. Nos. a–705; 45118.

Moldavite, see Obsidian.

Moonstone, see Albite or Oligoclase.

Mosaic. Ekaterinburg, Siberia. Jewel box made of rhodonite, aventurine quartz, agate, and jasper. Cat. Nos. b–837; 51397.

Mosaic. Russia. Mosaic slab of the Seventeenth Century, made of agate and lapis lazuli mounted on slate. Cat. Nos. b–838; 51396.

Moss agate, see Quartz.

Obsidian. Yellowstone National Park. Color, brown, with black blotches. Two pieces of equal size. Cabochon cut; elliptical girdle. Size, 26 by 19 by 6 mm. Cat. Nos. a–682–683; 46825. The U. S. Geological Survey.

Obsidian. Yellowstone Park. Color, brown. Cabochon cut; circular girdle. Two pieces, each 25 mm. diam., 10 mm. thick. Cat. Nos. a–684–685; 46825. The U. S. Geological Survey.

Obsidian. Yellowstone National Park. Color, brown, with black blotches. Cabochon cut; rectangular girdle. Two pieces, each 22 by 18 by 10 mm. Cat. Nos. a–686–687; 46825. The U. S. Geological Survey.

Obsidian. Yellowstone National Park. Color, dark brownish black. Cabochon cut; rectangular girdle. Two pieces; respective sizes, 28 by 21 by 7 mm., 35 by 19 by 6 mm. Cat. Nos. a–688–689; 46825. The U. S. Geological Survey.

Obsidian. Yellowstone National Park. Color, black. Elliptical disks. Two pieces, each 21 by 17 by 3 mm. Cat. Nos. a–690–691; 46825. The U. S. Geological Survey.

Obsidian. Yellowstone National Park, Wyoming. Color, smoky black. Cabochon cut; elliptical girdle. Cat. Nos. a–692; 48925. Gift of Dr. Robert H. Lamborn.

Obsidian, var. moldavite. Moravia. Color, dark green. Step-brilliant cut; elliptical girdle. Size, 24 by 17 by 11 mm.; weight, 22.55 carats. Cat. Nos. a–693; 45119.

Obsidian, var. moldavite. Moravia. Color, dark green. Brilliant cut; rectangular girdle. Size, 13 by 10 by 7 mm; weight, 4.83 carats. Cat. Nos. a–694; 45119.

Oligoclase. Hawk mica mine, near Bakersville, Mitchell County, North Carolina. Colorless. Step-brilliant cut; rectangular girdle. Size, 14 by 10 by 6 mm.; weight, 5.90 carats. Cat. Nos. c–279; 50103.

Oligoclase. Hawk mine, near Bakersville, Mitchell County, North Carolina. Colorless. Brilliant cut; square girdle. Size, 8.5 by 6 mm.; weight, 2.35 carats. Cat. Nos. c–230; 48470.

Oligoclase. Norway. Color, dark gray, with change of color. Cabochon cut; 2 elliptical, 1 square girdle. Sizes, 20 by 12 by 7 mm., 14 by 10 by 4.5 mm., 11 by 4 mm. Cat. Nos. a–281–283; 84183.

Oligoclase, var. moonstone. Delaware County, Pennsylvania. Color, light gray. Diamond shaped. Size, 54 by 30 by 17 mm. Cat. Nos. c–294; 84185. Gift of Charles Wilkes, U. S. N.

Oligoclase, var. moonstone. Colorless. Cabochon cut; rectangular girdle. Size, 22 by 10 by 7 mm. Cat. Nos. c–295; 50276.

Oligoclase, var. sunstone. Arendal, Norway. Color, brown. Cabochon cut; circular girdle. Two pieces. Size, 23 by 5.5 mm. Cat. Nos. c–269–270; 50332.

Oligoclase, var. sunstone. Krageroe, Norway. Color, reddish. Size, 8 by 5 by 2 cm. Cat. Nos. b–862; 84227.

Oligoclase, var. sunstone. Norway. Color, reddish brown. Cabochon cut; elliptical girdle. Five stones. Average size, 14 by 11 by 5.5 mm. Cat. Nos. c–271–275; 82850. The Lea Collection.

Oligoclase, var. sunstone. Norway. Color, reddish brown. Double cabochon cut; elliptical girdle. Size, 14 by 11 by 5 mm. Cat. Nos. c–276; 83528. Lea Collection. Gift of Dr. L. T. Chamberlain.

Oligoclase, var. sunstone. Norway. Color, reddish brown. Cabochon cut; rectangular girdle. Size, 32 by 9 by 3 mm. Cat. Nos. c–277; 84182.

Oligoclase, var. moonstone. Ceylon (?). Colorless. Cabochon cut; elliptical girdles. Seven gems. Size of largest, 21.5 by 9 by 4 mm.; average of remainder, 7 by 4 by 3.5 mm. Cat. Nos. c–410–416; 84186.

Oligoclase, var. moonstone. Floitenthal, Tyrol. Colorless. Cabochon cut; elliptical girdle. Size, 22 by 14 by 7 mm. Cat. Nos. c–417; 84187.

Oligoclase, var. sunstone. Media, Delaware County, Pennsylvania. Color, reddish gray. Cabochon cut; elliptical girdle. Size, 43 by 32 by 6 mm. Cat. Nos. c–267; 50281.

Oligoclase, var. sunstone. Media, Delaware County, Pennsylvania. Color, light gray. Cabochon cut; elliptical girdle. Size, 27 by 19 by 5.5 mm. Cat. Nos. c–268; 50281.

Oligoclase, var. sunstone. Media, Delaware County, Pennsylvania. Color, streaked white and brown. Rectangular disk. Size, 19 by 11 by 3 mm. Cat. Nos. c–278; 48933. Gift of Dr. R. H. Lamborn.

Oligoclase, var. moonstone. Delaware County, Pennsylvania. Colorless. Cabochon cut. Two gems. Size, 6.5 by 4.5 by 2.5 mm. and 4 by 2 mm. Cat. Nos. c–296–297; 82848. The Lea Collection.

Oligoclase, var. moonstone. Hanover County, Virginia. Colorless. Cabochon cut; elliptical girdle. Size, 30 by 15 by 7.5 mm. Cat. Nos. c–284; 47316. Gift of C. S. Bement.

Oligoclase, var. moonstone. Ceylon. Colorless. Cabochon cut; elliptical and circular girdles. Ninety-one small stones. Cat. Nos. c–298–388; 50328.

Oligoclase, var. moonstone. Ceylon. Colorless. Cabochon cut; elliptical and circular. Twenty gems. Size of one, 38 by 15 by 9 mm.; of two, 12 by 5 mm.; remainder small. Cat. Nos. c–398–408; 82849. The Lea Collection.

Oligoclase, var. moonstone. Ceylon. Colorless. Triangular pendant. Size, 44 by 25 by 8 mm. Cat. Nos. c–409; 50263.

Onyx, see Carbonate of lime or Quartz.

Oölite. Bristol, England. Color, reddish. Paper weight. Size, 10 cm. long, 1.3 cm. diameter. Cat. Nos. b–851; 84224.

Opal. Garfield County, Washington. Uncut mass. Cat. Nos. b–969; 51863. Gift of the Washington Onyx Mining and Milling Company.

Opal. Douglas City, Washington. Color, green. Uncut mass. Cat. Nos. b–970; 83326. Gift of Henry Hedges.

Opal. Queretaro, Mexico. Massive piece of fire opal in trachyte. Cat. Nos. b–972; 82565.

Opal. Queretaro, Mexico. Fire opal in trachyte. Cat. Nos. b–973; 82565.

Opal. Queretaro, Mexico. Mass of opal in matrix of reddish trachyte. Cat. Nos. b–974; 82511. The Lea Collection. Gift of Dr. L. T. Chamberlain.

Opal. Queretaro, Mexico. Color, bluish. Two small gems. Cabochon cut. Cat. Nos. b–980–981; 83762. Gift of Miss Knowlton.

Opal. Queretaro, Mexico. Color, blue. Cabochon cut. Cat. Nos. b–982; 50340.

Opal. Queretaro, Mexico. Color, white. Two small gems. Cabochon cut. Cat. Nos. b–983–984; 51137.

Opal. Queretaro, Mexico. Color, white. Cabochon cut. Cat. Nos. b–985; 50123.

Opal. Queretaro, Mexico. Three gems. Cabochon cut. Cat. Nos. b–986–988; 50105.

Opal. Queretaro, Mexico. Three fire opals. Cabochon cut. Cat. Nos. b–989–991; 50341.

Opal. Queretaro, Mexico. Five small fire opals. Cabochon cut. Cat. Nos. b–992–996; 50339.

Opal. Queretaro, Mexico. Five fire opals. Cabochon cut. Cat. Nos. b–997; c–2; 50337.

Opal. Queretaro, Mexico. Six small opals. Milky color. Cabochon cut. Cat. Nos. c–3–8; 50340.

Opal. Queretaro, Mexico. Five pieces. Color, milky. Cabochon cut. Cat. Nos. c–9–13; 50338.

Opal. Queretaro, Mexico. Thirteen small gems. Cabochon cut. Cat. Nos. c–14–26; 47841.

Opal. La Silleta, Jalisco, Mexico. Mass of common opal. Color, grayish green, streaked. Cat. Nos. c–27; 50121.

Opal. Mexico. Translucent with play of color. Cabochon cut; elliptical girdle; high summit. Size, 2.5 by 1.7 by 1 mm.; weight, 20 carats. Cat. Nos. 461; 84705.

Opal. Mexico. Transparent with play of color. Cabochon cut; circular girdle; high summit. Size 1 by 0.9 by 0.8 mm.; weight, 2.75 carats. Cat. Nos. c–462; 84705.

Opal. Mexico. Cabochon cut; elliptical girdle; low arch. Size, 1 by 0.8 mm; weight, 1.25 carats. Cat. Nos. c–463; 84705.

Opal. Honduras. Massive piece of fire opal. Cat. Nos. c–28; 83116. The Lea Collection. Gift of Dr. L. T. Chamberlain.

Opal. Honduras. Two large gems; milky white. Cabochon cut. Cat. Nos. c–29–30; 50342.

Opal. Honduras. Ten small precious opals. Color, white. Cabochon cut. Cat. Nos. c–31–40; 50342.

Opal. Czerwenitza, Hungary. Slab of trachyte containing small specks of precious opal. Polished. Cat. Nos. c–41; 45024.

Opal. Hungary. Color, white. Small gem. Cabochon cut. Cat. Nos. c–42; 84244.

Opal. Czerwenitza, Hungary. Color, bluish in gray trachyte. Cabochon cut. Cat. Nos. c–43; 50343.

Opal. Baracoo River, Queensland. Small piece of beautifully variegated opal in argillaceous limonite. Uncut. Cat. Nos. c–44; 83448.

Opal. Baracoo River, Queensland, Australia. Two large precious opals. Uncut. Cat. Nos. c–49–50; 83540. Lea Collection; gift of Dr. L. T. Chamberlain.

Opal. Baracoo River, Queensland, Australia. Veins of precious opal through matrix. Uncut. Cat. Nos. c–51; 81103. Gift of the Brisbane Museum.

Opal. Queensland, Australia. Two small pieces precious opal. Uncut. Cat. Nos. c–52–53; 51105.

Opal. Baracoo River, Queensland, Australia. Small polished slab containing deep blue opal. Cat. Nos. c–54; 45028.

Opal. Baracoo River, Queensland, Australia. Color, greenish blue. Two engraved opals on brown limonite. Cat. Nos. c–55–56; 50258.

Opal. Baracoo River, Queensland, Australia. Color, bluish. Seven small pieces. Cabachon cut. Cat. Nos. c–57–63; 51105.

Opal. Baracoo River, Queensland, Australia. Four small pieces of polished limonite containing precious opal. Cat. Nos. c–64–67; 48487.

Opal. Noto, Japan. Color, cream. Size, 5.7 by 2.3 cm. Cat. Nos. c–68; 18575.

Opal. Hacienda Esperanza, Queretaro, Mexico. Five fire opals. Cabochon cut. Total weight, 36.75 carats. Cat. Nos. c–459; 84481–3. One stone the gift of Dr. L. T. Chamberlain.

Orthoclase, var. adularia. St. Gothard, Switzerland. Three small colorless gems. Cabochon cut; elliptical girdles. Size, 10 by 9 by 4 mm.=2; 7 by 5 by 2 mm.=1. Cat. Nos. c–264–266; 50380.

Pearl. India. Color, white. Necklace of 148 round pearls and two pear-shaped pearls. Cat. Nos. c–97–246; 47352. Gift of Imaun of Muscat.

Perthite. Perth, Canada. Color, brown. Cabochon cut; elliptical girdle. Size, 45 by 35 by 10 mm. Cat. Nos. c–262; 51077. The Lea Collection.

Perthite. Perth, Canada. Color, brown with white veins. Cabochon cut; rectangular girdle. Size, 33 by 13 by 5 mm. Cat. Nos. c–263; 84181.

Phenacite. Siberia. Colorless. Brilliant cut; rectangular girdle. Size 12.5 by 11 by 7 mm.; weight, 5.10 carats. Cat. Nos. 830; 82914. The Lea Collection.

Phenacite. Siberia. Colorless. Brilliant cut; square girdle. Size, 8 by 8 by 5 mm.; weight, 2.09 carats. Cat. Nos. 831; 84069.

Plasma, see Quartz.

Porphyry. Sweden. Color, black matrix with red feldspar. Tabular cut; rectangular girdle. Cat. Nos. b-841; 84222.

Prase, see Quartz.

Prehnite. Hoxies Quarry, Paterson, N. J. Color, light green. Two gems; cabochon cut; each 17 by 6 mm. Cat. Nos. a-632-633; 84174.

Prehnite. Hoxies Quarry, Paterson, New Jersey. Color, light green. Cabochon cut. Size, 54 by 14 by 8 mm. Cat. Nos. a-634; 83580.

Prehnite, var. chlorastrolite. Isle Royale, Lake Superior. Color, green, speckled. Cabochon cut; elliptical girdle. Size, 20 by 17 by 4 mm. Cat. Nos. a-635; 51136.

Prehnite, var. chlorastrolite. Isle Royale, Lake Superior. Color, green, speckled. Cabochon cut. Average size, 15 by 11 by 5 mm. Cat. Nos. a-636-638; 83330. The Lea Collection. Gift of Dr. L. T. Chamberlain.

Prehnite, var. chlorastrolite. Isle Royale, Lake Superior. Color, green, speckled. Cabochon cut; elliptical girdle. Size, 12 by 8.5 by 6 mm. Cat. Nos. a-639; 50106.

Prehnite, var. chlorastrolite. Isle Royale, Lake Superior. Color, green, speckled. Cabochon cut; elliptical girdle. Five stones, three of which are small. Two are 14 by 11 by 5 mm. Cat. Nos. a-640-644; 84175.

Pyrope, see Garnet.

Pyroxene. South Fork of Yadkin River, Davidson County, North Carolina. Color, dark green. Polished slab. Cat. Nos. b-861; 13709. Gift of Dr. Edward Palmer.

Pyroxene, var. diopside. De Kalb, St. Lawrence, County, New York. Color, bottle green. Cabochon cut; elliptical girdle. Size, 18.5 by 13 by 6 mm.; weight, 10.42 carats. Cat. Nos. a-571; 46828.

Pyroxene, var. diopside. De Kalb, St. Lawrence County, New York. Color, grass green. Step-brilliant cut; square girdle. Size, 6.5 by 5.5 mm.; weight, 2.16 carats. Cat. Nos. a-572; 46828.

Pryoxene, var. diopside. De Kalb, St. Lawrence County, New York. Color, green. Step-brilliant cut; rectangular girdle. Size, 8 by 7 by 5 mm.; weight, 1.87 carats. Cat. Nos. a-573; 46828.

Pyroxene, var. diopside. De Kalb, St. Lawrence County, New York. Color, light green. Brilliant cut; rectangular girdle. Size, 7.5 by 6.5 by 5 mm.; weight, 1.52 carats. Cat. Nos. a-574; 84106.

Pyroxene, var. diopside. Renfrew County, Canada. Color, light green. Step-brilliant cut; rectangular girdle. Size, 7.5 by 7 by 4.5 mm.; weight, 1.68 carats. Cat. Nos. a-575; 82816. The Lea Collection.

Pyroxene, var. diopside. Tyrol. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 9 by 7 by 3 mm.; weight, 1.56 carats. Cat. Nos. a-576; 50323.

Pyroxene, var. diopside. Tyrol. Color, deep green. Step-brilliant cut; rectangular girdle. Size, 7.5 by 6 by 4 mm.; weight, 1.30 carats. Cat. Nos. a-577; 50323.

Pyroxene, var. diopside. Color, grass green. Step-brilliant cut; rectangular girdle. Size, 10.5 by 5 by 2.5 mm.; weight, 1.16 carats. Cat. Nos. a-578; 84107.

Quartz. Paris, Maine. Color, white, opalescent. Cabochon cut. Size, 44 by 23 by 12 mm. Cat. Nos. a-990; 49194.

Quartz. Fairfax Court-House, Virginia. Color, greenish, banded. Tabular cut. Size, 22 by 17 by 5 mm. Cat. Nos. a-994-995; 47847.

Quartz. Fairfax Court-House, Virginia. Color, greenish, banded. Cabochon cut; elliptical girdle. Cat. Nos. c-421; 48927. Gift of Dr. Robert H. Lamborn.

Quartz. Silesia. Colorless; opalescent. Two stones; double cabochon cut; circular girdles. Cat. Nos. a-991-992; 50362.

Quartz. Silesia. Color, pale yellow, opalescent. Brilliant cut; circular girdle. Size, 10 by 5 mm. Cat. Nos. a-993; 50362.

Quartz, var. agate. Agate Bay, Minnesota. Color, light brown. Ellipsoid; mounted as charm. Cat. Nos. b-199; 83328. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. agate. Lake Superior. Color, brown, banded. Rectangular disks. Size, 27 by 15 mm. Cat. Nos. b-312-313; 13426.

Quartz, var. agate. Lake Superior. Color, mottled red. Cat. Nos. b-324; 83325. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. agate. Lake Superior. Color, red, banded. Cat. Nos. b-790; 83325. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. agate. Brazil. Color, brownish gray. Cat. Nos. b-792; 44948.

Quartz, var. agate. Brazil. Color, brown. Cat. Nos. b-793; 49629. The Lea Collection.

Quartz, var. agate. Brazil. Color, brown. Cat. Nos. b-794; 44948.

Quartz, var. agate. Brazil. Color, red, banded. Cat. Nos. b-795; 44498.

Quartz, var. agate. Brazil. Color, brown and white bands. Cat. Nos. b-796; 44948.

Quartz, var. agate. Brazil. Color, green and gray. Cat. Nos. b-797; 45027.

Quartz, var. agate. Brazil. Color, reddish. Cat. Nos. b-798; 49273.

Quartz, var. agate. Brazil. Color, red and white banded. Large slab of agate carnelian. Cat. Nos. b-799; 50135.

Quartz, var. agate. Brazil. Color, red and gray. Carnelian agate cube, with edges truncated. Size, 5 cm. Cat. Nos. b-800.

Quartz, var. agate. Brazil. Color, reddish banded. Cat. Nos. b-801-802; 50135.

Quartz, var. agate. Brazil. Large mass. Cat. Nos. b-803; 51534. The U. S. Geological Survey.

Quartz, var. agate. Brazil. Color, white. Cat. Nos. b-804; 49629. The Lea Collection.

Quartz, var. agate. Uruguay. Small polished piece. Cat. Nos. b-195; 50424.

Quartz, var. agate. Uruguay. One face polished. Cat. Nos. b-805; 50424.

Quartz, var. agate. Uruguay. One face polished. Cat. Nos. b-806; 50424.

Quartz, var. agate. Oberstein, Bavaria. Circular button. Cat. Nos. b-196; 82862. The Lea Collection.

Quartz, var. agate. Oberstein, Bavaria. Five small rectangular slabs, artificially colored. Various colors. Cat. Nos. b-200-204; 83526. Gift of George F. Kunz.

Quartz, var. agate. Oberstein, Bavaria. Twenty-five agates of various cuts. Cat. Nos. b-205-229; 50402.

Quartz, var. agate. Oberstein, Bavaria. Thirty-nine agates, various cuts. Cat. Nos. b-249-287; 46816.

Quartz, var. agate. Oberstein, Bavaria. Cube. Size, 4 cm. Cat. Nos. b-807; 84218.

Quartz, var. agate. One face polished. Cat. Nos. b-808; 45005.

Quartz, var. agate. Oberstein, Bavaria. Two faces polished. Cat. Nos. b-809; 84250.

Quartz, var. agate. Oberstein, Bavaria. One face polished. Cat. Nos. b-810; 81418.

Quartz, var. agate. Oberstein, Bavaria. Small dish. Size, 8 by 6.2 cm. Cat. Nos. b-811; 82856. The Lea Collection.

Quartz, var. agate. Oberstein, Bavaria. Carved seal handle. Size, 8.5 cm. long. Cat. Nos. b-812; 50418.

Quartz, var. agate. Oberstein, Bavaria. Seven snuff boxes of various sizes. Cat. Nos. b-813-819; 82798. The Lea Collection.

Quartz, var. agate. Oberstein, Bavaria. Dish. Cat. Nos. b-820; 82856. The Lea Collection.

Quartz, var. agate. Germany. Carved seal handle. Cat. Nos. b-308; 82860. The Lea Collection.

Quartz, var. agate. Germany. Paper cutter. Cat. Nos. b-337; 82857. The Lea Collection.

Quartz, var. agate. Germany. Small cane handle. Cat. Nos. b–821; 82861. The Lea Collection.

Quartz, var. agate. Germany. Penholder. Cat. Nos. b–822; 82858. The Lea Collection.

Quartz, var. agate. Italy. Ring. Cat. Nos. b–197; 82795. The Lea Collection.

Quartz, var. agate. Japan. Elliptical disk. Size, 25 by 20 mm. Cat. Nos. b–198; 50423.

Quartz, var. agate. Nine small agates; various cuts. Cat. Nos. b–230–238; 50408.

Quartz, var. agate. Ten agates; various cuts. Cat. Nos. b–239–248; 50403.

Quartz, var. agate. Twelve small agates. Various colors. Cat. Nos. b–288–299; 82864. The Lea Collection.

Quartz, var. agate. Six agates of various cuts. Different colors. Cat. Nos. b–300–305; 50401.

Quartz, var. agate. Two slabs. Cat. Nos. b–306–307; 46801. Gift of Colonel Totten.

Quartz, var. agate. Seal handle. Cat. Nos. b–309; 84249. Gift of Dr. Robert Fletcher.

Quartz, var. agate. Rectangular slab. Cat. Nos. b–310; 47470.

Quartz, var. agate. Table cut; rectangular girdle. Cat. Nos. b–311; 48481.

Quartz, var. agate. Size, 24 by 20 by 6 mm. Cat. Nos. b–314; 16458.

Quartz, var. agate. Nine agates variously cut. Different colors. Cat. Nos. b–315–323; 84249.

Quartz, var. agate. Twelve clouded agates. Cabochon cut. Cat. Nos. b–325–336; 46815.

Quartz, var. agate. Rectangular slab. Cat. Nos. c–418; 44366. The Abert Collection.

Quartz, var. agate. Small intaglio. Cat. Nos. b–823; 50068.

Quartz, var. agate. One face polished. Cat. Nos. b–824; 84219.

Quartz, var. agate. Slab, one face polished. Cat. Nos. b–825; 48513.

Quartz, var. agate. Cat. Nos. b–826; 50552. The Lea Collection.

Quartz, var. agate. Cat. Nos. b–827; 82800. The Lea Collection.

Quartz, var. agate. Cat. Nos. b–828; 82799. The Lea Collection.

Quartz, var. agate. Cube with edges truncated. Size, 5.2 cm. Cat. Nos. b–829; 84220.

Quartz, var. agate. Cube with truncated edges. Size, 4.5 cm. Cat. Nos. b–830; 82801. The Lea Collection.

Quartz, var. agate. Cat. Nos. b–831; 46–832. Gift of F. W. Taylor.

Quartz, var. agate. Size, 10 by 5.5 cm. Cat. Nos. b–832; 84220.

Quartz, var. agate. Carved paper weight. Cat. Nos. b–833; 48484.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Square slab. Cat. Nos. b–775; 47962. Gift of the Drake Company.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Square slab. Cat. Nos. b–776; 84216.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Mosaic slab of small blocks of agatized wood, mounted on slate. Cat. Nos. b–777; 50110.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Color, black. Cross section of small tree. Cat. Nos. b–778; 47962. Gift of the Drake Company.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Color, red predominates. Three slabs and one cross section of tree. Cat. Nos. b–779–782; 47962. Gift of the Drake Company.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Dish-shaped ornament. Size, 12.5 by 8.5 by 3.5 cm. Cat. Nos. b–783; 48516.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Polished ball. Size, 11 cm. diam. Cat. Nos. b–784; 50269.

Quartz, var. agatized wood. Chalcedony Park, Arizona. Small carved dog's head. Cat. Nos. b–785; 48443. Gift of Maj. J. W. Powell.

Quartz, var. agatized wood. Humboldt County, Nevada. Rectangular block. Size, 6 by 5 by 2.5 cm. Cat. Nos. b–786; 15610.

Quartz, var. agatized wood. Longitudinal section of tree. Cat. Nos. b–787; 48539.

Quartz, var. agatized wood. Cross section of tree. Size, 9 cm. diam. Cat. Nos. b–788; 84217.

Quartz, var. amethyst. Stow, Maine. Color, deep amethyst. Step-brilliant cut; circular girdle. Size, 19 by 12 mm.; weight, 22.90 carats. Cat. Nos. b–717; 50278.

Quartz, var. amethyst. Stow, Maine. Color, amethyst. Rose cut; elliptical girdle. Size, 17 by 14 by 10 mm.; weight, 12.73 carats. Cat. Nos. a–721; 46826.

Quartz, var. amethyst. Brazil. Color, amethyst. Brilliant cut; circular girdle. Size, 17 by 10 mm. Cat. Nos. a–724; 84188.

Quartz, var. amethyst. Brazil. Color, amethyst. Brilliant cut; circular girdle. Size, 16 by 10 mm. Cat. Nos. a–725; 94188.

Quartz, var. amethyst. Brazil. Color, amethyst. Step-brilliant cut; elliptical girdle. Size, 22 by 16 by 8 mm. Cat. Nos. a–726; 84188.

Quartz, var. amethyst. Brazil. Color, amethyst. Step-brilliant cut; elliptical girdle. Size, 16 by 15 by 8 mm. Cat. Nos. a–727; 84188.

Quartz, var. amethyst. Brazil. Color, amethyst. Step-brilliant cut; circular girdle. Size, 13 by 8 mm. Cat. Nos. s–728; 84188.

Quartz, var. amethyst. Harz, Germany. Color, pale amethyst. Step-brilliant cut; elliptical girdle. Size, 10 by 9 by 6 mm. Cat. Nos. a–730; 47785. Gift of Dr. Henry A. Fisher.

Quartz, var. amethyst. Germany. Color, amethyst. Seal handle on gold base. Cat. Nos. a–742; 82786. The Lea Collection.

Quartz, var. amethyst. Siberia. Color, deep amethyst. Brilliant cut; square girdles. Eleven stones; average size, 5 by 3 mm. Cat. Nos. a–731–741; 84189.

Quartz, var. amethyst. Japan. Color, amethyst. Step-brilliant cut; oval girdle. Size, 21 by 19 by 11 mm. Cat. Nos. a–729; 50366.

Quartz, var. amethyst. Color, amethyst. Step cut; intaglio; rectangular girdle. Size, 18 by 16 by 9 mm. Cat. Nos. a–743; 50272.

Quartz, var. amethyst. Warlick, Burke County, North Carolina. Color, light amethyst. Step, brilliant cut; elliptical girdle. Size, 18 by 16 by 9 mm.; weight, 14.61 carats. Cat. Nos. a-718; 83742. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Macon County, North Carolina. Color, amethyst. Brilliant cut; elliptical girdle. Size, 7 by 13 by 8 mm.; weight, 9.93 carats. Cat. Nos. a-719; 48471.

Quartz, var. amethyst. Minas Geraes, Brazil. Color, deep amethyst. Step, brilliant cut; elliptical girdle. Size, 48 by 33 by 21 mm.; weight, 178.13 carats. Cat. Nos. a-722; 83538. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Brazil. Color, amethyst. Brilliant cut; elliptical girdle. Size, 21 by 16 by 11.5 mm. Cat. Nos. a-723; 84188.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size, 14 by 10 mm.; weight, 9.71 carats. Cat. Nos. a-713; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size, 12 by 8 mm.; weight, 6.39 carats. Cat. Nos. a-714; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, light amethyst. Step-brilliant cut; circular girdle. Size, 12 by 8 mm.; weight, 6.07 carats. Cat. Nos. a-715; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, light amethyst. Step-brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 2.36 carats. Cat. Nos. a-716; 83748. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size, 20 by 14 mm.; weight, 26.81. Cat. Nos. a-709; 83746. The Lea Collection; the gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size 15 by 11 mm.; weight, 12.57 carats. Cat. Nos. a–710; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size, 14 by 10 mm.; weight, 9.32 carats. Cat. Nos. a–711; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size, 14 by 10 mm.; weight, 9.75 carats. Cat. Nos. a–712; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; elliptical girdle. Size, 46 by 34 by 22 mm.; weight, 197.53 carats. Cat. Nos. a–706; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, deep amethyst. Brilliant cut; circular girdle. Size, 32 by 23 mm.; weight, 119.09 carats. Cat. Nos. a–707; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Ten miles southeast of Statesville, Alexander County, North Carolina. Color, amethyst. Step-brilliant cut; circular girdle. Size 21 by 14 mm.; weight, 32.39 carats. Cat. Nos. a–708; 83746. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Upper Providence, Delaware County, Pennsylvania. Color, deep amethyst. Step-brilliant cut; octagonal girdle. Size, 21 by 15 mm.; weight, 35.27 carats. Cat. Nos. a–720; 83537. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; elliptical girdle. Size, 25 by 21 by 10 mm.; weight, 32.66 carats. Cat. Nos. a–744; 50365.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; rectangular girdle. Size, 23 by 18 by 9 mm. Cat. Nos. a–745; 50365.

Quartz, var. amethyst. Color, amethyst. Size, 17 by 13 by 9 mm. Cat. Nos. a–746; 50365.

Quartz, var. amethyst. Color, amethyst. Brilliant cut; elliptical girdle. Size, 14 by 12 by 8 mm. Cat. Nos. a–747; 50365.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; octagonal girdle. Size, 11 by 10 by 7 mm. Cat. Nos. a–748; 50365.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; elliptical girdle. Size, 14 by 11 by 6 mm. Cat. Nos. a–749; 50365.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut. Sixteen stones. Size: Largest, 24 by 20 by 10; smallest, 7 by 7 by 4 mm. Cat. Nos. a–750–765; 82782. The Lea Collection.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; elliptical girdle. Fourteen stones; average size, 14 by 10 by 4 mm. Cat. Nos. a–766–779; 50368.

Quartz, var. amethyst. Color, amethyst. Step-brilliant cut; triangular girdle. Size, 20 by 14 by 10 mm. Cat. Nos. a–780; 82769. The Lea Collection.

Quartz, var. amethyst. Pale amethyst. Step-brilliant cut. Eight stones of various sizes. Cat. Nos. a–781–788; 82782. The Lea Collection.

Quartz, var. amethyst. Color, pale amethyst. Step-brilliant cut; oval girdle. Size, 16 by 13 by 6 mm. Cat. Nos. a–789; 92770. The Lea Collection.

Quartz, var. amethyst. Color, pale amethyst. Step-brilliant cut; square girdle. Size, 12 by 5 mm. Cat. Nos. a–790; 50368.

Quartz, var. amethyst. Color, smoky amethyst. Step-brilliant cut; elliptical girdle. Size, 14 by 11 by 6 mm. Cat. Nos. a–791; 82782. The Lea Collection.

Quartz, var. aventurine. Spain. Color, green. Polished slab. Cat. Nos. b–733; 45030.

Quartz, var. aventurine. Near Madrid, Spain. Color, brown. Cabochon cut; elliptical girdle. Size, 30 by 21 by 5 mm. Cat. Nos. b–735; 50364.

Quartz, var. aventurine. Russia. Color, brown. Polished slab. Cat. Nos. b–734; 45029.

Quartz, var. beekite. Devon, England. Color, yellowish. Small carved dish. Cat. Nos. b–789; 51935.

Quartz, var. bloodstone. India. Color, green with red spots. Five pieces, variously cut. Cat. Nos. b–632–636; 50399.

Quartz, var. bloodstone. India. Green with spots. Cat. Nos. b–637; 47466. Gift of George F. Kunz.

Quartz, var. bloodstone. India. Two small snuff boxes. Cat. Nos. b–638–639; 50400.

Quartz, var. bloodstone. India. Color, green with red spots. Cat. Nos. b–640; 50399.

Quartz, var. bloodstone. Egypt. Color, green with red spots. Cat. Nos. b–641; 44951.

Quartz, var. bloodstone. Color, green with red spots. Small intaglio. Cat. Nos. b–642; 48473.

Quartz, var. bloodstone. Color, dark green with red spots. Intaglio. Cat. Nos. b–643; 50067.

Quartz, var. bloodstone. Color, green with red spots. Six pieces of various cuts. Cat. Nos. b–644–649; 46817.

Quartz, var. bloodstone. Color, green with red spots. Two pieces. Cat. Nos. b–650–651; 49244.

Quartz, var. bloodstone. Color, green with red spots. Cabochon cut; elliptical girdle. Cat. Nos. b–652; 47393. Gift of Mrs. Spencer F. Baird.

Quartz, var. bloodstone. Color, green with red spots. Elliptical and shield shape. Five small pieces. Cat. Nos. b–653–657; 82796. The Lea Collection.

Quartz, var. bloodstone. Color, green with red spots. Cabochon cut. Two large pieces. Cat. Nos. b–658–659. Gift of Geo. F. Kunz.

Quartz, var. bloodstone. Color, green with red spots. Size, 2.7 cm. diam. Cat. Nos. b–660; 84211.

Quartz, var. bloodstone. With agate in silver mounting, as breastpin. Cat. Nos. b–661; 46508. Gift of Messrs. Harris & Shafer.

Quartz, var. carnelian. Brazil. Color, red. Paper cutter. Cat. Nos. b–504; 48538.

Quartz, var. carnelian. Germany. Color, red, banded. Bracelet of 6 buttons and 12 beads. Cat. Nos. b–605; 82859. The Lea Collection.

Quartz, var. carnelian. Oberstein, Bavaria. Color, red. Size, 24 by 19 mm. Cat. Nos. b–503; 14157. The Hawes Collection.

Quartz, var. carnelian. Palestine, Holy Land. Color, red. Size, 15 by 13 by 3 mm. Cat. Nos. b–502; 18243.

Quartz, var. carnelian. Color, red. Size, 12 by 10 cm. Cat. Nos. b–505; 45016.

Quartz, var. carnelian. Color, deep red. Cabochon cut; elliptical girdle. Size, 53 by 42 mm. Cat. Nos. b–506; 50406.

Quartz, var. carnelian. Color, red. Six small stones of various cuts. Cat. Nos. b–507–512; 46812.

Quartz, var. carnelian. Color, red. Twelve stones. Cat. Nos. b–513–524; 46813.

Quartz, var. carnelian. Color, red. Twenty-seven stones, variously cut. Cat. Nos. b–525–551.

Quartz, var. carnelian. Color, red. Fifty-three stones, variously cut. Cat. Nos. b–552–604; 82863. The Lea Collection.

Quartz, var. carnelian. Color, red. Fifteen small intaglios. Cat. Nos. b–606–620; 82865. The Lea Collection.

Quartz, var. carnelian. Color, red. Six small intaglios. Cat. Nos. b–621–626; 47396. Deposited by Thomas Wilson.

Quartz, var. carnelian. Color, red. Size small. Cabochon cut. Cat. Nos. b–627; 46812.

Quartz, var. carnelian. Color, red. Four small intaglios. Cat. Nos. b–628–631; 50069.

Quartz, var. cat's-eye. Cumberland, Rhode Island. Color, dark green. Cabochon cut; elliptical girdle. Size, 19 by 13 by 5 mm. Cat. Nos. b–25; 84198.

Quartz, var. cat's-eye. Bavaria. Color, brownish green. Cabochon cut; elliptical girdle. Size, 22 by 13 by 7 mm. Cat. Nos. b–27; 50379.

Quartz, var. cat's-eye. Hof, Bavaria. Color, dark green. Cabochon cut; circular and elliptical girdles. Three small stones. Size, 7 mm. diam. Cat. Nos. b–28–30; 50265.

Quartz, var. cat's-eye. Hungary. Color, dark green. Cabochon cut; elliptical girdle. Two stones. Size, 14 by 10 by 6 and 12 by 8 by 4 mm. Cat. Nos. b–31–32; 50321.

Quartz, var. cat's-eye. Ceylon. Color, pale greenish. Cabochon cut; elliptical girdle. Four pieces. Size, 29 by 17 by 10 and 10 by 6 by 5 mm. Cat. Nos. b–18–21; 82846. The Lea Collection.

Quartz, var. cat's-eye. Ceylon. Color, pale green. Cabochon cut; mounted in ring. Cat. Nos. b–32; 82847. The Lea Collection.

Quartz, var. cat's-eye. Ceylon. Color, pale green. Cabochon cut; elliptical girdle. Size, 15 by 12 by 8 mm. Cat. Nos. b–23; 50320.

Quartz, var. cat's-eye. Ceylon. Color, pale green. Cabochon cut; elliptical girdle. Size, 18 by 14 by 7 mm. Cat. Nos. b–24; 84199.

Quartz, var. cat's-eye. Madras, India. Color, pale green. 22 beads. Cat. Nos. b–26; 84200.

Quartz, var. cat's-eye. Color, dark green. Cabochon cut; circular girdle. Size, 9 by 4 mm. Cat. Nos. b–33; 84254.

Quartz, var. chalcedony. Fairfax Court-House, Virginia. Color, milky white. Cabochon cut; circular girdle. Size, 10 by 7 mm. Cat. Nos. b–70; 47849.

Quartz, var. chalcedony. Yellowstone Park, Wyoming. Cat. Nos. b–737; 83857.

Quartz, var. chalcedony. Yellowstone Park, Wyoming. Two pieces. Size, 7 cm. diam. Cat. Nos. b–738–739; 83857.

Quartz, var. chalcedony. Yellowstone Park, Wyoming. Color, gray. Cat. Nos. b–740; 83857.

Quartz, var. chalcedony. Germany. Color, milky white. Cabochon cut. Two pieces. Cat. Nos. b–68–69; 47469. Gift of George F. Kunz.

Quartz, var. chalcedony. Faroe Islands. Color, gray. Cat. Nos. b–741; 81976. The U. S. Geological Survey.

Quartz, var. chalcedony. India. Cabochon cut. Six stones. Cat. Nos. b–62–67; 50422.

Quartz, var. chalcedony. Ten stones, variously cut. Cat. Nos. b–71–80; 46808.

Quartz, var. chalcedony. Nine stones of cabochon cut. Cat. Nos. b-81-89; 46809.

Quartz, var. chalcedony. Color, yellow; banded. Four stones. Cabochon cut; rectangular girdle. Cat. Nos. b-90-93; 50413.

Quartz, var. chalcedony. Eighteen stones. Cabochon cut. Cat. Nos. b-94-111; 50416.

Quartz, var. chalcedony. Seventy stones of various cuts. Cat. Nos. b-112-181; 50417.

Quartz, var. chalcedony. Color, yellow, black, and green. Five stones of various cuts. Cat. Nos. b-182-187.

Quartz, var. chalcedony. Color, milky white. Cabochon cut. Four stones. Cat. Nos. b-188-191; 82794. The Lea Collection.

Quartz, var. chalcedony. Color, yellow. Cat. Nos. b-192; 82802. The Lea Collection.

Quartz, var. chalcedony. Cat. Nos. b-193; 44365. The Abert Collection.

Quartz, var. chalcedony. Color, light brown. Cabochon cut. Cat. Nos. b-194; 48480.

Quartz, var. chalcedony. Paper weight. Cat. Nos. b-742; 50147. The Lea Collection.

Quartz, var. chalcedony. Snuff box. Cat. Nos. b-743; 50414.

Quartz, var. chalcedony. Color, gray. Small intaglio. Cat. Nos. b-744; 47396. Deposited by Thomas Wilson.

Quartz, var. chalcedony. Color, brown. Six intaglios. Cat. Nos. b-745-750; 48472.

Quartz, var. chrysoprase. Tulare County, California. Color, green. Cabochon cut; elliptical girdle. Cat. Nos. b-726; 83554.

Quartz, var. chrysoprase. Silesia. Color, green. Sixteen stones, large and small. Brilliant and cabochon cuts. Cat. Nos. b-34-49; 50375.

Quartz, var. chrysoprase. Silesia. Color, green. Circular disk. Size, 19 mm. diam. Cat. Nos. b-50; 84251. The Lea Collection.

Quartz, var. chrysoprase. Color, apple green. Cabochon cut; circular girdle. Size, 24 by 13 mm. Cat. Nos. b-51; 46822.

Quartz, var. citrine. White Plains, Alexander County, North Carolina. Color, pale yellow. Brilliant cut; square girdle. Size, 34 by 23 mm.; weight, 133.01 carats. Cat. Nos. a-911; 83737. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. citrine. Brazil. Color, yellowish green. Step-brilliant cut; 5 stones. Cat. Nos. a-912-916; 50345.

Quartz, var. citrine. Brazil. Color, yellowish brown. Step-brilliant cut; elliptical girdle. Size, 43 by 35 by 18 mm.; weight, 151.91 carats. Cat. Nos. a-917; 50346.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; elliptical girdle. Size, 32 by 25 by 13 mm.; weight, 57.88 carats. Cat. Nos. a-918; 50347.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; rectangular girdle. Size, 23 by 20 by 11 mm.; weight, 34.14 carats. Cat. Nos. a-919; 50347.

Quartz, var. citrine. Color, brownish yellow. Step-brilliant cut; elliptical girdle. Size, 24 by 18 by 10 mm.; weight, 23.66 carats. Cat. Nos. a-920; 50347.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; rectangular girdle. Size, 20 by 17 by 10 mm. Cat. Nos. a-921; 50347.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; elliptical girdle. Size, 17 by 13 by 8 mm. Cat. Nos. a-922; 50347.

Quartz, var. citrine. Brazil. Color, brownish yellow. Step-brilliant cut; rectangular girdle. Size, 24 by 18 by 9 mm. Cat. Nos. a-923; 50348.

Quartz, var. citrine. Brazil. Color, yellowish brown. Step-brilliant cut; elliptical girdle. Three stones. Sizes, 17 by 11 by 6, 14 by 11 by 6, 12 by 9 by 5.5 mm. Cat. Nos. a-924-926; 50348.

Quartz, var. citrine. Brazil. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 44 by 33 by 20 mm.; weight, 155.95 carats. Cat. Nos. a–927; 50349.

Quartz, var. citrine. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 30 by 23 by 13 mm.; weight, 53.24 carats. Cat. Nos. a–928; 50349.

Quartz, var. citrine. Brazil. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 27 by 20 by 11 mm. Cat. Nos. a–929; 50349.

Quartz, var. citrine. Color, pale yellow. Brilliant cut; rectangular girdle. Size, 12 by 13 by 8 mm. Cat. Nos. a–930; 50349.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; rectangular girdle. Size, 22 by 16 by 11 mm. Cat. Nos. a–931; 82767. The Lea Collection.

Quartz, var. citrine. Brazil. Color, citrine yellow. Step-brilliant cut; octagonal girdle. Size, 12 by 5 mm. Cat. Nos. a–932; 82767. The Lea Collection.

Quartz, var. citrine. Brazil. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 12 by 10 by 7 mm. Cat. Nos. a–933; 82767. The Lea Collection.

Quartz, var. citrine. Switzerland. Color, citrine yellow. Step cut; rectangular girdle. Size, 34 by 27 by 15 mm.; weight, 89.64 carats. Cat. Nos. a–934; 50358.

Quartz, var. citrine. Switzerland. Color, citrine yellow. Knife handle. Size, 7½ cm. long. Cat. Nos. a–935; 50357.

Quartz, var. citrine. Italy. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 29 by 22 by 12 mm.; weight, 49.90 carats. Cat. Nos. a–936; 82768. The Lea Collection.

Quartz, var. citrine. Color, citrine yellow. Step-brilliant cut. Fourteen stones. Size, largest, 34 by 23 by 11 mm.; smallest, 10 by 8 by 5 mm. Cat. Nos. a–937–950; 50368.

Quartz, var. citrine. Color, pale yellow. Step-brilliant cut; elliptical girdle. Size, 37 by 30 by 15 mm.; weight, 97.22 carats. Cat. Nos. a–951; 82770. The Lea Collection.

Quartz, var. citrine. Color, citrine yellow. Step-brilliant cut; rectangular girdle. Three stones. Sizes, 18 by 15 by 8, 17 by 14 by 5, 13 by 9 by 4 mm. Cat. Nos. a–952; 954; 82770. The Lea Collection.

Quartz, var. citrine. Color, citrine yellow. Step-brilliant cut; elliptical girdle. Nine stones; average size, 14 by 10 by 6 mm. Cat. Nos. a–955–963; 82770. The Lea Collection.

Quartz, var. citrine. Color, citrine yellow. Brilliant cut; circular girdle. Nine stones; average size, 6 by 4 mm.; two stones larger. Cat. Nos. a–964–974; 82776. The Lea Collection.

Quartz, var. citrine. Color, citrine yellow. Step-brilliant cut; elliptical girdle. Nine stones. Size of largest, 25 by 18 by 12; of smallest, 11 by 9 by 6 mm. Cat. Nos. a–975–983; 82776. The Lea Collection.

Quartz, var. citrine. Florissant, El Paso County, Colorado. Color, citrine yellow. Brilliant top or mixed cut. Weight, 138.5 carats. Cat. Nos. c–456; 84376. Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. citrine. Color, citrine yellow. Seal with coat-of-arms mounted as watch charm. Cat. Nos. a–984; 84192. Deposited by W. R. Gibbs.

Quartz, var. flint. Chalk beds, England. Color, brown. Cabochon cut; elliptical girdle. Size, 25 by 21 by 6 mm. Cat. Nos. b–736; 50427.

Quartz, with inclusions. Rhode Island. Color, greenish; elliptical disk containing actinolite. Size, 28 by 20 by 3 mm. Cat. Nos. a–996; 84192.

Quartz, with inclusions. Fairfax, Virginia. Colorless, with dark inclusions. Size, 14 by 11 by 5 mm. Cat. Nos. c–420; 48926. Gift of Dr. Robt. H. Lamborn.

Quartz, with inclusions. Alexander County, North Carolina. Colorless, with red rutile needles. Rectangular disk. Size, 24 by 18 by 5 mm. Cat. Nos. a–997; 84193.

Quartz, with inclusions. Color, reddish brown. Cabochon cut; ellipitical girdle. Size, 21 by 17 by 6 mm. Cat. Nos. a–998; 84193.

Quartz, with inclusions. McDaniel's Farm, Iredell County, North Carolina. Color, brownish with rutile needles. Heart-shaped. Cat. Nos. a–999; 83741. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Iredell County, North Carolina. Two pieces of quartz filled with rutile crystals. Cat. Nos. b–758–759; 83681. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Iredell County, North Carolina. Polished piece containing rutile needles. Cat. Nos. b–760; 82781. The Lea Collection.

Quartz, with inclusions. Iredell County, North Carolina. Polished piece rock crystal, containing rutile needles. Cat. Nos. b–761; 84215.

Quartz, with inclusions. Burke County, North Carolina. Colorless, with crystal faces, containing black tourmaline needles. Cat. Nos. b–762; 82780. The Lea Collection.

Quartz, with inclusions. Near Hot Springs, Arkansas. Colorless, with green chlorite blotches. Step cut; square girdle. Cat. Nos. b–1; 84194.

Quartz, with inclusions. Near Hot Springs, Arkansas. Colorless, with green chlorite blotches. Step cut; elliptical girdle. Size, 24 by 19 by 7 mm. One-half filled with mossy chlorite. Cat. Nos. b–2; 84194.

Quartz, with inclusions. Near Hot Springs, Arkansas. Colorless, with red and green chlorite layer. Table cut. Size, 27 by 22 by 8 mm. Cat. Nos. b–3; 84194.

Quartz, with inclusions. Colorado. Color, black with göthite inclusions. Heart-shaped. Two stones. Sizes, 18 by 18 by 8 mm.; 16 by 16 by 5 mm. Cat. Nos. b–4–5; 50107.

Quartz, with inclusions. Clip, Arizona. Color, dark blue. Cabochon cut; elliptical girdle. Two pieces, containing dumortierite. Cat. Nos. b–16–17; 84196.

Quartz, with inclusions. California. Color, white with inclusions of gold. Small elliptical disk. Size, 27 by 21 by 3 mm. Cat. Nos. b–14; 50381.

Quartz, with inclusions. California. Color, white with inclusions of gold. Small slab. Cat. Nos. b–15; 84195.

Quartz, with inclusions. Brazil. Colorless, with reddish brown needles. Cabochon cut; elliptical girdle. Size, 34 by 27 by 6 mm. Cat. Nos. b–6; 50360.

Quartz, with inclusions. Brazil. Colorless, with brown rutile inclusions. Elliptical disk. Size, 40 by 35 by 4 mm. Cat. Nos. b–7; 82787. The Lea Collection.

Quartz, with inclusions. Brazil. Colorless, with planes of green chlorite. Cabochon cut; elliptical girdle. Size, 29 by 21 by 7 mm. Cat. Nos. b–8; 50361.

Quartz, with inclusions. Brazil. Colorless. Crystal of phantom quartz, with chlorite along the growth planes of crystal. Cat. Nos. b–763; 82958. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Brazil. Colorless. Contains rutile needles. Cat. Nos. b–764; 46821.

Quartz, with inclusions. Brazil. Colorless. Contains several long rutile needles. Cat. Nos. b–765; 46821.

Quartz, with inclusions. Brazil. Color, yellowish. Crystal of phantom quartz, with chlorite along growth planes of crystal. Cat. Nos. b–766; 51482.

Quartz, with inclusions. Switzerland. Colorless. Cabochon cut; elliptical girdle. Size, 38 by 28 by 8 mm. Cat. Nos. b–9; 50374.

Quartz, with inclusions. Siberia. Color, yellow. Carved seal handle, containing rutile needles. Cat. Nos. b–767; 51398.

Quartz, with inclusions. Colorless, with black hornblende needles. Cabochon cut; elliptical girdle. Size, 24 by 19 by 6 mm. Cat. Nos. b–10; 83340. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Japan. Colorless, with green tremolite. Double cabochon cut; elliptical girdle. Size, 20 by 15 by 9 mm. Cat. Nos. b–11; 83340. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Japan. Colorless. Two small prisms, containing tremolite needles. Cat. Nos. b–768–769; 83340. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, with inclusions. Madagascar. Slab filled with acicular rutile needles. Cat. Nos. b–770; 83764.

Quartz, with inclusions. Madagascar. Large, polished rock crystal, containing long rutile needles. Cat. Nos. b–771; 83764.

Quartz, with inclusions. Griqualand, South Africa. Color, brownish. Rectangular cut. Contains hematite veins in jasper. Cat. Nos. b–772; 18403.

Quartz, with inclusions. Colorless, with blotch of dark rutile fibers. Step-brilliant cut; elliptical girdle. Size, 15 by 12 by 7 mm. Cat. Nos. b–12; 82775. The Lea Collection.

Quartz, with inclusions. Colorless. Step-cabochon cut; rectangular girdle. Size, 16 by 12 by 4 mm. Cat. Nos. b–13; 82775. The Lea Collection.

Quartz, with inclusions. Color, smoky brown. Two slabs containing rutile needles. Cat. Nos. b–773–774; 83008. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. jasper. Hertfordshire, England. Color, brown. Breastpin and cuff buttons. Cat. Nos. b–667–669; 50260.

Quartz, var. jasper. Hertfordshire, England. Slab of pudding stone. Cat. Nos. b–670; 50390.

Quartz, var. jasper. Saxony. Color, red. Cat. Nos. b–666; 84252.

Quartz, var. jasper. Siberia. Color, red. Cat. Nos. b–662; 50136.

Quartz, var. jasper. Siberia. Color, red and green. Small slab. Size, 9 by 6.3 cm. Cat. Nos. b–663; 50397.

Quartz, var. jasper. Orenburg, Ural Mountains. Color, red and yellow. Slab. Cat. Nos. b–664; 51479.

Quartz, var. jasper. Orenburg, Ural Mountains. Color, green and red banded. Size, 25 by 19 mm. Cat. Nos. b–665; 50397.

Quartz, var. jasper. River Nile, Egypt. Color, brown. Two pieces; cabochon cut and slab. Cat. Nos. b–671–672; 50433.

Quartz, var. jasper. India. Color, red and green. Two large pieces. Cat. Nos. b–673–674; 51393.

Quartz, var. jasper. Color, reddish brown. Elliptical disk of agate jasper. Cat. Nos. b–675; 46804.

Quartz, var. jasper. Color, blue. Two colored pieces. Cat. Nos. b–676–677; 46811.

Quartz, var. jasper. Color, red and brown. Six pieces, variously cut. Cat. Nos. b–678–683; 46810.

Quartz, var. jasper. Color, red. Elliptical disk of agate jasper. Cat. Nos. b–684; 50405.

Quartz, var. jasper. Color, red. Cat. Nos. b–685; 84212.

Quartz, var. jasper. Cat. Nos. b–686; 48512.

Quartz, var. jasper. Color, yellow and red. Slab. Cat. Nos. b–687; 84253.

Quartz, var. moss agate. Kansas. Seven small stones. Cabochon cut. Cat. Nos. b–438–444; 50421.

Quartz, var. moss agate. Kansas. Cabochon cut. Cat. Nos. c–419; 50421.

Quartz, var. moss agate. Yellowstone Park, Wyoming. Two small pieces. Cabochon and elliptical cuts. Cat. Nos. c–426–427; 47844.

Quartz, var. moss agate. Yellowstone National Park, Wyoming. Three small pieces. Cat. Nos. c–428–430; 46827.

Quartz, var. moss agate. Yellowstone National Park, Wyoming. Cat. Nos. c–431; 82791. The Lea Collection.

Quartz, var. moss agate. Near Fort Bridger, Wyoming. Small piece. Cabochon cut; elliptical girdle. Cat. Nos. c–432; 50426.

Quartz, var. moss agate. India. Color, green. Size, 44 by 33 mm. Cat. Nos. b–338; 50419.

Quartz, var. moss agate. India. Cat. Nos. b–339; 83344. Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. moss agate. India. Ninety-two small stones. Cabochon cut. Cat. Nos. b–340–431; 50420.

Quartz, var. moss agate. Japan. Color, gray. Five stones. Cabochon cut. Cat. Nos. b–432–436; 82789. The Lea Collection.

Quartz, var. moss agate. China. Color, green. Cat. Nos. b–437; 82788. The Lea Collection.

Quartz, var. moss agate. Five stones of various cuts. Cat. Nos. b–445–449; 50404.

Quartz, var. moss agate. Three pieces. Cat. Nos. b–450–452; 50407.

Quartz, var. moss agate. Five small stones. Cabochon cut; circular girdles. Cat. Nos. b–453–457; 50409.

Quartz, var. moss agate. Cat. Nos. b–458; 50412.

Quartz, var. moss agate. Cat. Nos. b–459; 48483.

Quartz, var. moss agate. Two pieces. Cabochon cut. Cat. Nos. b–460–461; 48478.

Quartz, var. moss agate. Six small slabs. Cat. Nos. b–462–467; 47464. Gift of George F. Kunz.

Quartz, var. moss agate. Twenty-one pieces, of various cuts. Cat. Nos. b–468–488; 46814.

Quartz, var. moss agate. Thirteen small stones. Cabochon cut. Cat. Nos. b–489–501; 82790. The Lea Collection.

Quartz, var. onyx. Brazil. Small cameo. Cat. Nos. b–709; 48537.

Quartz, var. onyx. Germany. Color, dark brown and white banded. Two large pieces. Cat. Nos. b–707–708; 47467. Gift of George F. Kunz.

Quartz, var. onyx. One large and two medium-sized cameos. Cat. Nos. b–710–712; 48476.

Quartz, var. onyx. Small cameo. Cat. Nos. b–713; 84214.

Quartz, var. onyx. Two cameos. Cat. Nos. b–714–715; 50275.

Quartz, var. onyx. Color, red banded. Cat. Nos. b–716; 50411.

Quartz, var. onyx. Six small pieces. Cat. Nos. b–717–722; 50410.

Quartz, var. plasma. India. Color, dark green. Four buttons. Cat. Nos. b–56–59; 46805.

Quartz, var. plasma. India. Color, apple green. Cabochon cut. Two pieces. Cat. Nos. b–60–61; 46805.

Quartz, var. plasma. India. Cat. Nos. b–723; 50431.

Quartz, var. plasma. Color, dark green. Small intaglio. Cat. Nos. b–724; 47396. Deposited by Thomas Wilson.

Quartz, var. prase. Germany. Color, green. Cabochon cut; elliptical girdle. Size, 18 by 13 by 11 mm. Cat. Nos. b–52; 50377.

Quartz, var. prase. Breitenbrunn, Saxony. Color, dirty green. Two stones. Cabochon cut; elliptical girdles. Size, 20 by 13 by 5 mm. Cat. Nos. b–53–54; 50376.

Quartz, var. plasma. Tartary. Color, green. Elliptical disk. Size, 53 by 40 mm. Cat. Nos. b–55; 50430.

Quartz, var. rock crystal. Chestnuthill Township, Ashe County, North Carolina. Colorless. Large ball. Size, 11 cm. diameter. Cat. Nos. b–751; 83686. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Redhill, near Bakersville, Mitchell County, North Carolina. Colorless. Eighteen quartz arrowheads. Cat. Nos. a–854–872; 83683. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Brazil. Colorless. Cabochon cut; circular girdle. Cat. Nos. a–816; 50359.

Quartz, var. rock crystal. Brazil. Colorless. Step-brilliant cut. Size, 13 by 10.5 by 4 mm. Cat. Nos. a–851; 82767. The Lea Collection.

Quartz, var. rock crystal. Germany. Colorless. Two lenses. Cabochon cut; circular girdles. Size, 21 by 9 and 19 by 9 mm. Cat. Nos. a–799–800; 82772. The Lea Collection.

Quartz, var. prase. China. Color, green. Small, thin slab. Cat. Nos. b–725; 50378.

Quartz, var. rock crystal. Chestnuthill Township, Ashe County, North Carolina. Colorless. Rose cut; circular girdle. Size, 48 by 26 mm.; weight, 345 carats. Cat. Nos. a–793; 83735. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Chestnuthill Township, Ashe County, North Carolina. Colorless. Rose cut; circular girdle. Size, 50 by 23 mm.; weight, 341.55 carats. Cat. Nos. a–794; 83735. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Chestnuthill Township, Ashe County, North Carolina. Colorless. Brilliant cut; circular girdle. Size, 17 by 12 mm.; weight, 19.10 carats. Cat. Nos. a–795; 83725. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Italy. Colorless. Step cut. Size, 13 by 10 mm. Cat. Nos. a–796; 82771. The Lea Collection.

Quartz, var. rock crystal. Switzerland. Colorless. Carved knob. Cat. Nos. b–752; 50355.

Quartz, var. rock crystal. Mursinsk, Russia. Colorless. Carved seal. Size, 7 cm. long. Cat. Nos. b–753; 51481.

Quartz, var. rock crystal. Siberia. Colorless. Knob for drawer. Size, 61 by 19 mm. Cat. Nos. a–797; 50356.

Quartz, var. rock crystal. Siberia. Colorless. Carved seal. Size, 58 mm. long. Cat. Nos. a–798; 51480.

Quartz, var. rock crystal. Japan. Colorless. Step-brilliant cut. Fifteen stones. Size of largest, 17 by 13 by 5 mm.; smallest, 7 by 7 by 5.5 mm. Cat. Nos. a–801–815; 82777. The Lea Collection.

Quartz, var. rock crystal. Japan. Colorless. Carved turtle. Cat. Nos. b–754; 83339. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rock crystal. Colorless. Eighteen stones; step-brilliant and brilliant cuts. Size of largest, 39 by 21 by 13 mm.; smallest, 9 by 5 mm. Cat. Nos. a–817–834; 50368.

Quartz, var. rock crystal. Colorless. Sixteen stones, variously cut. Size of largest, 20 by 18 by 7 mm.; smallest, 10 by 5 mm. Cat. Nos. a–835–850; 82770. The Lea Collection.

Quartz, var. rock crystal. Colorless. Cat. Nos. a–852; 46818.

Quartz, var. rock crystal. Colorless. Seal. Size, 38 mm. long, base 9 mm. diameter. Cat. Nos. a–853; 46819.

Quartz, var. rock crystal. Colorless. Ball. Cat. Nos. b–755; 50261.

Quartz, var. rock crystal. Colorless. Two small intaglios. Cat. Nos. b–756–757; 47396. Deposited by Thomas Wilson.

Quartz, var. rock crystal. Colorless. Ball, 48 mm. diameter. Cat. Nos. c–453; 84262.

Quartz, var. rose. Paris, Maine. Color, light rose; opalescent. Cabochon cut; elliptical girdle. Size, 35 by 26 by 11 mm.; weight, 64.56 carats. Cat. Nos. a–985; 49185.

Quartz, var. rose. Stoneham, Maine. Color, light rose; opalescent. Cabochon cut; elliptical girdle. Size, 23 by 17 by 7 mm.; weight, 19.35 carats. Cat. Nos. a–286; 48485.

Quartz, var. rose. Albany, Oxford County, Maine. Color, rose. Ball, 42 mm. diameter. Cat. Nos. c–450; 83538. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. rose. McDowell County, North Carolina. Color, pale pink. Four rose-cut beads. Size, two 12 mm. diameter; two 10 mm. diameter. Cat. Nos. b–729–732; 84197.

Quartz, var. rose. France. Color, pink. Brilliant cut; elliptical girdle. Size, 19 by 15 by 11 mm.; weight, 17.98 carats. Cat. Nos. b–728; 46824.

Quartz, var. rose. Zwiesel, Bavaria. Color, light rose. Mixed cabochon cut; elliptical girdle. Size, 22 by 13 by 7 mm. Cat. Nos. a–987; 50363.

Quartz, var. rose. Zwiesel, Bavaria. Color, pale rose; opalescent. Step-brilliant cut; rectangular girdle. Size, 20 by 15 by 18.5 mm. Cat. Nos. a–988; 50363.

Quartz, var. rose. Ceylon. Color, pale rose. Brilliant cut; rectangular girdle. Size, 25 by 20 by 15 mm.; weight, 42.43 carats. Cat. Nos. a–989; 51138.

Quartz, var. sardonyx. Germany. Color, red and white banded. Three pieces. Cat. Nos. b–688–690. Gift of George F. Kunz.

Quartz, var. sardonyx. Eight small intaglios. Various colors. Cat. Nos. b–691–698; 50070.

Quartz, var. sardonyx. Color, reddish. Four small intaglios. Cat. Nos. b–699–702; 48474.

Quartz, var. sardonyx. Small cameo. Cat. Nos. b–703; 48479.

Quartz, var. sardonyx. Color, red. Two small elliptical discs. Cat. Nos. b–704–705; 46803.

Quartz, var. sardonyx. Color, red and white banded. Small intaglio. Cat. Nos. b–706; 84213.

Quartz, var. smoky. Mount Pisgah, Alexander County, North Carolina. Color, pale smoky brown. Rose cut; elliptical girdle. Size, 68 by 51 by 25 mm.; weight, 530.13 carats. Cat. Nos. a–873; 83734. The Lea Collection; gift of Dr. L. L. Chamberlain.

Quartz, var. smoky. Near Spring Mountain, Iredell County, North Carolina. Color, smoky brown. Rose; elliptical girdle. Size, 55 by 42 by 20 mm.; weight, 277.16 carats. Cat. Nos. a–874; 83726. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. smoky. Magnet Cove, Arkansas. Color, deep smoky brown. Rose cut; elliptical girdle. Size, 36 by 27 by 15 mm.; weight, 78.05 carats. Cat. Nos. a–877; 50351.

Quartz, var. smoky. Pikes Peak, Colorado. Color, smoky brown. Brilliant cut; circular girdle. Size, 35 by 27 mm.; weight, 159.45 carats. Cat. Nos. a–881; 50104.

Quartz, var. smoky. Near Florissant, Colorado. Color, smoky brown. Rose cut; elliptical girdle. Size, 73 by 54 by 33 mm.; weight, 766.05 carats. Cat. Nos. a–872; 83353. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. smoky. Brazil. Color, brown. Brilliant cut; circular girdle. Size, 25 by 13.5 mm.; weight, 43.52 carats. Cat. Nos. a–894; 47848.

Quartz, var. smoky. Scotland. Color, yellowish brown. Step-brilliant cut; octagonal girdle. Size, 22 by 13 mm.; weight, 34.20 carats. Cat. Nos. a–882; 50350.

Quartz, var. smoky. Scotland. Color, yellowish brown. Step-brilliant cut; elliptical girdle. Size, 17 by 13 by 10 mm. Cat. Nos. a–883; 50350.

Quartz, var. smoky. Aberdeenshire, Scotland. Color, pale smoky brown. Step-brilliant cut; rectangular girdle. Size, 19 by 16 by 7 mm. Cat. Nos. a–884; 82766. The Lea Collection.

Quartz, var. smoky. Aberdeenshire, Scotland. Color, pale smoky brown. Step-brilliant cut; rectangular girdle. Size, 14 by 12 by 6 mm. Cat. Nos. a–885; 82766. The Lea Collection.

Quartz, var. smoky. Switzerland. Color, pale smoky brown. Step-brilliant cut; elliptical girdle. Size, 51 by 40 by 21 mm.; weight, 261.95 carats. Cat. Nos. a–886; 50354.

Quartz, var. smoky. Australia. Color, reddish brown. Step-brilliant cut; elliptical girdle. Size, 45 by 34 by 18 mm.; weight, 164.88 carats. Cat Nos. a-893; 50353.

Quartz, var. smoky. Ceylon. Color, yellowish brown. Rose cut; rectangular girdle. Size, 31 by 26 by 18 mm.; weight, 94.65 carats. Cat. Nos. a–888; 82769. The Lea Collection.

Quartz, var. smoky. Ceylon. Color, smoky brown. Rose cut; elliptical girdle. Size, 39 by 30 by 15 mm.; weight, 124.98 carats. Cat. Nos. a–887; 82769. The Lea Collection.

Quartz, var. smoky. Ceylon. Color, smoky brown. Step-brilliant cut; rectangular girdle. Size, 18 by 13 by 4 mm. Cat. Nos. a–889; 82769. The Lea Collection.

Quartz, var. smoky. Ceylon. Color, pale smoky brown. Step cut; square girdle. Size, 27 by 12 mm.; weight, 61.42 carats. Cat. Nos. a–890; 82769. The Lea Collection.

Quartz, var. smoky. Ceylon. Color, pale brown. Step-brilliant cut; circular girdle. Size, 17 by 11 mm. Cat. Nos. a-891; 82773. The Lea Collection.

Quartz, var. smoky. Ceylon. Color, pale brown. Step-brilliant cut; rectangular girdle. Size, 15 by 10 by 6 mm. Cat. Nos. a–892; 82773. The Lea Collection.

Quartz, var. smoky. Australia. Color, dark brown. Carved seal handle. Size, 5.5 cm. long. Cat. Nos. b–727; 50270.

Quartz, var. smoky. Color, smoky brown. Step-brilliant cut. Six stones. Size of largest, 35 by 28 by 14 mm.; of smallest, 12 by 10 by 5 mm. Cat. Nos. 2–895–900; 50368.

Quartz, var. smoky. Color, brown. Rose cut. Size, 49 by 35 by 22 mm.; weight, 235.84 carats. Cat. Nos. a–901; 82770. The Lea Collection.

Quartz, var. smoky. Color, brown. Tetragonal prism. Size, 24 by 11 mm. Cat. Nos. a–902; 46807.

Quartz, var. smoky. Color, brown. Two cuff buttons. Size, 19 mm. diameter. Cat. Nos. a–903–904; 50271.

Quartz, var. smoky. Color, pale brown. Step-brilliant cut; square girdle. Size, 25 by 14 mm. Cat. Nos. a–905; 82770. The Lea Collection.

Quartz, var. smoky. Color, brown. Step-brilliant cut. Four stones, various sizes. Cat. Nos. a–906–909; 82770. The Lea Collection.

Quartz, var. smoky. Color, reddish brown. Step-brilliant cut; intaglio. Size, 18 by 14 by 7 mm. Cat. Nos. a–910; 83533. The Lea Collection; gift of Dr. L. T. Chamberlain.

Quartz, var. smoky. Mount Mica, Paris, Maine. Color, greenish brown. Step-brilliant cut; elliptical girdle. Size, 18 by 15 by 11 mm. Cat. Nos. a–876; 50352.

Quartz, var. smoky. Stoneham, Maine. Color, deep smoky brown. Step-brilliant cut; square girdle. Size, 27 by 14 mm.; weight, 61.44 carats. Cat. Nos. a–875; 84191.

Quartz, var. smoky. Fairfax Court House, Virginia. Color, smoky brown. Three gems. Brilliant cut; 2 elliptical girdles, 1 rectangular. Sizes, 16 by 13 by 7 mm.; 15 by 10 by 6 mm.; 11 by 8 by 5 mm. Cat. Nos. a–878–880; 47843.

Rhodonite. Cummington, Massachusetts. Color, red. Flat ellipsoid. Size, 36 by 26 by 12 mm. Cat. Nos. a–645; 46820.

Rhodonite. Trotter mine, Franklin, New Jersey. Color, red. Cabochon cut; elliptical girdle. Size, 53 by 40 by 9 mm. Cat. Nos. a–646; 50279.

Rhodonite. Selderekowa, Ural Mountains, Siberia. Color, red. Two sleeve buttons. Size, 35 mm. diameter. Cat. Nos. 647–648; 51480.

Rhodonite. Ural Mountains, Siberia. Color, red. Necklace of 47 rose-cut beads. Size, 10 mm. diameter. Cat. Nos. 2–649; 50111.

Rhodonite. Ural Mountains, Siberia. Color, red with black inclusions. Ash tray. Size, 14.5 by 8.2 cm. Cat. Nos. a–650; 51135.

Rhodonite. Ural Mountains, Siberia. Color, reddish. Slab. Size, 11 by 7.7 cm. Cat. Nos. b–850; 50396.

Rock crystal, see Quartz.

Ruby, see Corundum.

Rutile. Hiddenite, Alexander County, North Carolina. Color, dark red, nearly opaque. Brilliant cut; circular girdles. Five gems. Average size, 5 by 3 mm.; weight, 2.86 carats. Cat. Nos. a–601–605; 46821. Gift of J. D. Dana.

Samarskite. Mitchell County, North Carolina. Color, black opaque. Brilliant cut; circular girdle. Size, 12 by 6 mm.; weight, 6.39 carats. Cat. Nos. a–588; 83744. The Lea Collection; gift of Dr. L. T. Chamberlain.

Sapphire, see Corundum.

Sardonyx, see Quartz.

Satinspar, see Gypsum.

Serpentine. Newburyport, Massachusetts. Color, light and dark green. Necklace of 51 beads. Average size, 12 mm. diameter. Cat. Nos. a–629; 50253.

Serpentine. Newburyport, Massachusetts. Color, dark and light green. Carved ornament. Cat. Nos. b–923; 83341. The Lea Collection; gift of Dr. L. T. Chamberlain.

Serpentine, var. bowenite. Smithfield, Rhode Island. Color, light green. Ornamental piece. Cat. Nos. b–924; 46619.

Serpentine. Cold Springs, New York. Color, light and dark green mottled. Cat. Nos. b–925; 12370. Gift of E. Seymour.

Serpentine. Montville, New Jersey. Color, green and white. Cat. Nos. b–926; 47656.

Serpentine. Near Montville, Morris County, New Jersey. Color, green. Diamond-shaped slab. Size, 10.8 by 7.1 by 3.5 cm. Cat. Nos. b–927; 18848.

Serpentine. Montville, New Jersey. Color, greenish yellow. Two large pieces. Cat. Nos. b–928–929; 47656.

Serpentine. Montville, New Jersey. Color, dark green. Cat. Nos. b–930; 47657.

Serpentine. Marshall's quarry, Westchester, Pennsylvania. Color, light green with chromite. Prism. Cat. Nos. b–931; 49852. The Lea Collection.

Serpentine. Marshall's quarry, Westchester, Pennsylvania. Color, greenish black. Rectangular block. Size, 57 by 43 by 12 mm. Cat. Nos. b–932; 49852. The Lea Collection.

Serpentine. Glenn Mill, Delaware County, Pennsylvania. Color, light green. Cat. Nos. b–933; 50920.

Serpentine. Fritztown, Berks County, Pennsylvania. Color, yellowish green. Polished mass. Cat. Nos. b–934; 9775. Gift of H. W. Hollenbush.

Serpentine. Harford County, Maryland. Color, green. Polished slab. Cat. Nos. b–937; 50924. The Lea Collection.

Serpentine. Harford County, Maryland. Color, dark green. Rectangular block. Cat. Nos. b–938; 84239.

Serpentine. San Francisco, California. Color, grayish olive green. Flower ornament. Cat. Nos. a–630; 46000. Gift of Dr. R. E. C. Stearns.

Serpentine. Cornwall, England. Color, dark red and green. Cat. Nos. b–939; 13075.

Serpentine. Lizard Point, Cornwall, England. Color, dark green. Paper weight. Cat. Nos. a–631; 84173.

Serpentine. India. Color, deep green. Thin slab of williamsite. Cat. Nos. b–941; 46574.

Serpentine. China. Color, dark green. Lotus-leaf paper weight. Cat. Nos. b–942; 84240.

Serpentine. Color, greenish gray with black veins. Vase. Size, 20 cm. high. Cat. Nos. b–943; 84241. Gift of W. H. Abbott.

Serpentine, var. bowenite. Color, dark olive green. Flat ellipsoid. Size, 28 by 22 by 7 mm. Cat. Nos. a–626; 84171. Gift of George F. Kunz.

Serpentine, var. bowenite. Smithfield, Rhode Island. Color, pale yellow. Cabochon cut; circular girdle. Size, 9.5 by 6 mm. Cat. Nos. a–627; 84172.

Serpentine, var. williamsite. Wood's mine, Lancaster County, Pennsylvania. Color, bright green. Cabochon cut; circular girdle. Size, 10 by 7 mm. Cat. Nos. a–628; 48920. Gift of Dr. Robert H. Lamborn.

Serpentine, var. williamsite. Texas, Lancaster County, Pennsylvania. Color, grass green. Small piece. Cat. Nos. b–935; 82515. The U. S. Geological Survey.

Silver. Near Globe, Pinal County, Arizona. Nugget. Weight, 448 ounces. Cat. Nos. c–454; 83747. The Lea Collection; gift of Dr. L. T. Chamberlain.

Smithsonite. Marion County, Arkansas. Color, lemon yellow. Two specimens. Cabochon cut; elliptical girdle. Size, 26 by 22 by 8 mm. and 18 by 12 by 5 mm. Cat. Nos. a–594–595; 48930.

Smithsonite. Laurium, Greece. Color, grass green banded with darker green. Cabochon cut; elliptical girdle. Size, 25 by 22 by 13 mm. Cat. Nos. a–596; 45022.

Sodalite. Litchfield, Maine. Color, deep blue. Cabochon cut. Size, 14 by 12 by 5 mm.; weight, 4.33 carats. Cat. Nos. a–591; 47926.

Sodalite. Ice River, near Kicking Horse Pass, British Columbia. Color, blue with green. Cat. Nos. b–854; 51153.

Sodalite. Andes Mountains, Chili. Color, blue. Polished slab of rock. Size, 66 by 36 by 7 mm. Cat. Nos. a–592; 84113.

Spessartite, see Garnet.

Sphalerite. Picos de Europa, Santander, Spain. Color, resin yellow. Brilliant cut; square girdle. Size, 12 by 9 mm.; weight, 12.15 carats. Cat. Nos. a–589; 50282.

Sphalerite. Picos de Europa, Santander, Spain. Color, honey yellow. Rose cut; circular girdle. Size, 11 by 6.5 mm.; weight, 5.87 carats. Cat. Nos. a–590; 50282.

Spinel. Ceylon. Color, clear violet. Brilliant cut; square girdle. Size, 8 by 8 by 5 mm.; weight, 1.82 carats. Cat. Nos. 596; 50335.

Spinel. Ceylon. Color, violet. Step-brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1.15 carats. Cat. Nos. 597; 50335.

Spinel. Ceylon. Color, dark violet. Step-brilliant cut; square girdle. Size, 6 by 6 by 4 mm.; weight, 1.01 carats. Cat. Nos. 598; 50335.

Spinel. Ceylon. Color, bottle green. Brilliant cut; square girdle. Size, 9 by 9 by 4 mm.; weight, 2.34 carats. Cat. Nos. 599; 50262.

Spinel. Ceylon. Color, deep bluish green. Table cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.31 carats. Cat. Nos. 600; 50262.

Spinel. Ceylon. Color, violet. Table cut; square girdle. Size, 7 by 6 by 4 mm. weight, 1.32 carats. Cat. Nos. 601; 50262.

Spinel. Ceylon. Color, light violet. Table cut; rectangular girdle. Size, 7 by 5 by 3 mm.; weight, 0.90 carat. Cat. Nos. 602; 50262.

Spinel. Ceylon. Color, dark bluish green. Table cut; rectangular girdle. Size, 9 by 7 by 4 mm.; weight, 2.05 carats. Cat. Nos. 608; 82897. The Lea Collection.

Spinel. Ceylon. Color, deep wine red. Step-brilliant cut; elliptical girdle. Size, 9 by 8 by 4 mm.; weight, 1.83 carats. Cat. Nos. 609; 82895. The Lea Collection.

Spinel. Ceylon. Color, bright red. Step-brilliant cut; rectangular girdle. Size, 7.5 by 7 by 4 mm.; weight, 1.60 carats. Cat. Nos. 610; 82897. The Lea Collection.

Spinel. Ceylon. Color, bluish green. Step-brilliant cut; elliptical girdle. Size, 8 by 7 by 5 mm.; weight, 1.32 carats. Cat. Nos. 611; 82897. The Lea Collection.

Spinel. Ceylon. Color, dark violet. Step-brilliant cut; circular girdle. Size, 7.5 by 4 mm.; weight, 1.42 carats. Cat. Nos. 612; 82897. The Lea Collection.

Spinel. Ceylon. Color, ruby red. Cabochon cut; circular girdle. Size, 6 by 3 mm.; weight, 1 carat. Cat. Nos. 603; 50262.

Spinel. Ceylon. Color, bright red. Cabochon cut. Size, 5 by 3 mm.; weight, 0.45 carat. Cat. Nos. 604; 50262.

Spinel. Ceylon. Color, ruby red. Step-brilliant cut; square girdle. Size, 5 by 5 by 3 mm.; weight, 0.42 carat. Cat. Nos. 605; 83527. The Lea Collection; gift of Dr. L. T. Chamberlain.

Spinel. Ceylon. Color, reddish violet. Trap cut; rectangular girdle. Size, 10 by 8 by 5 mm.; weight, 3.07 carats. Cat. Nos. 606; 82897. The Lea Collection.

Spinel. Ceylon. Color, violet. Step-brilliant cut; rectangular girdle. Size, 9 by 7 by 5 mm.; weight, 1.77 carats. Cat. Nos. 607; 82897. The Lea Collection.

Spinel. Ceylon. Color, claret. Step-brilliant cut; square girdle. Size, 7 by 7 by 4 mm.; weight, 1.45 carats. Cat. Nos. 613; 82897. The Lea Collection.

Spinel. Ceylon. Color, yellowish green. Step-brilliant cut; rectangular girdle. Size, 7 by 6 by 5 mm.; weight, 1.43 carats. Cat. Nos. 614; 82897. The Lea Collection.

Spinel. Ceylon. Colors, green, wine-red, rose-red, violet-red, violet-blue, wine-brown. Step-brilliant cut. Six gems. Average size, 6 by 5 by 4 mm.; total weight, 4.55 carats. Cat. Nos. 615–620; 84047.

Spinel. East Indies. Color, deep red. Table cut; rectangular girdle. Size, 8.5 by 7 by 4 mm.; weight, 2.74 carats. Cat. Nos. 621; 50336.

Spinel. East Indies. Color, deep red. Eleven polished pebbles. Average sizes, 15 by 11 by 5—8 by 6 by 4 mm.; total weight, 47.80 carats. Cat. Nos. 622–632.

Spodumene. Brazil. Color, yellow. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 0.94 carat. Cat. Nos. a–252; 50325.

Spodumene. Brazil. Color, yellow. Brilliant cut; rectangular girdle. Size, 6.5 by 5.5 by 3 mm.; weight, 0.71 carat. Cat. Nos. a–253; 84092.

Spodumene. Brazil. Color, greenish yellow. Brilliant cut; circular girdle. Size, 4.5 by 3 mm.; weight, 0.30 carat. Cat. Nos. a–254; 84092.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, emerald green. Brilliant cut; circular girdle. Size, 6 by 3.5 mm.; weight, 0.68 carat. Cat. Nos. a–255; 83732. The Lea Collection; gift of Dr. L. T. Chamberlain.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, emerald green. Brilliant cut; rectangular girdle. Size, 5.5 by 4 by 2.5 mm.; weight 0.36 carat. Cat. Nos. a–256; 83732. The Lea Collection; gift of Dr. L. T. Chamberlain.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, emerald green. Step-brilliant cut; rectangular girdle. Size, 4 by 3.5 by 2 mm.; weight, 0.21 carat. Cat. Nos. a–257; 83732. The Lea Collection; gift of Dr. L. T. Chamberlain.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, light green. Step-brilliant cut; rectangular girdle. Size, 5.5 by 5 by 3.5 mm.; weight, 0.66 carat. Cat. Nos. a–258; 84093.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, light green. Step-brilliant cut; rectangular girdle. Size, 5.5 by 5 by 3 mm.; weight, 0.52 carat. Cat. Nos. a–259; 84093.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, light green. Step-brilliant cut; rectangular girdle. Size, 7 by 4 by 3 mm.; weight. 0.57 carat. Cat. Nos. a–260; 84093.

Spodumene, var. hiddenite. Stony Point, Alexander County, North Carolina. Color, light green. Brilliant cut; square girdle. Size, 5 by 3 mm.; weight, 0.45 carat. Cat. Nos. a–261; 84093

Stalagmite, see Carbonate of lime.

Sunstone, see Oligoclase.

Tablet of jasper, chalcedony, etc. Ekaterinburg, Siberia. Cat. Nos. b–829; 47853.
A tablet carved to represent fruit: Red currants, carnelian; white currants, rock crystal; blackberries, black chalcedony and serpentine; raspberries, rhodonite and amethyst; red cherries, carnelian; black cherries, black chalcedony; leaves, serpentine; base, jasper and black chalcedony.

Talc. India. Color, grayish green. Small carved box. Cat. Nos. b–911; 84237.

Talc. India. Grayish green. Carving. Cat. Nos. b–912; 84237.

Thomsonite. Grand Marais, Minnesota. Seventeen polished pieces and pebbles. Cat. Nos. c–433–449; 84263.

Thulite. Arendal, Norway. Color, brick red. Two polished slabs. Cat. Nos. b–855; 50086.

Titanite. Brewster, Putnam County, New York. Color, yellowish brown. Step-brilliant cut; circular girdle. Size, 13 by 12 by 8 mm.; weight, 8.30 carats. Cat. Nos. a–550; 51131.

Titanite. Brewster, Putnam County, New York. Color, yellow. Brilliant cut; circular girdle. Size, 9.5 by 5.5 mm.; weight, 2.49 carats. Cat. Nos. a–551; 83345. The Lea Collection; gift of Dr. L. T. Chamberlain.

Titanite. Bridgewater, Delaware County, Pennsylvania. Color, dark greenish brown. Step-brilliant cut: rectangular girdle. Size, 11 by 8.5 by 6 mm.; weight, 4.22 carats. Cat. Nos. a–553; 49517. Gift of Dr. W. H. Forwood.

Titanite. Zillerthal, Tyrol. Color, brownish green. Brilliant cut; rectangular girdle. Size, 12 by 10.5 by 7.5 mm.; weight, 6.02 carats. Cat. Nos. a–548; 50322.

Titanite. Zillerthal, Tyrol. Color, greenish yellow. Step-brilliant cut; rectangular girdle. Size, 10 by 7 by 4 mm.; weight, 2.61 carats. Cat. Nos. a–549; 84101.

Topaz. Stoneham, Maine. Colorless. Brilliant cut; square girdle. Size, 9 by 8.5 by 6 mm.; 2.80 carats. Cat. Nos. a–324; 47925.

Topaz. Baldface Mountain, Chatham, New Hampshire. Colorless. Brilliant cut; circular girdle. Size, 15 by 9 mm.; weight, 12.05 carats. Cat. Nos. a–323; 51191.

Topaz. Near Pikes Peak, Colorado. Color, cinnamon brown. Step-brilliant cut; rectangular girdle. Size, 19 by 14 by 6 mm.; weight, 14.27 carats. Cat. Nos. a–318; 82831. The Lea Collection.

Topaz. Near Pikes Peak, Colorado. Colorless. Brilliant cut; rectangular girdle. Size, 17 by 12 by 10 mm.; weight, 17.34 carats. Cat. Nos. a–319; 84094.

Topaz. Thirty miles southwest of Salt Lake City, Utah. Colorless. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.42 carats. Cat. Nos. a–320; 47842.

Topaz. Thirty miles southwest of Salt Lake City, Utah. Colorless. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.33 carats. Cat. Nos. a–320; 47842.

Topaz. Thirty miles southwest of Salt Lake City, Utah. Colorless. Brilliant cut. Size, 5.5 by 4 mm.; weight, 0.87 carat. Cat. Nos. a–322; 82830. The Lea Collection.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant cut; elliptical girdle. Size, 13.5 by 10 by 5.5 mm.; weight, 5.80 carats. Cat. Nos. a–270; 50284.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant cut; square girdle. Size, 10 by 5.5 mm.; weight, 3.80 carats. Cat. Nos. a–271; 50284.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant cut; elliptical girdle. Size, 11 by 8 by 5 mm.; weight, 3.16 carats. Cat. Nos. a–272; 50284.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant; rectangular girdle. Size, 11 by 6 by 3.5 mm.; weight, 2.02 carats. Cat. Nos. a–273; 50284.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant cut; square girdle. Size, 9 by 4 mm.; weight, 2.20 carats. Cat. Nos. a–274; 50284.

Topaz. Minas Geraes, Brazil. Color, wine yellow. Step cut; rectangular girdle. Size, 10 by 6 by 3 mm.; weight, 1.76 carats. Cat. Nos. a–275; 50384.

Topaz. Minas Geraes, Brazil. Color, honey yellow. Step-brilliant cut; pear-shaped girdle. Size, 9 by 8 by 4 mm.; weight, 1.62 carats. Cat. Nos. a–276; 50284.

Topaz. Minas Geraes, Brazil. Color, wine yellow. Step-brilliant cut; circular girdle. Size, 7.5 by 4.5 mm.; weight, 1.67 carats. Cat. Nos. a–277; 50284.

Topaz. Minas Geraes, Brazil. Color, wine yellow. Step-brilliant cut; rectangular girdle. Size, 8 by 5 by 4 mm.; weight, 1.34 carats. Cat. Nos. a–278; 50284.

Topaz. Minas Geraes, Brazil. Color, wine yellow. Rose cut; elliptical girdle. Size, 7 by 5 by 4 mm.; weight, 0.91 carat. Cat. Nos. a–279; 50284.

Topaz. Minas Geraes, Brazil. Color, pink. Rose cut; elliptical girdle. Size, 25 by 17 by 3.5 mm.; weight, 14.34 carats. Cat. Nos. a–280; 50283.

Topaz. Minas Geraes. Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 13 by 11.5 by 5 mm.; weight, 6.38 carats. Cat. Nos. a–281; 50283.

Topaz. Minas Geraes, Brazil. Color, amethystine. Step-brilliant cut; elliptical girdle. Size, 14 by 10 by 5 mm.; weight, 5.51 carats. Cat. Nos. a–282; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Rose cut; pear-shaped girdle. Size, 14 by 10 by 6 mm.; weight, 5.43 carats. Cat. Nos. a–283; 50283.

Topaz. Minas Geraes, Brazil. Color, rose. Step-brilliant cut; elliptical girdle. Size, 11 by 10 by 4 mm.; weight, 3.93 carats. Cat. Nos. a–284; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; square girdle. Size, 10 by 4.5 mm.; weight, 3.31 carats. Cat. Nos. a–285; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; pear-shaped girdle. Size, 16 by 6.5 by 4 mm.; weight, 2.84 carats. Cat. Nos. a–286; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 5 mm.; weight, 3 carats. Cat. Nos. a–287; 50283.

Topaz. Minas Geraes, Brazil. Color, wine. Step-brilliant cut; elliptical girdle. Size, 12 by 9 by 5.5 mm.; weight, 3.51 carats. Cat. Nos. a–288; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 12 by 7.5 by 4 mm.; weight, 2.78 carats. Cat. Nos. a–289; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 9 by 8 by 4 mm.; weight, 2.25 carats. Cat. Nos. a–290; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step cut; rectangular girdle. Size, 10 by 8 by 2.5 mm.; weight, 1.87 carats. Cat. Nos. a–291; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 12 by 8 by 4 mm.; weight, 2.89 carats. Cat. Nos. a–292; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; pear-shaped girdle. Size, 15 by 6 by 4 mm.; weight, 2.53 carats. Cat. Nos. a–293; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 9 by 8 by 5 mm.; weight, 2.72 carats. Cat. Nos. a–294; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 9 by 7.5 by 4 mm.; weight, 2.10 carats. Cat. Nos. a–295; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 11.5 by 7 by 5 mm.; weight, 2.15 carats. Cat. Nos. a–296; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 5 mm.; weight, 2.78 carats. Cat. Nos. a–297; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 10 by 7.5 by 4.5 mm.; weight 2.37 carats. Cat. Nos. a–298; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 10 by 7.5 by 4 mm.; weight, 2.23 carats. Cat. Nos. a–299; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 9 by 8 by 3 mm.; weight, 1.83 carats. Cat. Nos. a–300; 50283.

Topaz. Minas Geraes, Brazil. Color, pink wine. Step cut; rectangular girdle. Size, 11 by 5.5 by 4 mm.; weight, 1.94 carats. Cat. Nos. a–301; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 11 by 7 by 4 mm.; weight, 2.52 carets. Cat. Nos. a–302; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step cut; elliptical girdle. Size, 7 by 6 by 6 mm.; weight, 2.64 carats. Cat. Nos. a–303; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 8.5 by 7 by 4 mm.; weight, 1.63 carats. Cat. Nos. a–304; 50283.

Topaz. Minas Geraes, Brazil. Wine. Step-brilliant cut; square girdle. Size, 7 by 4 mm.; weight, 1.70 carats. Cat. Nos. a–305; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 8 by 6.5 by 4 mm.; weight, 1.45 carats. Cat. Nos. a–306; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 9 by 6 by 4 mm.; weight, 1.49 carats. Cat. Nos. a–307; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Brilliant cut; square girdle. Size, 7 by 5 mm.; weight, 1.72 carats. Cat. Nos. a–308; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 8.5 by 6 by 4 mm.; weight, 1.43 carats. Cat. Nos. a–309; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Cat. Nos. a–310; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 9 by 5.5 by 3 mm.; weight, 1.05 carats. Cat. Nos. a–311; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 7 by 5.5 by 4 mm.; weight, 1.27 carats. Cat. Nos. a–312; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 7.5 by 5 by 3 mm.; weight, 0.99 carat. Cat. Nos. a–313; 50283.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 14 by 8 by 6.5 mm.; weight, 5.63 carats. Cat Nos. a–314; 84095.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; elliptical girdle. Size, 15 by 9 by 4 mm.; weight, 4.45 carats. Cat. Nos. a–315; 84095.

Topaz. Minas Geraes, Brazil. Color, pink. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 4 mm.; weight, 2.82 carats. Cat. Nos. a–316; 84095.

Topaz. Minas Geraes, Brazil. Color, wine. Step-brilliant cut; rectangular girdle. Size, 8 by 6.5 by 5 mm.; weight, 2.20 carats. Cat. Nos. a–317; 84095.

Topaz. Japan. Colorless. Brilliant cut; circular girdle; weight, 18 carats. Cat. Nos. c–467; 84722.

Topaz. Takayama, Japan. Colorless. Brilliant cut; circular girdle. Size, 22 by 16.5 mm.; weight, 49.55 carats. Cat. Nos. a–268; 84097.

Topaz. Scotland. Color, pale blue. Step cut; square girdle. Size, 10.5 by 10 by 5 mm.; weight, 3.44 carats. Cat. Nos. a–269; 82832. The Lea Collection.

Topaz. Ural Mountains, Siberia. Color, aquamarine. Step cut; rectangular girdle. Size, 31 by 28 by 20 mm.; weight, 151.67 carats. Cat. Nos. a–262; 50286.

Topaz. Siberia. Colorless. Step cut; rectangular girdle. Size, 19 by 11 by 7 mm.; weight, 12.50 carats. Cat. Nos. a–263; 50285.

Topaz. Siberia. Colorless. Brilliant cut; elliptical girdle. Size, 12 by 9 by 6 mm.; weight, 4.06 carats. Cat. Nos. a–264; 50285.

Topaz. Siberia. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 10 by 8 by 3 mm.; weight, 2 carats. Cat. Nos. a–265; 50285.

Topaz. Siberia. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 13 by 9 by 7.5 mm.; weight, 7.09 carats. Cat. Nos. a–266; 84096.

Topaz. Siberia. Colorless. Brilliant cut; circular girdle. Size, 8 by 6 mm.; weight, 2.57 carats. Cat. Nos. a–267; 84096.

Tourmaline. Mount Mica, Paris, Maine. Color, dark green. Brilliant cut; square girdle. Size, 23–22.8 by 17 mm.; weight, 57.03 carats. Cat. Nos. a–156; 83739. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Mount Mica, Paris, Maine. Color, wine red. Brilliant cut; circular girdle. Size, 18 by 12 mm.; weight, 17.94 carats. Cat. Nos. a–157; 83536. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Mount Mica, Paris, Maine. Color, sherry. Brilliant cut; circular girdle. Size, 17 by 11 mm.; weight, 16.31 carats. Cat. Nos. a–158; 83536. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Paris, Maine. Color, deep blue. Brilliant cut; circular girdle. Size, 11.5 by 6.5 mm.; weight, 4.35 carats. Cat. Nos. a–159; 51192.

Tourmaline. Paris, Maine. Color, light green. Step cut; square girdle. Size, 12 by 8 mm.; weight, 7.74 carats. Cat. Nos. a–160; 51243.

Tourmaline. Paris, Maine. Color, violet red. Step cut; square girdle. Size, 10.05 by 10 by 6 mm.; weight, 4.01 carats. Cat. Nos. a–161; 51243.

Tourmaline. Paris, Maine. Color, violet red. Brilliant cut; rectangular girdle. Size, 12 by 10 by 6 mm.; weight, 4.36 carats. Cat. Nos. a–162; 51253.

Tourmaline. Paris, Maine. Color, bluish green. Step cut; rectangular girdle. Size, 11 by 9 by 6 mm.; weight, 4.78 carats. Cat. Nos. a–163; 51243.

Tourmaline. Paris, Maine. Color, pale green. Step cut; rectangular girdle. Size, 10.5 by 7 by 4.5 mm.; weight, 2.36 carats. Cat. Nos. a–164; 51243.

Tourmaline. Paris, Maine. Color, rose red. Step-brilliant cut; rectangular girdle. Size, 8.5 by 6.5 by 4 mm.; weight, 1.46 carats. Cat. Nos. a–165; 51253.

Tourmaline. Paris, Maine. Color, dark blue. Step cut; rectangular girdle. Size, 8 by 6 by 3 mm.; weight, 1.03 carats. Cat. Nos. a–166; 51243.

Tourmaline. Paris, Maine. Color, faint bluish. Step-brilliant cut; rectangular girdle. Size, 6.5 by 5.5 by 5 mm.; weight, 1.07 carats. Cat. Nos. a–167; 51243.

Tourmaline. Paris, Maine. Color, lavender blue. Brilliant cut; square girdle. Size, 6 by 5 mm.; weight, 1.20 carats. Cat. Nos. a–168; 51243.

Tourmaline. Paris, Maine. Color, black, opaque. Brilliant cut; rectangular girdle. Size, 6 by 4 by 3 mm.; weight, 0.53 carat. Cat. Nos. a–169; 51243.

Tourmaline. Paris, Maine. Particolored, half green, half colorless. Step-brilliant cut; rectangular girdle. Size, 13 by 9 by 4.5 mm.; weight, 3.32 carats. Cat. Nos. a–170; 83347. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Paris, Maine. Particolored, half rose, half wine. Step cut; square girdle. Size, 9 by 8.5 by 4 mm.; weight, 2.22 carats. Cat. Nos. a–171; 83347. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Paris, Maine. Particolored, rose and green. Step-brilliant cut; rectangular girdle. Size, 19 by 11 by 7 mm.; weight, 11.67 carats. Cat. Nos. a–172; 50305.

Tourmaline. Paris, Maine. Color, light green. Step cut; rectangular girdle. Size, 16 by 10 by 6 mm.; weight, 7.50 carats. Cat. Nos. a–173; 50305.

Tourmaline. Paris, Maine. Color, bluish green. Brilliant cut; circular girdle. Size, 12 by 6 mm.; weight, 5.41 carats. Cat. Nos. a–174; 50305.

Tourmaline. Paris, Maine. Color, light green. Step cut; rectangular girdle. Size, 11 by 9 by 6 mm.; weight, 3.28 carats. Cat. Nos. a–175; 50305.

Tourmaline. Paris, Maine. Color, light green. Step cut; rectangular girdle. Size, 10.5 by 8 by 5 mm.; weight, 3.28 carats. Cat. Nos. a–176; 50305.

Tourmaline. Paris, Maine. Color, ruby red. Step cut; square girdle. Size, 9.5 by 4 mm.; weight, 2.66 carats. Cat. Nos. a–177; 50305.

Tourmaline. Paris, Maine. Color, pale green. Step cut; rectangular girdle. Size, 11 by 7 by 5 mm.; weight, 3.01 carats. Cat. Nos. a–178; 50305.

Tourmaline. Paris, Maine. Color, pale wine. Step cut; square girdle. Size, 9 by 4 mm.; weight, 2.23 carats. Cat. Nos. a–179; 50305.

Tourmaline. Paris, Maine. Color, dark blue. Step cut; rectangular girdle. Size, 6.5 by 5 by 2.5 mm.; weight, 0.63 carat. Cat. Nos. a–180; 50305.

Tourmaline. Paris, Maine. Colorless. Brilliant cut; square girdle. Size, 8 by 6 mm.; weight, 2.03 carats. Cat. Nos. a–181; 50304.

Tourmaline. Paris, Maine. Colorless. Step-brilliant cut; rectangular girdle. Size, 8 by 5.5 by 3 mm.; weight, 1.03 carats. Cat. Nos. a–182; 50304.

Tourmaline. Paris, Maine. Color, pale pink. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 1.07 carats. Cat. Nos. a–183; 50304.

Tourmaline. Paris, Maine. Color, green. Step cut; square girdle. Size, 6 by 3 mm.; weight, 0.93 carat. Cat. Nos. a–184; 50304.

Tourmaline. Paris, Maine. Colorless. Step-brilliant cut; rectangular girdle. Size, 8 by 5 by 3 mm.; weight, 0.82 carat. Cat. Nos. a–185; 50304.

Tourmaline. Paris, Maine. Color, deep green. Step cut; square girdle. Size, 5.5 by 3 mm.; weight, 0.64 carat. Cat. Nos. a–186; 50304.

Tourmaline. Paris, Maine. Colorless. Step-brilliant cut; rectangular girdle. Size, 6.5 by 4.5 by 3 mm.; weight, 0.62 carat. Cat. Nos. a–187; 50304.

Tourmaline. Paris, Maine. Colorless. Step-brilliant cut; rectangular girdle. Size, 7 by 5 by 3 mm.; weight 0.71 carat. Cat. Nos. a–188; 50304.

Tourmaline. Paris, Maine. Colorless. Step-brilliant cut: rectangular girdle. Size, 6 by 5 by 4 mm.; weight, 0.82 carat. Cat. Nos. a–189; 50305.

Tourmaline. Paris, Maine. Color, light green. Step cut; rectangular girdle. Size, 6 by 4 by 2.5 mm.; weight, 0.49 carat. Cat. Nos. a–190; 50304.

Tourmaline. Paris, Maine. Color, pale green. Brilliant cut; circular girdle. Size, 6 by 3.5 mm.; weight, 0.52 carat. Cat. Nos. a–191; 50304.

Tourmaline. Paris, Maine. Color, bright green. Step cut; rectangular girdle. Size, 7 by 3 by 2 mm.; weight, 0.38 carat. Cat. Nos. a–192; 50304.

Tourmaline. Paris, Maine. Colorless. Brilliant cut; circular girdle. Size, 4.5 by 4 mm.; weight, 0.40 carat. Cat. Nos. a–193; 50304.

Tourmaline. Paris, Maine. Color, apple green. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 3 mm.; weight, 0.65 carat. Cat. Nos. a–194; 50304.

Tourmaline. Paris, Maine. Color, light green. Brilliant cut; rectangular girdle. Size, 5.5 by 5 by 4 mm.; weight, 0.61 carat. Cat. Nos. a–195; 84090.

Tourmaline. Paris, Maine. Color, deep bluish green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.65 carat. Cat. Nos. a–196; 84090.

Tourmaline. Paris, Maine. Color, deep green. Step cut; square girdle. Size, 5 by 3 mm.; weight, 0.50 carat. Cat. Nos. a–197; 84090.

Tourmaline. Paris, Maine. Color, bottle green. Step cut; rectangular girdle. Size, 6 by 5 by 3 mm.; weight, 0.60 carat. Cat. Nos. a–198; 84090.

Tourmaline. Paris, Maine. Color, yellowish green. Step-brilliant cut; triangular girdle. Size, 5 by 3.5 mm.; weight, 0.72 carat. Cat. Nos. a–199; 84090.

Tourmaline. Paris, Maine. Color, large stone smoky white; small stone grass green, cut from opposite extremities of the same crystal. Brilliant cut; circular girdle. Sizes, 13 by 10 mm. and 5 by 4 mm.; weights, 8.599 carats and 0.852 carat. Cat. Nos. c–454–455; 84269. The Lea Collection; gift of Dr. L. T. Chamberlain.

Tourmaline. Auburn, Maine. Color, pale blue. Step-brilliant cut; rectangular girdle. Size, 12 by 6.5 by 5 mm.; weight, 2.71 carats. Cat. Nos. a–200; 51190.

Tourmaline. Auburn, Maine. Color, bluish green. Step-brilliant cut; rectangular girdle. Size, 8 by 7 by 4 mm.; weight, 1.75 carats. Cat. Nos. a–201; 51190.

Tourmaline. Auburn, Maine. Color, dark green. Step cut; rectangular girdle. Size, 7 by 6 by 5 mm.; weight, 1.58 carats. Cat. Nos. a–202; 51190.

Tourmaline. Auburn, Maine. Colorless. Brilliant cut; rectangular girdle. Size, 8 by 7 by 5 mm.; weight, 1.53 carats. Cat. Nos. a–203; 51190.

Tourmaline. Auburn, Maine. Color, green. Brilliant cut; rectangular girdle. Size, 8 by 6 by 5 mm; weight, 1.70 carats. Cat. Nos. a–204; 51190.

Tourmaline. Auburn, Maine. Color, pale blue. Step-brilliant cut; elliptical girdle. Size, 7 by 6 by 4 mm.; weight, 1.05 carats. Cat. Nos. a–205; 51190.

Tourmaline. Auburn, Maine. Color, light green. Step-brilliant cut; rectangular girdle. Size, 7 by 5 by 5 mm.; weight, 1.19 carats. Cat. Nos. a–206; 51190.

Tourmaline. Auburn, Maine. Color, bluish green. Step-brilliant cut; square girdle. Size, 7 by 5 mm.; weight, 1.31 carats. Cat. Nos. a–207; 51190.

Tourmaline. Auburn, Maine. Color, pale bluish green. Step-brilliant cut; rectangular girdle. Size, 6.5 by 5.5 by 5 mm.; weight, 1.09 carats. Cat. Nos. a–208; 51190.

Tourmaline. Auburn, Maine. Color, dark green. Step cut; rectangular girdle. Size, 6 by 5 by 4 mm.; weight, 0.71 carat. Cat. Nos. a–209; 51190.

Tourmaline. Near Rock Landing, Middlesex County, Connecticut. Color, bluish green. Brilliant cut; circular girdle. Size, 6.5 by 5 mm.; weight, 0.97 carat. Cat. Nos. a–210; 83604.

Tourmaline. Near Rock Landing, Middlesex County, Connecticut. Color, bluish green. Brilliant cut; circular girdle. Size, 6.5 by 4 mm.; weight, 0.83 carat. Cat. Nos. a–211; 83604.

Tourmaline. Near Rock Landing, Middlesex County, Connecticut. Color, bluish green. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.75 carat. Cat. Nos. a–212; 83604.

Tourmaline. Dekalb, St. Lawrence County, New York. Color, pale yellow. Step-brilliant cut; rectangular girdle. Size, 11.5 by 8 by 6 mm.; weight, 5.54 carats. Cat. Nos. a–213; 50306.

Tourmaline. Macomb, Essex County, New York. Color, brown. Brilliant cut; circular girdle. Size, 6 by 4 mm.; weight, 0.85 carat. Cat. Nos. a–214; 49155.

Tourmaline. Macomb, Essex County, New York. Color, brown. Brilliant cut; circular girdle. Size, 7 by 5 mm.; weight, 1.18 carats. Cat. Nos. a–215; 49155.

Tourmaline. Brazil. Color, greenish yellow. Brilliant cut; rectangular girdle. Size, 15 by 13 by 8 mm.; weight, 8.96 carats. Cat. Nos. a–216; 51392.

Tourmaline. Brazil. Color, greenish brown. Step-brilliant cut; rectangular girdle. Size, 10 by 9 by 6 mm.; 3.73 carats. Cat. Nos. a–217; 50100.

Tourmaline. Brazil. Color, light yellow. Step-brilliant cut; elliptical girdle. Size 8 by 7.5 by 6 mm.; weight, 2.21 carats. Cat. Nos. a–218; 50100.

Tourmaline. Brazil. Color, dark green. Step cut; rectangular girdle. Size, 14.5 by 13 by 6 mm.; weight, 3.50 carats. Cat. Nos. a–219; 50307.

Tourmaline. Brazil. Color, dark bluish green. Step-brilliant cut; elliptical girdle. Size, 14.5 by 11 by 4 mm.; weight, 4.79 carats. Cat. Nos. a–220; 50307.

Tourmaline. Brazil. Color, light claret. Brilliant cut; rectangular girdle. Size, 11.5 by 9 by 7.5 mm.; weight, 5.06 carats. Cat. Nos. a–221; 50307.

Tourmaline. Brazil. Color, dark bluish green. Step-brilliant cut; square girdle. Size, 9 by 5 mm.; weight, 2.32 carats. Cat. Nos. a–222; 50307.

Tourmaline. Brazil. Color, dark bluish green. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 4.5 mm.; weight, 2.72 carats. Cat. Nos. a–223; 50307.

Tourmaline. Brazil. Color, dark green. Step-brilliant cut; rectangular girdle. Size, 9 by 7 by 5 by 3 mm.; weight, 1.46 carats. Cat. Nos. a–224; 50307.

Tourmaline. Brazil. Color, red and green in concentric bands. Cabochon cut; triangular girdle. Size, 28 by 10 mm.; weight, 58.53 carats. Cat. Nos. a–225; 50388.

Tourmaline. Brazil. Color, fine claret. Brilliant cut; elliptical girdle. Size, 14 by 9.5 by 6 mm.; weight, 5.03 carats. Cat. Nos. a–226; 84091.

Tourmaline. Brazil. Color, apple green. Step cut; rectangular girdle. Size, 9 by 6 by 3 mm.; weight, 1.38 carats. Cat. Nos. a–227; 84091.

Tourmaline. Color, grass green. Step cut; rectangular girdle. Size, 9 by 6 by 3 mm.; weight, 1.32 carats. Cat. Nos. a–228; 84091.

Tourmaline. Brazil. Color, dark green. Step-cut; rectangular girdle. Size, 7.5 by 6.5 by 3 mm.; weight, 1.10 carats. Cat. Nos. a–229; 84091.

Tourmaline. Brazil. Color, dark green. Step-cut; rectangular girdle. Four long gems. Average size, 15 by 4 by 3 mm.; weight, 4.49 carats. Cat. Nos. a–230–233; 84091.

Tourmaline. Brazil. Three small gems. Colors, 1 light green, 1 dark blue, 1 claret. One brilliant, 2 step-brilliant cut. Size, 5 by 5 by 3 mm. Cat. Nos. a–234–236; 84091.

Tourmaline. Isle of Elba. Color, rose and yellowish green. Step-brilliant cut; rectangular girdle. Size, 16.5 by 9.5 by 8 mm.; weight, 9.60 carats. Cat. Nos. a–251; 50099.

Tourmaline. Siberia. Color, light claret. Step-brilliant cut; elliptical girdle. Size, 9 by 7.5 by 6 mm.; weight, 2.44 carats. Cat. Nos. a–247; 51188.

Tourmaline. Siberia. Color, light claret. Step-brilliant cut; elliptical girdle. Size, 9 by 7 by 6 mm.; weight, 2.38 carats. Cat. Nos. a–248; 51188.

Tourmaline. Siberia. Color, claret. Step-brilliant cut; circular girdle. Size, 7 by 6 mm.; weight, 1.56 carats. Cat. Nos. a–249; 51188.

Tourmaline. Siberia. Color, ruby red. Step-brilliant cut; square girdle. Size, 5 by 3.5 mm.; weight, 0.54 carat. Cat. Nos. a–250; 51188.

Tourmaline. Ceylon. Color, grass green. Cabochon cut; elliptical girdle. Size, 15 by 12 by 6.5 mm.; weight, 12.22 carats. Cat. Nos. a–237; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, brown. Step-brilliant cut; elliptical girdle. Size, 10 by 9 by 6 mm.; weight, 3.06 carats. Cat. Nos. a–238; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, brown. Step-brilliant cut; square girdle. Size, 9 by 5 mm.; weight, 2.86 carats. Cat. Nos. a–239; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, brown. Step-brilliant cut; rectangular girdle. Size, 7.5 by 7 by 5 mm.; weight, 1.86 carats. Cat. Nos. a–240; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, resin yellow. Step-brilliant cut; elliptical girdle. Size, 8.5 by 6 by 5 mm.; weight, 2.60 carats. Cat. Nos. a–241; 83811. The Lea Collection.

Tourmaline. Ceylon. Color, reddish brown. Step-brilliant cut; rectangular girdle. Size, 8 by 6 by 4 mm.; weight, 1.03 carats. Cat. Nos. a–242; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, resin yellow. Step-brilliant cut; elliptical girdle. Size, 6 by 5 by 5 mm.; weight, 0.80 carat. Cat. Nos. a–243; 82811. The Lea Collection.

Tourmaline. Ceylon. Color, honey yellow. Step-brilliant cut. Three small gems; same size. Total weight, 1.41 carats. Cat. Nos. a–244–246; 82811. The Lea Collection.

Turquoise. Los Cerillos, New Mexico. Color, blue green. Cabochon cut; elliptical girdle. Size, 23 by 18 by 6 mm. Cat. Nos. a–652; 48756. Gift of Robt. H. Lamborn.

Turquoise. Los Cerillos, New Mexico. Color, apple green. Cabochon cut; elliptical girdle. Size, 24 by 16 by 6 mm. Cat. Nos. a–653; 48756. Gift of Robt. H. Lamborn.

Turquoise. Los Cerillos, New Mexico. Color, blue green. Arrowhead mounted as scarf pin. Size, 22 by 10 mm. Cat. Nos. a–654; 50255.

Turquoise. Cerillos Mountains, 6 miles from Los Cerillos, New Mexica. Color, blue green. Seven gems. Cabochon cut; 2 circular, 5 ellipital girdles. Average size, 15 by 10 by 6 mm. Cat. Nos. a–655–661; 51946. Gift of the American Turquoise Company, through President John R. Andrews.

Variscite. Lewiston, Utah. Color, green. Polished slab. Size, 13 by 9 cm. Cat. Nos. b–881; 83765.

Variscite. Lewiston, Utah. Color, green. Circular piece. Size, 10 cm. diameter. Cat. Nos. b–882; 84233.

Variscite. Candelaria, Nevada. Color, bright green with dark spots. Tabular cut; elliptical girdle. Cat. Nos. a–613; 81156. Gift of Mack Weber.

Vesuvianite. Color, greenish yellow. Brilliant cut; circular girdle. Size, 5 by 4 mm.; weight, 0.51 carat. Cat. Nos. a–570; 84104.

Wernerite. Templeton, Quebec, Canada; Color, yellow. Cabochon cut. Size, 30 by 22 by 11 mm. Cat. Nos. a–593; 83352. The Lea Collection; gift of Dr. L. T. Chamberlain.

Willemite. Taylor Zinc Mine, Franklin, New Jersey. Color, light greenish yellow. Brilliant cut; circular girdle. Three small gems; total weight, 0.78 carat. Cat. Nos. a–598–600; 84115.

Williamsite, see Serpentine.

Zircon. Ceylon. Color, dark bottle green. Step-brilliant cut; rectangular girdle. Size, 18 by 17 by 7 mm.; weight, 20.70 carats. Cat. Nos. a–325; 83555.

Zircon. Ceylon. Color, bottle green. Step-brilliant cut; rectangular girdle. Size, 9 by 7.5 by 5 mm.; weight, 1.83 carats. Cat. Nos. a–326; 51189.

Zircon. Ceylon. Color, dark green. Brilliant cut; square girdle. Size, 7 by 5 mm.; weight, 0.97 carat. Cat. Nos. a–327; 51189.

Zircon. Ceylon. Brilliant cut; square girdle. Size, 10 by 6 mm.; weight, 4.20 carats. Cat. Nos. a–328; 47311. Gift of C. S. Bement.

Zircon. Ceylon. Color, light blue. Brilliant cut; elliptical girdle. Size, 9 by 7 by 5 mm.; weight, 2.34 carats. Cat. Nos. a–329; 47311. Gift of C. S. Bement.

Zircon. Ceylon. Color, yellowish brown. Step-brilliant cut; rectangular girdle. Size, 11 by 8 by 5 mm.; weight, 4.27 carats. Cat. Nos. a–330; 51193.

Zircon. Ceylon. Color, yellowish green. Step-brilliant cut; rectangular girdle. Size, 10 by 8 by 7 mm.; weight, 3.68 carats. Cat. Nos. a–331; 51193.

Zircon. Ceylon. Color, brownish yellow. Step-brilliant cut; elliptical girdle. Size, 7 by 6 by 3 mm.; weight, 1.38 carats. Cat. Nos. a–322; 51193.

Zircon. Ceylon. Color, greenish brown. Rose cut; circular girdle. Size, 12 by 4 mm., weight, 4.86 carats. Cat. Nos. a–333; 50333.

Zircon. Ceylon. Color, pale greenish yellow. Rose cut; circular girdle. Size, 11 by 5 mm.; weight, 4.73 carats. Cat. Nos. a–334; 50333.

Zircon. Ceylon. Color, pale greenish yellow. Rose cut; circular girdle. Size, 11 by 4 mm.; weight, 4.50 carats. Cat. Nos. a–335, 50333.

Zircon. Ceylon. Color, pale greenish yellow. Rose cut; circular girdle. Size, 11 by 4 mm.; weight, 4.23 carats. Cat. Nos. a 336; 50333.

Zircon. Ceylon. Color, brownish yellow. Step-brilliant cut; elliptical girdle. Size, 9 by 8 by 7 mm.; weight, 4.96 carats. Cat. Nos. a–337; 50333.

Zircon. Ceylon. Color, brownish green. Step-brilliant cut; elliptical girdle. Size, 11 by 7.5 by 5 mm.; weight, 2.98 carats. Cat. Nos. a–338; 50333.

Zircon. Ceylon. Color, sherry. Step-brilliant cut; elliptical girdle. Size, 8.5 by 8 by 5.5 mm.; weight, 3.16 carats. Cat. Nos. a–339; 50333.

Zircon. Ceylon. Color, dark brown. Brilliant cut; elliptical girdle. Size, 11 by 7.5 by 3 mm.; weight, 2.28 carats. Cat. Nos. a–340; 50333.

Zircon. Ceylon. Colorless. Rose cut; oval girdle. Size, 9 by 6.5 by 4 mm.; weight, 1.88 carats. Cat. Nos. a–341; 50333.

Zircon. Ceylon. Colorless. Rose cut; elliptical girdle. Size, 8 by 7 by 5 mm.; weight, 1.89 carats. Cat. Nos. a–342; 50333.

Zircon. Ceylon. Color, green. Step-brilliant cut; circular girdle. Size, 7 by 4 mm.; weight, 1.56 carats. Cat. Nos. a–342; 50333.

Zircon. Ceylon. Color, light green. Brilliant cut; elliptical girdle. Size, 7.5 by 7 by 4 mm.; weight, 1.35 carats. Cat. Nos. a–344; 50333.

Zircon. Ceylon. Color, pale blue. Step-brilliant cut, rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1.42 carats. Cat. Nos. a–345; 50333.

Zircon. Ceylon. Color, pale blue. Step-brilliant cut; rectangular girdle. Size, 7 by 5.5 by 4 mm.; weight. 1.40 carats. Cat. Nos. a–346; 50333.

Zircon. Ceylon. Color, violet brown. Brilliant cut; elliptical girdle. Size, 9 by 5.5 by 3 mm.; weight 1.29 carats. Cat. Nos. a–347; 50333.

Zircon. Ceylon. Color, bottle green. Brilliant cut; rectangular girdle. Size, 6.5 by 5 by 4 mm.; weight 1.24 carats. Cat. Nos. a–348; 50333.

Zircon. Ceylon. Color, yellow. Brilliant cut; rectangular girdle. Size, 7 by 6 by 4 mm.; weight, 1.18 carats. Cat. Nos. a–349; 50333.

Zircon. Ceylon. Color, brown. Step-brilliant cut; circular girdle. Size, 7 by 4.5 mm.; weight, 1.09 carats. Cat. Nos. a–350; 50333.

Zircon. Ceylon. Color, yellow. Step-brilliant cut; square girdle. Size, 6 by 5 by 3 mm.; weight, 0.96 carat. Cat. Nos. a–351; 50333.

Zircon. Ceylon. Color, greenish yellow. Step cut; elliptical girdle. Size 7 by 4 by 2 mm.; weight, 0.69 carat. Cat. Nos. a–352; 50333.

Zircon. Ceylon. Color, bluish and yellowish. Rose cut; circular girdle. Thirteen gems about equal in size; 5 by 3 mm.; total weight, 6.64 carats. Cat. Nos. a–353–365; 50333.

Zircon. Ceylon. Color, bluish and yellowish. Rose cut; circular girdle. Eighty-three small gems. Average size, 3 by 2 mm.; total weight, 11.69 carats. Cat. Nos. a–366–448; 50333.

Zircon. Ceylon. Color, light bottle green. Rose cut; elliptical girdle. Size, 15 by 10 by 5.5 mm.; weight, 6.70 carats. Cat. Nos. a–449; 82913. The Lea Collection.

Zircon. Ceylon. Colorless. Ninety-eight minute gems of equal size. Brilliant cut; circular girdle; total weight, 3.24 carats. Cat. Nos. a–450–547; 82913. The Lea Collection.

Zoisite. Norway. Color, red. Cabochon cut; elliptical girdle. Size, 22 by 19 by 13 mm.; weight, 43.17 carats. Cat. Nos. a–582; 84112.

Zoisite. Norway. Color, red. Cabochon cut; elliptical girdle. Size, 17 by 13 by 5 mm.; weight, 8.26 carats Cat. Nos. a–583; 84112.

A BIBLIOGRAPHY.

ABDALAZIZ (AHMED BEN). Treatise on jewels.

ABEN EZRA (RABBI). Commentarium in Decalogum.
Basel (Basle), 1527.

ABICH (H.). De Spinello.
Berolini (Berlin), 1831.

ADLER (C., and CASANOWICZ). Precious stones of the Bible.
[In Biblical Antiquities, Report, U. S. National Museum. 1896, p. 943.]

AGOSTINI (L.). Gemmæ et sculpturæ antiquæ.
Franequeræ (Franecker), 1699.

AGRICOLA (G.). De ortu et causis subterraneorum de natura eorum quæ effluunt ex Terra.
Basel (Basle), 1558.

AGRIPPA (H. C.). Philosophie occulte.
[Translated by Levasseur.] La Haye (The Hague), 1655.
Contains material relating to the mystical properties of gems.

ALAMUS AB INSULIS (ALAIN DE LISLE). Dicta alani, etc.
Lugduni-Batavorum (Leyden), 1599.
An alchemical treatise containing material relating to the mystical properties of gems. Alamus ab Insulis, b. 1114, d. 1202, was the earliest Flemish alchemist.

ALBERTUS MAGNUS. Die mineralibus.
[In his opera, v. II.] Lugduni (Leyden), 1651.

———. De Vertutibus herbarum, lapidum animalum, etc.
Various editions.

———. Les admirable secrets d' Albert le grand, etc.
Lyon, 1758.
Contains extracts from the works of Albertus Magnus, relating to the magical and medicinal properties of gems.

ALCOT (T.). Gems, talismans, and guardians.
New York, 1886.

ARNALDUS DE VILLANOVA. Chymische schriften, etc.
[Translated by Johannem Hippdamum.] Wien (Vienna), 1742.
See also: Hermetischer Rosenkranz, Pretiosa Margarita, Manget, Theatrum Chemicum, etc. The several writings of this alchemist (also called Villanovanus, Arnald Bachuone, A. de Villeneuve, A. de Villneveé, and Arnaldus Novicomensis) contain much concerning the occult, medicinal, and other properties of gems.

ARNOBIO (CLEANDRE). De Tesoro delle Gioie, trattato maraviglioso.
Venit. (Venice), 1602.

ATHANÆUS. Deiphriosophistæ [Banquet des Philosophes] translated by Dalechamp.
Paris, 1873.

AUBREY (J.). Miscellanies.
London, 1857.
Contains an account of the use of the beryl in divination.

ANDRADA (M. D'). An account of the diamonds of Brezil.
[In Nicholson's Journal, I. 1797, 24.]

Antidotario de Fra D. d'E.
Napoli (Naples), 1639.
A treatise on pharmacy, containing a few accounts of the virtues of gems.
Argenville. Traité de l'Oryctologie.
Paris, 1740.
Argenville (A. J. D. d'). De l'Historie Naturelle éclaircie dans deux de ses parties principales: la Lithologie et la Conchologie.
Paris, 1742.
Aristotle. His works, especially the "Meteorology" and "Wonderful things heard of."
Aristotle was born about 384 B. C., and died about 322 B. C.
———. Lapidarius.
[De novo Græco translatus, Lucas Brandis.] Regia Mersbourg (Merseburg), 1473.
Avicenna (Abou-Ali-Alhussein-Ben-Adloulah). Canones Medicinæ.
[Lat. reddit.] Ven. (Venice), 1843.
Contains material relating to the medicinal and magical virtues of gems.
Babington (Charles). A systematic arrangement of minerals, their chemical, physical, and external characters.
London, 1795.
Bacci (Andræ). Le XII Piètre preziose.
Roma (Rome), 1587.
———. De Gemmis et Lapidibus pretiosis, tractatus ex Ital. Lingua Lat. red.
Francof. (Frankfurt), 1605.
———. De Gemmis ac Lapidibus pretiosis in S. Scriptura.
Roma (Rome), 1577; 8°, Franc. (Frankfurt), 1628.
Bacon (Roger). Opera Quædam hactenus inedita.
[Edited by J. S. Brewer.] London, 1859.
The appendix—Epistola . . . de secretis operibus artis et naturæ—contains some material relating to the magical and alchemical virtues of certain gems.
Ball (V.). On the occurrence of diamonds in India.
[In Geology of India, 3 vols., pp. 1–50, 1881.]
———. On the mode of occurrence and distribution of diamonds in India.
[In Proc. R. Dublin Soc., II, p. 551; also Jour. R. Geol. Soc. Ireland, VI, p. 10.]
———. On the geology of the Mahanadi basin and its vicinity.
[In Records of the Geological Survey of India, X, p. 167: map.]
———. A manual of the geology of India.
Calcutta, 1881.
———. On the identification of certain diamond mines in India which were known and worked by the ancients, especially those visited by Tavernier. With a note on the history of the Koh-i-nur.
[In Journal of the Asiatic Society of Bengal, L, 1881, p. 31; Report British Association for 1882, p. 625; and Nature, XXIII, p. 490, 1882.]
———. On the diamonds, etc., of the Sambālpúr district.
[In Records of the Geological Survey of India, X, p. 186: map.]
Bapst (G.). Les joyaux de la couronne.
[In Reveu des Deux Mondes, 1886, p. 861.]
Barbot (Ch.). Traité complet des pierres précieuses.
Paris, 1858.
Barrera (Mme. de). Gems and jewels.
London, 1860.
Bauer (Max). Edelstein kunde.
Leipzig, 1896.
Baumer (J. W.). Historia Naturalias Lapidum preciosorum omnium, etc.
Franc. (Frankfurt), 1771.

BAUMER (J. W.). Naturgeschiete aller Edelstein, wie auch der Erde und Steine, so bisher zur artznei sind gebraucht worden. Aus dem Latein von Karl, Freih. von Meidinger.
Wien (Vienna), 1774.
BAUMHAUER (E. H. von). Diamonds.
[In Ann. Phys. Chem., 2 ser., I, 1877, p. 462.]
BEARD (C. P.). Traité des pierres précieuses.
Paris, 1808.
BECHAI BEN ASCHAR. Biur al Hattorah—Exposition of the Law of Moses, a commentary on Exodus xxviii, 17–20.
A. M. 5207 (A. D. 1447).
Contains an account of the virtues and properties of gems.
BECHER (JOHANN JOACHIM). Physica Subterranea.
Lipsiae (Leipzig), 1739. An alchemical work.
BECK (R.). Die diamantenlager stätte von Newland in Griqualand West.
[In Zeits. fur Prakt. Geol., 1898, p. 158.]
BEHRENS (TH. H.). Sur la cristallisation du diamant.
[In Arch. Neerl., XVI, p. 376, 1881.]
BEKKERHEIM (KARL). Krystallographie des Mineralreichs.
Wien (Vienna), 1793.
BELLEAU (RENÉ). Les amours et nouveaux échanges des pierres précieuses.
Paris, 1576.
BELLERMAN (J. J.). Die Urim und Thummim.
Berlin, 1824.
BENIAM (MUTAPHIA). Sententiis sacro medicis.
Hamburg, 1640.
Contains material relating to the astrological virtues of gems.
BERQUEN (ROBERT DE). Les Merveilles des Indes Orientales et Occidentales, ou nouveau. Traité des Pierres précieuses, et des Perles.
Paris, 1661.
BESONDERE Geheimnisse eines wahren Adepti von der Alchymie, etc.
Dresden, 1757.
An alchemical treatise.
BEUMEMBERGER (J. G.). Der Volkomene Juwelier.
Weimar, 1828.
BIELHE (VON). Ueber die Bernstein-Gräbereien in Hinter Pommern.
Berlin, 1802.
BILLING (A.). Science of gems, coins, and medals.
New York, 1875.
BIRDWOOD (G. C. M.). Industrial arts of India.
Vol. 2, pp. 17–32, 1881.
BLEASDALE (J. J.). Gems and precious stones found in Victoria.
[In an essay in Official Record, Inter-Colonial Exhibition, Melbourne, 1867.]
BLUM (J. R.). Verzeichniss der geschnitten Steine in dem Königl. Museum zu Berlin.
Berlin, 1827.
———. Lithurgik, oder mineralien und Felsarten nach ihrer Anwendung in Oekon., artist, und Technischer Hinsicht systematische abgehandelt.
Stutgart, 1840.
BLUM (R.). Die Schmucksteine.
Heidelberg, 1828.
———. Taschenbuch der Edelsteinkunde.
Stutgart, 1840.
BLUMENBERG. Dissertatio Medica de Succino.
Jena, 1682.

Blumhof (J. C.). Lehrbuch der Lithurgik.
Frankfurt, 1822.
Boetius (Anselmus). Tractatus de Lapidibus.
Bolnest (E.). Aurora chymica, or a rational way of preparing animals, vegetables, and minerals for a physical use; by which preparations they are made most efficacious, safe, pleasant medicines for the preservation and restoration of the life of man.
London, 1672.
Bondary (Jean de la Taille de). Blason des Pierres précieuses.
Booke of the Thinges that are brought from the West Indies.
[English translation, 1580.] 1574.
Contains an account of the virtues of the bloodstone.
Boot (Anselmus Boetius de). Le parfaict joaillier, ou histoire des Pierreries, de nouveau enrichi de belles annotations par André Toll.
[Translated from Latin by J. Bachou] Lyon, 1644.
Boot (B. de). Lap. Gemmarum et Lapidum Historia.
Jena, 1647.
The first edition published at Jena in 1609; the second enlarged by A. Toll, Lugduni Bat. [Leyden], 1636, contains much concerning the mystical and medicinal properties of gems.
Boot (Anselmus Boetius de). Gemmarum et Lapidum Historia.
Hanover, 1690.
Bordeaux (A.). Les mines de l'Afrique du Sud.
Paris, 1898.
Born (Baron Inigo). Schneckensteine, oder die Sächsischen Topasfelsen.
Prag, 1776.
Bournon (Comte de). An analytical description of the crystalline forms of corundum from the East Indies and China.
[In Phil. Trans.: Abr., XVIII, p. 368, 1798.]
———. Description of the corundum stone, and its varieties, commonly known as oriental ruby, sapphire, etc.
[In Phil. Trans., 1801, p. 223.]
———. A descriptive catalogue of diamonds in the cabinet of Sir Abraham Hume.
London, 1815.
Boutan (M. E.). Diamant.
[In Frémy's Encyclopédie Chimique.]
———. Le Diamant.
Paris, 1886.
Contains a very full bibliography.
Boyle (Robert). Experiments and considerations upon color, with considerations on a diamond that shines in the dark.
London, 1663.
———. Essay about the origin and virtues of gems.
[In his works, v. III, 1772.]
———. Exercitatio de origine et viribus gemmarum.
London, 1673.
———. An essay about the origin and virtues of gems, with some conjectures about the consistence of the matter of precious stones.
London, 1672.
[Another edition in 1673.]
Brard (C. P.). Traité des Pierres Précieuses, des Porphyres, Granits et autres Roches propres a recevoir le poli. 1808.
———. Minéralogie appliquée aux arts.
Paris, 1821.

British Museum. Catalogue of Gems in the British Museum (Department of Greek and Roman Antiquities).
1888.

Britten (Emma H.). Art Magic; or mundane, submundane, and supermundane spiritism.
Contains accounts of mystical properties of gems.

Brongniart (Alexandre). Traité de minéralogie, avec application aux arts.
Paris, 1807.

Brown (C. B. and J. W. Judd). The rubies of Burma.
[In Phil. Trans. Roy. Soc. London, CLXXXVII, pp. 151–228.]
A very elaborate and complete account of the physical features, geology, and geographical distribution of the ruby-bearing rocks of the district.

Bruckmann (U. F. B.). Abhandlung von Edelsteinen.
Braunschweig (Brunswick), 1757–73.

———. A treatise on precious stones.
1775.

———. Gesammelte und eigene Beiträge zu seiner Abhandlung von Edelsteinen.
Braunschweig (Brunswick), 1778.

Buchoz (——). Les Dons merveilleux et diversement coloriés de la Nature dans le Règne Minéral.
Paris, 1782.

Buffum (W. A.). The tears of the Heliades or amber as a gem.
New York, 1900.

Burch (A.). Handbuch für Juweliere.
Weimar, 1834.

Burnham (S. M.). Precious stones.
Boston, 1886.

Burton (R. F.). Gold and diamond mines.
[In his Explorations of the Highlands of Brazil, 1869.]

Cadet (Le Jeune). Memoire sur les Jaspes et autres Pierres Précieuses de l'ile de Corse.
Bastia, 1785.

Caesalpinus (Andreas). De metallicis Libri tres.
Rom. (Rome) 1496.

Cahagnet (L. A.) Magie magnetique.
Paris, 1838.
A spiritualistic work containing material relating to the occult properties of gems.

Caire (A.) La Science des pierres précieuses appliquée aux arts.
Paris, 1833.

Capeller (Maur. Ant.). Prodomus crystallographiæ, de crystallis improprie sic dictis commentarium.
Lucernæ (Lucerne), 1723.

Cardanus (Hieronymus). De Lapidibus preciosis; also De Subtilitate.
These contain accounts of the magical and medicinal properties of gems.

Carosi (Johann). Sur la Generation du Silex et du Quartz.
Cracov, 1783.

Carton (J.) Englischen Juwelier, Kenntniss, Werthund Preisschatzung aller Edelsteine, Perlen, Corallen, ins Deut. ubersetzt nach der 10 ed.
Gratz, 1818.

Catalog des Bijoux nationaux.
Paris, 1791.

Castellani (A.) Gems, notes, and extracts.
[Translated from the Italian, by Mrs. J. Brogden.] London, 1871.

Cellini (Benevenuto). Trattato del' Oreficeria.
———. Del Arte del Gioiellare.
Fior. (Florence), 1568.
Chafer (——). Note sur la région diamantifére de l'Afrique Australe.
Paris, 1880.
———. On the occurrence of diamonds in India.
[Comptes Rendus, 1884, p. 113.]
Chand (Gulal). Essay on diamonds.
Lucknow, 1881.
Church (A. H.). Precious and curious stones.
[In Spectator, July 9, 1870.]
———. Townsend Collection.
[In Quart. Jour. Science, Jan., 1871.]
———. Precious stones.
London, 1882.
———. Discrimination, etc., of precious stones.
[In Jour. Soc. Arts. XXIX, p. 439.]
———. Physical properties of precious stones.
[in Proc. Geol. Assoc., V, No. 7.]
———. Colours of precious stones.
[in Magazine of Art. I, p. 33.]
Clauder (G.). Schediasma de tinctura universali, vulgo lapis philosophorum dicta, etc.
Norimbergæ (Nuremberg), 1736.
An alchemical treatise containing 13 folding tables having a list of minerals with their properties grouped under the following heads: Nomen, Substantia, Color, Pondus, Natura, Præparatio, Tractatio, Contenta.
Clave (Estienne). Paradoxes, ou Traittez Philosophiques des Pierres et Pierreries, contre l'opinion volgaire.
Paris, 1635.
Clutius (Augerius). Calsvee, sive Dissertatio Lapidis Nephritici, seu jaspidis viridis, naturam, proprietates, et operationes exhibens Belgice.
[Amsterdam, 1621, et Lat. per Gul. Lauremberg, fil.] Rostochii (Rostock), 1627.
Cohen (E.). Ueber Capdiamanten.
[In Neues Jahrbuch I, p. 184, 1881.]
Cohen (M.). Beschreibendes Verzeichniss einer Sammlung von Diamanten.
Wien (Vienna), 1822.
Collini (Cosmus). Journal d'un Voyage, qui contient différentes observations minéralogiques, particulierment sur les agates, avec un détail sur la menière de travailler les agates.
Mannheim, 1776.
Colonne (François Marie Pompée). Historie Naturelle de l'Univers.
[4 vols.] Paris, 1734.
Corsi (Faust). Delle Piedre antiche libri quattro.
Roma (Rome), 1828.
Croly (G.). Gems; etched by R. Dagley, with illust., in verse.
London, 1822.
Crookes (Sir W.). Diamonds.
[In Proc. Roy. Inst., 1897, p. 477.]
Crookes (William). Diamonds.
[In Report Smithsonian Institution, 1897, p. 219.]
———. On radiant matter.
[In Chemical News, XL, pp. 93, 104, and 127.]
Contains results of experiments on the phosphorescence of the diamond, ruby, and other minerals.

CURIOSE speculationen.
Leipzig, 1707.

CURL (MARTHA A.). Ancient gems.
[In American Antiquarian, XXII, p. 284, 1900.]

DALL (W. H.). Pearls and pearl fisheries.
[In American Naturalist, 1883, pp. 579, 731.]

DANA (E. S.). On the emerald green spodumene (Hiddenite) from Alexander County, North Carolina.
[In Am. Jour. Science, 1881, XXII, p. 179.]

DANA (E. S., and H. L. WELLS). Description of the new mineral, beryllonite.
[In Am. Jour. Science, 1889, XXXVII, p. 23.]

DAUBRÉE (M.) Rappor sur un mémoire de M. Stanislas meunier ayant pour titre: Composition et origine du sable diamantifère de Du Toits Pan.
[In Comptes Rendus, LXXXIV, p. 1124.]
A summary of the subject to the date.

DAVY (HUMPHREY). Some experiments on the combustion of the diamond and other carbonaceous substances.
[In Phil. Trans., 1814, p. 557.]

DE LAPIDIBUS, Avibus et Arboribus Indiae, Arabiae, et Africae.
[Harleian manuscripts.]

DERBY (O. A.). The geology of the diamantiferous region of the province of Paraná, Brazil.
[In Proc. Am. Phil. Soc., XVIII, p. 251; also Am. Jour. Science, 1879, XVIII, p. 310.]

———. On the occurrence of diamonds in Brazil.
[In Am. Jour. Science, 1882, XXIV, p. 34.]

———. Notes on certain schists of the gold and diamond region of eastern Minas Geraes, Brazil.
[In Am. Jour. Science, 1900, X, p. 207.]

DIAMANTENGRABEREIEN in Südafrika.
[In Zeits. deutsch. Ing. Arch. Ver., XXVI, 1883, p. 565.]

DIAMOND, Description of the.
[In Phila. Trans. Abr., II, 1708, p. 405.]

DIAMOND, The, or the pest of a day.
London, 1797.

DIAMOND, The artificial production of.
[In Nature, XXII, 1880, pp. 404, 421.]

DIAMOND (The).
[In Westminster Review, Jan., 1883.]

DIAMOND, Fresh . . . discoveries in New South Wales.
[In Iron, XXIII, p. 249, 1884.]

DIAMOND. Papers and notes on the genesis and matrix of the . . . by the late Henry Carvill Lewis, edited by H. C. Bonney.
London, 1897.

DIAMONDS.
[In Nature, Aug. 5, 1887, p. 325.]

DIAMOND CUTTING.
[In 13 Annual Report of the U. S. Commissioner of Labor.]
Deals with subjects relating to the comparison of hand and machine work.

DIAMOND mining at Kimberly, South Africa.
[In Geol. Mag., X, 1883, p. 460.]

DINGLEY (ROBERT). On gems and precious stones, particularly such as the ancients used to engrave on.
[In Phil. Trans. Abr., IX, 1747, pp. 345.]

DIEULAFAIT (L.). Diamants et Pierres Précieuses.
Paris, 1871.

DIEULAFAIT (L.). Diamonds and precious stones; a popular account of gems.
New York, 1874.

DIOSCORIDES materia medica.
Written about A. D. 50. A portion of the work treats especially of the medicinal properties of minerals.

DIXON (A. C.). Rocks and minerals of Ceylon.
[In Jour. Ceylon Branch Roy. Asiatic Soc., VI, No. 22, p. 39. Colombo.]

DOELTER (C.). Edelstein Kunde. Bestimmung und Untersuchung der Edelsteine und Schmucksteine Kuenstliche Darstellung der Edelsteine.
Leipzig, 1893.

DOLCE (LUDOVICO). Libré tre, nei Quali si tratta delle diverse sorti delle gemme che produce la Natura.
Ven. (Venice), 1564.

DÖLL (E.). Zum vorkommen des Diamants in Itakolumite Brasiliens und in den Kopjen afrikas.
[In Verh. k.-k. geol. Reichs., 1880, p. 78.]

DRÉE (——). Catalogue de Musée Mineralogique.
Paris, 1811.

———. Voyage aux mines de diamants dans le Sud de l'Afrique.
[In Tour du Mond, Nos. 931–933, 1878.]

DU CHESNE (J.). A Briefe Aunswere of Iosephus Quercetanus Armeniacus, etc.
London, 1591.
Contains a second part "concerning the use of minerall medicines."

DU MÉRSAN (T. M.). Histoire du cabinet des medailles, Pierres Gravées, etc.
Paris, 1838.

DUMONT (and JOURDAN). Pierres précieuses.

DUNN (E. J.). Notes on the diamond fields of South Africa.
[In Quart. Jour. Geol. Soc., XXXIII, p. 879, and v. 37, p. 609.]

DUTENS (LEWIS). Des pierres précieuses et des pierres fines, avec les moyens de les connoitre et de valuer.
[In his Oeuvres, II.] Londres, 1776.

ECCHELLENSIS (ABRAHAM). Versio Durrhamani de medicis Virtutibus animalum, plantarum et gemmarum.
Paris, 1647.

ECKERMAN (N.). Electra, oder die Enstehung des Bernsteins.
Halle, 1807.

ECKHEL (J. H.). Choix des Pierres gravées du Cabinet Impérial des Antiques.
Vienne (Vienna), 1788.

EICHORN (J. G.). Die gemmis scalptis Hebraeorum.
[In Goettingen Ges. d. Wiss. Comm., 1811–13.]

EKEBERG (ANDREW GUSTAVUS). Dissertatio de Tōpazio.
Upsal (Upsala), 1796.

ELLIOTT (JOHN). On the specific gravity of diamonds.
[In Phil. Trans.: Abr., IX, 1745, pp. 147.]

EMANUEL (H.). Diamonds and precious stones.
London, 1865.
Contains a very full bibliography.

ENCELIUS (CHRISTOPH). De Re Metallica, hoc est, de origine varietate et natura corporum metallicorum, Lapidum, Gemmarum atque aliarum quae ex fodinis eruuntur, Libri III.
Francf. (Frankfurt), 1551.

ENGELHARDT (AB. VON). Die Lagerstatte der Diamenten im Ural-Gebirge.
Riga, 1830.

EPIPHANIUS. De duodecim Gemmis in veste Aaronis.
[Gr. Lat. cum corollario Gesneri.] Tig. (Turin), 1565.

ERCKER (L.). Aula Subterranea.
1595.

ERMANN. Beitrage zur Monographie des Marekasit, Turmalin, und Brasilianischen Topas.
Berlin, 1829.

FABRE (P. J.). L'Abrégé des secrets chymiques, ou l'on void la nature des animaux, végétaux, et minéraux entiérement découverte.
Paris, 1636.

FALLOPIUS (G.). De Medicatis Aquis atque de Fossilibus, tractatus ab Andrea Marcolini collectus.
Venetia (Venice), 1564.

FERGUSON (A. M. and J.). . All about gold, gems, and pearls in Ceylon and southern India.
London, 1888.

FERNEL (JOHN FRANCIS). Pharmacia, cum Guliel, Plantii et Franc. Saguyerii Scholiis.
Hanov. (Hanover), 1605.

FEUCHTWANGER (L.). Treatise on gems in reference to their practical and scientific value.
New York, 1838.

———. Popular treatise on gems in reference to their scientific value: a guide for the teacher, etc.
New York, 1859.

FICORONI (F.). Gemmae antiquae; adnot. N. Galeotti.
Romae (Rome), 1757.

FINOT (L.). Les Lapidaires Indiens.
Paris, 1896.
Contains eight different Sanskrit books of the art of the Indian lapidary, two of which are translated. The gems are described with reference as to origin, their value as charms, and also as to their occurrence, color, class, and value.

FISCHER (G. DE WALDHEIM). Essai sur la Turquoise et sur la calaite.
Moscou (Moscow), 1810.

FISCHER (G. DE W.). Essai sur la Pellegrina, ou la Perle incomparable des frères Zozima.
Moscou (Moscow), 1818.

FLADE (C. G.). De re metallica Midianitarum et Phœnicorum.
Lipsiae (Leipzig), 1806.

FLADUNG (J. A. F.). Versuch über die Kennzeichen der Edelsteine und deren vortheilhaftesten Schnitt.
Pesth (Budapest), 1819.

———. Edelsteinkunde.
Wien (Vienna), 1828.

FONTENAY (——). Bijoux anciens et modernes.

FONTENELLE (——). Nouveau manuel complet du bijoutier.
Paris, 1855.

FORSTER (J. A.). Diamonds and their history.
[In Jour. Microscopy Nat. Science, III, 1884, p. 15.]

FOWLE (——). Occurrence of diamonds in China.
[In U. S. Consular Report, No. 198, 1897, p. 384.]

FOUQUÉ (F. and M. LÉVY). Synthèse des minéraux.
Paris, 1871.

FRÉMY (E. and TEIL). Artificial production of precious stones.
[In Jour. Soc. Arts, XXVI, 1878.]

Frémy (E. and Teil). Sur la production artificielle du corindon du rubis et de différents silicates cristallisés.
[In Comptes Rendus, LXXXV, p. 1029.]

Friedländer (I.). Artificial production of diamond in silicates corresponding to the actual mode of occurrence in South Africa.
[In Geol. Mag., p. 226, 1898.]

Frischolz (J.). Lehrbuch der Steinschneidekunst, fur Steinschneider, Graveurs, etc., und Jedens, welcher sich über die Veredlung der Steine zu unterrichten wünscht.
München (Munich), 1820.

Galamazar (——). Liber de Virtutibus lapidum pretiosorum quem scripsit Galamazar, Thesaurarius Regis Babylonie, ipso presenti et precipiente.
[In Harleian Manuscripts.]

Gautier (J.). Untersuchung über die Entstehung, Bildung und den Bau des Chalcedons, etc.
Jena, 1809.

Gems.
[In Spon's Encyclopedia of the Industrial Arts, p. 1042.]

Gerhard (C. A.). Disquisitio physico-chemica granatorum Silesiæ atque Bohemiæ.
[Inaug. Diss. Frankfurt a. d. Oder, 1760.]

Gesner (Conrad). Liber de rerum fossilium, lapidum et gemmarum, maxime figuris.
Tig. (Turin), 1565.

Gimma (D. Giacento). Della storia naturale delle gemme, delle pietre e di tutti minerali, ovvero della fisica sotteranea.
Napoli (Naples), 1730.

Ginanni (Fantuzzi M.). Osservazioni geognostiche sul coloramento di alcune pietre e sulla formazione di un agate nel museo Ginanni di Rivenna.
1857.

Gipps (G. G. de). Occurrence of Australian opal.
[In a paper read before the Australian Institute of Mining Engineers, 1898.]

Glocker (Ernst Friedrich). De gemmis Plinii, imprimis de topazio.
Vratislaviæ (Breslau), 1824.

Goepert (H. R.). Ueber pflanzenähnliche Einschlüsse in den Chalcedonen.
1848.

Gold and Gems. Mawe's Travels in the Brazils.
1812.

Gorceix (H.). Les diamants et les pierres précieuses du Brésil.
[In Comptes Rendus, 1881, p. 981; also in Rev. Sci., XXIX, 1882, p. 553.]

———. Études des minéraux qui accompagnent le diamant dans le gisement de Salabro (Brésil).
[In Bull. Soc. Min. Français, VII, 1884, p. 209.]

Gregor (William). An analysis of a variety of the corundum.
[In Nicholson's Journal, IV, 1803, p. 209.]

Greville (Charles). On the corundum stone from Asia.
[In Phil. Trans Abr., XVIII, 1798, p. 356; and Nicholson's Journal, II, p. 477.]

Griffiths (A. B.). On the origin and formation of the diamond in nature.
[In Chemical News, XLVI, 1882, p. 105.]

Groth (P.). Grundriss der Edelsteinkunde.
Leipzig, 1887.

Gronovius (J.). Gemmæ et Sculpturæ antiquæ depictæ ab Leonardo Augustino Senensi. 2 vols. in one.
Franequeræ (Franecker), 1694.

Grünling (Fr.). Über die Mineral vorkommen von Ceylon.
[In Zeits. Krystallographie, XXXIII, 1900, p. 209.]

Güthe (J. M.). Ueber den Asterios-Edelstein des Cajus Plinius Secundus; eine antiquarisch-lithognostische Abhandlung.
München (Munich), 1810.

Guyton-Morveau (B. L.). On the singular crystallization of the diamond.
[In Nicholson's Journal, XXV, 1810, p. 67.]

———. Account of certain experiments and inferences respecting the combustion of the diamond and the nature of its composition.
[In Nicholson's Journal, III, p. 298.]

Habdarrahamus (Asiutensis Ægyptius). De proprietatibus ac virtutibus medicis animalum, plantarum ac gemmarum.
[Ex Arab. Lat. redd. ab Abrahamo Ecchellensi]. Paris, 1647.

Haberle (C. C.). Beobachtungen über Gestalt der Grün- und Keimkrystalle des schorlartigen Berylls, und dessen übrige oryctognostische und geognostische Verhältnisse.
Erfurt, 1804.

Haeckel (E.). A visit to Ceylon.
London, 1883.

Haidinger (W.). Ueber den Pieochroismus des Amethystes.
Wien (Vienna), 1846.

———. Ueber eine neue Varietät von Amethyst.
[In Denkschr. Akad. Wien, 1849.]

———. Pleochroismus und Krystallstructur des Amethystes.
[In Ber. Akad. Wien, 1854.]

———. Der für Diamant oder noch werthvolleres ausgegebene Topas des Herrn Dupoisat.
[In Ber. Akad. Wien, 1858.]

Hamlin (A. C.). The tourmaline.
Boston, 1873.

———. Leisure hours among the gems.
1884.

Hannay (J. B.). On the artificial formation of the diamond.
[In Chemical News, 1880, p. 106.]

——— Artificial diamonds.
[In Nature, XXII, 22, 1880, p. 255.]

Hasse (J. H. F.). Der Aufgefundene Eridanus, oder neue Aufschlüsse über den Ursprung des Bernsteins.
Riga, 1769.

Haüy (René Just). Traite de la minéralogie.
Paris, 1780.

——— Mémoire sur les topazes du Brezil.
[In Ann. Mus. d'Hist. Nat., Paris, 1802.]

——— Observations sur les Tourmalines, particulièrement sur celles qui se trouvent dans les États Unis.
[In Mémoire du Muséum, Paris, 1815.]

——— Traite des caracteres physiques des Pierres précieuses, pour servir a leur determination lorsqu'elles sont tailles.
Paris, 1817.

Helmkacker (R.). On the Russian diamond occurrences.
[In Eng. and Min. Jour., Oct. 28, 1898.]

Hobbs (W. H.). The diamond field of the Great Lakes.
[In Jour. of Geol., VII, 1899, no. 4.]

Hermes Trismegistus. Tabula smaragdina vindicata.
1657.
An alchemical treatise.

Hertz (B.). Catalogue of Mr. Hope's collection of pearls and precious stones, systematically arranged and described.
London, 1839.

Hessling (Th. von). Die Perlmuschel und ihre Perlen.
Leipzig, 1859.

Hiller (M.). Tractus de Gemmis xii, in Pectorali Pontificis Hebraeorum.
Tubingen, 1698.

Hindmarsh (R.). Precious stones, being an account of the stones mentioned in the Sacred Scriptures.
London, 1851.

Histoire des Joyaux et des principales Richesses de l'orient et de l'occident.
Geneve (Geneva), 1665.

History of Jewels.
London, 1671.

Hodgson (John). Dissertation on an ancient cornelian.
[In Archaeol., II, 1773, p. 42.]

Hollandus (I.). Opera mineralia et vegetabilia.
Arnhem (Arnheim), 1617.

Hudleston (W. H.). On a recent hypothesis with respect to the diamond rock of South Africa.
[In Min. Mag. 1883, p. 199.]

Identification of gems.
[In Mineral Industries (annual), 1898, p. 278.]

Jacob (P. L.). Curiosités des sciences occultes; alchimie, médecine chimique et astrologique, talismans, amulettes, baguette, divinatoire, astrologie, chiromancie, magie, sorcellerie, etc.
Paris, 1885.

Jacobs (H. and N. Chatrian). Monographie du diamant.
Paris, 1880.
A second edition in 1884.

Janettaz (N. and E. Fontenay, Em. Vanderhegen, and A. Coutance). Diamant et pierres précieuses.
Paris, 1880.

Jannetaz (N.). Les diamants de la couronne.
[In Science et Nature,1884.]

Jennings (H.). The Rosicrucians.
London, 1870.
Another edition, 2 vols., in 1887.
Contains some references to the mystical lore of gems.

Jeffries (David). Treatise on diamonds and pearls, in which their importance is considered, plain rules are exhibited for ascertaining the value of both, and the true method of manufacturing diamonds is laid down.
London, 1750.

——— Traite des diamants et des perles.
Paris, 1753.

——— An abstract of the treatise on diamonds and pearls, by which the usefulness to all who are in any way interested in these jewels will sufficiently appear, and therefore addressed to the nobility and gentry of this kingdom, and to the traders in jewels.
London, 1754.

John (J. F.). Naturgeschichte des Succins, oder des sogernannten Bernsteins.
Köln (Cologne), 1816.
Jones (W.). Treasures of the earth, or mines, minerals, and metals.
London, 1879.
——— Precious stones, their history and mystery.
London, 1880.
——— Finger-ring lore.
London, 1890.
Jonstonus (Johannes). Notitia Regni Vegetabilis et Mineralis.
Lipseae (Leipzig), 1661.
——— Thaumatographia Naturalis.
Amsterdam, 1632.
Josephus. Antiquatum Judaicarum.
[Translated from the Greek by W. Whiston.] London, 1737.
In book III, chap. 8 is an account of the marvelous properties of the stones in the breast-plate of the high priest.
Judd (J. W. and W. E. Hidden). On the occurrence of ruby in North Carolina.
[In Min. Mag., 1889, p. 139.]
Jutier (——). Exploitation du diamant dans la colonie du cap.
[In Compt. Rendus Soc. Industr. Min. St. Etienne, p. 34.]
Juwelier, Der Aufrichtige, oder Anweisung aller Arten Edelsteine, Diamenten, und Perlen zu erkennen, nebst einer aus dem Englischen uebersetzten Abhandlung von den Diamanten und Perlen.
Frankfurt, 1772.
Kahler (M.). De Crystallorum Generatione.
Upsal (Upsala), 1747.
Kalm (P.). Nägra Kanne marken til nyttiga mineraliens eller ford och Baigarters upfinnande.
Aboae (Abo), 1756.
Key to precious stones and metals.
London, 1869.
King (C. W.). Antique gems.
London, 1860.
——— The natural history of precious stones and of the precious metals.
London, 1867.
——— The natural history of gems or decorative stones.
London, 1867.
——— Handbook of engraved gems.
London, 1885.
King (G. F.). Topaz and associated minerals at Stoneham, Maine.
[In Am. Jour. Science, XXVII, 1884, p. 212.]
Kirani Kiranides et ad eas Rhyakini koronides, sive mysteria Physico-Medica.
London, 1685.
Kircher (Athanasius). Mundus subterraneus in XII libros digestus
Amstellodami (Amsterdam), 1678.
Another edition, Le Monde Souterrain, in French.
Kirkpatrick (T. S. G.). Simple rules for the discrimination of gems
New York, 1895.
Klaproth (M. H.). Analysis of the spinel.
[In Nicholson's Journal, III, 1799, p. 549.]
Klebs (R.). Der Bernstein, Seine Gewinnung, Geschichte u. geologische Bedeutung.
Berlin, 1880.
Kleefeld (——). Die Halbedelstein.
Berlin, 1879.

Kleefeld (——). Die Edelstein.
Kluge (K. E.). Handbuch der Edelsteinkunde.
Leipzig, 1860.
Köhler (H. K. A. von). Kleine Anhandlungen zur Gemmenkunde.
———. Untersuchung über den sard, onyx und sardonix.
Braunschweig (Brunswick), 1801.
Kokscharow (N. von). Materialen zür mineralogie Russlands.
St. Petersburg.
Eleven vols. and atlas. Begun in 1853 and the parts issued from time to time. Contains mineralogical descriptions of gem minerals of the Russian Empire.
König (Emanuel). Regnum minerale, physice, medice, anatomice, alchymice, analogice, theoretice et practice investigatum.
Basil (Basle), 1689.
Könnenitz (L. von). Mittheilung mannichfaltiger Versuch Edelsteine Kunstgemass zu schleifen.
Weimar, 1841.
Krause (T. H.). Pyrgoteles, oder die edeln Steine der alten in Bereiche der Natur, etc.
Halle, 1856.
Kunz (G. F.). Precious stones.
[In Mineral Resources of the United States. Issued annually by the United States Geological Survey.]
———. Precious stones.
[In Appleton's Physical Geography.]
———. The gems in the National Museum.
[In Popular Science Monthly, April, 1886.]
———. Precious stones, gems, and decorative stones in Canada and British America.
[Ann. Rept. Geol. Survey of Canada, Ottawa, 1888.]
———. The fresh-water pearls and pearl fisheries of the United States.
[In Bulletin of the U. S. Fish Commission, 1897, p. 375.]
———. Gems and precious stones.
New York, 1890.
———. Folk-lore of precious stones.
1894.
A catalogue of specimens exhibited in the Department of Anthropology, World's Columbian Exposition, Chicago, 1893.
———. Sapphires from Montana, with special reference to those from Yogo Gulch, in Fergus County.
[In Am. Jour. Science, IV, 1897, p. 417.]
Labarte (M. Jules). Handbook of the arts of the Middle Ages and Renaissance, as applied to the decoration of jewels, etc.
London, 1855.
Lacaze (Duthiers H.). Histoire Naturelle du Corail, Organisation, Reproduction, Pêche en Algérie, Industrie, etc.
Paris, 1864.
Laet (John de). De Gemmis et Lapidibus Libri II, Quibus præmittitur Theophrasti Liber; de Lapidibus Gr. Lat., cum annotationibus.
Lugd. Bat. (Leyden), 1647.
Lancon (H.). L'Art du Lapidaire.
Paris, 1830.
Langius (Johannes). Epistolæ medicinales.
Lugd. (Leyden), 1557.
Lapidum Pretiosorum usus magicus, sive de sigillis.
[In Harleian Manuscripts.]

Launay (L. de). Les diamants du Cap.
Paris, 1897.
Lea (Isaac). Inclusions in gems.
[In Proc. Acad. Nat. Science, Philadelphia.]
Leisnerus (Gott. Christ.). De Coralliorum Natura, Præparatis et Usibus.
Wittembergæ (Wittemberg), 1720.
Lemnius (Levinus). Occulta Naturæ Miracula.
Antwerp, 1567.
Lenk (J.). Neue Entdeckung eines Steines Serpentin-Agat.
Wien (Vienna), 1802.
Leonardus (Camillus). Speculum Lapidum.
Venet. (Venice), 1502.
———. Tratto delle Gemme che produce la Natura; traduzione di M. Ludovico Dobe.
1565.
———. The mirror of stones, in which the nature, generative properties, virtues, and various species of more than 200 different jewels, precious and rare stones are distinctly described.
London, 1750.
Lewis (H. C.). Genesis and matrix of the diamond.
London, New York, and Bombay, 1897.
Libavle (A.). Alchemia.
Frankfurt, 1597.
Liber Hermetis, tractans de 15 Stellis et de 15 Lapidibus et de 15 Herbis et de 15 Figuris.
[In Harleian Manuscripts.]
Liversedge (A.). On the occurrence of diamonds in New South Wales.
[In Minerals of New South Wales, London, 1888.]
Loewm (——). Ueber den Bernstein und die Bernstein-Fauna.
Berlin, 1850.
Loninser (G.). Die Marmaroscher Diamanten.
Presberg, 1856.
Lösch (A.). Ueber Kalkeisengranat (Demantoid) von Syssertzk am ural.
[In Neues Jahrbuch, 1879, p. 785.]
Description of locality, occurrence, etc., of the green garnet (demantoid) used in jewelry.
Louis (H.). The ruby and sapphire deposits of Moung Klung, Siam.
[In Min. Mag., 1894, p. 276.]
Lucretius (——). De Rerum Natura.
Lullius (Raymundis). Lebelli aliquot chemici, etc.
Basileæ (Basle), 1600.
[See p. 319: "De compositione gemmarum et lapidum preciosorum."]
Makowsky (A.). Ueber die Diamanten des Kaplandes auf der Weltaustellung in Wien.
[In Verh. Nat. Ver. Brünn, XII, p. 16.]
Mallet (F. R.). On sapphires recently discovered in the Northwest Himalayas.
[In Rec. Geol. Surv. India, XV, 1881, p. 138.]
Mandeville (John). Le Grande Lapidaire, où sont déclarez les noms de Pierres orientales, avec les Vertus et Propiétés d'icelles, et îles et pays où elles croissant.
Paris, 1561.
Marbodæus (Gallus). De Gemmarum Lapidumque pretiosorum formis atque viribus opus culum.
Colon (Cologne), 1593.

MARBODÆUS (GALLUS). De Lapidibus pretiosis Enchiridion, cum Scholiis Pictorii.
Wolfenbültelæ (Wolfenbültel), 1740.
MARIETTE (P. J.). Traité des Pierres gravées.
Paris, 1750.
MARSHALL (W. P.). Notes on the Great Kimberley Diamond mine.
[In Midl. Nat., VII, p. 93.]
Marlborough gems. Gemmarum Antiquarum Delectus ex præstantioribus desumptus, quæ in Dactyliothecis Ducis Marlburiensis conservantur, 1845.
MARTIN (K.). Notizen über Diamanten.
[In Zeits. deutsch. geol. Gesells. XXX, p. 521; plate.]
A crystallographic study of the diamonds in the Leyden Museum.
MASKELYNE (N. S.). Artificial diamonds.
[In Jour. Soc. Arts, XXVII, p. 289.]
MASON (F.). Burma: Its people and productions.
London, 1882.
In 2 vols., I, geology and mineralogy.
MAWE (JOHN). A treatise on diamonds and precious stones, including their history, natural and commercial. To which is added some account of the best method of cutting and polishing them.
London, 1813.
———. Travels in the interior of Brazil, particularly in the gold and diamond districts of that country.
London, 1812.
MEINEKE (J. L. G.). Ueber den Chrysopras und die denselben begleitenden Fossilien in Schlesien.
Erlangen, 1805.
MEUNIER (S.). Composition et origine du sable diamantifére de Du Toits Pan (Afrique-Australe).
[In Comptes Rendus, LXXXIV, p. 250.]
MILES (C. E.). Diamonds.
[In Trans. Liverpool Geol. Soc., II, p. 92, 1882.]
M. L. M. D. S. D. Dénombrement, Faculté et Origine des Pierres précieuses.
Paris, 1667.
MÖBIUS (K.). Die echten Perlen.
Hamburg, 1857.
MORALES (G. de). Libro de las Virtudes y Propriedades maravillosas de las Piedras preciosas.
Madrid, 1605.
MORGAN (SYLVANUS). The Sphere of Gentry.
1661.
Contains an account of the heraldic meaning of gems.
MORRIS (J.). Gems and precious stones of Great Britain.
1868.
MORTIMER (CROMWELL). Remarks on the precious stone called the turquois.
[In Phil. Trans. Abr., VIII, p. 324.]
MÜLLER (J.). Nachricht von den in Tyrol entdeckten Turmalinen, oder Aschenziehern, von Ignaz Edeln von Born.
Wien (Vienna), 1787.
MURRAY (J.). Memoir on the diamond.
London, 1839.
MURRAY (R. W.). Diamond fields of South Africa.
[In Jour. Soc. Arts, XXIX, p. 370.]
NATTER (L.). A treatise on the ancient method of engraving precious stones compared with the modern.
London, 1754.

Natural Magick, in twenty books, wherein are set forth all the riches and delights of the natural sciences, with engravings.
London, 1658.
An English trans. of Porta's Magiæ Naturalis.

Nicols (Thomas). A lapidary, or history of pretious stones; with cautions for the undeceiving of all those that deal with pretitious stones.
London, 1754.

———. Arcula Gemmea; or the Nature, Virtue, and Valour of Precious Stones, with cautions for those who deal in them.
Cambridge, 1652.

———. Gemmarius Fidelis, or the Faithful Lapidary; experimentally describing the richest Treasures of Nature, in an Historical Narrative of the several Natures, Virtues, and Qualities of all Precious Stones, with a Discovery of all such as are adulterate and counterfeit.
London, 1659.

Northrup (H. D.). Beautiful gems.
1890.

Ochtchepkoff (J. W.). Qui à découvert le Diamant dans les Montes Ourals?
[In Bul. Soc. Oural. Sci. Nat., VII, p. 87, 1884.]

Opals (Australian).
[In Iron, XXII, p. 490, 1883.]

Orpen (G.). Stories about famous precious stones.
1890.

Orpheus. Hymni et de Lapidibus. Gr. Lat., curante A. C. Eschenbachio; accedunt H. Stephani notæ.
Traj. ad Rh. (Cologne), 1689.

Orton (J.). Underground treasures.
Philadelphia, 1881.

Page (D.). Economic Geology.
London, 1874.

Paracelsus (Philippus Aurelius Theophrastus). Nine books on the nature of things; into English by J. F.
London, 1650.

Paracelsus. Of the chymical transmutation, genealogy, and generation of metals and minerals [tr. by R. Turner].
London, 1657.

Parrot (——). Notices sur les Diamants d l'Oural.
[In Mem. de l'Acad. Imp., St. Petersburg, 1832].

Partsch (P.). Beschreibendes Verzeichniss einer Sammburg von Diamanten und der zur Bearbeitung derselben nothwendigen apparate.
Wein (Vienna), 1822.

Paxman (J. N.). The diamond fields of South Africa.
[In Eng. Min. Jour., XXXV, p. 382.]

———. On the diamond fields and mines of Kimberley, South Africa.
[In Proc. Inst. Civil Eng., LXXIV, p. 59.]

Paxton (J. R.). Jewelry and the precious stones.
[By Hipponax Roset, pseudon.] Philadelphia, 1856.

Petzholdt (M.). Beiträge zur Naturgeschichte des Diamants.
Dresden und Leipzig, 1842.

Philostratus. De Vita Apolonii.

Piererus (G. P.). Lazulus, Dissertatio chymico, medica.
Argentorati (Strasburg), 1668.

Pinder (——). De Adamante Commentatio Antiquaria.
Berlin, 1829.

Pirsson (L. V.). On the corundum-bearing rock from Yogo Gulch, Montana.
[In Am. Jour. Science, IV, 1897, p. 421.]

Pliny. Historia Naturalis C. Plinii secundi.
First issued A. D. 77.
The work is divided into 37 books, and these into short chapters; the last 5 books treat particularly of gems and other minerals.

Pluche (Antoine Noël de). Spectacle de la Nature.
Paris, 1732–39.

Plummer (J.). Australian localities of diamond.
[In Watchmaker, Jeweller, and Silversmith, XXIV, 1898.]

Plytoff (G.). Divination, calcul, des probabilités, oracles et sorts, songes, graphologie, chiromancie, phrénologie, physiognomie, cryptographie, magie, kabale, alchimie, astrologie, etc.
Paris, 1891.

Pole (W.). Diamonds.
[In London Archaeol. Trans., 1861.]

Porta (John Baptist). Magiæ Naturalis.
Porta [born 1538, died 1615] published the first edition of this work in 1553, when he was but 15 years old. It contains much concerning the mystical properties of gems. The work also contains a description of the camera obscura.

———. A method of knowing the inward virtues of things by inspection.
1601.

———. De Distillationibus.
Romæ (Rome), 1608.

Portaleone (Abraham). Shilte Haggeborim [The Shields of the Mighty].
Mantua, A. M. 5372 (A. D. 1612).

Pott (M. J.). Lithogeopnosie, ou examen chymique des Pierres et des Terres en général et de la Topaze et de la stéatite en particulier.
Paris, 1753.

Pougenieff. Precious Stones. Russian, with 2 coloured plates and numerous woodcuts.
St. Petersburg, 1888.

Pouget (N.). Traité des Pierres précieuses, et de la manière de les employer en parure.
Paris, 1762.

Pratt (J. H.). Notes on North Carolina minerals.
[In Journal Elisha Mitchell Scientific Society, XIV, part 2, p. 61, 1898.]
Describes occurrence of emerald.

Pratt (J. H., and W. E. Hidden). Rhodolite, a new variety of garnet.
[In Am. Jour. Science, V, 1898, p. 293; also VI, 1898, p. 463.]

Precious stones of the Bible; descriptive and symbolical.
1878.

Precious stones, cutting and polishing of.
[In Mineral Industries (annual), p. 229, 1899.]

Prinz (W.). Les enclaves du Saphir, du Rubis, et du Spinelle.
[In Bul. Soc. Belge. Microsc., 1882.]

Psellus (Michael Constantinus). De Lapidum Virtutibus.
Lugundi Batavorum (Leyden), 1795.

Ragoumovsky (——). Distribution Technique des Pierres précieuses, avec leurs caractères distinctifs.
Vienne (Vienna), 1825.

Rambosson (——). Les Pierres précieuses.

RANTZOVIUS (HENRY). De Gemmis scriptum olim a poeta quodam non infeliciter carmine redditum et nunc primum in lucem editum.
Leipzig, 1585.
A manuscript on the properties and effects of precious stones attributed to "Evax, a King of the Arabs."
RAVIUS (S. F.). Specimen arabicum, continens descriptionem et excerpta libri Achmedis Teifaschii "De Gemmis et Lapidibus Pretiosis."
Trajetum ad Rhenum (Leyden), 1784.
REYNAUD (J.). Histoire élémentaire des minéraux usuels.
Paris, 1867.
ROBERTSON (J. K. M.). The occurrence of opals in central Australia and Queensland.
[In Chem. News, LXV, 1882, pp. 95, 101.]
———. On the occurrence of opals in the colony of Queensland.
[In Proc. Phil. Soc. Glasgow, XIII, p. 427.]
ROSENMÜLLER (E. F. C.). Mineralogy of the Bible.
[Translated by Repp and Morren.] Edinburgh, 1840.
ROSS (W. A.). Pyrology.
London, 1875.
———. On the cause of the blue color of sapphire, lazulite, and lapis lazuli; the green color of emerald and the purple of amethyst.
[In Chem. News, XLVI, 1882, p. 33.]
ROTHSCHILD (M. D.). Handbook of precious stones.
New York, 1890.
ROY (C. W. VAN). Ansichten über Enstehung und vorkommen des Bernsteins, so wie praktische mittheilungen über den werth und die Behandlung desselben als Handelswäre.
Dantzig, 1840.
RUDLER (F. W.). Agate and agate working.
[In Pop. Science Rev., I (new series), p. 23.]
———. Artificial diamonds.
[In Pop. Science Rev., IV, 1880, p. 136.]
———. Diamonds.
[In Science for All, II.]
———. On jade and kindred stones.
[In Pop. Science Rev., III, p. 337.]
RUDOLPH (A.). Die edeln metalle und Schmucksteine, mit 37 Tabellen.
Breslau, 1858.
RUE (F. DE LA). De Gemmis.
Parisii (Paris), 1547.
Other editions: Lugd., 1622; Franc., 1626; Gron., 1626.
RUENS (F.). De Gemmis aliquot, iis praesertim quarum Divus Joannes Apostolus in sua Apocalypsi notavit.
Paris, 1547.
RULANDUS (M.). Medicina Practica.
Arg. (Strasburg), 1564.
———. Lexicon Alchemiæ.
Frankfurt, 1661.
First ed. dated 1612. The author, a physician to Rudolph II of Germany, gives several receipts for the development of the occult and medicinal properties of gems.
RUSKIN (J.). On the heraldic meaning of precious stones.
[In his lecture before the London Institute, Feb., 1876.]
SANDIUS (CHRISTOPHER). On the origin of pearls.
[In Phil. Trans.: Abr., II, p. 126, 1674.]

Sapphire.
[In Mineral Industries (annual), p. 235, 1896.]

Sapphire mines of Burma.
[In Mineral Industries (annual), p. 239, 1896.]

Sapphire mines in Siam.
[In Jour. Soc. Arts, XXVIII, p. 770.]

Sarmento (J. C. de). An account of diamonds found in Brazil.
[In Phil. Trans.: Abr., VIII, 1731, p. 503.]

Schindler (A. H.). The turquoise mines of Nishapur, Khorassan.
[In Rec. Geol. Survey, India, XVII, p. 132.]

Schmidt (C. J.). Das Wichtigste über dem Opal in Allgemeinen und über sein Vorkommen in Mähren im Besonderen.
[In Mitth. d. k. k. Mähr. Schles. Gesells., Brunn, 1855.]

Schrauf (A.). Handbuch der Edelsteinkunde.
Wien (Vienna), 1869.

Schulze (H.). Practisches Handbuch der Juwelierkunst und Edelsteinkunde.
Quedlinburg und Leipzig, 1830.

Scot (Reginald). Discovery of witchcraft.
London, 1651.
Contains several curious charms in which gems are used.

Scudalupis (P. Arlensis de). Sympathia Septem ac Septem Selectorum Lapidum ad Planetas.
An alchemical or astrological work; among other curiosities it contains a list of stones "in sympathy with the seven planets."

Serapion (J.). De medicamentis tam simplicibus quam compositis.
Mediolanum (Milan), 1473.

Shelly (F.). Legends of gems.
New York, 1893.

Shepard (C. U., senior). Notice of corundum gems in the Himalaya region of India.
[In Am. Jour. Science, XXVI, 1883, p. 339.]

Shepstone (T.). The geographical and physical characters of the diamond fields of South Africa.
[In Jour. Soc. Arts, XXII, 1874.]

Shipton (——). Precious gems.
London, 1867.

Silliman (B.). Turquoise of New Mexico.
[In Proc. Am. Assoc., XIX, p. 431; also Am. Jour. Science, XXII, 1880, p. 67.]

Slevogth (J. H.). De Lapide Bezoar.
Jenæ (Jena), 1698.

Sotto (Js.). Le Lapidaire du Quartorzième Siècle.
Wien (Vienna), 1862.

Spener (J. J.). De gemmis errores vulgares.
Lipsiæ (Leipzig), 1688.

Smyth (H. W.). Five years in Siam (1891–1896).
2 vols. London, 1898.

Spezia (G.). Sul colore del Zircone.
[In Atti R. Ac. Torino, XII, p. 37.]
His experiments show that the color is dependent upon the degree of oxidation of the contained iron.

Steinbeck (——). Ueber die Bernstein-Gewinnung.
Brandenburg, 1841.

Streeter (E. W.). Precious stones and gems.
London, 1877.

STREETER (E. W.). Great diamonds of the world.
London, 1892.
SUTTON (A. L.). Lingua gemmæ: cycle of gems.
1894.
TAGORE (S. M.). Mani-málá, or a treatise on gems. 2 vols.
Calcutta, 1879.
Contains a bibliography of Sanskrit, Persian, Arabic, and other Oriental works on gems.
TASSIE, (JAMES). Descriptive catalogue of a collection of ancient and modern engraved gems, cameos, and intaglios of the most celebrated cabinets in Europe; cast in colored pastes, white enamel, and sulphur; arranged and described by R. E. Raspe, 1791.
TAVERNIER (J. B.). Voyages in Turquie, en Perse et aux Indes.
Paris, 1676.
———. Account of diamond mines.
[In Pinkerton's Collection of Voyages, VIII, 1811.]
TAYLOR (L.). Precious stones and gems, with their reputed virtues.
London, 1895.
TAYLOR (N.). On the Cudgegong diamond field, New South Wales.
[In Geol. Mag.; IV, p. 399.]
TEIFASCITE (AHMED). Fior di Pensieri sulle Pietre Preziose, opera stampata nel suo originale Arabo di Ant. Raineri.
Firenze (Florence), 1818.
TENNANT (J.). Gems and precious stones.
[In Soc. of Arts. Lect., 1851–52.]
TESORO delle Gioie, Trattato curioso.
Venetitia (Venice), 1670.
THEOPHRASTUS. History of stones, with the Greek text and an English version, and notes, critical and philosophical, including the modern history of gems described by that author, by Sir John Hill.
London, 1746.
THOUSAND (A) notable things on various subjects.
London, 1814.
TIMBERLAKE.—Discourse of the travels of two English pilgrims.
1611.
Contains, among others, an account of a great jewel used in conjuring.
TOLL (ADRIANUS). Gemmarum et Lapidum Historia.
Lugduni (Leyden), 1636.
———. Le Parfaict Joaillier, où Histoire des Pierreries, où sont amplement descrites leur naissance, juste prix, etc.
Lyon, 1644.
TRAITÉ des Pierres de Théophraste.
[Translated from the Greek.] Paris, 1754.
TURNER (H. W.). The occurrence and origin of diamonds in California.
[In American Geologist, 1899, p. 182.]
VALENTINUS (BASILUS). Of natural and supernatural things, etc.
[Translated from the Dutch by D. C.] London, 1670.
An alchemical treatise containing several accounts of the occult and medicinal properties of gems. The German edition was issued at Eisleben in 1603.
VANE (G.). The pearl fisheries of Ceylon.
[In Journal of the Ceylon Branch Royal Asiatic Society, X, 1887. Colombo.]
VEGA (GARCILASO DE LA). History of the Incas.
[Various editions.]

Veltheim (A. F. von). Etwas über Memnons Bildsäule, Nero's Smaragd, Toreutik, und die Kunst der Alten in Stein und Glas zu schneiden.
Helmstadt, 1793.

———. Etwas über das Onyx-Gebirge des Clesias und den Handel der Alten nach Ost-Indien.
Helmstadt, 1797.

Venette (Nicholas). Traité des Pierres.
Amsterdam, 1701.

Vettermann (A.). Kurze Abhandlung über einige der vorzüglichsten Classen der bunten oder gefärbten Edelsteine.
Dresden, 1830.

Vogel (H. W.). Spectralanalytische Notizen.
[In Ber. Deutsch. chem. Gesell., X, p. 373, 1887.]
Examination of garnet, ruby, etc.

Wernher (——). Die Gewinnung und Aufbereitung der Diamanten in Süd-Afrika.
[In Wochenschr. Deutsch. Ing.-Arch.-Ver., p. 365.]

Westropp (H. M.). Manual of precious stones.
1874.

Weckerus (or Wecker). Antidotæ speciales de Lapidibus minus pretiosis alterantibus.

Williams (C. G.). Researches on emeralds and beryls.
[In Chem. News, XXXV, p. 256.]
A purely chemical paper.

Willimot (C. W.). Canadian gems and precious stones.
[In Ottawa Naturalist, Nov., 1891.]

Zepharovitch (V. von). Der Diamant, ein populärer vortrag.
Gratz, 1862.

Zerremer (C.). Anleitung zum Diamanten. Waschen aus Seifengebirge, Ufer- und Flussbett-Sand.
Leipzig, 1851.

———. De Adamanti Dissertatio.
Lipsiæ (Leipzig), 1862.

A B C

THE METEORITE COLLECTION.

A, The Casas Grandes Meteoric Iron; *B*, Tucson Meteoric Iron; *C*, Canyon Diablo Meteoric Iron.

DESCRIPTIVE CATALOGUE OF THE METEORITE COLLECTION IN THE UNITED STATES NATIONAL MUSEUM, TO JANUARY 1, 1902.

BY WIRT TASSIN,

Assistant Curator, Division of Mineralogy.

INTRODUCTORY NOTE.

The following catalogue has been prepared by Mr. Tassin mainly to facilitate exchanges and to aid in the building up of the collection, as was a former issue compiled by Prof. F. W. Clarke and printed in the Annual Report of the National Museum for 1885–86 (1889).

For purposes of ready reference, however, the alphabetical arrangement adopted by Wulfing is adhered to. For the same reason the samples belonging to the Shepard collection are included with those of the Museum proper, but always with the proper reference. Where a meteorite is represented in both collections, that belonging to the Museum is first mentioned.

As will be noted, the combined collections now represent 348 falls and finds, of which 143 are irons.

George P. Merrill,
Head Curator, Department of Geology.

DESCRIPTIVE CATALOGUE OF THE METEORITE COLLECTION IN THE UNITED STATES NATIONAL MUSEUM TO JANUARY 1, 1902.

By Wirt Tassin,

Assistant curator, Division of Mineralogy.

Abert. Iron. Weight, 150 grams. Section of mass. One face etched, showing coarse Widmanstättian figures. Locality unknown; found without label in a collection of minerals belonging to Col. J. J. Abert. Catalogue number, 44363. Gift of J. T. Abert.

Fragment. Weight, 11.3 grams. The Shepard Collection, No. 20.

Admire, Kansas. Stony iron. Weight, 5,460 grams. Catalogue number, 84798. Weight, 6,725 grams. Catalogue number, 84802. Weight, 2,048 grams. Catalogue number, 84812. Weight, 432 grams. Catalogue number, 84813. Gift of W. C. Davis.

Agen [Brethon, near Castelmoron], Lot-et-Garonne, France. Stone. Weight, 38 grams. Fell September 5, 1814. Fragment from interior. Ground mass light ash-gray, traversed by numerous streaks or veins of a darker color. Ground mass much fractured and containing white chondrules and metallic grains. Catalogue number, 84740.

Alais, Gard, France. Stone. Weight, 0.60 gram. Fell March 15, 1806, 5 p. m. Carbonaceous. A dark brown powder and some friable fragments. The Shepard Collection, No. 133.

Albareto, near Modena, Italy. Stone. Weight, 1 gram. Fell July, 1766. Fragment from interior. Ground mass light gray. The Shepard Collection, No. 124.

Albuquerque, New Mexico. Iron. Weight, 58.61 grams. Found 1884. (a) Section; weight, 0.56 gram, with original and etched surfaces. Catalogue number, 44372. Gift of Richard Pearce. (b) Turnings; weight, 2.61 grams. Catalogue number, 46615. Gift of L. G. Eakins.

Alexander County, North Carolina. Iron. Weight, 12.3 grams. Found 1860. Fragment, etched; etching develops large plates of taenite. The Shepard Collection, No. 82.

Alfianello, near Pontefico and Brescia, Cremona, Italy. Stone. Weight, 61.3 grams. Fell February 16, 1883, 3 p. m. Fragment from interior. Ground mass ash-gray flecked with rust and containing chondrules and metallic grains. Structure, fine granular. Catalogue number, 46625.

Two fragments from interior. Weight, 29.54 grams. The Shepard Collection, No. 237.

Allegan, Thomas Hill, Saugatuck road, Allegan County, Michigan. Stone. Weight, 30 kilograms. Fell July 10, 1899. (See Plate 2.)

Anderson, Little Miami Valley, Hamilton County, Ohio. Stony iron. Weight, 14.8 grams. Fragment. The iron matrix contains nodules of stony matter. Found in an Indian mound, No. 3 of the Turner group. Catalogue number, 47391. Gift of Peabody Museum of American Archaeology.

Angers, Maine-et-Loire, France. Stone. Weight, 0.72 gram. Fell June 3, 1882. Fragments from interior. The Shepard Collection, No. 147.

Angra dos Reis, Rio, Brazil. Stone. Weight, 8.57 grams. Fell January, 1869. Fragment with shining black crust. Ground mass dark brown, containing few, if any, chondrules, and no metallic grains. Structure, fine granular. Catalogue number, 47649.

Assam, India. Stone. Weight, 7 grams. Found 1846. Dark ash-gray fragment with crust; gray chondrules. The Shepard Collection, No. 168.

Assisi, near Perugia, Italy. Stone. Weight, 29 grams. Fell May 24, 1886. Fragment with crust. Ground mass ash gray, containing chondrules and metallic grains. The Shepard Collection, No. 239.

Auburn, Macon County, Alabama. Iron. Weight, 29 grams. Found 1867. Fragment. Catalogue number, 46067.

Eight fragments. Weight, 228.15 grams. The Shepard Collection, No. 76.

Augustinovka, Ekaterinoslav, Russia. Iron. Weight, 70 grams. Found 1890. Rectangular slice 9.5 by 2.5 cm. Etched surface showing typical Widmanstättian figures. Catalogue number, 84690. (a) Oxidized fragment; weight, 50 grams. (b) Oxidized fragment; weight, 24 grams. (c) Unoxidized fragment; weight, 7 grams. The Shepard Collection, No. 245.

Aumiers, Canton Massegros, Lozère, France. Stone. Weight, 0.45 gram. Fragment. Fell June 3, 1842. Fragment. The Shepard Collection, No. 165.

Aussun (Clarac), Montréjeau, Haute Garonne, France. Stone. Weight, 20.1 grams. Fell December 9, 1858. Two fragments, one showing crust. Ground mass ash gray flecked with rust and containing light and dark chondrules and metallic grains. The Shepard Collection, No. 185.

Babbs Mill, Green County, Tennessee. Iron. Weight, 38.4 grams. Known 1842. Catalogue number, 47339.

Three specimens; weight, 20.63 grams. (a) Small fragment. (b) Vial of filings. (c) Vial of turnings. The Shepard Collection, No. 34.

Bachmut (Alexejevka), Ekaterinoslav, Russia. Stone. Weight, 8.6 grams. Fell February 15, 1814. Fragment with crust and polished surface. Ground mass greenish gray with numerous metallic grains and chondrules. The metallic portion is more or less oxidized. The Shepard Collection, No. 142.

Bairds Plantation, Asheville, Buncombe County, North Carolina. Iron. Weight, 2.95 grams. Found 1839. Three fragments. The Shepard Collection, No. 29.

Ballinoo (10 miles south of), Murchison River, West Australia. Iron. Weight, 122 grams. Found 1892. Etched surface has a stippled appearance overlaid with a network of fine lines. The Shepard Collection, No. 104.

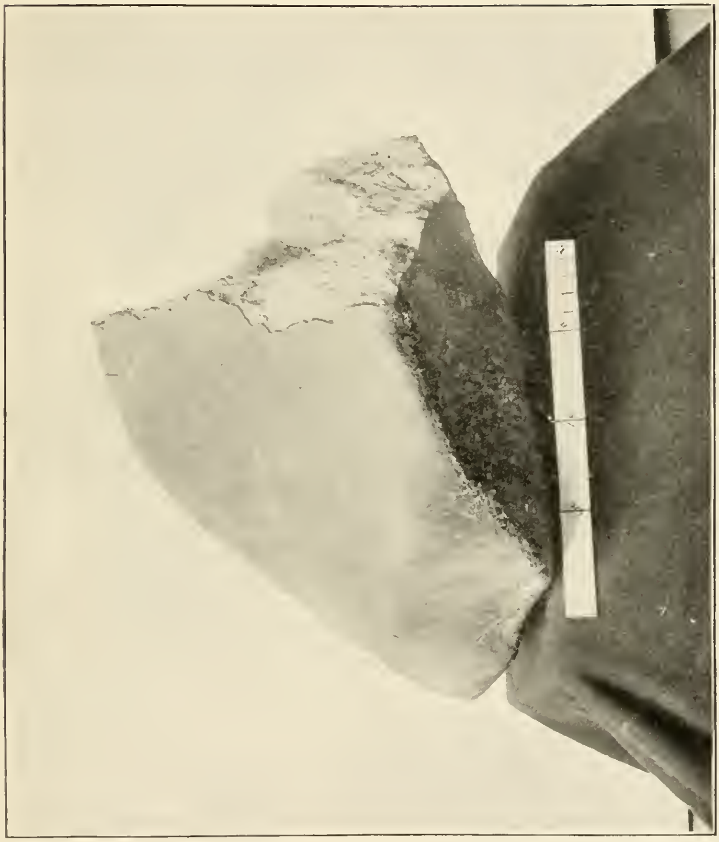
Weight, 1,266 grams. Found 1893. Cross section of mass. One face etched, showing Widmanstättian figures so small that to the unaided eye the surface has a granular or stippled appearance. The surface shows two large, and several small troilite nodules, and the mold of another. Catalogue number, 84809.

Bandong, Goemoroeh, Perang, Java. Stone. Weight, 1.6 grams. Fell December 10, 1871, 1.30 p. m. Fragment with crust. Catalogue number, 46079.

Fragment. Weight, 50.87 grams. Pitted dull-black crust. Ground mass ash gray, containing chondrules, grains of nickel, iron, and troilite, some of them quite large. The Shepard Collection, No. 212.

Barbotan, Roquefort, Gascogne, France. Stone. Weight, 28.7 grams. Fell July 24, 1790, 9 p. m. Section showing crust. Ground mass light gray and containing chondrules and numerous metallic grains. The Shepard Collection, No. 126.

Bath, Brown County, South Dakota. Stone. Weight, 25 grams. Fell August 29, 1892. Fragment with crust and polished surface. Crust dull black, papillated and somewhat blebby. Ground mass ash gray flecked with rust and containing metallic grains and chondrules. Fine granular, compact. Catalogue number, 83462.



THE ALLEGAN METEORITE.

FOR DESCRIPTION SEE PAGE 675.

Bear Creek, Jefferson County (?), Colorado. Iron. Weight, 27.73 grams. Found 1866. Thin section polished and etched, Widmanstättian figures good, tænite plates distinct. Catalogue number, 46605. Section of mass (weight, 117.20 grams), showing troilite nodule. Section (weight, 62.05 grams) with well-marked Widmanstättian figures and distinct plates of tænite. Two vials of fragments, showing octahedral cleavage. Total weight, 307.08 grams. The Shepard Collection, No. 75.

Beaver Creek, West Kootenai District, British Columbia. Stone. Weight, 330.5 grams. Fell May 26, 1893, 3 p. m. Mass with dull black, papillated crust. Interior dark ash gray, containing chondrules and metallic grains. Structure coarse granular. Catalogue number, 81155. Gift of James Hislop, through E. E. Howell.

Bella Roca, Sierra de San Francisco, Santiago Papasquiaro, Durango, Mexico. Iron. Weight, 152 grams. Found 1888. Irregularly shaped fragment, containing a cast of a large troilite nodule. One surface etched, showing Widmanstättian figures and scattering flakes of troilite. Catalogue number, 48346.

Bemdegó, Monte Santo, Bahia, Brazil. Iron. Weight, 102 grams. Found 1784. The Shepard Collection, No. 8.

Benares, Krakhut, Bengal, India. Stone. Weight, 1 gram. Fell December 19, 1798, 8 p. m. Fragment. Catalogue number, 46076. Fragment with crust. Weight, 7.32 grams. Polished surface shows chondrules and scattered metallic grains. The Shepard Collection, No. 131.

Bischtübe, Nikolaev, Turgai, Russia. Iron. Weight, 1,502.59 grams. Found 1888. Cross section of mass. One face etched, showing large, coarse Widmanstättian figures, numerous small plates and nodules of schreibersite, and some troilite. Catalogue number, 84718.

Bishopville, Sumter County, South Carolina. Fragment from interior. Weight, 102 grams. Catalogue number, 84697.

Stone. Weight, 1,090.4 grams. Fell March 25, 1843. Mass with grayish vitreous crust. One vial of chladnite. The Shepard Collection, No. 166.

Bitburg (Albacher Mühle), Rhenish Prussia, Germany. Pallasite. Weight, 22 grams. Found 1802. Fragment. Catalogue number, 47739. Gift of R. de Kroustchoff.

Bjelaja Zerkov, Ukraine, Kiev, Russia. Stone. Weight, 10.4 grams. Fell January 16, 1796. Fragment from interior. Ground mass ash gray deeply stained with rust. Catalogue number, 81175.

Bjelokrynitschie, Volhynia, Russia. Stone. Weight, 7.7 grams. Fell January 1, 1887. Fragment from interior, one surface polished. Ground mass rust-brown from oxidation and containing numerous metallic grains. Structure chondritic. Catalogue number, 84598.

Bjurbole, South coast of Finland. Stone. Weight, 620 grams. Fell March 12, 1899. Fragments with crust. Crust surface dull black; in swellings and showing well-marked lines of flow. Ground mass ash gray, flecked with rust, and containing numerous large chondrules and scattering grains of troilite and nickel iron. The mass is traversed by three metallic veins. Catalogue number, 84771.

Bohumilitz, Bohemia, Austria. Iron. Weight, 0.95 gram. Found 1829. Fragment with original surface. One side etched to show Widmanstättian figures. The Shepard Collection, No. 21.

"*Bonanza*," Bolson de Mapimi, Mexico. Iron. Weight, 238.6 grams. Found 1837. Two fragments etched. The Shepard Collection, No. 27.

Borkut, Marmaros, Hungary. Stone. Weight, 2 grams. Fell October 13, 1852, 3 p. m. Fragment from interior. Ground mass dark ash gray, containing numerous chondrules and metallic grains. Catalogue number, 82752.

Boyett, Wilson County, North Carolina. Stone. Weight, 9 grams. Fell May 24, 1892. Fragment. Crust dull black and papillated. Ground mass dark ash gray and containing metallic grains and gray chondrules. Catalogue number, 51670. Gift of B. E. Barnes.

Brahin, Minsk, Russia. Pallasite. Weight, 14 grams. Found 1810. Fragment of the iron matrix from which all the stony matter has disappeared. Catalogue number, 47741.

Weight, 5.13 grams. Fragment of iron matrix from which the stony matter has disappeared. The Shepard Collection, No. 118.

Braunau, Hauptmannsdorf, Bohemia, Austria. Iron. Weight, 7.35 grams. Fell July 14, 1847, 3.45 a. m. Fragment. Catalogue number, 46511.

Rectangular section containing troilite nodule. Etched surface shows a network of fine lines. Weight, 14.5 grams. The Shepard Collection, No. 45.

Bremervörde (Gnarrenburg), Hanover, Germany. Stone. Weight, 12 grams. Fell May 13, 1855. Crust brownish black. Ground mass dark ash gray, containing gray chondrules and few metallic grains. Catalogue number, 48432.

Brenham, Kiowa County, Kansas. Stony iron. Weight, 720 grams. Found 1890. (a) Mass having one surface polished; structure porous, having the sponge-like pores filled with olivine. (b) Section; the metallic matrix contains nodules of olivine and troilite. Catalogue numbers, (a) 49073, gift of George F. Kunz; (b) 51347, gift of Robert Hay.

Weight, 430 grams. Found 1890. Polished slice showing a sponge-like metallic matrix with olivine filling the cavities. The Shepard Collection, No. 120.

Burlington, Cooperstown, Otsego County, New York. Iron. Weight, 76.87 grams. Plowed up before 1819. Fragment, one surface etched showing Widmanstättian figures. Catalogue number, 46064.

Two pieces—larger one showing original surface. One face etched. Weight, 1,503.3 grams. Smaller one containing drill hole. Etched on three faces. Weight, 1,528.3 grams. The Shepard Collection, No. 19.

Bustee, Goruckpur, India. Stone. Weight, 0.2 gram. Fell December 2, 1852. Fragment. The Shepard Collection, No. 176.

Butler, Bates County, Missouri. Iron. Weight, 270 grams. Found 1874. Section 7.5 by 5.5 by 1.1 cm. One surface polished, showing troilite nodule. Catalogue number, 47337.

Section showing original surface. Etched face shows comb-like markings made up of fine lines. Widmanstättian figures very distinct. Minute nodules of troilite are scattered over the surface. Weight, 391 grams. The Shepard Collection, No. 86.

Butsura, Goruckpur, India. Stone. Weight, 11 grams. Fell May 12, 1861. Fragment with crust; ground mass stained deep brown from oxidation of metallic particles. Catalogue number, 47334.

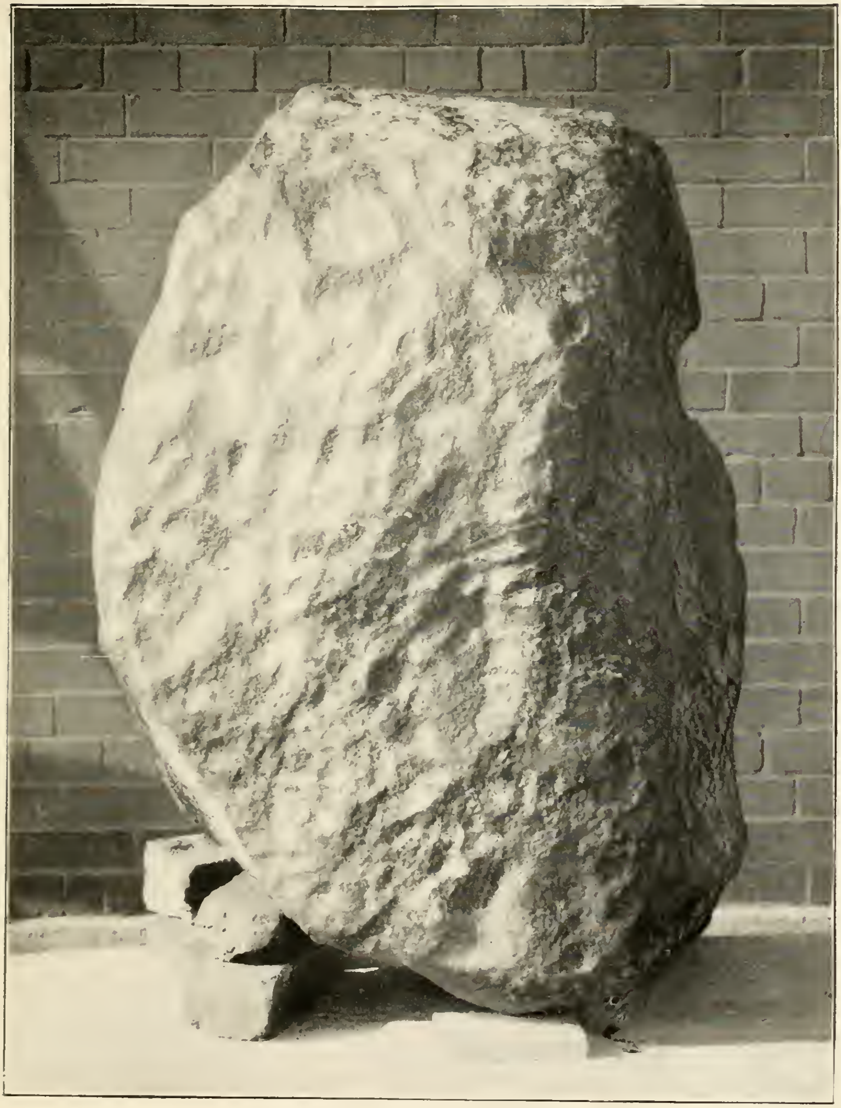
Fragment with crust and polished surface. Metallic grains present in large amount. Olivine chondrules 1 mm. in diameter. Weight, 7.83 grams. The Shepard Collection, No. 190.

Cabeza de Mayo, Murcia, Spain. Stone. Weight, 13.7 grams. Fell August 18, 1870. Fragment from interior. The Shepard Collection, No. 210.

Cabin Creek, Johnson County, Arkansas. Iron. Weight, 34 grams. Fell March 27, 1886. Irregularly shaped fragment showing octahedral cleavage. Catalogue number, 47183.

Cambria (Lockport), Niagara County, New York. Iron. Weight, 155 grams. Found 1818 (?). Slice polished and etched; shows Widmanstättian figures and troilite nodules. Catalogue number, 47361.

Etched slabs, containing large nodule of troilite. Etch figures coarse and approximately square. The Shepard Collection, No. 37.



THE CASAS GRANDES METEORIC IRON.

FOR DESCRIPTION SEE PAGE 679.

Campo del Pucara, Argentina. Stony iron. Weight, 0.192 gram. Found 1879. Fragment. The Shepard Collection, No. 112.

Canyon Diablo, Arizona. Iron. Weight, 1,890 pounds. Found 1891. (a) Cross section 37 by 41 by 2 cm. Etched. Shows numerous large troilite nodules; also graphitic nodules with hepatic markings of nickel iron. Widmanstättian figures coarse with numerous flakes of schreibersite. Weight, 8,955.54 grams; (b) complete individual; weight, 16,210.58 grams; (c) complete individual; weight, 32,080.98 grams; (d) complete individual; weight, 338,266 grams; (e) complete individual largely altered to limonite; (f) slice showing graphitic nodule containing veins of nickel iron; (g) complete individual; weight, 435,302 grams. The individuals have their surfaces indented with the characteristic pittings. Catalogue numbers, (a) 83442; (b) 83443; (c) 83444; (d) 83445; (e) 51109; (f) 83460; (g) 83774. (See Plate 1.)

Cape Girardeau, Missouri. Stone. Weight, 4 grams. Fell August 14, 1846. Fragment with crust. Ground mass ash gray flecked with rust spots and containing chondrules and metallic grains. Catalogue number, 47402.

Cape iron, Cape Colony, South Africa. Iron. Weight, 28.95 grams. Found 1793. Fragment. Catalogue number, 46069.

Weight, 182.5 grams. Section showing portion of original surface and containing troilite nodule. The Shepard Collection, No. 10.

Carthage, Smith County, Tennessee. Iron. Weight, 65 grams. Found 1840. Fragment. Catalogue number, 47338.

Weight, 43.1 grams. Section showing Widmanstättian figures; also delicate lines of tænite. The Shepard Collection, No. 36.

Casas Grandes, Chihuahua, Mexico. Iron. Weight, 1,317,920 grams. Complete individual. (See Plates 1 and 3.)

Casey County, Kentucky. Iron. Weight, 3.30 grams. Found 1877. Fragment. The Shepard Collection, No. 89.

Castalia, Nash County, North Carolina. Stone. Weight, 19.7 grams. Fell May 14, 1874, 2.30 p. m. Fragment with dull black papillated crust. Ground mass ash gray; granular and compact. Catalogue number, 47342.

Castine, Hancock County, Maine. Stone. Weight, fragment. Fell May 20, 1848. Fragment with crust. The Shepard Collection, No. 171.

Cereseto, near Otliglio, Alessandria, Piedmont, Italy. Stone. Weight, 65 grams. Fell July 17, 1840. Fragment with crust. Catalogue number, 84792.

Chandakapur, Berar, India. Stone. Weight, 3.9 grams. Fell June 6, 1838, 12 noon. Fragment with crust and polished surface. Ground mass stained with rust. Catalogue number, 45700.

Weight, 1.05 grams. Powder and angular fragments. The Shepard Collection, No. 159.

Chantonnay, Vendée, France. Stone. Weight, 12.1 grams. Fell August 5, 1812, 2 a. m. Fragment. Ground mass black, with metallic grains and gray chondrules. Catalogue number, 81168. Gift of R. de Kroustchoff.

Weight, 45.1 grams. Two fragments. The Shepard Collection, No. 141.

Charcas, San Luis Potosi, Mexico. Iron. Weight, 61 grams. Fragment containing nodule of troilite. Catalogue number, 48489.

Charlotte, Dickson County, Tennessee. Iron. Weight, 2.70 grams. Fell July or August, 1835. Triangularly shaped section. The Shepard Collection, No. 25.

Charsonville, near Orléans, Meung Sur Loire, Loiret, France. Stone. Weight, 54 grams. Fell November 23, 1810, 1.30 p. m. Fragment with crust. Crust pitted and somewhat oxidized. Ground mass granular and compact, ash gray, stained with rust, and traversed by delicate black veins. Metallic grains abundant. Catalogue number, 47969. (a) Fragment from interior; weight, 3.77 grams. (b) ["Bois de Fontaine"] fragments and powder from interior; weight, 3.27 grams. Catalogue numbers, (a) 138; (b) 150.

Chateau-Renard, Montargis, Trigueres, Loiret, France. Stone. Weight, 3.74 grams. Fell June 12, 1841. Fragment from interior. Ground mass ash gray, compact, and containing numerous metallic grains. The Shepard Collection, No. 162.

Chemnitz, Hungary. Iron. Weight, 75.27 grams. Found 1853. Part of a mass, perhaps Bitburg. The iron has apparently been heated in a forge. The Shepard Collection, No. 107.

Cherokee County (not Losttown), Georgia. Iron. Weight, 189 grams. Found 1894. Slab, cross section of mass; etched, showing grains of troilite and Widmanstättian figures made up of broad plates 1 to 5 mm. wide. Catalogue number, 83495. Gift of Georgia Geological Survey.

Chesterville, Chester County, South Carolina. Iron. Weight, 91 grams. Found 1847. (a) Irregularly shaped section; weight, 36.4 grams; etched surface shows a network of fine lines. (b) Rectangular section; weight, 54.6 grams; etched surface as above. The Shepard Collection, Nos. (a) 42, (b) 43.

Chile. Weight, 4.76 grams. Fragment consisting entirely of nickel iron. The Shepard Collection, No. 74.

Chulafinnee, Cleberne County, Alabama. Iron. Weight, 8.6 grams. Found 1873. Fragment. Catalogue number, 47322.

Weight, 54 grams. Thin slab, etched. Widmanstättian figures broad and well outlined. The Shepard Collection, No. 84.

Claiborne (Lime Creek), Clarke County, Alabama. Iron. Weight, 3.7 grams. Found 1834. Fragment. The Shepard Collection, No. 24.

Claywater, Vernon County, Wisconsin. Stone. Weight, 9.35 grams. Fell March 25, 1865. Slice polished; made up of coarse, transparent, nonmetallic grains, with scattering grains of nickel iron and chondrules, the whole resembling sandstone. The Shepard Collection, No. 198.

Cleveland (Lea Iron), east Tennessee. Iron. Weight, 260 grams. Found 1860. The Shepard Collection, No. 99.

Weight, 221 grams. A cross section of mass with polished and etched surfaces. Widmanstättian figures broad; contains nodule of troilite. Catalogue number, 46525.

Coahuila (Smithsonian iron), Mexico. Iron. Weight, 88.3 grams. Part of mass. Etched surface shows cubic structure. The Shepard Collection, No. 94.

Cold Bokkeveld, Cape Colony, South Africa. Stone. Weight (a), 4 grams; (b), 3 grams. Fell October 13, 1838, 9 a. m. (a) Two fragments, dull black with white specks. A carbonaceous meteorite containing a bituminous-like substance from which a wax-like carbon compound may be separated. (b) Fragment. Catalogue numbers (a), 8069, gift of J. Vorsfeld; (b) 81174, gift of R. de Kroustchoff.

Weight, 9.27 grams. Fragment of a dull black color, flecked with white. The Shepard Collection, No. 160.

Colfax, Rutherford County, North Carolina. Iron. Weight, 315 grams. Found 1880. Portion of mass, one face etched, showing Widmanstättian figures. Catalogue number, 48824. Gift of S. W. Cramer.

Coopertown, Robertson County, Tennessee. Iron. Weight, 633 grams. Cross section of mass 16 by 10 centimeters. One face etched. Widmanstättian figures distinct, made up of broad plates 2 to 8 millimeters wide. Catalogue number, 45746. Gift of D. Crockett through J. B. Lindsley.

Weight, 327.83 grams. Two slices etched, showing Widmanstättian figures made up of broad plates 5 to 7 millimeters in width. The Shepard Collection, No. 67.

Cosbys Creek, Cocke County, Tennessee. Iron. Weight, 7.24 grams. Fragment somewhat oxidized. Cleavage structure prominent. Catalogue number, 46624.

Weight, 69.16 grams. One lot of fragments, some of which show octahedral cleavage. The Shepard Collection, No. 32.

Crab Orchard, Crab Orchard Mountains, Powder Mill Creek, Rockwood, Tennessee. Stony iron. Weight, 77.9 grams. Found 1887. Two slabs, weight, 39.9 grams and 38 grams, with polished surfaces showing the metallic matrix containing siliceous grains of olivine, bronzite, etc. The metallic portion is about evenly distributed, except for two masses, one of which has a diameter of 1.8 centimeters; these have been etched and show well-marked Widmanstättian figures. Catalogue number, 47736. Gift of Ward and Howell.

Cranberry Plains, Poplar Hill, Virginia. Iron. Weight, 7.92 grams. Found 1852. Fragment. The Shepard Collection, No. 50.

Cranbourne, Victoria, Australia. Iron. Found 1854. One lot of fragments that have been heated in hydrogen; weight, 25.3 grams. Troilite nodule from mass; weight, 71.5 grams. (b) Yarra Yarra River; found 1858; weight, 15 grams. Catalogue numbers, 47329, 47330; (b) 47738.

Fragment much oxidized and somewhat decomposed from occluded Lawrencite; weight, 10.6 grams. (b) Yarra Yarra River; found 1858; weight, 21 grams. Oxidized fragment. The Shepard Collection, No. 59; (b) No. 59a.

Cronstadt, Orange River, Orange Free State, South Africa. Stone. Weight, 12.5 grams. Fell November 19, 1877. Fragment with crust and polished surface. Crust dull black, somewhat pitted and in swellings. Ground mass ash gray with abundant metallic grains. Chondrules gray and white. The Shepard Collection, No. 225.

Cross Timbers, Red River, Texas. Iron. Weight, 10.6 grams. Known 1808. Chiseled fragment. Catalogue number, 47336.

Weight 63.7 grams. Two pieces, one 62.85 grams; the other a cleavage crystal, 0.85 gram. The Shepard Collection, No. 18.

Cynthiana, Harrison County, Kentucky. Stone. Weight, 1.77 grams. Fell January 23, 1877. Fragment with crust. The Shepard Collection, No. 223.

Dalton, Whitfield County, Georgia. Iron. Weight, 36.4 grams. Found 1877. Fragment of the mass described by Shepard. Etched, showing coarse Widmanstättian figures. Catalogue number, 44590.

Weight, 735.71 grams. Two pieces—part of first mass found. Etched face shows broad Widmanstättian figures, with scattering plates of taenite. Surface more or less decomposed from presence of Lawrencite. The Shepard Collection, No. 90.

Daniels Kuil, Griqualand, South Africa. Stone. Weight, 4.6 grams. Fell March 20, 1868. Fragment from interior. Ground mass ash gray flecked with rust. The Shepard Collection, No. 204.

Deal, Monmouth County, New Jersey. Stone. Weight, 4.19 grams. Fell August 14, 1829. Fragment with crust. Ground mass ash gray, fine granular and compact, with delicate veins apparently filled with nickel iron somewhat oxidized. Structure chondritic with numerous metallic grains. The Shepard Collection, No. 157.

Denton County (near Austin), Texas. Iron. Weight, 7.97 grams. Found 1856. Etched fragment showing coarse Widmanstättian figures. The Shepard Collection, No. 63.

Descubridora, Catoroze, San Luis Potosi, Mexico. Iron. Weight, 24.8 grams. Known 1780. Oblong slab, etched. The Shepard Collection, No. 3.

Dhurmsala, Kangra, India. Stone. Weight, 47.5 grams. Fell July 14, 1860, 2.30 p. m. Fragment from interior. Ground mass ash gray, granular and compact, and containing large and small chondrules and metallic grains. Distributed through the mass are large, fine, granular bluish-gray nodules. Catalogue number, 47323.

Weight, 259.2 grams. Two fragments. (a) Fragment with crust. Crust faint, shining, and much pitted. Ground mass ash gray, compact, with finer grained bluish-gray nodules and oxidized metallic grains distributed through it. (b) Fragment from interior, one surface polished. Two faces show fragmentary slickensides. The Shepard Collection, No. 189.

Djati-Pengilon, Alastoewa, Ngawi, Java. Stone. Weight, 469 grams. Fell March 19, 1884. Fragment with dark-brown crust. Ground mass fine granular, compact, and containing numerous metallic grains with large and small chondrules. Color, dark brown. Catalogue number, 47731. Gift of the government of Netherlands India.

Dona Inez, Atacama, Chile. Stony iron. Weight, 59.5 grams. Found 1888. Portion of mass showing original and polished surfaces. The metallic and stony parts are about equal in amount, the latter being distributed through the mass in reticulated shapes. The specimen exhibits in a slight degree the characteristic cracked surface. The Shepard Collection, No. 117.

Doroninsk, Daurien, Irkutsk, Siberia. Stone. Weight, 7.7 grams. Fell April 6, 1805. Fragment with crust. Ground mass dark ash gray, with small grayish white chondrules and metallic grains. Catalogue number, 81173. Gift of R. de Kroustchoff.

Drake Creek (near Nashville), Davidson County, Tennessee. Stone. Weight, 28 grams. Fell May 9, 1827. Fragment with dull black papillated crust. Ground mass granular, ash gray, and containing metallic grains and small white chondrules. Catalogue number, 47341.

Weight, 4.18 grams. Fragment with crust. The Shepard Collection, No. 154.

Durango, Mexico. Iron. Weight, 45.43 grams. Found 1804. Fragment etched with Widmanstättian figures. One surface deeply pitted. The Shepard Collection, No. 13.

Duruma, Mombas, Wanikaland, East Africa. Stone. Weight, 1.5 grams. Fell March 6, 1853. Fragment from interior. Ground mass ash-gray with gray chondrules and metallic grains, the latter occasionally coarse. Catalogue number, 84593. Gift of G. P. Merrill.

Eagle Station, Carroll County, Kentucky. Stony iron. Weight, 36 grams. Found 1880. Polished section showing sponge-like structure. The pores contain nodules of olivine and troilite. Catalogue number, 49074. Gift of George F. Kunz.

Eichstadt, Bavaria, Germany. Stone. Weight, 1 gram. Fell February 19, 1785. Fragment from interior. Ground mass coarse granular. The Shepard Collection, No. 127.

Eisenberg, Altenberg, Saxony, Germany. Iron. Weight, 9.7 grams. Found 1873. Fragment. The Shepard Collection, No. 85.

Elbogen, Bohemia, Austria. Iron. Weight, 4.45 grams. Found 1400. Fragment. The Shepard Collection, No. 1.

El Capitan, El Capitan Mountains, New Mexico. Iron. Found 1893. (a) Chiseled fragment showing cleavage structure. Etched, Widmanstättian figures, coarse. Weight, 67 grams. Gift of C. R. Biederman. (b) Polished cross section of mass 19.5 by 11 by 0.7 cm. Weight, 573 grams. Gift of E. E. Howell. Catalogue numbers, (a) 81153; (b) 83496.

Emmitsburg, Frederick County, Maryland. Iron. Weight, 5.5 grams. Found 1854. Etched fragment showing coarse Widmanstättian figures. The Shepard Collection, No. 56.

Ensisheim, Elsäss, Germany. Fragment. Weight, 3 grams. Fell November 16, 1492, 11.30 p. m. One surface with black striæ resembling slickensides. Ground mass, granular compact, containing chondrules, nickel iron, and troilite. Catalogue number, 47740.

Weight, 4.3 grams. Two fragments from interior; one vial of powder, weight, 0.098 grams.

Erath County, Texas. Iron. Weight, 115 grams. Fragment etched. Catalogue number, 49053. Gift of Ward and Howell.

Erxleben, Saxon Prussia, Germany. Stone. Weight, 30.60 grams. Fell April 15, 1812, 4 p. m. Fragment with crust; also fragment from interior and vial of powder. The Shepard Collection, No. 140.

THE FELIX METEORITE.

FOR DESCRIPTION SEE PAGE 683.

Estherville, Emmet County, Iowa. Stony iron. Weight, (a) 292 grams; (b) 96 grams. Fell May 10, 1879, 5 p. m. (a) Stony fragment; weight, 145 grams. Fragment showing peckhamite, weight 82 grams. Nine masses, weight 65 grams, consisting chiefly of metal, and ranging in size from that of a pea to that of a walnut; their surfaces show rounded knobs, partly steel white and partly steel blue to black in color. (b) 31 small fragments. Catalogue numbers, (a) 20282, gift of C. P. Birge; (b) 46,072.

One hundred and nine complete individuals varying in size from that of a pea to that of a hen's egg; their surfaces show rounded knobs and are partly steel white and partly steel blue to black in color. A section shows the iron in spongiform masses, nodules, and irregular flakes distributed through the stony ground mass. The olivine nodules from above show a vitreous crust with marked lines of flow. Again they are coated with nickel iron. Two masses of chassignite. The Shepard Collection, No. 121.

Five masses composed chiefly of stone show deeply pitted crust. Ground mass containing large nodules of olivine, nickel, iron, and troilite. The Shepard Collection, No. 121.

Farmington, Washington County, Kansas. Stone. Weight, 489 grams. Fell June 25, 1890, 1 p. m. Mass having the appearance of a dark-gray dolerite. Crust smooth, showing scales or blisters in spots. Ground mass containing black chondrules; also white radiated chondrules and bronze-yellow metallic grains. The Shepard Collection, No. 242.

Fayette County, Texas. Stone. Weight, 247 grams. Found 1878. Two fragments. One, weight 137 grams, with a polished surface containing a black vein; another, weight 110 grams. Both show crust, somewhat decomposed, but with characteristic pittings. Ground mass fine grained, compact; greenish brown. Catalogue number, 47912. Gift of Ward and Howell.

Felix, Perry County, Alabama. Stone. Weight, 1,881.77 grams. Fell May, 1900. Complete individual. Crust surface dull black in blebs and swellings and indented with broad shallow pits. Ground mass dark ash-gray, fine grained, and containing numerous small chondrules which vary but little in color from the ground mass. No metallic veins are visible to the unaided eye. Catalogue number, 84744. (See Plate 4.)

Fisher, Polk County, Minnesota. Stone. Weight, 1,311.164 grams. Fell April 9, 1894. Complete individual of an irregular shape; surface completely covered with a dull black, somewhat papillated, and much pitted crust. Catalogue number, 84375.

Floyd Mountain, Indian Valley Township, Pulaski County, Virginia. Iron. Weight 8 grams, Found 1887. Drillings. Catalogue number, 51849.

Forest City, Leland, Winnebago County, Iowa. Stone. Weight, 127 grams. Fell May 2, 1890, 5.15 p. m. (a) Catalogue number, 49095. Gift of George F. Kunz. (b) Catalogue number, 49097. Gift of J. P. Dolliver. Fragment with crust. Surface indented with broad, shallow, and conical pittings. Ground mass ash gray with coarse and fine metallic grains and containing chondrules. (c) Catalogue number, 51986. Complete individual covered with thick dull-black crust and surface indented with broad, shallow, and conical pittings; also fragment showing interior.

Forsyth, Monroe County, Georgia. Stone. Weight, 9.50 grams. Fell May 8, 1829, 3.30 p. m. Two fragments; one with crust and one from interior. The Shepard Collection, No. 156.

Fort Duncan, Maverick County, Texas. Iron. Weight, 116 grams. Found 1882. Slab, one surface etched. Etching develops Neumann lines as a network on a granular or stippled ground; small grains of troilite are seen. The Shepard Collection, No. 96.

Frankfort, Franklin County, Alabama. Stone. Weight, 47 grams. Fell December 5, 1868. Fragment with shining black papillated crust having well-marked lines of flow. The Shepard Collection, No. 205.

Fukutomi, Kinejima, Hizen, Japan. Stone. Weight, 9.7 grams. Fell March 19, 1882. Fragment with black papillated crust. Ground mass dark ash gray with numerous light and dark chondrules and some metallic grains. Catalogue number, 47659. Gift of the Educational Museum at Tokio.

Futtehpore, Allahabad, Doab, India. Stone. Weight, 2.22 grams. Fell November 30, 1822. Fragment with crust and polished surface. The Shepard Collection, No. 148.

Gargantillo, Jalisco, Mexico. Stone. Weight, 4.14 grams. Fell August or September 17, 1879. Fragment from interior. Ground mass coarse granular. Catalogue number, 46074.

Weight, 511 grams. Mass with crust showing lines of flow and pittings. Fragment from interior; one lot of fragments and powder. The Shepard Collection, No. 229.

Girgenti, Sicily. Stone. Weight, 1.5 grams. Fell February 10, 1853, 1 p. m. Fragment from interior. Ground mass ash gray, fine granular. One surface shows a metallic slickenside. The Shepard Collection, No. 177.

Glorietta, Glorietta Mountains, Santa Fe County, New Mexico. Iron. Weight, 853.40 grams. Found 1884. Section. Etched surface shows poor Widmanstättian figures, with one large nodule of troilite and several small ones. The Shepard Collection, No. 98.

Weight, 380 grams. Polished slab, 13.3 by 6.6 by 1 cm. Catalogue number, 46509.

Grand Rapids (Walker Township), Michigan. Iron. Weight, 47,650 grams. Found 1883. Slab, 16 by 11 by 2.5. One surface polished and etched. Widmanstättian figures distinct, the bands made up of thin plates in parallel bundles. (b) A cast of original mass. Catalogue number, 45939. Gift of G. C. Pulcher.

Weight, 34.5 grams. The Shepard Collection, No. 97.

Greenbrier County (3 miles north of White Sulphur Springs), West Virginia. Iron. Weight, 11 grams. Found 1880. Contains crystals of chromite. Catalogue number, 47735.

Greenland (not Ovifak.) Iron. Weight, 15.65 grams. Found before 1860. Fragment etched. Widmanstättian figures fair. Catalogue number, 45698.

Grosnaja (Mikenskoi), River Terek, Caucasus, Russia. Stone. Weight, 4.5 grams. Fell June 28, 1861. Fragment with crust. Crust differs but little in color from the black, compact, fine granular chondritic ground mass. Metallic grains few. Catalogue number, 47969.

Grossliebenthal, near Odessa, Cherson, Russia. Stone. Weight, 8 grams. Fell November 19, 1881. Fragment from interior. Ground mass ash gray, containing white chondrules and metallic grains. A thin vein, composed apparently of nickel iron more or less oxidized, passes through the specimen. The Shepard Collection, No. 233.

Hainholz, Minden, Westphalia, Germany. Stony iron. Weight, 7 grams. Found 1856. Fragment, one surface polished, showing metallic grains scattered through a black fine-grained ground mass of bronzite and asmanite. Other surfaces stained with rust. Catalogue number, 47697.

Weight, 12.15 grams. Fragment with polished surface. Metallic grains small and scattered through a mass of bronzite in which are relatively large grains of olivine with some asmanite and troilite. The Shepard Collection, No. 114.

Harrison County, Indiana. Stone. Weight, 10 grams. Fell March 28, 1859. Fragment with crust. Ground mass light ash gray with howardite chondrules and few, if any, metallic grains. Catalogue number, 46523. Gift of J. Berrien Lindsley.

Weight, 36.4 grams. Fragment with crust and polished surface. The Shepard Collection, No. 187.

Hartford, Linn County, Iowa. Stone. Weight, 1,602.35 grams. Fell February 25, 1847, 2.45 p.m. Mass with thick dull black crust, pitted and marked with swells and furrows as a result of flow. Interior ash gray, one surface marked with a metallic slickensides, much oxidized. The mass is traversed by metallic veins or lines of fracture which mark slipping zones with slickensided surfaces. The Shepard Collection, No. 170.

Weight, 23.7 grams, B. Fell February 25, 1847, 2.45 p.m. Fragment with dull black crust. (b) Fragment with dull black blebby crust. Catalogue numbers, 47746; (b) 81348.

Henry County, Virginia. Iron. Weight, 30.25 grams. Found 1889. Oxidized fragment showing cleavage. Catalogue number, 49172. Gift of H. B. Battle.

Hessle (near Upsala), Mälar See, Sweden. Stone. Weight, 11.2 grams. Fell January 1, 1869, 12.30 p.m. Complete individual with dull black, papillated crust. Catalogue number, 45699.

Weight, 259.8 grams. Four fragments with thin, dull black, papillated crust. The Shepard Collection, No. 206.

Hex River Mountains, Cape Colony, South Africa. Iron. Weight, 14.3 grams. Found 1882. Section. Etched surface shows Neumann's lines. The Shepard Collection, No. 95.

Holland's Store, Chattooga County, Georgia. Iron. Found 1887. Clipping. Catalogue number, 47744. Gift of George F. Kunz.

Homestead (West Liberty), Iowa County, Iowa. Stone. Weight, 79 grams; (b) 322 grams. Fell February 12, 1875, 10.15 p.m. Fragment with thin, dull black crust. Ground mass dark ash gray, granular, and compact. (b) Complete individual covered with dull black and somewhat blebby crust. Surface indented with shallow pits. Catalogue number, 19361. Gift of J. R. Eastman. (b) 45275.

Weight, 3,185 grams. Four complete individuals covered with crust and indented with broad, shallow pits. Crust dull black, thin, and somewhat blebby. Three fragments showing interior having an abundance of metallic grains and a chondritic structure. The Shepard Collection, No. 219.

Honolulu, Oahu, Hawaiian Islands. Stone. Weight, 1.35 grams. Fell September 27, 1825. Fragment with crust. The Shepard Collection, No. 152.

Hraschina, Agram, Croatia, Austria. Iron. Weight, 0.737 gram. Fell May 26, 1751. Etched fragment showing Widmanstättian figures. The Shepard Collection, No. 2.

Imilac, Atacama, Chile. Stony iron. Weight, 25.75 grams. Found 1827. Fragment; the metallic matrix as well as the olivine have undergone decomposition. Vial of fragments of matrix with little or no olivine. Vial of fragments of iron and olivine but little altered. The Shepard Collection, No. 111.

Weight, 197 grams. Found about 1800. Three specimens of the spongiform metallic matrix, somewhat oxidized and containing but little of the stony portion. Catalogue number, 12116.

Inca (Llano del Inca), 35 leagues southeast of Toltal, Atacama, Chile. Stony iron. Weight, 66 grams. Found 1888. Section of iron matrix containing siliceous grains of olivine, bronzite, augite, etc. Catalogue number, 49076. Gift of Ward and Howell.

Indarka, Schuscha, Elisabethpol, Caucasia, Russia. Stone. Weight, 1.4 grams. Fell April 7, 1891. Fragment from interior. Ground mass black with scattering black chondrules. Catalogue number, 84698.

Iridell, Bosque County, Texas. Iron. Weight, 98 grams. Found 1898. Rough fragment, with small etched surface showing granular structure and fine Neumann lines. Catalogue number, 84824.

Itapicuru-mirim, Maranhão, Brazil. Stone. Weight, 9.7 grams. Fell March, 1879. Fragment with dull black crust. Ground mass ash gray, fine granular, and compact. Catalogue number, 47648.

Ivanpah, San Bernardino County, California. Iron. Weight, 70 grams. Found 1880. One lot turnings. Catalogue number, 46629. Gift California State Mining Bureau.

Weight, 11.75 grams. Section etched showing Widmanstättian figures. The Shepard Collection, No. 92.

Jamestown, Stutsman County, North Dakota. Iron. Weight, 74.15 grams. Found 1885. Cross section of mass with polished surface. The Shepard Collection, No. 101.

Jefferson, 30 miles from Denver, Colorado. Iron. Weight, 41 grams. Fell June, 1867. Fragment containing troilite nodule; somewhat decomposed from occluded chlorides. The Shepard Collection, No. 81.

Jenny's Creek, Wayne County, West Virginia. Iron. Weight, 25 grams. Found 1883. Fragments showing cleavage octahedrons. Catalogue number, 46361. Gift of G. M. Crabtree.

Jerome (Smoky Hill River), Gove County, Kansas. Stone. Weight, (a) 101 grams; (b) 9 grams. Found April 10, 1894. Section of mass, one surface polished. Ground mass fine granular compact containing numerous small grains of nickel, iron, and many chondrules of bronzite and olivine, with fragmental crystals of olivine, bronzite, and some pyroxene, also some plagioclase fragments. No troilite present. Crust and ground mass rust-brown from oxidation. (b) Slice. Catalogue number, 845 7.

Jewell Hill, Madison County, North Carolina. Iron. Weight, 0.91 gram. Found 1854. Thin section etched. Catalogue number, 46519. Gift of J. Berrien Lindsley.

Weight, 31.85 grams. Rectangular section showing portion of surface. Etched face showing Widmanstättian figures. Taenite plates well developed. The Shepard Collection, No. 54.

Jhung, Punjaub, India. Stone. Weight, 1.22 grams. Fell June, 1873. Four fragments. Catalogue number, 46626.

Jigalowka, Charkow, Russia. Stone. Weight, 26.2 gram. Fell October 13, 1787. Fragment from interior. Ground mass ash gray, fine granular. Catalogue number, 81164. Gift of R. de Kroustchoff.

Joe Wright Mountain, near Batesville, Independence County, Arkansas. Iron. Weight, 309 grams. Found 1884. Catalogue number, 47970. Weight, 20 grams. Section showing typical Widmanstättian figures. The markings are broad and regular, with large plates of troilite. The Shepard Collection, No. 100.

Jonzac, Charente inférieure, France. Stone. Weight, 0.17 gram. Fell June 13, 1819. Fragment. The Shepard Collection, No. 143.

Juvinas, Ardêche, Languedoc, France. Stone. Weight, 2 grams. Fell June 15, 1821, 3.30 p. m. Fragment with shiny black, somewhat blebby crust. Ground mass coarse, granular, containing augite, anorthite, and small amount of troilite. Catalogue number, 46073.

Weight, 39.5 grams. Fragment from interior. The Shepard Collection, No. 146.

Kaba, near Debreczin, Hungary. Stone. Weight, 6.20 grams. Fell April 15, 1857. Fine powder. The Shepard Collection, No. 182.

Karakol, Kirghis Steppes, Russia. Stone. Weight, 4.2 grams. Fell May 9, 1840. Fragment with crust. Ground mass ash gray, fine granular. Catalogue number, 81167. Gift of R. de Kroustchoff.

Kendall County, Texas. Iron. Weight, 767 grams. End section of mass with crust and etched surfaces. Etched face exhibits a brecciated appearance and contains schreibersite and troilite, the latter more or less oxidized. Catalogue number, 84810.

Kenton County, Kentucky. Iron. Weight, 146 grams. Found 1889. Slab 4 by 4.2 by 1 cm. Etched surface shows faint Widmanstättian figures and scattering grains of troilite. Catalogue number, 83467.

Kerilis, Côtes du Nord, France. Stone. Weight, 2.70 grams. Fell November 26, 1874. Fragment with crust. The Shepard Collection, No. 218.

Kernouvé, Morbihan, Bretagne, France. Stone. Weight, 52.65 grams. Fell May 22, 1869, 10 p. m. Fragment from interior. The Shepard Collection, No. 207.

Kesen, Iwate, Japan. Stone. Weight, 218 grams. Fell June 13, 1850. Mass with dull, black crust. Surface blebby and indented with broad shallow pits. One surface polished, ground mass ash gray, granular compact, and traversed by several black veins and checks. Catalogue number, 83461.

Khairpur, Bhawalpur, Mooltan, India. Stone. Weight, 26.75 grams. Fell September 23, 1873. Fragment with polished surface and crust. Crust dull black, blebby, and showing lines of flow. Ground mass dark gray, compact. The Shepard Collection, No. 217.

Knyahinya, near Nagy Berezna, Hungary. Stone. Weight, 32.83 grams. Fell June 9, 1866, 5 p. m. Complete individual covered with thin black crust and having a pitted surface. Fragment with crust and polished surface. The Shepard Collection, No. 200.

Fragment with crust. Crust surface indented with broad, shallow, and conical pits. Another surface polished. Ground mass ash gray, granular, and compact. Weight, 27.8 grams. Catalogue number, 47343.

Krasnojarsk, Jeniseisk, Siberia. Pallasite. Weight, 327 grams. Found 1749. Section. The spongiform metallic matrix incloses nodules of olivine of varying diameters, more or less transparent and vitreous, and varying in color from honey yellow to nearly black. Also fragments of matrix from which the olivine has disappeared. The Shepard Collection, No. 110.

Weight, 6.8 grams. Fragment of iron matrix containing some olivine. Catalogue number, 45696.

Krasnoj-Ugol, Räsan, Russia. Stone. Weight, 5.8 grams. Fell September 9, 1829. Fragment from interior. Ground mass ash gray, granular and compact. Catalogue number, 81176. Gift of R. de Kroustchoff.

Kuleschowka, Poltawa, Russia. Stone. Weight, 5.95 grams. Fell March 12 (midnight), 1811. Fragment with crust. The Shepard Collection, No. 139.

Weight, 5.4 grams. Two fragments each weighing 2.7 grams. One with crust, other from interior. Ground mass ash-gray, fine granular. Catalogue number, 81165. Gift of R. de Kroustchoff.

L'Aigle, Normandie, Orne, France. Stone. Weight, 11.35 grams. Fell April 26, 1803, 1 p. m. Fragment with crust. The Shepard Collection, No. 132.

Weight, 56 grams. Fragment with brownish black crust. Crust surface pitted and stained with iron oxide. Ground mass ash-gray, stained with rust; granular, compact. Catalogue number, 46512.

La Bécasse, Indre, France. Stone. Weight, 5 grams. Fell January 31, 1879. Fragment with crust. The Shepard Collection, No. 228.

La Caille, near Grasse, Var, France. Iron. Weight, 1.48 grams. Found 1600. Fragment. The Shepard Collection, No. 4.

La Grange, Oldham County, Kentucky. Iron. Weight, 223 grams. Found 1860. Fragment 4 by 4.5 by 1.5 cm. Catalogue number, 46520. Gift of J. Berrien Lindsley.

Weight, 2,002 grams. (a) Section marked "Oldham," weight, 1,019 grams. Widmanstättian figures slightly indicated. (b) Section, weight, 983 grams, with well-marked Widmanstättian figures. The Shepard Collection, No. 69.

Lancé, Loir et Cher, France. Stone. Weight, 9 grams. Fell July 23, 1872. Weight, 7 grams. Fragment from interior. Catalogue number, 84773. Fragment with dull-black blebby crust. Ground mass dark gray, fine grained, compact. The Shepard Collection, No. 215.

Lenarto, Scharosch, Hungary. Iron. Weight, 17.52 grams. Found 1814. Two fragments. One polished, weight, 1 gram. One, weight, 16.52 grams, etched on both sides, showing Widmanstättian figures. The Shepard Collection, No. 17.

Les Ormes, Yonne, France. Stone. Weight, 0.70 gram. Fell October 1, 1857. Fragments from interior. The Shepard Collection, No. 183.

Lexington County, South Carolina. Iron. Weight, 65 grams. Found 1880. Fragment showing octahedral structure. Catalogue number, 18876.

Weight, 3,992 grams. Part of mass containing large troilite nodule. The Shepard Collection, No. 93.

Lick Creek, Davidson County, North Carolina. Iron. Weight, 9.72 grams. Found 1879. Fragment. The Shepard Collection, No. 91.

Lime Creek, Walker County, Alabama. Iron. Weight, 14 grams. Found 1832. Fragment. Catalogue number, 47737.

Limerick, Adare, Ireland. Stone. Weight, 24 grams. Fell September 10, 1813. Fragment from interior. Catalogue number, 84793.

Lion River, Great Namaqualand, South Africa. Iron. Weight, 34.87 grams. Catalogue number, 46604.

Weight, 20.85 grams. Section showing original surface. Etched portion shows fine Widmanstättian figures. The plates narrow and distinct. The Shepard Collection, No. 51.

Lissa, Bunzlau, Bohemia, Austria. Stone. Weight, 47 grams. Fell September 3, 1808. Fragment showing somewhat blebby crust. Crust surface indented with a broad, shallow pit. Interior light ash-gray, somewhat flecked with rust and traversed by darker veins and containing chondrules and bright metallic veins. Catalogue number, 84717.

Little Piney, Jefferson City, Pulaski County, Missouri. Stone. Weight, 75.44 grams. Fell February 13, 1839. Fragment from interior. The Shepard Collection, No. 161.

Lixna, Dünaburg, Witebsk, Russia. Stone. Weight, 1.19 grams. Fell July 12, 1820. Fragment with crust. The Shepard Collection, No. 145.

Long Creek, Jefferson County, Tennessee. Iron. Weight, 571 grams. Found 1853. Of doubtful origin. An irregularly shaped mass having its surface more or less indented and somewhat oxidized. One part polished and etched, showing peculiar markings which are neither Widmanstättian figures nor Newmann lines. Fractured surfaces show a tendency toward crystallization. Catalogue number, 46879.

Long Island, Phillips County, Kansas. Stone. Weight, 1,893 grams. Found 1891. Three masses: (a) Weight 493 grams, having a slickensided surface, which later was fused to a smooth crust. (b) Weight, 159 grams, and (c) 1,241 grams. All have their surfaces much oxidized, and in places coated with a grayish incrustation of carbonate of calcium. Ground mass compact and fine granular; brownish-black. Catalogue number, 83845. Gift of F. W. Clarke.

Losttown, Cherokee County, Georgia. Iron. Weight, 6.65 grams. Found 1867. Oxidized fragment. Catalogue number, 46065.

Weight, 75.4 grams. Found 1864. Section, one surface etched showing Widmanstättian figures. Three vials of powder. The Shepard Collection, No. 77.

Lucignano d'Asso, Siena, Tuscany, Italy. Stone. Weight, 3.7 grams. Fell June 16, 1794. Fragments. The Shepard Collection, No. 243.

Lumpkin, Stewart County, Georgia. Stone. Weight, 1.62 grams. Fell October 6, 1869, 11.43 a. m. Fragment with crust and polished surfaces. The Shepard Collection, No. 209.

McKinney, Collin County, Texas. Stone. Weight, 1,180 grams. Fell 1870. Mass with reddish brown, much oxidized crust. Ground mass greenish black, fine granular, compact. Catalogue number, 82751.

Macao, Rio Grande do Norte, Brazil. Stone. Weight, 68.5 grams. Fell November 11, 1836. Fragment with crust deeply stained with iron oxide. Ground mass compact and fine granular. Catalogue number 47904.

Madoc, Hastings, Ontario, Canada. Iron. Weight, 19.65 grams. Found 1854. Section showing coarse Widmanstättian figures. The Shepard Collection, No. 57.

Maême, Hislugari, Satsuma, Japan. Stone. Weight, 29.2 grams. Fell November 10, 1886. Fragment with crust. Crust somewhat pitted and in blebs. Ground mass light ash gray, granular, compact. Catalogue number, 47658. Gift of Educational Museum at Tokio, Japan.

Magdalena, Socorro County, New Mexico. Iron. Weight, 22 grams. Found 1899. Slice, 5 by 2 cm. Etched, showing coarse figures made up of broad plates. Catalogue number, 84596.

Magura (Arva), Szlanicza, Hungary. Iron. Weight, 98 grams. Found 1840. Slice, etched, showing delicate Widmanstättian figures. Catalogue number, 45667.

Weight, 123.50 grams. Two vials and one fragment. The Shepard Collection, No. 35.

Manbhoom, Bengal, India. Stone. Weight, 2 grams. Fell December 22, 1863. Fragment. Catalogue number, 48490.

Marshall County, Kentucky. Iron. Weight, 68.23 grams. Two fragments. The Shepard Collection, No. 62.

Mart, McClennan County, Texas. Iron. Weight, 456 grams. Found 1898. Slice, etched, etching develops typical Widmanstättian figures showing plates of taenite in parallel bundles; small nodules of troilite are scattered over the surface, together with several veins of the same mineral. Cast of original mass. Catalogue number, 84600.

Maryland. Weight, 2.735 grams. A shaving from burned museum in Baltimore. The Shepard Collection, No. 15.

Mauerkirchen, Austria. Stone. Weight, 0.5 gram. Fell November 20, 1768, 4 p. m. Fragment from interior. The Shepard Collection, No. 125.

Menow, Mecklenburg, Germany. Stone. Weight, 2.1 grams. Fell October 7, 1862, 1.30 p. m. Fragment from interior. The Shepard Collection, No. 191.

Mezö-Madaras, Transylvania, Hungary. Stone. Weight, 86.8 grams. Fell September 4, 1852, 4.30 p. m. Nearly complete individual with crust. The Shepard Collection, No. 175.

Mighëi, Trans Caucasus, Russia. Stone. Weight, 10 grams. Fell June 18, 1889. Fragment, dull black and soft friable, soiling the fingers. A carbonaceous meteorite. The Shepard Collection, No. 241.

Milena (Pusinsko Selo), Warasdin, Croatia, Austria. Stone. Weight, 46.25 grams. Fell April 26, 1842, 3 p. m. Fragment from interior, one surface appreciably slickensided. The Shepard Collection, No. 164.

Minas Geraes, Brazil. Stone. Weight, 10.9 grams. Fragment with crust. Catalogue number, 47647.

Miney, Taney County, Missouri. Stony iron. Weight, (a) 34 grams; (b) 108 grams. Found 1856. (a) Fragment; (b) slice with polished surface showing the reticulated metallic portion holding the siliceous material, consisting of olivine, bronzite, augite, and plagioclase. Catalogue numbers, (a) 47745. (b) 83468. Gift of George F. Kunz.

Misshof, Courland, Russia. Stone. Weight, 45 grams. Fell April 10, 1890. Section of mass with crust. Ground mass ash gray, flecked with rust, and containing numerous metallic grains and chondrules. Catalogue number, 84761.

Weight, 109 grams. Fragment with crust. Catalogue number, 84794.

Misteca, Oaxaca, Mexico. Iron. Weight, 18.5 grams. Found 1804. Two fragments; one, weight 2.5 grams, polished; other, weight 16 grams, etched, developing Widmanstättian figures. The Shepard Collection, No. 12.

Mocs, Transylvania, Hungary. Stone. Weight, 95 grams. Fell February 3, 1882, 4 p. m. Two nearly complete individuals. Crust brownish black, somewhat pitted, and showing lines of flow. Catalogue number, 44478.

Weight, 17.85 grams. Fragment with crust, one surface polished. The Shepard Collection, No. 234.

Molina, Murcia, Spain. Stone. Weight, 3.67 grams. Fell December 24, 1858. Fragment with crust, one surface apparently slickensided. The Shepard Collection, No. 186.

Monroe, Cabarrus County, North Carolina. Stone. Weight, 343.6 grams. Fell October 31, 1849, 3 p. m. Fragment with crust; another with two surfaces polished. The Shepard Collection, No. 173.

Monte Milone (Macerata), Italy. Stone. Weight, 0.73 gram. Fell May 8, 1846. Fragment with crust. The Shepard Collection, No. 169.

Mooresfort, Tipperary, Ireland. Stone. Weight, 1 gram. Fell August, 1810. Fragment with dull black crust. The Shepard Collection, No. 137.

Mordvinorka, Pavlograd, Ekaterinoslav, Russia. Stone. Weight, 18 grams; (b) 5.25 grams. Fell May 19, 1826. Polished slice. (b) Fragment from interior. Catalogue numbers, 47742; (b) 47734.

Weight, 3.11 grams. Three fragments, one with crust. The Shepard Collection, No. 153.

Morristown, Hamblen County, Tennessee. Stone. Weight, 1,820 grams. Found 1887.

Motecka-nugla, Bhurtpur, Rajputana, India. Stone. Weight, 3 grams. Fell December 26, 1868. Fragment. Catalogue number, 47333.

Motta di Conti, Piedmont, Italy. Stone. Weight, 1.53 grams. Fell February 29, 1868. Fragment with papillated shiny black crust. The Shepard Collection, No. 202.

Mount Joy, Adams County, Pennsylvania. Iron. Weight, 2,161 grams. Found 1887. Fragments, originally a section, weight, 2,026.99 grams, and containing numerous cracks or veins filled with carbonaceous matter and chlorides; also containing numerous troilite nodules. The decomposition due to the occluded chlorides. Catalogue number, 84377. Gift of E. E. Howell. Fragment. Weight, 135 grams. Catalogue number, 51110.

Mount Oscuro, Socorro County, New Mexico. Iron. Weight, 243.7 grams. Found December 10, 1895. (a) Fragment showing portion of original surface with indications of octahedral cleavage; weight, 103.5 grams. (b) Fragment with original and etched surface. Widmanstättian figures poor; weight, 140.2 grams. Catalogue number, 84378.

Murfreesboro, near Nashville, Rutherford County, Tennessee. Iron. Weight, 57.5 grams. Oblong slab, 3.2 by 2 by 0.6 cm. Catalogue number, 47340.

Fragment. Weight, 5.88 grams. The Shepard Collection, No. 41.

Nagaya, near Concepcion, Entre Rios, Argentina. Stone. Weight, 3.5 grams. Fell July 1, 1879. Fragment, black in color with scattering gray specks. A carbonaceous stone. Catalogue number, 48431.

Nanjemoy, Charles County, Maryland. Stone. Weight, 31.22 grams. Fell February 10, 1825, 12 p. m. Fragment with crust. The Shepard collection, No 151.

Nejed, Wadee Banee Khaled, Central Arabia. Iron. Weight, 309 grams. Fell spring of 1865. Sawn section etched. Widmanstättian figures typical. Catalogue number, 84786. Weight, 37 grams. Sawn section. The Shepard Collection, No. 73.

Nelson County, Kentucky. Iron. Weight, 370 grams. Found 1860. Section 5 by 6 by 2 centimeters. Shows portion of original surface and contains fine grains of troilite. Catalogue number, 46521. Gift of J. Berrien Lindsley.

Weight, 58.3 grams. Section of mass. The Shepard Collection, No. 68.

Nentmannsdorf, near Pirna, Saxony, Germany. Iron. Weight, 15.15 grams. Found 1872. Fragment, weight, 2.45 grams. Fragment (weight, 12.70 grams) showing a greenish efflorescence of nickel compounds. The Shepard Collection, No. 83.

Ness County, Kansas. Stone. Weight, 108 grams. Found spring of 1899. Nearly complete individual; one face polished showing ground mass deeply stained with rust and containing numerous large and small gray chondrules, with small metallic grains. Crust surface brown from oxidation. Catalogue number, 84707.

Weight, 206 grams. Catalogue number, 84803. Weight, 903 grams. Two complete individuals weighing 833 and 70 grams respectively. Catalogue number, 84814. Weight, 469 grams. Five specimens weighing 191, 138, 63, 48, and 29 grams, respectively. Catalogue number, 84815.

Netschaëvo, Tula, Russia. Iron. Weight, 61.95 grams. Found 1846. Fragment. The Shepard Collection, No. 38.

New Concord, Guernsey, and Muskingum Counties, Ohio. Stone. Weight, 3,311.87 grams. Fell May 1, 1860, 12.45 p. m. Nearly complete individual covered with a somewhat pitted black crust. The Shepard Collection, No. 188.

Weight, (a) 197 grams; (b) 1,720 grams. Fell May 1, 1860, 12.45 p. m. (a) Complete individual with crust; one surface striated resembling slickenside. (b) Mass, black, papillated and somewhat pitted crust. Ground mass dark ash gray, fine granular compact. Catalogue numbers, (a) 8065, gift of E. B. Andrews; (b) 46610, gift of J. B. Lindsley.

Newstead, Roxburghshire, Scotland. Iron. Weight, 51 grams. Found 1827. Triangularly shaped fragments. The Shepard Collection, No. 22.

Novo-Urei, Krasnoslobodsk, Pensa, Russia. Stone. Weight, 4 grams. Fell September 22, 1886. Fragment from interior. Ground mass black (ureilite); coarse granular. The Shepard Collection, No. 240.

Oakley, Logan County, Kansas. Stone. Weight, 320 grams. Found 1895. Sawn section. The dark gray, nearly black ground mass contains numerous metallic grains and chondrules. Catalogue number, 84788.

Obernkirchen, Oldenburg, Schaumberg-Lippe, Germany. Iron. Weight, 152.5 grams. Found 1863. Catalogue number, 47328.

Weight, 53.4 grams. (a) Section showing troilite nodule. Weight, 30.3 grams. (b) Section weighing 23.1 grams. The Shepard Collection, No. 71.

Ochansk (Taborg), Perm, Russia. Stone. Weight, 161 grams; (b) 13.3 grams. Fell August 30, 1887. Fragment from interior. (b) Two fragments; one, weight 10 grams, without crust, and one, weight 3.3 grams, with a trace of crust. Catalogue numbers, 47733; (b) 81169. Gift of R. de Kroustchoff.

Oktibbeha, Mississippi. Iron. Weight, 1.89 grams. Found 1854. The Shepard Collection, No. 55.

Orange River, South Africa. Iron. Weight, 99.4 grams. Fragment. Catalogue number, 47320.

Weight, 21.41 grams. Etched section with original surface. Widmanstättian figures coarse; taenite plates narrow. The Shepard Collection, No. 64.

Orgueil, Montauban, Tarn et Garonne, France. Stone. Weight, 9.62 grams.

Weight, 98 grams. Fell May 14, 1864, 8 p. m. Fragment with crust. Crust surface much crackled and deeply pitted. Catalogue number, 8473.

Coarse, black friable powder. The Shepard Collection, No. 196.

Ornans, Salins, Doubs, France. Stone. Weight, 6 grams. Fell July 11, 1868. Fragment from interior. Ground mass dark ash gray. Chondrules made up of ornansite and Ngawite. The Shepard Collection, No. 203.

Orvinio, Umbria, Italy. Stone. Weight, 0.12 gram. Fell August 31, 1872. Fragment with crust. Ground mass dull black and flecked with numerous white efflorescences. The stone contains no iron. Catalogue number, 84743. The Shepard Collection, No. 216.

Ösel (Kaande), Poland, Russia. Stone. Weight, 13 grams. Fell May 11, 1855, 3.30 p. m. Fragment with crust. Ground mass ash gray; fine granular compact. Catalogue number, 81170. Gift of R. de Kroustchoff.

Weight, 4 grams. Fragment from interior. The Shepard Collection, No. 178.

Pacula, Jacal, Hidalgo, Mexico. Stone. Weight, 23 grams. Fell June 18, 1881. Fragment from interior. Catalogue number, 84787. Two fragments from interior. Ground mass traversed by several delicate veins. The Shepard Collection, No. 236.

Parnallee, Madura, Madras, India. Stone. Weight, 87 grams. Fell February 28, 1857, 12 m. Fragment with crust. Catalogue number, 8067. Gift of C. A. Young.

Weight, 331.48 grams. Two fragments with crust. Crust black, pitted, and in swellings. The Shepard Collection, No. 181.

Pavlovka, Sartov, Russia. Stone. Weight, 5.61 grams. Fell August 2, 1882. Fragment with crust; also a vial of fragments. The Shepard Collection, No. 235.

Petersburg, Lincoln County, Tennessee. Stone. Weight, 30.7 grams. Fell August 5, 1855. Two fragments with crust. Crust shiny black and pitted and in swellings. The Shepard Collection, No. 179.

Pillistfer, Aukoma, Poland, Russia. Stone. Weight, 2.6 grams. Fell August 8, 1863, 12.30 p. m. Fragment from interior. The Shepard Collection, No. 192.

Pipe Creek, Bandera County, Texas. Stone. Weight, 168 grams. Found 1887. Polished section. Ground mass brownish black, granular, compact. Catalogue number, 83466.

Plymouth, Marshall County, Indiana. Iron. Weight, 182 grams. Found 1893 (1883?). Polished slab 5.5 by 5.5 by 0.7 cm. Catalogue number, 83464.

Politz, near Gera, Reuss, Germany. Stone. Weight, 0.163 grams. Fell October 13, 1819, 8 a. m. Fragment with crust. The Shepard Collection, No. 144.

Prairie Dog Creek, Decatur County, Kansas. Stone. Weight, 220 grams. Known 1893. Mass with crust. Crust scorified on one surface, papillated on another. The Shepard Collection, No. 244.

Prambanan, Java. Iron. Weight, 2.3 grams. Found 1797. Fragment. The Shepard Collection, No. 11.

Pricetown, Highland County, Ohio. Stone. Weight, 2.45 grams. Fell February 13, 1893. Fragment with dull black, papillated, and somewhat blebly crust. Ground mass ash gray, fine granular, and compact. Structure chondritic. Catalogue number, 83226. Gift of F. W. Clarke.

Pultusk, Poland, Russia. Stone. Weight, 304.76 grams. Fell January 30, 1868, 7 p. m. Seven complete individuals. Crust dull black, more or less papillated and pitted. A cross section of an individual with crust and polished surface. The Shepard Collection, No. 201.

Weight, 158 grams. Complete individual with dull black, papillated, and somewhat pitted crust, and showing a portion of the interior. Catalogue number, 44477.

Puquios, Chile. Iron. Weight, 28 grams. Found 1885. Two fragments, one etched. Weight, 10.3 grams and 17.7 grams. Catalogue number, 49054. Gift of Ward and Howell.

Putnam County, Georgia. Iron. Weight, 328 grams. Found 1839. Oxidized mass showing cleavage. The cleavage plates separated by taneite. Catalogue number, 46518. Gift of J. Berrien Lindsley.

Weight, 68.55 grams. Four fragments. The Shepard Collection, No. 28.

Quenggouk, Pegu, Burma. Stone. Weight, 19.65 grams. Fell December 27, 1857. Fragment with crust. One vial of powder. The Shepard Collection, No. 184.

Rafrüti, Emmenthal, Bern, Switzerland. Iron. Weight, 23 grams. A polished section. Catalogue number, 84804.

Rakorka, Tula, Russia. Stone. Weight, 23.5 grams. Fell November 20, 1878. Fragment with crust indented with broad shallow pits. The Shepard Collection, No. 227.

Ranchito, Bacubirito, Sinaloa, Mexico. Iron. Weight, 14.4 grams. Found 1871. Fragment with original and etched surfaces. Delicate Widmanstättian figures. Catalogue number, 51669. Gift of G. E. Bailey.

Weight, 171.4 grams. Found 1871. Part of mass with original and etched surfaces. The Shepard Collection, No. 102.

Rasgata, Tocavita, United States of Colombia. Iron. Weight, 15 grams. Found 1810. Small polished section. The Shepard Collection, No. 16.

Weight, 0.895 grams. Two fragments, etched. Widmanstättian figures typical. Catalogue number, 45695.

Renazzo, near Cento, Ferrara, Italy. Stone. Weight, 7.20 grams. Fell January 15, 1824. Fragment with crust. The Shepard Collection, No. 149.

Richmond, Virginia. Stone. Weight, 3.69 grams. Fell June 4, 1828, 8.30 a. m. Fragment from interior. The Shepard Collection, No. 155.

Rochester, Fulton County, Indiana. Stone. Weight, 2 grams. Fell December 21, 1876. Fragment with crust. Catalogue number, 46078.

Weight, 48.27 grams. Two fragments with dull black blebly crust. The Shepard Collection, No. 221.

Roeburne (200 miles southeast of), West Australia. Iron. Weight, 157 grams. Found 1892. Section etched, showing typical Widmanstättian figures with scattering grains of troilite. The Shepard Collection, No. 109.

Rowton, Wellington, Shropshire, England. Iron. Weight, 19.5 grams. Fell April 20, 1876. Slice, 4.2 by 1.2 by 0.5 cm. Catalogue number, 47327.

Ruff's Mountain, Lexington County, South Carolina. Iron. Weight, 9.7 grams. Found 1844. Fragment. Catalogue number, 46066.

Weight, 5,461 grams. Large block etched on one face and showing Widmanstättian figures. Two small fragments. The Shepard Collection, No. 46.

Russell Gulch, Gilpin County, Colorado. Iron. Weight, 76 grams. Found 1863. Rectangular section 4.5 by 1.7 by 1.2 cm. One surface that of original mass; another etched, having a granular or stippled appearance and containing numerous grains of taenite (?). On another face is a cavity or cast of a troilite nodule. Catalogue number, 81349. The United States Geological Survey.

Sacramento Mountains, Eddy County, New Mexico. Iron. Weight, 4,420 grams. Found 1876. Cross section of mass. One surface etched, showing well-marked Widmanstättian figures with a few small scattered nodules of troilite. Catalogue number, 84726.

Saint Francois County (southeast Missouri), Missouri. Iron. Weight, 5.6 grams. Found 1863. Fragment. The Shepard Collection, No. 72.

Weight, 275 grams. One slab; weight, 245 grams. Two fragments; weight, 30 grams. Catalogue number, 47747.

Saint-Mesmin, near Troyes, Aube, France. Stone. Weight, 69 grams. Fragment with dull black crust. Catalogue number, 84826.

Weight, 1.59 grams. Fell May 30, 1866. Fragment with crust. The Shepard Collection, No. 199.

Salles, near Villefranche, Rhône, France. Stone. Weight, 41 grams. Fragment with sawn and fractured surfaces showing brecciated structure; also a portion of the dull black crust. Catalogue number, 84827.

Weight, 2 grams. Fell March 12, 1798. Gray powder. The Shepard Collection, No. 130.

Salt Lake City, Utah. Stone. Weight, 2.81 grams. Found 1869. Fragment with brownish black crust. Catalogue number, 47401.

Salt River, Kentucky. Iron. Weight, 51.56 grams. Found 1850. Two sections; weight, 26.2 grams and 25.36 grams. Etched surface shows Neumann lines. The Shepard Collection, No. 47.

San Angelo, Tom Green County, Texas. Iron. Weight, 607 grams. Found July, 1897. Section. One face etched, showing Widmanstättian figures with several cracks or fissures, the larger of which are filled with graphitic carbon. Catalogue number, 84811.

Sanchez Estate, Coahuila, Mexico. Iron. Weight, 183.7 grams. Two fragments, one showing fracture. The Shepard Collection, No. 61.

San Emigido Range, San Bernardino County, California. Stone. Weight, 119 grams. Catalogue number, 47833.

San Luis Potosi, Mexico. Iron. Weight, 57.4 grams. Rectangular fragment, three faces etched, showing Widmanstättian figures. One face marked "Parte de aerolito del Estado de S. Luis Potosi caido en el Añno de 1871;" another marked "a Ulisis S. Grant." Catalogue number, 47190. Received among the Grant relics.

Santa Catharina, Rio San Francisco do Sul, Brazil. Iron. Weight, 253.9 grams. Known, 1873. (a) Section showing no evidence of alteration. One surface etched; Widmanstättian figures broad, with scattering plates of tænite and some troilite. Analysis shows 36 per cent of nickel. (b) Two fragments somewhat oxidized on surface, but with a compact metallic interior. (c) Complete mass apparently altered to limonite; surface somewhat pitted by decay. The Shepard Collection, Nos. 87, 88, and 105.

Weight, 82.4 grams. Mass but slightly altered; a polished surface, having a good metallic luster. Catalogue number, 47360.

Santa Rosa, Coahuila, Mexico. Iron. Weight, 19.3 grams. Found 1837. Polished fragment. Catalogue number, 45744. Gift of N. T. Lupton, who described it in American Journal of Science, 3d Ser. XXIX, p. 232.

Sarepta, Saratov, Russia. Iron. Weight, 3.3 grams. Found 1854. One lot of turnings. The Shepard Collection, No. 60.

Saskatchewan River, Victoria, British Columbia. Iron. Weight, 125 grams. Found 1871. The Shepard Collection, No. 79.

Schönenberg, Pfaffenhausen, Burgau, Swabia, Bavaria, Germany. Stone. Weight, 8 grams. Fell December 25, 1846. Fragment with crust. Crust surface thick, scoriaceous, and somewhat shining. Ground mass dark ash gray, with light and dark chondri and metallic grains, the latter occasionally coarse. Interior traversed by narrow veins of nickel iron. Catalogue number, 84599.

Schwetz, Prussia, Germany. Iron. Weight, 10.55 grams. Found 1850. Fragment. The Shepard Collection, No. 48.

Scottsville, Allen County, Kentucky. Iron. Weight, 99.8 grams. Found 1867. (a) Section, weight 66.5 grams, contains troilite nodules. (b) Section, weight 33.3 grams. Etched surface contains troilite nodules and presents a granular or stippled appearance overlaid with a network of fine lines. (c) Cast of original mass. Catalogue number, 47184.

Weight, 713 grams. Cross section etched, showing Neumann lines. The Shepard Collection, No. 80.

Scriba, Oswego County, New York. Iron. Weight, 9.15 grams. Fragment. Etched surface shows no structure, but has a granular or stippled appearance. Catalogue number, 4651.

Weight, 61.33 grams. Polished section. The Shepard Collection, No. 23.

Searsmont, Waldo County, Maine. Stone. Weight, 16 grams. Fell May 21, 1871, 8.15 a. m. Two fragments from interior. Catalogue number, 8068. Gift of A. C. Hamlin.

Weight, 62.5 grams. Fragment with dull black papillated crust. The Shepard Collection, No. 211.

Seeläsgen, Brandenburg, Prussia, Germany. Iron. Weight, 104.5 grams. Found 1847. Cross section of mass. Etching shows the mass to be made up of irregular plates of the nickel-iron alloys. Catalogue number, 47321.

Weight, 111.6 grams. Etched slab showing irregular lines of troilite and plates of nickel-iron alloy. The Shepard Collection, No. 44.

Seneca Falls, near Waterloo, Cayuga County, New York. Iron. Weight, 80.2 grams. Found 1851. Section of mass. The Shepard Collection, No. 49.

Senhadja, Aumale, Constantine, Algeria. Stone. Weight, 17.5 grams. Fell August 25, 1865. Fragment with light-brown crust differing but little in color from that of the ground mass. Catalogue number, 48823.

Shalka, near Bissempore, Bancoorah, Bengal, India. Stone. Weight, 53 grams. Fell November 30, 1850. Fragment with crust. Catalogue number, 84791.

Shingle Springs, Eldorado County, California. Iron. Weight, 32.4 grams. Found 1869–70. Fragment. Catalogue number, 47359.

Shytal, Dacca, Bengal, India. Stone. Weight, 1.32 grams. Fell August 11, 1863. Fragment from interior. The Shepard Collection, No. 193.

Siena, Tuscany, Italy. Stone. Weight, 6.75 grams. Fell June 16, 1794. Complete individual, showing crust and interior. The Shepard Collection, No. 128.

Sitathali, near Nurrah, Raipur, Rajputana, India. Stone. Weight, 13.5 grams. Fell March 4, 1875. Fragment with crust. Catalogue number, 47332.

Ski, Amt Akershuss, Norway. Stone. Weight, 0.25 grams. Fell December 27, 1848. Fragment. Catalogue number, 46611.

Weight, 1 gram. Fragment with crust. The Shepard Collection, No. 172.

Slobodka, Juchnow, Smolensk, Russia. Stone. Weight, 3.7 grams. Fell August 10, 1818. Fragment. Catalogue number, 81163. Gift of R. de Kroustchoff.

Smithland, near Salem, Livingston County, Kentucky. Iron. Weight, 12.935 grams. Found 1839–40. The Shepard Collection, No. 30.

Smiths Mountain, Rockingham County, North Carolina. Iron. Weight, 58.8 grams. Found 1863. Thin slab, etched, coarse Widmanstättian figures with scattered grains of troilite. Catalogue number, 47335.

Smithville, De Kalb County, Tennessee. Iron. Weight, 214 grams. Found 1840. Section of mass with original and polished surface. Shows large troilite nodule. Catalogue number, 83463.

Weight, 1,937 grams. Iron. Found, 1893. A portion of mass; natural surface in part altered from occluded chlorides. One surface showing nodules of troilite. The Shepard Collection, No. 106.

Sokobanja (Sarbanovac), Servia. Stone. Weight, 1.75 grams. Fell October 13, 1877, 2 p. m. Fragment with crust. Catalogue number, 46075.

Weight, 15.98 grams. Fragment with crust. The Shepard Collection, No. 224.

Ställdalen, Nya Kopparberg, Dalecarlia, Sweden. Stone. Weight, 151.7 grams. Fell June 28, 1876, 11.30 a. m. Two fragments with crust. Crust surface indented with broad shallow pits. Ground mass shows fragmentary slickensides. The Shepard Collection, No. 220.

Stannern, Iglau, Moravia, Austria. Stone. Weight, (a) 14 grams; (b) 33 grams. Fell May 22, 1808, 6 a. m. (a) Fragment with crust. (b) Nearly complete individual; crust surface shiny black, papillated and showing lines of flow. Catalogue numbers, (a) 47325; (b) 47972.

Stannern, Iglau, Moravia, Austria—Continued.

Weight, 25.70 grams. Fragment with glossy black to shiny crust. The Shepard Collection, No. 136.

Staunton, Augusta County, Virginia. Iron. Weight, (a) 145 grams; (b) 9.86 grams. Found (a) 1858–59, (b) 1887. (a) Mass described by Mallet in 1871; a rectangular slab etched, showing coarse Widmanstättian figures with scattering grains of troilite. (b) Mass described by Kunz, found 1887. Fragments. Weight, 9.86 grams, much oxidized. Catalogue numbers, (a) 46623; (b) 46621.

Weight, 1,662 grams. Cross section of mass containing large troilite nodule. Etched surface shows typical Widmanstättian figures. The Shepard Collection, No. 78.

Starropol, Caucasus, Russia. Stone. Weight, 52.4 grams. Fell March 24, 1857. Fragment with crust. Ground mass ash gray and fine granular. Catalogue number, 81171. Gift of R. de Kroustchoff.

Steinbach, Saxony, Germany. Stony iron. Weight (a) 65.45 grams, (b) 16.8 grams. Fell 1164 (?). (a) Rittersgrün, found 1847. Section with crust. The stony portion exceeds the metallic, which consists chiefly of nickel iron with some small masses of troilite. On one surface the metallic portion has been etched, showing Widmanstättian figures. (b) Fragment. The Shepard Collection, Nos. (a) 113, (b) 115.

Weight, (a) 38 grams, (b) 2 grams, (c) 53.7 grams. Fell 1164 ? (a) Rittersgrün, found 1847. Slice polished; the stony portion exceeds the metallic. The latter etched, showing typical Widmanstättian figures. (b) Steinbach, found before 1751. Fragment; the metallic portion has been etched, showing Widmanstättian figures. (c) Breitenbach, found 1861. Catalogue numbers (a) 12463 (gift of Adrian Van Sinderen), (b) 47971, (c) 47331.

Supuhee, Goruckpur, India. Stone. Weight, 4.3 grams. Fell January 19, 1865. Fragment with crust. Crust contains small globules of nickel iron. The Shepard Collection, No. 197.

Tabor, Bohemia, Austria. Stone. Weight, 2.45 grams. Fell June 3, 1753, 8 p. m. Section from interior. The Shepard Collection, No. 123.

Tajgha, Krasnojarsk, Siberia. Iron. Weight, 64 grams. Found 1891. Fragment with original surface. Etch figures coarse and poor. The Shepard Collection, No. 246.

Tarapaca, Hemalja, Chile. Iron. Weight, 84 grams. Found 1840. Fragment. The Shepard Collection, No. 31.

Tazewell, Claiborne County, Tennessee. Iron. Weight, 152 grams. Found 1853. Irregularly shaped mass. Catalogue number, 46520. Gift of J. Berrien Lindsley.

Tennasilm, Esthland, Russia. Stone. Weight, 48.2 grams. Fell June 28, 1872. Fragment with papillated, and in part somewhat blebly, crust. Ground mass dark ash gray and coarse granular. Catalogue number, 47324.

Weight, 1.76 grams. Two fragments with a small portion of crust. The Shepard Collection, No. 214.

Tieschitz, Prerau, Moravia, Austria. Stone. Weight, 27 grams. Fell July 15, 1878. Fragment with dull black crust. The Shepard Collection, No. 226.

Timoschin, Juchnow, Smolensk, Russia. Stone. Weight, 6.8 grams. Fell March 25, 1807. Fragment from interior. Catalogue number, 81166. Gift of R. de Kroustchoff.

Weight, 15 grams. Fragment from interior. The Shepard Collection, No. 134.

Tjabé, Bodgo-Negoro, Padangan, Rembang, Java. Stone. Weight, 29.1 grams Fell September 19, 1869. Fragment with crust. The Shepard Collection, No. 208.

Toluca, Xiquipilco, Mexico. Iron. Found 1784. Weight, 688 grams. (a) Etched slice, weight, 850 grams; Widmanstättian figures distinct; contains irregularly shaped nodules of troilite. (b) Complete individual; weight, 99.75 grams; surface pitted and somewhat oxidized. Catalogue numbers, (a) 47091, (b) 83465.

Toluca, Xiquipilco, Mexico—Continued.

Complete individual, having a pitted surface. The Shepard Collection, No. 5. Two polished and etched slices showing Widmanstättian figures. The Shepard Collection, No. 6.

Tombigbee River, Choctaw and Sumter Counties, Alabama. Iron. Weight, 2,443 grams. Found 1878. Section with original and polished surfaces. The polished surface shows masses of schreibersite irregularly arranged, and resembling, in form, Arabic writings. The ground mass contains numerous straight lines appearing like scratches, some of which are regularly arranged in parallel columns. Catalogue number, 84808.

Tomhannock Creek, Rensselaer County, New York. Stone. Weight, 9 grams. Found 1863. Thin section of mass. Catalogue number, 45694.

Weight, 8.74 grams. Two slices, polished and showing crust. The Shepard Collection, No. 195.

Tonganoxie, Leavenworth County, Kansas. Iron. Weight, 195 grams. Found 1886. Cross section of mass, one face etched, showing Widmanstättian figures, and a few small, scattered grains of troilite. Catalogue number, 84808.

Tourinnes La Grosse, Tirlemont, Belgium. Stone. Weight, 9.04 grams. Fell December 7, 1863. Fragment with crust. The Shepard Collection, No. 194.

Travis County, Texas. Stone. Weight, 2,650 grams. Found June, 1889. Nearly complete mass. Surface much oxidized. Ground mass nearly black and deeply stained with rust. Catalogue number, 48488. Gift of R. T. Hill.

Trenton, Washington County, Wisconsin. Iron. Weight, 327 grams. Found 1858. Section 8.3 by 7 by 1.5 cm. Etched. Shows large troilite nodule. Catalogue number, 46613.

Weight, 91.46 grams. Two fragments. The Shepard Collection, No. 66.

Trenzano, Brescia, Lombardy, Italy. Stone. Weight, 3.8 grams. Fell November 12, 1856, 4 p. m. Fragment. The Shepard Collection, No. 180.

Trinity County, California. Iron. Weight, 3.65 grams. Found 1870. Fragments (clippings). Catalogue number, 46070.

Weight, 22.55 grams. Fragments. The Shepard Collection, No. 108.

Tucson, Arizona. Iron. Weight, 621,531 grams. The ring meteorite.

Weight, 84.5 grams. Fragment from inner circle of ring meteorite. The Shepard Collection, No. 40. (See Plate 1.)

Tucson (Carlton), Arizona. Iron. Weight, 36.84 grams. Found 1846. The Shepard Collection, No. 39.

Tucuman, Otumpa, Argentina. Iron. Weight, 23.8 grams. Found 1788. Fragment having one surface polished. The Shepard Collection, No. 7.

Tysnes, Norway. Stone. Weight, 29.3 grams. Fell May 20, 1884. Fragment from interior. The Shepard Collection, No. 238.

Union County, Georgia. Iron. Weight, 124.5 grams. Found 1853. (a) Section having a much oxidized surface and showing cleavage lines; weight, 87 grams. (b) Section, weight 36.5 grams. (c) Vial of oxidized crust. The Shepard Collection, No. 53.

Unknown iron. Weight, 3,510 grams. Found without record in old Smithsonian Institution collection. Mass nearly complete. Catalogue number, 46612.

Utrecht (Blaauw Kapel), Holland. Stone. Weight, 8.8 grams. Fell June 2, 1843. Two fragments, one 3.1 grams with crust; another from interior, 5.7 grams. The Shepard Collection, No. 167.

Weight, 28.7 grams; 25.9 grams of coarse powder. One fragment 2.81 grams. Catalogue number, 47326.

Vaca Muerta, Atacama, Chile. Stony iron. Weight, 449 grams. Known 1861. Mass with original surface. The nonmetallic portion in excess of the metallic. Catalogue number, 6991. Gift of the University of St. Jago, Chile.

Vaca Muerta, Atacama, Chile—Continued.

Weight, 27.63 grams; (b) 29.8 grams. Found 1862; (b) 1867–68. Three fragments, two of which are thin sections; the third shows original and polished surfaces. Structure somewhat granular, with the metallic and nonmetallic portions about equally distributed. (b) Mejillones. Thin section in which the metallic portion is distributed in occasional nodules and filiform shapes throughout the stony ground mass. The Shepard Collection, Nos. 119; b, 116.

Veramin (Karand), Teheran, Persia. Stony iron. Weight, 6.5 grams. Fell February, 1880. Fragments. Catalogue number, 84700. Gift of G. P. Merrill.

Victoria West, Cape Colony, South Africa. Iron. Weight, 2.15 grams. Found 1862. Fell (?) 1862. Fragments of crust almost completely altered to limonite. The Shepard Collection, No. 70.

Vouillé, near Poitiers, Vienne, France. Stone. Weight, 14.57 grams. Fell May 13, 1831. Fragment from interior. The Shepard Collection, No. 158.

Waconda, Mitchell County, Kansas. Stone. Weight, 8 grams. Found 1874. Two fragments, one with crust. Catalogue number, 46609. Gift of G. W. Chapman.

Weight, 996.55 grams. Mass with pitted and blebly crust, showing lines of flow; also a fragment from interior. The Shepard Collection, No. 213.

Warrenton, Warren County, Missouri. Stone. Weight, 11 grams. Fell January 3, 1877, 7 a. m. Fragment from interior. Catalogue number, 46077.

Weight 27.25 grams. Fragment with crust. The Shepard Collection, No. 222.

Welland, Ontario, Canada. Iron. Weight, 36.5 grams. Found 1888. Section having original and etched surface. Widmanstättian figures coarse and regular, with scattering grains of troilite. Lines of octahedral cleavage well marked. The Shepard Collection, No. 103.

Werchne-Udinsk, River Niro, Trans Baikal, Siberia. Iron. Weight, 36.30 grams. Found 1854. Etched section; Widmanstättian figures coarse. The Shepard Collection, No. 58.

Weston, Fairfield County, Connecticut. Stone. Weight, 17 grams. Fell December 14, 1807, 6.30 a. m. Fragment from interior. Catalogue number, 47743.

Weight, 74.37 grams. Three fragments, one without crust. The Shepard Collection, No. 135.

Wichita County, Brazos River, Texas. Iron. Weight, 20.8 grams. Found 1836. Fragment 4 by 1 by 0.7 cm. Catalogue number, 45273.

Weight, 212.4 grams. (a) Section with original and etched surface; weight, 143 grams; (b) section as above; weight, 69.40 grams. Both show coarse Widmanstättian figures, with nodules of troilite and flakes of schreibersite. The Shepard Collection, No. 26.

Wold Cottage, Yorkshire, England. Stone. Weight, 13.02 grams. Fell December 13, 1795, 3.30 p. m. Fragment with crust and polished surface. The Shepard Collection, No. 129.

Wooster, Wayne County, Ohio. Iron. Weight, 2.86 grams. Found 1858. Rectangular fragment. The Shepard Collection, No. 65.

Yatoor, near Nellore, Madras, India. Stone. Weight, 2.81 grams. Fell January 23, 1852, 4.30 p. m. Fragment from interior. The Shepard Collection, No. 174.

Zaborzika, Volhynien, Russia. Stone. Weight, 4.1 grams. Fell April 10, 1818. Fragment from interior. Ground mass ash gray, fine granular, friable. Catalogue number, 81172. Gift of R. de Kroustchoff.

Zacatecas, Mexico. Iron. Weight, 175.3 grams. Found 1792.

Weight 14.8 grams. Fragment. Catalogue number, 46524. Gift of J. Berrien Lindsay. Fragment with original and etched surfaces. Widmanstättian figures good. The Shepard Collection, No. 5.

Zavid, Bosnia, Bohemia, Austria. Stone. Weight, 31 grains. Fell August 1, 1897. Fragment with dull brown crust. Ground mass ash-gray, and containing numerous chondri and grains of iron and troilite. Catalogue number, 84741.

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