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DR. V. K. TING
Director of the National Geological Survey of China

NATURAL HISTORY
VOLUME XXI JANUARY-FEBRUARY, 1921 NUMBER 1

THE NATIONAL GEOLOGICAL SURVEY OF CHINA

BY

J. G. ANDERSSON*

The geology of China is so closely related to the future welfare of that country, and especially to its agriculture, its forestry, its mines, and mechanical industries, that we welcome in NATURAL HISTORY the full and interesting account of the National Geological Survey and its fine museum, prepared by Dr. J. G. Andersson, well known as a geologist and palæontologist, who was called from the University of Upsala to the staff formed by Director V. K. Ting; and as the Survey of New York State was the most important factor in building up the state museum, so we may be sure that the Survey of China will give a great impetus to the establishment of museums in that country. When our thoughts go back to the institution of the Natural History Survey of the State of New York in 1836 and we witness the intellectual and practical benefits to the people of the state, we may express the hope and belief that the year 1911 may be no less auspicious in the future history of China.

In its Third Asiatic Expedition the American Museum of Natural History plans to coöperate with the Geological Survey of China in the same way that it at home is coöperating with our national and state surveys for the promotion of knowledge and the welfare of the people.

—HENRY FAIRFIELD OSBORN.

THE young and progressive institution which carries the name "The Geological Survey of China" is a child of the revolution which overthrew the Imperial régime of the Manchus and inaugurated the present Republican era. When, at the end of 1911, the Provisional Government was formed at Nanking, Mr. H. T. Chang, a graduate of Tokyo University, was appointed chief of the section of geology in the Department of Mines under the Board of Commerce and Industries, and in the following year he published in the *Proceedings of the Geographical Society of China* a program for a systematic geological survey of the country.

Upon the removal of the Central Government to Peking, Mr. Chang was appointed geological expert in the Ministry of Agriculture and Forestry. Shortly afterward the two ministries became amalgamated as the Ministry of Agriculture and Commerce, and the section of geology of the Bureau of Mines came under the leadership of Dr. V. K. Ting, a pupil of the eminent British geologist, Professor J. W. Gregory, of Glasgow.

When it was planned by Messrs. Chang and Ting to begin extensive geological field researches, a serious difficulty was encountered in the total lack of a staff of experienced field geologists. In his above mentioned program for a national geological institute Mr. Chang had proposed the establishment of a school for the training of surveying geologists, and this school was organized in September, 1913, with Mr. Chang as its director.

The pupils were selected from among the graduates of middle schools, and the aim of the enterprise was to give to these young men a course of about three years' intensive training in the branches necessary to a field geologist. It will be noted that this "geological school" boldly replaced university training as it was then given, and the eminent success of the experiment will commend it to the interest of all colleagues of Messrs. Chang and Ting, who in other countries have tried to solve by different methods the

*Late Director of the Geological Survey of Sweden, Mining Adviser to the Chinese Government, and Curator of the Museum of the Geological Survey of China

Students of the Geological School, Peking, during an excursion in the Kaiping coal basin, April, 1916

difficult problem of recruiting a body of field geologists.

The teachers of the Geological School were mostly officials in the Ministry of Agriculture and Commerce who, during nearly three years, persistently carried on these courses voluntarily and without any remuneration. Within an officialdom which by foreign writers is not infrequently spoken of with contempt as being devoid of patriotic sentiments, this patient and unostentatious work certainly stands out as a piece of splendid patriotism. I believe that it has never before been told in foreign language how these representatives of Young China quietly but zealously worked for years to teach a still younger generation how to open up this immense country for geological research. It gives me especial pleasure to pay this tribute to the teachers of the Geological School, which is no longer in existence because it has fully accomplished its aim, which was to give the Geological Survey of China its first staff of efficient field men.

I well recall these courses which, during the later terms, were held in the premises of the present Geological Survey where I also had my office. At every hour of the day the bell rang for a change of teachers, and often, when I arrived to begin my day's work, I met one or another of my Chinese friends who had just finished his first teaching hour for the day and who then went to his routine work in some office of the Ministry.

Besides Mr. Chang, the founder of the school, and Dr. Ting, the director of the present Geological Survey, I want to mention among the teachers Dr. W. H. Wong, graduate of the University of Louvain, a charming man and distinguished scientist, our petrologist who, in Dr. Ting's absence, is acting director of the Geological Survey.

Another most noteworthy member of the staff of teachers of the Geological School was Mr. Chang Yi-ou, M. E., educated in Mons. He was the first director of the Department of Mines, a position so eminent that a holder of such a rank in title-ridden Europe would hardly dream of stepping down to become a teacher of youths. Yet, in this land of ceremonies and of formalism, this high mandarin, in rank next to a Minister of State, walked quietly to his classes in metallurgy.

The subjects of study in the school were selected for the sole purpose of training geologists for the Survey. Besides pure and applied geology, including mineralogy, petrology, and palæontology, with some short courses in biological sciences, the program included chemistry, physics, geodetic and topographic surveying, mining methods, the elements of metallurgy, and some teaching of foreign languages.

The training was conducted not only in the schoolroom but also during numerous and trying field excursions. The average upper class Chinese is very little inclined to corporal exertions, but the writer of this article, who has traveled with educated Chinese of many types, can testify that the graduates of the Geological School have totally abandoned the sedan chair and fully realize that a pair of strong legs is the field geologist's sovereign means of locomotion.

When the last term of the school neared its end I was asked by the Minister of Agriculture and Commerce to undertake the examination of the twenty-two students, and I was permitted to conduct this in the form of an excursion in the Kaiping coal basin, where we stayed ten days. During the first three days we went as one party all over the field, after which each student was given a week's time to examine a selected portion of the region in detail. To some was assigned a mine, to others a special group of strata, and to still others an examination of the industries based upon the mineral materials of the region.

After their reports, written in English, had been turned in, I had the pleasure, in consultation with the director and the teachers of the school, to recommend the larger number of the graduates for promotion to junior membership on the staff of the Geological Survey.

There is no doubt that the Geological School has proved a success. I have since carried on field work for months with a number of these young men. There are of course large individual differences, but these men are all serious and very active workers. A number of them have been sent abroad, mostly to the United States, for additional training. One of them, who recently left for the United States, completed, before his departure, a monograph in English on the western hills of Peking, which is a piece of remarkably ripe and clear thinking, while at the same time it is a fine linguistic performance for a young fellow who had never been abroad. The paper is now in print and will soon be distributed.

This article began with the statement that the Geological Survey was in its beginning a product of the revolution of 1911. In its present form it is a creation of the Emperor-elect Yuan-Shih-Kai, who in 1916 was the center of an attempt to restore the monarchy.

In 1915 the writer of this article had an opportunity, under the auspices of the then Minister of Agriculture and Commerce, Chow-Tzu-Chi, to explain during a two hours' audience to President Yuan, and to illustrate by means of maps, sections, and numerous specimens, the result of our work with reference to iron ore deposits. This demonstration remains for me a most remarkable memory because of the deep impression I received of the powerful strength and penetrating genius of this man who was then the almighty ruler of China. I believe that to some small extent it contributed toward giving to President Yuan a clearer understanding of the methods and possibilities of geological research.

The would-be emperor, Yuan, desired to enhance the splendor of his ascension to the throne by creating a number of modern institutions intended to promote industries and education. Orders to this effect were given to the different ministers, and in our Board a number of institutions were planned or created, among them an enlarged Geological Survey with a considerable staff and a budget able to meet the necessary

CENTRAL BUILDING OF THE GEOLOGICAL MUSEUM, PEKING

EXHIBITION IN THE GEOLOGICAL MUSEUM, PEKING, DEVOTED TO IRON AND COAL

THE SECTION OF STRATIGRAPHY AND PALÆONTOLOGY

METALLIFEROUS DEPOSITS (EXCEPT IRON)

expenses. Some of Yuan's innovations have not materialized because of the prolonged political struggle which followed upon his tragic downfall. But the Geological Survey has, under Dr. Ting's able and determined leadership, always enjoyed the full support of the men in power, and has become such an important factor in the development of China's mineral resources that it may be safe to consider its continued growth fully assured.

The staff of the Survey at present includes thirty persons, among them eighteen field geologists. For practical reasons the Ministry has very largely utilized the personnel for the examination of various kinds of mineral deposits, and a large number of ore bodies and coal fields have been surveyed in detail on the scales of 1: 20,000, 1: 10,000, and larger scales. The iron ore deposits have been made the object of special detailed research, and a monograph on the iron ore resources of China, prepared by Dr. F. R. Tegengren, who for a number of years was connected with the Survey, is ready for publication.

The general geological survey of the provinces of Chihli, Shantung, and Shansi has also made considerable progress, and the geological description of the two last named provinces will soon be completed. Surveys for China's participation in the international geological map on the scale of 1: 1,000,000 have recently been begun.

Two series of publications have begun to appear, a *Bulletin* for smaller communications and *Memoirs* for larger monographic work. The first number of the *Bulletin* (1919) is available to the public, as well as the first *Memoir*, in which Dr. Wong gives a summary of all available data on the mineral resources of China (metals and nonmetals except coal). In this work is contained a vast amount of information on the mineral deposits of China hitherto absolutely unattainable to foreigners. So far Dr. Wong's work is issued only in Chinese,

NONMETALLIC DEPOSITS (EXCEPT COAL)

but a French edition is planned to appear in the near future.

No distribution of the publications to geological surveys in other countries will take place before another far advanced memoir is fully completed.

The greatest difficulty for scientific work within the Survey has been the lack of literature. In the early part of this year the director of the Survey succeeded in collecting from private donors, principally a number of mining companies, funds sufficient to start the establishment of an up-to-date geological library. The building is under construction, and at the same time the literature is being collected through many channels in Europe, as well as in the United States of America.

Even in the early days of the Survey a beginning was made in the establishment of a geological and palæontological museum. The larger part of the exhibition is devoted to the mineral resources of the country. In addition to a large section devoted to practical geology there are small but comprehensive collections of the minerals of China and of its igneous rocks and its fossils. The stratigraphic section is at present undergoing revision, and a section for dynamic geology has recently been organized. At present there are 2850 specimens on exhibition, under glass and properly labeled, all collected in China by our own men.

A very considerable extension of the museum is contemplated within a few years, in order to put on exhibition the large series of animal and plant fossils which we have already collected and which are at present in the hands of a number of specialists for monographic preparation.

It is not surprising that a Geological Survey which is only a few years old and which has been kept busy with technical problems, has not yet had time to do much purely scientific research. But extensive and systematic collecting of fossils of all kinds has been carried on during a number of years, and several prominent coworkers have been secured for the examination of this material.

In 1917 Dr. Th. G. Halle, keeper of the palæobotanical department of the Stockholm Museum of Natural History, traveled extensively in this country, collecting fossil plants. Since then we have continued the collecting, and at present Dr. Halle is engaged in the study of the very extensive material of Palæozoic and Mesozoic floras thus brought together.

In 1916 I began research work on the Cenozoic deposits of northern China, and in this connection a large number of fossil vertebrates, mostly mammals, have been brought together. As palæontological collaborator for this material I have succeeded in securing the coöperation of another of my countrymen, Prof. Carl Wiman, of Upsala, who is now engaged in preparing a monograph on the Hipparion fauna.

Recently Dr. A. W. Grabau, formerly professor of palæontology in Columbia University, New York, has come to China in the joint capacity of palæontologist to the Geological Survey and professor of palæontology in the National University of Peking. This eminent expert on invertebrate fossils has begun work on the material, mostly of Palæozoic age, which has been accumulated as the result of a number of seasons of field work.

It has been decided by the director of the Survey to issue the monographs to be prepared by Messrs. Grabau, Halle, and Wiman, as well as by other future palæontological coworkers, in a special publication entitled *Palæontologia Sinica*, which is intended to cover in a series of independent monographs all the fossil faunas and floras of China proper, as well as such material from the vast dependencies of China as may be brought together by the Survey.

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JET AND TURQUOIS INLAY

These objects were found in the ruin of Pueblo Bonito by members of the Hyde Expedition

DATING OUR PREHISTORIC RUINS

THE SEARCH FOR CIVILIZATION'S TIME CLOCK IN THE SOUTHWEST MAY REVEAL DEFINITE FACTS REGARDING THE STORY OF MAN IN PREHISTORIC AMERICA

BY

CLARK WISSLER

FOREWORD.—The Archer M. Huntington Survey of the Southwest was organized in 1909 by Clark Wissler, curator of anthropology in the American Museum, to include work among the living Indians of the American Southwest as well as a search for the history of the builders of the ruins so numerous throughout that region. The persons who have taken an active part in the investigations are: P. E. Goddard, R. H. Lowie, H. J. Spinden, N. C. Nelson, Leslie Spier, E. H. Morris, and M. L. Kissell, of the American Museum staff. In addition, a special investigation of the Zuñi was made by Prof. A. L. Kroeber, of the University of California. The tree-ring investigation has been delegated to Prof. A. E. Douglass, of the University of Arizona, the originator of the method. The entire investigation to date has been supported by Mr. Archer M. Huntington.

FOR many years a band of wild Indians concealed themselves in a bit of wilderness in the mountains of California, but were at last reduced to a single man, who, after a hopeless struggle against hunger and want, staggered forth into civilization and into captivity. Through the humanity of two or three professors in the University of California, he was given a home. He became the subject of many investigations. One of these professors, an expert in archery, soon found that, although the Indian had always used the bow, his archery was inferior. The professor out-shot the Indian in every trial. Like every true professor, he began to inquire into the reasons for this, making a number of experiments, the outcome of which was that the white man excelled the Indian solely because his methods were better. There is a profound truth in this result. The civilized man of today is far more efficient than the man of the Old Stone age, chiefly because his methods are superior. The graduate of a medical college handles a case of typhoid, whereas an African conjurer would make a mess of it, the difference being one of technique. And we shall not be far wrong if we say that man has advanced in proportion to the improvements in his methods, particularly in his methods for getting at the facts.

Wells, in his remarkably readable *The Outlines of History* calls attention to the generally recognized fact that the status of astronomical knowledge is an index to the degree of civilization. And the fundamental thing in astronomical affairs is precision in the reckoning of time. This science began with the first efforts of primitive men to keep a date and advanced bit by bit until today the clock and the calendar are so intricately interwoven with our civilization that they could by no possible means be eliminated without destroying the whole fabric. One would have even more chance of keeping his rug after pulling out the warp than of maintaining a civilization without calendars or clocks.

But, you ask, what has this to do with ruins in the United States or elsewhere? It has everything to do with them. All of the earth sciences and all of those having to do directly with man are eternally concerned with time in one form or another. Geology, that dignified and imposing science of the rocks, would be a ghastly chaos without its periods, and what are these periods but marks on the time chart of creation! So, when we set out to study ruins, we are concerned first and last with their time-relations.

In 1909 Mr. Archer M. Huntington expressed himself as sufficiently interested in the prehistory of southwestern United States to finance a systematic survey of the ruins found there, with a view to discovering their time-relations. In other words, men

Photograph by N. C. Nelson

SECTION OF REFUSE HEAP AT PUEBLO BONITO, CHACO CAÑON, NEW MEXICO

Something of the history of any human settlement may be learned by examining the accumulations of débris thrown out from day to day during the life of the community. At Pueblo Bonito, one of the largest and most interesting ruins in the Southwest, and one from which the American Museum possesses extensive collections, the accumulated refuse lying in front of the village forms a long mound measuring about 75 x 500 feet at the base and all of 16 feet in height. In 1916 two separate trial sections were made, of which the above is the highest. The results were disappointing in that the broken pottery, and other industrial remains found showed comparatively little change during the supposedly long process of accumulation. Elsewhere in the Southwest the stylistic changes, for example, in pottery, are often very marked were to be sent out to seek in these ruins the marks by which they could be arranged in order, according to their ages. So a research staff was organized to grapple with this problem and has been engaged upon it at intervals during all the succeeding years.

At the outset it was conceived that since the earth left telltale marks of its progress in the rocks and sands, so man in and about these ruins must also have left the record, if one could find out how to read it. Just lately, for example, a celebrated European geologist has been touring this country to see how the clays beneath our soil are laid down and he is reading in their hitherto imperceptible lines the successive pulsations of time. So in the case of the ruins, it promises to be but a matter of method, and the Archer M. Huntington Survey may be said to have as its object the discovery of civilization's time clock in the Southwest. Once with its key in our hands we can unravel many of the mysteries of the cliff dweller, the mesa dweller, and the builders of the great pueblos like Bonito and Aztec.

Experience in other parts of the world, particularly in Egypt and western Europe, suggested that the most likely means of dating ruins was to be found in the fragments of pottery scattered about. Pottery is truly an art, for while it has utility, it is at the same time so plastic in origin as to give almost free rein to styles of artistic expression and the use of decorative technique. Further, though pots are easily broken, their pieces are practically indestructible, so whenever and wherever pottery was made, one may find the samples. The record, therefore, is in the simple potsherds, and our problem was to find a method for reading it. Descriptions of technique are apt to be wearisome, so we will content ourselves with a few of the simpler steps in the method of dating ruins by potsherds.

In the first place, where things pile up on the ground, the first to go down will be at the bottom of the heap. In the days of our pioneer forefathers, a cabin was built in the forest, and a clearing made. As the ashes accumulated in the fireplace, they were dumped out behind the cabin. Here also were cast the sweepings from the hearth, bones, broken glass, dishes, etc. So, in the course of time, a considerable heap was formed in which was recorded, in one way and another, the story of what went on in the cabin. Now, it so happens that most of the ruins in southwestern United States are of the community type, that is, they contain a number of rooms, in a few instances as many as five hundred, one to a family. The families usually cast their ashes and sweepings in one place, where from year to year the community dump grew and grew, until in some cases it reached a depth of twenty feet. It was in these dump heaps that our investigators found part of the answer to their questions. Such a deep deposit of ashes and other waste contains several kinds of pottery and of these the oldest is at the bottom and the latest at the top.

This method of dating, according to which is above and which is below, is, for convenience, called the method of superposition, or the stratigraphic method, because it has some analogy to the earth's strata which the geologist interprets in terms of time.

If the people once living in what is now a ruin in southwestern United States had never moved away and had always rebuilt near the same spot, there would be little difficulty in reading their history. All we would then need to do would be to dig a trench through the accumulated ashes, sweepings, etc., and study the markings and contents of the exposed sections, where everything is laid down more or less successively in order of time. But nowhere is the problem so simple. Every now and then the population shifted. For aught we know, new peoples came as conquerors and evicted the rightful owners.

Photograph by G. H. Pepper

DETAIL OF CEILING IN PUEBLO BONITO

This rectangular room has ceiling beams of pine placed transversely and covered with a layer of willow stalks, which in turn is covered with cedar bast; a four-inch layer of adobe over this formed the floor surface of the room above. The bark-stripped beams and peeled willows give the ceiling the most ornate appearance of any in the pueblo

Photograph by E. H. Morris

CEILING CONSTRUCTION AT THE AZTEC PUEBLO RUIN, NEW MEXICO

The Pueblo Indians from the earliest times to the present appear to have used only two types of ceiling construction, of which the above is the simplest and most common. Heavy timbers up to eighteen inches in diameter served as chief support and were laid usually (not so in the illustration) two or more feet apart and across the long axis of the chamber. Resting on these came a longitudinal course of lighter timbers, placed only a few inches apart. Next above was placed a transverse course of thinly split timbers, or else sticks, laid as close together as possible. This in turn was covered with a layer of twigs, bark, or grass and then capped with a few inches of clay or adobe, pounded down hard. The surface of the adobe, if it was to serve as a floor, was sometimes coated with blood and then smoothed and polished with a stone

Photograph by N. C. Nelson

VILLAGE OF TAOS, NEW MEXICO

This is the northernmost of the Pueblo villages in the Rio Grande Valley and one which has been sufficiently conservative to have preserved for us another type of communal house construction. The village consists of two main buildings, each four or five stories high. These buildings are terraced in the shape of a rough pyramid, in place of being terraced only on the south side, as in the case of Acoma. The doors, windows, and chimneys, as well as the hive-shaped ovens to be seen on the ground level adjoining the buildings, are of European origin. Population in 1910 was about 500

Photograph by N. C. Nelson

VILLAGE OF ZUÑI, NEW MEXICO

This is the largest Indian village in the United States, having a population of about 1700. It is the home town, as it were, of a separate tribe or linguistic stock, many members of which live in outlying settlements during the farming season. The apparent rise of ground on which the village stands is due in part to the accumulated débris of fallen houses surmounted by later constructions. Until recently the building material consisted largely of sun-dried clay or adobe. The fenced areas are garden plots. The Zuñis were the first of the Pueblos to come in contact with the Spanish explorers more than 350 years ago

Photograph by N. C. Nelson

STREET SCENE IN ACOMA, NEW MEXICO

This Keresan village is unique in several respects. It is built on top of an isolated rock about 360 feet high, and has occupied that fortress-like situation since before the white man invaded the country in 1540. Probably, therefore, it is the oldest inhabited community in the United States. Again, this village, housing today about 700 people, preserves for us one of the most highly developed types of ancient Pueblo architecture. Thus it consists of three long, parallel, communal buildings, all facing south, there being no doors or windows in the north wall, which latter rise sheer two or more stories, as seen in the left of the picture. In the foreground at the east end of the principal "street" may be seen the water reservoir, occupying a hollow in the surface of the great rock. This stronghold was stormed and partly burned by the Spanish in 1598

Photograph by N. C. Nelson

VILLAGE OF LAGUNA, NEW MEXICO

This village was founded in historic times, which partly accounts for its lack of architectural compactness. Thus here, in addition to the modern doors and windows, we see isolated one-story houses, strongly suggestive of the breaking up of the communal form of organization. To this might be added the further fact that the greater number of the population credited to this village, 1441, actually live in small outlying settlements, all far more favorably situated for agriculture and stock raising than is the home village itself

Photograph by N. C. Nelson

SPRUCE TREE HOUSE, MESA VERDE, COLORADO

Of the several large cliff houses in the Mesa Verde National Park, Spruce Tree House is the most picturesque with respect to situation and is, besides, a fine example of this type of habitation. The ruin was discovered by members of the Wetherill family of Mancos, Colorado, in 1888; it was partly excavated by Baron G. Nordenskiöld, of Stockholm, in 1891, and in 1908, was completely cleared and repaired by Dr. J. W. Fewkes, of the Bureau of American Ethnology. The ruin occupies a shallow natural cave, 89 feet deep and 216 feet long. It contains 114 secular and 8 ceremonial rooms, and it is estimated that it accommodated a population of about 350

Photograph by N. C. Nelson

BALCONY HOUSE, MESA VERDE, COLORADO

Balcony House, so named from the shelf or veranda on the second-story level seen near the extreme right of the picture, is regarded as exhibiting the highest architectural achievements of the Mesa Verde cliff dwellers. It is one of the best preserved ruins of the communal cliff-dweller type, several of the twenty-five rooms being intact. A retaining wall, in places raised high enough to serve as a balustrade, is to be seen along the front of the cave, keeping enemies out and preventing the younger inmates from falling into the deep chasm below

Photograph by N. C. Nelson

CLIMBING TO "INACCESSIBLE HOUSE," MESA VERDE, COLORADO

The manner in which the original cliff dwellers reached their most secure abodes is not always apparent. In some places, where no natural edge gave access, traces of steps cut in the living rock remain; elsewhere, small holes sufficiently large for the insertion of the toes and the grip of the fingers have been chiseled into the steep face of the cliff, sometimes along a horizontal and sometimes along a vertical line. Commonly, however, there is no evidence whatever either of natural or artificial approaches, and we must suppose that the inhabitants entered by means of ladders. To reach some of these eyries is one of the exhilarating features of a trip to the cliff-dweller regions

Anyway, what we do find is that some ruins were occupied for a very long time, others for but a brief time, but none of them for all of the time. So, to get a time chart for the Southwest as a whole, the results obtained from many, many different ruins must be patiently pieced together and by precise methods. Just how this was done is a long but interesting story, but what we are now concerned with are some of the results obtained by the use of these methods.

Before going on we should note that the Archer M. Huntington Survey is making use of other methods of estimating time. Many of the ruins encountered still hold the spruce and cedar logs used to support the ceilings. Now, it so happened that a specialist in the growth of trees had devised a method by which he could tell whether the trees from which logs were cut were growing at the same time, or to what extent their life periods overlapped. This again is a triumph in the precision of method by which the annual growth rings of the trees are read as time charts. So the logs in the ruins were subjected to these methods and some interesting things found out. For instance, all the logs in the great ruin at the town of Aztec, New Mexico, seem to have been cut within a span of nine years or less, which would mean that the whole of the great building, with its four hundred or more rooms, was planned in advance and built with astonishing speed, when we take into consideration that all of these timbers were worked with stone tools and the stones of the walls dressed by pecking with sharp-pointed pebbles. But this is not all, for timbers from the great ruin of Bonito in the Chaco are being compared with those from Aztec to see which ruin is the older. From the results so far, it appears that Bonito is the older by at least a quarter of a century. The work, however, has not yet gone far enough for us to be certain of this. All that we need note here is that where timbers are preserved we can even read the time records in their cross sections. Professor A. E. Douglass, the discoverer of this remarkable method, explains in another article just how the thing is done and shows us how he measures the growth of living trees. Our only point here is that this is another improvement in our methods for dating ruins in the Southwest and was first applied to them by the Archer M. Huntington Survey.

It may be that the work of this Survey has not gone far enough to give us the outlines of man's career in the Southwest, but it can give it with some precision for two large areas in which the most intensive work was done. One of these areas is in the vicinity of Santa Fe, along the Rio Grande in the state of New Mexico, the other is the extreme northwestern part of the state and the adjoining parts of Arizona, Utah, and Colorado, or the basin of the San Juan River. A glance at a map will show that these two areas stand as two large samples of the central area of Pueblo Indian culture and so may be considered representative of the whole. Fortunately, other investigators are working in adjacent fields so that the results of all can be coördinated, thus giving us, for the first time, a chronology for this prehistoric wonderland of our country. Since, as we hinted at the outset, the best indexes to time differences are the changing styles of pottery, so the large historical periods under which the ruins are grouped are named in terms of pottery. This does not mean that these styles of pottery are the only distinguishing characteristics between the periods; each of them can be checked with architectural features, for example, but pottery characters are the most accessible and lend themselves most readily to the method of superposition. So remembering that the successive styles of pottery are merely indexes, and that by them we can determine the time sequence in the historical development of the Indian in the Southwest, the periods in the following chronological table will be understood:

(7) The Historic Period (1540–1921); pottery index, Two-Color Glazed Ware, modern type.
(6) Period of Three-Color Glazed and Painted Wares (?–1540); this is the latest prehistoric period.
(5) Period of Two-Color Glazed Wares, early type.
(4) Late Period of Two-Color Painted Wares.
(3) Early Period of Two-Color Painted Ware.
(2) The Pre-Pueblo Period, crude pottery only.
(1) The Initial Period, or Basket Makers, pottery generally absent.

One of the first things to strike us in this table is that the historic period begins in 1540 and that all before that is prehistoric. This may sound strange, for in the Old World prehistoric often means earlier than a few thousand years B. C. Yet, since the first visitor to the region we are now considering came in 1540, that is when its real history begins. All this serves to show how arbitrary and artificial is the distinction between what is history and what is prehistory. Although six of the seven periods outlined above cannot be dated in the strict sense of the word, we can nevertheless give their relative time-relations, for we can prove one to have come after the other. We can go even further and estimate the length of the periods as shorter or longer in proportion to the territory they cover and the number and variety of their remains. Yet, the details of this cannot be entered into now.

When the first Spanish expedition came on the scene in 1540, they found Indians living in large houses, just as they do today, the Hopi, Zuñi, and the many tribes about Santa Fe which, for convenience, we designate as Rio Grande Pueblos. These are the people of the historic period (7), and it is from the study of them that we can the more readily understand the preceding periods. For example, in 1540 no such people were living anywhere in the valley of the San Juan where we find the great ruins like Aztec and Bonito, excavated by the American Museum; in fact, these great ruins belong to Period 4 in our table, and so far no ruins have been found in that area that fall in any of the later periods, although some of the ruins belong to Period 3 and some to Period 2. On the other hand, we know that the people who, in Period 5, built the ruins farther east, around the upper Rio Grande, copied largely from the older inhabitants of Aztec and Bonito. Anyway, they had the same styles of pottery and the same architectural ideas. This is one of the many interesting points brought out by the Huntington Survey and it means that, in the earlier prehistoric periods, what we know as modern Pueblo culture had its beginnings in the region of the San Juan or that part of the United States adjacent to the four corners of Arizona, New Mexico, Utah, and Colorado. Then, for some reason, the center of culture shifted eastward to the valley of the Rio Grande, with a few outposts elsewhere. Probably it was the same kind of a shift as that from Greece to Rome, or better still, like the movements in civilization that left the glorious Babylon a wreck in the desert.

The cliff houses about which so much has been written and which so stir the imagination are all in and about this same San Juan country. These also belong to Period 4, and some of the houses in what is now Mesa Verde Park were almost contemporary to the great ruins of Aztec and Bonito. Perhaps some of them were earlier; that remains to be found out. Certainly many of the cliff houses of the adjacent parts of Utah are earlier, falling at the opening of this period.

There are many other interesting points in the story of the Southwest, some of which are shown in the arrange-

Photograph by G. H. Pepper

PUEBLO BONITO, CHACO CAÑON, NEW MEXICO

This photograph taken from the cliff shows the west third of the ruin partly excavated. In the foreground may be seen under construction the field laboratory of the expedition ment of the collections in the American Museum. The attainment of the above chronological outline and the perfecting of the methods noted for reading the time-relations of ruins has been a slow and laborious process and is, like most things of this kind, not the work of a single individual. A number of investigators have given their best efforts to the problem, but the Huntington Survey has predominated in the two regions noted, the San Juan and the east Rio Grande district, through the work of Mr. N. C. Nelson and Mr. E. H. Morris, of the American Museum staff. The work now under way promises to reveal the subdivisions of the periods given in our table and thus render our dating more exact. It seems clear then, that the Archer M. Huntington Survey will in the end contribute something precise and definite to the story of man in prehistoric America. It has already given us better methods and, as we have seen, the attainment of better methods promises new triumphs.

Two fine examples of two-color painted ware from Pueblo Bonito. The colors are black and creamy white

26a

A PAINTED TABLET OF WOOD
From the ruined pueblo of Bonito, New Mexico. The Hyde Expedition

DATING OUR PREHISTORIC RUINS

HOW GROWTH RINGS IN TIMBERS AID IN ESTABLISHING THE RELATIVE AGES OF THE RUINED PUEBLOS OF THE SOUTHWEST

BY

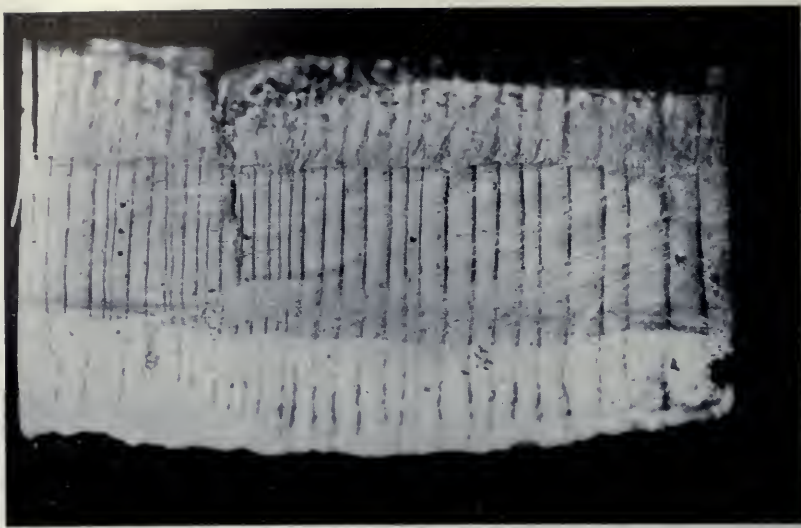
A. E. DOUGLASS*

THE freedom from undergrowth of the pine trees of northern Arizona and their exposure to the characteristic drouths of the country, first suggested to the writer the idea that their chief variations in growth had a climatic origin. Accordingly a long search was made for evidence of climatic effects, which has resulted in the identification, dating, and measurement of more than 100,000 rings in nearly 400 different trees. Many interesting results have been obtained, and an extensive technique of ring-study has been developed. Of that technique the most important feature of present interest is the cross-identification of the growth rings in the different timbers. This was first developed in 1911 in studying trees near Prescott, Arizona, where it was found that nineteen trees out of twenty had ring systems showing marked resemblance to one another. This gave additional confidence in the yearly identity of the rings and the climatic character of their major variations. The extent of area over which this extreme similarity is found may be only a half mile, as in the mountainous region near Prescott, or 50 miles as found between groups in the Sequoia region, or even more than 200 miles, as shown between Flagstaff, Arizona, and Durango, Colorado. Occasional rings of extreme character are found to be alike in the Sequoias of California and in the pines of Arizona, 450 miles away. Very rare rings have been traced across 750 miles of country.

In 1915 Dr. Clark Wissler wrote a letter expressing interest in the study of tree rings and offering sections of beams from ruins in New Mexico. The offer was gladly accepted and a selection was made at once from beams, from surrounding trees, and from trees growing in ruins. From these specimens it was evident that pine and spruce beams were very good for this study, while juniper often was very disappointing. In 1918 Mr. Earl H. Morris, working in the Aztec ruins for the American Museum, sent six sections from Aztec and three from Pueblo Bonito, in Chaco Cañon. The six from Aztec were immediately found to cross-identify, three or four of them very well and the other two or three only fairly. The three from Chaco Cañon have not yet been identified.

Part of this was very encouraging, and in August, 1919, I visited Aztec in order to plan more satisfactorily the next step. I found that the sections had come from a pile of loose beams whose exact locations in the ruins were not known. It was immediately evident that the location of each beam should be known and that a way must be devised to get the rings without injuring the floor beams or other parts of the structure still in a good state of preservation. Accordingly soon after this visit I had special borers made of steel tubing, one inch in diameter, with saw teeth at the one end and brace attachment at the other. Small teeth, some ten to the inch, have proved better for dry beams than coarse teeth of twice that size. These borers were tried out at the laboratory in Tucson and the fine-toothed one sent to Mr. Morris. With patience and skill he has used this borer on the beams at Aztec and obtained for me cores from twenty-six beams located in sixteen different rooms, without injury to the ancient construction of the building.

*Professor of Physics and Astronomy, University of Arizona



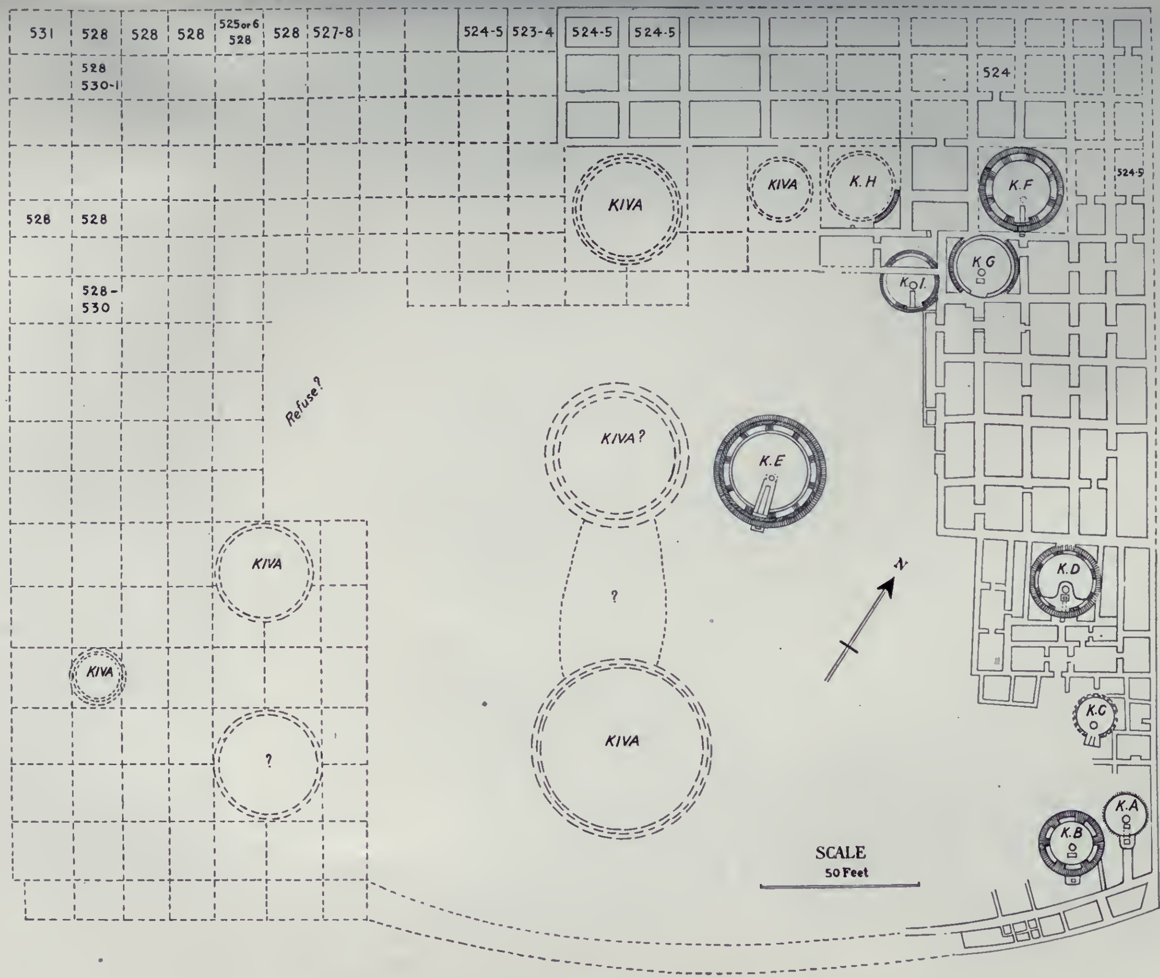
Core from northwest corner room at Aztec, showing latest cutting date, R.D. 531. Three black dots (really pin pricks in the wood) form the century mark, one dot indicates the decade. (Twice natural size)

I obtained finally the ring-records of thirty-seven different beams, of which thirty-two were accurately located in the ruins. About twenty different rooms were included, passing across the large north portion of this great 450-room building. The cross-identification in nearly all was perfectly easy and satisfactory and the relative dates of cutting the timber ascertained. In order to express these conveniently a purely hypothetical date, R. D. (Relative Date) 500, was assumed for one of the larger of the outer rings and all dates expressed with reference to that year, whatever the real date in our era may have been.

It will be seen from the diagram that nine years will cover the time of cutting the various timbers examined and that it was not continuous. The principal cutting years were R. D. 524–25 and 528. The builders probably worked in the forest in the colder part of the year and obtained enough logs to last two or three years. These were used until nearly or entirely exhausted, when more were obtained.

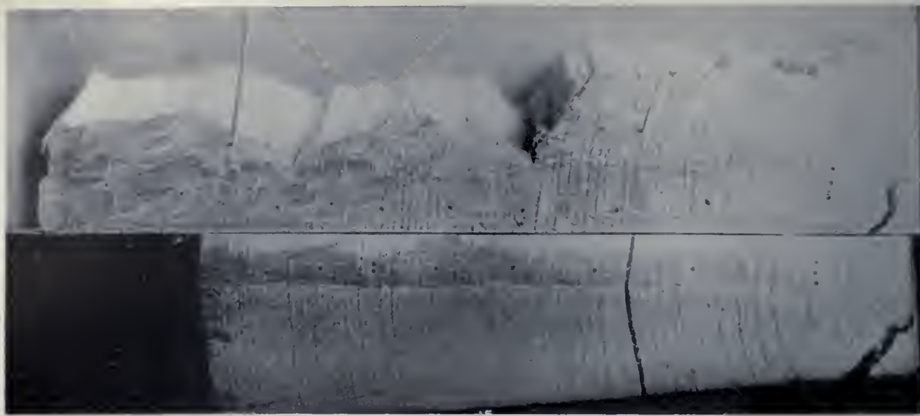
As a result of this study, the beams brought back to the American Museum by the Hyde Expedition to Chaco Cañon, twenty-five years ago, were examined and sections cut from seven. Of these one was cedar and could not be interpreted and one was a small pole used in pueblo floor construction to lay upon the beams. Two were posts, the rest ceiling beams. It was noticed that a peculiar sequence of rings occurred near the outside of each. This made the determination of the relative cutting dates in this group very easy. Then it was recollected that a similar sequence existed in the Aztec beams. Upon careful comparison the cross-identification between these ruins became absolutely convincing. Similarity was found for the years R. D. 480–84, 475, 470, 461, 454, 448 or 449, 435, 432; 427, 423, 418, 408, 406, 402, 393–95, etc. There is no doubt that the beams in Aztec and Pueblo Bonito were living trees together during more than a hundred years and that the cutting of the timbers for Aztec followed that for Pueblo Bonito by from forty to forty-five years.

Finally one beam from Peñasco Blanco, a few miles down the Cañon from Pueblo Bonito, appears to have



PLAN OF THE AZTEC RUIN

This shows the location of the dated beams, with the relative dates of the cutting of the timbers, and the condition of the excavations at the end of 1917. Much has been done since



Sections of two beams, the upper from Aztec and the lower from Pueblo Bonito, placed side by side with their rings matching, to show how much the Aztec timbers grew after the Pueblo Bonito timbers had been cut

been cut about twenty years after the greater number of the Pueblo Bonito beams. Two of these Pueblo Bonito beams are from identified rooms, namely 32 and 36 as numbered by the Hyde Expedition.

In conclusion I should state that an extensive study has been made of the types of growth records which most nearly resemble the rainfall periods in localities near by and very careful selection and weighting of the Aztec and Pueblo Bonito curves of tree growth have been completed. The resulting curves have been combined and standardized and show yearly growth as in the accompanying figure. This curve undoubtedly gives us a fair idea of rainfall variations near this ruin during the two centuries preceding its construction. There is reason to hope that by the aid of the Sequoias it may sometime become possible to determine just how long ago this particular sequence of variations occurred in northwest New Mexico.

Tree growth at Aztec and Pueblo Bonito from R.D. 288 to R.D. 527, arranged to test climatic periods by an optical method

Baron Gerard De Geer, Professor of Geology, University of Stockholm

BARON GERARD DE GEER AND HIS WORK

BY

JAMES F. KEMP*

AMERICAN and Canadian geologists and many others interested in geological science have recently had the great pleasure and privilege of welcoming on this side of the Atlantic Baron Gerard De Geer, past-president of the International Geological Congress of 1910, professor of geology in the University of Stockholm, and foremost among the European investigators of the great Ice Age. Baron and Baroness De Geer, with two experienced assistants, have been applying in Canada and the northeastern United States the methods of investigation already carried by them to an almost perfect technique in Scandinavia. Very promising results are indicated, and in Canada and the United States the full publication of the report of the expedition will be awaited with deep interest. Geologists in these two countries have already profited greatly by field trips, conferences, and lectures extended by our distinguished visitors.

Baron De Geer is now in his sixty-

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third year. His university training was gained in the ancient seat of learning of Sweden, Upsala, where the traditions of Linnæus and Berzelius still linger. While yet a candidate for his degree, he began his work on the Swedish Geological Survey in 1878, and soon became especially attracted by the problems presented by the moraines, sands, and clays left by the retreating continental glacier in the geological times just preceding our own. In 1882 he made the first of five trips to Spitzbergen, then a No Man's Land in the Polar sea. In 1896, 1898, and 1901 he went again, and in 1910 he conducted a large party from the International Congress of that year. The Spitzbergen work has thrown a flood of light on the geological formations of this far northern land and has given a clue to the structure and large tectonics not alone of the islands but of the North Atlantic ocean bottom, as well.

Baron De Geer's most interesting results have been attained, however, in the study of the laminated clays which were deposited in many parts of Sweden from south to north. It appears that the melting and retreating continental glacier backed up in front of it extended bodies of fresh water, which often reached considerable depths next the ice itself. Into these waters the sediment-laden streams, fed by the melting ice, poured from tunnels in the bottom of the glacier just as they do now from the fronts of glaciers resting on the surface in the valleys of the Alps and elsewhere. In the warm seasons the melting was great and the supply copious; in the winter the melting ceased and the streams failed. Following the cold months the supply of water and suspended sediment was renewed and passed through the annual cycle of the seasons. The sediments in the cold and heavy waters spread out over the lake bottom and, as they settled, produced widely extended deposits of laminated clays.

The laminated clays thus were laid down in annual layers of the same significance as are the rings of growth in a tree trunk. As melting waned in the autumn, the amount and coarseness of the sediment fell off, giving a layer of fine, fat clay, which is easily recognizable and which marks the close of a year's work. By its aid the annual increments can be detected, measured in thickness, and counted. They vary widely. Some may reach six inches when the summer was unusually hot and melting was copious. Some may be only an inch or even less, corresponding to cold summers which may have been occasioned by sun spots. When the annual layers have been measured by ingenious and expeditious methods, the thickness of each one can be represented to scale by a vertical line, and the lines can be drawn in series, standing one half centimeter apart upon one base line for a long series of years or measurements. When the summits of these vertical lines are connected, a saw-tooth curve results which practically shows the ups and downs of the seasons, the very hot ones being shown by high summits in the curve, the very cold ones by low notches.

After years of work in developing these methods, Baron De Geer realized that, of the markedly hot seasons, each prevailed over a wide area, and would be recognizable by its especially high summit in the curves which were plotted for separated places perhaps many miles apart. The summit was necessarily preceded and followed by characteristic ups and downs. Matching the curves soon revealed such startling uniformity that individual years could be correlated without an appreciable chance of error. Still more remarkable was the later discovery that curves taken in Finland across the Baltic Sea and the Gulf of Bothnia, as well as others over the mountainous divide in Norway, could be matched with those established in Sweden, and the same years in each could be recognized. Now comes the question, can they not also be matched and compared with those taken in North America, since study of comparative meteorological records today brings out a practical uniformity in hot years and cold years on both sides of the Atlantic.

Baron De Geer was therefore moved to come to America, measure as many exposures of laminated clays as possible, plot the curves, and compare them with his series of similar ones in Scandinavia. In the four months since his arrival in August last he has found exposures of much interest in Vermont, Quebec, Ontario, Wisconsin, New York, and in the Connecticut Valley of the New England States. In the elaboration of the details he will be greatly aided by his assistants, Dr. Ernst Antevs and Dr. Ragnar Lidén. The former is spending a year in the United States, working over the problems during the closed season at one or two of the American universities, and with the coöperation of American and Canadian friends and colleagues, will resume field work when the warm weather comes around again. Should the establishment of correlated years result for both sides of the Atlantic it would be a great step forward.

In Sweden Baron De Geer has reached a measurement of about 13,500 years for the retreat of the continental glacier across Sweden. For the first portion of the time of retreat, which is represented by the area lying between the terminal moraine in Denmark and Germany, and which is partly beneath the North Sea, measurements are less accessible than for the succeeding stages. The latter are, however, almost, if not quite as accurate as if he could have counted the rings of growth on a gigantic, long-lived tree. In southern and central Sweden 5000 years have been established, with an almost negligible limit of possible error, and in northern Sweden 8500 years with a possible error of one or two centuries.

Various interesting corollaries follow. For instance, a deposit of prehistoric flint implements has been found on a delta in Sweden whose relations with known laminated clays can be made out, giving a pretty accurate clue to the number of years ago that primitive users of flint followed the retreating ice into Sweden. Again, the continental glacier extinguished plant life, and, on its retreat, gradually the vegetation followed it northward. The actual number of years can now be quite closely made out, and the time required to change inhospitable sands, gravels, and clays to soils capable of supporting the present plants and trees can be determined. A chronology is afforded for the distribution not alone of plants, but of animals as well. Should a parallel chronology result for America, we shall be able to check the estimates of time already based on the retreat of the crest of Niagara Falls, on the retreat of the Falls of Minnehaha, of the Mississippi, and the one or two local attempts by American observers to count clay layers in single localities.

NOTE.—The arrangements for the trip of Baron De Geer and his party through the United States and Canada were under the general charge of the American-Scandinavian Foundation, with coöperation from the International Educational Alliance. The following groups of American and Canadian geologists cordially joined in making the trip a success: President Henry F. Osborn, of the American Museum of Natural History; Director George Otis Smith, of the United States Geological Survey; Dr. I. C. White, president of the Geological Society of America; Vice Chancellor Adams, of McGill University; President Branner, of Stanford University; Professor Chamberlin, of Chicago University; Professor Coleman, of Toronto University; Dr. W. O. Hotchkiss, director of the Wisconsin Survey; Professors Kemp and Luquer, of Columbia University; Dr. Leverett, of the United States Geological Survey; Professor Lindgren, of the Massachusetts Institute of Technology; Professor Scott, of Princeton; Dr. Upham, of Minneapolis; and Professor Woodworth, of Harvard. An executive committee consisting of Consul General Lamm, of Sweden, Mr. John G. Bergquist, Dr. I. C. White, Dr. Waldemar Lindgren, Dr. H. G. Leach, president of the American-Scandinavian Foundation, with Dr. J. F. Kemp as chairman, gave attention to the details. Baron De Geer lectured at Chicago, Columbia, Cornell, Harvard, and Michigan universities; and before the American Geographical Society, the American Philosophical Society, the Carnegie Institution, the National Academy of Sciences, and the New York Academy of Sciences. At the annual meeting of the last-named he was elected one of the limited number of Honorary Members.

M. Curie

MARIE SKLODOWSKA CURIE

BY

GEORGE F. KUNZ

RADIUM, discovered in 1898 by Mme. Curie in association with her husband, Pierre Curie, marked an epoch in the development of physical science, for the wonderful phenomena shown by this strange element seem destined to revolutionize our conception of the material universe.

It was Mme. Curie who took the initiative in the researches leading to this discovery, following the indications offered by some experiments on uranium made by Henri Becquerel, and in coöperation with her husband she carried on the investigation step by step until it resulted in the great discovery. She was born in Warsaw, Russian Poland, November 7, 1867, and is the daughter of Ladislaus Sklodowski, professor of physics and chemistry in the University of Warsaw. In 1891 she went to Paris, where, in 1893, she received a licentiate's degree in mathematics, and in 1895 a degree in physical and chemical sciences. She soon after became instructor in physics at the high school of Sévres. In 1908, two years after her husband's death, she was appointed chief professor of physics in the Sorbonne (Université de Paris). In conjunction with her husband and with Henri Becquerel, she was awarded in 1903 the Nobel Prize in physics, and in 1911, the Nobel Prize in chemistry was awarded to her alone.

When Mme. Curie's visit to the United States was announced, her many admirers were united in the wish to offer her some notable testimonial of their regard. While this recognition of her work was highly appreciated by her, she steadfastly refused all proffers of a fund for her personal use, but in the spirit of the true scientist, she consented to accept the gift of one gram of radium, which she could use for her experiments.

Contributions toward the Marie Curie Radium Fund, organized for the purpose of making such a gift possible, may be sent to the Equitable Trust Company, Treasurer, 37 Wall Street, New York City. One gram of radium costs $100,000; thus far $78,000 have been raised.

The ceremonies attending the presentation of the radium to Mme. Curie will take place at 4 P.M. on May 20, 1921, in the White House, Washington. President Harding himself will make the presentation.

A reception in honor of Mme. Curie, which will be held in the auditorium of the American Museum on the evening of Tuesday, May 17, at 8:15, is being arranged by the American Museum of Natural History, the New York Academy of Sciences, and the New York Mineralogical Club, which have selected from their membership the following representatives to act as a reception committee: Dr. Henry Fairfield Osborn, Dr. Frank M. Chapman, Dr. William J. Gies, Dr. Edmund O. Hovey, Dr. D. Willis James, Mr. Ivan O. Lee, Dr. Frederic A. Lucas, Dr. William D. Matthew, Prof. Alexander H. Phillips, Dr. Edward L. Thorndike, Dr. Ralph W. Tower, Mr. Herbert P. Whitlock, Dr. George F. Kunz.

Mme. Curie will speak on this occasion and, in addition, addresses will be made by Professor Michael Ivorsky Pupin, Dr. George B. Pegram, Professor Alexander H. Phillips, President Henry Fairfield Osborn, Dr. Robert Abbe, Dr. Francis Carter Wood, and Dr. George F. Kunz.

An important collection of radio-active minerals will be exhibited in the west wing of the American Museum, comprising a full series from the magnificent Morgan Collection of the museum, supplemented by interesting specimens from the private collections of the members of the New York Mineralogical Club, and minerals and apparatus, both physical and medical, loaned by other institutions and individuals. Some interesting literature relating to the history of radium will also be shown. The exhibition will be opened the night of the meeting and will continue indefinitely thereafter.

APPROACHING TUBANO FROM THE SOUTH ALONG THE WELL TRAVELED TRAIL

BIRD COLLECTING IN THE HIGHLANDS OF SANTO DOMINGO*

BY

ROLLO H. BECK

I ARRIVED in Santo Domingo City in the fall of 1916 direct from a South American bird collecting trip, with instructions to reach, if possible, the higher portions of the island of Santo Domingo. The presence, however, of American marines in full control of the city and the reports of bands of insurrectionists in various parts of the country made immediate compliance with the instructions out of the question. After consulting the military commander, I collected about the city for a couple of months, crossing the river to visit promising ground on the other side and hiring a boat to go up the river a few miles. I also worked the wilder plantations outside the city limits. One day, while walking along the river bank, I heard shooting on the other side and saw natives running along the far bank and disappearing in the brush; sailors from the warship on the river pulled hurriedly for shore and hastened up the main street of the village. Later in the day I learned that two American officers had been shot by natives who had escaped in the thick brush that surrounded the village.

Prudence suggested that I circumscribe my going and coming still more, so much so that I packed up one day and took the steamer for Sanchez on the north side of the island. The marines at this post and the native population seemed to be on friendly terms, so a visit to La Vega, a town forty miles inland, was planned. Here conditions were more strained and a guard was sometimes placed at the entrance to the country roads to search incomers for firearms.

At this place I discarded my khaki shirt and pants and bought a cheap native outfit. Attired in the blue denim, soaked from hours of rain, and sloshing along through mud puddles and pools of water on one of the less frequented lanes, I, no doubt, looked like a *mal hombre* (bad man), as one native muttered when in the morning I passed his hut at a rapid stride, headed for the hills. At any rate, my looks were not reassuring to one of the young marines who was occupying the post on my trail as I neared town. He wanted to know where I was going, and whether I had a permit for the gun, but he allowed me to proceed when I mentioned his Major's name and offered to show his signature to my pass. A battle took place twenty miles from La Vega a few days later between marines and natives, but my peregrinations about the country were not interrupted. Completing my work in the vicinity, I returned to Santo Domingo.

Quiet reigning there, I left for Azua, where a guide and mules were hired and the trip to the higher parts of the island was begun. We started before daylight and were well on our way by sunrise. The call of the burrowing owl by the roadside gave way to the cooing of doves as we passed a stream of water and headed out through the brushy lowlands toward the rolling hills in the distance. Wild guinea fowl crossed the road on foot once or twice ahead of us and one covey lost a member, as the twenty gauge was ready when they flushed from the side of the road at our approach. By noon we had reached a small brook of warm water but it was late afternoon before we arrived at our destination, the village of Tubano, where the search for specimens was to begin. Tubano consists of a couple of dozen houses, two stores, and a church, and is located in a little valley on the south side of the Rio de los Cueves, a fine stream

* Illustrations from photographs by the Author

of water heading among the highest peaks of the island. A letter to the leading storekeeper from a friend in Azua placed me in possession of a good bed in the rear of the store, with all facilities for satisfactory work, but after a few days' collecting about the village I decided that a camp nearer Mt. Tina, the highest charted peak in the West Indies and distant only fifteen miles or so, would be more productive of desirable birds.

The bird collector and his guide returning from a mountain trip in Santo Domingo

Arrangements were made with Señor Ramon Velasquez, a prominent resident who lived up the river several miles, and, saddling the mules, we moved up and located in the storeroom of the ranch. The ranch was built on a high bluff overlooking the river which here ran between mountains of considerable height. There were three or four other houses near by, but the clearings where tobacco and cane were grown, I learned later, were miles away.

One of my first acts on reaching the settlement was to drop a red-tailed hawk which was swooping down toward a flock of chickens in the back yard. Judging by two or three experiences in Santo Domingo, I believe such wing shooting was unknown to the natives. Several red-tailed hawks lived near the settlement, and although they frequently caught fowls and were not wild, they were permitted to live on until my advent. One of them with a chicken in its crop I shot one evening, and another was taken care of when it lit near my camp in the cane field to watch an old hen and her brood.

Although my guide from Azua claimed to have done much hunting, his success with the gun which I furnished was very negligible, but when he told me the reason of his inability to shoot a certain kind of pigeon that was occasionally seen in the underbrush near our camp at Mt. Tina, and which later proved to be a new variety, it surprised me so that I soon found it necessary to send the mules back to Azua in his care and depend on local guides in my further wanderings about the higher peaks of the island. As possibly some American shooter may be interested, I will give the reason for his nonsuccess with my gun. It was that the pigeon, when approached near enough to be in range, continued to walk away instead of standing perfectly still until the shot was fired! I later went over the ground this guide had hunted and secured several of the pigeons. The gun I used luckily did not require such an immovable target previous to the pulling of the trigger.

Mt. Tina lay at the head of a stream which entered the river close by the settlement, and Señor Velasquez a couple of days after my arrival agreed to pilot me to the top of it. We left one afternoon, following up the bed of the cañon to an old camp occasionally used by pig hunters. Two young men and four dogs accompanied us to hunt for wild pigs. When we reached the hut we found it occupied by two other pig hunters and their retinue of canine assistants. Shortly before reaching the camp, which was located on the creek bank at the lower end of a wide flat, we climbed up over a steep, rocky formation where a warm stream of water, bubbling out of the hillside a few yards away, kept a growth of green grass flourishing. From this we flushed a couple of killdeer uttering their characteristic notes as they flew out to meet us. They seemed to me decidedly out of place in the bottom of a narrow, heavily forested cañon, where beautiful trogans and strident-voiced parrots were the principal avian inhabitants. Here, as darkness fell, I

Mountain guides with outfit on slopes of Mt. Tina

FORT AT SANTO DOMINGO

The old fort built in the days of Columbus still houses troops heard for the first time the clear, sweet notes of the hilgaro, a small bird that sings usually only at dusk or daylight. The natives consider this the finest songster in the island.

We started from camp early next morning and soon left the bottom of the cañon to begin a steep, zigzag course that, after luncheon, led us out on the ridge terminating at the peak of Mt. Tina. The last few hundred feet to the top was a stiff climb, and the Azua man, complaining of a tired feeling, was left in charge of the horses, while the Señor and myself went to the top. We found it to be an acre or so in extent, thickly covered with ferns and bushes and with no evidence of having been visited before. It dropped sharply away on all sides and afforded a fine viewpoint from which to locate other peaks in the range, but the height was disappointing to me, for several other peaks not far distant are some hundreds of feet higher. I regretted not having an aneroid barometer with me, but my work was originally planned for sea level conditions and the desirability of an instrument for measuring uncharted mountain heights was not thought of.

I have not yet learned who first proclaimed Mt. Tina to be more than ten thousand feet high, as it is marked on the charts, or whether some other peak might have been measured and Mt. Tina given the credit.

To one doing the measuring by climbing the mountain itself Mt. Tina affords easy approach on horseback, but to reach Mt. Pedro Blanco a few miles to the south, or Mt. Pelone some twenty or so miles to the north, both slightly higher than Mt. Tina, considerable foot work is required. One of the objects in visiting the highest part of the island was to search for nesting sites of an ocean bird, *Pterodroma jamaicensis*, one of the West Indian petrels, which formerly nested on Jamaica and Guadeloupe islands but apparently has now been exterminated on those islands by the introduced mongoose. No petrel burrows were found, but from the scattered pines of the mountain tops to the mangrove swamps of the sandy shores, wintering warblers from the Eastern States were always in evidence, the black and white and the redstart being two of the most common. It interested me greatly some months later to find on the summit of Cuba's highest peak, after a week's chopping and climbing to reach it, a black and white warbler sharing with a common island tody the distinction of being the only birds present at the time of my visit. On our return from Mt. Tina late at night, the pig hunters were found at camp, having been unable to follow their dogs through the tangled brush that the wary pigs frequented.

Señor Velasquez and his men returned to their homes next day, while the guide and myself spent several days at the camp collecting a number of species that found favorable living conditions in the deserted flat and the tall branching trees that dotted its surface.

There were several old, sour-orange trees scattered along for a mile near the trail through the flat, and these were particularly patronized by the parrots, for the seeds of the ripe oranges seemed to form one of the principal items of their food just then.

"Pericos," the local name for a smaller paroquet that was sometimes seen, did not appear to favor this part of the cañon, although a chattering flock used to sweep down through the royal palms in the cane fields about five miles below our camp, and later I obtained specimens down there. The handsome blue ground pigeon, living more like a quail or partridge than like our American pigeons, we sometimes caught sight of, or shot at in the shady parts of the forest, and it was here and with this species that my guide demonstrated his unfitness as a bird collector's assistant. When our provisions ran short we packed up and went down to the ranch house, the guide returning with the mules to Azua while

The Santo Domingo burro seems able to carry as large a load of charcoal as two men can pile on his back

Watching a boy in the warehouse at Sanchez shoveling over the drying cocoa beans reminded me of former years in California when I shoveled dried prunes in a similar manner in a San Jose warehouse

Tobacco for pipe smokers is wrapped in a palm leaf, tightly roped by a burly laborer, and left to dry for some time before shipment to market

In the vicinity of La Vega one strolls but a short distance along the river bank before encountering a busy washerwoman intent on her work

THE RIVER BANK AT SANTO DOMINGO IS A BUSY PLACE IN THE EARLY MORNING

CANOE LOADS OF FIREWOOD AWAITING PURCHASERS AT SANTO DOMINGO

I collected about the settlement, awaiting a fresh supply of rice, beans, bologna sausage, and coffee from Tubano.

The tobacco harvest was on at this time and the boys were routed from their slumbers at two o'clock in the morning to get a drink of coffee, mount their mules, and ride several miles up the river to the tobacco field, to return in the afternoon with the capacious saddlebags heaped with dried tobacco leaves. It was cold work, until sunrise at least, for I shivered under my two blankets as I watched the shivering boys saddle their mules, drink their coffee, and ride out of the yard into the windy, starlit trail. The tobacco was brought in, moistened with water and stripped by hand (a half dozen neighbors helping at this part of the labor), and then either rolled into cigars or wrapped up in a palm leaf to be tightly roped and pressed into a long, cylindrical roll for shipment to Santo Domingo. When the tobacco was gathered it was time to cut a part of the sugar cane, fifty acres of which were growing on a cleared hillside two miles up the cañon, so the family moved to the cane field and I shifted also to a shelter in the lower part of the field, spending several days collecting pigeons, numbers of which flew into the royal palms morning and evening to eat the ripening seeds; also blackbirds, which were more numerous here than elsewhere, paroquets, one compact flock being a daily visitor to the palms, as well as some of the smaller birds that the cleared land had an attraction for.

The cane was carried on the backs of burros to the crude press, was crushed by horse power between primitive rollers, and then boiled in an iron cauldron, one of the family standing by to keep the fire going and the scum cleared from the boiling juice. When boiled, the syrup was poured into clean, neatly sewn palm leaf molds which, when filled, weighed about a kilo each. This is the standard sugar of the villagers and finds ready sale in Tubano.

I wished to visit some of the higher peaks to the southward of Mt. Tina, so Señor Velasquez furnished me a good guide, and taking beans, corn meal, coffee, sugar, and a roll of bologna sausage sufficient for a five days' trip, we walked up the river some distance and then turned into a cañon that led toward the peaks.

We kept to the bottom of the cañon for hours until a solid wall of rock faced us, with water pouring over in a picturesque fall. We were compelled to retrace our steps to where an easier slope offered a chance to scale the southern side of the cañon. Slowly cutting a trail and holding to the tough bushes, we succeeded in reaching a ridge that stretched upward in the direction we were headed for.

We cut our way upward until nearly dark and then camped by a trickle of water not far from a ridge that would carry us straight up to our destination. On the morrow we started out in good shape and by eleven o'clock had arrived within a mile of the peak I desired to ascend.

The guide at this point refused to go farther. He insisted on turning down a cross ridge that led back toward the settlement miles away. My imperfect knowledge of Spanish prevented me from fathoming his reasons for not wanting to go higher, so I told him to wait a few hours for me and I would come back that way in the afternoon.

An indistinct pig trail up the mountain-side was thereafter my guide, but this led me in a roundabout way to the tops of several peaks with little valleys in between, where there were more North American birds singing and flying about than West Indian. A few of the little mountain sparrows, a hummer or two, and a flock of calling parrots could not compete in numbers with the many warblers flying back and forth from one pine tree to another. Soon after one o'clock a fog began to gather around the peaks and, finding no birds differing from those of the lower levels, I returned

Late in the afternoon the washerwomen of Sanchez stroll homeward

to my baggage and dropped down to where the guide was to await me.

I arrived at the spot and called. He answered from a mile away, across two dangerous looking cañons. As they did not seem absolutely impassable, I started across; by dint of careful climbing—at one place throwing the gun and bag across a grassy slide and holding on to the grass roots as I worked over, and getting out of one rockbound cañon by crawling up a long pine-tree root that with all its twisting could find no crack large enough to crawl into—reached the narrow, broken ridge down which the trail led. The guide pointed across a small valley to a fire burning on the mountain-side above it, and said we must reach that as the country below us was too rugged to work through.

We plunged down through ferns and bushes, and dodging rocks and boulders, crossed the valley and reached the top of the jagged ridge at last to find a long, easy trail stretching away below us.

At one point the fire, started by a pig hunter hours before, was burning over the ridge we ascended, and while for me it was a matter of stifling heat and holding my breath as we ran up across the burning area, for the shoeless guide it must have been still more interesting with hot rocks and burning sticks underfoot, as he stepped high and lively after me. Our way led down the crest of a long, fern- and pine-covered ridge to the thickly forested slopes below—my former camp at Mt. Tina—but it was long after dark when we reached the camp, for the guide failed to locate the right cross trail and we were forced to take a tortuous cow path that eventually landed us in the flat where the trail was known to both of us even in the darkness.

A couple of days at the flat and a couple more at the ranch finished the Mt. Tina region, and I returned to Tubano to hear a tale of woodpeckers on the slopes of Mt. Pelone about thirty miles to the northwest on the

At Bani many of the residents were shingling their roofs with a fresh covering of palm leaves

headwaters of the San Juan River. Woodpeckers were a desiderata, so a guide was hired and we started forth on a search for them. A day's ride into the mountains landed us at a friendly mountaineer's home, and here a second guide and his son were obtained to lead us into a region never visited by anyone other than the few mountain residents, who used the well watered valley lying at the base of Mt. Pelone to pasture a few cattle in the summer time. Reaching this valley late one afternoon, we found a little open hut and a well built corral where the cattle were held overnight before starting out on the return journey to the settlement. Immediately on our arrival the boy started out to round up a couple of cows with small calves. The calves were corralled and we had fresh milk for coffee every morning during our stay.

The cold water and frosty mornings of this mountain valley were very invigorating after my months of coast living in the tropics. If some kindly disposed sportsman would plant a few trout from the United States in the headwaters of the San Juan River, this region would furnish an excellent recreation ground for lowland dwellers who desired a change of climate at little cost.

Wild pigs range in all the cañons but the pigeons and doves of several species are found more common at a lower altitude. The most interesting birds to me, after thorough search failed to reveal signs of the mythical woodpeckers, were the crossbills, typical boreal birds which somehow had become residents of this tropical isle. Their presence on the island had been discovered but a few months before by Doctor Abbott, an old Smithsonian collector, of whom I used to read years ago in short museum papers as discoverer of new species on various East Indian islands. I met him in Sanchez as he was leaving for Washington and he told me the rainfall of the interior of Santo Domingo would equal that of any East Indian land he had visited. Fortunately for me the rainy season was over when I reached the highlands of the island and only a desultory shower or two were encountered during my entire stay.

The crossbills, as a rule, kept to the high pine ridges and much climbing was necessary to reach their haunts, but a flock of crows that also frequented the region were more friendly and often flew down to light on the corral fence but a few yards away from us.

I climbed to the top of Mt. Pelone one day and left a small monument on the highest point as a record of my visit. On the rocky slope below me a forest fire was crawling slowly upward, and the next day from a distant ridge I saw it sweeping over the barren dome of the mountain. Fire-setting seems to be a favoritepastime of the mountaineers and, while it may help the pasture and reduce the wild pigs' refuges, it is bound, by the destruction of so much vegetation on the steep mountain-sides, to cause greater floods along the lowland river banks when the rainy season is at its height. Although the woodpeckers proved non-existent, I was well satisfied with the week's stay at Mt. Pelone and returned to Tubano with a good series of Dominican birds.

The patriarchal schoolmaster of the village came in the first night of our return to enthuse over the success of the trip, and I still have at home a congratulatory letter he wrote to me at Señor Velasquez's ranch after our ascent of Mt. Tina, in which he characterizes, in rich Castilian phrases, the climb as the first successful attempt by a foreigner to scale the highest peaks of the island since the day that Columbus first sighted them in 1492. To his beneficent interest in my work I attribute much of the success of the trip, for without it the question of guides would have been much more serious.

After packing the birds for mule-back transportation, I left Tubano one morning with a pack train bound for Azua and with a much higher regard for the mountain inhabitants of the Dominican Republic than I had expected to have on my entrance to their fastnesses.

From Azua I elected to travel overland to Santo Domingo instead of waiting for a steamer, so, arranging for transportation of specimens and outfit, I hired a boy and mules and sallied forth. At Bani an auto-stage became the means of transportation, and rough though the road was, it surpassed the slow travel of the ancient mules except at river crossings where ox teams became the motive power. It was roofing week in Bani seemingly, and most of the residents of the town were replacing their house coverings with a fresh coating of leaves. Bani is quite a shipping point for coffee and several yards of drying coffee were seen as we entered the town.

As Santo Domingo was neared, cleared fields and cultivated plantations became more common, and the last few miles over an excellent motor road gave one a feeling of pleasant anticipation for the change to city living. A few days in Santo Domingo City suffices one, and the next steamer for the Haitian coast saw me aboard as a passenger for Aux Cayes to outfit for a trip to the higher parts of the La Hotte Mountains in southern Haiti.

JACKASS PENGUINS AT HOME

The so-called jackass penguins of southern South America and South Africa do not incubate their eggs upon ice as some other species are obliged to do, but enjoy the shelter of a burrow a few feet deep. They are now seen in the bottom of their home after being dug out by the inquisitive photographer

DAYS WITH THE BIRDS OF TIERRA DEL FUEGO*

BY

F. E. BLAAUW, C.M.Z.S.

Last June the American Museum was visited by the author of this article, who is one of the best known of living aviculturists. On his estate at Gooilust, between Amsterdam and Utrecht, Holland, he has a park 140 acres in extent, devoted to the rearing of exotic mammals and birds. As far back as 1889 one may read in the *Bulletin de la Société Nationale d'Acclimatation* an account by Mr. Blaauw of the collection of living animals and birds at Gooilust, and for many years he has kept white-tailed gnus, American bison, blesbok, banteng (or Malayan ox) eland, Przewalski's horses, and kangaroos.

Among the birds his favorites are the waterfowl, and the ornithological and avicultural journals of France, Holland, and England contain many an entertaining account from his pen of the habits and nesting of the rare species of birds that he has kept and bred. In 1897 Mr. Blaauw published a *Monograph of the Cranes*, beautifully illustrated from paintings of live specimens in the Zoological Garden of Amsterdam, which constitutes an authoritative review of this family of birds.

Wishing to see more of South American waterfowl in the wild state, he undertook in 1911 a journey across the southern part of that continent to Chile and south to Tierra del Fuego. It is of his visit to this remote Land of Fire that we are fortunate to read in the following account. Three years later he paid a visit to South Africa, observing both the wild birds and the farming of ostriches.

Like all nature lovers at the present time Mr. Blaauw is deeply concerned over the gloomy prospect confronting the wild creatures of even the most remote lands. In the letter to President Osborn which accompanied this manuscript he called attention to a few of the most glaring instances of slaughter. "In Zululand, following the advice of some professor or other, they are waging a great war against all the wonderful game of that country, under the delusion that this will also exterminate the tsetse fly. Just as if the fly won't find other animals to live on! In the Addo Bush near Port Elizabeth they have almost exterminated the last South African elephants to please the greed of the surrounding land owners, who want the reserve notwithstanding the fact that thousands of acres are not being used elsewhere.

"I fondly hope," he writes, "that my paper will not send people with guns to Tierra del Fuego to kill and destroy what I have loved to watch. So if you think that it may have this effect, please burn it instead of printing it."—The Editor.

IT WAS in April of 1911 that I visited Punta Arenas in the Strait of Magellan, with the object of crossing over to see something of Tierra del Fuego, that land of wonders which I knew only from Darwin's description in the *Voyage of the Beagle*. Although this great island is so near Punta Arenas, I found it extremely difficult to get any useful information concerning the country, and it required a couple of days to complete my preparations so that I could cross the strait.

When at last I was ready to start, I left the bulk of my luggage in the care of a hotel keeper at Punta Arenas, confiding to him also a pair of live, long-billed parrakeets which I had brought from Osorno. Taking only a valise, I proceeded to the boat, which was to leave at half past three that afternoon. The little steamer was of the worst possible description, and looked as though the least bit of bad weather would prove its undoing.

At the last moment, just as we were about to cast off, a peon arrived with two saddle horses, expecting to board the vessel. The captain, a young Norseman who spoke English, refused to submit to such a delay, saying it was too late to load the horses, and off we went, leaving the poor man on the pier!

All about the harbor, on every buoy or empty boat, were numbers of white-breasted cormorants (*Phalacrocorax albiventer*), and as we proceeded we saw many penguins (*Spheniscus magellanicus*) swimming in the sea. The latter navigate in long strings, one behind the other, and I counted as many as forty-nine in such a file. They would swim unconcernedly until quite near the vessel and then suddenly take fright and dive. They would reappear at a short distance, but their fear would cause them

*Illustrations from copyrighted photographs by Rollo H. Beck

General view of the town of Punta Arenas, from which the author started on his trip to Tierra del Fuego

Waves at high tide along the water front at Punta Arenas to dive again with a jerk, and this would be repeated until they were far away. On one occasion as the ship crossed their course they were so near that they dived right under the keel, reappearing on the other side. Their behavior gave one the impression that they saw the ship or realized what it was only when quite close. They were most entertaining to watch, and I saw them during nearly the whole trip across the strait. There were also plenty of black-backed gulls and terns about.

We were apparently midway between Punta Arenas and Tierra del Fuego when I asked the captain at what time we were to land.

"Oh, sir, we will probably not land at all tonight," was his unexpected answer. "I cross for the first time, and the entrance of Porvenir is very difficult; so if there is a fog, I dare not risk it."

"But in that case where am I to spend the night?" I inquired.

"Oh, you will have to spend the night, sir, on the sofa in the saloon."

As he said this a cold shudder ran down my back. The "sofa" was the dirtiest bench imaginable, and the saloon a low, stuffy compartment full of evil smelling half-castes.

"But," continued the captain, "if there is no fog, and the moon comes out, I'll venture it."

Heartily did I pray that the moon would come out; and when we were close to the land, my trust was rewarded. So my friend the captain said he would attempt to enter the harbor. "I am glad for your sake," was his good-natured remark. "It would not have been comfortable for you to spend the night on that sofa."

As we neared the land, there was no vestige of any habitation or entrance, and I began to wonder where Porvenir could be; the boat approached still closer, and then I saw a side entrance of the sea into the land. Thither we steered under a glorious moon, and I began to realize that the captain had not exaggerated in saying that the entrance was difficult. We were obliged to follow a zigzag course, to double three or four corners, and to avoid, so I was told, numerous sand bars, before the lights of Porvenir became visible in the distance, at the end of a deep bay. Near the last turn there was a wide sand bank, and on it a large flock of upland geese (*Chloëphaga dispar*) were quietly watching us pass. A little farther on a pair of steamer ducks fluttered away from our vessel.

At length we tied up at a pier a good distance from the lights of the "town"; and there being no one to help me with my valise, the captain kindly detailed a seaman to carry it for me. This sailor seized my bag and ran off into the darkness. My shouting brought him back. "Where are you going, my friend?" I said. "I believe I told you I wanted to go to the inn."

"Well, sir, I was never here before," he answered.

"I don't doubt it," said I, "but you surely must suspect that the houses are where we see the lights." So telling the man to follow me, I steered through the obscurity toward the town, hoping to find the inn called the "Hôtel Alleman." Eventually I succeeded; the hostess, who was a German, asked me whether I wanted a first- or a second-class accommodation. Upon my demanding her best first-class room she showed me into a small one at the end of a long passage. It contained a bed and a washstand, but nothing else. The room, however, looked clean, so I pronounced myself satisfied, and begged her to prepare dinner. This she promised.

In the meantime her husband, an Englishman, had come in. I told him I wished to go on to Jente Grande the next day. "Then you had better telephone." What a welcome and unexpected answer! "You can do that at a shop close by."

So to the store I went, and by telephone received a most courteous answer from the Jente Grande Company, with

JACKASS PENGUINS ON BLEAKER ISLAND, FALKLANDS

The penguins seen by the author in the Strait of Magellan also breed on the Falklands, congregating in considerable numbers. We can easily forgive the good old near-sighted saint of Anatole France's *Penguin Island*, who mistook the birds for men and proceeded to evangelize them. But here the naturalist pauses to reflect that the "pingouin" of the original really means an auk, and the translator has taken a decided ornithological liberty

GULLS RESTING IN A QUIET COVE IN THE FALKLANDS

Near the gulls stands a night heron very similar to that which haunts our northern ponds at dusk. These two familiar types of birds seem in strong contrast to the penguin a little farther back

What's in a name? The steamer ducks were so called after a noisy, old-fashioned side-wheeler, rather than the stolid freighters which here serve them as a background. Perhaps we can call them namesakes, nevertheless

the offer of a saddle horse, and for my luggage the use of a cart which took goods to their place from the steamer. The favor was gladly accepted, and I went back to my inn, hoping for dinner.

In a clean-looking room was a well-set table—even flowers were not lacking. The apartment, however, was icy cold, while a big stove stood there fireless but apparently quite ready to light. When requested to start the fire, my host replied that the stove would give no warmth, only smoke; I asked him nevertheless to try, and in ten minutes volumes of smoke filled the room.

Now I happened to be well acquainted with this kind of stove, and I soon put things right, so that a genial heat replaced the choking fumes. My host was very much astonished, but . . . fuel is scarce in some parts of Tierra del Fuego.

Next I asked for my dinner. This was no easier to get than the heat, and consisted of one egg, a slice of meat, and a little bread. Say what I would, nothing else was to be had. So I went to bed rather hungry, enjoining my hostess to get me something more for the next morning.

This she did, and after breakfast I went out to enjoy the beautiful views about Porvenir, the capital of Chilian Tierra del Fuego. This settlement lies at the end of the deep bay, which looks more or less like a lake, and is surrounded by rising ground. Around the bay were large flocks of upland geese, upon its waters some pairs of steamer ducks, and flying about were several pairs of crested[1] ducks (*Anas cristata*) which often came quite near.

The males of these last birds seemed a little larger than the females, and showed more white in the wing; they were very pretty and quite tame. The bay, I afterward heard, was a sanctuary where no birds could be shot.

The steamer ducks in the bay were of

[1] "Crested duck" is the oldest name for *Anas cristata*. It was used by Latham. Unfortunately Sclater and Hudson use "crested duck" for a bird of another genus, *Sarkidiornis*. Crawshay, in *Birds of Tierra del Fuego*, calls *Anas cristata* the "Antarctic duck." This name is not very appropriate, because the bird ranges north to Peru and is not found in the true Antarctic regions.

the small, "flying" species, and they also went in pairs. I may as well give my opinion concerning these birds and tell of my experiences at the same time. It is a subject of controversy among ornithologists whether there are one or two species of steamer ducks. In my belief there cannot be the slightest doubt that there are two species. Much has been said and written on this subject, but the differences between the two species have seldom been properly appreciated.

The typical *Tachyeres cinereus*, the steamer duck of seafarers, is a big, heavy bird quite unable to fly, not only when old, but even less able when just attaining maturity. These birds cannot even rise above the water, but when alarmed make off by striking the water with their wings, so that a great splashing ensues. They are absolutely confined to large bodies of salt water; and I have seen great numbers of them in Smith Channel, in Eden Harbor, Indian Reach, —as many as forty-two together. These flocks consisted of pairs of old birds with full-grown young of the year.

In this species both sexes are gray; the male has a pale or pearl-gray head and neck, and a bright yellow bill. In the female the gray is duller, so that the head is not strikingly paler than the rest of the body. The bill is also yellow, but not so clear in color. In the young birds seen by me in Smith Channel, and later on at Melinka near the northernmost island of the Chonos Archipelago, the plumage is tinged in some parts with brownish gray, but not enough to obscure the generally gray aspect. The bill-color of such young birds is mixed with a dark greenish tint, and their legs are dark.

These birds were evidently young of the year, since they were under the guidance of a pair of adults. This was readily observed at Melinka, where they were tame. Yet they looked even heavier and clumsier than the adults, and most certainly could not fly. They were expert divers.

Closer view of two steamer ducks resting on the rocks.—The differences between flying and nonflying birds are not evident in a photograph; indeed, some of our most competent authorities on ducks are not yet converted to the view that they are of specific importance

The second, or flying species, is quite a different bird. To begin with, both sexes are much smaller than in *Tachyeres cinereus*, and the female is still smaller than the male. She is also very differently colored. The male is clear gray with a white breast and a clear yellow bill. His tail is elongated, and its point carried upright when swimming. The female has a brown head, and the rest of the body is of a beautiful vinaceous color, with a white breast. The bill is brown. The white speculum in the wing is present in both species.

On the seashore near Jente Grande I saw small flocks of these flying steamer ducks, and a good many pairs on the lagoons inland. I watched them repeatedly flying high overhead, and at the sea coast I noted that they went from the inland lakes toward the shore, and vice versa. Not a single bird of the nonflying species was observed by me in this part of Tierra del Fuego.

My kind hosts at Jente Grande, who aided me in these researches, were quite convinced of the validity of the two species, as was also Mr. Cameron, the director of the Jente Grande Company. The smaller kind is found a good deal inland, they told me, but the large one is restricted entirely to the sea. This quite agrees with my own observations.

In the lagoons about Jente Grande the birds were very tame, and when I rode around a pond or stood at the edge of the water, pairs of small steamer ducks would come near to look at me. When alarmed they sometimes start off without getting quite clear of the water, then they rise above it but still touch with the points of the wings as they fly away. This is nevertheless quite a different mode of progression from that of *Tachyeres cinereus*, and resembles the way a coot sometimes starts away. The larger steamer duck does not succeed in raising its heavy body out of the water, but strikes right into it with both wings, and makes a great splashing.

Of the small flying species of steamer duck (for which the name *Tachyeres patachonicus* has been proposed) there are a female and a young male (both from the Falklands) in the Leyden Museum, several females in the British Museum, and an adult pair in the Buenos Aires Museum.

Let us return now to the fine clear day when I was admiring Porvenir Bay. In a farmhouse on the far side I caught signs of movement; a small wagon was taken out and a pair of horses harnessed to it; then a white saddle horse was brought forward. Half an hour later the wagon was seen advancing in my direction and a man mounted the white horse. This seemed not so easy, for the animal resented it very much. With the man on its back, the horse advanced by jerks and starts, with nose in the air, and after a while both wagon and rider were at my door. The man descended, my valise was placed in the vehicle, and I mounted the white horse.

The wagon was to show me the way; this was easy, and I followed at some distance. We first ascended the hills behind Porvenir, and then reached some undulating ground grown over with short grass and low bushes but quite without trees. Soon we were passing along a little piece of water where many upland geese were running about, feeding on the short grass; they let us go by without their being disturbed in the least. Climbing still higher, I now enjoyed a good view of the country, most beautiful in its wild loneliness, its undulating surface apparently without end, short grass and low bushes stretching away until everything was lost in the purple of the horizon.

Several lagoons were passed, some large and of intricate shape, with deep bays, high promontories, and outstanding islets. Others were round, with smooth margins like an ornamental lake in a park of old Europe,—or sometimes only a part was thus rounded, the rest running on to more irregular shape, full of bends and corners.

In one section of a large lagoon were great numbers of coscoroba swans, and as I approached, they challenged me with their call of "coscoroba." In the different museums I visited in South America I found only fairly large cygnets of *Coscoroba candida*, which had lost the markings of the newly hatched young, and were now yellowish gray. I am therefore very much pleased to be able to figure, through the kindness of the Duchess of Bedford, the newly-hatched young of the species, bred at Woburn, England.

The so-called coscoroba swan I have always regarded as a gigantic tree duck, and the character of the head markings found on the downy young at this age go far to prove that I was more or less correct in my surmise. In fact these markings as shown in the figure combine those of the duckling of a shelduck with those of a tree duck. The head markings show to a great extent the characteristics of those of a young tree duck, while the pattern on the body is very like that found in the downy young of a shelduck.

About the same body of water thousands of upland geese were running everywhere, and a good many crested ducks were along its margin and in the lake. All these birds were so tame that I could get quite near them. After admiring them for a while I rode on, and having passed over some higher ground, came to another piece of water, or perhaps another arm of the same lagoon.

There a great number of black-necked swans (*Cygnus melanocoryphus*) greeted my view. It was a beautiful sight; there were some little islands and everywhere black-necked swans, with only an occasional coscoroba among them. Probably these two species do not mix readily, but they were both equally tame, and I could ride down to the margin of the lake without their taking wing. On the little islands, I afterward heard, black-faced ibises (*Theristicus melanopsis*) breed.

Leaving the black-necked swans I rode on after my guide and passed flock upon flock of upland or black-banded geese (*Chloëphaga dispar*). This goose is often called the Chilean form of *Chloëphaga magellanica;* but the expression is misleading, for although Tierra del Fuego belongs for the greater part to Chile, *C. dispar* was not found by me in Chile proper. I have been over a good part of southern Chile, but I have never seen a single specimen, nor even heard of it.

On the other hand it inhabits Tierra del Fuego in countless numbers as a resident, and would probably be still more numerous were it not so much persecuted. One meets it almost everywhere, and it seems to be especially attracted by the fine grass which results from the grazing of sheep. In spite of its being a resident in Tierra del Fuego its life history is not completely known; for example, several people told me it had never been found molting. Indeed, the common belief was that it did not

Coscoroba cygnet two weeks old, sketched by the author. The peculiar color pattern indicates that in spite of its large size it is probably more closely related to the shelducks and tree ducks than to the typical swans. The ground color is white, the markings are dark gray, bill and feet flesh color molt like other geese. Now it is quite certain that *Chloëphaga dispar* molts its flight feathers all at the same time like nearly every other goose. There is really only one exception to this rule, *Anseranas melanoleuca*, the Australian pied goose, which molts like a hen, and can always fly. So it only proves that at the critical time of the molt the birds wander away to some unknown part of Tierra del Fuego, or to some of the adjacent islands, where they can renew their pinions in peace and security. This circumstance is probably all that keeps the species from destruction, inasmuch as it would certainly be exterminated if it molted in the inhabited country, and meanwhile lost the power of flight.

Among all the flocks of *Chloëphaga dispar* I have seen only very few white-breasted birds belonging to the allied *C. magellanica* of the Falklands. They had probably lost their way and joined flocks of *C. dispar*. Nor have I ever met any considerable number of *C. magellanica* together.

At last after a three hours' ride from Porvenir, I saw a deep bay formed by the sea, and not far from it some houses, painted yellow with scarlet roofs. The bay is the "Jente Grande" and the houses constitute the settlement of the same name, where I was going to spend a few days. I was welcomed with the greatest kindness by the director of the Jente Grande Company, and at luncheon made the acquaintance of his whole household.

Kelp goose (a near relative of the upland goose) and her family.—The female shows a considerable degree of protective resemblance to her surroundings, yet the young are less fortunate in this respect. As for her consort, unless nature designed him to lure enemies away from the brood, we cannot guess why he was made so conspicuous

Two thousand sheep were to be shipped that afternoon. They are loaded by driving them in small parties on to a narrow bridge that ends on the vessel. At the end of the gangway that rests on the ship the hurdles along its sides are so close together that but one sheep can pass at a time. In this way it is possible to count the sheep and to get them into the spaces prepared for them, which hold six sheep each. The difficulty is to get one or more sheep to set foot on the gangplank, but this achieved, the others follow in the proverbial way, so that a continuous stream of sheep flows into the ship. These poor creatures were to be taken across the strait to Rio Secco, where all were to be slaughtered the next morning.

On the morrow I was again in the saddle, and under the kind guidance of Mr. Aylwin set out to see as much as possible of the birds around Jente Grande. The first ones seen that day were large flocks of ruddy-headed geese (*Chloëphaga rubidiceps*) or "brent" as they were called there. These geese were grazing not a hundred yards from the house, and only took wing after I came quite near, alighting again a hundred yards farther on. Unlike the upland geese (*C. dispar*), these are only summer visitors to Tierra del Fuego. At the time of my visit in the beginning of April they had gathered into flocks previous to their departure, which would take place probably in a few days.

I was told that still another member of the genus *Chloëphaga poliocephala*, a scarce breeder and summer visitant in this country, sometimes associates with the ruddy-headed geese in these flocks, but personally I did not see a single example of this goose in Fireland.

Proceeding on our ride we came to a large but apparently very shallow lagoon, with flat margins. Some of these bodies of water are fresh, others are salty. On this one I found five flamingos (*Phoenicopterus chilensis*), which my guide told me came to the Jente Grande lagoons in autumn to spend the winter. They were rather shy and flew off as we came near. While I was standing at the water's edge looking at the flamingos, a pair of large ducks came flying overhead, and landed or, better, alighted in the water with a splash not far from where I stood. They proved to be the flying steamer ducks mentioned before. Riding along the shore, I observed five more pairs of these ducks; when I stood still they all came quite near, so I could see them well. All were of the same kind, the males light gray, larger, and with bright yellow bills, the females vinaceous, and with brown bills. This was a fine sight!

In the same lagoon in the shallow water stood numbers of upland geese, while a good many crested ducks were swimming about. One large red-necked grebe (*Æchmophorus major*) was also seen.

Leaving the lake, we came into some hilly country, and in a small valley where the bushes had attained slightly greater dimensions were two old carancho nests. These were built of sticks right from the bottom of the bush, filling it entirely and reaching a height of five or six feet. The carancho or carrion hawk (*Polyborus tharus*) is a large bird of prey, with more or less vulturine habits, very characteristic of southern South America.

Sitting on the ground as though sunning themselves, were two big eared owls looking like cats, and fairly tame. In the same neighborhood a beautiful gray hawk, probably *Buteo erythronotus*, with white tail tipped with black, flew over the ground; and I also met the cinnamon kestrel (*Tinnunculus cinnamomeus*). The chimangos (*Milvago chimango*), likewise large birds of prey of versatile habit, were not very numerous. In a tall shrub there perched a flock of black starlings (*Curaeus aterrimus*) singing lustily in their peculiar busy way.

That afternoon I went out on foot alone to see something of the sea birds along the Jente Grande Bay. Between the house and the bay were some low meadows with water holes in them. In the dampest places grew great masses of a succulent plant, extraordinary in appearance, of most vivid scarlet and carmine shades, but reaching only to the height of a few inches.

A Fuegian Indian couple in camp. It is easy to believe that a race accustomed to a rude out-door life in this inclement region is scarcely fitted to combat the insidious dangers of a more comfortable existence

Following the shore line I came to a projection of stones and pebbles on which were great numbers of the white-breasted cormorant (*Phalacrocorax albiventer*), as well as some small gray gulls (*Larus glaucodes*), with black hoods and orange-yellow bills, and some oyster catchers (*Hæmatopus leucopus*). Then rounding a promontory I came upon a number of lesser steamer ducks, several of which flew away as I approached. These were all of one species, and a lone pair of crested ducks was near them.

The next day I was to go to Philips Bay, where there is a station of the Explotadores Company; and I was to lunch half way at the second farm of the Jente Grande Company. It was a glorious morning, but with a driving, icy-cold wind. The road at first led along the eastern shore of Jente Grande Bay, after which I turned inland amid lovely scenery. The country here was hilly, wild, and grand in its desolation. On an eminence to my right a guanaco stood out clear against the sky, watching me intently. Never before had I appreciated the wild, elegant beauty of the guanaco. The rich rufous color of his coat and the black of his head harmonized to perfection with the ruddy grass of the hills. After looking at me for a while he cantered away at a fine springy gait. On I rode, and after a time, turning around, I saw him again watching me alertly as before.

Everywhere were flocks of upland geese. A little later I sighted another guanaco, and toward noon I saw the sea from the top of a hill on my way, but then the road carried me more to the landward. Passing a small stream, I encountered a flock of a couple of thousand sheep being driven to Philips Bay, under the guidance of two mounted peons and some dogs. Farther on by the bank of another small stream I saw a brown pintail duck (*Dafila spinicauda*) squatting motionless, allowing me to pass in the hope of remaining unobserved. Nor did I wish to undeceive it.

One more turn between some hills, and the Jente Grande farm, Estancia Sarita, lay before me. It was reached in a few minutes. Near the manager's house I alighted, and my horse, wet as it was from the exertions of the ride, was simply tethered to a post in spite of the driving wind.

At the house I had lunch and was taken after that to a small stream in a hollow where ducks usually abounded. I was "in luck" for the ducks were there, and I could admire, as they swam in a small pool, the Chiloe widgeon (*Mareca sibilatrix*), yellow-billed teal (*Nettion flavirostre*), gray teal (*Querquedula versicolor*), brown pintail (*Dafila spinicauda*), and red shoveler (*Spatula platalea*), the last of which had not yet been recorded from Tierra del Fuego. The only ones to take wing at our intrusion were the widgeons; the others were exceedingly tame, taking no more notice of us than my own captive ducks of these species at home in Holland. No one was allowed to disturb the birds, said the manager, and they became tame accordingly.

After inspecting the ducks I saw a few tame Indians. They served as peons, and I was sorry to hear that these poor creatures do not stand civilized life, even in a low stage. Clothes and houses cause them to contract tuberculosis; the children succumb first, then the adults.

About half past one we again mounted our horses to proceed to Philips Bay.

Fuegian squaw in her canoe. South America has provided the African native with his domestic duck, and primitive man, even in Tierra del Fuego, it appears from this picture, has adopted the domestic cat, an animal of largely African descent

A SUMMER VIEW OF SOUTHERN TIERRA DEL FUEGO

This picture reminds us in no small degree of Alaska. The similarity does not of course extend to the fauna, and the only birds showing a close relationship to the northern representatives are those belonging to cosmopolitan groups such as the gulls and terns

DOMINICAN GULLS ENCIRCLING A "FRIGORIFICA"

These gulls, which replace ecologically the vultures of warmer climates, are here shown about a meat-packing establishment to which they have been attracted by the presence of offal

The country to the east of Estancia Sarita was at first quite flat. In little pools I saw more gray and yellow-billed teal, as well as some coots, and in the grass countless flocks of upland geese. Next we passed over some beautiful, wild, hilly country, and in front of us lay a large plain as flat as a billiard table, with the sea to the north and hills to the east. Coarse rufous grass growing in patches covered the plain, and a great many cows and horses were feeding upon it.

As we rode on, some buildings came into view. They were those of the Philips Bay station of the Explotadores Company, which holds the greater part of Chilean Fireland. Close to the sea stood the largest building, the so-called "grasserie," where every year thousands of sheep are slaughtered for the preparation of tallow.

This ghastly establishment was shown me by the manager, but the only things I found at all attractive were the thousands of sea birds, which fed on the blood and refuse that had run from the factory into the sea. Among them were countless gulls (*Larus dominicanus*), many crested ducks, oyster catchers, little plovers, and occasionally other birds. After seeing the birds I was taken to the manager's house, situated in the midst of this wild country, grand in its monotony.

The following morning I took a walk into the hills, and coming to a part where some low bushes grew, I saw a small bird fluttering helplessly in front of me unable to fly. A short run and I had caught it, a very beautiful sparrow-like creature, yellow, gray, and black, with gleaming black eyes. It uttered a low, continuous, rattling sound as I took it up. Apparently it had flown against a telephone wire and hurt its wing. This was a male of the finch known as *Phrygilus princetonianus*. The species is a representative of the Lapland bunting (or longspur) in the southern hemisphere. Its habits, style of song, its form, and hind toe with long claw all point to this, and the bird is really not a *Phrygilus* at all, though usually so called.

I took it back to the house, and my host procured a small cage in which to put the poor little bird. It was very thin and feeble, and after having drunk, it took a sound sleep. After that it began to feed on canary seed, and I ultimately succeeded in bringing it home in good health. Later on, during the homeward voyage, as the weather grew warmer, this bird, quite tame, came into full voice. Its charming song, in style much like the continuous one of the Lapland bunting, and very sweet, began on shipboard every morning as soon as the day broke.

After my host had helped me care for my bird, he told me that he had another surprise for me in the form of a living seed snipe (*Attagis malouinus*), which had also damaged its wing against a telephone wire near the house. This was brought forth, and I could now admire a living example of this curious grouselike bird at close range. Unfortunately its wing was so badly broken that I could not venture to add it to my traveling menagerie. So it was decided to put the bird out of its misery. My host told me that the seed snipe bred inland in wild, desolate country, laying only four eggs.

In the great plain mentioned above which I passed in going to Philips Bay, there are still some guanacos, living peacefully with the cattle. The adult animals are not killed, but the young that they bear are at once secured for the sake of their skins. In snowy winters, moreover, many guanacos die of starvation throughout the sheep districts. Before the sheep were so numerous the guanacos could live on the long grass which stuck out of the snow, but now that this grass is entirely eaten by the sheep, there is nothing for their wild competitors to live on, if the snow lies thick for any length of time. This fact, and the destruction of their young, must

SEASHORE VIEW AMONG THE ISLANDS OF SOUTHERN CHILE

The rowboat is traversing a patch of great brown seaweed; the bleak shore supports little vegetation other than tussocks of coarse grass. For the birds, however, isolation spells safety, and most of the waterfowl have little need of more luxuriant plant life on land very soon put an end to the existence of the guanaco; I deem it a great pity that some means are not adopted by the settlers for its preservation.

In the afternoon of my second day at Philips Bay I was to leave Tierra del Fuego, where I had spent such a delightful time. A boat was to take me across the strait to Rio Secco on the mainland, with a cargo of live sheep. Because of the low water, the boat could not land near the Philips Bay station, so I had to drive out to the place of its anchorage, five or six miles away. The best road to take went along the shore, and I passed again near where the many birds were feeding on the blood of the sheep. A small flock of nine guanacos was also admired on the way.

At different places along the shore I saw great tangles of giant sea weed, colored brown; also some kinds that were green, and others carmine red. We reached our boat in good time, and after taking leave of my kind host, I went aboard with my luggage and my bird.

At ten o'clock that same night we arrived at Rio Secco on the other side of the strait, but I passed the night on board, and breakfasted next morning at the house of the manager of the Refrigeratores Company. He showed me what became of the sheep which had come over with us. These were all animals of the first quality; they were slaughtered and their carcasses frozen for shipment to England.

The manager had some business in Punta Arenas, so about eleven o'clock he kindly offered to take me with him, and after an hour's drive which took us continually through the remains of burnt forest, I was back again at the Kosmos Hotel in Punta Arenas. There I found the luggage I had left, and my two long-billed parrakeets, which were still in good health.

Sunrise in Beagle Channel, along the cold, forbidding coast of Tierra del Fuego. But if you would see the waterfowl, go rather to the earth's remote, desolate fastnesses than to wooded shores on the equator where lurk so many of the deadliest enemies of birds

Type of truck that will be used on the Mongolian Plateau and the Gobi Desert

THE MOTOR TRUCK IN CENTRAL ASIA

BY

ROY CHAPMAN ANDREWS*

WITHIN the last few years it has been found that automobiles can be operated successfully on the grasslands of Inner and Outer Mongolia and the rolling surface of the Gobi Desert. Motoring on the Gobi is not quite like rolling down Fifth Avenue. If anything happens to your car there are no garages just around the corner—in fact, there are no corners! You must be prepared to remedy any difficulties yourself, for to be alone on the desert when something is wrong with the digestion of your automobile can have its serious aspects. If you are on the main caravan trail it may mean a walk of only forty or fifty miles to the nearest well, where you will perhaps spend days of waiting until help arrives from Kalgan or Urga—unless you are an expert mechanic and have an assortment of spare parts. But if you happen to be running across one of the vast areas which separate the caravan trails and your car goes wrong, help is out of the question; you must depend upon your own resources.

I remember once when we were returning to Kalgan from Urga, the capital of Mongolia, we discovered that the oil of our motor had all leaked out of the cans. It was impossible to go much farther and we were debating what to do. As our car swung over the summit of a rise, we saw the white tent and grazing camels of an enormous caravan. Of course, Mongols would have mutton fat and why not use that for oil! The caravan leader assured us that he had fat in plenty and in ten minutes a great pot of it was warming over the fire.

We poured it into the motor and proceeded merrily on our way. But there was one serious obstacle to our enjoyment of that ride. We had had very little food for some time and were very hungry. When the engine began to warm, a most tantalizing odor of roast lamb arose from the car! Shortly, I even imagined that I could smell mint sauce.

Once again we were without cup grease for the cars and Mrs. Andrews sacrificed all the cold cream and vaseline which she had prepared for a summer in the field. Mongol cheese, too, was substituted with good results.

The caravan trail between Kalgan, Urga, and Kiachta on the Siberian frontier is one of the oldest trade routes in the world and is the only one in Mon-

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golia on which automobiles have been operated to any extent. The Chinese government maintains a passenger service as a branch of the Peking-Suiyuan Railway over this route and it has proved successful after some initial difficulties. A private Chinese company also ran cars in 1918–19 between Kalgan and Urga, but they had a great deal of misfortune. During one year nineteen cars were smashed and lay in masses of twisted metal beside the road. The difficulty was due largely to the native chauffeurs. Although these men can drive a car they have no mechanical training and danger signals from the motor are entirely disregarded. Moreover, all Chinese dearly love "show" and the chauffeurs delight in driving at tremendous speed over roads where they should exercise the greatest care. The deep cart ruts are a continual menace, for between them the road is often smooth and fine. But a stone or a tuft of grass may send one of the front wheels into a rut and capsize the car. The Chinese company has lost count of the passengers killed or injured!

We must be prepared to meet all sorts and conditions of ground in Mongolia. In some places the grass-covered plains are as hard and smooth as a floor; in others the surface is a chaotic mass of ruts and holes, and on the Gobi Desert soft sand alternates with solid beach like stretches of fine gravel.

Our motor equipment will consist of six five-passenger cars and two one-ton trucks. The latter will act as movable bases and the expedition can thus work in widely separated regions. Supplies of gasoline will be carried in the trucks, or will be sent by camel caravan to various wells in the region which will be the center of operation.

The use of motor trucks will be a new departure and one which should have important economic results. Transportation is the greatest of all commercial factors in the Orient and upon it largely depends the development of any country. In Mongolia the problem can be easily solved. At present it rests upon camel caravans, ox- and pony carts, and upon automobiles for passengers. Camel traffic begins in September and is virtually ended by the first of June. Then its place on the trail is taken by ox- and pony carts. Camels make the journey from Kalgan to Urga in from thirty to fifty days but the carts require twice as long. They travel slowly at best, and the animals must be given time to graze and rest. Of course they cannot cross the desert when the grass is dry, so that transportation is divided by the seasons—camels in winter and carts in summer. Each camel carries from 450 to 500 pounds, and the charges vary from five to fifteen cents (silver) per *cattie* (one and one third pounds). Thus by the time goods reach Urga their value has increased vastly.

As against thirty to ninety days for the journey between Kalgan and Urga, motor trucks could easily make the trip in five days. Trucks have never yet been used on the Mongolian plateau and our expedition will have the honor of "breaking the trail." The machines which we have selected are the regular one-ton trucks made by the Fulton Motor Company, of Farmingdale, Long Island. This car has a speed of forty miles an hour, is light, and so strongly made that it is especially fitted for the rough work on the plateau.

The motor transportation of the expedition will be in charge of Mr. Bayard Colgate, of Orange, New Jersey. Mr. Colgate, who has a thorough knowledge of automobiles and their construction, will be responsible for the care and operation of the cars and will have a number of native mechanics under his direction.

Unfortunately, the Mongolian plateau is the only region which the expedition will investigate where motor transportation is possible under present conditions.

The greatest need of China is good roads and every year sees an advance in this direction; with increasing development of its natural resources road building will inevitably advance and a great field will open for motor transportation.

THE GREAT FRIAR OF THE PARAMO

BY

HERBERT J. SPINDEN*

The *Espeletia* takes its name from one of the Spanish viceroys of New Granada, named Espelata. It is the characteristic plant of the paramo or land above timber line in the eastern Andes of Colombia and Venezuela and grows to a height of six or seven feet. The few leaves which come out fresh each year are felted deep against the cold with a cottony growth that almost conceals the underlying green. The name Frailejon—the great friar—comes from the general similarity of these plants, when seen at a distance, to a human figure in white cowl and black cloak

I am the stalwart Frailejon,
  The guardian of the wind-swept pass.
Upon bold peaks and ridges lone
  I piously hold watch and mass.

*Associate Curator of Mexican and Central American Archæology, American Museum

My gown is black of withered leaves
  That hang about my body cold;
My felted cotton cowl receives
  In spring a garlanding of gold.

Where winds the one trail to the gap
  Up from the peopled gorge below,
To drop again to Comfort's lap,
  A cross is set that men may know.

For muleteers there a mass I hold
  Where sodden mosses mat the ground,
And ice-carved cliffs guard off the cold·
  For me, I take my place as found.

Across the faithless paramo,
  Where dwell the gods of ancient days,
Up to the glacier's edge I go
  To make my prayer and tell my praise.

Let Chen, the Fog God, belch his hate
  From caves below the riven peak.
With lifted heart I mock his state
  And for the true Church loud I speak.

My brothers of the easy life,
Who fatten in the vale below—
They know not Hunger, Frost, and Strife,
That walk upon the paramo.

I ask no tithe to purchase wine,
Nor do I plot for worldly power,
Only I ask the sun to shine
Upon me for one little hour.

Must I be left the last of those
That scorn delights and joys resign,
While all my brothers seek repose,
Or jockey for a place in line?

I am the aged Frailejon
That stands and faces wind and snow.
My pains the sins of all atone
Who cross the trackless paramo.

My rusty rags of withered leaves
A gaunt and shivering form enfold,
Save when my felted cowl receives
In spring its broideries of gold.

VIEW OF THE EXHIBITION OF ANCIENT AND MODERN MEXICO
Bullock's Piccadilly Museum

GLIMPSES OF EARLY MUSEUMS

BY
FREDERIC A. LUCAS

SOMETHING more than two thousand years ago King Solomon wrote, "Is there anything whereof it may be said, See this is new! It hath been already of old time which was before us."

And some of our younger museum men, installing their striking habitat groups, do not realize that these were foreshadowed a century or more ago nor give the earlier men credit for what they did in the face of many obstacles. What would the present generation accomplish if it had to work in rooms that relied upon fireplaces for heat and candles for light?

So a few words about Bullock's museums that flourished in London from 1795 to 1824 may serve to show how many things were thought of and how much accomplished more than a hundred years ago.

I am indebted to Major W. H. Mullens for the loan of the original engravings from which the illustrations were made and have drawn my information from his account of Bullock's Museum published in Volume XVII of the *Museums Journal.*

"In 1801 Bullock had housed his museum at 24, Lord Street, Liverpool, and in the *Companion* issued in that year he described himself as 'William Bullock, Silver Smith, Jeweller, Toyman, and Statue Figure Manufacturer.' In 1804 or 5 Bullock removed with his rapidly increasing collection from Lord Street to 'premises at the corner of Church Street and Whitechapel [Liverpool] that had been just erected on the site of the old poorhouse, where he had fine apartments fitted up for the museum.' (G. H. Morton.)

"In 1809 Bullock finally removed his museum from Liverpool to London; this date can be definitely fixed from the fact that he published two issues of the seventh edition of the *Companion* in that year. The first describes the museum as being at 'The House of William Bullock, Jeweller and Silversmith to his Royal Highness the Duke of Gloucester, Church Street, Liverpool,' while the second informs us that it was 'now open at 22, Piccadilly, London.' This, however, was but a temporary resting-place, and in the twelfth edition, 1812, it is described as removed to the Egyptian Temple, Piccadilly—known afterward as the Egyptian Hall—which had been 'just erected for its reception.'

"In December, 1822, Bullock, accompanied by his son, sailed from Portsmouth, via Jamaica, to Mexico, remaining in that country some six months, and on his return landing at Portsmouth November 8, 1823.

"In Mexico Bullock was well received by the authorities, and with their assistance he took over possession of the abandoned silver mine of Milan, or Del Bada, near Themascaltepec, and with the aid and sanction of the Mexican Government, he collected many valuable curiosities both ancient and modern, including 'Original Specimens of Ancient Sculpture and Paintings; of Casts of the Enormous and monstrous Idols of the supreme Temple; of the grand Altar or Sacrificial Stone, on which thousands of victims were annually immolated; of a Cast of the famous Kallender Stone (commonly known as Montezuma's watch); of a model of the immense Pyramid of the Sun; of the original map of the ancient City, made by order of Montezuma for Cortez; of remarkable Manuscripts and Picture writings; and of Antiquities in Arts, Manufactures, etc., etc., of this Aboriginal People.'

"With these materials and with specimens of the industry and art of the country, of its mineral resources and vegetable products, and of its natural history, comprising numerous specimens of birds collected by himself, he opened in May, 1824, an Exhibition at the Egyptian Hall entitled 'Ancient and Modern Mexico.'"

Ancient and Modern Mexico is very interesting, for its modeled foreground

BULLOCK'S LONDON MUSEUM

The Group of African Mammals

and painted background, so arranged as to be viewed from a distance, foreshadow the cyclorama so popular in modern times. This exhibition, the outcome of a journey to Mexico, was installed at Egyptian Hall in 1824, or five years after Bullock had disposed of his "London Museum."

One feature of Ancient Mexico, the gigantic Serpent Column that dominates the landscape, is something of a puzzle: As we know today, the Serpent Columns were the door jambs of the Temple of the Jaguars and supported the lintel on their upraised tails—why is this one reversed? Bullock visited Mexico in 1823 and made molds of the Calendar Stone and the Earth Goddess. Why did he figure the Serpent upside down? It is quite possible—even probable—that he was unable to visit Chichen Itza, knew the columns by hearsay only, and constructed them in what seemed to him the correct attitude.

But that Bullock exhibited actual casts of objects like the Earth Goddess and Calendar Stone that were not shown in the United States until sixty years later, speaks volumes for his energy.

The Group of African Mammals occupying the center of the hall is worthy of note as a bold attempt at a "habitat group." Even today it is a courageous curator well provided with funds that would attempt to show the great mammals of Africa; but here is an exhibit, made by a private individual a century ago, years before Livingstone had even touched the edge of Darkest Africa, that included the largest known mammals.

More than this, some of the groups shown in Bullock's Museum seem to have been provided with painted backgrounds and artificial foliage! As stated in the introduction to the *Companion to Bullock's Museum*, published in 1813:

"Various animals, as the lofty Giraffe, the Lion, the Elephant, the Rhinocerous, etc., are exhibited as ranging in their native wilds and forests; whilst exact models, both in figure and colour, of the rarest and most luxuriant plants from every clime give all the appearance of reality; the whole being assisted with a panoramic effect of distance and appropriate scenery affording a beautiful illustration of the luxuriance of a torrid clime."

This seems very much like a description of some recent habitat group, in fact, one can say little more of our Florida and Orizaba groups in the American Museum. And when we consider the handicap of building and especially of lighting under which these early museum men labored, we can but admire their courage and skill.

But even earlier than this, that universal genius, Charles Willson Peale, wrote: ". . . it is not only pleasing to see a sketch of a landscape, but by showing the nest, hollow, cave or a particular view of the country from which they [the animals] came, some instances of the habits may be given." And this was written about 1800, while the first bird group was installed in the British Museum in 1877, and the first in the American Museum of Natural History not until ten years later.

So if "old-timers" like Akeley and myself are inclined to smile at some of the "discoveries" now and then brought forward by younger members at meetings of the Association of Museums, it is well to remember that some of our own discoveries were anticipated by museum men of other days, and to recall, for example, that when in 1885 Akeley and Critchley were called upon to mount the famous Jumbo, they used practically the same method that was employed by French taxidermists in mounting the elephant that died at the Jardin du Roi about one hundred years before. No wonder that after due consideration, Solomon again wrote, "There is nothing new under the sun."

LOON ON AN ADIRONDACK LAKE, CALLING AND RUNNING OVER THE WATER IN A COURTSHIP EVOLUTION

Portrait of a least sandpiper.—Ideal treatment of bird drawing for purposes of scientific illustration

COURTENAY BRANDRETH'S BIRD PAINTINGS

BY

FRANK M. CHAPMAN*

THE form of a bird at rest is so definite, its lines so simple and continuous, that one might imagine they could be reproduced by anyone with even slight talent for drawing. Nevertheless, good bird artists are rare. Possibly the very simplicity of the bird's outline makes it a difficult subject, for although each species possesses its own characteristics of form, pose, and expression, which to the bird student are pronounced and obvious, they are not evident to the artist who has not sufficient interest in bird life to study his subject sympathetically. How many otherwise excellent paintings are marred by the introduction of the figures of birds as anatomically incorrect as would be a human figure drawn with arms, let us say, attached to the hips instead of to the shoulders! No artist would attempt to draw a man without having previously studied the original; why, therefore, should he hope for success in bird portraiture when he relies on his imagination rather than on nature for a model?

It requires, however, something more than study from life to produce a wholly adequate bird picture, just as it requires something in addition to good draftsmanship to paint the portrait of a human subject. Where on the one hand there is needed that sympathetic insight into human nature which permits of character interpretation, so on the other there is need for that love of birds which sees not merely a feathered form but a creature marvelously endowed with its own special traits, disposition, and potentialities, which are evident only to one who is familiar with what we call the *habits* of his subject. It is clear, for example, that one should not depict a dove with the expression of a hawk, but only the bird student knows the difference in expression, physiognomy, and attitude between a warbler and a vireo. Without going further it may be said, in a word, that no one has ever reached or ever will reach the first rank of bird artists who is not possessed of that keen interest in birds which marks the born ornithologist.

*Curator of Ornithology, American Museum

BLACK BRANT

The original of this painting was observed at Ossining on the Hudson and the scene in which the bird is placed does not therefore typically represent the haunts of this coast-loving species

This sharp, vibrating response to the sight of a bird or the sound of its voice is a heritage as rare as it is priceless, and when in the fortunate individual possessing it we find also the talents of an artist, we have that exceptional combination of gifts which makes the true bird artist. The world has known but few men and no women of this type, and those who are interested watch eagerly for the exhibition of gifts which mark their possessor as a man of promise in the field of bird art.

During November, 1920, there was held at the Congressional Library in Washington an exhibit of bird paintings at which twenty-four artists were represented. Among the pictures shown were several by Mr. Courtenay Brandreth, of Ossining, New York. Mr. Brandreth's name is new among bird artists, but his pictures aroused such favorable comment that he was subsequently invited to exhibit his work in the American Museum. About twenty-five of his paintings were therefore shown in the forestry hall of the museum in December, 1920, several of which are herewith reproduced.

Black and white reproduction unfortunately gives no indication of Mr. Brandreth's skill as a colorist, but does do justice to his draftsmanship, to the excellence of which the most exacting technical ornithologist would bear witness. Mr. Brandreth's success in portraying form, pose, and expression is due to his natural gifts, to genuine love of birds which sends him to nature for his subjects, and to a course of study under Louis Agassiz Fuertes, master painter of bird portraits.

Not only are his birds correct in form, but also in feather. To the landscapist who introduces an alleged eagle or gull into his painting for purely artistic purposes it is quite immaterial whether his figure has five or ten primaries; nevertheless, the same man would not think of giving a human subject an incorrect number of fingers, and to the ornithologist it is quite as important to give a bird its proper number of wing quills.

Mr. Brandreth has certainly not detracted from the beauty of his figures of birds by giving them their due allotment of feathers; he has thereby greatly increased their charm to the bird student who is as much pained by a picture of a five-primaried swallow as he would be by that of a two-fingered man.

But Mr. Brandreth is something more than a gifted and accurate drawer of birds. Among artists of his class his pictures show that he has already attained an unusual measure of success in placing his bird in the landscape, or perhaps I should say in placing landscape about his bird.

The purposes of scientific illustration to aid in the identification of the species drawn are best served by the elimination or suppression of all unnecessary accessories. Given a branch on which to perch, or a stick to stand upon, and all other suggestion of out-of-doors may be omitted. The accompanying evening grosbeak and least sandpiper pictures are good illustrations of this kind of bird drawing. But it is one of the most promising features of Mr. Brandreth's art that he is not content to rest here. In several of the paintings in his exhibition he has aimed to portray not merely the bird on the bough, but the bird in its haunts, a kind of bird painting in which it is evident success can be won only by an artist who is a good landscapist as well as a good bird portrait painter.

The painting of the loon, here inadequately reproduced in black and white, gives some conception of the character of Mr. Brandreth's work in this higher branch of ornithological art. The loon, a male, is shown in one of its courtship evolutions when, calling loudly, it seems to half run, half jump over the water about the female. The bird's excitement at this season is increased by an approaching storm, and its calls echoing over the water voice the spirit of the wilderness. No one who has been thrilled by the loon's weird cries can fail to have the experience recalled by Mr. Brandreth's painting,—an indication, therefore, that

RED PHALAROPE

A swimming member of the order of sandpipers and snipes which sits lightly on the water

TREE SWALLOW PLAYING WITH A FEATHER
Note the detail with which the feathers of the wing are drawn

Female evening grosbeak.—An excellent example of bird portraiture

the artist has at least approached the mark toward which he was aiming.

The brant pictured was captured in the Hudson near Ossining, an unusual locality for this coastwise bird, and the scene in which it is placed is therefore far from typical. The painting, however, is pleasing not only because of the admirable manner in which the bird is drawn, but also because of the skill with which the artist has enveloped the bird in the delicate lavender atmosphere of his painting, without in any way affecting the scientific accuracy with which the colors of the bird's plumage are rendered.

Other subjects give additional proof that if Mr. Brandreth continues to follow the path in which he has made so promising a start, he will win a place among the few men who can claim to be both painters of birds and of nature.

LOCO WEEDS

BY

ARTHUR HOLLICK*

INSTANCES of the poisoning of live stock, especially sheep and cattle, due to their eating plants that possess toxic properties, are frequently reported from widely separated localities throughout the eastern United States; but such instances are isolated and usually only a few or individual animals are victims; and the effects, as a rule, are immediate and acute, with either death or complete recovery following quickly. "Mountain laurel" (*Kalmia latifolia*) and "sheep laurel" or "lambkill" (*Kalmia angustifolia*) appear to be responsible for most of the cases of sheep poisoning, while "poison hemlock" (*Conium maculatum*) and "water hemlock" or "cowbane" (*Cicuta maculata*) are probably responsible for a majority of the cases of cattle poisoning.

In extensive regions west of the Mississippi River, however, the annual loss of horses, cattle, and sheep from "loco poisoning," as it is called, is a serious matter which has to be reckoned with as though it were a disease or pestilence, and unremitting precautionary and preventive measures are necessary in order to minimize its ravages. In some parts of Montana, Colorado, Nebraska, and Kansas, because of the large number of horses that die of loco poisoning, it has been found impossible to allow them to run freely upon the ranges. The losses of cattle have been heavier in Colorado, apparently, than in any other state, while the losses of sheep have been more serious in the states to the north, especially in Montana. The effects are relatively slow in manifesting themselves and the ultimate outcome may be long deferred; but death or more or less permanent physical and nervous derangement is inevitable, according to the extent of the poisoning. The plants that produce these effects are called "loco weeds" and the animals poisoned by eating them are said to be "locoed." This term is of Spanish origin, meaning "crazy," and it is applied by reason of the erratic actions and behavior of the animals during the early and secondary stages of the disease.

Certain initial symptoms appear to indicate a disturbance of the nervous system, resulting in a condition of hallucination. A locoed horse, if led or ridden up to some slight obstacle or inequality in a road, such as a fence rail or a conspicuous rut, will stop short and, if urged forward, will leap as though trying to surmount some obstruction several feet in height, or as if to clear a wide ditch. Objects and inequalities apparently appear to it to be exaggerated in size, although loss of normal muscular control may be the explanation, in part. A badly locoed horse is likely to shy violently, often apparently at some imaginary object, or to move straight ahead until stopped by walking or running into some perfectly obvious bar to further progress. It may also let a person approach without, apparently, its taking any notice, and then will suddenly rear and perhaps fall over backward. Abnormal development of the mane and tail is also a characteristic feature of badly locoed horses.

A steer will start, tremble, and may rear and jump backward if suddenly alarmed and, when badly afflicted, may become frantic and run around or straight ahead until exhausted or stopped by some obstruction. A cow may lose her calf and never be able to find it again, and will not recognize it if brought to her. Loco poisoning also seems to predispose to abortion, and the normal increase in locoed herds is thus seriously reduced.

The symptoms in connection with sheep are not characterized by the

*New York Botanical Garden, Bronx Park

Typical locoed horse.—The abnormal growth of mane and tail is one of the characteristics of loco poisoning in horses. (Photograph through courtesy of the United States Department of Agriculture)

spectacular, violent actions seen in horses and cattle. Lack of muscular control is perfectly evident, but a condition of weakness is the most obvious characteristic. They stumble, fall, and rise again with difficulty. In the final stages all animals are rough-coated, become more or less paralytic, lose flesh, refuse to eat, and ultimately die of starvation.

Practically all grazing animals in the regions where loco weeds grow eat them, at times, to a greater or less extent; but if grass is abundant this is generally preferred, and they do not seem to take naturally to the weeds, as a rule, if grass or other good fodder is readily obtainable. Individual animals, however, sometimes appear to have a predilection for them, and nearly all are liable to contract the loco habit, in which event they will seek the weeds and eat them almost exclusively.

Exactly when it was that loco poisoning first attracted serious attention is somewhat uncertain, so far as any published records are concerned; but it must have been some time prior to 1870, as indicated by an article on the subject by George Vasey, describing instances in California, included in the report of the United States Commissioner of Agriculture for the year 1874. The probability seems to be that it was not until the finer breeds of animals were introduced that loco poisoning produced effects sufficiently extensive to cause apprehension and to lead to careful investigation. Generally speaking, the poorer the breed the less liable to poisoning it appears to be, and native breeds are seldom locoed to the same extent as are those that are imported. The former are more familiar with the forage plants of the region and are more accustomed to travel long distances in search of those that are desirable, whereas imported animals have not learned by experience, and they are also more inclined to eat whatever is most easy of access.

Typical locoed steer.—Note particularly the rough coat characteristic of locoed cattle. (Photograph through courtesy of the United States Department of Agriculture)

Sheep in final stage of diseased condition due to loco weed. (Photograph through courtesy of the United States Department of Agriculture)

Purple loco (*Astragalus mollissimus*). Horses are the principal victims of this plant, which because of its dense covering of hairs is known also as woolly loco, a name applied, however, to several other more or less hairy species. (Photograph by American Museum of specimen in herbarium, New York Botanical Garden)

Blue loco or rattleweed (*Cystium diphysum*). Superficially resembling alfalfa, this plant is particularly dangerous to horses. Cattle and sheep, however, also succumb to its fatal effects. (Photograph by American Museum of specimen in herbarium, New York Botanical Garden)

Probably at least a dozen different species of more or less closely related plants have had loco properties ascribed to them; but similarity in general appearance, and the application of the color character in connection with the popular name,—"white loco," "blue loco," "purple loco," etc.,—have resulted, inevitably, in considerable confusion of identity, especially as striking color variations are common in several of the species. It appears probable that not more than five or six possess toxic properties sufficiently virulent to make them seriously dangerous to live stock, and recent critical investigations by the United States Department of Agriculture have resulted in officially reducing the number of poisonous species of serious importance to three.

The three species now recognized as the typical loco weeds of the West were formerly included, with several hundred others, in the comprehensive genus *Astragalus*, which in recent years, however, has been split up into about seventeen distinct genera. Incidentally, also, it is of interest to note that these and nearly all other plants that are known or suspected to possess true loco properties belong to the Leguminosæ, the family that includes the pea, bean, clover, alfalfa, etc.,—all of them plants of the highest forage value.

Aragallus Lambertii (Pursh) Green (=*Oxytropis Lambertii* Pursh) has the greatest range of the three species mentioned, extending from Mexico to Alaska, east to middle Minnesota and west to middle Arizona and Utah. It includes a dozen or more forms which many botanists are inclined to regard as species; but economically they may all be regarded as belonging to the one species. The flowers are commonly bluish purple, but in some localities a white or albino form is predominant and in others pink is the prevailing color. This species is therefore known either as blue, purple, white, or pink loco, according to the locality in which one or the other color form prevails. It has no true stem and hence is sometimes called "stemless loco"; and the pods, when dry, rattle and make a sound like a rattlesnake, by reason of which the name "rattleweed" is also applied to it. None of these names, however, possesses any value, so far as identifying the plant is concerned, inasmuch as one or another of the names is equally applicable to several other species. The leaflets are relatively long and lanceolate in form. *Aragallus Lambertii* is probably the most destructive of all the loco weeds, not only because of its wider distribution but also because it is equally deadly to horses, cattle, and sheep. It is a source of heavy annual losses in all of these classes of animals.

Astragalus mollissimus Torrey has a range that extends from Mexico to South Dakota, east to middle Kansas and Oklahoma and west to middle Arizona. It rarely grows anywhere in such abundance as the species previously mentioned, but occasionally it occurs in patches that cover several acres. The flowers are usually bright purple in color and the range of color variation is, relatively, inconsiderable, for which reason it is more generally known as "purple loco" than are either of the others. The leaflets are ovate or elliptical and the entire plant, especially the leaves, is densely covered with hairs, from which the popular name "woolly loco" is derived. This name, however, is also applied to several other more or less hairy species that occur in certain areas of the range. *Astragalus mollissimus* is particularly fatal to horses.

Cystium diphysum (A. Gray) Rydberg (=*Astragalus diphysus* A. Gray) is more restricted in its distribution than is either of the others. It ranges from southern Arizona and New Mexico to middle Utah and Colorado and west to southern California. In many localities it grows in great abundance, covering acres almost to the apparent exclusion of all other vegetation. The flowers are

BLUE, PURPLE, WHITE, PINK, OR STEMLESS LOCO

This widely distributed plant (*Aragallus Lambertii*) is alike fatal whatever color form it assumes. Because of its great northward and southward range—from Mexico to Alaska—coupled with the fact that it is equally deadly to horses, cattle, and sheep, it probably deserves the opprobrious distinction of being the most destructive of all the loco weeds. (Photograph by American Museum of specimen in herbarium, New York Botanical Garden) prevailingly blue in color, hence the commonly applied name "blue loco," and the entire plant presents quite a different appearance from the other two. The leaflets are small, ovate or oblong. In color of flowers and leaves and general style of growth it resembles alfalfa. The seed pods become inflated and bladder-like and, if disturbed when dry, make a noise which has earned for the plant the name "rattleweed" in common with *Aragallus Lambertii* and several other species in more or less closely related genera. *Cystium diphysum* affects mostly horses, but is also fatal to cattle and sheep.

Apparently this species was the first loco weed to attract serious attention, although it may have been confused with *Astragalus Hornii* Gray and *A. lentiginosus* Douglas, both of which, it is said, possess loco properties, and all three of which are native in the southern parts of California.

The exact nature of the constituent that produces loco effects has not, as yet, been satisfactorily determined. The hairs on certain species of loco weeds have been suspected, and it has also been suggested that some obscure fungoid or animal parasite on the plants may be responsible. Neither of these theories, however, has been substantiated. Chemical analysis, also, has failed to isolate any alkaloid of a poisonous nature; but certain mineral elements have been found to be common to nearly all loco plants, and further experimentation with these will, it is believed, yield the information and proof desired.

Photograph by Albert E. Butler

A Colorado meadow, with *Aragallus Lambertii* of evil repute in the foreground

THE GILA MONSTER

The species shown here (*Heloderma suspectum* of Arizona) is distinguished from its less known but larger Mexican relative (*H. horridum*) by the greater number of orange and yellow spots on the head. Both forms may be seen in a series of reptiles on the second floor of the American Museum, including the one which served as the original of this photograph

THE VENOM OF HELODERMA[1]

BY

LEO LOEB*

THE Gila monster is a poisonous reptile which is found in certain parts of the United States and in Mexico. There seems to be little definite information concerning the degree of its poisonous character, and occasionally we may hear reports which are evidently exaggerated. It might, therefore, not be without interest to refer to a few of the observations and experiments which were made by us and our collaborators more than ten years ago under a grant from the Carnegie Institution. Two species of Gila monster are known, the common species, *Heloderma suspectum* which is found in Arizona, and the less familiar Mexican form, *Heloderma horridum.* We studied mainly the former.

Heloderma possesses two poison glands of large size which are situated on the outer side of the anterior half of the lower jaw, immediately under the skin. These are a transformed sublabial gland, in contradistinction to the poison gland of snakes which is situated higher up and which corresponds to the parotid gland of mammals.

Each poison gland of the Gila monster consists of three or four lobes, and each lobe ends in a canal which opens on the outer side of the jaw close to the base of the tooth in a groove in which the venom may collect. While in snakes a muscle coat surrounds the gland and expresses the venom, in *Heloderma* the mechanism is somewhat different; here the contraction of the muscle makes tense a fibrous fascia which in turn presses out the fluid from the sacs of the gland. When the animal bites, the secretion gushes into this groove. Consequently the venom is ejected in the neighborhood of several wounds made by the teeth, the grooves present on the outer side of the teeth carrying the venom into the wound. There is, however, no means by which the *Heloderma* can inject venom directly into an enemy as does the *Crotalus.* In order to collect the venom we caused the animal to bite upon a piece of soft rubber, and with a capillary pipette we drew off the secretion from the lower side of the rubber. An animal in good condition will usually chew the rubber for several minutes and each time the jaw closes there is a gush of venom into the groove.

The poison gland resembles glands which prepare digestive juices such as we find in the intestines and stomach of man. In the secreting cells there appear very minute granules in both the ordinary digestive glands of the intestines and in the poison gland. These granules are the carriers of the active digestive substance as well as of the poison. There is known a toxic substance (pilocarpine) which stimulates the production of digestive ferments; we found that this substance stimulates equally well the production of the *Heloderma* venom.

The real function of the poison gland in snakes has not been definitely determined. Some investigators have maintained that it merely eliminates from the blood of the snake the venom which had been formed elsewhere by different cells; others believed that the poison gland itself produces the venom. In snakes the blood or even some organs are poisonous as well as the poison gland; therefore the exact function of the gland cannot very well be analyzed. In *Heloderma* we found the blood and other organs to be free from venom and, through removal of the poison gland, we could determine quite definitely that it is the function of the poison gland to produce

[1]"The Venom of Heloderma," by Leo Loeb, with the collaboration of Carl L. Alsberg, Elizabeth Cooke, Ellen P. Corson-White, Moyer S. Fleisher, Henry Fox, T. S. Githens, Samuel Leopold, M. K. Meyers, M. E. Rehfuss, D. Rivas, and Lucius Tuttle. Carnegie Institution of Washington, Washington, D. C., 1913.

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the venom and not merely to eliminate the preformed product.

In order to procure a large amount of venom for experimental purposes we kept a number of Gila monsters in our laboratory. When fed with chicken eggs, these reptiles lived for a considerable time in captivity and behaved quite normally. We thus had a chance to study the properties of the venom and especially its effects on various kinds of animals. We found that the venom as it comes out of the mouth of the animal contains many bacteria which may be quite virulent for certain animals. It was therefore necessary before injecting it to sterilize the venom. This could readily be done by heating it to 100 centigrade for ten minutes. Thus the virulent bacteria were killed, while the venom was preserved. It resisted heat better than the much more poisonous venom of the cobra snake which it otherwise resembled in many respects. If kept in the liquid state the venom gradually deteriorated; but by drying it its strength could be preserved for a long period of time.

It was also possible to free the venom from bacteria by filtering it through porcelain filters with very fine pores, through which the venom passed readily while the bacteria were held back. Through parchment paper, on the other hand, the venom diffused only very slowly.

We tested the effect of the venom on many kinds of animals by injecting it in measured quantities in various ways. All kinds of warm-blooded animals were found to be susceptible to the venom. The lethal dose for a guinea pig was, on the average, $\frac{5}{100}$ of a cubic centimeter of fresh venom or 5 milligrams of the dried material. On the whole, there was not much difference in the sensitiveness of different species of warm-blooded animals, but white rats seemed to be slightly less susceptible. Cold-blooded vertebrates are much less sensitive to the venom than mammals and birds; and especially the toad can stand a great amount, about thirty times as much as the guinea pig, if figured out for equal weights of both species. The venom is not toxic for invertebrate animals.

Wherein does the toxic action of the venom consist? It acts mainly on that part of the brain which regulates respiration, as Van Denburgh and Wight had already observed. When a warm-blooded animal receives a lethal dose of *Heloderma* venom, the first conspicuous effect is a disturbance of respiration. The breathing becomes quickened and the respirations are forced. After a time the respiratory rate diminishes and the respirations grow shallow, until after a period of respiratory spasm they cease altogether.

The venom produces, as we could show, some changes in the structure of the nerve cells. In only a few of the other organs does it produce changes, which usually are very slight.

After a person has been bitten by a *Heloderma*, there may be some swelling near the seat of injury; but it is doubtful whether this effect is due to the action of the venom as such. It is more probable that it is caused by an admixture of another secretion or perhaps it is due to bacterial action.

In general, as to its action on man, a bite of *Heloderma* may cause very marked local changes which, however, in most cases are of a temporary character. It is said that in some instances persons have died as a result of the bite. However that may be, we have not been able to find an authentic case where death was due to the action of the *Heloderma* venom. Knowing the lethal dose for animals, we can figure out that it would be necessary for the Gila monster to introduce at least one half of a cubic centimeter of venom into the wound in the process of biting, in order to kill an adult, but probably a much greater amount would be needed. It seems hardly possible for an animal to succeed in injecting so large a quantity of venom into the wound.

One of the most interesting observations which have been made in the study of poisonous animals is the fact that the animals are generally resistant to their own venom. This holds good in the case of snakes, and the same we found to be true in the case of *Heloderma*. If we inject, for instance, into a Gila monster as much venom as is sufficient to kill in a short time forty-five guinea pigs, no effect whatever is noticed. On the other hand, *Heloderma* is susceptible to the toxic action of snake venom and snakes are susceptible to the toxic action of *Heloderma* venom. We carried out a series of experiments in which we tried to determine to what mechanism may be attributed this immunity of the Gila monster to its own venom. It seems possible that it is due to the fact that in *Heloderma* the liver and probably also the kidneys have the power to hold back greater quantities of venom than the same organs can in other animals, and these organs thus prevent the venom from reaching the sensitive parts of the brain in a concentration which might be injurious.

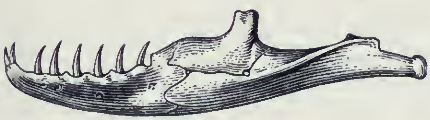
It is possible to immunize artificially other kinds of animals, for instance, rabbits, against the venom of *Heloderma*, by injecting them at regular intervals with gradually increasing doses of the venom; thus the injected animals acquire a resistance against the venom. Two of our rabbits withstood the injection of about eight times the dose lethal for ordinary rabbits.

While these rabbits were thus to some extent protected against the toxic action of the venom, they did not yield in their blood an antitoxin which was able to protect another individual not immunized previously against the toxic action of the venom; but inasmuch as we have seen that the venom of *Heloderma* is usually not lethal for human beings, the production of such an antitoxin is not of particular practical importance.

We found, however, that an antitoxin which is active against cobra venom and which has been produced by the French pathologist, Calmette, has a slight antitoxic effect even if mixed with *Heloderma* venom; but this effect is much less than that exerted against cobra venom. As to the chemical character of the *Heloderma* venom Dr. Carl S. Alsberg, who analyzed our material, found that it was not of a protein nature but much simpler in structure, and that it resembled in this respect some snake venoms which had been previously studied.

As we stated above, the action of *Heloderma* venom resembles very much that of the cobra snake; both act mainly on the respiratory center of the brain, both have a slight effect on the blood corpuscles under certain conditions, both are devoid or almost devoid of such marked local destructive actions as are found at the seat of the bite of a poisonous viper or in case the viper poison is injected under the skin of animals. The toxic action of *Heloderma*, however, is much weaker than that of the cobra; and there can be no doubt that both venoms are chemically different.

We see, therefore, that with different mechanisms of secretion, with differently situated poison glands, with different kinds of venom, somewhat similar biological and pathological effects are obtained in two species as distinct from each other as the *Heloderma* and the cobra.



Lower jaw of the Gila monster

ROCK CRYSTAL BALL, TEN CENTIMETERS IN DIAMETER, MOUNTED ON A BRONZE ELEPHANT OF HINDU WORKMANSHIP

Presented to the American Museum by Messrs. Sidney and Victor Bevin

ROCK CRYSTAL BALLS

BY

HERBERT P. WHITLOCK *

AMONG the semiprecious stones there is none, with the exception of jade, which has been so extensively used as a material for carved objects as rock crystal. From Italy and France have come the graceful vases, chalices, bowls, and drinking vessels of classic beauty, of fine and rich ornamentation; from Russia art objects of more severe and geometric treatment, as well as exquisite statuettes and figurines in this limpid medium; and from the Orient the odd-shaped vases and snuff bottles characteristic of Chinese art.

Among all of these, however, there are probably no series of objects fashioned of rock crystal which are more striking than the spheres made by the lapidary artists of Japan. The best of these are cut from flawless quartz crystals, clear and absolutely colorless, and are usually mounted on bronze wrought into decorative forms, such as dragons, storks, tortoises, and grotesque human figures. The clear, polished ball, contrasting with its dark bronze mounting, is preëminently an artistic object, lending itself with especial facility to the Japanese taste, which sets aside one beautiful thing as sufficient to contemplate and admire in an entire room. Groups of these balls delicately balanced in their mountings have been frequently employed in that land of earthquakes to give warning of shocks, the slight preliminary tremors shaking them from their balanced poises.

Rock crystal spheres have, moreover, been since very ancient times the especial stock in trade of the occult foreteller of events. Gazing into the still depths of these bits of earth's clearest substance, these seers of the future, so they tell us, can conjure up pictures impossible of production from commonplace glass. It is this alleged occult property which has raised the rock crystal sphere from a place of preëminent beauty to one of even higher romance and of unreality and woven around it an intricate web of legendary mysticism.

Dr. Dee, a crystal gazer of the seventeenth century, has handed down in his diary a very elaborate and complete description of the methods employed by occultists of that period, which are practically the same as those in use today. The crystal ball is supported upon a background of neutral tone, preferably black, in a room hung with similar draperies and lit only with candles or lamps which concentrate what little light there is present on the crystal. The operator fixes his gaze upon the brilliant spot of light reflected from the polished surface of the crystal until consciousness of his surroundings is replaced by subconscious "vision." It is significant that, in all descriptions of these "visions," what we may call the critical period is marked by the fading away of the image of the ball itself from conscious sight and its replacement by a thin cloud or mist upon which the prophetic "images" appear.

In a certain sense no less marvelous than the alleged occult powers of the crystal ball are the simple means employed by the Japanese artisans in producing them. This art, which, it is said, has been handed down from father to son for generations, consists of manual dexterity carried to a superlative degree. Armed with only two primitive tools, the lapidary shapes from an angular quartz crystal a sphere of perfect roundness and high polish. The quartz crystal is first roughly shaped to the form of a ball by chipping and abrading it with a piece of steel about twelve inches long and one half inch wide, which has a concave cutting edge somewhat like a carpenter's gouge. When by means of this treatment the mass has been made

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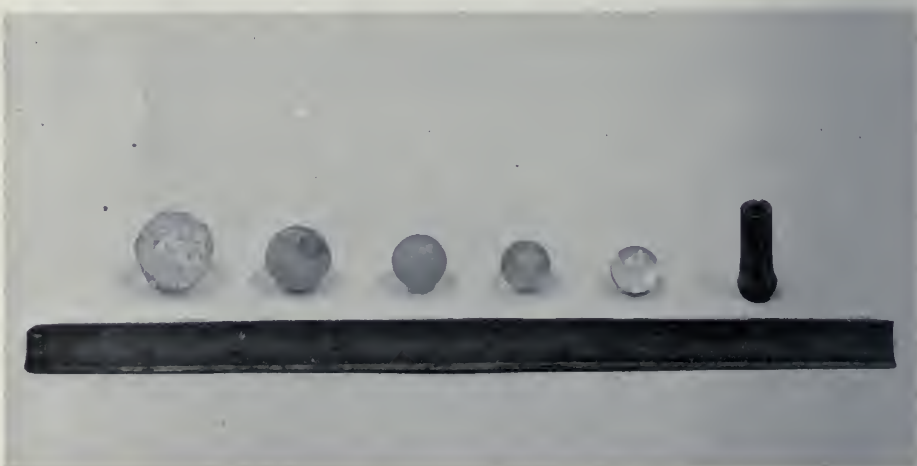
round and approximately smooth, a joint of bamboo is used to complete the polishing, quartz dust, which lodges in the pores of the bamboo and, finally, rouge, furnishing the abrasives.

This all sounds extremely simple and no doubt is, to one who is trained to do it, but let the reader undertake it himself if he doubts the wonderful manual skill of these Orientals. Of course, in the lapidary shops of Europe and America where the grinding and polishing of crystal balls are undertaken, the lathe and the casting of just the right curvature for a ball of required diameter render the task infinitely more simple; but even with these aids the production of a rock crystal ball of a diameter of, say, three inches is a matter of weeks.

Inasmuch as the labor expended on a crystal ball of even modest size renders it a very costly object, the question which naturally presents itself is how can a purchaser be sure he is buying quartz and not glass? There are two very good ways of distinguishing quartz from its much more plebeian imitator. In the first place, almost every piece of glass large enough for a ball of even small size is reasonably sure to contain one or more round bubbles. Although extremely minute, these may be detected with a good "loop" or hand lens. And inasmuch as quartz never contains round cavities, the presence of these latter will at once stamp the ball in which they are found as spurious.

There is, moreover, a much more exact test, which the writer has found to be applicable to balls from about one and one half inches diameter up. Quartz has the optical property, called double refraction, of exhibiting two images of everything which is viewed through it in a certain direction. It therefore becomes a very easy matter to apply the test by drawing a cross of fine lines on a piece of paper and then resting the ball on this cross and shifting it until a double image of the lines appears to the eye through the ball. It is impossible for a glass ball to produce this effect. So we come at the end to an actual vision which any one can see by gazing into a rock crystal ball.



Primitive tools used by the Japanese lapidaries when making a crystal ball, which is shown in five successive stages of completion. The specimens pictured are from the Egleston Museum, Columbia University

NOTES

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Associate Benefactors, Messrs. Childs Frick, H. P. Whitney, and Mrs. Henry Clay Frick.

Patrons, Messrs. Sidney M. Colgate and Arthur A. Fowler.

Life Members, Mesdames Frank E. Aiken, William H. Collins, Augustus Kirkham, the Misses Virginia Frances Ballard, Margarethe Watson Potter, Cornelia Safford, Emily Schwarz, Colonel John C. F. Tillson, Commendatore Bartolomeo Mazza fu Crescenzo, Professor A. Lacroix, Messrs. John Aspegren, James Carr Dunn, Maynard D. Follin, Fenley Hunter, Mengo L. Morgenthau, George L. Nichols, Donald Rowell, J. M. Vandergrift, and Cornelius Ayer Wood.

Sustaining Members, Messrs. Gerard Fountain, E. C. Henderson, and Harold S. Sloan.

Annual Members, Mesdames H. Harrington Bursch, J. Caesar Guggenheimer, J. R. Walsh, Frank Osman Warner, Arnold Whitridge, Walter Wurzburger, the Misses Clara Altschul, Ethel Boyd Bowers, Elizabeth Falconer, Martha Gamble, Florence E. House, Fanny E. Roberts, Harriet Otis Smith, Gladys Vore, the Reverend Edward Pouthier, Brother Leo, Doctors Mathilde Beusaude, Sidney V. Haas, Wm. Van Valzah Hayes, C. Frederic Jellinghaus, S. Pollitzer, John A. Robinson, the Hon. Morgan J. O'Brien, Messrs. James Fred Allen, Edgar S. Asch, Wm. Henry Barnum, William M. Chadbourne, George C. Clark, Jr., Nelson S. Clark, Frank E. Compton, G. R. Crossley, Wm. B. Davenport, Franklin Edson, Max Farrand, Cornelius F. Fox, Giulio Gatti-Casazza, Ralph Goddard, Walter D. Goodale, Edward L. Grueby, A. A. Hopkins, H. C. Hoskier, Albert F. Jaeckel, Richard M. Jesup, Frank E. Karelsen, Jr., James B. Kilsheimer, Jr., Adolph Leewitz, Robert H. Lyman, M. D. Mason, Joseph L. B. Mayer, Carl A. Mead. Frederic J. Middlebrook, Andrew J. Miller, H. H. Moore, Charles A. Munn, Rollin C. Newton, Bedell Parker, James D. Pell, William Pfoertner, Leo M. Prince, G. Ellis Reed, Saml. W. Reyburn, Louis W. Rice, Ellis G. Richards, Owen F. Roberts, Percy A. Rockefeller, S. M. Rosenthal, Cleon J. Sawyer, George Schmitt, Nelson S. Spencer, Joseph W. Stein, Meyer Stern, S. B. Thorne, G. B. Vitelli, John Waller, R. L. Wegel, and Lazarus White.

Associate Members, the Misses Phebe H. Beadle, Gertrude E. Dixon, Bessie C. Engle, Doctors R. A. Beise, Ernest W. Brown, Ira Eugene Cutler, Ralph E. De Lury, Moses J. Eisenberg, Harry Friedenwald, Charles B. Graves, Michael F. Guyer, Sidney Storrs Hall, E. B. Hart, Morris Herzstein, Theodore Hough, G. Carl Huber, William Jepson, Erneste Johansen, James T. Johnson, Edwin O. Jordan, Howard T. Karsner, Franklin John Kaufmann, W. W. Keen, F. M. Kelly, Howard A. Kelly, Arthur D. Kinsman, S. Kirkpatrick, Otto Klotz, Karl K. Koessler, J. S. Lankford, William Lerche, Jas. H. Linford, W. B. Morrison, Murray Galt Motter, Lloyd Pilkinton, E. T. Warren, Professor William C. Hoad, Messrs. D. Curry Armstrong, Roscoe G. Baker, Jeremiah S. Black, Jr., George F. Bowerman, George De Lury, J. R. Dymond, James R. Elliott, Thos. H. Foote, W. T. Foster, H. Warren K. Hale, Robert T. Hatt, Laurence Heilprin, Thomas Sloan Hewerdine, S. M. Hunter, Laurence T. Kerr, Laurence La Forge, Carl O. Lampland, J. Federico Legrand, Matthew Luce, Herbert Lyman, M. Hall McAllister, E. A. Miller, E. J. Molera, R. Kenneth Perry, H. Severn Regar, Carl T. Robertson, Adrian E. Smith, Eugene R. Smith, G. J. Spencer, A. W. Thompson, Carroll S. Tyson, Jr., Andrew S. White, Rembert Wurlitzer, and Stanley P. Young.

On December 14 President Henry Fairfield Osborn, of the American Museum, attended a dinner in celebration of the organization of the Cleveland Museum of Natural History and delivered an address on "The City and the Museum." Mr. Paul Marshall Rea, president of the American Association of Museums, was inaugurated as director of the new institution.

On January 14 Director Rea and not a few of the trustees of the Cleveland Museum visited the American Museum and were entertained at luncheon by President Osborn. In acknowledging the courtesies shown them, which included an explanation in detail of the educational work of the museum, Mr. Harold T. Clark, secretary of the board of trustees of the Cleveland Museum, paid this handsome compliment: "It is our hope that in working toward the goal of our ambition for Cleveland we shall always follow the same broad, unselfish policy of helping other institutions that has been so characteristic of the American Museum of Natural History."

President Henry Fairfield Osborn, of the American Museum, received notice in January of his election to honorary membership in the Société Belge de Géologie, de Paléontologie et d'Hydrologie, a society founded at Brussels on the seventeenth of February, 1887.

The Society has an appropriate motto, *Mente et Malleo* (with the mind and with the hammer), and numbers among its members Dr. Louis Dollo, Dr. A. Rutot, and other leading palæontologists and geologists of Belgium.

Dr. Frederic A. Lucas, director of the American Museum, was elected a Foreign Member of the Zoological Society of London, at their January meeting. This honor is restricted to twenty-five residents of foreign countries and carries with it the privilege of receiving the *Proceedings* of the Society. Dr. Lucas has been a Corresponding Member of the Society since 1911.

Dr. Henry E. Crampton, curator of invertebrate zoölogy in the American Museum, was elected vice president of the American Society of Naturalists at their annual meeting in Chicago in December.

At the last meeting of the American Association for the Advancement of Science, Mr. Roy W. Miner, associate curator of lower invertebrates in the American Museum, was elected a fellow.

On January 25, 1921, Dr. Robert Cushman Murphy, associate curator of marine birds in the American Museum, was elected a Life Fellow of the American Geographical Society.

Mr. Roy Chapman Andrews, associate curator of mammals of the eastern hemisphere in the American Museum and leader of the Museum's Third Asiatic Expedition, expects to sail from San Francisco on March 19, headed for Peking. The scientific staff of the expedition during the first and second years includes, in addition to Mr. Andrews: Messrs. Walter Granger, palæontologist, Charles P. Berkey, geologist; James P. Chapin, ornithologist; George Olsen, assistant in palæontology; Clifford Pope, assistant in zoölogy, and Bayard Colgate, motor transportation. In contrast to the slow and laborious travel by means of the old-time caravan, the expedition will traverse the Mongolian plains with up-to-date motor trucks. The reader is referred to Mr. Andrews' article on pages 69–70 of this issue.

Mr. H. E. Anthony, associate curator of mammals of the western hemisphere in the American Museum, and Mr. George K. Cherrie, representing the department of ornithology, recently returned to the Museum after a very successful expedition to Ecuador. It is unusual on such a trip to secure mammals exceeding in number a few hundred, but the mammal specimens brought back by the present expedition reached the substantial total of 1560, of which 940 were collected by the expedition. The birds secured numbered about 2200 specimens. The working up of this material should reveal not a few forms new to science. Among the mammals taken are many species hitherto very poorly represented, while the large series collected of the common species will give a much-needed insight into the degree of importance of individual variation.

The base of operations for field work was at an early stage established at Portovelo, the mining camp of the South American Development Company, where the expedition was given every facility and assistance. From this base were made trips lasting from one month to six weeks. An account of the Jivaro Indians. with whom the expedition came in contact, will be given by Mr. Anthony in a subsequent number of Natural History. Specimens of the handicraft and war trophies of these Indians are familiar to those who have visited the third floor of the Museum.

While at Quito, Mr. Anthony called upon Mr. Ludovic Söderstrom, whose name stands out as a landmark in the study of the natural history of Ecuador. For fifty years Mr. Söderstrom has resided in the South American republic, regarding the fauna of which he has accumulated a vast store of valuable data. Mr. Söderstrom generously presented to the American Museum a number of rare and very choice mammals.

The American Museum is cordially appreciative also of the valuable assistance given the expedition by Señor Dr. Don Rafael E. Elizalde, Ecuadorian Minister to the United States, whose interest and help went far toward making the trip a success; by the officers of the South American Development Company, including its president, Mr. William Adams Kissam, its vice president, Mr. J. W. Mercer, its resident manager, Mr. A. M. Tweedy, and its superintendent, Mr. L. O. Kellogg, who gave the expedition housing facilities and assisted in the securing of pack animals, and in many other ways manifested their interest in the undertaking; and by Mr. E. Hope Norton, president of the Guayaquil & Quito Railway Company, and Mr. Paget, superintendent of terminals at Guayaquil, who by their courtesy and aid smoothed the path of travel for the members of the expedition.

Through the instrumentality of its president, Henry Fairfield Osborn, and the good offices also of the Abbé Henri Breuil, of the Institut de Paléontologie Humaine in Paris, the American Museum recently obtained a fine series of stone implements from northwest Africa. This makes the second collection from Africa acquired during 1920, the first one—a gift from Mr. August Heckscher—being of Egyptian origin. Still other collections of fairly recent acquisition from the late "Dark Continent" hail from Somaliland, the Congo, and Rhodesia, with minor additions also from Cape Colony.

The material in the new collection comprises about 1300 pieces, including implements of flaked and chipped flint, of ground and polished stone, of bone, and also some beads made from stone and from thick egg shells. Geographically, the collection is derived from two principal localities; namely, the vicinity of Tebessa in the Government of Algeria and the region of the Sahara Desert close to the Moroccan border. In all, seventeen or more specific sites are indicated. Chronologically, all the local culture stages, ranging from the Chellean through Acheulean, Mousterian, Capsian (equivalent in time to the Upper Palæolithic of western Europe), and Neolithic, are represented.

While the Museum is not prepared at this time to give a full account of the specimens typical of each culture level, it may be stated at once that the deliberate classification made by Breuil yields some surprises. For example, the Chellean and Acheulean traits do not seem to be distinguished very sharply with respect to the *coup de poing*. What is equivalent to the *Levallois* flake of France is, however, as we should expect, confined to the Acheulean. It is the Mousterian series which is the most startling. Here, in addition to the typical so-called "point," there is a large representation of stemmed points! These are crude and irregular in outline, but otherwise conform to the Mousterian-Aurignacian practice in being retouched on the convex side only. The strange thing is that they disappear with the Mousterian to reappear again, in perfected form, in the Neolithic. A similarly startling fact is the presence in the upper Mousterian of double-pointed blades, chipped on both sides after Solutrean and Neolithic fashion. These also disappear with the rise of the Capsian. The Capsian series itself represents but a crude approach to the varied specializations of the Aurignacian, Solutrean, etc., of western Europe. Toward the end, the double-pointed blade, chipped on both sides, turns up again, this time to be regarded as a forerunner of the Neolithic. The Neolithic series, finally, includes broken pottery, beads of stone and egg shell, some polished celts, and quite a number of chipped arrow points. These last fall into four distinct groups as follows: stemmed, stemless with round base, stemless with straight base, and stemless with a notched base.

Altogether the grouping of the material is not entirely convincing, but as it has been done by one of Europe's most brilliant investigators of the Palæolithic, it must stand for the present. Perhaps the significance of these discoveries in Africa is that we must ultimately give up the idea that the French Palæolithic industrial development is standard for the world.

Dr. Charles-Edward A. Winslow, curator of public health in the American Museum and professor of public health in Yale University School of Medicine, is at present abroad in connection with his responsibilities as general medical director of the League of Red Cross Societies with headquarters at Geneva, having succeeded in this office Dr. Richard P. Strong. Dr. Winslow is impressed with the sound lines on which the League is operating and predicts that it will accomplish a great work. "One turns," says he, "from the organization of a child welfare clinic in Slovakia to a malarial campaign in Spain, a nursing school in Serbia, and a social hygiene conference in Copenhagen, with an inspiring sense of the unity and importance of the modern public health campaign."

While in London, Dr. Winslow took occasion to visit the different museums dealing with public health. He was particularly interested to note that in the great Natural History Museum in South Kensington the central hall on the ground floor was devoted largely to public health. An impressive set of exhibits dealing with insects and diseases there found place. "It is certainly encouraging," Dr. Winslow comments, "to find that in England, as in America, the public health aspects of natural history are recognized as deserving a leading place."

During the great war the American Museum, interested in furthering the cause in which the nation was engaged, prepared a food exhibit. In the form of wax models of different edibles, accompanied by explanations of their value in calories and their food properties, this exhibit served as a trustworthy guide to the community at a time when a judicious use of food was being emphasized as one of the factors necessary to the winning of the war. This exhibit, of service in times of peace as well as of strife, has deservedly survived the emergency that called it into existence. It is now being rearranged to meet the altered conditions. A more or less kindred reminder of war time Dr. Winslow found at the Museum of the Royal Medical College. Here he saw what he describes as "a most wonderful collection of original material dealing with military hygiene, which could not be equaled anywhere else in the world."

Dr. Winslow contemplates a visit also to the Swiss and German museums.

The *American Museum Novitates* is a new publication issued, as occasion requires, for the embodiment of preliminary announcements, descriptions of new forms, and similar matters. The articles are numbered serially but paged independently. An index will be provided for each three hundred (approximately) pages.

The first two numbers, which appeared on January 31, are devoted respectively to "The Evolution, Phylogeny, and Classification of the Proboscidea," by Henry Fairfield Osborn, and "Descriptions of Apparently New Birds from Bolivia, Brazil, and Venezuela," by Frank M. Chapman.

SINCE the first of the year three letters have been received from Mr. Rollo H. Beck, the American Museum's field representative of the Whitney Expedition in the western South Pacific. The first contains news from Tahiti, where Mr. Beck and his associate, Mr. Quayle, encountered great difficulty during their arduous collecting work, owing to the constant rains and the swollen state of the mountain streams. Among the birds obtained was an interesting species of black rail.

In January Messrs. Beck and Quayle visited Christmas Island, through the courtesy of its owner, Pére Rougier, and also one or more islands of the Marquesas group. At these islands and in the surrounding waters they obtained many species of sea birds, including petrels, gulls, terns, boobies, frigate birds, and tropic birds, as well as doves and other land birds. Noteworthy among the specimens are examples of the rare petrel, *Bulweria bulweri*.

Upon Christmas Island the collectors had the novel experience, as shown in the accompanying illustrations, of visiting by automobile the breeding grounds of birds. Several cases of specimens are now *en route* from the field and their arrival is awaited with deep interest, for no adequate series of specimens, accompanied by exact data, have previously reached the museum from these parts of the world.

THE redwoods (*Sequoia sempervirens*), which share with the Big Trees of the Sierras (*Sequoia gigantea*) the distinction of being the oldest of living things, are threatened with destruction and only prompt action can save them. Along the State Highway in Humboldt County, California, tie camps are being erected with a view to start lumbering as soon as the season permits. To rescue from impending annihilation some at least of these magnificent trees a bill has been introduced in the California State Legislature asking an appropriation of $300,000. The bill vests authority and power in the State Board of Forestry to make purchases out of the appropriation stipulated, of redwood timber lands in Humboldt County, adjacent to the State Highway, to manage and control these lands and, whenever in the judgment of the board it is necessary, to exercise the right of eminent domain in acquiring such lands by condemnation proceedings.

President Henry Fairfield Osborn, of the American Museum, ever vigilant in protecting the natural wonders of our land, sent under date of February 23 to Governor William D. Stephens, of California, the following appeal:

"I write as president of the American Museum of Natural History and as president of the Zoological Society of the City of New York—institutions with combined memberships from all parts of the United States of eight thousand public-spirited citizens, also with combined popular attendance of more than five million people annually—to urge strongly your support of the bill now before the State Legislature of

California providing for an appropriation of $300,000 to purchase redwood groves through Humboldt County.

"I have followed the great movement in New York State which led to the establishment of the superb Palisade and Highland, and Adirondack parks, which are now enjoyed by all the people of the state and especially by those of limited means who cannot afford to travel abroad or to distant countries. It is in the democratic interests of these people of limited means but of firm patriotism that the reserves in the state of California should be made. As you know, I have traversed this country personally. I know almost every foot of it. I think there is no doubt that future generations will call this generation blessed if we save these majestic forests before it is too late and will cheerfully pay the small annual tax. The mind and spirit and soul of man are far more important than his body, yet how readily we tax people for the care of their bodies—for water supply, for sewerage, for roads—and how loath we are to tax them for the enjoyment and advancement of the beauties of nature!

"It is one of the glories of the state of California that so large a percentage of tax funds is devoted to educational purposes. I regard the saving of the redwoods by a small addition to the educational tax as of the greatest value to all the people."

It is to be hoped that by the enactment of the proposed bill and through the activities of the Save the Redwoods League this impressive tree may be permitted to continue to justify its scientific name *sempervirens*, "ever-living," instead of succumbing, after having survived the vicissitudes of the centuries, to the destructiveness of man.

On December 27 last the University of Pennsylvania entertained as guests the American Anthropological Association and the American Folklore Society when these two organizations held their joint meeting in Philadelphia. For the coming year Dr. William C. Farabee, of the University Museum, was elected president, and Dr. John R. Swanton, of the Bureau of American Ethnology, editor and treasurer, to suc. eed Dr. P. E. Goddard, curator of ethnology in the American Museum, who has edited the publication for the last six years. A number of interesting papers were read, including one by Dr. Robert H. Lowie, associate curator of ethnology in the American Museum, on "The Cultural Connection of Californian and Plateau Shoshonean Tribes," and one by Dr. P. E. Goddard entitled "Notes on the Wailaki of California."

The government of Chile has under construction at Santiago a large agricultural college equipped with a model farm, vineyards, stables, and other necessary facilities for the teaching and investigation of agricultural subjects. Mr. Vincente Valdivia, director of the department of œnology in the college, recently visited the United States to study the grape industry of California.

An appeal for the preservation and, in some cases, utilization for camping sites of the Indian rock shelters (*asiniwikams*) in Palisades Interstate Park is made by Mr. Meade C. Dobson in the *Conservationist*. These are the only monuments of the aborigines throughout this region. They consist of natural lean-tos or projecting ledges used by the Indian hunters when on the trail. Quantities of arrow points, spear heads, and other relics have been found on their floors at various times, among others by Mr. Max Schrabisch, who explored them extensively in connection with the archæological survey of the state of New Jersey undertaken some years ago by the American Museum. Mr. Dobson's recommendation that park trails be made to pass close to these shelters and that they be converted into comfortable overnight rest places by the use of chestnut slabs and concrete floors, is a picturesque idea but some at least should be kept intact.

There is probably no more striking instance of the evil results of man's interference with nature than that shown by the ravages of the gypsy moth (*Porthetria dispar*). This insect was accidentally turned loose in the United States and sums running into the millions have been expended in the effort to exterminate, or at least to limit the range of, the pest. The recent discovery that it had entered New Jersey, a state previously free from its devastations, was, therefore, viewed with alarm. Happily, intelligent efforts are being applied to its control. Mr. H. B. Weiss, chief of the Bureau of Statistics and Inspection, New Jersey State Department of Agriculture, who in the issue of Natural History for September-October, 1920, gave a statement of the problem with which the New Jersey authorities were confronted, records, in the paragraphs that follow, the progress that has been made in combating the evil:

"Due to the prompt action of the New Jersey Legislature in appropriating $112,000 on November 8, for immediate use in fighting this insect, it was possible by the last week of November to place a force of fifty men in the field. This force was increased as rapidly as possible until now (February 1, 1921) there are almost 100 men engaged in the work.

"The infested area at present covers approximately 150 square miles, reaching New Brunswick on the east, Clover Hill on the west, Pluckemin on the north, and Kingston on the south. In this area, the territory in the vicinity of

Duke's Park, Manville, Millstone, Blackwell's Mills, and Bound Brook, which comprises about 50 square miles, is generally infested, while the remainder of the area appears to be only mildly infested. Light infestations have been found also in both ridges of the Watchung Mountains north of Bound Brook.

"At the present time the work consists of locating and killing egg clusters (by painting them with creosote). Of all located egg clusters, two thirds have been creosoted, and the scouting of the entire territory is about one third completed.

"The spraying, which will take place in the spring when the eggs are hatching, will be confined to places in the area where enough eggs were found to warrant the application of the spray. Arsenate of lead will be used. Contracts have been made for the purchase of nine high-power, solid-stream, automobile sprayers, each capable of maintaining a pressure of 225 pounds at the nozzles.

"Two hundred and seventy-three shipments of nursery stock made by the James B. Duke estate to various parts of New Jersey, have been traced and infestations found at eight places; namely, Glen Rock, Wyckoff, Paterson, Madison, Elizabeth, Scotch Plains, South Orange, and Deal Beach. All egg masses found at such places are being creosoted. In the course of the work a rather severe infestation was found in three apple orchards near Mendham, New Jersey, this infestation apparently having no connection with the Somerville colony and its origin being obscure. With the coöperation of the owners, several hundred of these trees are being cut and burned together with brush, etc., in the immediate vicinity.

"All of the extermination work is being conducted jointly by the New Jersey Department of Agriculture and the United States Bureau of Entomology, and the experience of the federal men, gained by long association in fighting the 'moth' in New England, is reflected in the satisfactory progress made in New Jersey during the past several months."

It is the ravages of insects like the gypsy moth that are doubtless responsible for the belief, not infrequently held, that a substantial part of the insect world is inimical to man. Nothing however, could be farther from the truth. As pointed out in connection with the exhibit of insects on the third floor of the American Museum the damage done is almost entirely due to less than 1 per cent. of the species. It is only fair to remember that while the havoc wrought by some insects is extensive, pollination of crops like clover would be impossible without insect visitations, while many of our most beautiful flowers and delicious fruits largely owe their existence to the pollination of their blossoms by the same agencies. Finally, it is upon parasitic insects that man must rely in large measure for the control of insect pests. In waging war upon the gypsy moth the Government has, among other insects, a valuable ally in the beetle *Calosoma sycophanta*.

Mr. William Beebe, director of the Tropical Research Station of the Zoölogical Society in British Guiana, returned on April 5 from Georgetown on the S.S. "Guiana" of the Furness Line. The vessel took fire while approaching the harbor of St. Kitts, and Director Beebe stood by Captain Carmichael in the difficult work of extinguishing the fire. Fortunately his valuable collections of notes, photographs, and drawings were saved without serious damage; the loss of this fourth season's work would have been irreparable. An article will soon appear in Natural History describing some of the general features of the work of this laboratory. The *Bulletin* and *Annual Report* of the Zoölogical Society will also contain a full account. Three important articles are in preparation for the third volume of *Zoologica*, which is now chiefly devoted to the work of the Station. One of the most distinguished visitors to the Station this year was Prof. William Morton Wheeler, research associate in social insects, of the American Museum. The working staff included Mr. Tee Van, first assistant; Miss Isabel Cooper and Miss Mabel Satterlee, artists; and Mr. Inness Hartley, Mr. Alfred Emerson, and Prof. J. F. M. Floyd, of Glasgow University.

The sinister project of utilizing for irrigation purposes the Falls River Basin in Yellowstone Park, with the contemplated erection and maintenance of a dam not more than three miles below the outlet of Lake Yellowstone, has prompted President Henry Fairfield Osborn, of the American Museum, to direct the following vigorous protest to the Hon. Charles L. McNary, chairman of the committee on Irrigation and Arid Lands, United States Senate:

"As president both of the American Museum and the Zoölogical Society, institutions with a national membership of more than ten thousand public-spirited citizens, I record emphatic protest against the corporate influences threatening to invade and despoil the heart of the Yellowstone National Park. Some years ago the Hetch Hetchy Valley of the Yosemite was invaded on a similar plea of the interests of the people of San Francisco. It has now revealed itself in its true light as a water-power project and the people of San Francisco are forgotten. I have studied all the national parks at first hand since 1878. Their enjoyment by the people of the great arid region of the West is exerting a great educational and uplifting influence incomparably more important to the future of America than the present purely material and economic movement. I hope to appear in person before the Committee at a later date and I request this hearing."

Senator McNary, who presided February 22 at the hearing on the bill before the Committee on Irrigation, United States Senate, stated that the meeting was only the first part of a general hearing that would be held. He added that he had received a number of telegrams and letters protesting against the adoption of the bill and that he had notified the objectors that opportunity would be given for a full hearing.

Sir Lazarus Fletcher, the noted English mineralogist, died at Grange-over-Sands on January 6 last, in his sixty-seventh year. Sir Lazarus was appointed director of the British Museum of Natural History in 1909 and held the position until 1918, when he retired to give place to the present director, Dr. Sidney F. Harmer. A note concerning his retirement appeared in Natural History for March, 1919.

Before Sir Lazarus was twenty, his natural aptitude for science and mathematics had won for him two medals and a science scholarship. His deepening interest in the study of crystals brought him to the attention of Professor Story-Maskelyne, who was the Keeper of the Minerals at the British Museum. Sir Lazarus was appointed an assistant in the Mineral Department in 1878, being then twenty-four years of age, and two years later he succeeded to the Keepership. Despite the many duties and responsibilities of his position, he continued with marked success the work on meteorites of Dr. Walter Flight, whose "Chapter in the History of Meteorites" he edited in 1887. In 1892 he published "The Optical Indicatrix and the Transmission of Light in Crystals."

One of his great talents was the ability to use to the fullest extent the educational power of the museum exhibit. The perfection of the specimens in the galleries he arranged, and their logical disposition, the lucid and clear-cut explanations he supplied, the guide books he composed—planned with especial consideration for the needs of the beginner—have proved invaluable to those in search of information.

Next to the conundrum, "Does the flying fish fly?" no question has probably met with so many diverse answers as, "Is the bite of the Gila monster poisonous?" Replies have been made by Gray, Gunther, Cope, Mitchell, Yarrow, and Garman, to say nothing of men less widely known, and while these have agreed that *Heloderma* is a suspicious character, some have said that its bite was deadly and some that it was harmless.

More recently Dr. Leo Loeb investigated the poison of the Gila monster with great care, and he has very kindly prepared for Natural History a summary of the results of his researches, which will be found on pages 92-95. Briefly, these are that the venom of *Heloderma* is much like that of the cobra, and its effects, when injected, much the same as those that follow the bite of that snake. And yet there seems to be no evidence that a man has died from the *bite* of *Heloderma*, although several have died *after* it. For it is on record that one man, bitten by a Gila monster, was subsequently run over by a trolley car, and another died happily from acute alcoholic poisoning. It is quite possible, too, that remedies for *Heloderma* bite in the shape of large quantities of poor whisky may have killed one or two persons, as has happened in cases of snake bite. As for pigeons and kittens, it seems to be necessary to shave off the feathers or hair in order to render the bite fatal; otherwise the venom seems to be wiped off before it can penetrate the wound. That birds and small mammals die from injections of *Heloderma* poison is not at all surprising, but *Heloderma* itself fortunately cannot give a hypodermic injection.

Thus *Heloderma* is one of nature's paradoxes, not to say blunders. In it we have an animal provided with a deadly poison but without the apparatus for using it properly. Not only is *Heloderma* devoid of the hypodermic syringe of the rattlesnake, but the poison glands are in the under side of the mouth and imperfectly connected with the teeth, and as liquids do not flow uphill, in order to bite to advantage the lizard should turn itself upside down. Moreover, being a short-legged, heavy-bodied creature, *Heloderma* is sluggish in its movements and still further handicapped by warning coloration. But it has been under a cloud from its first introduction to so-called civilized man, for as early as the middle of the seventeenth century the Spaniards brought from Mexico accounts of a reptile so venomous that even its breath caused death. As with other suspicious characters, it is safest to leave it alone, for at the best it is a beast of uncertain temper: the first one the writer ever saw was used as a plaything by Professor Ward's five-year-old daughter and never offered to bite; the last one, after being handled for a year by an attendant at the Children's Museum, Brooklyn, inflicted the worst bite on record, catching the attendant in the fleshy base of the thumb when the jaws were vertical and there was a good chance for the venom to run along the teeth. But as Goldsmith might have written, the man recovered from the bite; the *Heloderma* died—though some time later.

F. A. L.

Dr. Luis Maria Torres, curator of the departments of archæology and ethnology in the Museo de la Plata, has been elected to the directorship of that museum to succeed Professor Lafone Quevedo, who died on June 18, 1920. Professor Quevedo was a distinguished archæologist and linguist, well known in the United States and in Europe.

As showing the growing recognition and importance of physical anthropology, we have just received from P. Blakiston's Son and Company of Philadelphia a laboratory manual of anthropometry by Dr. Harris H. Wilder that will be reviewed at length in a subsequent number of NATURAL HISTORY.

Two noted anthropologists, the Abbé Henri Breuil, famous for his investigations in connection with palæolithic cave paintings in France, and Sir James G. Frazer, author of the "Golden Bough," received the degree of doctor of letters (*honoris causa*) from Cambridge University last year.

WE ARE apt to think of the bison as of American origin, but ancestral forms of the bison lived in Europe and Asia long before the animal reached the western hemisphere during the Pleistocene. Indeed in Lithuania the *Bos bison* or *Bison bonasus* has survived to the present time. The superb representations of the bison in the Altamira cave in Spain—to cite only one case—testify to the interest that early European man took in this ungulate.

The American Museum has recently received from the Cambridge Museum of Zoology an incomplete skull of the European bison (*Bison priscus*), commonly known as the wisent, with the horn cores nearly perfect and finely preserved. The specimen, which was found in the older Pleistocene gravels of Great Barrington, near Cambridge, was secured as the result of an exchange arranged by the curator of the Cambridge Museum of Zoology, who at one time studied palæontology under Dr. William K. Gregory, curator of comparative anatomy and associate in palæontology in the American Museum.

From the same source and through the same friendly agency the American Museum has obtained a fine skull and jaws of the urus or extinct wild ox of Europe (*Bos primigenius*). It has been thought that this animal represents, in a general way at least, the primitive stock from which the existing domestic cattle have been derived. This view point is discussed in the course of an article on the urus and the bison which Dr. W. D. Matthew, curator of vertebrate palæontology in the American Museum, will contribute to a later issue of NATURAL HISTORY.

MR. EDWARD JAMES NOLAN, for fifty-eight years recording secretary and librarian of the Philadelphia Academy of Natural Sciences, died on January 9 at the age of seventy-four.

THE New York Zoological Garden announced the birth of a pygmy hippopotamus on January 26. This is the second born in captivity. The first was born in the Garden two years ago but was unable to nurse and lived only a few days; it was presented to the American Museum and may be seen in the hall of mammals. The mother is one of three hippopotami brought from Liberia six years ago.

PROGRESS in making anthropometric measurements of inhabitants of the Hawaiian Islands is reported by Mr. Louis R. Sullivan, assistant curator of physical anthropology in the American Museum. Six thousand six hundred individuals had been examined at the close of February and a good growth series obtained of Chinese, Japanese, Portuguese, American, and part-Hawaiian children. It will be difficult, Mr. Sullivan points out, to secure a growth series of pure-blooded Hawaiian children, for among the younger generation of Hawaiians, individuals without admixture of foreign blood are a rare occurrence.

At a meeting of the trustees of the Bernice P. Bishop Museum, held on December 16, 1920, the following motion was unanimously passed:

"*Voted* to record the appreciation of the trustees of the Bernice P. Bishop Museum of the spirit of coöperation in scientific research so graciously shown by the American Museum of Natural History in the leave of absence on full salary allowed to Mr. Louis R. Sullivan, assistant curator in anthropology, in order that he might join one of the Bayard Dominick Expeditions of Yale University now being conducted by this Museum; and

Voted that the secretary be directed to forward a copy thereof to the president of the American Museum of Natural History."

IT IS with great regret that we learn of the death on January 30 of Mr. C. E. Fagan, secretary of the British Museum (Natural History) The following brief but excellent summary of Mr. Fagan's long and valuable services is taken from *Nature* for January 13:

"Mr. C. E. Fagan is expected to retire from the British Museum (Natural History) in the spring of this year. He entered the service of the Trustees in 1873, and became assistant secretary in 1889. He received the title of secretary in 1919, in recognition of the conspicuous value of his services. It is safe to say that Mr. Fagan has done more than any other living man in developing the importance of the museum as a center of scientific activity. His long experience, his grasp of affairs, and his unfailing capacity for forming a correct judgment have made his coöperation and advice invaluable to the Trustees and to his colleagues. His administrative ability has been of the greatest service to successive directors, whom he has assisted in innumerable ways, while during more than one period of interregnum he has succeeded in maintaining the efficiency of the museum at a high level. Although not himself an investigator, Mr. Fagan has taken a keen interest in many aspects of natural history and has been quick to appreciate the importance of an opening, whether the chance of securing a valuable collection or the opportunity of encouraging an expedition to some distant country. He has been closely associated with such societies as the British Ornithologists' Union and the Royal Geographical Society, the interests of which are connected with those of the Natural History Museum. Opportunities of making the museum practically useful have a special appeal for him and he has taken great interest in exhibits of economic importance. From the first he has been a strong supporter of the close connection which happily exists between the museum and the Imperial Bureau of Entomology. Mr. Fagan has rendered exceptional services to science by single-minded devotion to his ideal of increasing and developing the scientific importance of the museum. The fact that he is suffering from a severe illness at the time which he had hoped to devote to putting the finishing touches to his long period of successful service will command the ready sympathy of his many friends."

Dr. George F. Herbert Smith (D. Sc. Oxon), late of the department of minerals in the British Museum (Natural History) succeeds Mr. Fagan as assistant secretary.

Mr. Basil H. Soulsby, M. A., has been appointed librarian of the British Museum (Natural History), in the general library, with supervision over the five departmental libraries, —zoölogy, entomology, geology, minerals, and botany.

There has been a growing feeling among the employees of the American Museum that, because of the very evident necessity for specialization in the work of the various departments, a proper perspective and knowledge of the work of the museum as a whole was not possessed by its workers. In answer to many requests to remedy this situation, the administration has inaugurated a series of informal talks for its employees, to be given every other Wednesday from 12:45 to 1:15 o'clock. It is planned to supplement these lectures by visits to the different exhibition halls under discussion until eventually all the departments of the museum have been covered.

The introductory lecture was given on January 19 by Director Lucas, who chose as his subject, "The Purpose and Aim of a Museum." This was followed on February 2 by Dr. Reeds' address on "The Meaning of Geology to a Museum." A week later Dr. Reeds conducted a tour through the hall of geology. "Why Palæontology," was the subject of Dr. Matthews' address at the last meeting in February.

In line with our efforts to save the redwoods it is worthy of note that in far-off New Zealand enlightened protest has been made against the wanton destruction of the native trees. As long ago as 1903 a vigorous and convincing plea for timely protection of the forests of the islands was made in the Second Annual Report of the Department of Tourist and Health Resorts, New Zealand. "Our forests," says the Report, "have been and still are being destroyed in a wholesale, ruthless manner, without a thought being given to the future. In many cases bush lands have been sold for very small sums, and valuable timber has been wasted in a manner which is absolutely a crime against the nation. The timber on areas of utterly worthless land, quite unfit for settlement, has been burnt off, denuding the soil of the only crop it will ever produce."

Both in the conditions encountered and in their solution, which includes the recommendation that "the Government immediately proceed to resume the control of specially interesting and attractive forest lands on the principal routes of travel," the Report shows that the struggle for scenic preservation that has been waged in our own country has had its counterpart in other lands.

The members of the American Museum have been cordially invited to join the Cascadians during their summer outing on the east side of Mount Adams, Washington, from August 7-21. The club proposes that those taking part in the outing leave Yakima, Washington, by automobile at eight o'clock on the morning of August 7. Camp fire programs will be arranged and games played on the greensward at permanent camps. There will be many easy trips for those who cannot take part in the more strenuous excursions of the seasoned climbers. Communications should be addressed to Mr. J. R. Vincent, Yakima, Washington.

Not the least interesting thing in the recent report of the Biological Survey is the fact that it shows very clearly the difficulties man has brought upon himself by his intentional or unintentional interference with nature. Also, that an animal may be beneficial at one time or in one locality and harmful at another.

On one page we are told of the plague of rabbits, on another of the bounties on coyotes, nature's most effective check on the rabbits. Ground squirrels and prairie dogs are pests in some places, but we see nothing about encouraging badgers to keep them in check. On one page we are told that meadow larks are seriously destructive of sprouting oats, and two pages farther on that they are among the birds having the best records as destroyers of grasshoppers.

One of the last items in the report is a timely plea for conservation of marsh areas, whose utility is generally overlooked. In parts of Massachusetts the influence of the conversion of "pond holes" and swamps into cranberry bogs is well marked in the shrinkage of ponds and the consequent decrease of fishes. There is the ever-recurring clash between the "sentimentalist" and the so-called "practical man," and we are by no means sure that the former gets just treatment—why should thousands of people be deprived of the pleasure of seeing birds and mammals amid their natural surroundings because a few people wish to make a few more dollars? For the practical man does not for a moment think of any one besides himself and, while he poses as a public benefactor, he has not the slightest intention of sharing his profits with his neighbor. Not that the sentimentalist can have it all his own way, either—it is doubtful, for example, if beavers can be allowed in many parts of the Adirondacks, but in others they should be a source of revenue. Man is himself partly to blame for this state of things for he has depleted the forest to such an extent that it cannot recuperate fast enough to keep the beaver in provisions.

ALONG with other heads of government departments the Commissioner of Fisheries reports a serious depletion of his technical staff (36 per cent) during the last year.[1]

Notwithstanding this depletion, the biological investigations of the Commission have been notably advanced. The commissioner reports progress in the study of the life histories and migration of the Pacific Coast salmon and of the whitefish and ciscoes of the Great Lakes. Valuable information has been secured also from investigations on the paddlefish and smelts. Diseases of fishes in the St. Lawrence River were investigated and experimental work in fish culture has been carried on. The Commission's steamers, *Albatross* and *Fish Hawk*, which had been loaned to the Navy Department for war service, were returned and again utilized in oceanographic studies and fishery trials. Of the laboratories, the only one actively operated was that at Woods Hole, Massachusetts, which was engaged in investigations on oysters, the reddening of salt fish, gelatin from seaweed, and the habits, food, and parasites of fishes.

THE first text in the English language on anthropometry, the science of human measurements, has just been published by Dr. Ales Hrdlička of the United States National Museum. It is a wholly original work based on the international anthropometric agreements. Dr. Hrdlička covers all aspects of the science: the use of the instruments, technique of measurements on the living, on skeletal remains, and on the cadaver. He also includes some physiological observations. In the issue of NATURAL HISTORY for November-December, 1920, mention was made (p. 595) of the recently installed exhibit in the southwest pavilion on the second floor of the American Museum, illustrating the definite points of measurement agreed upon by anthropologists to insure uniformity of methods and thereby make possible a comparison of the results of one investigator with those obtained by another. This exhibit will prove particularly valuable to those interested in physical anthropology.

THE *History and Bibliography of Anatomic Illustration in Its Relation to Anatomic Science and the Graphic Arts*, by Dr. Ludwig Choulant, first published in 1852, has recently been republished in translation by the late Dr. Mortimer Frank, secretary of the Society of Medical History, Chicago (University of Chicago Press). The work includes an account of pictorial anatomy from the earliest times, chiefly in the form of biographic-literary notes on different anatomists and artists. Three appendixes have been added: one by Dr. Choulant on "Chinese Anatomy"; a second by Dr. Fielding H. Garrison and Dr. Edward C. Streeter on "Sculpture and Painting as Modes of Anatomical Illustration"; and a third by Dr. Garrison on "Anatomical Illustration Since the Time of Choulant."

INCREASED efficiency in the use of the microscope for biological purposes has been attained with ultra-violet light by means of which photographs are taken showing greater resolution than with ordinary light.[1] As objects which are transparent in ordinary light show definite absorption bands in ultra-violet light, this photographic method is its own staining process. An additional advantage is that the material can be dealt with in the living state. The chief difficulties lie in the technique which requires considerable familiarity with physical methods, and in the expense of the optical apparatus, which must be computed from fused quartz.

[1]Annual Report of the Commissioner of Fisheries to the Secretary of Commerce for the year ended June 30, 1920.

[1]J. E. Barnard. "Microscopy with Ultra-violet Light." *Nature*, Vol. 106, p. 378. Nov. 18, 1920.

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JOHN BURROUGHS

From his portrait by Her Serene Highness, the Princess Lwoff. Shown by courtesy of the artist

NATURAL HISTORY

VOLUME XXI MARCH-APRIL, 1921 NUMBER 2

REMINISCENCES OF JOHN BURROUGHS

BY

G. CLYDE FISHER*

SOME twenty years ago there fell into my hands the first volume of Mr. Burroughs' essays that I had ever seen. It happened to be *Signs and Seasons*. I am now sure that the result would have been the same, had it been any other volume. The interest and charm that this book held for me prompted me to secure and read the others that he had written up to that time, and to be on the look-out for those that have come from his pen since. One cannot read any book by Mr. Burroughs without a feeling of affection for the author. He has put his lovable self into his essays in a way that few men of letters have succeeded in doing.

As my interest and admiration grew, I ventured to hope that I might sometime have the privilege of knowing him personally. On my first visit to New York, eighteen years ago, what I wanted to do more than anything else was to visit the Sage of Slabsides. So I went up to Riverby, his home, which is situated on the west bank of the Hudson about eighty miles north of New York City. It will not be difficult to imagine my disappointment when I was informed by Mrs. Burroughs, who came to the door, that her husband had gone to Slide Mountain, the highest peak in the Catskills, and would not return for several days. I could not wait, so had to leave without seeing him. Like a thoughtless schoolboy, I had neglected to find out beforehand whether he would be at home and whether it would be convenient to have me call. However, I saw Riverby, the stone house, the building of which he describes in the essay "Roof-Tree," which is included in the first book of his that I had read. Here he makes us feel the joy he felt and the enthusiasm he had in building his home by the river.

It was not until after I joined the staff of the American Museum eight years ago, that I actually had the privilege of meeting the poet-naturalist, and later of visiting him at Riverby. This first visit was on a bright November day in 1915, an ideal day for such a pilgrimage. Mrs. Fisher and I were to be the guests of Dr. Clara Barrus, Mr. Burroughs' physician and friend, while we visited our hero. Mr. and Mrs. Burroughs were then living in the stone house at Riverby, but were taking their meals with Dr. Barrus, who lived in The Nest on adjoining grounds. This cottage, which Dr. Barrus on making her home there had rechristened The Nest, had been built for Mr. Burroughs' son, Julian. It is one of the most attractive little houses I have ever seen. There is no varnish or paint or veneer anywhere. The naked beams and ceilings of chestnut, the wainscoting of curly birch and other woods that had grown on the surrounding hills, the panels of white birch with the bark intact,—all these reminded one of what Mr. Burroughs had written in "Roof-Tree:"

"The natural color and grain of the wood give a richness and simplicity to an interior that no art can make up for. How the eye loves the genuine thing;

*Associate Curator, Department of Public Education, American Museum how it delights in the nude beauty of the wood!"

The fine, large fireplace in the living-room, shown in the photograph on page 123, makes it complete.

When reading *John Burroughs—Boy and Man* by Dr. Barrus, I was much interested to learn President Roosevelt's reaction when he stepped into the big living room of this cottage in the summer of 1903—how he rushed out, calling to Mrs. Roosevelt, "Come here, Edith! I want you to see this—something original, and American."

Knowing that Mr. Burroughs did his writing in the forenoons, we proposed not to disturb him until lunch time. He had said, "My mind works best, and my faith is strongest, when the day is waxing and not waning." He was not a burner of midnight oil.

I had brought my camera hoping to get one picture of the great poet-naturalist. Before noon I started out to secure a few photographs about his home. First I undertook to make one of the Summer House on the banks of the Hudson just a few steps from the bark-covered Study between the stone house and the river. In this Summer House, which commands a wonderful view up and down the river, Mr. Burroughs used to sit by the hour during the warmer months of the year, reading or thinking out the essays he has given us. While focusing my camera on the Summer House, I was discovered by Mr. Burroughs, who appeared at the door of his Study, and after cordially greeting me, said, "I thought you might like to have me in the picture." I was so delighted that I could hardly operate my Graflex camera. However, I made a picture of John of Birds examining a wren box on the big sugar maple by the Summer House, one of him standing in the door of the Study looking out over the Hudson, and one of him sitting by the fireplace in the Study. So, my wish was more than fulfilled on that first visit.

The Study is a most interesting place, a beautiful little one-room building lined with books, with here and there on the wall a portrait of a friend. Among these photographs were those of Emerson, Muir, and Whitman. At one end is a large fireplace, the chimney of which is made of cobblestones. In this Study before Slabsides was built, Mr. Burroughs wrote many of his essays, and since that time has written there during the winter months.

In the orchard at Riverby, there were a few of "the gentle but sharp-nosed gillyflower" or sheep-nose apples still hanging on one of the trees, apparently unharmed by whatever frosts had come previous to November 6. These reminded us of one of Mr. Burroughs' most delightful essays, "The Apple," which was published in his second nature book, *Winter Sunshine*.

"A rose when it blooms, the apple is a rose when it ripens. It pleases every sense to which it can be addressed, the touch, the smell, the sight, the taste; and when it falls, in the still October days, it pleases the ear. It is a call to a banquet, it is a signal that the feast is ready."

"The apple is indeed the fruit of youth. As we grow old we crave apples less. It is an ominous sign. When you are ashamed to be seen eating them on the street; when you can carry them in your pocket and your hand not constantly find its way to them; when your neighbor has apples and you have none, and you make no nocturnal visits to his orchard; when your lunch basket is without them, and you can pass a winter's night by the fireside with no thought of the fruit at your elbow,—then be assured you are no longer a boy, either in heart or in years."

Mr. Burroughs' love of the apple is not completely expressed in that early essay, for in his volume of verse, *Bird and Bough*, published many years later, one of the best poems is "In Blooming Orchards." One of his later books, which was written in the orchard back of Woodchuck Lodge, although not expressing any of his thoughts about the apple, is entitled *Under the Apple Trees.*

Several acres of the grounds at Riverby are devoted to a vineyard, and especially during the early years of his residence there Mr. Burroughs spent considerable time growing grapes, by which activities he gained the nickname, "The Vinedresser of Esopus." Before the development of West Park, the village of Esopus was his post-office address. On a subsequent visit he told me how men and boys were in the habit of pilfering his vineyard at night, and how some, not content with what they could eat at the time, carried away large quantities in rowboats across the Hudson. So, one night he concluded to watch. He put on a long black coat, and sat down in the vineyard for a period of "watchful waiting." He had not long to wait before three boys came down the road on bicycles. Laying their wheels by the roadside, they climbed over the fence into the vineyard and began sampling the luscious grapes. Mr. Burroughs got up and walked slowly down between the rows of grapes toward the boys, who soon spied him and started to run, the owner of the vineyard after them. Two of the boys reached the fence, scaled it, mounted their wheels, and rode off. The third was not so fortunate. "Just as he was going over the fence," said Mr. Burroughs, "I caught him by the leg. He let out an unearthly yell, and as I did not want to scare him to death let him go." The boy picked up his bicycle and hurriedly attempted to mount it, but in his excitement, he fell off. Then he jumped to his feet and abandoning his wheel, ran down the road after his companions. The next morning the owner of the wheel returned and begged for it, declaring that he had never been in the vineyard before and would never enter it again. Leading him down to the vineyard, Mr. Burroughs presented him with a hatful of grapes to take home and restored to him his bicycle.

At luncheon, in deference to my training, Mr. Burroughs told us about some of the botanical rarities he had found in the vicinity—the showy lady's-slipper, climbing fumitory or mountain fringe, and others, the finding of which he so vividly describes in the volume of outdoor essays entitled, *Riverby.* Since his first discovery of mountain fringe, it has become a common plant around Slabsides. Last November, on the anniversary of our first visit, we found it blooming in profusion around that cabin.

After luncheon, Mr. Burroughs conducted us up to Slabsides—which is located about a mile and three quarters in a westerly direction from Riverby. After leaving the main highway, we followed a somewhat winding woods road which led through a beautiful stretch of hemlock forest. As we walked along, Mr. Burroughs would occasionally pluck a gorgeous oak leaf from a young tree and, holding it between his eye and the sun, would comment on its beauty. I never realized until then how much more beautiful an autumn leaf is by transmitted light than by reflected light.

On the way we flushed a ruffed grouse, or partridge, from the road in front of us, and it whirred away through the woods. We were all delighted with this glimpse of wild life. As Mr. Burroughs watched its flight he said, "I hope it will escape the gunners this fall." Subsequent visits to Slabsides have shown that there are ruffed grouse still to be found about this cabin. Late in May two or three years after this first visit, I surprised a mother ruffed grouse and her family of downy young on this very road. It is to be hoped that the woods about Slabsides will be made a permanent sanctuary, so that the birds, which meant so much to Mr. Burroughs and about which he has written so charmingly, may be found there always.

Slabsides is so well hidden by the natural conformity of the encircling

Lover of children.—A human, kindly man with a warm spot in his heart for children, and the children returned his love. This baby, ordinarily reserved toward strangers at the time of her first visit immediately showed full confidence in Mr. Burroughs

The Sage of Slabsides.—At the table where Burroughs wrote *Walt Whitman: a Study* and many of his outdoor essays. The last photograph ever made of him in Slabsides—November 7, 1920. He was at Slabsides but once after this date

John and Demijohn.—John Burroughs and his only grandson, John Burroughs 2d, of whom he was pardonably proud, for the younger John is a chip of the old block, once removed, being fond of camping and tramping and other outdoor activities hills, that one comes almost upon it before seeing it. We reach the cabin and notice how it is sheltered under the brow of a steep, rocky cliff (see illustrations in NATURAL HISTORY, December, 1919, p. 576, and November-December, 1920, p. 572). The weather boarding is made of slabs with the bark still on,—hence the name. At the south end is a stone chimney connecting with the huge fireplace within. Inside, Slabsides, by virtue of its rustic furniture and its partitions of yellow birch with the beautiful bronze-colored bark still on, is even more attractive than outside. There were rustic hickory chairs, and two wonderful rustic beds, with old-fashioned coverlets which Mr. Burroughs' mother had had made. The bed on the first floor is built into the house and has a substantial, comfortable look. The one in the south room up-stairs is even more picturesque. It is made chiefly of bark-covered yellow birch, the upright pieces at the head being water beech (*Carpinus*).

The legs of the table upon which Mr. Burroughs wrote many of his essays are tridents of staghorn sumac. He told me that inverted, symmetrical tripod-formations were to be found more frequently in staghorn sumac than in any other of our trees or shrubs.

Mr. Burroughs had an eye for the picturesque in the natural forms to be found in the trees. This is evidenced many times in his mountain cabin,—by the arm at the end of a window seat; by the spiral-shaped crosspiece above the fireplace, caused by the strangling by bittersweet or some other twiner; by the peculiar, X-shaped pine root over the door of the bedroom downstairs. This last and another similar to it, which lies back of the front door in the living room, were dug up when the swamp just south of the cabin was drained.

For the best description of Slabsides that has been written, read two chapters in *Our Friend, John Burroughs*, by Clara Barrus,—one entitled "The Retreat of a Poet-Naturalist" and the other "A Winter Day at Slabsides." These suggest the atmosphere of the place and give much of the man who tarried there.

Mr. Burroughs built Slabsides in 1895, to get away from the annoyances of civilization. At Slabsides, on this first visit I asked Mr. Burroughs about a number of distinguished visitors he had had there. Dr. Chapman of the American Museum had gone to see him when he was clearing the ground for the rustic cabin, and was one of his earlier visitors after the cabin was built. These pilgrimages were written up in the first number of the first volume of *Bird-Lore* and in a chapter in *Camps and Cruises of an Ornithologist*. Whenever I went to see Mr. Burroughs, he always asked about Dr. Chapman.

His friend, Walt Whitman, visited him where Slabsides was subsequently built, and wrote a vivid description of Black Creek and the surrounding region, which was later printed in *Specimen Days*. Black Creek, whose falls are within hearing of Slabsides, is a wild place where Mr. Burroughs used to go every May for warblers. More than once in May, since my first visit, I have tramped along this creek (in "Whitman Land") looking for warblers and finding them, too. All wild life about this mountain cabin is unusually interesting because it has been immortalized in the essays of the great naturalist.

John Muir was one of the earliest visitors to Slabsides. He came in 1897 and spent several days. After discussing the qualities and work of the Naturalist of the Sierras, Mr. Burroughs said, "Muir told us the story of Stickeen one night in Slabsides. We did not go to bed until one o'clock that night!" *Stickeen* is a fascinating story to read, but how much more impressive it would have been to have heard Muir tell this story, and in Slabsides with John Burroughs as one of the listeners! "*Stickeen*, by John Muir," said Mr. Burroughs,

John Burroughs and President Roosevelt watching an eruption of Old Faithful.—"At the time I made the trip to Yellowstone Park with President Roosevelt in the spring of 1903, I promised some friends to write up my impressions of the President and of the Park, but I have been slow in getting around to it. The President himself, having the absolute leisure and peace of the White House, wrote his account of the trip nearly two years ago! But with the stress and strain of my life at 'Slabsides,' administering the affairs of so many of the wild creatures of the woods about me,—I have not till this blessed season (fall of 1905) found the time to put on record an account of the most interesting thing I saw in that wonderful land, which, of course, was the President himself." (From *Camping and Tramping with Roosevelt.*)

"will rank with *Rab and His Friends*, by Dr. John Brown, as one of the greatest dog stories of literature."

Burroughs returned this visit a dozen years later and Muir showed him the Grand Cañon and the Yosemite.

I asked Mr. Burroughs about the visit of President and Mrs. Roosevelt in July, 1903. They had come up the Hudson in "The Sylph" on the hottest day of the summer—96 degrees in the shade at Slabsides. The host and his guests walked from the river up to the mountain cabin. "How the President did perspire!" said Mr. Burroughs. At luncheon in Slabsides, although his cup had been filled with cold water from the spring near by, the President jumped up and helped himself several times during the meal. In discussing the strenuous life of the President, Mr. Burroughs said: "There is no dead wood in Roosevelt."

Mr. Burroughs also related how he and President Roosevelt had gone birding one day at Pine Knot, Virginia, and how they had identified some seventy species of birds, two of which were new to the President and two of which were new to Mr. Burroughs. Had they found a Lincoln's sparrow, which President Roosevelt had seen there before, and which Mr. Burroughs had never seen, the President would have been one ahead. He told about the difficulty they had in identifying a female blue grosbeak. Mr. Burroughs said, "Roosevelt knows the birds."

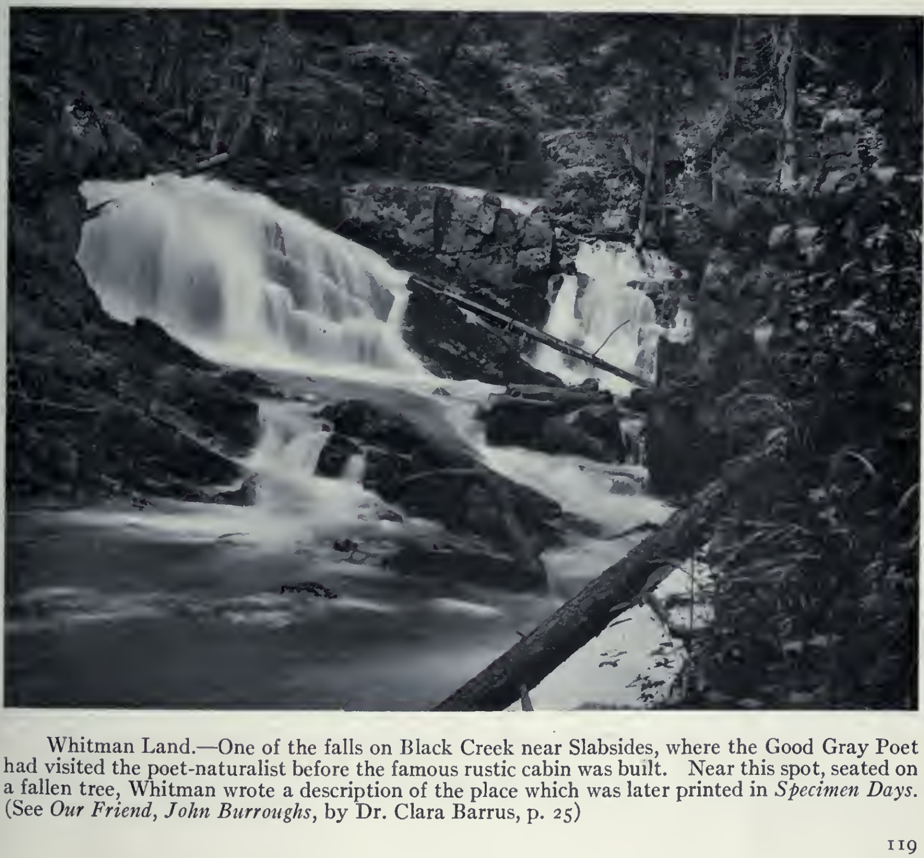
Upon leaving Slabsides on that memorable day, I found an herb-robert in bloom, and plucking the little, red-purple flower, placed it between the leaves of the first volume of my set of Burroughs' works, which I had brought along in order to ask Mr. Burroughs to inscribe it. When I reached home, I pressed the specimen and mounted it in the back of *Wake-Robin*, a suitable place, I thought, to preserve a flower plucked while walking with John Burroughs.

On the way back to Riverby from Slabsides, I expressed my appreciation to Mr. Burroughs for what he had done to stem the tide of sham natural history which was sweeping over the country

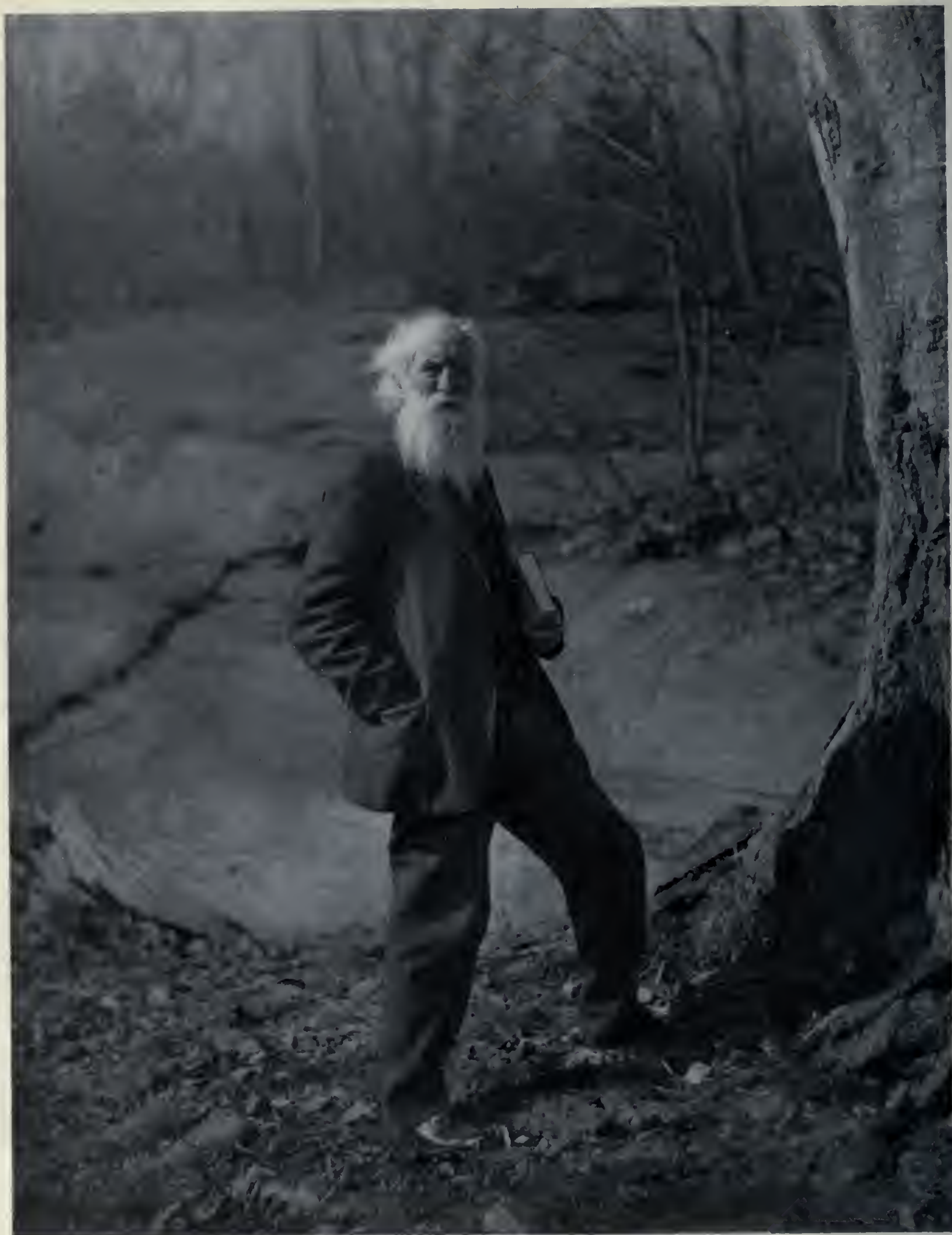
Deacon Woods where Burroughs saw his first warbler.—In the woods shown in the middle ground, John Burroughs, when a boy, saw his first warbler, and then many years later described the incident in "The Invitation," the last essay in *Wake-Robin*.

The notch in the mountains back of the Deacon Woods in this photograph is Montgomery Hollow where our naturalist in his boyhood went fishing with his grandfather.

It is probable that these early fishing trips, as well as the sight of that first warbler, had much to do with making him a naturalist



Whitman Land.—One of the falls on Black Creek near Slabsides, where the Good Gray Poet had visited the poet-naturalist before the famous rustic cabin was built. Near this spot, seated on a fallen tree, Whitman wrote a description of the place which was later printed in *Specimen Days*. (See *Our Friend, John Burroughs*, by Dr. Clara Barrus, p. 25)



JOHN BURROUGHS ON HIS EIGHTY-THIRD BIRTHDAY

"Lucky is he who can get his grapes to market and keep the bloom upon them, who can carry some of the freshness and eagerness and simplicity of youth into his later years, who can have a boy's heart below a man's head."

"The longer I live the more my mind dwells upon the beauty and wonder of the world." (From *The Summit of the Years*) some twelve years before. He then told me how he had discovered the work of one of the most active and, at the same time, one of the most popular writers of this fake natural history. One of the books of this author had been highly recommended to Mr. Burroughs by a New York school teacher. Upon finding at a subsequent meeting that Mr. Burroughs had not yet read the book, this teacher offered to send him a copy. When he received it, Mr. Burroughs sat down expecting an enjoyable hour reading it. "But," said Mr. Burroughs, "I had not read ten minutes until I kicked out in the air—I just *had* to kick out against something, and I exclaimed, 'This writer is a humbug.'" His love of truth prompted him to write an article in the *Atlantic Monthly* for March, 1903, entitled "Real and Sham Natural History," which was directed against this sort of thing. Other naturalists, including Roosevelt and Chapman, took sides with Mr. Burroughs in this fight, and before long, they had about snuffed out the writer referred to, as well as others of his kind. As a result, these books of fake natural history have been ruled out of the lists of supplementary reading in many of the public schools of the country, and their harmful effects have been reduced to a minimum.

Since the days of that controversy, Mr. Burroughs said he had talked with people who know the writer above referred to, and that they had assured him that this writer actually believed the things he wrote. "So, now," said Mr. Burroughs, "I think of him as a mythomaniac."

Upon bidding farewell to his guests at the railroad station at West Park that evening, Mr. Burroughs said, "Whenever you want to come to Slabsides, the key is yours." In response to this generous invitation, we have camped in this mountain cabin, for two or three days at a time, about twice a year since that first visit. We have been there in May when the warblers were abundant, and we have been there the last week in November, with the thermometer down to twenty at night, when, instead of warblers around the cabin, we had the winter wren, the junco, and the chickadee.

First things make lasting impressions, and so it is with my first visit with John Burroughs, but the visits that have meant the most to me have been subsequent ones. Perhaps the most inspiring have been those at Woodchuck Lodge on the home farm near Roxbury in the western Catskills, where for many years it has been his custom to spend his summers. The farm on which he was born is situated "in the lap of Old Clump," which has since been rechristened Burroughs Mountain. Woodchuck Lodge is only about a half mile distant from his birthplace. It gets its name from the abundance of woodchucks in the vicinity.

The country about Woodchuck Lodge is full of interest. In the apple orchard back of this cottage was located Bush Camp, where he wrote the collection of essays entitled *Under the Apple-Trees*. It is where he found out how the chipmunk digs its burrow, which he describes in the first essay of this volume. Up the road a little way is the barn which he used for a study when he wrote "A Barn-Door Outlook," "A Hay-Barn Idyl," and other essays. A little farther up the road toward the birthplace are the "Giant's Stairs," a natural stair-step formation, though crude—the steps being too high to be negotiated by a human being—hence the name, applied when he played there as a boy.

Across the road are many hour-glass-shaped thorn trees or haw trees (*Cratægus*) in every stage of development, which is influenced by the browsing of the dairy cows.

"The way the wild apple trees and the red thorn trees in the pasture, as described by Thoreau, triumph over the cattle that year after year browse them down, suggests something almost like human tactics. The cropped and bruised tree, not being allowed to shoot upward, spreads more and more laterally, thus pushing its enemies farther and farther away, till, after many years, a shoot starts up from the top of the thorny, knotted cone, and in one season, protected by this *cheval-de-frise*, attains a height beyond the reach of the cattle, and its victory is won. Now the whole push of the large root system goes into the central shoot and the tree is rapidly developed." (*Ways of Nature*, p. 153.)

Immediately after the central shoot gets up beyond the reach of the cows the tree becomes strikingly hour-glass-shaped.

At the hay barn at Woodchuck Lodge, one day, Mr. Burroughs was discussing Thoreau, speaking very highly of the essays, "Walking" and "Wild Apples," both of which are included in *Excursions*. Then he referred to certain peculiarities, and to a number of surprising inaccuracies to be found in the writings of this author. "But," he said finally, "I would rather be the author of Thoreau's *Walden* than of all the books I have ever written."

While I do not sympathize with that statement, it must be admitted that Burroughs could hardly have paid a higher compliment to Thoreau. For myself, I would rather be the author of Burroughs' *Wake-Robin* than all I have ever read of Thoreau's works.

Nearby is the Deacon Woods where Mr. Burroughs, when a boy, saw his first warbler—a black-throated blue—originally described in *Wake-Robin*, in the chapter, "The Invitation." On my first visit to Woodchuck Lodge, as we walked past this woods on our way down to the birthplace, Mr. Burroughs retold this story to me. He said, "My brothers were with me, and they saw the bird; however, they did not remember it,—but it 'stuck in my craw.'" I often think how much the sight of that beautiful little warbler may have influenced him to become a naturalist; how much it may have added to his natural bent; how much this and the early fishing trips to Montgomery Hollow with his grandfather may have had to do in preparing him for the influence that the Audubon books had upon him when he discovered them many years later in the library of the West Point Military Academy. It happens that Mr. Burroughs was the first person to find an occupied nest of the black-throated blue warbler, which had been his first warbler. This reminds us of other contributions to ornithology made by Mr. Burroughs, such as the finding of the first nest of the mourning warbler and the first description of the flight-song of the ovenbird. However, his actual discoveries in natural history are not his most important work. It is his literary interpretation of the common things about us,—in short, his books, that are his great legacy to mankind.

Near the birthplace is the sugar bush where Mr. Burroughs had made maple sugar from his early youth. He says the only farm work that appealed to him as a boy was sugar-making in the maple woods in spring.

From an autobiographical sketch in *Our Friend, John Burroughs*, we learn that here he earned his first money. Anticipating the general tapping a week or so, he would tap a few trees on his own account along the sunny border of the woods, and would boil the sap down on the kitchen stove, to the distress of the women folk as he said. Then he carried the small cakes of maple sugar to the village where they found ready sale, being the earliest on the market. He bought his first algebra and his first grammar with some of this precious money.

At his eighty-third birthday party at Yama Farms Inn I made several photographs of Mr. Burroughs boiling down maple sap, when he evidently thoroughly enjoyed showing his friends how he used to do it. (See photograph on page 123).

In the garden at Woodchuck Lodge,

By the fireside.—John Burroughs and Dr. Clara Barrus, his literary executor and biographer in The Nest at Riverby

Boiling down maple sap.—John Burroughs making maple sirup at Yama Farms on his eighty-third birthday

A brigand steak.—The last one Burroughs ever cooked at Slabsides, November 7, 1920. (Photograph by Farida A. Wiley)

Mr. Burroughs raised peas, beans, golden bantam sweet-corn, Hubbard squashes, etc. At the time of one of my visits, he had two of the largest Hubbard squashes I had ever seen, and I had observed a great many, for they were a favorite product on the farm on which I was born and reared. Later, Burpee, who had furnished the seed, assured him in reply to a note telling of the weight, that the heaviest one was a record. (For photograph of Mr. Burroughs and one of these squashes, see NATURAL HISTORY, December, 1919, page 577). When I gave Mr. Burroughs a copy of this photograph, he said: "I sent that squash to Edison, and told him it was the largest squash Old Mother Hubbard ever had in her cupboard."

The Laird of Woodchuck Lodge was proud of his garden up there, but it would have been impossible to have had a garden if nothing had been done to hold the woodchucks in check. So Mr. Burroughs shot a great many of them. One day I asked him how many he had killed that season, and he replied that the number was more than forty and the season was not over. He said at times it did not appear to do any good,—that when he shot one, several others seemed to come to the funeral. However, he had a good rifle, and when he was past four score years, I have seen him hit them at surprisingly long range—at longer range than I would have cared to chance a shot. Sometimes he would trap them at their burrows. One morning we went out to inspect a trap that he had set, and when we reached the burrow, to our surprise and regret there was in the trap not a woodchuck but a skunk. If I should tell you what he said, you would know that he was human.

Out of the woodchuck skins he made rugs for Woodchuck Lodge, a coverlet for his bed on the sleeping porch, a great coat for himself, and a coat for Dr. Barrus. The coat he had made for himself now belongs to his son, Julian.

During the last few years woodchuck became a favorite dish at Woodchuck Lodge. The fact that he learned to eat woodchuck so late in life proves that he had not grown old, that he was still as adaptable as a boy. And I want to say that when I ate woodchuck with John Burroughs, I liked it too.

At Woodchuck Lodge, I saw the home-made cradle in which John Burroughs had been rocked more than eighty years ago. It is made of apple wood and is painted a dull gray-blue.

As we slept on the porch one night, we heard just across the road from Woodchuck Lodge, the bark, or squall as Mr. Burroughs called it, of a red fox that had come down from the mountain. It was a delight to hear this wild voice of the night, especially when sojourning with the poet-naturalist who had given us such a faithful word-picture of Reynard in *Winter Sunshine.*

In "The Heart of the Southern Catskills," in *Riverby,* Mr. Burroughs describes his favorite valley in that range. Twice I had had a wonderful tramp in this, the Woodland Valley, along the brook where our naturalist friend had camped and tramped and fished for trout. Once I climbed Wittenberg and slept on its summit with his grandson, John Burroughs 2d. In like manner years before the elder had climbed it and slept on the top with a companion. On these tramps I had seen the painted wake-robin (*Trillium undulatum*) growing in great abundance, and I naturally suspected that this was the flower that had suggested the title for his first book. So, one morning in the kitchen at Woodchuck Lodge, while Mr. Burroughs was frying the bacon and making pancakes for breakfast, I asked him whether it was the painted wake-robin for which his first book was named. "No," he replied, "it was not, but it was the large-flowered white wake-robin (*Trillium grandiflorum*).

"I had several possible titles, and I took them to Walt Whitman. He looked them over, and when he came to 'Wake-Robin,' he asked, 'What's that?' I told him it was the name of a wild flower. He then said, 'That's your title'—and this helped me to decide upon the name 'Wake-Robin.'

"After the book was published, in speaking to me about it, Emerson said, 'Capital title! Capital title!'"

At the close of a visit at Woodchuck Lodge, my host undertook to drive me in his Ford car to the railway station at Roxbury. We had not gone far when the car refused to go. I got out and pushed, thinking that, if I could move it to the brink of a slight incline, it would probably pick up and go again. Pushing an automobile is not child's play, and as I was not making rapid headway, my host got out to help me. I said, "Mr. Burroughs, you should not do this." He turned on me and quick as a flash replied, "Why shouldn't I?" He always retained the spirit of youth, and I had by implication accused him of being no longer young. I was reminded of this incident again when I read that classic on old age by William Dean Howells, entitled "Eighty Years and After."

My last visit with John Burroughs was during the week end of November 6–8, 1920, the first of these three days being the anniversary of my first visit. We camped in Slabsides, and on the second day (November 7) Mr. Burroughs ate his midday meal and spent several hours with us. He cooked one of his favorite brigand steaks for luncheon—the last he ever cooked at Slabsides. While preparing the steak, we talked about his latest book, *Accepting the Universe*, which had appeared a little while before. He told me of a number of letters he had received concerning it, and that two or three preachers had thanked him warmly for writing such a book. (See review in NATURAL HISTORY, November-December, 1920.)

On the afternoon of that day, I made what proved to be the last photographs of him at Slabsides. In fact, he visited Slabsides only once after this date. We found the herb-robert in bloom near by, as we found it on my first visit. We also found the climbing fumitory or mountain fringe and the witchhazel in bloom.

When he left Slabsides toward evening, we walked with him to the bend of the road in the hemlocks, and there bade him good-bye. Little did we think that this would be the last time we would see him alive. While we shall not be able to talk with him again, or to shake his hand, or to look into his honest gray-blue eyes, he still lives in our hearts. The spirit of John Burroughs will live on.

Boyhood Rock.—"Here I climbed at sundown when a boy to rest from work and play, and to listen to the vesper sparrow sing, and here I hope to rest when my work and play are over—when the sun goes down—here by my boyhood rock." (See *John Burroughs—Boy and Man*, by Clara Barrus, M.D., p. 47).

The rock which marks Burroughs' last resting place lies in the pasture field on the old home farm near Roxbury in the western Catskills

STONE RUINS IN GUAM

The ruined stone pillars upon which the Chamorro natives built their houses in ancient times are found at various places in the "bush" of Guam and of other islands of the Mariana group. The retiring Governor of Guam and the new Governor are standing in the background

A JOURNEY TO THE MARIANA ISLANDS—GUAM AND SAIPAN[1]

BY

HENRY E. CRAMPTON*

"BUT why go to Guam?" "Where *is* Guam?" Almost invariably these questions were forthcoming when plans were announced early in 1920 for a journey to our far-distant possession in the western Pacific Ocean. It is the object of the present article to answer such queries, and to describe the incidents of travel and observation during a sojourn of two months in the two most important members of the Mariana Group,—the American island of Guam, and the island of Saipan, now in the hands of Japan.

In its entire course, the expedition extended later to the Philippine Islands, China, Siam, Java, and Australia; its general purpose throughout was to gain fuller knowledge of the zoölogy and ethnology of the western Pacific and of the contiguous areas of Malaysia and Asia. The five expeditions that the author had made in former years to islands of the Pacific Ocean were concerned primarily with southeastern Oceania, or Polynesia in the stricter sense, where the Society, Cook, Tonga, and Samoan islands are situated; it is in this subordinate area that the material selected for special investigation is most abundant and most interesting,—namely, the land snails of the genus *Partula*, which have proved so valuable for the study of variation, distribution, and evolution.[2]

In view of the profitable nature of the Polynesian researches, still in progress, it seemed desirable to make a comparative exploration of the extreme northwestern part of the entire oceanic area occupied by the genus in question, that is, in Micronesia, or the "region of little islands," where the Mariana and Caroline Islands are the most important. In brief, therefore, Guam and Saipan were chosen for investigation in the direct continuity of the author's special researches on evolution. Incidentally, of course, general zoölogical collections were to be made, in the interests of the American Museum and of the Bishop Museum in Honolulu as well, for the latter institution generously came to the support of the project, which was also assisted by Mr. James B. Ford and Mr. B. Preston Clark.

A word may be added with reference to the ethnological problems. The scientific traveler in Polynesia inevitably becomes deeply interested in the natives of the several groups of islands, whose distribution in the islands and evolution during the past are precisely the same in principle as in any group of lower organisms. The people of Tahiti, Rarotonga, Tonga, Samoa, New Zealand, and Hawaii are clearly related in ancestry, and the evidence of such relationship is provided by the fundamental likeness in physique, in language and in other cultural matters, beneath the diversities that are the results of recent differentiation. And in their common qualities the true Polynesians differ markedly from the natives of Fiji, the Solomon Islands, and the New Hebrides, whose black, Ethiopic qualities give to the southwestern region the subtitle of Melanesia; while, on the other hand, the Malayan features of the peoples of Micronesia separate them from the Polynesians and Melanesians, and ally them more closely with the natives of Malaysia and the Philippines. The traditions of the Polynesians tell of their origin long ago from a distant land, "Hawaiki," which was probably

[2]See NATURAL HISTORY, Vol. XX, No. 4, Sept.-Oct., 1920.

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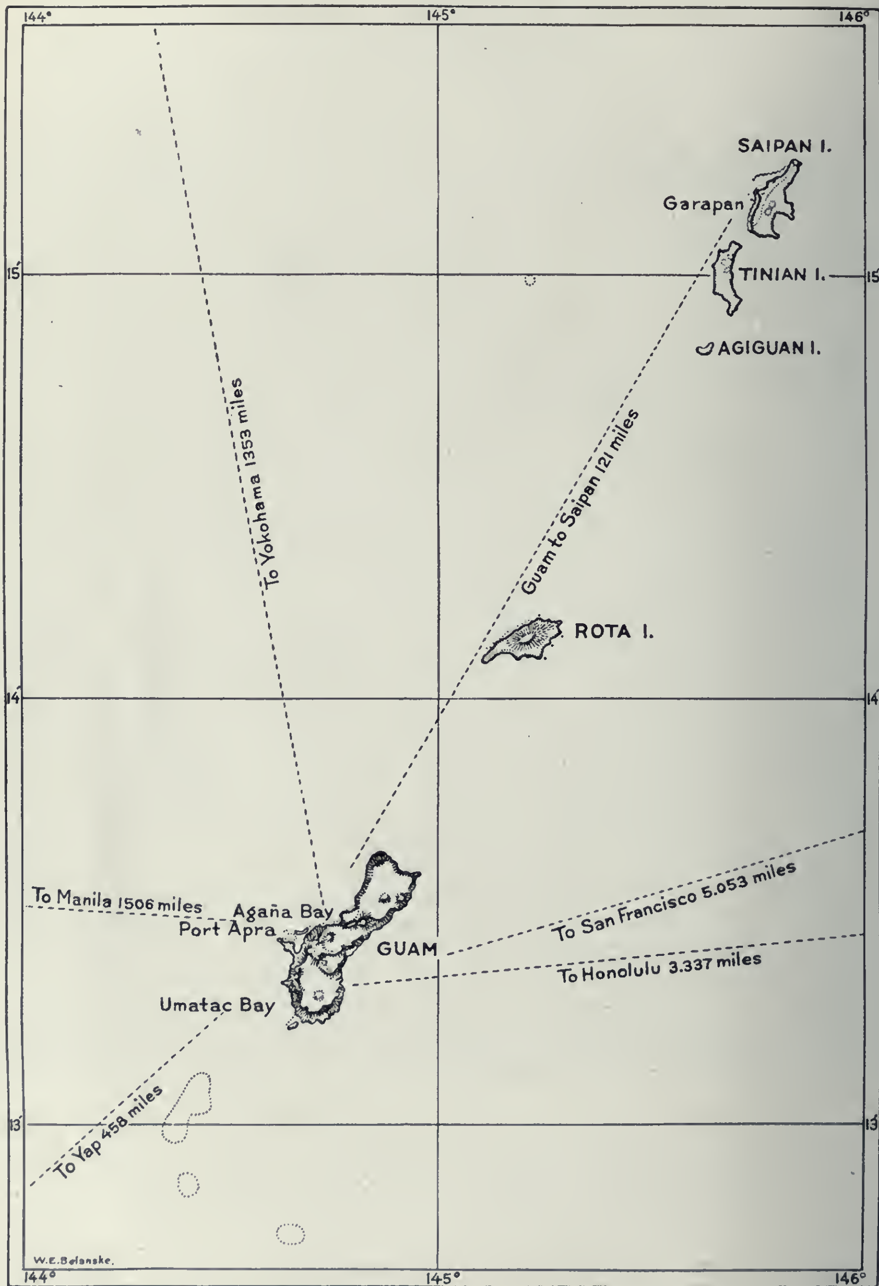

THE SOUTHERN ISLANDS OF THE MARIANA OR LADRONE GROUP in southern Asia; and their migrations throughout the centuries traversed Malaysia and Melanesia, and possibly parts of Micronesia on the way to Hawaii. In view of these and similar facts, it was certain that the countries to be visited during the last expedition would yield, as they did, many interesting observations on the natives and their cultural characteristics which would indicate points of contact, linguistic relations, and other mutual influences in the centuries long past.

The Mariana Group consists of a chain of fifteen islands, together with a few coral banks and shoals, that spread out along a line about 420 miles in length. As a slightly curved bow, this line trends generally north and south; it extends from approximately 13° to 20° north latitude, and it lies between 144° and 146° east longitude. Guam is the southernmost and largest member of the group, and its approximate sailing distances from ports of primary interest in the Pacific are as follows: San Francisco 5053 miles, Honolulu 3337 miles, Yokohama 1353 miles, Manila 1506 miles, and Yap, in the neighboring Caroline Group to the south, 458 miles. Saipan lies about 120 miles north-northeast of Guam.

Many of the northern islands are smoking volcanic cones that are still growing; others have only recently ceased to be active, and some rise to heights of more than two thousand feet. Passing southward, the islands prove to be geologically older, and the evidences of volcanic origin are more or less effaced, while the limestone masses of ancient reefs, now uplifted as dry land, constitute the lower ground above which rise the weathered and truncated mountain peaks.

On June 26, 1920, our ship came in sight of the Marianas after the long voyage of three weeks from San Francisco, broken for a day or two by a stop at Honolulu. Practically the sole means of reaching Guam is by transport, and through the good offices of the then Secretary of War, the Hon. Newton C. Baker, my family and I were privileged to travel on the United States Army transport "Logan," and to become acquainted with the genial company of officers of the Army and Navy, proceeding with their families to their distant posts in the Far East. A most fortunate circumstance was the presence on board of Captain Ivan C. Wettengel, U. S. N., and Mrs. Wettengel, whose aid during the following weeks was indispensable for the successful accomplishment of the scientific work, and whose hospitality made our sojourn delightful beyond any possible anticipation.

Almost at the same time, Guam and Rota, the smaller island to the north, emerged from the mists of the horizon, becoming ever more definite in form and green in color as the ship approached. We could well imagine the joy of Magellan and his crew when in 1521 they first discovered these islands during the famous voyage of circumnavigation of the globe, at a time when illness and shortage of food and water made their plight most serious. In Magellan's time, the people were notable sailors and exploiters of the sea, and as their sailing canoes put out to meet the newcomer, Magellan was so impressed by their craft that he named the group the "Islands of the Lateen Sails." When, however, he had anchored and obtained the much-needed provisions and water, his quondam hosts proceeded to steal various objects about the ship and the cordiality of their mutual relations disappeared. Magellan thereupon re-named the place the Ladrones, or "Islands of the Robbers"; and to this day the name is largely used, although for obvious reasons the people themselves do not approve of it. The Spaniards established their sway some decades later, missionaries of the Catholic Church began their work, and in the seventeenth century, the group was named the Mariana Islands, in honor of Queen Maria Ana de Austria.

From our vessel, as we rounded the northern end of Guam, we could see much of the general character of the island. Guam is about thirty miles in length, and from four to seven miles in width. The northern half is relatively flat, and consists of limestone strata raised high above the sea and terminating in abrupt drab-colored cliffs. Dense, green forests cover this part of the island. Coming southward on the western side, we neared the Bay of San Luis de Apra, now called Apra Harbor for the sake of brevity, where the mountains of the southern half came into view. The upper ground does not bear so much vegetation of higher growth, save in restricted areas, but is covered for the most part with grasses of xerophytic nature. Coming to anchor, the launches put out to convey us to the landing port of Piti, whence by automobile we traversed the five miles of excellent road that follows the winding shore to Agaña, the principal town and the seat of government of the island. It seemed a veritable home-coming to be again in a tropical island, to pass by a plantation of graceful cocoanut palms, or a hedge of scarlet-flowered hibiscus, fronting a bungalow or a row of native houses. Yet even on first acquaintance, there were differences to be seen in the flora, and more strikingly in the natives and their houses, which made it evident that we were not in Polynesia but in the contrasted geographical region of Micronesia.

In Agaña headquarters were established in the Officers' Club, where also we resided for a time until, with the departure of the retiring executive, Captain W. W. Gilmer, U. S. N., we removed to the "Palace" as the guests of Governor and Mrs. Wettengel. Almost every day, and sometimes twice a day, field trips were made to one and another part of the island, in quest of the specimens for the American Museum's collections and of the special material in the way of land gasteropods. The weather was very hot during the early weeks, with occasional showers, but later the season changed and the westerly monsoon brought heavy rains almost every day. The region of the Pacific Ocean where Guam is situated seems to be the place where typhoons take their disastrous form before they sweep on westward toward the Philippine Islands and the China Sea. Although the wet weather rendered it impossibe to be entirely comfortable during the hours of field work, yet the increased moisture brought the snails from their hiding places, so that many more could be found than on a clear, sunny day. So the time passed profitably and all too quickly as the exploration of Guam was brought toward completion.

Agaña is a town of great antiquity. Even at the time of first discovery there was a village on the plain within the shallow roadstead at this place, and undoubtedly this site was selected on account of the river that rises as a spring in the central hills back of the town, which provides the town with an adequate water supply at all seasons of the year. Agaña extends for more than a mile along the shore, and has several streets paralleling the water front, as well as numerous intersecting roadways at right angles. Nowadays, the streets are well paved with the abundant limestone rock called *cascao*, or *cascajo*, which makes a very satisfactory surface. Good water supply is provided, and electric lights, as well. The general aspect of the town is most pleasing, owing to the cleanliness of the streets and the neatness of the white houses.

As limestone is very plentiful, the better homes as well as the government buildings are made of this material; the walls are thick, so as to make the interiors as cool as possible. Wooden houses are also made, and they, too, are whitewashed as a rule. If the roof consists of tiles or of corrugated iron,

The town of Agaña as viewed from the hills to the south. Agaña is the principal town of Guam and the seat of government

The road through Umatac, which is a characteristic outlying village of Guam

The "Palace" or Government House at Agaña in Guam at the time of the ceremony of installing the new Governor, July 7, 1920

The Cathedral or Church of Dulce Nombre de María, recently rebuilt. This church stands on the site of the original house of worship built in 1669 its slope is gradual, but if thatch is employed as a covering, the pitch is usually steep, so as to make an effective rainshed.

The entire population of Guam is upward of 13,000, and of these almost 9000 live in Agaña. Very few indeed live in the open ranch country, for they prefer to dwell in the main city and in the smaller towns that are situated at intervals on the coasts of the southern half of the island; there are few such villages in the north. Efforts have been made to induce the people to reside on their ranches and little farms, for they lose considerable time during the week in their daily journeys to and fro, in their slow-moving ox-carts, but the age-old custom is strongly fixed, and little success has been attained as a result of such efforts. The rigid custom owes its origin to the fact that the Spaniards in olden times required the people to come back to the settlements at night, not so much for the purpose of mutual protection, but rather for the purpose of maintaining the religious hold of the priestcraft upon the minds and thoughts of the natives. Incidentally, it may be remarked that at the time of Magellan 100,000 natives were said to dwell in Guam; two hundred years later there were 1000!

The Plaza is the center of the official life of Guam. It is a beautiful field about three or four hundred feet square, bordered by cocoanut and royal palms. The old Palace or Government House stands on the south, toward the hills of the interior; it is a masonry building, constructed long ago, and modernized lately so as to be more in keeping with American ideas. The lower or ground floor is occupied by the offices of the Governor and his staff and by some of the government departments, while living quarters take up the whole upper floor. The Marine Barracks adjoin the Palace on the west, and beyond these stands the new school, Dorn Hall. The old prison, the island bank, and quarters of ranking officers stand on the north, while the Cathedral grounds adjoin the Plaza on the east. East of the church stands an excellent and well-equipped hospital to whose competent staff we were to become eternally grateful for skilful care at critical times during the following weeks.

Although it wears the aspect of great age, the Cathedral as it now stands is not old. It was rebuilt in 1912 because it had been badly damaged by the earthquakes of former years. However, much of the stone work was taken from the former edifice, and the newer parts have been so blended as to preserve the general appearance of antiquity. The name "Dulce Nombre de María" is the same as that of the first church which was built in Agaña in 1669, and there are evidences that the present Cathedral stands on the original site, even if the building is not actually the same. The Chamorros are Roman Catholics with few exceptions, and the services on Sundays and Saints' days are fully attended. As the people come out of the doors after their devotions, the Plaza for a time is bright with the varied colors of the women's holiday garments, and the fresh white of the men's clothing.

Then, too, the routine of a naval establishment gives an unusual amount of life to the Plaza. Every morning at eight o'clock, the full band assembles before the Palace, and the halliards of the two flag staffs are manned by marines. Promptly at the first stroke of "eight bells," the band plays the "Star-Spangled Banner," and the national flag and the Union Jack are hauled up, while everyone in sight and hearing stands at attention. All the children of the primary grades have previously assembled in formation on the parade ground itself, and after "colors" they go through calisthenic exercises while the band plays suitable music. On Sunday mornings, the men of Agaña are exercised in military drill, which is compulsory for all the able-bodied men within certain age limits. While they have a standard or uniform dress, this is worn only on special occasions. Yet dress parade is a truly dignified affair, for the youths maintain that erect and self-reliant carriage which is so characteristic of native races. Occasionally a most interesting drill is witnessed of the "carabao cavalry," as it is called, although the mounts are not water buffalo but domestic cattle. All through the day, the bells tell the time as on shipboard, and bugles sound the calls that direct the military life of the station. Again at seven o'clock in the evening, the musicians assemble in the bandstand and play classical and other selections for an hour, while the officers and their families stroll about in the comparative cool of the evening.

A drill of the "carabao cavalry" on the Plaza in Agaña

Captain W. W. Gilmer, U. S. N., was the governor in office at the time of our arrival, and his courteous aid of our scientific work put us under real obligations to him, as the extended assistance and hospitality offered by his successor, Captain Ivan C. Wettengel, U. S. N., assured the memorable success of our two months' stay in the island. Soon after our arrival, namely on July 7, occurred the formal ceremonies when the transfer of authority was made. On a bright and rainless morning, the officers of the station assembled in the lower verandah of Government House, while the marines in khaki and the bluejackets in white duck were drawn up under the palms of the roadway. Seventeen guns spoke their farewell to Governor Gilmer after his valedictory had been delivered, and the flag had been hauled down for an interval. Governor Wettengel then read his official orders, seventeen guns gave their loud greeting, and the flag was again hauled into place on the staff. The new administration had begun.

Owing to the oceanic isolation of Guam, its animal life is restricted and peculiar to a marked degree. The earlier explorers reported the presence of two mammals only, both of which are bats and these still exist in the island. The large fruit-eating "flying fox" (*Pteropus*) is not an uncommon sight during the daytime, as it goes about the forest in its quest for bread fruit, guavas, and the edible fruit of a kind of screw pine. The smaller bat is insectivorous, and is like our own common forms in its crepuscular habits. Since early days, several mammalia have been introduced, of which one is a wild animal; this is the Guam deer, of Malayan affinities, which was brought in during the latter part of the eighteenth century by the Spanish governor of the period. The deer are more abundant on the more thinly settled inlands of Saipan and Tinian, but now and again they are killed in the wilder parts of Guam. The inevitable rats and mice have established themselves without any direct human interposition, having landed from vessels that harbored them; in the case of the former, much loss is caused by their attacks on cocoanuts as everywhere else in the Pacific islands.

The carabao or water buffalo holds a high place in the list of domesticated quadrupeds, by virtue of its strength. The animal was introduced from the Philippines long ago, and if it can enjoy a daily wallow in a muddy pool or stream, it thrives very well. Cattle are also employed as draft animals, as well as for dairy purposes. Hogs are highly prized as food, and many have escaped to run wild in the forests where they find a sufficiency of roots and fallen fruit to sustain them. Horses are few, for they do not breed well. Naturally, dogs and cats are abundant, and many of these also have become wild pests.

The birds, like the indigenous mammals, are not frequently met with, although there are many more species of this class. The boobies nest in considerable numbers on the rocks near the entrance of Apra Harbor, and terns occur in some abundance in places. Herons and a kingfisher are the frequenters of the rivers, and a few snipe as well; the kingfisher is remarkable on account of its habit of eating small lizards. The fruit doves of the wooded regions are the most showy in plumage, and their colors are set off to advantage by the green leaves and shadows of the forest.

Lizards are ubiquitous. Along the roads, on logs and tree trunks, quantities of small, blue-tailed skinks sun themselves and lurk for insects. Little tan-brown geckos appear in prodigious numbers in the evening when the lights are lit and insects fly about. At that time the geckos take up their stations on the ceilings and walls of the verandahs, as well as on the white houses near the street lamps. Their pursuits of beetles and small moths are most amusing to watch, as well as their contests for special points of vantage. They are called "Guam canaries" on ac-

Chamorro native riding on a carabao or water buffalo


The large monitor called by the natives iguana or leguan

count of their cheerful, chirping calls; in point of fact, the same kind of lizard is elsewhere called the "Manila canary" and the "Siam canary," so that its distinction in Guam is not peculiar. The natives never molest the geckos, because they consume large numbers of insects, including the all too prevalent mosquitoes.

Of course there is a large lizard called "iguana" or "leguan," although it is not an iguana but a monitor, which often attains a length of more than four feet. While it is more abundant in the thickly wooded portions of the island, it also lurks about the plantations, where it attacks young chickens, and robs the nests of their eggs. In Saipan it is even more abundant than in Guam, even in the immediate neighborhood of Garapan and the smaller town of Tanapag. Only one small snake a few inches in length exists in the Mariana Islands; it is a *Typhlops*, which lives like the earthworms it resembles, under logs and stones.

Insects of nearly all orders are represented, although the numbers of species are not great. Butterflies are few, excepting those which are naturally to be expected in a region near to Malaysia. Dragon flies are more in evidence. The most annoying insect that we encountered in the bush was a small wasp, whose sting is very painful for a time. On Cabras Island, north of Apra Harbor, these wasps are so numerous as to render collecting a very lively occupation indeed.

Centipedes of small and large kinds are present almost everywhere. On one occasion the author was severely bitten by one of these organisms during the night's sleep in bed, and the severe pain lasted for several hours. One instance of death came to notice, where a native woman had been bitten four times at short intervals; but such fatalities are very rare, and ordinarily the effects of a bite can easily be tolerated.

The life of the shores and the coral reefs constitutes another realm. The reefs are not continuous about the island, and hence the dead shells of mollusks and crustacea are cast up on local areas of the main island. No thorough investigation has yet been made of the varied and interesting fauna of the reefs and shores.

The natives of Guam and of the Mariana Islands in general, are called Chamorros, and they are extremely interesting in history, culture, language,

The Bay of Umatac with its characteristic shores and background of mountains. In Spanish times the Governors lived in Umatac during the hotter season and the ruins of the old residence are still to be seen, overgrown with vegetation

Characteristic "bush" in Guam. Pandanus, or screw pine, and the sago are the dominant plants and physique. To the newcomer their pallid, light brown color and Malay features are the most marked qualities that distinguish them from the Polynesians. Since the time of their discovery by Magellan they have changed somewhat as a result of the alien influences of many kinds that have affected their lives; nevertheless their race constitutes a distinct group, whose affinities with other Pacific peoples are capable of specification with some certainty.

The early navigators and missionaries have left very satisfactory and unusually consistent accounts of the people and their lives during the centuries that followed Magellan's discovery. The student of the Mariana Islands, and indeed of the Pacific Ocean in general, is fortunate in having available an extensive volume by Lieutenant William E. Safford, U. S. N., retired, an officer for some time on the staff of the Smithsonian Institution. This work is entitled *The Useful Plants of Guam*, but in addition to its exhaustive botanical sections, it comprises a full account "of the physical features of the island, of the character and history of its people, and of their agriculture." Lieutenant Safford has also written extensively on the language of the Chamorros; needless to state, his works have afforded indispensable guidance to the studies of the present writer.

In early days, the Chamorros were tall and well formed, robust, and unusually free from disease, living to an age often exceeding a century. They were expert boatmen and swimmers, but time has led them to live their lives more and more upon the land, so that very few now engage in fishing and life upon the sea. In origin, the Chamorros unquestionably came from a fundamental Malay stock, but their isolation in their chosen island homes was followed by distinctive evolutionary changes. They used the betel nut for chewing with lime and pepper-leaf, as the Malays do today, and they grew rice. These two customs are most significant in connection with the question of origins. Furthermore, they did not use "kava" as a beverage or the paper mulberry for the manufacture of "tapa" bark cloth, as did the peoples of the eastern Pacific Islands. Nevertheless, the Chamorro language displays many likenesses with Polynesian dialects in structure and in the astonishing number of similar words for the commoner objects of everyday experience. There are also Melanesian elements in their culture, as well as Polynesian components. The best summary statement with regard to Chamorro origins is the following paragraph from Safford's work:

"From a consideration of these features in the language, customs, and arts of the aboriginal inhabitants of Guam it is evident that they did not accompany the settlers of Polynesia in their exodus from the region of their common origin, but that they remained united or in communication with the ancestors of the inhabitants of the Philippines, Madagascar, Malaysia, and certain districts of Cambodia until after the evolution of the grammatical features which are common to their languages and the introduction of rice as a food staple. And it is probable that they did not leave the cradle of the race until after the adoption of the habit of betel chewing, which was introduced from India long after the departure eastward of the settlers of eastern Polynesia, who took with them yams, taro, sugar cane, and cocoanuts from their former home."

Today there are no pure-blooded Chamorros because so much mixture with other races has taken place. The Spaniards themselves infused a new element into the racial complex, while Filipinos were brought to Guam in considerable numbers as workers and as prisoners, and their intermarriages have had even greater effects. One of the results has been a marked decrease in the average height of the people, which is now scarcely greater than in the

A family of Chamorro natives at Umatac. The man is the teacher in charge of the local school

Filipinos proper. Despite the adoption of many words from other languages, the old language still lives, because the Chamorro mother passed it down to her children.

The people are occupied largely with agricultural pursuits, in which nearly all are engaged, for they have only a slight degree of economic division of labor, and virtually everyone is a "jack of all trades." The care of their farms and of their domesticated animals engrosses them completely during the week. They grow rice, maize, sweet potatoes, and the like, each family for itself. The only real industry with an export value is the making of copra from cocoanuts.

The smaller villages distant from the capital are lesser counterparts of Agaña, but more primitive in the nature of the case. They comprise fewer stone houses, of course, but there is always a stone church and usually one or two places belonging to the leading men are built of the more durable materials. Every town has its schoolhouse and teacher; and even in the smallest places the work of education is carried on. Lately a spirit of rivalry has been developed through the institution of district fairs, when the people exhibit their prize livestock and farm products as well as the best examples of their handiwork in the way of basketry and embroidery. The effect has been most stimulating, and has led to awakened interest in affairs that were formerly regarded as matters of drudgery and routine.

Much might be written about the botanical characteristics of Guam and its associated islands, with which the field naturalist becomes closely acquainted during the days of study and collection. The flora is what is called the "strand association" because it includes so many elements like "*Barringtonia*" and the many kinds of *Pandanus* that are characteristic of island shores. The northern half of Guam, above the transverse zone of farming country, is covered almost completely by a dense bush, which does not grow very high as there are few of the more lofty kinds of trees. The mountainous territory is relatively bare, save in the upper regions of a few of the southern and western heights. The southeastern areas are covered with "cogon" grasses, excepting where the darker green bush grows along the borders of the main streams and their tributaries, marking the water courses with great distinctness.

The journey to Saipan was made during the last week of July, 1920, and yielded some of the most interesting experiences of the whole expedition. My son and I had looked forward to this trip with much keenness, partly because the collections from another island of the group would be particularly valuable in comparison with the material from Guam, and partly because we knew that in Saipan there was a colony of natives from the Caroline Islands, with distinctly different physical characteristics. It was necessary first to cable to the Foreign Office at Tokio, requesting official sanction for our prospective visit, for Japan now controls all of the Mariana Islands, with the sole exception of Guam. Before the Great War, these islands belonged to Germany, to whom they were sold by Spain, with the acquiescence of the United States, after the Spanish War and the capture of Guam by our vessels. A prompt reply from Tokio gave us the desired permission to visit Saipan, as well as the intervening islands of Tinian and Rota, but as it transpired, we were able to land only at the first named place. There are no vessels plying between Guam and the Japanese islands; the latter are reached only from Yokohama by the trading steamers that touch at Saipan and then proceed to some of the places in the Caroline Group, such as Yap, Truk, and Ponape. But Governor Wettengel added to the many favors he had already conferred, by arranging for our transportation by the "Bittern," a small naval vessel stationed at Guam. Accordingly we embarked late one evening, and steamed out of Apra Harbor at midnight under the clear light of the tropic moon.

With the dawn we were passing Tinian, which is much like the northern half of Guam in its characters; for the most part it is composed of elevated reef limestone, and it is thickly covered with cogon grass and low bush. Saipan appeared more rugged in character as the distance lessened, and its broken mountain ridges, trending north and south, rose high above the flat coastal plains of disintegrated limestone and soil. Only the lower ground, devoid of the thick forests of the heights, is suitable for the many small plantations of the natives and the larger enterprises of the newly established Japanese companies. The general aspect of the lower country, seen from a distance, was most abnormal in so far as the cocoanut trees were sadly affected by the scale insects introduced from the Carolines; fully 80 per cent. of the trees were destroyed, and either hung their dejected clusters of brown fronds from the top of the curving trunk, or were entirely devoid of leaves. Our destination was the town of Garapan, situated on the western side of the island, and this soon came distinctly into view at a point about midway between the northern and southern points of land.

The "Bittern" came to anchor off the reef which grows far out from the shore, and a launch was put over the side to convey us to land. The sea was rough and dangerous, but the opening in the

The old church and the new Japanese headquarters at Garapan, in the island of Saipan

reef was found and passed without mishap; we glided over the quieter waters of the lagoon with a sharp lookout for submerged coral masses, and neared the little "summer house" on a wharf that seemed to be the proper landing place. Long before we stepped on shore, all the natives of the town who were at home and not at work on their distant farms, thronged to the jetty to await our coming—Japanese in their characteristic robes, Chamorros in singlet and trousers, and the brown Caroline Islanders with far less in the way of clothing. They manifested considerable excitement, for the event was of a most unusual order; an American vessel from the South was about as unaccountable as an aëroplane. We were met by three or four Japanese officials in formal uniforms that had hastily been donned as our intention to land became evident, and to these officials our various credentials were presented.

In spite of the fact that some of the Japanese could converse in English, the situation was rather strained, and it would have been difficult indeed to explain our visit and its purposes without assistance. By the greatest good fortune, there was present a young Spanish Chamorro named Gregorio Sablan, who was entirely proficient in English and Japanese, and, as I learned later, in six or seven other languages as well. I had hoped he was at Garapan, and had brought letters to him from relatives in Guam, where he had been born and had formerly resided. Sablan was not only a teacher and missionary, but he was also the official interpreter on all occasions. It was through his capable services that we came to an understanding with the officers who met us at the shore. And he remained with us when our little party climbed the hill above the old stone mission church, built long ago by the Spaniards, to present our respects and to explain our presence to the Governor, Lieutenant Commander Yamamoto, of the Imperial Japanese Navy, who awaited us at headquarters in a modern building of wood, above which floated the white flag with its red sphere as the symbol of Japanese authority. Over the warm lemonade and cigars, cordial relations were soon established, while we discussed the scientific work which was our special object. The "Bittern" returned

Natives of the Caroline Islands, now residing in Saipan, dressed in gala costume. These are the chief dancers of the settlement

An informal group of Caroline Island natives to Guam until it should call for us a few days later at a time that had been agreed upon.

Señor Sablan virtually adopted us, very much to our satisfaction. After consulting with various officials he arranged for our occupation of a suite of rooms belonging to the absent Civil Governor, in a well built stone house on a back street of the town. Sablan also conducted the necessary negotiations with a Japanese restaurateur for our meals, which were duly brought by Japanese maids wearing clattering *gitas*, or sandals raised on little blocks of wood. He accompanied us at all times in our excursions about the island, and he manifested as much interest in our pursuits as we ourselves would show in the place and its people. In effect, he made our stay in Saipan a real success.

Garapan is the home of less than 3000 people. There are a few score Japanese officers and traders, while the bulk of the population is composed of Chamorros and Caroline Islanders in approximately equal numbers. The town extends along the shores for a mile or so, and its houses are built on two or three straight and wide roadways paralleling the strand. Stone buildings are few, and for the most part the dwellings are made of wood or bamboo, with thatched roofs, as in the remoter towns of Guam. The two main components of the population dwell in separate halves of the town, the Chamorros to the north and the Caroline Islanders to the south. Their relations are entirely amicable, but practically no intermixture of the two races has taken place through intermarriage. Each perpetuates the culture of its ancestors without modification.

The Caroline Islanders were of the greatest interest to us. Our temporary home stood in their part of Garapan, and they were about our doors and windows at all times. We were the only Caucasians on the island, and as such were objects of much curiosity, especially in the case of my son, Henry, who was the only white youth many of them had seen. Whenever we strolled about the town, there was invariably a following group of youngsters in our train, observing every detail of our dress and speech and action. The women of this race ordinarily wear a single strip of cloth about the body below the waist, or the more characteristic mat of woven banana or hibiscus fiber, dyed in pleasing patterns and colors. The men wear a simple loin cloth, while the children run about naked until the age of ten or twelve. The gala costume comprises highly colored mats, bead necklaces of various forms, and ornaments of tortoise shell, while bright flowers are worn as garlands and decorations in the hair. This whole community has been constituted by emigrants from Yap, Uleai, and the Mortlocks, and several other islands to the south, who first came to work on plantations owned by foreigners. Formerly there were a few in Guam, but after the Spanish war they joined their fellows in Saipan. They are colloquially called "Kanakas," but this term refers properly to the true Polynesians. In many respects the Caroline Islanders do resemble the Polynesians, and their likenesses are all the more emphasized by their real differences from the Chamorros, who, as we have noted, are more like the natives of the Philippines and Malaysia.

Despite the heavy rains and oppressive heat, our work progressed favorably. Early in the morning, Señor Sablan would appear with one or two heavy native carts drawn by cattle. Soon we would be joined by a Japanese officer named Mr. Kowno, who had been assigned by the Governor to accompany and aid us in our travels. The creaking carts jolted over the worn and uneven roads in such a way as to rack our bones and bruise our muscles, so that we were glad now and then to walk for a little distance or to dash into the brush after a novel species of butterfly or dragon fly. On occasions we were the noontime guests of Japanese planters, in houses that seemed to have been transported entire and complete from Tokio, and where our hosts in flowing garments tendered the polite hospitality of their race. At other times, the journey to a forested height would be made necessarily on foot, across the farm lands of the natives and through the thick brush, where we found the desired land snails in satisfactory abundance. In all, about four thousand specimens were brought back from Saipan.

The evenings were fully occupied with the care of the collections, the writing of notes, or the quest for night-flying insects. On one occasion, Governor Yamamoto tendered us a formal banquet at which we met most pleasantly some of the prominent officers and citizens of Saipan. Not the least memorable was an evening *en famille* with Señor Sablan and his relatives, when after dining we talked over many things of mutual interest, and the nephews and nieces sang songs in English and Chamorro which their gifted uncle had taught them.

During the last two or three days, the rains were virtually incessant, and the winds were blowing strongly from the storm-breeding quarter of the west. It was with some concern that we looked forward to the day when the "Bittern" was to return for us. A real typhoon did indeed develop, but fortunately its center passed to the eastward so that we escaped its greatest severity. Nevertheless, the sea was very high when finally the expected vessel arrived off the reef, and we put off on the tossing waves to be received again on board.

On the road in Saipan. The carts are strongly built to stand the jolting on the uneven roads. The natives on the left are Caroline Islanders residing in Garapan

The eventful trip to Saipan was ended when on the following morning we reached Apra Harbor at Guam.

At last the day arrived when the transport came that bore us to Manila. The two months in the Mariana Islands, so crowded with interesting experience and observation, were over, and the collections were packed and ready for shipment to New York. It was hard indeed to say farewell to our new-won friends, whose many kindnesses had made our sojourn so profitable and enjoyable. As the island faded in the receding distance, the hope grew ever more definite that fate would be so kind as to take us again to the delightful island of Guam.

The author's son, Henry E. Crampton, Jr., and our Japanese companion, Mr. Kowno. The photograph was taken in Saipan at a splendid collecting ground for Partulæ, and it shows a number of the animals on a leaf of the elephant's-ear, or *Caladium*

VALLEY OF THE RIO ZAMORA, ECUADOR

Looking down into the heart of the "Oriente." Jungle of the densest character covers all of these slopes

THE JIVARO INDIANS OF EASTERN ECUADOR[1]

BY

H. E. ANTHONY *

IN southern Ecuador the Andes form a broad strip, running north and south, made up of numerous short ranges which extend in all directions and make it exceedingly difficult for the traveler to discern any definite system of main mountain ranges. When the easternmost edge of this strip is reached, however, a lofty barrier of high, wind-swept peaks marks the beginning of Amazonian drainage, and the region eastward from their Atlantic-facing slopes is known as the "Oriente." It is in the "Oriente" that the tribe of the Jivaros make their home.

Accompanied by Mr. George K. Cherrie, the veteran of many a South American expedition, I spent about a month in the "Oriente" and during that time saw a little of these Indians and was told a great deal concerning their customs by the few scattered families of whites who live on the edges of the Jivaro territory.

The Jivaros are a tribe of warriors and hunters, and devote but little attention to the cultivation of the soil. They live in small, scattered communities located on the rivers, and raise a little cotton and such things as yuca or cassava. Although they recognize a captain or chief, his authority appears to be largely nominal. He exerts but little influence upon the members of the tribe. As a result the communities are controlled by the heads of the families and the system may, perhaps, be best described as patriarchal. The father of a family is a responsible member of the community and his relatives aid him in offensive campaigns or rally to his defense.

The Jivaro looks down upon the white man, who has only one wife, because among the Indians the measure of a man's valor is the number of his wives. Polygamy is regularly practised and a man may have four or five wives or even as many as eight. This custom is the cause of the greater part of the fighting and killing that takes place in the Jivaro territory.

When a daughter reaches the marriageable age, twelve to fourteen years, she is given to a man who is friendly to the father. There is no price set on the girl and the transaction involves merely the good will of the two men. The girl herself is not consulted. This method of gaining a wife is, however, rather a slow process for the ambitious Jivaro who is striving to acquire a large household in a region where women are at a premium and every girl of marriageable age is much sought for. A more efficacious method, provided all goes well, is to wage war upon some neighbor or against a family of an adjacent tribe and to confiscate, as the spoils of victory, the widows of such a man. By a carefully planned stroke of this kind the Jivaro may gain several wives at once.

The Jivaros do not believe in a benign deity, but in a power which is spoken of by the Spaniards as *el diablo*, the devil. This being is not necessarily malicious in his attributes, but rather is considered to be a "Super-Jivaro," one powerful in all matters, omnipotent for good or evil, but not loving evil for its own sake. When an important project is under consideration—a foray for wives or a long hunting trip into the territory of a hostile neighbor—the Jivaro deems it of the utmost importance that the "devil" be consulted. For this purpose he retires to some secluded spot, let us say a small hill off in the jungle, and there drinks a quantity of a certain vegetable extract. This extract, made from the bark of a root, is a dark fluid

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A burly Jivaro who was a frequent and interested visitor at our skinning table

resembling coffee. It produces a narcotic effect upon the human system and the Jivaro passes into a stupor of several hours' duration, during which he experiences various weird hallucinations. One of these hallucinations is that the devil comes to him and gives advice regarding the proposed plan. If favorable views upon the matter are entertained by the devil, the project will be attempted. Consultation with the devil may be had by any man, for it is not the special province of any priestly class. I have spoken with white men who have sampled this narcotic drink and from the reports of its effects I judge the active principle of it must be some powerful alkaloid.

Perhaps some neighbor in the same tribe has been selected as a victim and the Jivaro plans to kill him with as little personal risk as possible. These Indians are adept in the use of the long blowgun, employing poisoned arrows, but prefer

"T'serie," a young man of the Jivaro tribe. I was told that "T'serie" is the name these people give to the small marmoset monkey

to do the man-hunting with guns which they obtain from traders. The approved method, when the raiding party consists of two or more individuals, is to surround the hut of the designated victim, and wait for the man to come out through the doorway. As he steps forth, he receives the contents of several muzzle-loading muskets at close range. Then the place is raided and all the women and children are taken prisoners. The women enter the household of the victor as wives, while the children are adopted and given the same treatment as the man's own offspring. That is to say, the captives are not considered to be slaves, but henceforth are a part of the victor's immediate personal family.

The Jivaro has his own peculiar method of celebrating the successful *coup* against an enemy and in many respects this custom might be compared with that of the North American Indians in taking scalps. The Jivaro cuts off the head of his enemy and, when he has returned to the safety of his own hearth, converts it into a lasting trophy by removing the skull and shrinking down the skin into a miniature head about the size of a man's fist. The process whereby the head is prepared is described in a separate article in this issue by Mr. Charles W. Mead. As a culmination this trophy is used in a ceremonial dance, which generally occurs within a month of the time when the head was taken. The event is in some respects the counterpart of certain scalp dances. The victorious Jivaro dances with his trophy to celebrate his bravery in overcoming an enemy. His friends attend the ceremony and drink quantities of an intoxicating liquor, making much of the occasion. Until this ceremony is consummated, the Jivaro cannot be persuaded to part with the head, but afterward he will trade it for a sufficient inducement, such as a rifle, or in the absence of such a consideration he may hang it up in the hut. The possession of several heads fixes the standing of the owner, although the acquisition of each new head makes the retention of his own the more uncertain, for the relatives of the slain man will assuredly attempt vengeance.

Thus it is that there exists constant warfare in the land of the Jivaro, where the two powerful, primal passions prevail, struggle for woman and thirst for vengeance.

The lot of the Jivaro woman is not a happy one as she is destined to do the greater part of the work and is the storm center for most of the strife. On the other hand, the men impressed me as being good-natured toward the women and spoke kindly to them. I believe, therefore, that in all minor matters the women receive some consideration.

Sternest discipline, however, awaits any woman, who is found to be unfaithful to her husband. Even for the first offense an extremely cruel punishment is inflicted. The erring woman is thrown to the ground and held there while her husband, using the long, heavy machete or brush knife, cuts down on her head as hard as he dares to do without actually killing her. He cuts a number of times in one direction and then again at right angles, so that when the woman is released her hair is all chopped to bits and she is streaming blood.

If this treatment does not deter her from a second manifestation of infidelity, an even more rigorous punishment awaits her. She is pinned to the earth by the large lance or spear used by the men, the spear being thrust through the fleshy parts of the legs and then deep into the ground. She is kept thus for several days or even as long as three weeks, being given food and water and sufficient attention to preserve life. The punishment for the third offense is death outright.

The men are hunters of the highest order, and are keen observers of all that takes place in the jungle about them. They penetrate the thickest tangle, using game trails wherever they find them; the bear makes many a highway for these hunters. They never get lost and their highly developed sense of direction enables them to point back at any time toward a given place, such as the camp they left in the morning. This ability is known to those whites who occasionally penetrate into "Jivaría." Sometimes a white man, wishing to test their powers, will ask them at different times to point out the direction to camp or to a certain river, thereby earning the supreme contempt of the Jivaro, who thinks that any fool should know such simple matters.

The Jivaros have a specific name for practically every bird and mammal to be seen about them and, when our skinning table was piled up with specimens for the day's work, one of them would unhesitatingly name each animal. If a test was made on a later date with a bird or mammal of the same species, the designation previously used was invariably applied, proving that these names were not made up on the spot.

A VISITING JIVARO

Decked in all of his best finery of feathers and beads and spotted with bright paint, this Jivaro dandy, who visited our camp, presented a picturesque appearance

The "kinkajou" or "honey-bear" of the Jivaros has no immediate relatives north of Mexico. Its thick fur is a soft golden-brown

On one occasion, Mr. Cherrie had shot an olive-backed thrush, a sober-colored species that nests in North America and migrates southward in the winter, and consequently not one of the birds strictly belonging to the region. A Jivaro who was going over the birds and naming them, promptly singled out the thrush and said in substance: "This bird is a foreigner. He visits us only in the winter and does not nest here." An instance of this sort implies the keenest sort of observation, because the Jivaro must meet with from two to three hundred distinct varieties of birds, most of the smaller species of which have at best little value to him as food and consequently are of but minor importance. The birds of brighter color are often killed so that they may be attached as ornaments to the ceremonial necklaces, headbands, etc. that are worn in the dances.

A great part of their game the Jivaros kill with the blowpipe or blowgun. The blowpipe is a long, slender rod of wood, made from two strips which are carefully hollowed out down the midline, in such fashion that when bound together by a long strip of bark there is a straight, smooth, cylindrical bore the full length of the rod. The blowpipe is generally made of black palm, which has a very tough, interlacing fiber, so that the rod, though slender, has great strength and will not warp or twist. The ammunition for this weapon may be either little balls of clay or arrows. Clay is shaped into small balls, of a diameter just big enough to fit the bore. These balls, after having been baked in the sun, are placed in the mouth and blown through the tube as a small boy blows a bean in a toy blowpipe, but the length of the Indian blowpipe, often eight to ten or more feet, gives the clay ball a great velocity. As a result the projectile will kill small birds or mammals such as squirrels or rabbits. The arrows are long, slender strips of cane, straight and with a sharpened point; a tuft of cotton is twisted about the rear end of the arrow to make it fit the bore in an airtight manner. These arrows fly exceedingly true and game may be struck with them at long distances. For larger game poison is used; for small birds the arrow is plain.

For this purpose the Jivaros use a black, gumlike substance brought up from the lower Amazon and undoubtedly a form of *curare*. The arrows are prepared by dipping into the poison about half an inch of the tip which then looks very much as if it had been coated with tar. This poison is narcotic in its action and very deadly and an animal that has been wounded with an envenomed arrow will drop in a very few minutes. If the Indian is hunting monkeys, his favorite game, the arrow is scored with a knife about an inch back of the point so that it may break readily at this place. The monkey shows considerable cleverness when hunted and, if wounded, invariably plucks out or breaks off the arrow. He is outwitted, however, by this precaution, because the

Demonstrating the use of the blowpipe.—This Jivaro had killed an enemy but a short time previously and was still on the vegetable diet, which, in accordance with the tribal custom, is prescribed at such times

arrow breaks and leaves the poisoned tip in the wound. I was told that salt is an antidote for the poison, and if the Jivaro wishes to take a monkey alive, he may do so by hurrying at once to a stricken animal and placing salt in its mouth.

Another weapon frequently seen among these people is the lance or spear. The point of the lance is of iron, very sharp and flat; the shaft is of some tough wood. With this they may kill bear, peccary, or any of the larger terrestrial mammals.

The Jivaro lives along the water courses and does considerable fishing in a very ingenious fashion. A variety of creeper or vine, called *barbasco*, is gathered at some point along a stream, and then the plants are pounded into a pulp upon the rocks. When sufficient *barbasco* has been prepared—the quantity may total from two to three hundred pounds—and the Indians have stationed themselves down stream, the mass is thrown into the river. The juice of the bruised vine is a poison and, if the river is not flowing a great volume of water, it kills any fish in its path for a distance as great as three miles down stream. The Jivaros catch the fish as they come floating along belly up and in this way secure great hauls. The use of *barbasco* does not spoil the fish for human consumption, as we can attest through personal experience. One disadvantage in its use is the heavy drain upon the fish life of that particular region, and a stream cannot be fished in this manner indefinitely. Even a large river may be poisoned by this comparatively small amount of *barbasco*.

The Jivaro will eat most of the animals of the forest, but there are one or two surprising exceptions. For some

A FIRST GLIMPSE OF ZAMORA

Palms are a conspicuous feature of the landscape in Jivaría and are frequently found in great groves

A NEARER VIEW OF ZAMORA

This historic little settlement lies in a narrow valley where the beautifully clear Bombascaro flows down to meet the turbulent Rio Zamora

TWO CONTRASTED TYPES OF JIVAROS

Distinct methods of headdress and individual facial characteristics are here indicated. The figure in the center and the one on the right are different pictures of the same Indian. Fastened into the hair of this man are strands of coarse cotton cord of native manufacture, similar to those which are attached to the lips of the shrunken heads shown on p 160

WOMEN OF THE JIVARO TRIBE

The girl, although only about fourteen years old, is married. She was very shy and difficult to photograph. The older women showed no fear of the camera and posed readily. Note the small piece of cane in the lower lip of the girl unknown reason he will not touch the flesh of the deer although he has no scruples against killing it for a white man to eat.

A very peculiar custom we observed is the diet chosen by one who has recently killed an enemy. Such a man avoids meat, confining himself to a vegetable diet. The reason given us was that if he consumed meat, he would be easily surprised and killed by the friends of the man he had slain, whereas if he ate vegetables he would be hard to surprise.

These people have a very wholesome respect for the snakes of their jungles and with good reason, for there are several venomous varieties among them. It is said they have an antidote for snake bite, using some plant which counteracts the venom. Because they go about barefooted, they are often bitten but, thanks to this plant, seldom killed by a snake. Among the material collected during a day's work I had a small coral snake (genus *Micrurus*) which was alive although somewhat incapacitated through rough handling in capture. At the time I judged it to be a non-venomous species, but nevertheless retained enough caution to handle it by the back of the neck so it could not strike me. A Jivaro who was standing over our table, very much interested in everything that was transpiring, displayed some apprehension when I showed him the snake coiled up in a small can, and beat a very hasty retreat when I took it out in my hand, acting in much the same manner as might a timid girl in the presence of a mouse.

The Jivaros have the reputation of being rather cowardly. As far as open warfare is concerned, the experience of the whites who have lived among them has been that the Indian will not dare to attack the white man under any conditions that approximate equal combat. As an instance, I was told of a Spaniard who lived among the Jivaros for a number of years in a rather remote locality where he was far separated from any other whites. He early incurred the enmity of the Indians and, as he was harsh in his dealings with them, it was not long before he was a marked man. On several occasions parties of the Jivaros attempted a raid against him, having first consulted their "devil" as to the propitiousness of the opportunity, but it would seem that the Spaniard as well must have been on intimate terms with the devil for he learned each time of the projected attack and killed so many of the Jivaros that the parties fled. By means of this bold front he was able to more than hold his own with them for a great many years, but eventually he so far relaxed as to hand over his gun to one of his Jivaros to carry while he went on ahead, and the Jivaro promptly made the most of the unexpected opportunity.

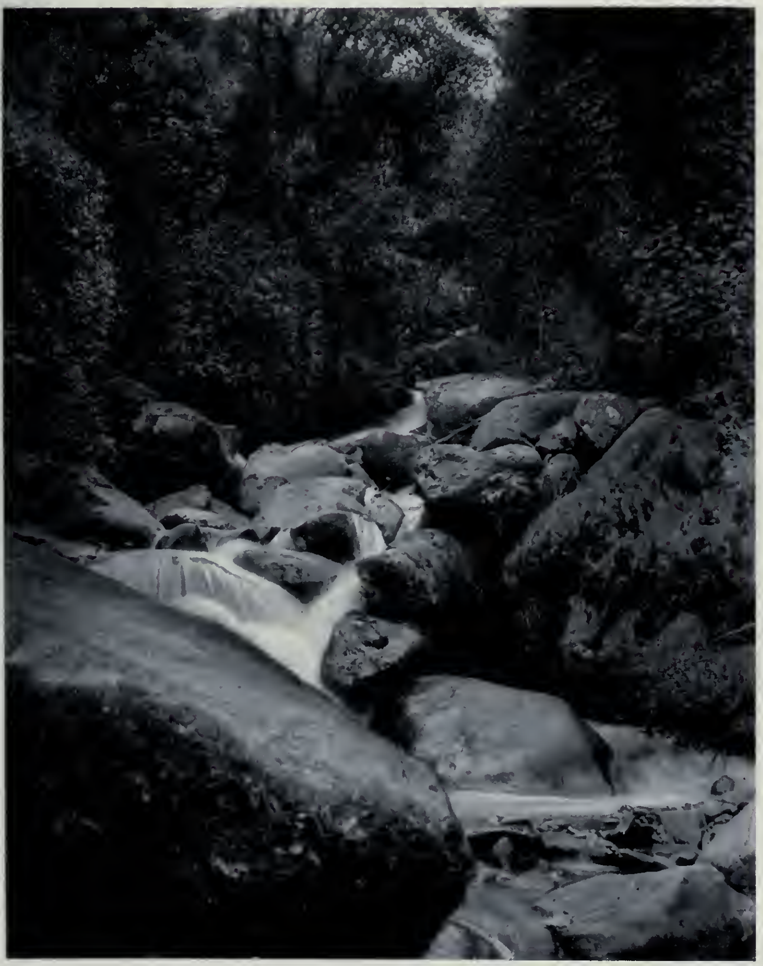
In general their behavior toward the whites who treat them properly leads to rather amicable relations. With us they were very friendly and very good-natured, answering any questions as well as their poor Spanish allowed. Only a few of them speak Spanish, but they are intelligent and quick to grasp an idea so that a few words in Spanish aided by signs, may convey much. No one of those we met knew much Spanish, and a peculiarity I noted was the fact that almost always the verbs were used in the participial form. This gave to their conversation a sound very like that produced by riming verse. As an example, I heard this sentence:

"En camino pasando, animales encontrando, un mono matando, cuero sacando, billetes ganando," which would be translated as: "He goes along the trail, meets animals, kills a monkey, skins it, and gets some money."

The Jivaros were very much interested in our work, which appealed to them because it dealt with the most vital feature of their daily lives, the animals of their own jungles.

They are a rather difficult people with whom to deal, for the reason that money has scarcely any value in "Jivaría" and their material wants are few. It is possible to gain their friendliness by gifts of such a nature as mirrors, needles, fishhooks, or powder and shot; but if one desires to secure the labor of a Jivaro, as a canoe man for example, it may be necessary to do a great deal of patient and tactful trading before you succeed in engaging him.

The Jivaro hut is a simple affair, made of a long, rectangular frame of poles stuck into the ground and thatched over with the leaves of palms or plantains. The fire is built inside on the ground and the smoke finds its way out through the most convenient openings. As evidence of their handiwork, I saw very creditable cotton cloth, which had been made by them from their own cotton. Strangely enough, the men, when questioned, said that they personally had woven this, the household weaving of fabrics being peculiarly a feminine province everywhere else in Ecuador.



THE RIO DESTROZO

One of the countless, crystal-clear, streams that plunge down the slopes of the "Oriente." It owes its significant name of Destroyer to the fact that its descent to the Zamora is accomplished in a series of precipitous leaps, the water tearing away everything in its path except the largest bowlders

WAR TROPHIES OF THE JIVARO INDIANS OF ECUADOR

These human heads, which have been subjected to a shrinking process after the removal of the bones, are a ghastly tribute to the cunning rather than the prowess of the Indian who has acquired them. To the notion of the white man this method of warfare, which is pursued partly for the acquisition of heads but also and to an even greater extent for the purpose of gaining wives—the victim's family being incorporated in that of the conqueror—is but stealthy assassination

SHRUNKEN HUMAN HEADS AND HOW THEY ARE MADE

BY

CHARLES W. MEAD*

THE diminutive shrunken heads made by the Jivaro Indians, suggesting, save for their long, straight hair, the heads of Negro pygmies, have been familiar objects in museums for many years and many have been the queries as to how and why they are made. Just how they are made is a problem that has only recently been solved, though many, and oftentimes absurd, have been the speculations as to the way the Indians managed to shrink them to so small a size. One that for some time obtained widespread credence was, that in an early stage of the work the skin of the head was boiled. Of course, boiling would have caused it to fall to pieces. The heads are always black in color, and this was accounted for by the supposition that they had been smoked over a fire.

The details of the process did not come to us all at one time, but by driblets from different travelers who had visited some part of the Jivaro country in eastern Ecuador. Indians guard such tribal secrets very jealously, and it is extremely difficult, and in most cases impossible, for one who remains but a short time in their country to obtain exact information about them. The method is as follows:

The head, with a small part of the neck, is severed from the body. A cut is made from the base of the skull down through the skin of the neck. Through the opening thus made the bones of the head are carefully removed, and the skin and remaining soft parts are dipped into the juice of the *huito* fruit, which stains them black.

The skin is now ready for the shrinking process, which varies somewhat in different localities. In some divisions of the Jivaro tribe a number of hot stones are put into the cavity, and the whole is constantly turned in order to bring them in contact with all parts of the inner surface. When one Indian tires, the head is passed to another. It is said that the process sometimes continues for a week or more before the head is reduced to the desired size.

In other localities a single stone, nearly the size of the head, is first used, then a smaller one, and so on until the work is completed. In still other localities hot sand takes the place of stones. Long, pendent cords usually fasten the lips together, and one is run through the top of the head to suspend it. The cut in the back of the neck is then sewed up, and the trophy is finished.

The first heads that found their way out of the Jivaro country did so by being passed from hand to hand until they came into the possession of some trader who brought them down the Amazon to Para, where they were disposed of. Unfortunately the Jivaro soon learned that these heads were much in demand by white men and began to prepare them for the traders, being by no means particular as to whose head was used, and it is said that advance orders were frequently taken and filled. Certain it is that now and then short-haired heads bearing mustaches find their way into the market.

In early times the Spaniards, and after them several South American countries, passed laws with severe penalties for any one known to have prepared one of the heads; but it was difficult for the law to reach the transgressors and not much seems to have been accomplished toward stopping the practice.

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MARIE SKLODOWSKA CURIE

Honorary Fellow of the American Museum of Natural History and Honorary Member of the New York Mineralogical Club

A picture taken in her Paris laboratory shortly before her departure for America, showing her concentrated on her scientific investigations that have already enriched the world with one of the greatest discoveries of all time. With the gram of radium recently presented to her, Madame Curie will have the opportunity of pursuing her research under conditions not hitherto enjoyed, with results that may further amaze the scientific world and redound to the benefit of mankind

SCIENCE HONORS MADAME CURIE AT THE AMERICAN MUSEUM

ON the evening of May 17, in the Auditorium of the American Museum, which was packed to capacity, three scientific bodies,—the New York Academy of Sciences, the American Museum of Natural History, and the New York Mineralogical Club,—united to do honor to Madame Marie Curie, "a lady whose name," to use the eloquent words of Dr. George F. Kunz, who presided on the occasion, "will live long, long after those who have aspired to fame ostentatiously or otherwise, will all have passed away."

In addition to the tribute paid from the platform to the genius of Madame Curie by such distinguished scientists as Professor Henry Fairfield Osborn, Dr. Robert Abbe, Professor Alexander H. Phillips, Professor Michael Idvorsky Pupin, and Doctor Kunz, supplemented by the enthusiasm of an audience that gave warm expression to its appreciation of her achievements, two testimonials were presented to the discoverer of radium,—the one a certificate signalizing her election as an Honorary Fellow of the American Museum of Natural History, the other conferring upon her Honorary Membership in the New York Mineralogical Club. In bestowing the former, President Osborn said:

"My pleasant duty tonight is to extend the hospitality of the American Museum of Natural History to Madame Curie and to announce that, by unanimous vote of the scientific staff and unanimous vote of the trustees of this institution, we have elected Madame Curie an Honorary Fellow of the American Museum of Natural History. I have in my hand the certificate of membership and I would present this certificate to Madame Curie with the statement that she is the first woman to receive this honor; that it is given in recognition of her great discovery in the fields of physics, of mineralogy, and of chemistry; and that we give it with the greatest enthusiasm because of the fundamental character of her discoveries in these fields.

"Madame Curie, may I greet you as an Honorary Fellow of the American Museum of Natural History?"

In presenting the certificate of honorary membership in the New York Mineralogical Club, a ceremony which took place toward the close of the evening, Professor Phillips spoke as follows:

"The New York Mineralogical Club, by unanimous vote, at the annual meeting of the organization, on the evening of April 20, 1921, at the American Museum of Natural History, desiring to express its fullest appreciation of Madame Curie and her transcendent service to humanity through the discovery of radium in the year 1898, and many great contributions to radial knowledge since, hereby confers Honorary Membership, with life tenure appended thereto.

"It gives me great pleasure to present this, Madame Curie, and the three organizations that arranged this meeting are here to honor you, Madame Curie, and to show their appreciation of your great services to humanity."

Madame Curie then arose and, speaking with the modesty that is characteristic of greatness, said:

"I am very grateful to the New York Academy of Sciences, the New York Mineralogical Club, and the American Museum of Natural History, for this beautiful reception and for the recognition of my work.

"I cannot say how happy I am that I was permitted to be the discoverer of radium, but I would like to remind you of the names which are associated with this, of which you know many,—as Sir William Ramsay, Berthelot, Rutherford, Soddy, Becquerel, Abbe, etc.

"Then I would like to say how deeply I am moved by the beautiful progress of the medical application of radium, of which you have just now heard from Doctor Abbe, and we must remember that the success of that is due, not only to the discovery itself, but also to the splendid efforts of distinguished specialists which were made and especially by Doctor Abbe, and we must be thankful to all of them, just the same as to the discoverer."

Dr. Robert Abbe, alluded to in Madame Curie's address and introduced by Doctor Kunz as "one of our first surgeons to use radium, and one of the first to realize that successful as he was with the knife, it was possible to avoid using the knife by using other means," had given earlier in the evening an impressive account of the therapeutic uses of radium.

"What is the present status of cancer *versus* radium and X-rays?" Doctor Abbe answered the question he had himself propounded:

"The biological science has furnished us with a classification of malignant diseases, which has gradually been modified to malignant and semimalignant—all of them antagonistic to life; some of them curable, some of them not *yet*. The obstructionist surgeon still says, 'If you speak of a wart or a small tumor, oh, I can cure that; I can cut it out or burn it out with caustic.' That sometimes helps the patient but never cures the disease. It simply removes it.

"Now we have put in our hands an invincible weapon, a little tiny tube of radium—no larger than a small penholder. The diseased tissue of a tumor isn't cut out; it isn't burned out; it is simply showered with a little fine peppering of radium energy,—little electrons of negative electricity. What happens? Nothing, for a week—but in a month, the tumor has gone. It has melted away, and thereby the disease has been made to cure itself.

"Now, as to the nature of the various things that radium will cure. The gravest forms of cancer in the smallest areas we can find it, say, no bigger than rice grains, are easily cured by radium. The diseased cells are restored completely and become part of a healthy structure, but in larger masses it is impossible to say at the present time that it can be cured. We can reduce it, but to say we can effect a cure is to claim too much. It takes so many years to demonstrate a cure that we wait patiently. The people cannot be more eager than the surgeons and doctors to find a remedy.

"Meanwhile, is it nothing that a wart can be cured? Is it nothing that a young woman had lost her beautiful singing voice? Then her breathing became obstructed as her larynx filled up with warts. Surgery has never been able to cure that. The warts always come back.

"Eight years ago a young woman with a beautiful singing voice and a throat full of such warts had a radium tube put in her throat for half an hour. Two months later the warts had gone. Today, after eight years, her voice is more beautiful than ever.

"Is it nothing that a little, three-year-old girl had a tumor growing in her tongue? Was it cancerous? No. *Lympho sarcoma* it is called; destructive to life but not cancerous. It was cut out; it came back. The surgeon knew it was a serious case. It was then burned out with caustics; it came back. Then there was a conference of surgeons and they said to the distracted mother of the child: 'There is only one thing now that surgery can do; we must cut the tongue out unless radium can save it.' That little, malignant tumor was pinched between two tubes of radium for twenty minutes. In six weeks, the tumor was gone. Two weeks ago I saw that young girl of thirteen years. She was the picture of health (she was three years old when the radium was applied), and her mother was perfectly happy.

"Is it nothing that a young man of seventeen with a tumor on his jaw should have been restored to health? Eighteen years ago, when I had one of the first two tubes of radium that Madame Curie allowed to come to America[1], a young man with a diseased jaw came to me. I used the radium for half an hour upon it. The jaw on one side was replaced by the tumor (destructive *Myeloid sarcoma*), and the teeth were loosened and separated. I put the radium upon the tumor and into it. In two months it was rapidly changing for the better; the bone was getting hard; the jaw was solid; the teeth were firmly embedded in the jaw. In six months the tumor had shrunken away. As years went by, that tumor and all indications of it utterly disappeared. Marvelous! That very large, solid tumor shrank back completely and the jaw became of normal size. That young man today is married and has four children, and his jaw is as solid and beautiful on the side where the tumor was as it is on the other side, and all the teeth are solid.

"Is it nothing that a gentleman, one of the best scientists in this country, came to me two years ago, with cancer of the eyelid? He had been unable to get it cured and was obliged to give up his work; would radium cure it? I used radium upon it for half an hour; today it is perfectly well. Last week he sent me a bundle of checks, gathered from the men with whom he is associated in his work, $308, given in gratitude to Madame Curie to swell that little fund for her. Life is full of dramatic incidents. When he was cured, he said, 'You didn't notice my other eye, Doctor? It is a glass one. I lost that eye when I was a boy.' Those are the dramatic things that occur every day. Thousands of the smaller tumors, many forms of what has always been considered incurable, are being easily cured by this wonderful radium. It seems reasonable to expect that if Madame Curie can be equipped with the beautiful laboratory that is being thought of, and can be free from distractions, so that she can work with her accustomed concentration in quiet, she will be able to reveal something new, something that will help all humanity,—the women of this country especially."

Professor Pupin in the course of his address pointed out that the radiation of radium is not like the radiation of an ordinary luminous body. Positive and negative electrons are sent out by it. "These projectiles furnish the physicist a new key to unlock the secret chambers of nature and to see things which he never dreamed of seeing. You can easily see that an electron like that, the diameter of which is ten thousand times as small as the diameter of an atom, is a beautiful projectile to hit an atom directly and make it vibrate and send forth the new light which we call X-rays, and today we are studying these X-rays with the same ease and the same accuracy with which we formerly studied ordinary light. And what does this reveal? Briefly stated, that in all probability, *matter is electricity*, because the atoms are made up of positive and negative electricity."

Those present listened with keenest interest to the presentation of the various aspects of the subject and rejoiced in being able to do honor to the discoverer of this new element, a woman who has been repeatedly designated "the greatest living scientist."

Considered from the standpoint of the chemist, the mineralogist, the physicist, or the physician, radium remains a substance surpassingly wonderful.

[1]Part of this first radium was presented to the American Museum of Natural History by Dr. Edward Dean Adams for the experiments carried on by Dr. George F. Kunz and Prof. Charles Baskerville. It was exhibited at the American Museum of Natural History at that time, the announcement bringing six thousand visitors in one day. This was the first radium used by the Memorial Hospital in its experiments upon cancer. Part of this is still in the possession of the Museum.

AROUSED, WITH NECK INFLATED

The Central American chicken snake, *Spilotes pullatus mexicanus*, is perfectly harmless, but by inflating the anterior part of its body it is capable of making itself appear very terrifying. The inflating habit seems to have been acquired independently by a number of unrelated snakes. The mechanism is apparently in all cases the same

SNAKES THAT INFLATE

THE SIGNIFICANCE OF AN AGGRESSIVE WARNING ATTITUDE ASSUMED BY CERTAIN REPTILES

BY

G. KINGSLEY NOBLE

THE American Museum Expedition to Nicaragua in 1916 brought back alive a beautiful specimen of the Central American chicken snake, *Spilotes pullatus mexicanus*, measuring more than six feet in length. Hardly had the creature been placed in a cage when, with a low hissing sound, it drew in a long breath, and in another moment had inflated the whole anterior region of its body. The snake was very nervous in its new environment. With wide open mouth, it lunged forward at any one who approached close to the wire netting of its cage. At the same time it beat with the end of its tail against the cage wall, producing a dry and whirring rattle that reminded one instantly of the danger signal of the rattlesnake. This whole performance,—the swollen neck, the vicious lunges, the vibrating tail,—was sufficiently startling to make even the most assured hesitate before drawing near to this entirely harmless creature.

It must be emphasized that this impressive bulging of the neck region was a true inflation, not a mere spreading. Still, the swollen chicken snake could not fail to remind one of the deadly cobra, which, with widely distended neck, rears well up before striking. The cobra's hood, however, is different in character from the inflated neck of our chicken snake. In the first place, it is flattened in a horizontal plane. Of more importance is the fact that it is spread by a series of elongate ribs and not just ballooned into shape as would seem to be the case in our chicken snake.

Many snakes are able to flatten their heads and to spread their necks widely without the aid of any specialized mechanism such as is possessed by the cobra. The "threatening" attitude of our spreading adder, *Heterodon contortrix*, is known to many boys living in our eastern states. The habit is not a common one among snakes in general. It seems to have been acquired independently in different groups throughout the world. *Liophis epinephelus* and *Ninia atrata* in Central America, *Ithycyphus*[1] in Madagascar, *Tropidonotus piscator* in India, *Pseudoxenodon* in China and *Macropisthodon* in the East Indies flatten their necks remarkably when disturbed. None of these snakes is poisonous. The old myth that a poisonous snake may be distinguished by its flat, triangular head has not the slightest foundation.

Spilotes is not the only snake capable, when excited, of inflating with air the anterior part of its body. In Siam, there is a large snake, *Coluber radiatus*, with much the same habits as the Central American chicken snake. It lives on the outskirts of the plantations and feeds chiefly on rats. According to Smith,[2] the snake when disturbed swells its neck and assumes a defensive attitude "with the fore-part of its body thrown into a series of loops, and the mouth widely agape, ready to dash at anything". One specimen of *C. radiatus*, after four months in captivity "was nearly as wild and fierce as on the day it was captured".

In India, Baluchistan, and Transcaspia, there is an inflating snake, *Boiga trigonata*, belonging to a totally different group, Opisthoglypha,—characterized by the presence of one or more grooved teeth posteriorly on the upper jaw. In Africa there are two other opisthoglyphs which have developed this peculiar habit of distending the anterior part of the body with air. One of these, the

[1]Krefft, P. 1910. *Blätter für Aquarien und Terrarienkunde* XXI, pp. 460–62.

[2]Smith, M. 1914. *Journ. Nat. Hist. Soc.* Siam, Vol. I, p. 95.

famous boomslang, *Dispholidus typus*, of South Africa, is the rare exception of a "back-fanged" snake having a bite fatal or nearly so to man. Most opisthoglyphs feed on cold-blooded vertebrates and their fangs are neither long enough nor their poison sufficiently virulent to be dangerous to human beings. According to Fitzsimons,[1] "the boomslang distends its throat and body . . . only when in a furious state of anger". The other inflating opisthoglyph of Africa, *Thelotornis kirtlandii*, has been carefully studied by Müller.[2] His graphic account may be quoted in part (p. 608, translation):

"If one should annoy the snake, something very remarkable happens. It raises itself, lifts threateningly the fore part of its body and swells its neck greatly. The neck is distended only below by this inflation, so that it appears laterally compressed. . . . The neck of the snake . . . appears in the inflated condition dazzlingly light with dark bands, and I consider it very probable that a natural enemy is in no slight degree terrified by this sudden appearance of the brilliantly banded fore part of the body. . . .

"It is, in fact, a very surprising sight when the snake, which before was scarcely to be distinguished from a liana, lifts up the fore part of its body and shows among the foliage its inflated and brilliantly colored neck. The strangeness of the sight is enhanced by the coloring and the peculiar movement of the tongue. The tongue is a glistening vermilion with shiny black points; the tongue points are capable of spreading apart until they form an angle of almost 180°, and then in turn may approach another until they merge completely. When excited, the tongue, with adpressed points, is stretched far forward. In this position it is held for a long time motionless; then the snake bends the tongue slowly upward and backward, while the points spread far apart. . . . Suddenly the excited animal lunges forward to strike the disturber of its peace. As long as the object of its anger is present, the snake retains its warning attitude."

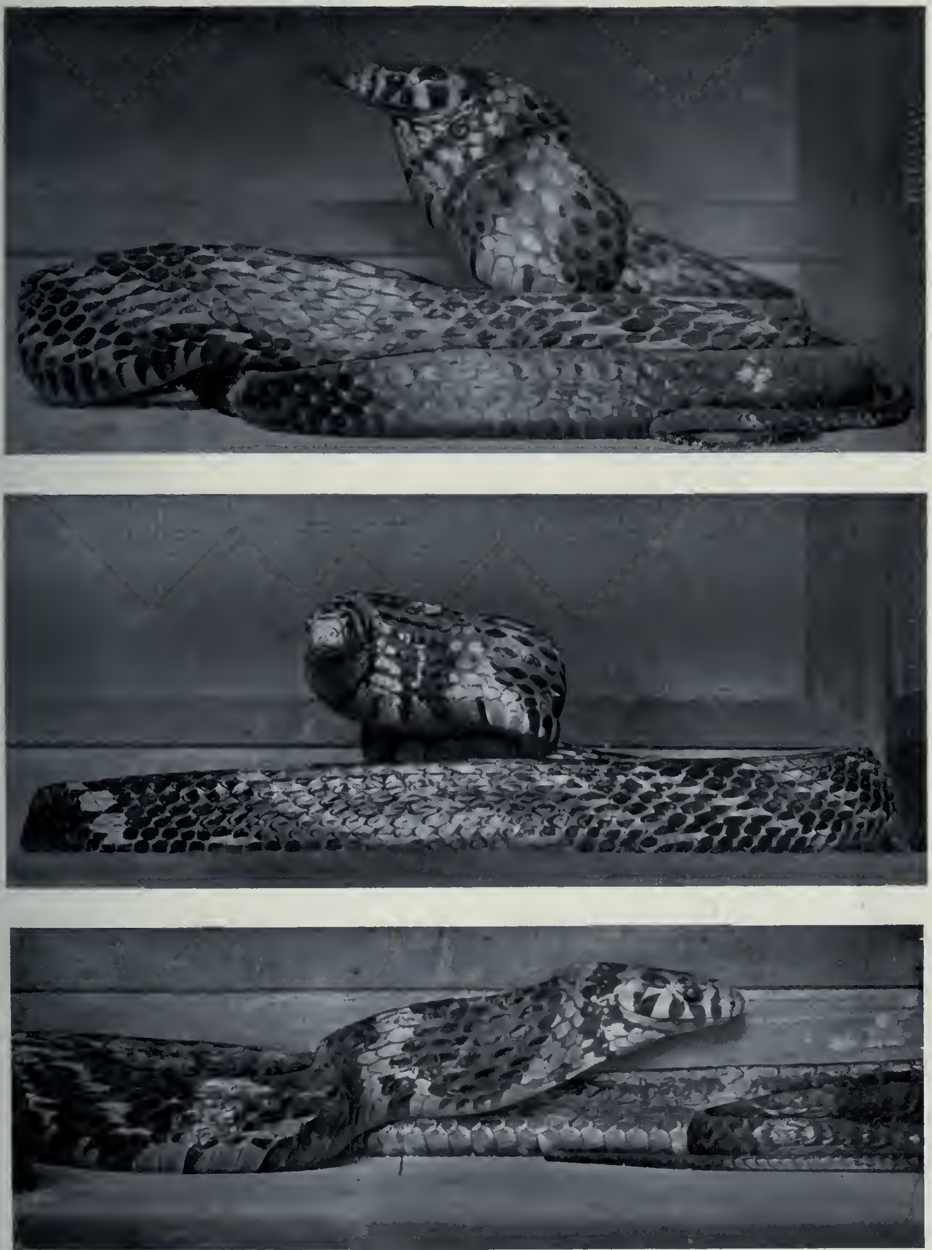
Thelotornis, like most of the opisthoglyphs, is harmless. There is in Africa one species of inflating snake that has a bite "invariably fatal."[3] This snake is the black mamba, *Dendraspis angusticeps*. It is not at all related to any of the other snakes that inflate, but is closely allied to the cobras. The black mamba attains a length of twelve feet. It has the disagreeable habit, in certain sections of South Africa, of concealing itself in the foliage of trees overhanging the trails. The black mamba readily swells up when surprised in the open. Inflation, in this case, can scarcely be said to be a very useful habit, for one familiar with the black mamba would not attempt to molest it without taking unusual precautions.

The mechanism by which snakes are able to inflate themselves does not seem to have aroused the interest of the various observers, who have contented themselves in the main with a description of the external appearance of the swollen snakes. Certain chameleons are able to inflate their heads and necks and to assume a very droll, if not terrifying, attitude. The extraordinarily complex mechanism of air sacks and tracheal valves in these reptiles has been fully described in recent years. Inflation in the snakes is as simple as it is complex in the chameleons. In all snakes the trachea is very long and is provided throughout its whole length with cartilaginous rings which are incomplete dorsally. The membrane which covers the dorsal portion of the trachea, connecting the free ends of the tracheal rings on each side, is very much thinner than the sheath of tissue forming the

[1] Fitzsimons, F. W. 1912. *The Snakes of South Africa*, p. 511.

[2] Müller, L. 1910. *Abh. Bayer. Akad. Wiss. München*, Vol. XXIV, pp. 545–626, Pl.

[3] Fizsimons, F. W. 1912. *The Snakes of South Africa*, p. 205.



When the cage was approached, this chicken snake would draw in a deep breath and in another moment would balloon out the neck region to twice its normal size. Such an inflation was not mere bluff, for if one approached too close, the snake would lunge forward viciously.

For another picture of the same snake see p. 166

Photograph by H. Lang

This snake, an African "back-fanged" known to science as *Thelotornis kirtlandii*, has acquired the same inflating propensities as the Central American chicken snake. The neck region in the above instance is only partly distended

body of the trachea and binding the successive tracheal rings into a continuous tube. The dorsal membrane of the trachea in most snakes is narrow, not wider than a tracheal ring. In *Spilotes pullatus mexicanus*, *Dispholidus typus*, *Thelotornis kirtlandii*, and, by inference, in all snakes having the power of inflation, this dorsal membrane becomes an enormously expanded sheet capable of great distention. Inflation is accomplished in *Spilotes* by a series of movements. Air is apparently first taken into the lungs; the glottis is then closed and the powerful body muscles contract, forcing the air into the trachea, which balloons out, distending the whole neck region into a great zeppelin-shaped structure. The fact that the distention is limited to the tracheal region explains why the whole body is not inflated but only the anterior portion. In *Coluber radiatus* and *Thelotornis kirtlandii* the behavior seems to be much as in *Spilotes pullatus mexicanus*. The boomslang, however, is apparently able to inflate its trachea and lungs, at the same time distending the whole body until it appears like an elongate toy balloon.

The dorsal membranous portion of the trachea seems to have undergone parallel modification in these unrelated groups of inflating snakes. This is not the only type of tracheal modification found in the snakes. In a number of unrelated families, the lung sends a diverticulum, or tracheal lung, forward along the dorsal membrane, which usually becomes split into two halves for nearly its entire length, as in the case of the rattlesnake and the copperhead. The presence or absence of such a diverticulum has been used as a basis of classification. But the whole subject is much in want of further study. Cope[1] states that all the solenoglyphs,—*Fer-de-Lance*, copperhead, etc., possess a tracheal lung. The bushmaster, *Lachesis mutus*, has been placed until recently in the same genus as the *Fer-de-Lance*. I can confirm Cope's statement that the *Fer-de-Lance* and most of the solenoglyphs possess a well developed tracheal lung. The bushmaster, however, has no vestige of such a structure. *Trimeresurus gramineus*, *Agkistrodon mokasen*, *Crotalus atrox*, *C. terrifi-*

[1]Cope, E. D. 1894. *Proc. Amer. Philos. Soc.* Vol. XXXIII, p. 222.

cus, etc., generally recognized as relatives of the bushmaster, possess a large diverticulum from the lung opening into the trachea for nearly its entire length. This discrepancy will probably be accounted for when the anatomy of the bushmaster is well known. It may be that the bushmaster has no close affinity to the other solenoglyphs.

It seems obvious that the tracheal lung and the expansible trachea have each arisen independently a number of times in unrelated groups of snakes. The boomslang and the Central American chicken snake have no close affinity to each other or to the black mamba. The dorsal membrane of the primitive trachea was susceptible to change, and parallel modifications have occurred. Other reptiles besides the snakes exhibit many impressive examples of parallelism in adaptation.

It has been mentioned that the warning attitude of *Spilotes* consisted in part of a vibration of the tail. This habit crops out in many unrelated groups of snakes. The case of the rattlesnake needs no further comment. Many snakes, however, devoid of a rattle, agitate their tails when annoyed. Our common king snake, *Lampropeltis getulus*, is an excellent example. Several of our Colubers, such as the black snake, have the same propensity. Other neotropical snakes besides *Spilotes* vibrate a rattleless tail. *Oxyrhopus coronatus* and *Drymobius boddaertii*,[1] two common and harmless forms, whip their tails against leaves or other vegetation. These manifestations suggest that the rattlesnake may have vibrated its tail long before it acquired the habit of leaving the tip of its shed skin attached to its posterior end to form with the tips of previous molts the familiar rattle. There is no doubt that the rattlesnake is a very nervous creature, delicately adjusted to its environment. Its vibrating tail seems to be an outward sign of its inward discomfiture over the intruder's presence. The Central American chicken snake vibrates its tail, too, and probably for the same reason.

The inflation of the body and the agitation of the tail are both indications of uneasiness. Both phenomena may be called warning attitudes but it still remains to be shown that such actions are not simply manifestations of an uncomfortable nervous state produced by the presence of some disturbing factor.

[1] Mole & Urich. 1894. *Proc. Zoöl. Soc. London*, pp. 499–518.

Photograph by H. Lang

An African cobra, *Naja melanoleuca*, in attitude assumed before striking. The cobra does not inflate; its hood is spread by means of elongate and moveable ribs

Courtesy of M. Forbin

REMAINS OF ANCIENT PILE-DWELLER VILLAGE, LAKE MORAT, SWITZERLAND

This Neolithic village has only very recently been laid bare by the receding of the waters, due to prolonged drought. The site chosen is typical, namely, a broad, shallow margin of the lake. Wherever the bottom was too hard to drive the piles very deep, stones were thrown in to help maintain them in an upright position. On the platform supported by these piles the houses composing the village were erected, and the whole was usually connected with the shore by means of a causeway. This particular village was more than twice the indicated dimensions

SWISS LAKE-DWELLER DISCOVERIES

BY

N. C. NELSON*

A FEW weeks ago the American Museum of Natural History received from a European friend, Monsieur L. Forbin, of Paris, two photographs of a newly exposed pile-dweller station on the shore of Lake Morat, Switzerland. It appears that the water in the Swiss lakes is unusually low this year, owing to "the absence of rain in Western Europe for several months" past. As is well known, it was a similar accident which led to the original discovery of these remarkable repositories of antiquities in 1854, and it is to be hoped that the present circumstance will lead to new and precise investigations. One of the photographs is here reproduced and the facts of the case with illustrations, M. Forbin writes, will appear shortly in *L'Illustration.*

Lake Morat, it may be explained, is a comparatively small body of water situated between the cantons of Vaud and Fribourg, a short distance east of the lower end of Lake Neuchâtel. M. Forbin writes that the existence of about twenty Neolithic villages in that lake was known previously, but that this is the first time in modern history that their remains have been visible. Several of these sites, it may be added, have already been worked in a submerged state, and the collections in the American Museum contain specimens from the station known as Greng. As a matter of fact, the American Museum's Lake-Dweller collections, totaling more than 1300 catalogue entries, represent the arts and industries of no less than twenty-three stations, some from each of the principal lakes. The material ranges over both the Neolithic and the Bronze ages, the Iron Age alone being unrepresented. When this Iron Age material shall have been procured, the exhibits in the Old World section of the archæological hall will furnish a complete demonstration of all the principal steps in the evolution of human culture, in so far as this can be demonstrated by material evidence.

In a general way the Swiss Lake Dwellings are to the Neolithic and Bronze ages what the French and Spanish caves are to the Palæolithic Age. That is to say, the more or less stratified Lake-Dweller remains furnish almost our only indisputable proof of the order of development of the various arts and industries for the culture periods covered. When man at the end of the Palæolithic stage left his cave habitations he became a roamer once more, or at least he ceased to live on the same spot for any really long period of time.

The shell-heaps along the shores are in some degree exceptions to this statement, although in reality they cover only the introductory phase of the Neolithic. In Denmark, for example, where the nature of the shell-heaps was first discovered and where the chronological arrangement of antiquities is an old story, the ordering had to be done ultimately not on the basis of stratigraphy but on the basis of what is called a typological study of the implements. To give an illustration, there are found in Denmark no less than five types of axes of widely different forms and finish and obviously not of the same age. By an intensive study of these different forms it was determined that they could be derived by modification the one from the other only in a certain definite order. This order furnished the key to the relative antiquity of the various monumental remains like dolmens, passage-graves, cist-graves, and so on. It was investigation of this general character also which enabled the Scandinavian archæologists to announce, long before it was actually proved, that man at first made his

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implements of stone, later on of bronze, and finally of iron. Modifications, or rather expansions, of this so-called three-period scheme have been made, but the general order still holds.

In Switzerland, as has been stated, the various successive stages of art or of implement manufacture were actually laid down in the lake mud in stratified order. There are instances in which the pile dwelling burned down and was replaced several times, silt meanwhile collecting to keep the remains from each successive village somewhat apart. A finer arrangement between man and nature for telling his story to his successors could hardly be imagined. And yet much of this valuable stratigraphy has doubtless been destroyed, owing to the roughshod methods that have been used at times in dredging under water for the relics. When, therefore, as has now happened, a station is raised above the water level in such a way that the deposit can be worked by hand, it is an event of real importance. The difference between collecting with grappling hooks and collecting by hand makes all the difference between antiquarianism and archæology.

The first recorded discoveries of Lake-Dweller antiquities took place at Ober-Meilen on Lake Zürich as long ago as 1829, but it was not until 1854, at a time of extremely low water, that implements and upright piles were found in sufficient quantities to impress their significance upon the finders, who were workmen and lake-front property holders trying to reclaim some of the dry beach. By 1855, finally, the antiquarians, among them Dr. Ferdinand Keller, of Zürich, took hold, and the results obtained since that day have been little short of marvelous. More than two hundred stations have been discovered in the Swiss lakes alone and the quantity of relics found in them is almost unbelievable, as is also the state of their preservation. The remains include not only objects of such comparatively imperishable material as stone, pottery, bronze, and iron, but also objects of destructible material like bone, horn, and wood. Artifacts of wood are almost unknown except when hidden away in dry caves or buried in desert sands; but here they have been preserved in the silt of the lake bottom for all of 6000 years.

The impetus that these discoveries gave to archæology cannot be estimated at this time. The preceding half century had been one long struggle to gain acceptance for the bare facts of the science. Danish antiquarians, having to make no extraordinary claims for the antiquity of man, won the first battle of the series. In England various workers from 1797 on had announced the discovery of implements made at a "remote period" and by "people who had not the use of metals" but it was not until 1858 when Charles Lyell, Prestwich, Owen, Hugh Falconer, and other authorities became convinced of the facts that the turning point came. In that year also Boucher de Perthes, of Amiens across the channel in France, through the support of these same Englishmen, won his fight, which had lasted for more than a quarter of a century.

Altogether, the decade just preceding the publication of Darwin's *Origin of Species* is the most interesting in the whole history of science, and it was during this decade that the Swiss Lake-Dweller remains were discovered. To one more than ordinarily interested in archæology the most valuable result of it all has been the fact that classical scholars have let up somewhat on parsing and scanning as well as on the art of spinning theories of civilization out of their own inner consciousness and instead have gone to work with the spade to find out what the culture of classic lands really was like. We are in a fair way now to present the unbroken story of human progress.

PHOTOGRAPHING GREAT HORNED OWLS*

BY

FRANK OVERTON, M. D.

EARLY in March, 1915, I found a nest of the great horned owl in an old crow's nest fifty feet from the ground in the top of a pitch-pine tree about two miles from Patchogue, Long Island.

Unique experiences with the birds shed light on their methods of attack, and tend to confirm their reputation for wisdom.

Three young birds were hatched—one large, one medium-sized, and one runt. Their food for the first week or two was rabbits, and at every visit which I made I observed half a rabbit in the nest. After that time, the food was principally perch, which could easily be obtained from a pond near by. A hatful of fins and scales soon accumulated in the nest.

The old birds demonstrated their parental devotion at almost my first visit. As I was balancing myself with uncertain footing, on the topmost limbs of the tree, trying to take a picture of the young with a Graflex camera, one old bird suddenly struck a heavy blow upon my head which nearly knocked me out of the tree. My scalp was torn, and my head ached for the rest of the day. I can readily imagine what happens to a rabbit which is struck as I was. I then turned up my coat collar and took the bird's repeated attacks upon my head and shoulders, and succeeded in obtaining photographs of the bird, both coming and going. At the end of an hour my thick canvas coat was pretty well torn, and my shoulders were bleeding from the effects of the attacks. I next stationed an eager boy, protected with a thick canvas helmet, beside the nest, while I climbed the next tree, about forty feet distant, and photographed the bird as it attacked the boy repeatedly. The shutter was set at $\frac{1}{800}$ second and blurred the picture just enough to give the impression of motion. A study of the photograph will show that the bird attacks with its feet and not with its bill or wings.

When the young were about three weeks old, a heavy storm of wind and rain one night destroyed the nest and killed the smallest young bird, but the other two were found on the ground uninjured, and were being fed by their parents. I made a burlap hammock nest beside the original site and placed the young birds in it, and the old birds accepted it as if nothing had happened.

The old birds usually sat in some tree within a radius of about two hundred feet of the nest; but a few times they sat for their photographs within fifteen feet of the camera. Their attacking flight was absolutely silent, but they often preceded the attack by a few hoots and a brief pose with the head and body horizontal.

As the birds sat in the top of an adjoining tree, I frequently observed them ejecting the undigested parts of their meals. The ejecta were not formed pellets, but were semi-liquid.

The birds afforded no end of fun. The old ones were good for a fight on any afternoon, and it was my favorite amusement for weeks to photograph the attacking birds two or three afternoons each week. I banded the two young birds when they were ready to fly, and during the following Christmas holidays I received word that one of them had been caught in a steel trap at a duck ranch at Moriches, twelve miles from its home nest. The proprietor of the ranch was so interested in the bird that he kindly set it free.

The old birds, or their doubles, nested again the following spring in another crow's nest about a mile from the first nesting site, and again they showed the same willingness to fight for the defense of their one offspring. After my first visit, a bad boy tore the nest to pieces and took the young bird home, and I was a week in locating it. I then took the young bird and made a hammock nest for it in a tree about a quarter of a mile distant across the swamp from its first nest site. The old birds soon found the young one and fed it as if it had never been disturbed. It is doubtful if any other species of birds would have had sense enough to do that.

The great horned owl, savage and unsocial by nature, is as a rule irreconcilable in captivity. If there is stoical passivity in the attitude here assumed, the glint in the bird's eye suggests its readiness for combat if opportunity offers. This is the owl that was caught at a duck ranch in Moriches and subsequently released. At the time the picture was taken the owl was nine months old

THE GREAT HORNED OWL*

REMARKABLE CLOSE-RANGE PICTURES OF THIS EXCLUSIVE BIRD THAT IS SO RESENTFUL OF HUMAN INTRUSION AND, WHEN DISTURBED, PROVES ONE OF THE PLUCKIEST OF FEATHERED ANTAGONISTS

BY

FRANK OVERTON, M. D.

In its search for a nesting site the great horned owl is not indifferent to the shelter offered by hollows in trees. As these, however, are rarely spacious enough to give entrance to the large adults, the deserted nests of other birds, such as those of the crow or of the hawk, are often used instead. Even the nests of squirrels are occupied. In the top of the pitch-pine tree here reproduced, an old crow's nest is housing as new tenants the family of owls depicted in the illustrations that follow

Three young birds—one large, one medium-sized, and one runt—were the zealous care of their parents, who never hesitated vindictively to attack any one threatening the security of the brood

Numerous rodents fall victims to the onslaughts of the great horned owl, but birds too and even fish succumb to its voracity. In this picture the substantial carcass of a rabbit would seem to offer a rather formidable feast for the downy banqueters, yet such is the food given the newly hatched

A sanctimonious attitude that belies the young bird's real nature

The real nature of the bird asserts itself

THE OWL WINGING ITS WAY TO AN ENCOUNTER

The bird is about to attack the photographer, who had taken position beside the nest

A FLIGHT IN RETREAT

The bird had attacked the photographer from behind

STAGES IN THE ATTACK OF THE GREAT HORNED OWL

As the bird approaches its animal victim, or in this case a man who has incurred its wrath by standing beside its nest, its legs are stretched forward tensely and it is with these, and not with the bill, that the thrust is delivered

IN ANGRY ASSAULT

In the picture at the left the bird is shown delivering its blow upon the thick canvas helmet worn for protection by the intruder. The photograph on the right represents the owl in its onrush immediately after striking the man.

This persistant combatant does not content itself with a single demonstration of valor but again and again flings itself with outstretched legs against the person that has aroused its anger


A young bird sitting for its portrait


The same bird snapped in action

NOTES ON THE SCIENTIFIC MUSEUMS OF EUROPE

BY

W. D. MATTHEW*

HOW do the European museums compare with ours? What are they like? And especially what happened to them during the war?

These are questions that everyone interested in museums must have asked. It has been very difficult to answer them. During the war, and since, we had various contradictory reports in newspapers and letters. One hardly knew what to believe. It seemed likely enough that museums would be utterly neglected in the stress of war and after-war conditions, as they had been pictured to us, and fortunate indeed if their treasures were not stolen or openly looted. Yet, after all, if we stopped to think, we were considerably absorbed in the war ourselves, and still our museums hadn't been disrupted or even seriously neglected. Granting that conditions were much worse over there, it seemed likely that the alarmist rumors we had heard were a bit exaggerated.

The following notes were made during a visit to various European museums in the autumn of 1920. I was commissioned by the American Museum to arrange exchanges of publications, specimens, etc., and to renew as far as possible the old relations of coöperation in scientific work which had been interrupted by the war. Mostly the notes are extracts from letters and reports sent home in the course of my visit and are to be understood as random impressions from what I actually saw, chiefly the palæontological collections, and not the results of a systematic study of the museums as a whole. During the three months I visited thirty museums in Sweden, Germany, Austria, Italy, Switzerland, France, Belgium, and England, and the time was taken up mainly with study and notes on the fossil collections and conferences regarding exchanges and related subjects. Most of these institutions I had seen twenty years ago, and the changes noted reflect the great scientific progress in the years preceding the war, as well as the effects of war and of post-war conditions.

Generally speaking it was a great relief to find so much scientific activity and progress in spite of the heavy handicaps under which the museums have suffered in recent years. It speaks well for the energy and devotion of our scientific colleagues across the Atlantic that, although often lacking support and hampered by the enormous rise in wages, living expenses, and the cost of materials, they have contrived to guard and maintain the collections in their charge, to continue their researches, and with varying success to keep the museums open to the public. The best conditions are to be found in the neutral countries, Sweden and Switzerland. Vienna has been hardest hit, yet even there less irreparable injury or loss has been suffered than one might expect. One may well hope that, with a return to normal economic conditions, the old activities of the museums, in Western Europe at least, will be resumed before many years have passed. There can be no question that such aid and encouragement as we can give on this side will go far to quicken their recovery. In science even more obviously than in commerce the prosperity of each institution works to the advantage of all. Each has its special field of research and discovery and contributes its quota to the advancement of science as a whole.

Stockholm, Sept. 17, 1920. . . . The new Natural History Museum is a very fine building about three miles north of the central railroad station and outside the built-up city. (Stockholm is peculiar in having no suburbs;

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it is all large, solidly built business and apartment buildings to a certain line and beyond that open fields. There are no small private houses). The museum has three great divisions of which the geological-palæontological department occupies the center. Professor Gerhard Holm is in charge of this division. The installment, completed within the last five years, is in every respect an admirable one. The hall is well lighted; the cases are well placed and spaced, so that everything in them has good light and no reflections.

Table cases are used very largely, and in these fit, three to a side, shallow trays about two feet square with narrow wooden sides one inch deep. These trays also fit in the closed racks beneath the cases, so that it is very easy to shift and retire or remove material. Trays are lined with cartridge paper of suitable color for the exhibit. This last detail is to be compared with our method of painting the bottoms of cases. It seems a much cheaper and more flexible method. The finish of the cases is plain varnished wood. Ours is much handsomer—worth the extra cost, I think. Glass shelves are used throughout on the high cases.

Descriptive labels are very freely used—even more than has yet been done in our department (Vertebrate Palæontology). The style and the scope are very like ours. Those in charge have made admirable use of the casts and models purchased from us, giving full and prominent credit to the museum.

In comparison with other exhibits they have made a very large use of casts and models among the vertebrates, as well as of photo-enlargements and large, simply drawn diagrammatic wall charts, all of them well filled out with explanations, etc.

The most important original collection is the South American Pampean material brought by Nordenskjöld from the classic Tarija valley in Bolivia, . . . somewhat different from the Pampean of Buenos Aires. The most interesting specimens are two fine skulls of *Mastodon andium*, with the tusks in position . . .

At Upsala I had a very friendly reception from Dr. Wiman and his colleagues, and saw the first consignment of the Chinese fossils received from Dr. Andersson at Peking. Dr. Wiman is not the usual Swedish type. He is small, dark, quick, and active, very French in type. He reminds me very much of Zittel but is a more vivid personality. They have wonderful material from Spitzbergen at the Upsala Institute: Devonian fish and Triassic fish and amphibians. Dr. Erik Stensjö is working up the fish in a very admirable manner. The amphibians Wiman has done. The third member of the group whom I met was Dr. Zdansky, an Austrian-Pole, a pupil of Abel's. He is really a specialist on fossil mammals but is not allowed by the Chinese government to study these Chinese fossils because he is an enemy alien!

At Stockholm I met Dr. Leche, a very polished, courteous, and rather aristocratic old gentleman, with whom I had a very profitable talk. He is still working actively on the Insectivora. He is a great admirer of the American Museum, especially of Gregory, whose contributions on the "Orders of Mammals," etc., he regards as of a very high order. . . . Prices of everything in Stockholm are quite as high as in New York, even allowing for the exchange. Transportation charges are fearfully high. Railroad rates are from four to five and a half cents a mile, second class, but third class is very good in Sweden. . . .

Berlin, Sept. 26, 1920. . . . The Natural History Museum is greatly changed in its contents since I saw it twenty years ago, but not improved in its installation, which is mostly quite out of date, and at present very dingy and dirty owing to lack of care. A large number of limb bones of the Tendaguru collection have simply been laid out on the floor behind the cases and roped off. The most complete specimen is the *Dicræosaurus*, a nearly complete series of vertebræ from cervicals to caudals inclusive. . . . Among the mammals they have some interesting Proboscidea. . . . This whole town looks miserably dingy and dirty; very much down-at-heel compared with the Berlin of twenty years ago, when I saw it before. The people look very much run down; a large part of the population, I think, is much underfed. The bread is of wretched quality, heavy, soggy, and full of grit. Prices of everything in the stores, allowing for the present value of the mark (about 1⅝ cents), are a third to a half lower than in New York; everything, however, is of the very cheapest and most inferior quality. . . . Branca is no longer in charge at the Museum für Naturkunde, but Pompečki is the head of the Geological-palæontological Institute, with Janensch as curator, and Reck and Dietrich as assistants. I missed seeing Janensch, who, as they explained to me, was away getting married, but the others were very cordial. Pompečki in particular gave me an entire day and showed me all through the great Tendaguru collection and various other interesting material. I was, he told me, the first foreigner who had seen this collection. It is a *magnificent* collection, far larger and more varied than I had any expectation of finding, and in preservation equal to the best of our Morrison material. Of their great "*Brachiosaurus*" skeleton I saw the skull and jaws, the entire cervical series with some dorsals and some ribs, as well as the entire fore limb; of the *Dicræosaurus* an entire vertebral column of one individual from the axis nearly to the end of the tail; pelves, vertebræ, and limb bones of various other great and medium-sized Sauropoda; a huge series of bones of their *Kentrurosaurus*, representing dozens of individuals and practically every part of the skeleton, but no association; a large number of partial skeletons and parts of skeletons of a small new Iguanodont dinosaur; and various "oddments" representing other types. Theropoda were scarce: two or three series of vertebræ of, I think, doubtful pertinence, and numerous teeth, large and small.

I have grave doubts whether the *Brachiosaurus* is really congeneric with our Colorado species. The little that is available for comparison indicates similar general proportions, but the humerus and the dorsals do not seem to me very like the same bones in the Colorado beast. The rest of the fauna is widely different from anything in the American Morrison, although often paralleling it in one way or another. . .

I feel certain from examining this fauna that it is not at all nearly related in any part to our Morrison, but is a separate parallel evolution from some common stock of perhaps Lower Jurassic age. How far the Jurassic dinosaurs of the English Lias, etc., represent this ancestral stock I do not know.

The Berlin museum will have a fine series of duplicates available for exchange, and Pompečki has promised to reserve a first-class set for us and to supplement the originals with casts of certain important parts not duplicated, such as the skull of *Brachiosaurus* (the biggest Sauropod skull ever found, and, I am inclined to add, the best). Of the *Kentrurosaurus* they will have duplicates of practically every bone. . . . Pompečki is very anxious to resume the interchange of publications. Neither his Geological-palæontological Institute nor the general library of the Museum für Naturkunde has any papers from us later than 1916. . . .

At Frankfurt I saw the new *Trachodon* with skin. It is as fine as ours, and supplements ours[1] admirably, showing the skin of the back very nearly complete. I was surprised to see how thin and delicate is the skin of the back and how small the pattern.[2] I had expected it to show the coarse pattern of the tail, but it does not.

Drevermann . . . is working tremendously hard to put the museum on its feet and keep it going, and to set an example to the city of plain living and hard work as the one and only cure for their troubles. Frankfurt is very different in appearance from Berlin, and I can well believe that he strikes the chief reason in saying that the people here are beginning to get to work again while in Berlin they are still listless and despairing. Drevermann impresses me as a most remarkable man, and what he has accomplished is an inspiration and a lesson to all of us. . . .

He has received nothing from us since 1916, and is very desirous of having our palæontological papers and also NATURAL HISTORY. He has a *very* high opinion of the latter, which he regards as the most valuable publication of its kind. He desired me to convey to Miss Dickerson his highest appreciation of the importance and success of her work, which he said he used a great deal and kept always at hand. . . .

I had the pleasure of meeting Dr. Lotichius, who desired to be especially remembered to friends in New York. He and Dr. von Strasse showed me through the modern mammals, an extraordinarily fine and well selected series. An Arctic habitat group just finished is wonderfully well done, an artistic piece. . . .

Munich, Oct. 8, 1920. . . . At Bonn I met Professor Pohlig, and saw the most important specimens of his collection, and enough of the others to get an idea of their size and quality. I found him a rather mild old gentleman, speaking fair English, but our discussion was mainly in German. He was very courteous and pleasant. The University collections, which he personally showed me as well as those of Dr. Krantz, include one important Pterodactyl type; nothing else worthy of special note, but the usual fine series of marine reptiles. . . .

Stuttgart: Director Schmidt was away, and so also was Dr. Pfitzenmeyer, whom I wanted to meet. Dr. Graeff showed me over all the collections, both those on exhibition and the material temporarily withdrawn. A magnificent *Plateosaurus* skeleton is the prize of the collection, the most perfect dinosaur skeleton that I have ever seen. With trifling exceptions it is complete and uncrushed, the surface of the bone everywhere beautifully preserved. It is from the red and green variegated Knollenmergel (Rhaetic) of southern Württemberg. I visited the quarry later with von Huene. They have casts of the skull and fore-foot, which we can obtain, and I have been urging them to get the whole skeleton cast. From the same quarry came the smaller and much less perfect skeleton of *Sellosaurus*, which is very closely related, and from a lower level in the Trias a skeleton of the quite small *Teratosaurus*, about five feet long, a good deal like the others in construction though placed by von Huene as a pro-Megalosaurus while the larger ones he regards as pro-Sauropoda. The mounting of these three skeletons is eccentric, the pose based upon the Iguana, involving some very obvious disjointing of the articulations.

Besides the Triassic dinosaurs, there is a fine series of Phytosaur skulls, etc., from the Stubensandstein quarries, and a splendid series of ichthyosaurs, crocodiles, plesiosaurs, etc. from Holzmaden, but perhaps the best thing, if one except the dinosaurs, is the fine Steinheim mammoth skeleton,—nearly as large as the *Elephas meridionalis* in the Paris Museum and very complete. Tusks were in place in the skull, the points turned inward as in the Texas mammoth skull we mounted in 1899. . . . The Fayûm collection was rather disappointing. A beautiful *Arsinoitherium* skull and a very fine *Palæomastodon* (both better than ours) in addition to what has been described. . . .

At Tübingen I met von Huene, who has been extraordinarily kind, giving up practically the whole of three days to museum and field excursions with me. His collection is exceedingly fine in marine Reptilia—the best series in that line that I have seen, although not such choice selections nor so beautifully mounted as in Frankfurt. . . . I visited the quarries from which the Stuttgart dinosaurs and other Triassic reptiles came, also many in Tübingen. The *Plateosaurus* quarry would be well worth further excavations. . . .

In Munich I found the collections vastly in-

[1]The reference is to the "mummy dinosaur" on the fourth floor of the American Museum. It is most unusual to secure fossils with skin attached. The preservation of the skin is due, it has been surmised, to the exposure of the carcass on a dry sand bank until thoroughly baked and hardened by the sun and to its subsequently being carried off by a sudden flood and buried quickly and deeply in sediment before the skin had time to soften and decay.

[2]Unlike modern lizards, these dinosaurs were devoid of scales. Instead they were covered by a tessellated surface of little mosaic plates, arranged in patterns of small spots, which, it is believed, corresponded with a color pattern of some sort.

creased from the old Zittel days. I think one can say without question that it is the finest museum for fossil Vertebrata in Germany. There is a very fine series of reptiles, and there are far more mammals than elsewhere. . . . The most interesting things to me were Strömer's new fauna from the late Cretaceous of the Baharijeh oasis in Egypt. Only a part is on exhibition as yet, but Dr. Strömer showed me all he had in Munich. A part, it appears, was still in Egypt when the war broke out, and has been detained temporarily by the Egyptian government. . . . It is a more peculiar fauna, decidedly, than the Tendaguru. It is just what one might expect if Africa was isolated during the Cretaceous and the fauna developed independently of the rest of the world. Strömer thinks there is every reason to expect that much more will be found by systematic collecting. Specimens are difficult to secure, being far from water and involving very expensive transport, and his own material is very crudely and roughly collected, although the preparation at Munich is good. . . .

I have hardly ever seen a more keenly intellectual face than Schlosser's. It is interesting simply to watch him talk. Broili was, of course, the same fine, genial chap that he always was; and in observing his methods I understand his appointment to so high a responsibility as the leadership of the Munich collections.

Vienna: I spent three days here, of which the first was mostly devoted to going through the formalities incident to getting away from the city. I have not made much note of this, but the passport and ticket business has been made excessively difficult,—I am told in order to discourage travel, which the various governments do not want on account of the universal scarcity of coal and consequent difficulty in running enough trains to take care of the traffic. For example, to get a ticket from Vienna to Venice I had to apply first at the ticket office in the city, was referred thence to another ticket office, thence to the Italian consulate, thence to an Italian military mission, where I obtained authority to buy a ticket, thence to a third ticket office, where I bought it. All these were in different parts of the city, all involved waiting in line, and none had anything to do with the visé, which I had already obtained after a similar series of delays. No one knows much about these regulations; you have to go from place to place to find out; and they are not always consistent. . . . But all this is aside, as indication of my reasons for not getting through as much as I had hoped to accomplish.

Dr. Schaffer at the Museum and Dr. Abel at the University of Vienna were most cordial. The museum building is a magnificent one. I never saw fossils so luxuriously installed before; and although Schaffer is rather resentful of so much being expended on building that they had no money for specimens, yet it seemed to me that to install the collections in such dignified and grandiose surroundings gave to the visitor an exalted impression of their importance and value. At present the museum is in a very bad way. . . . They have succeeded after great efforts in getting salaries raised to equal $500 a year each for himself and his assistants, and on that he says they can get along. But they *must* have aid to meet the necessary maintenance charges. He thinks that with $480 per annum for this purpose his department can keep up its work and keep the collections in order, setting aside for the present, of course, all thought of purchasing any new material. . . .

I saw a melancholy example of the results of lack of funds in the present condition of the magnificent meteorite collection (which they regard as the finest in existence). Owing to the lack of coal for heating the museum buildings last winter, the protective varnish covering all their sectioned surfaces was badly checked, and the damp got in at the iron and has rusted it very badly. All these sections will have to be reground and polished at a heavy expense. Other damage by the cold to alcoholic and other preparations is irreparable. They have a new collection from Samos at the museum, purchased shortly before the war, and none of it as yet on exhibition. It is beyond comparison the finest Samos collection. . . . The collections on exhibition include some fine things from the later Tertiary, of which I have notes; the first good Maragha collection, some fine *Dinotherium* jaws, a fine *Tapirus* skull from the Hungarian Pliocene, etc. . . .

Dr. Abel is one of the most attractive and brilliant personalities I have met. He is very busy with his new department and very anxious to obtain photographs, casts, or specimens of study material for his courses. We can do a good deal in that way for him, and although we have sent considerable material to the museum, the university is so completely separate that he needs all he can get, especially in Equidæ and other evolution series. His assistant, Dr. Antonius, has specialized on Equidæ, and in my judgment knows more about the later Tertiary and Pleistocene Equidæ than anyone in Europe. Abel, also, has had almost nothing since 1914, and had not even heard of our *Diatryma*. He does not want large and bulky or showy casts or originals, for he has no room for them, but he would use a study series very effectively. . . .

At Padua I made acquaintance with Professor Giorgio Dal Piaz, head of the department of geology and a very fine chap. He is doing active work in collecting Tertiary mammals, etc., has published a number of excellent memoirs on the geology and palæontology of Venetia, and has brought together a small but valuable series of fossil vertebrates, mostly Venetian, the best of them Cetacea, except for an important new fauna that he has secured from the late Oligocene of Belluno. . . .

From Padua I came to Bologna, where I met Professor Capellini. He is now a very old gentleman, eighty-seven years old, but still active. He continues by especial dispensation to give his lectures, though far beyond the age limit. The museum has been named and officially dedicated in his honor as the Capellini Museum, and he is naturally proud of it. He speaks very fair English, an unusual thing here—I have had mostly to depend on French—and is greatly interested in American science. . . . The most important specimen in the museum is the skeleton of *Mastodon arvernensis*. . . . There is also a considerable series of Tertiary Cetacea and Sirenia, including a fine *Halitherium* skull and jaws. There are no other vertebrates calling for special notice.

From Bologna I went to Florence, where I failed to find the director of the museum but persuaded the "technician" to let me see the collections. Considerable material from the Val d'Arno is there, including an especially fine *Mastodon arvernensis*, of which I took notes; they may be able to make casts of certain important types, in return for casts of some of our fossils.

From Florence I went to Rome, where I found nothing of palæontologic interest, although the historic and prehistoric remains are extraordinarily impressive. Thence I traveled to Naples, where also the interest is history and archæology rather than palæontology. I took an excursion to Pompeii, thence to Amalfi, Sorrento, and Capri, and then to Vesuvius.—all very wonderful in themselves but of somewhat remote relations to vertebrate palæontology. Thence I went to Genoa, Turin, and Milan. At Genoa there is a museum, a fine little building, beautifully situated, but offering nothing special to report upon. Turin was more interesting. There they have a large collection from the Pliocene of Asti and other localities in the neighborhood, including a fine series of mastodon and of the southern mammoth. There is also one of the best *Megatherium* skeletons I have seen. Among the Asti specimens is the *M. arvernensis* which Sismondi restored many years ago (1850). This restoration gives a very good idea of the amount of "constructive imagination" possessed by our predecessors. One does not so much wonder on seeing it that Balzac credited Cuvier with restoring an extinct animal from a tooth. The Sismondi specimen is very incomplete, not at all comparable to the specimen at Bologna later restored by Capellini.

At Milan I found an active, energetic staff, a comparatively new museum, which they are anxious to build up by exchange of originals or of casts, and a considerable amount of interesting material. Included in the collection are some very fine Tertiary Cetacea, some fair Proboscidea, a fine *Megatherium* skeleton, etc.

I searched carefully in the Genoa museum for the cast on which *Rhyncotherium* is based. It was not there; and as everything is placed on exhibition, I am pretty sure that it is not in the Genoa museum. I shall make careful inquiry for it at Geneva.

At Zürich the National Museum is at present shut up tight for alterations, and in the limited time at my disposal I did not succeed in obtaining entry. In the natural history collections I found yet another *Megatherium* skeleton—not a very good one—and a considerable Pampean collection made by Santiago Roth, and fairly well exhibited; also the original *Andrias scheuchzeri*,[1] of which we ought to have a *good* photograph.

I spent two days at Basle, and got some idea of Dr. Stehlin's collection, which is one of the most important study collections in Europe, second only to Munich among those I have seen in its Tertiary mammals. It is very greatly improved from the old days. There is a magnificent collection from Quercy. . . Then there is a very interesting series of collections from various horizons of later Oligocene and Miocene, and a Pliocene collection from Senèze that equals the Val d'Arno fauna or the Asti fauna in richness. Proboscideans are scarce, but all the smaller forms far better represented. Dr. Stehlin has already several fine skeletons mounted from this horizon—*Cervus*, *Machærodus*, etc. Among the antelopes is one quite near to *Oreamnus* (our mountain goat). This is certainly one of the great faunas, and it is fine to see it in such competent hands. . . .

From Basle I traveled to Geneva, where the old Pictet collection has slumbered for nearly half a century, but is now likely to be made the nucleus of an active center of work and of expansion if Dr. Revilliod stays there. He is one of Stehlin's pupils, a comparatively young man, full of enthusiasm for the development of the collection, and I hope he will accomplish a great deal. He is an authority on Chiroptera, the only man who knows much about the Tertiary genera.

A skull of *Elasmotherium* in the Geneva collection is interesting because the so-called horn base is very perfectly preserved, and there are five of the upper teeth on one side, two on the other. I do not think this is a real horn base. It is much more the type of a callus-covered boss, and quite unlike the structure in any of the horn-bearing rhinoceroses. There is a considerable collection from the Pampean here, made by Santiago Roth (who was a Swiss by birth). I examined carefully all the mastodon material and casts in a vain search for the classic *Rhyncotherium* cast. One cast, curiously enough, had been labelled as from an original in Mexico City, but Dr. Revilliod had recently discovered that this was an error, and that it was from an original in Lyons, and of much later date than Falconer's time. It was equally obvious to me when I saw the cast that it was not from any American species of mastodon. The existence of this curious mislabelling leads me to suspect that the "*Rhyncotherium*" cast was once here but has disappeared and that its label has been transferred by accident to another cast. At all events it is not here now.

At Lyons, Professor Depéret was most cordial and friendly and spent all his spare minutes during the day and a half that I was at the university, in showing me his material and talking over interesting points. He has accumulated a magnificent collection, without doubt I should say the best Eocene collection in Europe. He has a fine, *articulated*, complete skeleton of the big *Palæotherium* from Mormoiron. . . . There is also considerable good Oligocene and Miocene material and a fine

[1]This is the specimen which old Jacob Scheuchzer described in very moving and pathetic terms as "*Homo diluvii testis*"—the remains of one of our antediluvian forebears, destroyed and buried by the Deluge. It is really a fossil giant salamander.

series from Senèze. . . Altogether it is a very splendid collection and I wish I could spend a couple of months studying it.

I could give only half a day to the Lyons City Museum, and spent most of that in discussing with Dr. Gaillard his situation and researches. He also was most cordial and desired me to express his best wishes to President Osborn and to the American Museum, and to assure the president that the museum could count upon him for any photographs, measurements, or casts of specimens in his collection in which we are especially interested. He has many of the old types, especially from Grive St. Alban. . . .

At the Muséum de Palæontologie in Paris Dr. Boule received me very cordially and wished to be remembered to President Osborn in the most friendly terms.

Père Teilhard de Chardin is engaged at present upon a revision of the famous Cernaysian fauna. He is a very able scientist, keen, judicious, and very strongly interested in the fauna in question and its correlation with ours. He showed me all of the material, and there is much to confirm our provisional correlations. . . .

They have here a choice series of Eocene Primates, especially of small fronts of skulls and complete dentitions, some new, others described from the Phosphorites, beautifully preserved, and the most *Tarsius*-like skull that I have seen. . . .

Boule showed me also his Chapelle-aux-Saints skeleton, and also two, male and female, from La Ferrassie, equally complete and important. The feet in both the Ferrassie skeletons are wonderfully fine. The male skull, originally much crushed, has been carefully taken apart and reconstructed. It is more complete than the Chapelle-aux-Saints; the teeth are present though worn to the roots. The reconstruction of the skull is a marvelously skillful piece of work. Boule said it took him and his assistants six years to complete it; in any event it is mighty well done. It duplicates the characters of the Chapelle-aux-Saints skull very exactly; so, too, those of the skeleton. These are partly figured in Boule's forthcoming book on fossil man[1]. . .

The mounted skeleton of *Mastodon angustidens* is incomplete as to the skull, and more or less of the skeleton is restored.

With Paris the series of letters from which I have been quoting comes to an end, and for the remainder of the trip I write from memory, as my notebooks contain details and figures but no general impressions.

The Natural History Museum of Brussels is especially noted for the unique series of Iguanodont skeletons—no less than twenty-eight of them, found at Bernissart near the French border. It has, however, other new and unusual features no less remarkable than these huge dinosaurs. The fossil vertebrates are all Belgian and arranged to illustrate the geological history of Belgium. The great hall, 300 x 100 feet, is divided into four stages, each representing a distinct geologic epoch. The skeletons have been mounted without any plaster restoration, very skilfully and artistically; the cases are very handsome; locks and keys have been done away with; and the labels are recognized everywhere as a model of style for popular natural history. Professor Dollo, who has created this splendid exhibit in thirty years of active work, is still busied in improving and extending it. The German occupation during the war brought the activities of the museum practically to a standstill, but the collections did not suffer through any loss or neglect.

After two months on the continent, England seemed like home, and our confrères in London welcomed us not as visiting strangers but as old friends. The Natural History Museum in South Kensington still maintains the general arrangements of twenty or thirty years ago, but in every alcove one sees changes and improvements keeping it in touch with recent discoveries and ideas. The halls of fossil vertebrates comprise probably the most broadly representative collection in existence; every important fossil fauna from every country of the world is represented by collections more or less admirable. The finest features are the marine reptiles and the fossil proboscideans. The great extinct moas of New Zealand, the fossil mammals of Australia, and the ancient reptiles of South Africa, the classic fossils of the Siwalik hills of India, and the rare and tiny Jurassic mammals are other important items of this great collection.

Here, too, is the famous Piltdown skull, which I studied with due reverence, and discussed earnestly—and to me very profitably—with Dr. Smith Woodward and Professor Elliot Smith. I hope to give the results of this discussion in another article.

There is probably no other city in the world where so large a number of leading scientific men can meet together and exchange ideas in the various formal and informal gatherings of the scientific societies. Washington has much of this stimulating atmosphere, and so no doubt have Paris and Berlin and other great continental cities, but it was in London, for several reasons, that it impressed me most.

After spending nearly three weeks in London, mostly at the South Kensington Museum, I had but a few days for Cambridge and Oxford, where the natural history collections, admirably selected for university teaching, are complementary rather than comparable to the exhibition and the research development seen in the South Kensington Museum. It is the men and the atmosphere of culture and learning and of old-world dignity pervading the university life, that chiefly color one's recollections here. Our old friend Forster Cooper, the magnetic personality of Dr. Haddon, the brilliant and many-sided Sollas, the quiet thoroughness and insight of Professor Goodrich—these are the remembrances on which one would like to enlarge. But these random notes have already reached the limit of the space here allotted to them and upon these pleasant memories I must close.

[1]These three skeletons are the most perfect specimens of the extinct Neanderthal man.

INSECTS AS FOOD

HOW THEY HAVE AUGMENTED THE FOOD SUPPLY OF MANKIND IN EARLY AND RECENT TIMES

BY

J. BEQUAERT*

WHEN the turmoil of the World War threatened to imperil the food resources of civilized nations, the question of "substitutes" became a serious one, and, among other suggestions, experiments were urged by the eminent entomologist, Dr. L. O. Howard, to ascertain the food value of insects. Favorable as the results may have proved, one can well imagine the storm of protest that would have resulted had the adoption of such a program by the general public been advocated. Yet to many it is surprising and can be attributed only to prejudice, that civilized man of today shows such a decided aversion to including any six-legged creatures in his diet.

The ancient Greeks, so circumspect in all that pertained to their personal welfare, rated as a great delicacy the grasshoppers which, as we learn from one of Aristophanes' comedies, were brought by the Bœotians to the market place at Athens. In another of his plays the same author jocosely remarks: "Are locusts superior in flavor to thrushes? Why! do you want to fool me? Everybody knows that locusts taste much better!" And his compatriot, Alexis, mentions the locust among the provisions of a poor Athenian family:

"For our best and daintiest cheer,
Through the bright half of the year,
Is but acorns, onions, peas,
Ochros, lupines, radishes,
Vetches, wild pears nine and ten,
With a locust now and then."

The *Cossus* of the Greeks and Romans, so highly prized even at the tables of the rich, was the grub of a beetle living in the trunks of trees, perhaps that of the stag-beetle (*Lucanus cervus*). Pliny tells us that the epicures of his time considered these insects on a par with the daintiest meats and even fed them on meal in order to fatten them and heighten their flavor.

Both the Old and the New Testament contain a number of allusions to insects as food, and among eastern peoples it is still customary so to regard them. In Leviticus, XI: 21–22, Moses describes four kinds of locusts which the Hebrews were permitted to eat: "Yet then may ye eat of all winged creeping things that go upon all four, which have legs above their feet, to leap withal upon the earth; even these of them ye may eat; the locust after its kind, and the bald locust after its kind, and the cricket after its kind, and the grasshopper after its kind." The locusts upon which St. John the Baptist (Mark, I:6) lived in the desert have been the subject of much discussion, some authors seeing in them the fruit of the carob tree, while others maintain they were true Orthoptera and to prove this refer to the practice of the Arabs in Syria at the present day. "Those who deny that insects were the food of this holy man," says Hasselquist (*Travels*, p. 419) "urge that the locust is an unaccustomed and unnatural food; but they would soon be convinced to the contrary, if they would travel hither to Egypt, Arabia, or Syria, and take a meal with the Arabs. Roasted locusts are at this time eaten by the Arabs, in the proper season, when they can procure them; so that in all probability this dish was used in the time of St. John. Ancient customs are not here subject to many changes, and the victuals of St. John are not believed unnatural here; and I was assured by a judicious Greek priest that his Church had never taken the word in any other sense, and he even

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laughed at the idea of its being a bird or a plant." In fact, locusts have been highly prized as food in the Orient from remotest antiquity, and Layard in his *Discoveries among the Ruins of Nineveh and Babylon* figures a sculptured Assyrian slab on which, among the attendants carrying fruit, flowers, and game to a banquet, several appear bearing dried locusts fastened to rods.

Nowadays the use of insects as a diet is practically restricted to wild or half-civilized peoples, but even so they form an important item in the food supply of mankind. Although many of those considered edible are too scarce to furnish more than an occasional dainty morsel, or because of their rarity are reserved for some special purpose, other kinds are gathered in great quantities, dried, and preserved for a time as part of the staple food supply of the tribe.

A common beetle of the Orient, *Blaps sulcata*, is put up in a preparation which the women of Egypt, Turkey, and Arabia consume for the purpose of acquiring a degree of plumpness corresponding with their notion of beauty. The large, fleshy grubs of certain wood-boring beetles—curculios, longicornes, and the like—are greedily sought by many native tribes of tropical regions. Thus we are informed some planters in the West Indies used to keep negroes whose sole duty it was to go into the woods in quest of the large larvæ of *Prionus damicornis*, chiefly found in the plum and silk-cotton trees. These when opened, washed, and carefully broiled over a charcoal fire, were said to be tempting even to a jaded appetite. Ælian speaks of an Indian king who for dessert set before his Grecian guests, instead of the usual fruit, a roasted worm taken from a plant. This worm, he says, the Indians pronounced very delicious —a verdict confirmed by the privileged few who tasted it. In western Australia the decaying trunks of the grass tree house large colonies of a grub with a flavor very much like marrow, and these larvæ, either uncooked or roasted, form a favorite dish of the aborigines.

It is, perhaps, among African negroes that insects are most extensively used as food—a practice undoubtedly due more to necessity than choice. Owing to peculiar climatic conditions and the ravages made by animal diseases, but few goats, sheep, and cattle are kept

The "grub" or larva of the goliath beetle, one of the largest among the Coleoptera, lives in the swelling near the roots of the banana tree. Frequently it is five and one half inches long. It is said that when roasted on a stick this larva is a gastronomic treat among the natives of the African forest, as much for its tempting size as for its rare flavor. The specimen figured was obtained by Mr. Herbert Lang, leader of the American Museum Congo Expedition, at Medje, Belgian Congo by the natives and these are too highly prized to enter very frequently into the diet, serving rather as signs of wealth; chickens and occasionally dogs are the only domestic animals freely eaten. The meat supply of the various tribes is, therefore, limited, necessarily consisting mainly of fish and game, the capture of which involves not a little trouble and is dependent on too many contingencies. To this scarcity is attributable the perpetual craving for animal food from which the black race has been suffering for centuries and which is undoubtedly to a large extent responsible for cannibalism. Although at least in the forest regions bananas, cassava, sweet potatoes, and corn offer a steady and regular sustenance obtained with comparatively little labor, in many other sections the soil is so poor or the drought so frequent and severe that the crops often fail. Considering that some of the most important products grown at present by the African blacks, such as cassava and corn, are of comparatively recent introduction, one cannot fail to see that formerly famine must have been a very frequent scourge. Is it strange, then, that the natives, facing starvation, tried to sustain life with whatever was handiest and so came to include insects in their regular diet?

From Doctor Livingstone comes the story that in the valley of the Quango River, Angola, the natives dig large, white larvæ out of the damp soil adjacent to the streams, and use them as a relish with their vegetable food. In many regions of South Africa where the produce is barely sufficient for the few scattered inhabitants, flights of locusts are looked on as such a blessing that the medicine man sometimes promises to bring them, instead of rain, by his incantations. Doctor Sparrman relates that the Hottentots rejoice greatly at the arrival of the locusts, about whose origin they have a most curious notion. They ascribe them to the good will of a mighty spirit a great distance to the north, who,

At certain seasons great numbers of these slender grasshoppers (*Homocoryphus*) are collected for their food value by the Logo of the northeastern Belgian Congo. Whole villages turn out into the surrounding savannah country to gather thousands of these insects by sweeping the high grass with fish nets

having removed the stone from the mouth of a certain deep pit, releases the locusts in order to furnish the tribe with food. The grateful natives collect and consume this provision so appreciatively that in the space of a few days they grow visibly fatter and appear in a much better state of health. It is the female insects principally that are eaten, especially just before their migratory flight, at a time when their wings are short and their bodies heavy and distended with eggs.

To Diodorus Siculus, who lived in the time of Julius Cæsar, is due the credit for first describing the "Acridophagi" or locust eaters of Ethiopia, who, he says, are smaller than other men, of lean and meager bodies and exceedingly black. According to his account the south winds rise high in the spring and drive out of the desert an infinite number of locusts of an extraordinary size, furnished with very dirty, unsightly wings (probably the common migratory

Photograph by H. Lang

In Africa termite nests often attain huge proportions, sometimes giving the landscape the effect of hill formation. This structure of *Termes natalensis* was photographed at Kwamouth, Belgian Congo. Built of clay carried up to the surface by worker termites, it was a labyrinth of galleries and chambers, which housed numberless tiny inhabitants. Although the outer walls of such termitaria are extremely hard, they are often demolished by the natives in search of these insects, which form a welcome addition to their diet

locust, *Pachytylus migratorius*). These locusts furnish a plentiful food supply. From information kindly given me by Mr. Herbert Lang, leader of the American Museum Congo Expedition, I gather that in the northeastern corner of the Belgian Congo the Logo enjoy especially a grasshopper, apparently of the genus *Homocoryphus*, shown in the accompanying photograph.

Photograph by H. Lang

The royal chamber of *Termes natalensis* is located toward the center of the termite nest, often a foot or more below the surface of the earth. It is shared by one or more queens, huge, helpless creatures about three inches long. Niangara, Belgian Congo

Photograph by H. Lang

Termitarium of *Acanthotermes spiniger* at Stanleyville, Belgian Congo, showing how the natives envelop the structure in broad leaves to prevent the escape of the winged individuals. The cap of leaves over the top of the nest, and the side pocket from which the termites are scooped out by the natives, were removed before the photograph was taken

Throughout practically the whole of Africa termites or "white ants" are such an important addition to the regular diet of the natives that most travelers in their accounts comment upon the fact. So anxious are the Azande and Mangbetu of the Uele district to secure these so-called ants that termite hills are considered by them private property, and during the harvest of the insects, fights, often resulting fatally, occur between rival claimants. From Mr. Lang I learned also of an ingenious automatic device by means of which the natives of certain regions he visited collect the winged, sexual forms of the white ants at the season of their marriage flight. They tightly enfold the termite mound in several layers of the broad leaves of a marantaceous wood reed, the interstices soon being closed with earth by the termites, which usually join the inner leaves to the nest. A projecting pocket, built on one side of the leaf cover, serves as a trap, for when the winged termites begin to swarm, they find no egress and finally drop in masses into the pocket from which they are scooped out by the watching negroes. In other instances the nests themselves are dug up to obtain the workers, soldiers, and huge, fat queens, which form a dainty titbit when broiled over the fire. At Banalia along the Aruwimi River in December, 1913, I was rather surprised to find, among many strange articles of food offered for sale by the natives at the weekly market, baskets of dried soldier termites.

Junker, one of the first white men to reach the Azande country, relates how Chief Ndoruma sought to win his favor by sending him twenty large baskets of termites, each load so heavy that it was all a porter could carry. In this instance the contents made such an excellent oil that a chicken cooked in it tasted as delicious as if fried in butter.

Notwithstanding the odor of the formic acid, true ants, too, are frequently collected and eaten by natives of various continents. According to Bingham, in Kanara and other parts of India, and throughout Burma and Siam, a paste of the green weaver ant (*Œcophylla smaragdina*) is served as a condiment with curry. Beccari records that the Dayaks of Borneo mix this ant with their rice, to which it lends a pungent, acetic flavor. Concerning the same insect, Saville Kent, in his fascinating *Naturalist in Australia* has this to say: "Beauty, in the case of the Green Ant, is more than skin-deep. Their attractive, almost sweetmeat-like translucency possibly invited the first essays at their consumption by the human species. Mashed up in water, after the manner of lemon squash, these ants form a pleasant acid drink which is held in high favor by the natives of North Queensland, and is even appreciated by many European palates."

It is generally known that certain American Indians are at times myrmecophagous. John Muir, in his *First Summer in the Sierra* tells how the Digger Indians of California eat the tickly acid gasters of the large jet-black carpenter ants. The Mexican Indians and those of our Southwest make a practise of eating the replete workers, or living honey-pots, of the celebrated honey ant (*Myrmecocystus*) and regard them as a delicacy with which to honor their guests. In some cases the insects are pressed and the honey thus extracted enjoyed with meals, in others they are put aside to ferment into a highly flavored wine. Certain African tribes collect the huge queens of *Carebara* at the time of their nuptial flight, when these ants emerge in large numbers from the termitaria in which their nests are concealed. In this case the gasters only are eaten, either uncooked or roasted, and are considered a great delicacy. Many of the South American Indians treat in a like manner the queens of the leaf-cutting ants (*Atta cephalotes* and *Atta sexdens*).

Caterpillars are often appreciated as

food in direct proportion to the ease with which large-sized species and those that occur in great numbers are collected. There appeared in the *Journal of the New York Entomological Society* for 1912 an interesting article by Mr. J. M. Aldrich regarding the use as food of the larvæ of a saturnid moth (*Colorado pandora*) by certain Indians of the Nevada-California border. Quite recently the same entomologist has published further notes on this strange Indian food, describing, among other points, the manner in which the caterpillars are collected from their food plant, the Jeffrey pine. Richard Schomburgh records how the Indians in British Guiana actively gather for culinary purposes a caterpillar and its pupæ which appear at the rainy season. Many African tribes, especially those of the forest country, consider these insects choice morsels. The Pangwe of southern Cameroon, according to Tessmann, eat no less than twenty-one different kinds. Not only do the natives distinguish by name a number of edible species, but they also know the particular food plants on which they are to be found. The caterpillars of the silk-weaving *Anaphe*, a genus of notodontid moths of equatorial Africa that have the peculiar habit of congregating when full-grown, sometimes to the number of a dozen or more, to spin a common silk nest in which they make their cocoon and pupate, are eaten and their silky nests offered for sale.

In mentioning that the *Anaphe* larvæ are relished by the natives of Gazaland, Swynnerton writes: "This is hardly of special interest in itself, for many other moth-larvæ are also eaten by them, but what is perhaps of some slight interest is their alleged differential effect on particular individuals eating them. I was first informed of this by a native skinner and collector in my employ, whose statements I have in general found to be reliable; and he specially remarked that even brothers, eating from the same dish larvæ that had been

Photograph by H. Lang

Communal silk cocoon made by caterpillars of a species of *Anaphe* in the Ituri Forest, at Medje, Belgian Congo. The larvæ of this and other members of the genus are eaten with great delight by many Central African tribes

Dried, and preserved, these *ebbo* caterpillars form part of the staple food supply of the Medje, who live in the Ituri Forest. When the heavy spines have been scraped off, the caterpillars, properly boiled and seasoned, are a dish of which the natives are exceedingly fond

captured and prepared together, differed thus in their reaction: one brother suffering no ill effects whatever, the other being always completely prostrated for as much as two or three days in the more serious cases. The statement has been completely corroborated by such natives as I have since spoken to on the subject. All have further agreed in saying that the larvæ are much liked, and that their inability to eat them is felt as a misfortune by those whom they affect unpleasantly."

In addition to the nests of *Anaphe*, the Medje diligently collect in the proper season various other caterpillars. Those called *ebbo* are especially sought; dried and smoked they can be preserved for many months. The most common species collected by Mr. Lang and reproduced here is evidently the larva of a ceratocampid moth of the genus *Micragone*, agreeing almost exactly with the description and figure given by Packard for *M. herilla*. Heavy spines cover the body but are scraped off before cooking. Two other species of caterpillars in the same collection also belong to the Ceratocampidæ. Another delicacy among the Medje is the grub of a curious psychid moth (*Clania moddermanni*) which lives in a tightly woven bag of its own making covered on the outside with stalks and reaching a length of two and one half inches and a diameter of three quarters of an inch.

According to Tessmann, the Pangwe even hunt for the aquatic larvæ of dragon flies, to which they attribute diuretic properties. It is said that cicadas are a common article of food among the natives of Lower Siam, and the peculiar manner in which they are caught is in itself an interesting chapter as described by W. W. Skeat: "Two or three natives gather together at night round a brightly burning wood fire, one of them holding a lighted torch. The others clap their hands at regular intervals, and the Cicadæ, attracted by the noise and guided by the light, fly down and settle upon the people as they stand by the fire." In the region of Garamba, Belgian Congo, I am told, the natives not only eat the honey accumulated in the nests of wild bees, but even gather the larvæ and pupæ, which they roast over the fire before consum-

Photograph by H. Lang

This caterpillar of a psychid moth (*Clania moddermanni*) from the Ituri Forest, Belgian Congo, lives in a baglike house which it weaves of silk and covers with small sticks. The worm never leaves its envelop but has been removed here to be photographed

ing. Moreover, the nests of certain social wasps are also sought for the same purpose.

It is impossible to mention here more than a few of the many insects used for culinary purposes, for members of nearly all orders enter into the diet of one people or another. A few words may be added, however, about the two-winged insects, which are seldom used, probably because in most cases they are difficult to gather in great quantities. Williston and Aldrich have called attention to the case of certain small flies of the genus *Ephydra*, the adults of which are found by the thousands along the shores of Mono Lake, California. In the latter part of the summer the puparia are washed up on the beach where they accumulate in heaps and can be collected by the bushel. In days gone by Indians came from far and near to gather them for food and a few still continue to do so. The worms are dried in the sun and the shell is rubbed off by hand. A yellowish kernel remains, very similar to a small grain of rice. This is oily, very nutritious, and under the name *koo-chah-bee* or *koo-tsabe* used to form a very important item of food. Its flavor is described as not altogether unpleasant and according to an informant: "If one were ignorant of its origin, it would make nice soup. It tastes more like patent 'meat biscuit' than anything else I can compare it with." There are also a few instances recorded of the adult flies themselves having been eaten. A leptid fly of the genus *Atherix* at certain seasons appears in astonishing numbers along brooks in northeastern California. Trees, bushes, and rocks are covered with them to a depth of five or six inches. The Indians scrape them off and collect them in great heaps, cooking them between hot stones in an oven-like pit. The resulting reddish brown mass of about the consistency of headcheese, is made into loaves like bread, and can be counted on as a mainstay during the winter.

On some of the Central African lakes in the dry season a minute midge, one of the Chironomidæ, rises from the water in clouds so dense that from a distance the effect is that of smoke. Near Lake Nyasa the midges are known as *kungu* and round out the larder of many of the shore tribes. When great hosts of them are driven landward by the wind, they are swept off the bushes and rocks by the natives or caught against mats hung up for the purpose; they are then compressed into oily cakes, roasted, and eaten. According to Koch, the Sesse Islanders collect and prepare in a similar manner the may flies which swarm in dense columns over Lake Victoria.

In spite of the weight of evidence from the historical point of view, it is not the purpose of the present article to furnish arguments regarding the value of insects as food or for including them in our own diet. What we eat and what we do not eat is, after all, more a matter of custom and fashion than anything else. Many years ago a learned French physician, J. J. Virey, made an exhaustive study of the question "Whether man *may* eat insects and whether he *should* eat them," with this conclusion: "Man may eat insects: nothing in his anatomical organization or his physiological functions is opposed to it. He should eat insects: in the first place, because his cousins the monkeys and his ancestors the bats, or to be brief the primates, eat them; in the second place, because insectivorous animals are superior to the other species of their order, as well in their more perfect organization as in the superiority of their intelligence." Still, it must be admitted that this line of reasoning will have but slight appeal to the average white man. In my opinion the habitual consumption of insects may not be without danger. The greater number of them have such a heavy, indigestible skeleton of chitin that their continued use might well lead to dyspepsia. In addition, the small size of most of them makes it impossible to eliminate from their bodies all organs in which the waste products are accumulated, and which, because of their recognized poisonous properties, are as a rule carefully removed in the case of our meat and fish.

Be this as it may, those inclined toward reforming our food habits may be interested in a booklet published by Vincent M. Holt under the title *Why not eat insects?* They will find there an array of recipes for the preparation of various insects and also a number of menus for entomophagous dinners. If the time ever comes when insects are universally used as food, Mr. Holt's book will undoubtedly be greatly treasured by all gastronomes. Perhaps some day he may be regarded as one of the benefactors of humanity, for did not Brillat-Savarin write: "He who invents a new dish does more for the happiness of his fellowmen than all the philosophers, writers, scientists, and politicians together."

NOTES

A Resolution was unanimously adopted by the Executive Committee of the American Museum, electing Mrs. Olivia Sage, Mr. A. D. Juilliard, and Mrs. Helen C. Juilliard, benefactors, in recognition of their generous bequests to the Permanent Endowment Fund.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Honorary Fellow: Madame Marie Sklodowska Curie.

Life Members: Messrs. F. William Gertzen, Walter Alfred Hafner, O'Donnell Iselin, A. Van Horne Stuyvesant, Jr., H. N. Thurston, and Hugo Weigert.

Sustaining Members: Messrs. Eugene S. La Bar and Israel Unterberg.

Annual Members: Mesdames John Lee Connable, E. F. Dwight, Irving R. Fisher, Joseph Addison Goetz, Lucy W. Hewitt, R. G. McGregor, Charles Miner, Richard O'Gorman, Arthur W. Page, Charles G. Peters, George Taylor, John H. Thomas; the Misses Alma Lissberger, G. Lundquist, Louise E. von Bernuth; Dr. Frederick Tilney; the Rev. F. S. Idleman; Messrs. George W. Alger, Copley Amory, Thornton W. Burgess, Harold T. Clark, Harry Collins, Cyrus S. Eaton, Howell Fisher, Arthur G. Frey, George Wilbert Grandin, Walter T. Hathaway, Warren S. Hayden, Louis Jersawit, M. F. Loewenstein, Charles Capron Marsh, George T. Maxwell, Josh. W. Mayer, Robert H. Montgomery, John Ballantine Niven, D. Raymond Noyes, George S. Olds, Martin Pless, H. A. Pomroy, Henry H. Reed, Victor F. Ridder, Richard P. Robison, Geo. M. Rogers, Armand Schmoll, L. E. Schwab, Philipin Schwarz, Joseph H. Seaman, Richard Seckels, George A. Seligmann, Carl Shaff, Frank G. Shattuck, Herbert Prescott Shreeve, Joshua Silverstein, W. W. Skiddy, Thomas W. Slocum, Henry G. Smith, Stanley Smith, Joseph Spector, Emil Stern, Isaac E. Sternberg, Jules P. Storm, Raymond E. Streit, Charles William Taussig, Herbert C. Taylor, Herbert L. Thowless, Wallis S. Turner, George B. Veit, George Wathen, Alex. Weinberg, C. H. Wilcox, Ernest J. Wile, Irwin Wile, Oscar J. Wile, Matthew A. Wilks, Sigmund Wimelbacher, W. E. Winchester, and George M. Yorke.

Associate Members: Mrs. B. C. Madeira; the Misses Jean H. Hart, Kathleen Marguerite Hempel; Doctors F. A. Drake, Bernays Kennedy, Ernest C. Levy, L. B. Manchester, Arnold Peskind, F. X. Pomainville, Charles Rayevsky, Russell Richardson, David Riesman, William J. Ross, G. C. Sabichi, Florence R. Sabin, Adolph Sachs, Joseph Sailer, Edward C. Sherman, D. Laurence Smith, Harry A. Spangler, Colin C. Stewart, George A. Still, Carl G. Swenson, Alfred H. Tickell, A. E. Turman, J. Van der Laan, Ralph W. Webster, Lewis H. Weed, Harry M. Wegeforth, Joseph D. Weis, Wanda Weniger, Wm. B. Wherry, Henry A. Whiting, Willis R. Whitney, Otis B. Wight, Ernest L. Willetts, J. Pearson Willits; Major Henry J. Nichols, M. C., U. S. A.; the Rev. Wallace Rogers; Professors A. R. Sawyer, David H. Tennent; Messrs. F. W. Adams, Nathan A. Bowers, P. Burns, D. S. Culver, Otto Degener, Elwyn H. Dole, Harry C. Dudley, John W. Fulton, J. W. Lytle, W. C. Matthews, W. R. Morris, Leslie W. Newberry, Charles P. Noyes, Prescott Oakes, Andrew J. O'Reilly, Stanley Partridge, J. F. Max Patitz, W. E. Pease, Win Proebstel, Buell H. Quain, Ivar L. Sjöström, Harrison Stidham, Julius F. Stone, Edward B. Taylor, C. H. Thomas, H. S. Tullock, Samuel Tobias Wagner, Edward H. Waldo, B.C. Wolverton, Samuel S. Wyer; the Swarthmore College Library; and the Department of Mining Geology, School of Mines, University of Pittsburgh.

"The Evolution, Phylogeny, and Classification of the Proboscidea," was the subject of an address delivered by President Henry Fairfield Osborn, of the American Museum, at the annual meeting of the National Academy of Sciences, held in Washington, D. C., on April 25-27. The address was illustrated by lantern slides.

Prof. Henry E. Crampton, honorary curator of lower invertebrates in the American Museum, recently returned from his third tour in the Polynesian Islands. Through his industrious collecting the Museum is enriched by a large number of specimens representative of the fauna of the Mariana Islands, Manila, China, Siam, the Malay Peninsula, the Dutch East Indies, and Australia.

He reports (April 8, 1921) that of snails of the genus *Partula* he was able to secure, for purposes of research, upward of 10,000 specimens from more than forty localities in Guam and Saipan of the Mariana Islands.

Herpetological material, collected by Doctor Crampton at various places, consisted of thirty-four lizards, snakes, and frogs, in twenty-two vials and bottles. In addition to these he brought back with him three bottles containing five snakes, which were presented to the American Museum by Lieut. Gen. E. W. Trotter, adviser to the King on military affairs, Bangkok, Siam.

Three thousand dried insect specimens of the orders Lepidoptera, Coleoptera, Odonata, Hymenoptera, etc., and thirty-five vials containing ants and other insects, as well as spiders, preserved in alcohol, were delivered to the department of entomology.

For the department of lower invertebrates Doctor Crampton secured sixty vials of Myriapods, miscellaneous land shells, worms, and Isopods. In addition he brought back numerous marine shells, which have not yet been definitely estimated.

Certain items of ethnological interest were obtained for the department of anthropology. Doctor Crampton was able, also, to make preliminary arrangements for the purchase by this department of a complete and classified series of baskets from the northern Siamese territory occupied by the Lao people.

A few geological specimens from Australia were secured for the department of geology.

Nearly four hundred and fifty photographs, some of which are used as illustrations for the article in the present issue entitled, "A Journey to the Mariana Islands—Guam and Saipan," were taken by Dr. Crampton, and in addition there were purchased a representative series of photographs in the Philippine Islands, in Siam, in Java, and in Australia.

Dr. Frank M. Chapman, curator of ornithology in the American Museum, recently returned from a trip to England made for the purpose of studying the types of Ecuador birds in the British Museum, work which is a preliminary part of his studies for the second volume of the faunal monographs on the South American birds. The volume relating to Ecuador will be of the same nature as the Columbian book published in 1917. In addition to his study of specimens in the British Museum and the Zoölogical Museum at Tring, Doctor Chapman arranged, while abroad, an important exchange of ornithological specimens.

President Henry Fairfield Osborn and Mr. George N. Pindar, of the American Museum, who are respectively chairman and secretary of the New York State Roosevelt Memorial Commission, attended a meeting of that organization held in Albany on March 31. Among the proposals considered was that the memorial take the form of a building for the American Museum, to be known as the Roosevelt Memorial Hall.

Dr. L. C. Sanford, who some weeks ago was elected to the Board of Trustees of the American Museum, has quite recovered from his recent illness and is once again in close touch with the work of the department of ornithology and of the Whitney South Sea Expedition, of which he is chairman.

Dr. Charles-Edward A. Winslow, curator of public health in the American Museum, and professor of public health in Yale University, is still in Europe, discharging his important duties as general medical director of the League of Red Cross Societies. Dr. Winslow writes that in Poland things are progressing well and that the antityphus work in particular, which he went to inspect as a representative of the League of Nations, is being handled with remarkable efficiency.

Notwithstanding his heavy responsibilities in connection with the work of the Red Cross, Dr. Winslow has been visiting certain of the European museums. On page 101 of the January-February issue of Natural History, his impressions are given of the different museums in London having health exhibits. In a more recent letter he comments upon the Natural History Museum of Vienna, to which Dr. W. D. Matthew gives extended consideration on page 188 of the present issue. The collections of that museum impressed Dr. Winslow as being very tastefully arranged, effective use being made of dark backgrounds. "At the Natural History Museum and everywhere else," he writes, "I heard tales of desperate privations." He adds that the situation in Vienna seems almost hopeless and that he is "deeply impressed with the need for making every possible effort to save the rich and artistic culture of that city from destruction."

Dr. Robert Cushman Murphy, associate curator of marine birds, American Museum, has been delivering lectures before a number of different institutions and societies in the United States and Canada. On March 12 he addressed an audience of 3600 in Boston; on March 19 he spoke in Chicago, and on March 26 again in Boston. His addresses have been chiefly on the Peruvian guano industry and bird conservation in South America. On April 16 Dr. Murphy lectured at the University of Toronto regarding "Explorations among the Islands of Peru." On April 21 he delivered an address in Philadelphia at the opening session of the convention of the American Philosophical Society, on "The Influence of the Humboldt Current on the Distribution and Abundance of Marine Life."

Mr. Louis R. Sullivan, assistant curator of physical anthropology in the American Museum, who has been making a study of mixed-blood children and adults in the Hawaiian Islands, has been asked by the Bishop Museum of Honolulu to act as joint representative of that institution and of the American Museum in presenting the results of their coöperative work to the Second International Congress of Eugenics that will be held in New York in September of this year. The Hawaiian Islands—a meeting ground of East and West—constitute a laboratory for the study of the amalgamation of different races and the resulting physical and mental characteristics. The data which Mr. Sullivan has gathered during his sojourn in the Islands should prove of distinct value to the congress.

The Heckscher Museum, at Huntington, Long Island, which was opened to the public last summer, is nearing the completion of its installations. While primarily a museum of fine arts, containing a number of exceedingly valuable canvases, it will house also several choice collections of minerals and of archæological objects. Mr. N. C. Nelson, associate curator of North American archæology in the American Museum, has just completed the installation of the archæological material, which at present consists of a fine series of specimens from Long Island and another equally fine series from Egypt. The Egyptian exhibit includes Palæolithic, Neolithic, and Post-Neolithic types of flint implements, and is the pick of a large collection made a number of years ago by Robert de Rustafjaell. The remainder of this collection, for which there was no room at Huntington, was generously given to the American Museum some months ago. The builder and patron of the museum at Huntington is Mr. August Heckscher, of New York City.

The hall of prehistoric man, which is to replace the old general archæology hall in the southwest pavilion on the second floor of the American Museum, is slowly taking shape. To make the place more attractive, Mr. Albert Operti, of the Museum staff, has been engaged for several weeks in the reproduction of some of the famous palæolithic cave paintings of western Europe, several of which are already in place on the walls.

Formerly the hall was devoted entirely to the archæology of North America north of Mexico—exclusive of the Pueblo and Eskimo culture areas. This exhibit was arranged by states, and as such was very useful for the student of comparative archæology. A somewhat similar but much condensed exhibit will remain in the new hall, one half of which, however, is to be devoted to the archæology of the Old World. The remaining half of the hall will be divided between the two portions of the New World. In other words, the old exhibit will be reduced by about three fourths, and the new hall is to show in succinct form the complexion of human culture throughout the prehistoric world. The main idea underlying the whole exhibition scheme is to be evolution or development. To demonstrate this fact of development, the material will be arranged as far as possible on a chronological basis.

The demonstration of cultural evolution is to be reinforced in the adjoining tower room by an exhibit showing the physical development of man. This will include casts and restorations of all the remarkable skeletal finds of ancient date, as well as reproductions showing the surviving racial types. Some of this material is already in place.

The old saying, "There is nothing new under the sun," may apply in human history and life but certainly does not apply in many branches of science, perhaps least of all in palæontology. In the year 1913 a gigantic and wholly unexpected type of mammal turned up in southwest India and was named *Baluchitherium osborni* by its discoverer, C. Forster Cooper, who is now head of the University Museum of Zoölogy in Cambridge, England. The relationships of this animal were as mysterious as its size was astonishing. Little clew was afforded by the parts preserved except that the ankle bone was that of an odd-toed ungulate and that a portion of the tooth remotely resembled that of a rhinoceros. The second vertebra of the neck was found by Mr. Cooper to be totally different from that of the rhinoceros, and indicated an animal with a very long neck rather like that of the horse, but even longer; the vertebra itself, however, was not horselike. The same animal has now turned up in Turkestan, and the Russian palæontologist Borissyak, has described it under the name *Indricotherium* quite independently of the description of Cooper. Borissyak's published account, curiously enough, is almost the same as Cooper's in extent, and although his paper will diminish the novelty of Cooper's material, it is not less important and interesting. Cooper is now preparing to publish a separate account, rather fully illustrated, in which will appear a translation of Borissyak's paper. The Russian palæontologist agrees with the Cambridge savant in noting a tendency to monodactylism—that is, concentration of the weight of the body on one digit, with a consequent analogy in the wrist toward that of the horse, while it still retains the rhinoceros features in part.

Work on Volume III of Dr. Bashford Dean's *Bibliography of Fishes* is making good progress. All the various addenda to this volume, which has been extended and edited by Dr. E. W. Gudger and indexed by Mr. Arthur Henn, of the department of ichthyology of the American Museum, are completed, and but for the printers' strike at Cambridge, the University Press more than a month ago would have printed the first 338 pages. Doctor Gudger, Mr. Henn, and Miss

Francesca La Monte are all at work on the index. A good part of this has been completed and is in galley proof.

A companion undertaking to the *Bibliography of Fishes* is a *Bibliography of Arms and Armor*, which Dr. Bashford Dean is planning and which will be issued by the Metropolitan Museum of Art.

Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere in the American Museum, and Mr. Herbert Lang, assistant curator of African mammals in the same institution, attended the third annual meeting of the American Society of Mammalogists, which was held at Washington, D. C., on May 2, 3, and 4. On the afternoon of the second day of the meeting Mr. Lang delivered an illustrated address entitled "Life Histories of African Squirrels and Related Groups." On the morning of the third day Mr. Anthony spoke on "Life Zones of Southern Ecuador," accompanying his address with lantern slides. At the business meeting Mr. Anthony was elected a director of the society.

Dr. E. W. Gudger, associate in ichthyology, American Museum, recently gave a lecture before the Biology Club of Princeton University on "The Structures and Habits of Some of the Sharks of Southern Florida."

Visitors to the American Museum are invariably impressed by the remarkable picture of the "Total Eclipse of the Sun as Seen in Baker, Oregon, June, 8, 1918," which was painted by Mr. Howard Russell Butler and presented to the Museum by Mr. Edward D. Adams. This painting has recently been revarnished and retouched so as to enhance the brilliancy of the prominences and of the corona.

The same artist has deposited with the Museum for six months his "Northern Lights, Maine Coast, August, 1919." The picture has been placed in the room on the first floor that has been set apart for Mr. Butler's paintings. "Northern Lights" was given the place of honor in the center of the north wall of Vanderbilt Gallery at the National Academy of Design during the winter exhibit, 1919.

The aurora of August 11, 1919, was perhaps the finest for color and brilliancy ever seen in the vicinity of Ogunquit, Maine. It occurred on the night of the full moon.

"I have painted Bald Head Cliff, which appears in the picture, in moonlight several times," writes Mr. Butler. "One of these won the Carnegie Prize in 1916. I was at work on still another on the night of August 11. The Cliff was to the north of my view point. I had just finished my sketch of the Cliff when (about quarter to ten) this wonderful display suddenly appeared, flooding the heavens with light. Vertical shafts soon rose near the horizon in almost every direction and reached to the zenith, where they united in a complicated weaving. The view northward over the Cliff was particularly fine. Arches appeared from which additional shafts ascended. The colors varied from pale greens to rose. The intense illumination lasted for about twenty minutes.

"I was most fortunate in being in such an excellent position for observation and in having my sketching materials with me; also in having my foreground already completed.

"I was working on dark gray paper with black and white, with no light but that of the moon and the aurora itself. While this enabled me to record the values—lights and shades—for colors I had to rely on formulas, as when painting the eclipse. The following day I painted a *first* picture on which the final picture is based.

"Prof. Frederick Ehrenfeld, of the University of Pennsylvania, was on the Cliff and wrote an article describing this aurora, which appeared in *Science*, August 22, 1919. He did not know of my picture and I did not know of his article till long afterwards."

In addition to its astronomical pictures the American Museum is fortunate in possessing eight paintings of Mt. Pelé of Martinique during the great eruptions of 1902-3, which are excellent examples of the skill of the painter—the famous geographer and intrepid explorer—Angelo Heilprin, of Philadelphia. Some of the sketches for these paintings were made by Professor Heilprin at the imminent risk of his life, for they were done at close range, while the volcano was in action.

Perhaps the most beautiful of them all is that of the Tower of Pelé, showing that remarkable feature at almost the extreme of its development. Professor Heilprin's reputation rests upon his work as a scientist but these paintings, from their delicacy of touch, accuracy of drawing, and feeling for color, reveal him as an artist of talent. Professor Heilprin died in 1907 and the paintings came to the Museum as a memorial gift from his family.

In the Academy Room is a beautiful painting of Mt. Pelé, as it was in March, 1903, at the time of the greatest development of the new cone, which was built up within the crater by the eruptive activity of 1902-3. The spine, which is so prominent in this painting, was the feature left by continued explosions, as the lava welled up from the conduit.

The painting was made by Mr. Charles R. Knight, after photographs taken by Dr. E. O. Hovey, when on an expedition sent by the American Museum for the purpose of studying the phenomena of the great eruptions on the islands of Martinique and St. Vincent, 1902-3.

For purposes of comparison, it would be very desirable to secure a painting showing Mt. Pelé

Courtesy of the American Federation of Arts

NORTHERN LIGHTS, MAINE COAST, AUGUST, 1919
A painting by Howard Russell Butler

as it is now, with the famous spine gone and with the slopes of the mountain partly restored to their former beauty by the advancing tropical vegetation.

In connection with the article (p. 191 of this issue) on "Insects as Food" by Dr. Joseph Bequaert, assistant in Congo zoölogy in the American Museum, the reader will recall that J. Henri Fabre, whose zeal for science sometimes led him to make quaint experiments, once sampled a dish of cicada nymphs. Aristotle had been quoted as extolling their delicious taste and Fabre wanted to see how well justified were his praises. Accompanied by his family he set forth to scour the region about his dwelling. Two hours' search yielded but four nymphs—sufficient, however, to determine whether the dish deserved to be revived for the benefit of the modern epicure. The insects were cooked according to the simplest recipe lest too elaborate preparation spoil their flavor: "a few drops of oil, a pinch of salt, a little onion, and that is all." Everyone had a taste of the titbit, but instead of the toothsome delicacy promised, Fabre and his family found the insects "tough as the devil and anything but succulent."

The experiments of Fabre are paralleled in this country by those of Prof. Charles V. Riley and Dr. L. O. Howard, who in the eighties tested the palatability of the periodical cicada or seventeen-year locust. This insect seemed to give promise of an abundant, even if intermittent, addition to our food supply. A stew was prepared to which the cicada contributed "a distinct and not unpleasant flavor" but the insects themselves were reduced in the process to bits of flabby skin and were not at all palatable. Fried in butter, they remind one, it is said, of shrimps but, adds the account in the *Proceedings of the Entomological Society of Washington* for 1885, "They will never prove a delicacy." In this conclusion the average individual will doubtless concur without feeling impelled to put his conviction to the test. Yet it should be remarked that the Indians ate cicada both before and after the coming of the white man, and that the inherent repulsion which most of us feel toward sampling such an insect is hard to reconcile with our partiality for a scavenger like the lobster, which belongs to the same subkingdom as the insects, or for the ooze-reared oyster, their remoter cousin.

Through the voluntary assistance of several members of the staff, the American Museum has been able to coöperate with the American Red Cross in conducting a recreational and educational experiment this spring at the United States Public Health Hospital at Fox Hills, Staten Island.

Between eleven and twelve hundred men, whose disabilities have been caused directly or indirectly by their services during the Great War, are receiving treatment at the Fox Hills Hospital and the problem of their entertainment is a difficult one. The suggestion that the Museum lecturers attempt its solution was first made in February by Mr. Ralph W. Hees, the Special Representative for Civilian Relief of the Atlantic Division of the Red Cross, who considered it advisable to modify the usual program of vaudeville and motion pictures by introducing something of an instructive nature. Although some doubt was expressed as to the success of Mr. Hees' plan, the coöperation of several members of the Museum staff was secured for a course of five weekly lectures. Dr. G. Clyde Fisher opened the series on March 16 with the motion picture lecture, "How Life Begins."

Effective posters and cartoons were drawn at the Hospital and used to advertise the lectures with the result that five hundred patients, in hospital robes and in uniforms, on crutches and in wheel chairs, came out to hear Doctor Fisher. Attendance has varied at the different lectures, but the representatives from the Museum have always been well received by an audience which would not hesitate to express its real feelings. When the degree of mental receptivity, the restlessness and despondency of these men are taken into consideration, the experiment appears surprisingly successful. The members of the staff who have assisted Mr. Hees in this undertaking are Dr. G. Clyde Fisher, Mr. James P. Chapin, who gave his lecture, "In Central Africa," Miss Ruth E. Crosby, who talked on "Hiawatha," Dr. Robert C. Murphy, discussing "Sea Elephants and Penguins of South Georgia," Mr. George H. Sherwood, who described "Neighbors of the Sea and Land," and Mr. Carl E. Akeley, who entertained the boys with tales of "Roosevelt's Africa." All of these lectures were made graphic by the use of slides and motion pictures.

In connection with the Second International Congress of Eugenics, a eugenics exhibition will be held September 22 to October 22, in the forestry hall of the American Museum of Natural History. Charts, maps, pictures, models, and scientific apparatus are considered proper means for displaying and demonstrating eugenical facts and principles, but any other kind of display material which any particular exhibitor desires to offer will be most carefully considered. The exhibits should be of such a nature that the man of ordinary intelligence and education, but without special scientific training, may readily comprehend and appreciate them.

All exhibits should be started in time to reach the American Museum on or before July 15, 1921. They are to be labeled: Dr. H. H. Laughlin, Eugenics Congress, American Museum of Natural History, New York City.

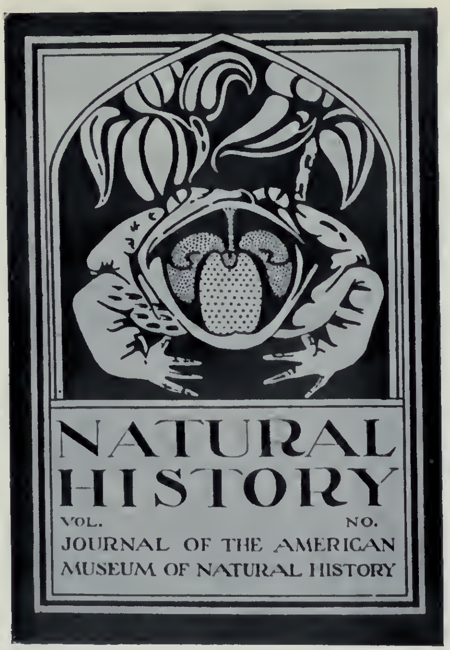
When Natural History was considering the replacement of its former cover by a new one, it suggested to the authorities at the Washington Irving High School, 40 Irving Place, New York City, the desirability of having a contest among the students in the industrial art division of that school. The demonstrated ability of these art students gave assurance that an unusually attractive series of cover designs would be forthcoming. A first prize, a second prize, and seven general prizes were offered. The school took up the suggestion with enthusiasm and the splendid series of sixty-two designs that were submitted for adjudication justified the highest hopes that Natural History had entertained. The competition revealed not only talent of a high degree but unusual skill in treating decoratively natural subjects without sacrifice of, on the contrary with emphasis upon, their essential character.

Three classes—those of the Misses Marie E. Gurnee, Florence Newcomb, and Bertha S. Shepard—participated in this contest, under the general direction of Mrs. Samuel T. R. Cheney, chairman of the art department of Washington Irving High School. The ages of the girls taking part in this contest ranged from fifteen to eighteen years.

Certain recommendations or guiding principles were adopted: the designs, including figures, were to be relevant to the title, Natural History; a specified wording was to appear on the cover; the stock for the cover might be any color but must be readily obtainable in the market. Preference was expressed for one color ink but provision was made for an additional color if the artist found it desirable. Above all things the designers were urged to express their own ideas.

A number of visits were made by the contestants to the Museum, independently as well as under the supervision of their teachers, for the purpose of studying subject and composition, of correcting the drawings made in the class room, and of adding the necessary details.

The full series of designs has been placed on exhibition in the hall of forestry, on the ground floor of the Museum.



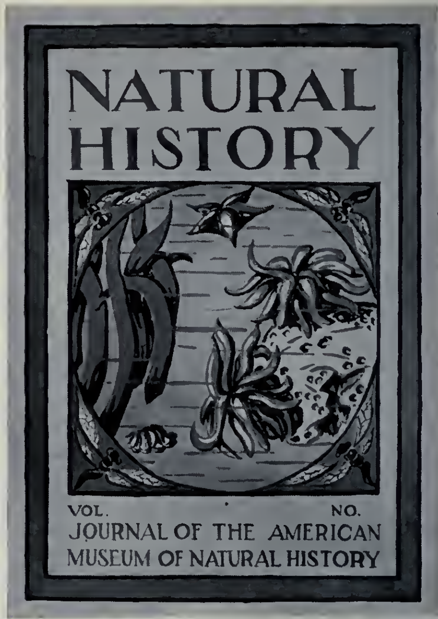
To this cover design by Bertha N. Jaffe was awarded the first prize in the competition recently instituted by Natural History. Other prize winning designs are shown on the two pages following

For the third successive time an ornithologist has been awarded the Daniel Giraud Elliot Gold Medal. The two earlier recipients of this distinction, which is bestowed upon the author of such paper, essay, or other work on some branch of zoölogy or palæontology published during the year, as is in the opinion of the judges most meritorious and worthy of honor, were Dr. Frank M. Chapman for his "Distribution of Bird-Life in Columbia," which appeared in 1917, and Dr. William Beebe, for the first volume of his "Monograph of Pheasants," published in 1918.

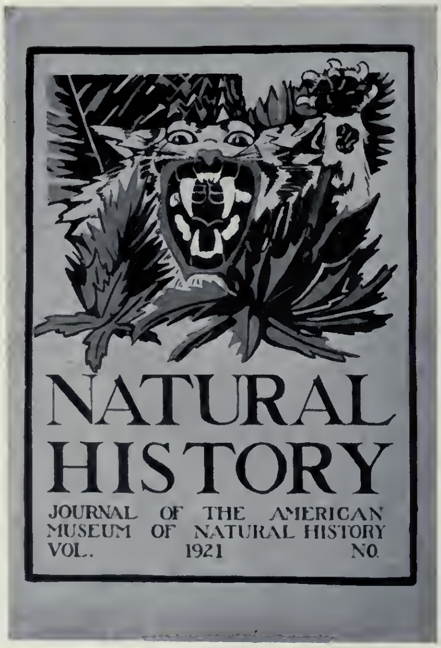
The present recipient is Mr. Robert Ridgway, curator of the Division of Birds in the United States National Museum, and the award is made in recognition of the eighth volume of *The Birds of Middle and North America*, which appeared in 1919. This monumental work, which will be complete in ten volumes, already totals 6800 pages, defines nearly 900 genera, and describes more than 3000 species and subspecies. Professor Henry Fairfield Osborn, in his address as chairman of the Elliot Medal Committee, referred to Mr. Ridgway's work as one which "in method, comprehensiveness, and accuracy, as well as in volume, has never been surpassed in the annals of ornithology."

On April 9 there gathered at the American Museum the representatives of three societies—the American Association for the Advancement of Science, the National Academy of Sciences, and the National Research Council. The purpose of the meeting was to form a joint committee on conservation. One of the aims will be to educate the public to the importance of safeguarding our resources, in many cases already depleted too greatly by their prodigal use in the past. All natural resources—forests, coal, oil, fisheries, and wild animals—will claim the attention of the committee. Preliminary steps to effect organization were taken and methods discussed for the raising of the necessary funds.

— By
Frances Gessner



By
Florence Breiner



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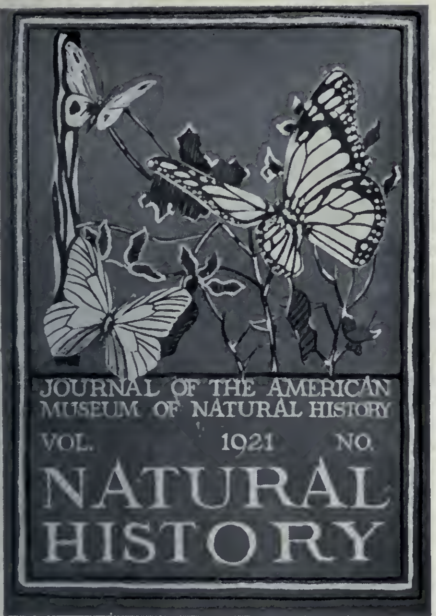
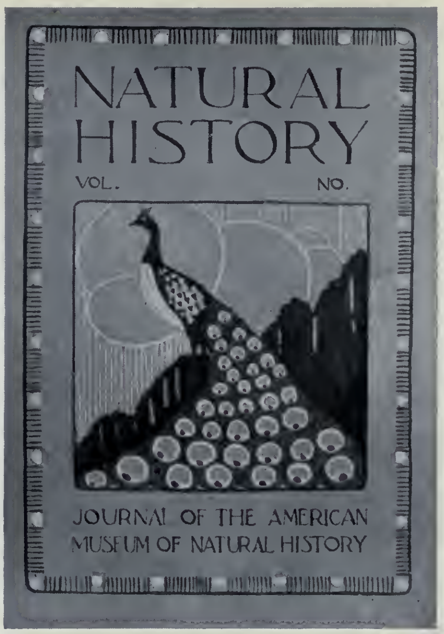
E. De Takacs

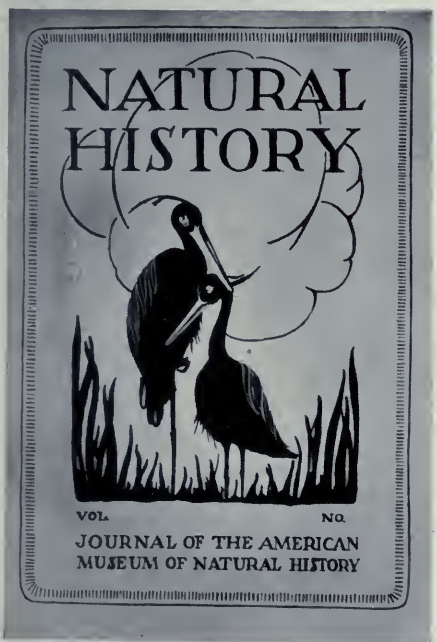
By
Elsie Willheim



By
Anne Bailey



By
M. Isaacs



By
Ideme E. McAleese

By
Miss Tonjes

Among those present were Messrs. John C. Merriam, Isaiah Bowman, J. McKeen Cattell, John M. Clarke, H. S. Graves, Vernon Kellogg, C. E. McClung, Barrington Moore, and V. E. Shelford.

Few deaths have stirred scientific circles more profoundly than did that of John Daniel, the little gorilla, late of Ringling Brothers Circus, who departed this life on the morning of April 18, and the old-time conundrum as to who was to have the skates of the little boy who was drowned while skating sunk into insignificance before the query—who was to have the body of the gorilla.

One anatomist desired his brain, another his skull, another the feet, and still another the viscera, and an absent member of the American Museum staff was interested in the structure of the hair.

The public was eager to see him mounted and so naturally were Ringling Brothers, to whom the American Museum was already under obligations for important animals that, reposing in the study series, made no show.

Fortunately, due to the foresight of Dr. William K. Gregory, curator of comparative anatomy, the American Museum had put in a plea for John, should any unforeseen misfortune befall him, little thinking that calamity was so near. By the mutual exercise of a little self-denial, everybody was made more or less happy and the remains of poor John are being carefully studied by the group of experts referred to in the note that follows. Later it is hoped that he may, phœnix-like, rise from his (metaphorical) ashes and take his place in the hall of primates at the American Museum with his fellow great apes.

We are under obligations to Ringling Brothers for so courteously and promptly turning John over to the Museum with "no strings attached," so that he might be cared for without delay, and it may be said that already very interesting results have been obtained from the examination of details of his structure regarding the relationship of the gorilla to his more or less distant relative, man.

It is small compensation for the loss of so rare and costly an animal that he is of great interest from a scientific standpoint, but it is at least a satisfaction to know that the utmost use was made of the opportunity offered to study a fresh gorilla in New York City.

After the removal of the hide of the gorilla, which will be mounted by Mr. Frederick A. Blaschke, of the staff of the American Museum, the body was dissected by Dr. George S. Huntington, professor of anatomy at the College of Physicians and Surgeons, and by his assistants. The brain was handed over to Dr. Frederick Tilney, professor of neurology and neuro-anatomy at the College of Physicians and Surgeons, who is already well known for his researches on the anatomy of the brains of the great apes and of man. Dr. Dudley J. Morton, an orthopædist, and Dr. William K. Gregory, curator of comparative anatomy in the American Museum, are studying the bones, muscles, tendons, and ligaments of the feet. Dr. Milo S. Hellman, an authority on the dentition and dental arches of primates and of men, will report on the dentition. Small strips of the skin and hair are being preserved for Mr. Louis R. Sullivan, assistant curator of physical anthropology in the American Museum. Casts of the head and face were made for Prof. J. Howard McGregor, research associate in human anatomy in the American Museum, well known for his restorations of primitive races of man. Several other anatomists will also take part in the investigation.

Preliminary reports indicate a number of interesting new or little known features of the anatomy. The appendix is curiously human in type, and the same is true of the kidneys, brain, and other organs. Impressions of the sole of the foot will be studied by Prof. H. H. Wilder, the Galton Society expert on palms and soles. The general appearance of the footprint, although more human than that of the other great apes, has the great toe set off from the other four toes instead of being parallel with them as in man. The delicate ridges of the sole and of the toes differ in many details from those of the ordinary human types, but Doctor Wilder has recorded a single case of a human footprint which has many characteristics of the chimpanzee, and his examination of this gorilla footprint will be awaited with interest.

Prof. J. Howard McGregor, of Columbia University, research associate in human anatomy in the American Museum, left the Museum on May 12 on a special mission for the American Museum of Natural History and the Galton Society for the Study of the Evolution of Man. The trustees of the Museum have appropriated a sum toward the expenses of his tour of research among the museums and private collections of England, France, Belgium, Germany, Austria, and Bohemia, which contain all that has thus far been discovered of our human and prehuman ancestors. Professor McGregor carries letters to Doctor Duckworth of Cambridge, to Professor Sollas of Oxford, to Prof. G. Elliot Smith of the University of London, to Dr. Arthur Smith Woodward of the British Museum (Natural History), and to Dr. Arthur Keith of the Royal College of Surgeons in London. The most interesting early remains in Great Britain are those of the Piltdown man, which are preserved with great sanctity in the British Museum, and the Gibraltar skull in the Royal College of Surgeons. In Belgium Professor McGregor expects to study the famous

Neanderthal skeletons of Spy. He carries letters to Professors Max L'Hoest, Charles Fraipont, and J. Sèrvais, of the University of Liége. In Germany he will visit Prof. Hans Lehner, director of the Provinzial Museum in Bonn, where is preserved the original Neanderthal skeleton; in Heidelberg he hopes to examine the Mauer jaw, now in the custodianship of Dr. Wilhelm Salomon of the University of Heidelberg.

The chief center of Palæolithic remains is in the various museums and institutions of France. Here Professor McGregor looks to the friendly aid of Prof. Marcellin Boule of the Museum of Natural History, who is also director of the Institut de Paléontologie Humaine; to Dr. René Verneau, monographer of the skeletons of the Crô-Magnon and Grimaldi races; to Dr. Henri Martin; and to the distinguished archæologists, L'Abbé Henri Breuil and Professor Doctor Capitan, of Paris, and Professor Cartailhac of the University of Toulouse. In Holland Professor McGregor will visit Prof. E. Dubois, director of the Laboratory of Mineralogy and Geology of the University of Amsterdam, and examine the remains of *Pithecanthropus*. If time permits, he will visit Bohemia, where, besides studying materials in the University of Prague, he will examine the remarkable collections of skeletons from Predmost brought together by the late Professor Maška.

The main object of Professor McGregor's tour is to examine and compare the remains of the Neanderthal race in various museums with a view to making complete restorations of the skeletons and models of the Neanderthal figure for the hall of the Age of Man in the American Museum. For this purpose he will secure as many casts and reproductions of these precious remains as possible, supplementing these portable materials by very careful observations and measurements so as to distinguish as far as possible the true racial characters of the Neanderthal skeleton from the characters due to age, to sex, to different environmental and geographic conditions. These studies will supplement and continue those of Prof. Marcellin Boule in his masterly monograph on the skeletal characters of the neanderthaloids of France.

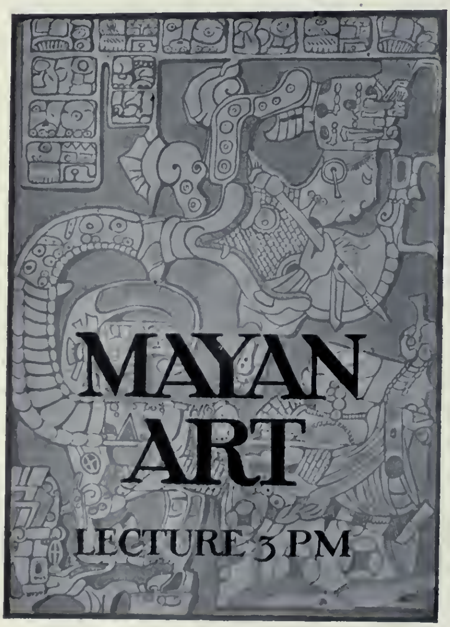
In connection with this tour President Henry Fairfield Osborn of the American Museum is addressing a circular letter to the heads of the above and other similar institutions on the continent of Europe, announcing that the research materials in the American Museum collections are now open to the freest examination and study by accredited students of palæontology, anthropology, and comparative anatomy from all parts of the world, and that the Museum desires to secure equal facilities in the museums of other countries. The best means of reëstablishing helpful relations among the nations of the world is by opening these international treasures to all duly accredited students and investigators. It is understood that every investigator comes with a guarantee of his personal character and integrity and also of scientific attainment sufficient to enable him to make proper use of the materials extended to him. It is further understood that material which has not been monographed or described is made available by courtesy and that no advantage will be taken by the prior description of unpublished material. It is also understood that all materials that have been monographed and described are freely open to the students of the world. This is what our great national and international museums are created for.

A series of five lectures arranged by the American Museum for the Boy Scouts of the metropolis and delivered by members of the staff was completed on May 14. Dr. G. Clyde Fisher opened the series on March 19 with an account of "Wild Animals Near Home." On April 2 Mr. Herbert P. Whitlock spoke on "Water in the Atmosphere," which was followed on April 16 by Mr. James P. Chapin's "Bird Study for Scouts." "Scouting for Insects" was the subject of Dr. Frank E. Lutz' address on April 30. The completing lecture was given by Dr. Chester A. Reeds on "Geology in and about New York City."

The Reverend Harry R. Caldwell, who rendered such practical assistance to Mr. Andrews on the First and Second Asiatic Expeditions of the American Museum, has sent to that institution from China a collection of three hundred and fifty mammals, including an exceptionally fine tiger skin. Mr. Caldwell recently returned to his duties at the Methodist Episcopal Church Mission in Yenping, Fukien, China. In February Mr. Caldwell started on a five weeks' itinerary through his conference, expecting to walk nearly three hundred and fifty miles. Traveling in Yenping is necessarily done on foot except for an occasional boat trip and such long walking expeditions afford splendid opportunities for collecting. Mr. Caldwell, who is a remarkably successful trapper and accurate marksman, always carries his butterfly net and rifle with him. His avocation and his profession supplement each other still further inasmuch as the missionary's ability to rid a neighborhood of the tigers lurking in its ravines has won for him the gratitude of the villagers. It is Mr. Caldwell's hope to secure for the American Museum this summer one of the large badgers to be found on the rolling uplands of Yenping.

An interesting series of posters devoted to the red man and his arts has recently been on exhibition in the hall of the Southwest Indians on the

A representation of a *katcina*, or supernatural being, revered by the Hopi Indians of the Southwest. To children are given wooden figures of this kind, which are both playtoy and means of instruction, familiarizing the little ones in time with the many gods of the Hopi pantheon



The serpent, often represented with a human head projecting from its mouth, is a favorite theme of Mayan art. At first of totemic significance, the snake became in time a sign or attribute of divinity in general

ground floor of the American Museum. These posters, made by students in the second year advertising class at the New York School of Fine and Applied Art, and based to a large extent on material in the collections of the American Museum, represent a variety of different subjects including designs borrowed from Mayan art, Hopi katcinas, masks of the false-face society of the Iroquois. and the implements and arts of the West Coast Indians and of the Plains Indians. The artistic effect of these posters is as fine as the purpose is commendable of familiarizing the public in this way with the customs and achievements of the aborigines. Some of the competing students are ex-service men, working under the direction of the Federal Vocational Board.

A CORRESPONDENT, Major J. R. Whitaker, writing from Grand Lake, Newfoundland, calls attention to a fact which some of the zoölogists of the American Museum have overlooked, namely, that the great mural in the hall of the Age of Man representing the migration of the reindeer and the mammoth cannot be described as of early spring, because the reindeer are still carrying their antlers. In response to an inquiry as to what time the Labrador and Newfoundland reindeer drop their antlers Major Whitaker writes (April 26, 1921) as follows:

"The fully mature bulls shed their antlers usually between November 5 and 15 and the younger ones a little later. A three-year-old stag will sometimes carry his until about Dec. 15, but that is late. A pricket will often not drop his until towards the end of December, and the cows carry theirs until well on in April. I once saw a cow with an 18-point head on April 20. This, of course, was an exceptional head for a female; however, I have heard of one being killed here with thirty-six points.

"About fifteen years ago there were quite a lot of caribou in this country. The main migration passes close to my place and I used to see large numbers go by every fall. We used to think it a very poor day if we did not see from one hundred to four or five hundred moving over some large tundra. The spring migration is a much more leisurely affair. The stags and does with no fawns go north directly the snow melts. Many does remain on the high barrens south of the lake until they have their young, then move north. These you see passing up to about July 20. There are quite a number of caribou which live in the southern part of the island and never come north at all."

It will be necessary, therefore, to change the legend on this mural to "A Late Autumn Migration of the Reindeer and Mammoth along the River Somme," because there is no question that the reindeer in Pleistocene times shed their antlers exactly at the same season of the year as they do now. This error, now corrected by Prof. Henry Fairfield Osborn, is an instance of how easy it is to slip into a seasonal anachronism and how difficult it is to assemble all the facts for the restoration of conditions in the remote past. Each of these murals is to be regarded as a trial hypothesis subject to development and correction from time to time as fresh discoveries are made and learned criticism and suggestions like those of Major Whitaker are received.

The mural representing the early Neolithic stag hunters, at the western end of the hall, has by way of encouragement, received some recent confirmation in one very important particular, namely, the racial characters of the men of the Campignian Age. In designing this mural Professor Osborn ventured to assign the Campignian culture of northern France to early members of the fair-haired northern race arriving in northern Europe. Marcellin Boule, in his recent work, *Les Hommes Fossiles*, partly assents to this opinion. The veteran Swedish archæologist, Montelius, writing in the *Antiquarian*, traces the Campignian culture into Denmark and possibly into Sweden and expresses the very positive opinion that these people were the direct ancestors of modern Scandinavians and, consequently, of the Nordic race.

These murals not only have been seen by thousands of visitors since they were begun four years ago, but they are now sending their information all over the world through the pages of *L'Illustration*, London *Illustrated News*, New York *Times*, *Midweek Pictorial*, and *Nature*. In the issue of the last mentioned weekly for April 21, 1921, Professor Osborn has redescribed the hall of the Age of Man as it now appears. Director F. A. Lucas is issuing a special *Guide Leaflet* descriptive of this hall, based on the article which appeared in the May–June, 1920, number of NATURAL HISTORY.

In the meantime the Neanderthal group has been completed by Mr. Charles R. Knight and is placed over the east doorway. To the right of this are four spaces for murals, which will be devoted entirely to the fauna of the Rancho-la-Brea, the famous tar pools of southern California, including especially the sloths, the imperial mammoths, the saber-toothed tigers, and the wolf of the period in the first large mural of the eastern wall. In studying the mammals for this composition the Museum is greatly aided by the personal direction of Prof. John C. Merriam, to whom the world is principally indebted for our knowledge of this wonderful fauna. It is planned to complete this mural during the present year.

MR. ROLLO H. BECK, leader of the Whitney South Sea Expedition, has recently sent to the American Museum two shipments of specimens from the field. One of these, comprising the birds collected at Tahiti, has not yet arrived, but the other, representing about 340 skins and a series of nests and eggs from Christmas Island and the Marquesas Archipelago, reached the Museum in April, together with a set of photographs from the same localities. This material proves to be of high scientific value and for the most part the species are new to museum collections in the United States.

The land birds number several species which are rapidly being exterminated by the mongoose and by other agencies in Polynesia, and which, therefore, it might not be possible to obtain a few years hence. Among them are two species of fruit pigeons, several kinds of Old World flycatchers, including the warbler which is peculiar to Christmas Island, as well as kingfishers, swifts, etc.

The water birds include three species of boobies, two of tropic birds, one of the man-o'-war bird, seven of terns, five of petrels, and many more. Among them are several quite new to the collections of the American Museum of Natural History. Particularly noteworthy are the series of a rare white-breasted petrel, known as *Fregetta albigularis*, splendid series of the ghost tern (*Gygis*), the extremely rare blue ternlet (*Procelsterna*), and four breeding examples of a species of man-o'-war bird described by Gmelin in the eighteenth century but not previously represented in America except by one or two immature examples. All these, as well as the specimens of the red-tailed tropic bird—one of the most beautiful of all sea birds—include examples in all stages of growth from newly hatched chicks to fully mature birds, and it is almost needless to add that in quality and exactness of the accompanying scientific data, the specimens are of the usual standard of the material collected by Mr. Beck. They should form the basis of important work in both ornithological classification and zoögeography.

The latest word from Mr. Beck is contained in two letters dated March 17, the day before he was to start for the Austral Islands and Rapa, to be gone about a month. This phase of his work ought to prove especially worth while, for it will take him south of the region of South Equatorial Drift into a zone where winds, ocean currents, and the temperature of the waters are all different from those of the region in which he has been working. The fauna should also show a corresponding difference, and we may confidently expect a shipment of specimens of equal excellence after his return.

THE sixth annual meeting of the American Society of Ichthyologists and Herpetologists was held Tuesday, March 8, 1921, at the Academy of Natural Sciences, Philadelphia, Pennsylvania. Dr. E. W. Gudger and Mr. Henn of the department of ichthyology, and Mr. G. K. Noble and Mr. Camp, of the department of herpetology represented the American Museum of Natural History. Among the interesting papers presented were: "Snakes Swallowing Their Young in Ancient Fable," by F. G. Peck; "Notes on the Habits and Morphology of the Nurse Shark," by Dr. E. W. Gudger; "Some Notes on Amphibians Collected in China in 1920," by H. H. Wilder (presented by Miss L. Smith); "Some Remarks on a New Method in the Study of Bone and Cartilage as Applied to Herpetology," by G. K. Noble; "Some Observations on Local Amphibians and Reptiles," by J. F. Street; and "The Fishes of Butler County, Pennsylvania," by H. W. Fowler.

The next meeting of the Society is to be held in conjunction with the American Society of Mammalogists, which meets with the American Society of Ornithologists. It will be the first occasion on which all groups of vertebrate zoölogists will meet together.

The Irwin Expedition of Indiana University, consisting of Dr. C. H. Eigenmann, Miss Adele Eigenmann, and Dr. William Ray Allen, devoted the period from June, 1918, to June, 1919, in part to the collecting of fishes in the highlands of Peru. In May, 1920, Doctor Allen started, without English-speaking associates, on the Centennial Expedition of Indiana University for the purpose of extending the survey of the fish fauna to the lower levels of the rivers of eastern Peru. The plan pursued by the latter expedition was to collect exhaustively from a few representative localities in the river basins, for the most part within the great Department of Loreto.

In addition to shorter sojourns and trips, ten days were spent at Puerto Bermudez, and a month in the vicinity of Contamana on the lower Ucayali; a fortnight was devoted to the Puinahua and Pacaya, and another two weeks to the region of the Iquitos. A cruise a month in duration was made along the upper Marañon from Iquitos to the Pongo de Manseriche, and along the tributaries, Tigre and Morona. An examination of the lower Huallaga was made possible by a sojourn of three weeks in the region of Yurimaguas.

A large number of families of fishes and of aquatic mammals are represented in the waters of this region, many species of fish from the lower Amazon becoming distributed to the very foot of the Andes and throughout oriental Peru.

Interesting news has been received in connection with the excavations that are being made at Aztec, New Mexico, by Mr. Earl H. Morris with the aid of the Archer M. Huntington Fund. It has been known for a long time that the interior court of this ruin contained a great kiva, more than forty feet in diameter. This kiva has now been excavated and proves to be a very interesting structure indeed. It has a tier of rooms around it in circular formation, thus resembling a wheel. The most interesting point, however, is that underneath this kiva was an old structure apparently belonging to the first building at Aztec. From this were taken about 200 pounds of pottery fragments, from which it will be possible to reconstruct thirty or more complete vessels. The impressive thing about this pottery is that it is precisely of Pueblo Bonito type. Not only is the common run of pottery found at Pueblo Bonito represented in this collection, but from the débris were taken two effigy vessels, one representing a deer and the other a seated hunchbacked figure similar to those found at Pueblo Bonito by Mr. George H. Pepper. The discovery of this pottery, therefore, quite clears up the chronology of this ruin, showing without a doubt that it was established by people from Pueblo Bonito or the neighboring ruins and is, accordingly, of later origin than the ruins in the Chaco Cañon.

Mr. Earl H. Morris has under preparation a full report on this most recent find, which will be ready for publication shortly.

The large collection of pottery obtained last year from the neighboring site on the Navajo Reservation is now on its way to the American Museum and arrangements have been made for the excavation of the same site. There are good reasons for expecting a very large collection.

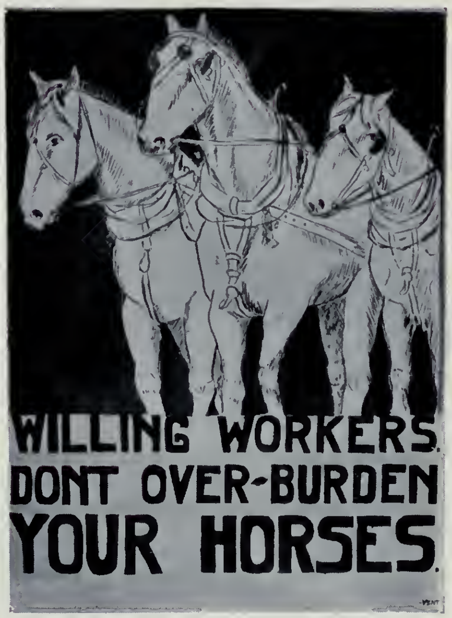
The Founder's Medal of the Royal Geographical Society has been awarded to Mr. Vilhjalmur Stefansson "for his distinguished services to the Dominion of Canada in the exploration of the Arctic Ocean," and the Patron's Medal to General Bourgeois, Senator for Alsace "for his long and eminent services to geography and geodesy." At the foundation of the Royal Geographical Society, William IV granted an annual donation of fifty guineas as a premium for the encouragment and promotion of geographical science and discovery. From 1832–35 those honored with the award received the sum in money; since 1836, however, gold medals have usually, though not invariably, been bestowed instead. The Founder's Medal bears on the obverse side the portrait of the Founder, King William IV; the Patron's Medal has impressed upon it the portrait of the reigning monarch.

Other awards made at the same time were as follows: the Murchison grant to Commandant Maury, for his surveys in the Belgian Congo; the Bach grant to Miss Marian Newbigin, in recognition of her contributions to geography, especially to the geography of the Balkans; the Cuthbert Peek grant to Captain J. B. L. Noel, for his reconnaissance of the eastern approaches of Mount Everest and other geographical accomplishments; and the Gill Memorial to Lieutenant Colonel M. N. MacLeod, R.E., for his contribution to the theory of survey from air photographs.

On the third floor of the American Museum there has recently been on exhibition a series of posters urging humane treatment of animals. The posters are the work of pupils of the elementary schools of Greater New York and were submitted in the Humane Education Poster Contest held under the auspices of the New York Woman's League for Animals, in which the late Mrs. James Speyer took a keen interest. The prize-winning drawings and many, too, which failed to achieve that distinction, are interesting not only from the standpoint of execution but also from that of their conception, which has a freshness often lacking in the more labored efforts of adult draftsmen. All of the posters express that love for dumb brutes which is such a pleasing trait in children.

The poster by Fred Fountain, grade 4 B, Public School 94, Queens, to which was awarded the first prize in class I, is an original assemblage of colored cut-outs pasted on a paper background. It represents a horse and a turkey separated from each other by a fence, with a fringe of grass in the foreground. The first prize in class II was won by a pupil named Aventiniglio, in grade 8 A, Public School 40, Manhattan. The Subject is "Willing Workers" and represents three horses pulling abreast. A pleasing fancy is revealed in the sketch by Ethel Plate "Love All Pets," which depicts a rabbit and a bird seated at opposite ends of a neatly spread table, the one with a carrot before him, the other with a bowl. A drawing of a caged rhinoceros by David Cohen, Public School 175, Brooklyn, carries the caption, "How would you like to be caged far away from home?"

An effective poster, with a striking caption, that arrested the attention of visitors to the recent exhibit.



To this poster was awarded the first prize in class II of the Humane Education Poster Contest. Design by a pupil named Aventiniglio

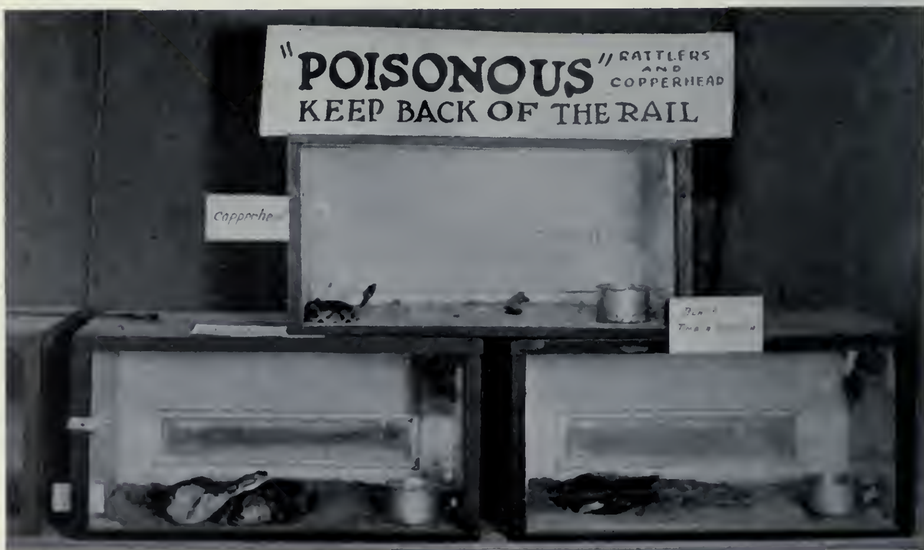
John Burroughs' son, Julian Burroughs, and Dr. Clara Barrus, literary executor of the John Burroughs estate, have given their endorsement to a plan for a Memorial Association to take over and care for Slabsides, Riverby, and Woodchuck Lodge (the three places most closely associated with the life and writings of the poet-naturalist) and the Memorial Field, where the mortal remains of Burroughs lie buried.

A call for a meeting of Burroughs' friends, for the purpose of selecting a Memorial Committee, was sent out by Prof. Henry Fairfield Osborn, Dr. Frank M. Chapman, Dr. G. Clyde Fisher, Mr. Carl E. Akeley—all of the American Museum—and Mr. Hamlin Garland, Dr. Clara Barrus, Mr. Kermit Roosevelt, Mr. Irving Bacheller, Mr. W. Ormiston Roy, and Mr. Edwin Markham.

The meeting was held at the American Museum on April 15, and was attended by a large number of Burroughs' friends. On resolution of Mr. Garland, a committee of nine was chosen to have the organization incorporated as a Memorial Association, devoted to the purpose of acquiring and preserving the places associated with the memory of Burroughs and of promoting and extending his spirit and teachings.

The members of the committee are: Doctor Chapman, chairman; Dr. G. Clyde Fisher, Mr. Hamlin Garland, Mrs. Henry Ford, Mrs. Thomas A. Edison, Judge A. T. Clearwater, Mr. Kermit Roosevelt, Mr. Carl E. Akeley, and

Interior of a natural history museum established through the coöperative effort of boys enrolled in the summer camp in the Interstate Park. On the table to the left are specimens of their taxidermy



An interesting section of the museum was that devoted to live snakes, including not a few that had to be labeled "handle with care"

Mr. W. Ormiston Roy. The organization, now incorporated, is ready to begin active work.

The memory of John Burroughs can be honored in no more fitting way than by assuring to posterity the kind of influences that were so deep an inspiration to him. Of happy significance, therefore, is the memorial offered the great naturalist by the Conservation Commission of New York State in coöperation with the Raymond Riordan School, located at Highland, Ulster County, New York. By the boys of this school there will be planted this year on state lands near Big Indian in the Catskills, not far from the place where Burroughs was born, no less than ten thousand trees, which will constitute the nucleus of a forest that will be enlarged by additional plantings year after year. The work was begun by the boys on April 17.

How a museum may be built up through the coöperative effort, wisely directed, of a group of youngsters is illustrated by the Boy Scout Museum established at Kanohwahke Lakes, Interstate Park, New York. On the three lakes with contiguous shore line that constitute this group are located eighteen camps, each on an average composed of one hundred boys. The problem of interesting the boys, whose stay in many cases is limited to two weeks, in natural history, early presented itself to the directors in charge. They hit upon the happy plan of building up a natural history museum by enlisting the boys to collect the specimens for the exhibits. Such a suggestion was a great incentive and served the double purpose of creating a center for the study of nature and at the same time of teaching natural history in the course of its establishment. Real zest developed when the boys realized that they were building a museum which actually belonged to them and which was expanding due to their individual and united effort.

The leaders in this movement were selected from boys whose stay in camp was to extend throughout the summer. These in turn brought into the group the boys who were to do the field collecting. A small library was acquired and the end of the season witnessed an exhibit of which the boys had every reason to be proud. With such good results was the experiment attended that those arriving late in the summer, when the museum was in full development, were constantly asking for leave to visit it, and many earned points for their camp emblem by study of the specimens in the museum as well as by field observations.

A very creditable mineral collection was made, the dumps of the old iron mines providing a valuable source of supply.

The American Museum interested itself in the undertaking and loaned a collection of the birds of the park and other nature exhibits in cases. The New York Zoölogical Society loaned a good collection of snakes. With these acquisitions the central pavilion took on a real museum atmosphere.

The coming season at Kanohwahke Lakes promises to be one of great activity, supported financially by the Interstate Park Commission and by the Boy Scout camps. The sum secured from these sources will make possible a permanent scientific staff of at least four experts in the natural sciences. On the evenings of Wednesday and Saturday of each week visiting scientists will give the boys informal talks. Special hikes will also be organized under these auspices. In addition six young naturalists and certain Boy Scouts who have shown special proficiency in nature study and in the instruction of others will help in the work.

The period of May 22-28 was set apart by proclamation of the President of the United States as Forest Protection Week, during which citizens were requested to do their utmost to bring before the people at large the serious effects of the present unnecessary waste by forest fires, and the need of individual and collective efforts in conserving the natural resources of America. Thirty-three thousand or more forest fires occur each year, involving a loss of approximately $20,000,000 and about 12,500,000 acres of timberland. A large percentage of these fires can be prevented through the exercise of greater care and vigilance.

The National Academy of Arts and Letters, of which John Burroughs was an honored member, will hold a John Burroughs memorial meeting on the afternoon of Tuesday, November twenty-second. This meeting will be similar to those held in honor of William Dean Howells and other members of the Academy who have recently passed away. Professor William M. Sloane, president of the Academy, has invited President Henry Fairfield Osborn of the American Museum, to deliver one of the addresses on the occasion. The other speakers selected are Dr. Frank M. Chapman, curator of ornithology, and Messrs. Bliss Perry and Hamlin Garland.

Mr. David Charles Davies succeeds the late Dr. Frederick Skiff as director of the Field Museum, Chicago. Mr. Davies has been connected with the museum for no less than twenty-seven years and has worked in close association with Doctor Skiff, whose assistant he was. He superintended the removal of the museum exhibits from the building in Jackson Park to their imposing new quarters in Grant Park.

Mr. J. Reid Moir, of Ipswich, England, has recently made a collection in book form of his writings on pre-Palæolithic man, to which he has added some new material. He takes up the much discussed question of the evidence of human handiwork on the pre-Palæolithic flints—the so-called eoliths—which have been dug up in great numbers in England. Mr. Moir endeavors to show by chipping experiments of his own that these flints could not have received their present form through accidental fracture or pressure.

Mr. Moir, it will be recalled, has been active for more than a decade in the discovery and discussion of evidence bearing on the "Eolithic problem" or, in other words, on the question of the existence and activity of man during Tertiary times. His name is especially linked with the supposedly intentional type of flint implement known as the rostro-carinate or "eagle beak," found at the base of the Red Crag formation of Pliocene date, in Suffolk. The authenticity of this implement is championed by no less a personage than Sir Ray Lankester, and if this opinion should prove correct, the find is the oldest surviving evidence we have of the intelligent expression of the human mind. Mr. Moir has also discovered in and about Ipswich a human skeleton beneath the chalky bowlder clay, as well as several open Aurignacian and Magdalenian floors with hearths and worked flints. He was one of the authorities to pass judgment on the supposed implements found with the Piltdown man. These he distinguished as Eolithic and pre-Chellean.—N. C. N.

THE disastrous famine that is today decimating the Chinese provinces of Honan, Shensi, and Chihli, is due, according to foresters of the United States Department of Agriculture, to the wanton destruction of the forests and the failure to take any steps toward reforestation. Where formerly tree-covered mountains absorbed much of the annual rainfall and regulated the stream flow, so that there was throughout the year a steady supply of clear water, today a treeless, shrubless, and even grassless soil offers no resistance to the roaring torrents which in times of rain replace the shrunken streams of muddy water that trickle down through the rest of the year. Crops cannot grow under conditions such as these and people starve.

Once upon a time the Hwang or Yellow River, which drains a large part of the famine-stricken region, flowed through a fertile valley, the hills adjacent to which were well wooded. Today the river is for most of the year a moving quicksand, its water reduced to a minimum. When the floods come, the aspect of the land is completely changed. In 1886 this river, which is known as "China's Sorrow," flooded about 20,000 square miles of territory, sweeping away thousands of villages and towns and taking a toll of 2,000,000 lives.

The plight of China may serve as a warning to the rest of the world. A country that squanders its natural resources is ultimately doomed to decadence.

THE Hon. Herbert Hoover, Secretary of Commerce, invited investigators, administrative officers, and all other interested persons to meet June 8-10 at the Fisheries Biological Station, Fairport, Iowa, for a conference regarding the conservation of resources of interior waters and the ways and means of applying science more effectively to their preservation and increase. With the growth of population and the development of industrial communities along the rivers and lakes of our country, the public waters have become increasingly unfit as places of abode for the fish and other forms of life to which in the past they offered sanctuary. To ascertain whether such a condition of things is avoidable and, if so, what steps can be taken to effect improvement, was the purpose of the conference.

The gathering provided for full and general discussion, which might be from the points of view of coöperation in scientific research, the training of men to prosecute investigations, the education of the public, the reconciliation of conflicting group interests, the union of effort to secure adoption of appropriate conservation measures, and the possibility of periodic gatherings for promotion of harmonious action.

"NATURAL HISTORY"

THE JOURNAL OF THE AMERICAN MUSEUM

RETROSPECT AND PROSPECT

NATURAL HISTORY, entering its twenty-first year, is coming of age. During 1921 it will appear as a bimonthly, beginning with the issue of January-February. It will continue to represent exploration, all branches of natural history, anthropology, nature education, and the ever vital cause of the conservation of the beauty of the world's forests, flowers, and animal life.

Among the articles in train for early publication are "Rancho-la-Brea" and "The Restoration of Extinct Animals" by Henry Fairfield Osborn; "Experiences in a Volcano Observatory" by T. A. Jaggar, Jr., of the Hawaiian Volcano Observatory and "The Great Extinct Volcano, Haleakala," by E. O. Hovey, curator of geology and invertebrate palæontology, American Museum, both articles accompanied by impressive illustrations; "The Cordilleran Ice Sheet" by L. C. Read, whose splendid pictures of Llewellyn Glacier will be recalled by readers of the magazine; "Wind and Rain as Influences on the Development of Life in Southern Ecuador" by H. E. Anthony, associate curator of mammals of the Western Hemisphere, American Museum; "Some Little Known Songs of Common Birds" by Francis H. Allen; "Phosphorescent Animals and Plants" by Ulric Dahlgren, director of the Harpswell Laboratory; "Nature Study with the Microscope" by Phillip O. Gravelle; "The Part Played by Fish in the Control of Yellow Fever" by Dr. Michael E. Connor, of the International Health Board of the Rockefeller Foundation; "Nature Study in a Summer Camp" by G. Clyde Fisher, associate curator, department of public education, American Museum; "The Artistic Anatomy of Trees" by John W. Harshberger, professor of botany, University of Pennsylvania; "Pitcher Plants and Their Moths" by Frank M. Jones; "Pictures of Miocene Fish" by David Starr Jordan; "The Staten Island Museum" by Charles W. Leng, its director; "A Women's Ceremony among the Hopi" by Robert H. Lowie, associate curator of ethnology, American Museum; "Urus and Bison" by W. D. Matthew, curator of vertebrate palæontology in the American Museum; "The Geology of New York City and Its Environment" by Chester A. Reeds, associate curator of invertebrate palæontology, American Museum; articles on Indian Corn by Charles W. Mead and Henry M. Steece; "Making Naturalists in Norfolk Street" by Mrs. John I. Northrop; "The Miami Aquarium" and "What Sharks Really Eat" by John T. Nichols, associate curator of fishes, American Museum; "The Search for the Marsupial Frog" by G. K. Noble, assistant curator (in charge) of herpetology, American Museum; "How Diamonds are Polished" by Herbert P. Whitlock, curator of mineralogy, American Museum.

Several of our most distinguished contributors during the last twenty years, like Peary and Roosevelt, have passed away, but their memory and inspiration will be kept alive through the work and writings of the younger men whom they have inspired. Among those whose articles have appeared in NATURAL HISTORY in the past are numbered the following:

EXPLORERS AND NATURALISTS

Carl E. Akeley	W. Elmer Ekblaw
Malcolm P. Anderson	Adolphus W. Greeley
Roy C. Andrews	William T. Hornaday
H. E. Anthony	Ellsworth Huntington
Rollo H. Beck	Herbert Lang
William Beebe	Donald B. MacMillan
Herbert L. Bridgman	Leo E. Miller
Barnum Brown	Robert Cushman Murphy
James P. Chapin	Henry Fairfield Osborn
Frank M. Chapman	Robert E. Peary
George K. Cherrie	Knud Rasmussen
James L. Clark	Theodore Roosevelt
Henry E. Crampton	Vilhjalmur Stefansson

ZOÖLOGISTS AND ANATOMISTS
(Mammals, birds, fishes, reptiles)

Joel A. Allen	Raymond L. Ditmars
Alfred M. Bailey	Charles E. Eastman
Thomas Barbour	David Starr Jordan
Ernest Harold Baynes	Frederic A. Lucas
John Burroughs	C. Hart Merriam
Eric Dahlgren	Thomas S. Palmer
Bashford Dean	Hugh M. Smith
Ned Dearborn	R. W. Tower
Mary Cynthia Dickerson	Charles H. Townsend
	Walter Winans

ANTHROPOLOGISTS
(Evolution of Man)

Franz Boas	J. Howard McGregor
M. D. C. Crawford	Frederick W. Putnam
George T. Emmons	Marshall H. Saville
William K. Gregory	G. Elliot Smith
Pliny E. Goddard	Harlan I. Smith
Alfred L. Kroeber	Herbert J. Spinden
Berthold Laufer	Louis R. Sullivan
Robert H. Lowie	Clark Wissler
George Grant McCurdy	Robert M. Yerkes
N. C. Nelson	

BIOLOGISTS
(Marine and Insect Life)

T. D. A. Cockerell
Edwin G. Conklin
G. Clyde Fisher
Frank R. Lillie
Leo Loeb
Frank E. Lutz
Alfred G. Mayor
Roy W. Miner
John K. Small
William Morton Wheeler

FOREST LIFE AND CONSERVATION, BOTANY

Charles C. Adams
William F. Badè
Edward W. Berry
Mrs. N. L. Britton
John B. Burnham
John M. Coulter
Mary Cynthia Dickerson
Henry S. Graves
Barrington Moore
William A. Murrill
T. Gilbert Pearson
George W. Perkins
George D. Pratt

EDUCATION, HISTORY, BIOGRAPHY, SOCIOLOGY, AND PUBLIC HEALTH

Maurice A. Bigelow
L. H. Bailey
Allan Brooks
Joseph H. Choate
Frank S. Dellenbaugh
John M. Finley
Hamlin Garland
Walter B. James
Douglas W. Johnson
Robert Underwood Johnson
William W. Keene
Graham Lusk
William H. Maxwell
George Bird Grinnell
Hermann Hagedorn
Walter G. Holmes
Mrs. John I. Northrop
William E. Ritter
George H. Sherwood
Charles-Edward A. Winslow

GEOLOGY, GEMS, MINERALS

Charles R. Berkey
John M. Clark
L. P. Gratacap
R. A. Harris
Edmund Otis Hovey
Charles R. Van Hise
George Frederick Kunz
Herbert P. Whitlock

PAST HISTORY OF THE EARTH—PALÆONTOLOGY

Robert Brown
Amadeus W. Grabau
Walter Granger
William Diller Matthew
Henry Fairfield Osborn

ASTRONOMY, PHYSICS

Howard Russell Butler
S. A. Mitchell
Sylvanus G. Morley
Michael I. Pupin
Elihu Thomson

ART AND ARCHITECTURE

L. A. Fuertes
Charles R. Knight
Howard McCormick
Sigurd Neandross
Will S. Taylor
S. Breck Trowbridge

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY, EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

MAY—JUNE, 1921
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NATURAL HISTORY

VOLUME XXI CONTENTS FOR MAY–JUNE NUMBER 3

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To my friend
President Henry Fairfield Osborn
from
Carl Lumholtz

NATURAL HISTORY

VOLUME XXI MAY-JUNE, 1921 NUMBER 3

MY LIFE OF EXPLORATION

BY

CARL LUMHOLTZ

FOREWORD.—In the accompanying pages we have a unique contribution from a man who is a charming writer and above all a great explorer. This autobiographical sketch was prepared at the request of NATURAL HISTORY and with a deal of modest embarrassment on the part of the author. Its charm lies in that in the writing of it Dr. Lumholtz took the same objective, discriminating view that characterizes his travel narratives. Later explorers following in his footsteps have often testified enthusiastically to the skill and exactness of Dr. Lumholtz in hitting upon the outstanding features of each new environment encountered and his ability to convey these snapshots to the reader with few words. One thus gets the feel of the country from the printed pages. So when one reads the following narrative he obtains in retrospect characteristic glimpses of a career occupied above all with five major expeditions, each of which has added greatly to our knowledge of the remote corners of the earth. The collections and data from two of these great expeditions were deposited in the American Museum. It has often been said that one of the greatest gifts and the rarest is the genius for exploration; however that may be, there can be no doubt as to the genius of Dr. Lumholtz.—CLARK WISSLER.

AT school as a ten-year-old boy, I found the lessons about beasts and birds of the most absorbing interest. At that time not much attention was given to natural history in the schools of Norway and I was sorry after a short time to have to give up the study of animals for that of Latin and Greek. However, I later received some instruction in botany and learned how to collect plants, and during the last years of my school days I devoted almost every afternoon in the season to such collecting. In that way I made a fairly representative herbarium of the phanerogam flora of inland Norway, which some years later was presented to the Kew Gardens near London.

In taking my second degree at the University of Christiania I naturally chose the branches of natural science. I was particularly interested in zoölogy, which attracted me more than botany ever had. It was the desire of my father, who was a captain in the Norwegian army, to make a clergyman of me and, being of the old school, he did not see much value in the study of zoölogy. As theology did not appeal to me nor the position of clergyman in a state church barring the attractiveness of the farm with which he is provided, and as under such circumstances I could not make up my mind what course to pursue, I accepted a position as teacher in a private family in the country and continued in that capacity for over a year and a half. Finally I decided to meet my father's wishes and study theology. The great naturalist, Michael Sars, father of the present Prof. G. O. Sars, of the University of Christiania, was a country parson at the time he made his startling discoveries of animal life in the deep fjords of Norway and at times I thought perhaps there might be a similar opening for me, through the gates of theology, to cultivate what was according to my inclination.

I took my degree in theology but it had already become perfectly clear to my mind that I should never be a clergyman. To secure my degree I had had to work sixteen hours a day for several months; this strain brought on a nervous breakdown, which, however, unexpectedly turned to my benefit. To regain the stability of my nerves I now devoted myself exclusively to the collecting of birds and animals and to a study of their modes of life. The specimens secured I sent to the zoölogical museum of the University of Christiania and I always felt happy when Professor R. Collett's letters of acceptance arrived with some remarks about the specimens sent.

In the summer I made tours, always alone, up to the mountains in the central part of Norway, and how wonderful it seemed to be in touch with nature again! Never shall I forget how beautiful some clumps of small mountain willows looked one early morning as I passed through them in the enchanting summer light of the northern countries. After a rainy night, newly formed pools reflected the brilliant sunlight in which the leaves of the willows fairly seemed to sparkle. There was enrapturing freshness in the landscape, which was high above the usual abode of man. The beauty of nature took hold of me and I felt my freedom from the confinements of metaphysics and scholasticism. I was overcome by emotion and wept from joy.

The winter was no obstacle to my enthusiasm for zoölogy. The skiis, in themselves a wonderful stimulant to a love of nature, carried me far away into the hills and ranges surrounding Lillehammer, my native town in central Norway, famous for the natural beauty of its environment.

Love of nature took stronger and stronger hold of me and one day it occurred to me what a misfortune it would be to die without having seen the whole earth. I could hardly endure the thought which haunted me. There seemed very small prospect of my being able to realize my ambition because we were a large family and, although we were all very well brought up, my father had no fortune to speak of.

One day, however, Prof. R. Collett proposed to me that I should go to Australia to collect animals and birds for the zoölogical museum of the university. I was elated at this suggestion. It was arranged also that the various museums of the university make contributions toward the expenses of my proposed expedition. One of the best Norwegian sailing vessels, bound for South Australia with a lumber cargo, took me aboard as a guest, and after a hundred days of sailing we came to Adelaide. From here in due time I arrived at Gracemere, a cattle station near Rockhampton, Queensland, where the owners, Messrs. Archer, who were Norwegians of Scottish descent, had invited me to make my headquarters as long as I liked.

After I had collected at this station for a few months, an opportunity came to accompany a wagon driver who was going to take provisions four hundred miles inland to Minnie Downs Station, which my friends also owned, on the Barcoo River. Here I spent some time collecting. Not far from the house, in the dry creek, a certain fossil shell was found in abundance; it was a gigantic *Inoceramus* from the Cretaceous period and turned out to be a new species (*giganteous*).

Riding one horse and leading my pack horse I continued my journey alone westward to the Diamentina River, usually staying for a night at some sheep or cattle station, where hospitality is always extended to the traveler. I had a burning desire to continue the trip right to the Gulf of Carpentaria, but on the Diamentina River I contracted disagreeable wounds on the lower part of my legs, the result of bites inflicted by fleas living on the ground. This infection troubled me for several weeks, affecting my whole body, and finally obliged me to return to the coast.

Mr. Walter J. Scott, a great "squatter" whom I met in Brisbane, had been kind enough to invite me to stay at Herbert Vale, an abandoned cattle station which he owned on the Herbert River in Northeast Queensland, about 18 degrees south latitude. He had moved his station up to the highland about a hundred miles westward, but good buildings had been erected at the original place and he had left an old man in charge. Here I might make my headquarters as long as I desired. It was a very tempting offer and, as soon as circumstances permitted, I found myself at the deserted cattle station on the Herbert River.

I at once sought the natives, who were prowling about in the neighborhood and who would come to the station every time we killed a bullock in order to secure the offal. These were so-called "civilized" blacks, that is to say, they had picked up a few words of English and had learned to smoke tobacco, of which these aborigines are inordinately fond; they were ambitious to secure such ornaments as a cast-off shirt or, better still, a hat,—to their mind the principal distinction between a white man and a black. These savages, with very few exceptions absolutely nude, who seemed to fit so well with their surroundings, at once attracted me, and on my daily excursions into the neighborhood, proved to be good companions.

The coast range not far away, at an elevation of four thousand feet, seemed always to beckon to me so invitingly; there ought to be rare, probably new, species of animal life in the dense jungle of that lonely range. But how to get there when the blacks of that region were reputed to be "bad"? After a while I decided on a bold undertaking, to camp and travel with these aborigines alone. I felt that surely they would help me to find animals hitherto unknown to science. As far as I know, no white man has ever attempted to camp alone with the wild natives of Australia; the first warning the colonists give you is, "Never have a black fellow behind you." My daring was, however, richly rewarded by the finding of new species of mammals, by the insight gained into the life of primitive man, and by the intense interest derived from real touch with nature.

Courtesy of Charles Scribner's Sons.

Native Australians from Northeast Queensland with their characteristic wooden clubs and shield. A wooden sword is on the ground

This sojourn for the better part of a year in the coast range near Herbert River became, in fact, the opening chapter of my life as an explorer. Thus far I had been a zoölogist. My life, however, among the blacks of Northeast Queensland awakened my interest in primitive man, and since then native races have been my life study.

From my headquarters I usually took along a dozen or more pieces of mildly salted and dried beef, some flour, and a small quantity of sugar, but as these provisions were quickly consumed because I was obliged to share them with my men, who were very fond of them, I also secured from my men the food that the natives use. There is a vine growing in that jungle that has a comparatively large root, which is excellent eating when roasted, but unfortunately it is rather rare. As for the rest of the vegetables that the blacks in those parts of the country use, they are very unattractive. Some of them in their natural state are actually poisonous, and have to undergo a process of heating and soaking in water before they may be eaten.

An Australian black fellow climbing a gum tree by the aid of a vine cut from the jungle. With the left hand he holds on to a notch in the vine and, after looping the tree with the free end, winds that end around his right arm. By flipping upward his rope-like support, he skilfully ascends

In respect to meat I was somewhat better off. The large lizards should not be despised, but the flesh of snakes was dry and practically unfit as food, though the liver is as pleasing to the taste as that of chicken. I often ate the animals and birds I skinned, but most of them were unpalatable. The meat of the tree kangaroo (*Dendrolagus lumholtzii*), which I had the pleasure of discovering, was, however, really attractive in taste, reminding one of game; this is very far from being the case with the meat of the ordinary kangaroo or of the wallaby. My favorite dish was the larva, eaten toasted, of a large brown beetle; the larva is found in decaying acacia trees. Contrary to what one expects the Australian native cooks his food well, and if there is the slightest indication of the meat smelling, he throws it away. He does not know the use of salt.

The curious "incubating" habit of the "brush turkey" (*talegalla*), which deposits its eggs in large mounds, there to be hatched by themselves, now and then offered us a chance of sitting down to a really good meal, for the eggs are large and very tasty. From the natives I learned the use of honey, which since then never has been missing on any of my expeditions. It makes a wholesome and pleasant drink and is rich in vitamines.

Every evening the blacks at my request made a hut of branches, which was rather low but long enough to enable me to stretch out at full length, an opportunity for relaxation which the natives are never particular about. If it looked like fine weather, my men did not even trouble to make any hut for themselves. Their one preparation for a comfortable rest was, by the aid of a stick and their fingers, to make a hole in the ground big enough to fit the hip. To keep warm in the night three or four would sometimes huddle together, absolutely nude and without any cover whatsoever.

A very important part of my outfit was tobacco, which served me instead of money; for tobacco they would do anything. In Australia the "weed" imported from America could be purchased as plates of the strong "niggerhead" variety and, when about to be used, was broken up in sticks of the size of a finger. Clay pipes were also taken along, for the tobacco is never chewed by these natives. They were well satisfied with a small bit but had to be paid for any services, however trivial, that they did.

Next to tobacco my gun exercised great powers over them though I always had to bear in mind that missing my aim even once would mean a dangerous reaction in their estimate of the white man's superiority. During the latter part of my stay, whenever I found the behavior of my men less satisfactory, in the evening just before going to bed I would fire a shot from my revolver, which they called "the gun's baby" and for which they had a wholesome fear. It reminded them of my superiority. Not one word more was said. It was like my "good night" to them.

We naturally slept around the same fire, which at first they insisted upon making small in order that their enemies should not discover their whereabouts. It was a very fortunate circumstance for me that in the winter time when I began this camping life I used to feel cold at night in spite of the fact that I had brought along a blanket. I had to rouse my lazy black fellows and induce them to secure more wood for the fire. By being disturbed in this way they got it into their heads, as I later discovered, that the white man slept but little and always had the "baby" ready.

I had one friend among the savages, a young black fellow called Yokai, who took a singular interest in the white man, helped me to gather men for my expeditions, and evidenced a certain attachment to me. He loved tobacco and all the things I had seemed to interest him; nothing made him as happy as to be allowed to make *damper*, the bread of those who rough it in Australia, consisting of flour and water and cooked in the hot ashes. To him no doubt I owed my life, as he on one occasion said to me "it was no good killing the white man." He was remarkably naïve and often blurted out information about the other blacks which was of the greatest value to me. Nevertheless, I felt that if matters were brought to a crisis, I could not depend even upon him, for the Australian blacks are like big children. I never knew when he might be persuaded by his elders to allow them to kill me, which they most likely would have done by smashing my head with a stone during the night.

My little supply of tobacco, my shirts, and above all my white blanket were objects of envy to my men, and in consequence there was a constant temptation to kill their possessor. One reason why the blacks became very dangerous was that one of my own blacks had killed a lone white man who was attempting to reach the highland by walking. I exerted myself to have the murderer punished and the blacks all turned against me.

I always treated them justly and I did not feel called upon to shoot any of them; in fact, I have not as yet shot any man. My friend Yokai reproached me for being too kind. "You are not angry enough," he once said. "Shoot them, shoot plenty," he added.

There was nothing else to do but to return to civilization and I was truly glad when I arrived with all my collections at the sugar plantation on the lower part of the Herbert River. I had discovered, in addition to the tree kangaroo above mentioned, three other mammals. I was close on the track also of another animal, a large, carnivorous marsupial which the natives called *yarri*. This animal still awaits discovery. That it really exists I do not doubt, because in such matters the natives are to be depended upon.

The first three months of my camping

life with the natives of Australia are the most interesting, I might almost say fascinating, time I have had. I was then at the zenith of my power and it is, of course, pleasant to be the first, even among admiring savages. My whole sojourn, covering many months, with the men of the Stone Age was, however, an experience I am glad to have had.

The senses of the Australian blacks are superior to ours, their eyesight extraordinarily so. As he walks through the jungle, this savage man will constantly, without stopping, scoop up a handful of the soil and smell it, to ascertain whether some animal has passed that way or not. On the trunks of the trees there is always seen a bewildering number of claw marks left by different animals, for most of the animals of that region live in trees. He reads, as in an open book, what kind of animal ascended that tree the night before, and whether it is now up in the hollow of the trunk.

The most interesting scene I have witnessed during the many years spent with natives of different countries was the annual settlement of disputes, in use among the blacks of Herbert River. It is called *bórbobi* and is, in fact, dueling conducted on a large scale, several pairs fighting at the same time by throwing boomerangs and clubs, then spears, and ending by pounding each other with the heavy wooden swords used in Northeast Queensland. Huge shields are used for protection. On the occasion I attended one man was mortally wounded by a spear which actually went through the shield and into his stomach.

After having written a book on Australia[1] I went to the United States to lecture on my unusual experience and also with the hope of being given an opportunity to make researches among the primitive men of the American continent. My lectures created considerable interest and as early as the autumn of 1890 I was able to realize my project of exploring the northern part of the Sierra Madre, Mexico, conducting an expedition under the auspices of the American Museum of Natural History and the American Geographical Society. Professor W. Libbey of Princeton University joined the party and as we were about to enter a little-known region, I thought it advisable to take along a few collectors in the domain of natural history.

Starting from Bisbee, Arizona, in September, I entered Mexico through San Pedro, traveling in a southerly direction through Sonora and then turning eastward up into the Sierra Madre at Nacori. From here on to Casas Grandes in Chihuahua we had to make our own trail, which was done successfully in spite of the fact that it was winter and the size of my party considerable. With nearly a hundred animals—mules, donkeys, and horses—we crossed the Sierra Madre, at times camping in the snow. To this day our trail has remained the commercial road between the States of Sonora and Chihuahua.

Arriving at the Mormon colony, Pacheco, on the eastern slopes of the Sierra, we found some very interesting old cave dwellings to explore. Later on we settled on the lowlands of San Diego, where for many months excavations were made of several large mounds that covered house groups. We unearthed about five hundred pieces of beautiful pottery.

Among the fifty-five mammals secured on this first expedition to Mexico was a superb-looking red squirrel of the high Sierra, which received the name of *Sciurus apache*. Our botanical collectors, Messrs. C. V. Hartman and F. E. Lloyd, found themselves in a hitherto neglected field and their labors were rewarded with the finding of twenty-seven new

[1]An account of my Australian travels of four years was published in several languages,—the English edition *Among Cannibals*, by John Murray, London, 1889, followed a little later by the American edition, under the imprint of Charles Scribner's Sons, New York. The French edition, *Au Pays des Cannibals*, was published by Hachette et Cie, Paris.

Courtesy of Charles Scribner's Sons

Although the majority of the Tarahumare Indians live in simple shelters, usually made of rough pine boards leaning against each other, they all love caves. Many families go to the caves for a change of domicile, others live in them permanently. In fact, these Indians may properly be called the cave dwellers of the America of today

species of plants, some of them of much importance.

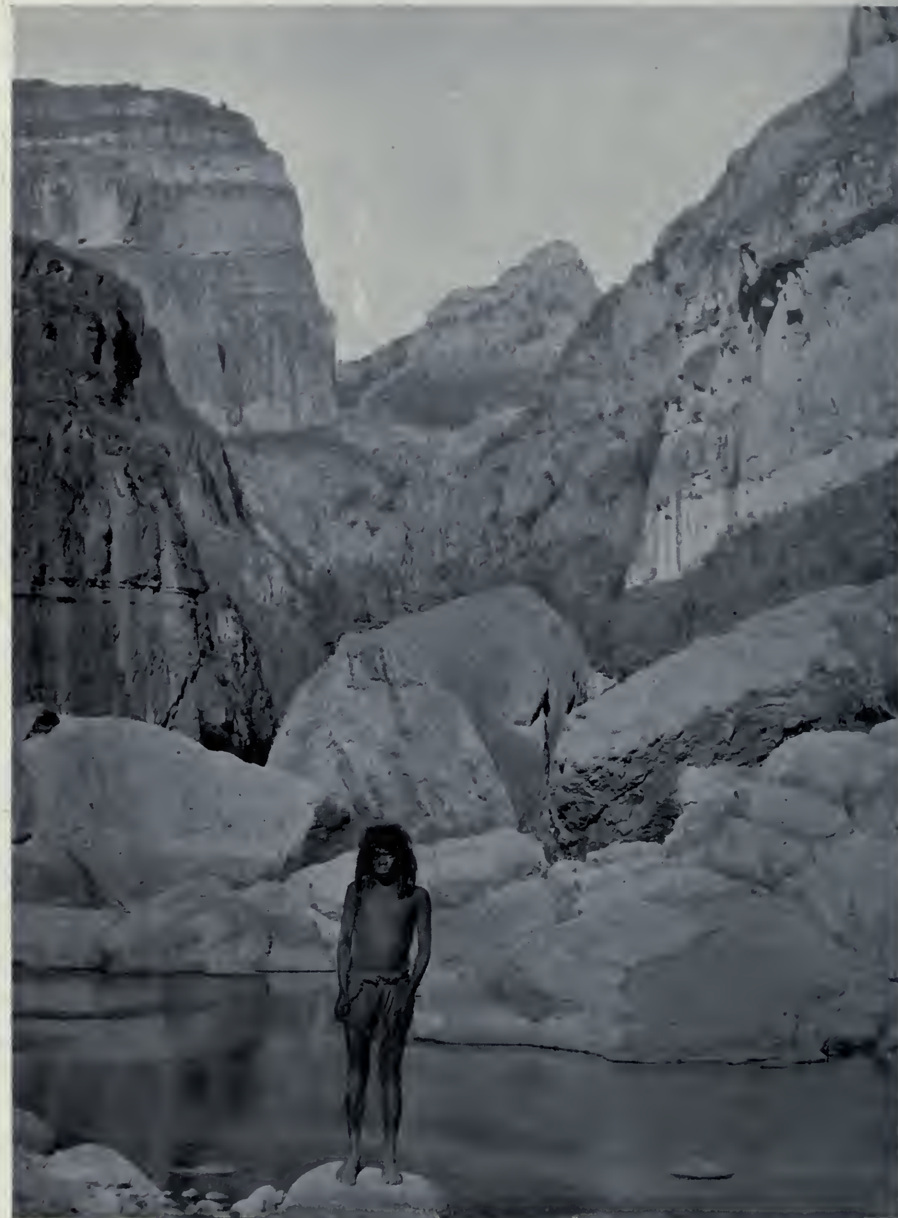
After an absence of some months in the United States I returned toward the end of the year to my camp at San Diego, and in January, 1892, with a much reduced force began my second expedition to Mexico, ascending again the Sierra Madre and following it southward.

At Tutuhuaca we met with a new species of pine (*Pinus lumholtzii*), which is very ornate on account of its slender, whiplike branches and its long, hanging needles. Later we often saw it growing in groups at high altitudes on decomposed volcanic tuff.

For one and one-half years I traveled in the extensive and picturesque country of the Tarahumare Indians, the great tribe of the State of Chihuahua. In order to save expense and to concentrate my efforts on ethnological research in the interesting region in which we found ourselves, I dispensed after a few months with my assistants, Mr. C. H. Taylor, civil engineer and photographer, and Mr. A. E. Meade, mineralogist. Mr. Hartman remained a few months longer as assistant in ethnology. Finally, however, I conducted my investigations alone, following the wild (so-called *gentiles*) Indians into the distant retreats in the deep cañons for which the States of Chihuahua and Durango are famous.

The Tarahumares are timid, honest, and bashful people, their habits and customs often being singularly interesting. Their dances, a kind of religious exercise, have been minutely described by me. A dancing place is found near all dwellings and on it is raised a small wooden cross to which to dance, and which represents a man with arms outstretched, Father Sun, the perfect man.

By selling most of my animals and a large part of my outfit and through the untiring efforts of two American ladies whose friendship I highly esteemed, I was enabled to continue these researches until August, 1893, when I took my Tarahumare and Tepehuane collections to Chicago and exhibited them at the World's Fair. Extensive vocabularies of the Tarahumare and Tepehuane languages as well as a vocabulary of the now almost extinct Tubares were among the results of this expedition, besides



Courtesy of Charles Scribner's Sons

BARRANCA DE SAN CARLOS IN CHIHUAHUA

It may be compared with the Grand Cañon of the Colorado so far as depth is concerned, and the sides are steeper, but the latter excels in extensive and picturesque views. The present picture, showing one of the author's carriers, a Tarahumare Indian, in the foreground, was taken in the upper part of the cañon, which is not as deep as the lower part anthropological measurements, samples of hair, and osseous remains.

The great possibilities Mexico offers to ethnology proved an irresistible incentive to new researches, and seeing the results of my previous expeditions, the American Museum of Natural History of New York again sent me out on what was to be my third and most extensive Mexican expedition, lasting from March, 1894 to March, 1897. During these three years I again traveled alone, that is, without any scientific assistants. I had with me at first two or three Mexicans; soon, however, I found that my best companions were the so-called civilized Indians, or even Indians in their aboriginal state, who not only helped me by their mere presence to win the confidence of their tribesmen but also served me as subjects of observation. As before, I stopped for months with a tribe, discharging all alien attendants, and roughing it with the Indians. In this way I spent ten months among the Coras and Huichols. At first the natives persistently opposed me; for Indians are very distrustful of the white man, and no wonder, since he has left them little enough and they are therefore forced to guard that little the more vigilantly. I managed, however, to make my entry into their midst and gradually to gain their confidence and friendship, mainly through my ability to sing their native songs and by always treating them justly.

All along my route I gathered highly valuable material from the Tarahumares, the Northern and the Southern Tepehuanes, the Coras, the Huichols, and the Tepecanos,—all of which tribes except the last-named dwell within the Sierra Madre del Norte; also from the Nahuas on the western slopes of the Sierra, as well as from those in the States of Jalisco and Mexico; and, finally, from the Tarascos in the State of Michoacan. Of most of these tribes little more than their name was known, and I brought back large collections illustrating their ethnical and anthropological status, besides extensive information in regard to their

Huichols of the author's party crossing a swollen torrent on a bridge of their own construction

HUICHOL BOY

Raising maize and hunting the deer, as well as frequent participation in religious ceremonials, occupy the time of youths as well as men among this mountain people customs, religion, traditions, and myths. I also completed my collection of vocabularies and aboriginal melodies.

Especially fruitful in results was my stay with the Huichol Indians. These Indians had been known mainly to a small number of Mexican half-breed traders and I was the first white man to visit them. The country was difficult of access and Mezquitic, the little town from which the tribe is reached, is distant three or four days' journey on muleback. The isolation of these Indians on a tall spur of the Sierra Madre had been their salvation and I found them living practically in the same state of culture as when Cortez put foot on American soil.

They had their temples and sacred caves, which were filled with symbolical objects of singular interest, thus throwing light not only on the cultural status of a barbarous tribe but even on that of their far more advanced kinsmen, the Aztecs. When my friend, that great ethnological genius, the late Frank Hamilton Cushing, saw the exhibition of my Huichol collection at the American Museum of Natural History, he exclaimed, as he let his eyes pass over the richly laden tables of the room: "This is like seeing a new species of man."

Courtesy of Charles Scribner's Sons

A flower (*Œnothera trichocalyx*) of the desert. It usually makes its appearance along the courses of the dried-up creeks

Of the ethnological results gained during my travels in Mexico I consider the information which was collected about the anciently well-known *peyote* (*lophophora*) among the most important. It is a well established fact that this little cactus when partaken of exhilarates the human system, allays all feeling of hunger and thirst, and produces color visions. In the Huichol tribe this highly interesting plant cult reached its greatest development. The Tarahumares also worship this plant.

In order to collect *híkuli*, as the cactus is called, a pilgrimage lasting forty-three days is annually undertaken into the State of San Luis Potosi.

Of late years the *híkuli* cult has, strangely enough, been adopted by certain tribes in the United States and well meaning people are trying to stop this on the ground that it is a kind of debauche. Nothing could be farther from the truth. By all manner of means prevent the Indians from getting the white man's brandy, which ultimately and surely ruins them, but *híkuli*, or *peyote*, is an entirely different matter.

As far as my experience goes, the partaking of *peyote* is not injurious to health; besides, the cult is observed only during a limited season of the year. The effect of the plant on the nervous system is very different from that of alcohol; the balance of the body is even better than

The author's pack train wending its way through the Sonora desert. The sand dunes owe their graceful outlines to the shaping force of the winds

under normal conditions. There is nothing vicious about the *híkuli* cult. Abstinence from sexual intercourse is imposed on its devotees and a marked effect of the plant is temporarily to take away all sexual desire.

On my journey through the Tierra Caliente of the Territory of Tepic, and the States of Jalisco and Michoacan, I obtained a number of archæological objects of great historical value and importance. Among the antiquities secured may be mentioned a beautiful jar in the shape of a turkey, strikingly ornamented with thin gold plates. Furthermore, a number of large terra cotta figures were found in a subterranean chamber near Iztlan representing ancient Tarascan culture. About three hundred skulls of Mexican Indians were collected in the course of my first expeditions to the republic. These were all described years ago in a scholarly work by Dr. A. Hrdlicka. The publication of this important work has thus far been impossible through lack of funds but it is to be hoped that such funds may be provided for the purpose in a not distant future.

In 1898, accompanied by Dr. Hrdlicka, I revisited the Tarahumares and the Huichols. In 1905, I alone visited the Huichol and Tepecano Indians. My observations of the latter tribe have not yet been published.

In 1909–10 I made my last expedition to Mexico, traveling in the Sonora Desert and the southern part of Arizona, a fascinating country in spite of the arid conditions prevailing there. The wonderful colors of the late afternoon, the glorious sunshine, the peace and calm of night, and the thrills that accompany early dawn are sources of constant delight to the traveler. The extraordinary adaptations of plant and animal life, even the domestic animals of Indians and Mexicans subsisting without difficulty for months without water, cannot fail to interest the observer. With the exception of the Seri and the Pima Indians, the natives of the desert had so far received little attention from those engaged in the study of primitive races. The Papago are the great desert people of America and are remarkably stable in their racial characteristics, still preserving the traditions and habits of the past, which soon will disappear.

I was fortunate in being able to describe their harvest festival and in other ways to give an insight into their

A drinking pool in the Sonora desert. In the cavernous depressions, known as *tinajas*, of the lava formations, water is also obtained

tribal life. It is well authenticated that the tribe knows a cure for hydrophobia and, in order that the secret shall not die with the tribe, I may take this occasion to state that the main ingredients of the medicine are certain excrescences, of wonderful antiseptic quality, found on the greasewood (*Covillea tridentata*), the humble but very attractive bush of the desert.

My researches in Mexico and the Southwest, extending from Casa Grande, Arizona, down to west of the City of Mexico, thus covered a period of nearly eight years, six and a half of which were spent among the Indians of those regions.[1]

Ever since my adventurous life among the blacks of Northeast Queensland it had been my desire to explore New Guinea, the largest island on the globe, and among the least known regions thereof. In 1914 it really seemed that I was on the point of realizing the dream of my youth. I found myself in Batavia, Java, about ready for the start eastward to New Guinea. It was a Norwegian Expedition, which had the support of their Majesties, the King and the Queen of Norway; the Norwegian Geographical Society, the Royal Geographical Society of London, and the Royal Netherlands Geographical Society, each made a contribution to my funds, which, besides, were increased by American and English friends. With the outbreak of the great war, however, my plans suddenly had to be changed. His Excellency, the Governor General of the Dutch Indies, Mr. A. W. F. Idenburg, regretted his inability to give me a military escort and other assistance for carrying out my plans, and advised me to await a more favorable opportunity. As I had never been in British India, I decided to go there while awaiting developments. In India I studied Hindu religions, a fascinating occupation, but after eight months spent there I decided to return to the Dutch Indies and undertake an expedition to Central Borneo, parts of which are unexplored and un-

[1]My publications on Mexico are, besides minor articles:

Unknown Mexico, in 2 vols, illustrated, Charles Scribner's Sons, New York, 1902.

New Trails in Mexico, illustrated, Charles Scribner's Sons, New York, 1912.

Symbolism of the Huichol Indians, Memoirs of the American Museum of Natural History, 1900.

Decorative Art of the Huichol Indians, Memoirs of the American Museum of Natural History, 1904.

Courtesy of Charles Scribner's Sons

The floor of the desert sometimes rivals the "ribbed sea sand" in its minute sculpturing. Such wavy lines owe their origin to the action of the wind. The scene is of the desert northwest of Pozo del Caballo, Sonora

known to the outside world. The Governor General with the greatest courtesy assisted me in furthering my project, and gave me a small escort of six Javanese soldiers under the command of a Dutch lieutenant. An excellent native surveyor was attached to the expedition and for part of the time one of the government's photographers.

The journey through central Borneo, which consumed nine months, was successfully made. There are no roads in Borneo, all communications being by water, the large rivers enabling the traveler to ascend far inland. Numerous rapids, often very difficult to conquer, have to be passed. In the central part of the great island, the absence of life—in other parts abundant—was very striking. The only birds that you might hear or see were the great hornbill, the sandpiper, and a kind of kingfisher. No more fish were caught in the rivers; there were not even mosquitoes, hence there is no malaria in the interior. As for human beings, large tracts of the inland country are uninhabited.

There was no change, however, in the exuberant richness of the tropical vegetation. As we ascended the Upper Busang River, the scenery was often beautiful beyond words; silence reigned supreme. It was like having a pleasant dream.

I extended my travels to other parts of the great island and thus spent the better part of two years among its very interesting natives. They form many different tribes, which, however, present many similarities and are therefore included under the general name of Dayaks. Some of the tribes I met with had never been studied before. I may, perhaps, not be accused of being immodest in claiming the credit for having been able to put the head hunters of Borneo in the right light before the civilized world.

My researches prove that this very repulsive and extraordinary custom of taking heads is not due to particular viciousness on the part of those who practise it, but has its foundation in their vivid realization of a life after this; in fact, to the Dayaks, as to many Oriental people, there is no essential difference between this life and the next.

At the very moment that a Dayak cuts off the head of a man belonging to another tribe, his soul conquers that of the departed, who becomes his slave. If that head, or in other words the soul residing in it, is treated well, it becomes a friend and guardian of the tribe. Such a head protects against the evil spirits and even insures material benefit. This is in a few words the idea underlying head hunting.

An important medicine man of the Huichols and his wife. Girdles and pouches like those worn by the man are woven by the women, the designs often being astonishingly artistic. The pouches are for ornament, not for use. The object on the head of the man is not a cap but a woven ribbon used for binding the hair

A medicine man of the Huichols beating his deer-skin-covered drum. The drum plays an important part in many of the ceremonies of this people. The curious easy-chair in which he is seated is of native manufacture and is reserved for the important members of the tribe, such as temple officials and medicine men

Farther up the river men of the Kenyah tribe of Borneo have been beating the roots of the *tuba* vine to free the poisonous juices therein contained. These juices, mingling with the waters, stupify the fish and thus make possible their capture. In the picture women of the tribe are seen with hand nets held in readiness to scoop up the fish that are being carried along helpless in the current

Sections of bamboo stalks are used as containers for rice or for pork, important items in the diet of the Dayaks. A little water is added but no salt. As long as the stalks are green, they resist burning. Rice cooked in this way has a sweet, delicious flavor

The long-nosed monkey (*nasalis larvatus*) is peculiar to Borneo. These creatures are sometimes found in groups of a hundred or more travelling through the forest by swinging from branch to branch

These "wild men of Borneo" neither tell lies nor steal. To appropriate the property of another is a thing they take good care not to do, for a thief in the next life will be seen carrying around on his back all the stolen goods, thus exposing himself to ridicule and contempt. The Dayaks are hospitable, generous, and loyal. During the two years I traveled among them I never once observed children quarreling or fighting.

The results of my journey were very satisfactory. Vocabularies of many tribes were studied and collected; anthropometric measurements were taken and much new information gathered about the habits and customs of the natives. I brought back material for several treatises, especially in regard to the decorative art of the Dayaks and also concerning a much developed protective system which certain tribes possess in carved wooden figures called *kapatongs*.

Skins of mammals and birds were secured, as well as specimens of fishes and reptiles in alcohol. So far only the mammals have been examined; these yielded one new species and two new subspecies.

It is a curious fact that both among the Chinese and the Malays individuals are met with who are thoroughly convinced of the existence of brown men with short tails. Many will tell you that they themselves have seen them. I was able to collect from the Dayaks the legend of the tailed men, which may be found in my book on Borneo.[1]

The Great Archipelago in which I found such a remunerative field for my efforts appeals to me more than any other part of the earth which I have visited. In its humid and warm climate I thrived, feeling, in fact, better there than here. The great possibilities of discovery in those distant islands fascinate me now as they did when I was in Australia. I have decided to devote the rest of my life to science, to visit little known or unknown parts of the earth with the hope of increasing our knowledge from a geographical and anthropological point

Courtesy of Charles Scribner's Sons

The Manx cat is not the only one with a rudimentary tail. In Borneo there is a domestic feline that is either stub-tailed or with a ball at the end of its exceptionally short caudal appendage

[1]An account of my exploration of Borneo is given in *Through Central Borneo—Two Years' Travel in the Land of the Head Hunters*, Charles Scribner's Sons, New York, 1920.

From a cinematograph showing a Penyahbong of Central Borneo gracefully executing a war dance practised by many Dayak tribes. Before seizing his sword and shield and indulging in the more violent movements of the dance, he went through the preliminary of exercising all his flexible muscles. His motions were lithe as those of a serpent

of view and also with the expectation of making further contributions in the field of natural history.

I am more than ever interested in carrying out my New Guinea project, which was so unexpectedly thwarted by the outbreak of the war. No country offers such rewards to the intrepid explorer as New Guinea, the largest island on the globe, lying just to the north of Australia with which it was once connected.

In 1920 I went abroad in the hope of securing in Norway the necessary funds for this the greatest of all my undertakings. If I had come one year earlier, I should have gotten all the money needed, and more, my friends assured me, but the great financial depression which had then begun to manifest itself in Norway made it impossible to secure more than a small part of what was needed. It must be said that my countrymen did all that they could to further my purpose in which they are intensely interested, but "*Ultra posse nemo obligatur.*"

I am now trying to get the necessary support in the United States for an enterprise that cannot fail to give the valuable results desired and which may prove of direct benefit to civilization by the discoveries I expect to make. This is not the place for a detailed account of my plans, which I shall always be most happy to furnish to anyone interested in the matter, but may I not be allowed in a few words to state the object of my proposed expedition?

I intend to cross New Guinea from south to north at its broadest point, having chosen a route where no white man has ever been before me. We shall have to cross at an elevation of 10,000 feet the great Snowy Range, whose highest measured peak is 18,000 feet. From the time when I shall have established my headquarters at the foot of the range until I am able to emerge on the north coast of the island, one year will have elapsed. The backbone of

The artistic ability of the Dayaks expresses itself in carving rather than in music. Nevertheless, they have musical instruments, the chief of which is here represented. Its notes are rather pleasant

my expedition will be 175 Dayaks, who will be brought to New Guinea from Borneo. They are to be our carriers, builders of boats and of houses. I shall have two taxidermists and a botanical collector; an experienced geologist, whom I hope to secure in the United States, will be an important member, for this great island is of particular interest to geology, which here will find the solution of many of its most important problems.

For many years I have studied the food question, and there need be no fear that beri beri or kindred diseases will attack the expedition.

Among people who know, it is the universal verdict that no region offers such inducements for exploration as New Guinea. We expect to meet natives that have never seen a white man. Whenever a collector has gone up a hitherto unvisited river in New Guinea, he has invariably brought back new species of birds of paradise, and without any doubt we, too, will discover new species of these most gorgeous creatures. We are confident, too, of coming upon new species of mammals, some, maybe, of considerable size. Superb butterflies and interesting land shells may be expected. Botany will naturally gain much that is novel. In geology, specially valuable results may be anticipated, and we are likely to find new minerals.

Thus we may hope to make a valuable contribution to the history of the earth, as well as to our present knowledge of the mineral, plant, and animal kingdoms. Some of our discoveries may even prove of great economic value.

A tame horn-bill that often came to roost on the author's tent. The Dayaks refrained from laughter, no matter how ridiculous were the antics of this bird, for they hold the belief that those who laugh at animals will be stricken with illness

HEADS OF AFRICAN ELEPHANTS

DISPARITY IN SIZE BETWEEN THAT OF THE MALE AND THAT OF THE FEMALE

BY

HENRY FAIRFIELD OSBORN

IN recent studies of the Proboscidea, living and extinct, I have been very much impressed with the marked contrast between the males and the females throughout the whole period of their evolution. This, in fact, has attracted the attention of observers from early times. The disparity in size between the sexes appears to be even greater than among other ungulates. For purposes of comparing the head in the two sexes, I have recently had photographed from above two superb heads in the American Museum. The male belongs to the subspecies *Loxodonta africana peeli*. It was obtained in northern Uganda in the year 1911 by Mr. Carl E. Akeley, and was chosen as the typical bull for his African Elephant Group, which is nearing completion. It is shown in the accompanying photograph, $\frac{1}{24}$ natural size. Photographed to the same scale is the head of a female. This specimen belongs to Mr. Paul J. Rainey, who collected it north of Mt. Kenia, and is regarded as a record female in weight and in length of tusks. It will be observed that the tusks of the female, while extremely slender, are almost as long as those of the male. The spread of the ears is almost equally great, but there is a marked disparity in the size of the head, also of the proboscis. The exact proportions have not been established, but it would appear that the head of the female is not two-thirds the mass of that of the male. Closely similar disparity is found in the American mastodon, of which the American Museum collection contains fine examples of both sexes. The tusks of the female of the mastodon are equally slender.

In commenting on the relative size of the tusks of these two heads Mr. Carl E. Akeley reminds us that the cow is very old and the tusks have reached practically their limit of size, whereas the bull is young, under thirty-five years, and, barring accidents, had he lived to the age of the cow, his tusks would have been at least twice as long as they now are—that is, the exposed portion of the tusk. The proportionate size of the ears varies greatly in individual elephants. These remarks apply in less degree to the relative size of the skull in male and female African elephants, which is probably fairly shown in these photographs.

Apropos of the condition of the tusks in the female, Mr. Haagner writes from South Africa that many of the females in the Addo herd, which has recently been nearly exterminated, are without tusks. The deliberate decimating of this herd in South Africa is the latest episode in the long history of crimes committed by man in the world of mammalian life. In a single shoot, under pretense of protecting the crops and of keeping down the nagana disease, the herd was reduced from one hundred to sixteen. While the government has stepped in to prevent further killing, it is doubtful whether this small herd of sixteen, which is all that remains of the vast numbers that roamed over southern Africa in former times, will be of sufficient size to preserve this southern species from extinction.

African elephant reduced to $\frac{1}{24}$ of their natural size. The male is of the subspecies *Loxodonta africana peeli.* Note that while the span of the ears is approximately equal in the two specimens, the head of the male is bulkier and his trunk more elongated. The male is younger than the female and had he been permitted to live as long as she, the exposed part of his tusks would have attained at least twice the present length

MAJOR LEONARD DARWIN

Because of his untiring devotion to the cause of eugenics and his eminent accomplishments in furthering that cause Major Darwin's selection for the delivery of the opening address at the Congress of Eugenics, to be held at the American Museum, September 22-28, is one that cannot fail to command wide approval

THE SECOND INTERNATIONAL CONGRESS OF EUGENICS

Of transcendent importance will be the Second International Congress of Eugenics, which is to be held in the American Museum of Natural History, September 22–28, nine years after the First Eugenics Congress, which assembled in London. There is no subject so vital to human welfare and to the ultimate destiny of mankind. The great war has taken an appalling toll of the best stock of each nation; it has spared many less desirable types. Those whom the draft found unfit and who, through the immunity thus enjoyed, are relatively a larger element in the population than before, will have their part, a disproportionate part, in fixing the physical and mental types of the generations that are to succeed. All important, therefore, is a congress such as the one that will gather, for only through the interchange of thought among those who have given intensive study to the subject can light be thrown on the question of racial improvement.

The Congress will open in the new Hall of the Age of Man on Thursday evening, September 22. President Osborn of the American Museum will preside and give the address of welcome. Major Leonard Darwin, President of the Eugenics Education Society of Great Britain and Presiding Officer at the First Eugenics Congress, will deliver the opening address on the history of the eugenic movement from its institution by Francis Galton. Dr. Charles P. Davenport, the present leader of the eugenics movement in America, will review the progress which has been made in America and will outline the program of the Second Congress.

The comprehensiveness of the proposed program is indicated by the fact that it is divided, according to subject matter, into four sections. The leading address of Section I will be given by Dr. Lucien Cuénot, of Nancy, France, one of the great students of heredity, whose researches among the lower organisms have enriched science. This section will occupy itself with the results, on the one hand, of investigations in the domain of pure genetics in animals and plants and, on the other, of studies in human heredity. The application to man of the laws of heredity and the physiology of reproduction, as worked out in the case of some of the lower animals, will be presented.

Dr. Herman B. Lundborg, of the University of Uppsala, Sweden, an authority on psychiatry and neurology and widely known for his painstaking study of disease as a factor in heredity, will deliver the leading address in Section II. Dr. Lundborg, conducting an investigation similar to that made by Dugdale of "The Jukes," examined the records of several thousand individuals of a Swedish family of unfortunate heredity extending over a period of some two hundred years. The investigation has been characterized as "the most comprehensive and thorough examination of a family that has ever been made." Section II will weigh the factors which influence the human family. First among the agencies for the improvement of the race is a proper understanding of the significance of marriage. Those who enter into such a union should appreciate the fact that it involves in most cases the destiny of other lives, in addition to those of the contracting parties. A knowledge of the significant family traits of which each of the parties to the proposed marriage is the bearer and the method of inheritance of these traits should, no less than natural sentiment, govern those who would wed. In this connection will be brought forward data bearing upon improved and unimproved families and showing the persistence, generation after generation, of the best as well as the worst characteristics.

The fecundity of different strains and

the application of social and legal controls in the case of strains that are undesirable is a subject deserving the painstaking consideration it will receive. Phases of this question are the undue postponement of marriage and the restriction of the birth-rate among those often best fitted to transmit their characteristics to the next generation, and the unrestrained assumption of parenthood by inferior stocks. The effect of war, epidemics, and endemic diseases upon different elements of the population, resulting in a differential mortality among the eugenically superior and inferior will receive due emphasis.

Dr. V. de Lapouge, of Poitiers, France, author of *The Fundamental Laws of Anthropo-sociology*, *The Social Rôle of the Aryan*, and other noteworthy volumes, whose race studies have yielded important results, will present the leading address in Section III. This section will concern itself with the topic of racial differences and their significance. It is the popular tendency to confuse race with nationality. Political boundaries and differences of language do not constitute differences of race. Indeed, within a single nation there may be several racial strains,—France, for instance, furnishing Nordic, Alpine, and Mediterranean types as one travels from north to south. The migration of races, the influence of racial characteristics on human history, the teachings of the past in their bearings on the policies of the future will receive attention in this section. Certain prejudices directed toward existing races will be dispelled when allowance is made for the influence of their social and educational environment, and their fundamentally sound and strong racial characteristics are brought to light. On the other hand, it will be shown that the development of certain races has limits that cannot be passed and that it is futile, therefore, to try through education and environment to change their fundamental characteristics. Consideration of the advantages and disadvantages involved in the mingling of races and of unions that have proved fateful to social progress, falls within the sphere of this section. Differences in racial resistance to disease will also be discussed.

Section IV, dealing with applied eugenics, is of culminating importance. The leading address in this section will be delivered by Major Leonard Darwin, one of the sons of Charles Darwin, and himself distinguished for notable achievements in more fields than one. Born in 1850, he was educated at the Royal Military Academy, Woolwich, and in his subsequent career in the Army served for five years on the Staff, Intelligence Department, War Office. He was a member of several scientific expeditions; he has served in Parliament. Among the offices which at one time or another he has held are: President of the Royal Geographical Society; Chairman of the Professional Classes, War Relief Council. Since 1913 he has been Chairman of the Bedford College for Women, University of London. He is President of the Eugenics Education Society and presided at the First Eugenics Congress in 1912. Section IV will discuss eugenics in relation to the state, to society, and to education, and will bring the subject to bear on the various social problems and movements of the day. "Eugenics in International Affairs," "Some Eugenic Aspects of the Problem of Population," "Educability and Inheritance"—titles which appear among the announced addresses for this section—indicate to some extent its scope and purpose.

About sixty scientists from all parts of the world have already arranged to give addresses on different phases of eugenics. It is anticipated that the number of papers will far exceed the opportunity of their presentation. A large number of scientific bodies and institutions, some as remotely situated as the University of Punjab, India, have signified their intention to send delegates.

Efforts are being made to raise funds to bring from Europe and remote parts of the Americas the most representative workers in the field of Eugenics. An opportunity is offered for those interested to become patrons of the Congress by subscribing $500 each, to be expended for this purpose. The Carnegie Institution has made a grant of $2,000 toward the entertainment of the delegates to the Congress and toward the expenses of certain European scientists. The following organization and individuals are already enrolled as patrons: Race Betterment Foundation (through Dr. John H. Kellogg), Charles K. Gould, Archer M. Huntington, Cleveland H. Dodge, Mrs. Worthan James. For the purpose of the Eugenics Exhibition, allusion to which was made in the March-April issue of NATURAL HISTORY (p. 206), Mrs. E. H. Harriman has contributed $2,500.

There are two classes of members, sustaining members and active members. Sustaining members will have the privilege of attending all sessions and gatherings of the Congress and they will receive bound copies of the Proceedings of the Congress. Their names will appear as sustaining members on programs and in all permanent publications of the Congress. Dues for this membership are $100. Active members will have the privilege of attending all sessions of the Congress. They will be enrolled as Active Members and will receive a certificate of membership. Dues, $5.00.

For any information concerning the Congress, address Dr. C. C. Little, Secretary-General, American Museum of Natural History, 77 Street and Central Park West, New York City.

Though the American Museum will be the center of activity of the Congress, visits are planned also to other places. On September 25 an excursion will be made to Castle Rock, the residence of President Henry Fairfield Osborn of the American Museum. On September 28 a trip is planned to Cold Spring Harbor, Long Island, where the Congress will be welcomed by the department of genetics of the Station for Experimental Evolution, Carnegie Institution of Washington.

As a result of the views interchanged during its sessions, the Congress will undoubtedly on disbanding disseminate a great many constructive suggestions, the adoption of which should tend to elevate humanity and bring into the range of vision the goal toward which it is striving. When one thinks of the staggering public burden that is being carried because of the existence in the populace of elements that on account of inherent incapacity or depravity can never be other than a drag upon their fellows and a source of irritation to themselves, it would seem that any gathering looking seriously to the ultimate correction of such evils and to the establishment of better ideals of life could not fail to win the support of all thinking men.

MUSSEN MOUNTAIN

A portion of this impressive mountain—a temptation to the climber, who is rewarded by the splendid view obtainable from its summit—is here shown. The south end of Bold Bluff occupies the right of the picture. Toward the left center is High Falls, a nearer view of which is obtained in the illustration on page 255

THE CORDILLERAN ICE SHEET*

BY

L. C. READ

THE Cascadian region cannot fail to inspire with enthusiasm the student of glaciers and glacial action, for it was the seat of the great Cordilleran ice sheet of Pleistocene times. There is abundant evidence that the region was covered, over an extent of hundreds of miles, by superincumbent ice thousands of feet in thickness. The ice must necessarily have been of great depth to flow to termini as distant as those which the evidence postulates.

On the east, the Cordilleran coalesced with the Keewatin ice sheet in the region of the Rocky Mountains. In the north, it evidently flowed far toward the Arctic via the Yukon River, but in a much thinner sheet than to the west and south. The evidence seems to be conclusive that the ice flow extended south into the state of Washington some eight hundred miles distant and even reached Idaho and Montana.

Given a grade of but twenty feet to the mile, the ice must have been sixteen thousand feet above sea level to have arrived at its termini. To the west—where one is filled with wonder at the mighty work accomplished—the ice had to traverse less than one hundred miles to reach the sea. Even if the grade was much greater in that direction, the ice must have been thousands of feet deep as it shoved its way far out into the Pacific to the point where the bergs tore themselves free from the parent field.

These stupendous bergs may have circled for a time in an eddy of the great Gulf of Alaska, swinging in a mighty orbit to the diapason of Old Ocean, before starting south to tropical waters, there to be dissipated. Grinding, jostling, pushing one another, turning somersaults, scintillating prismatic colors of great beauty and mammoth design, slicing off protruding promontories here and there from the shore, sometimes grounding and massing the whole parade, ploughing the succession of great fiords that constitute the famous "Inside Passage" to Alaska, reshaping the whole Pacific coast line for a thousand miles,—such must have been the stupendous scene that was enacted where the opposing forces of the Japan Current met the cold air and waters of the North Pacific, unfortunately for us before man had a written language.

If we take Surprise Lake, twelve miles east of Atlin Lake, as the névé or dome of alimentation (which seems but reasonable as it is the highest lake of any size in the region), we shall find a recession of altitudes in every direction for many miles; but as we arrive at the periphery, we notice a very marked increase in elevations. This leads one to suspect that before glaciation the head waters of the Yukon were much higher than at present.

The study of the rivers and mountain ranges discloses the mighty struggle Mother Earth had with this great protuberance of ice upon her breast. Depression must have occurred; then after the ice receded, an effort at readjustment came into play, which may be, probably is, proceeding at the present time.

The rivers and creeks seem to be searching, almost in vain, for a feasible route to the sea,—they evidence a lack of decision that is quite noticeable. Sloko Lake is but two and one half miles from Atlin Lake to the south, but is some two hundred and fifty feet higher. At one time it drained into Atlin Lake; later the outlet was filled with morainic deposition and its course changed in consequence. The outlet at present follows an erratic course, first moving to the east, then bending to the south and west, finally joining Taku River and emptying into the Pacific, thus in its later stage reversing the direction it had originally taken.

The present front of Llewellyn Glacier is about two miles from the shore of Lake Atlin and near its southern end. The average rate of recession seems to be about twenty feet per annum. If this has been constant, the ice left the shore of the lake more than five hundred years ago, and the north end of the lake, some twenty-three thousand years ago,—a calculation which corresponds very well with estimates as to the beginning of the post-glacial period. If conditions remain the same, recession should be completed in about ten thousand years, when there will be discoverable hardly a remnant of the present glaciation.

There are few real glaciers of good size more easily accessible than these of the Cascadian region, if one knows the routes to pursue. And yet, probably the most readily attainable one of all, Llewellyn, is coyly hidden amidst the wilds of northern British Columbia, in a practically new and wild region.

To visit Llewellyn Glacier, we disembark from the boat at Glacier Bay, and an easy walk of two and a half miles by wooded trail and terminal moraine takes us to the face of the ice. A few minutes' climb over morainic débris lands the aspirant on the ice. Women, and sometimes men, hesitate at this point, thinking of crevasse, moulin, bergschrund, and other dangers that may confront the climber, as the guide assists in adjusting "ice creepers" and runs out the long rope that all may have something to hang on to, while traversing the first two hundred yards to the more nearly level ice field above. When this is attained, the rope is coiled up and every one is at liberty to traverse at will the nearly level ice plain, which is many miles in extent.

On the right is the wreck of the great ice arch of 1919, illustrated on page 617 of the December, 1919, issue of NATURAL HISTORY. Only the abutments are left now, covered with gravel. No one would suspect the structure had ever existed except for the photograph and background. High above the remains of the arch, in all their majesty, rise the snow-covered peaks of Mussen Mountain, which is a long range extending south well into the ice field. It was from the southern peak of this mountain that the panorama photograph of the northeastern portion of the névé (p. 614, NATURAL HISTORY, December, 1919) was taken, August 10, 1918.

In a southern direction the seracs (ice pinnacles) are several miles away; nevertheless, many people make a start for them, not realizing the distance. The thirsty climber eagerly drinks the clear, cold ice water found running in pretty, ice-blue rivulets on the surface and disappearing in crevasses or moulins of great depth and loveliness.

On the left, about a mile distant, the wide, fan-shaped medial moraine is slowly coasting along on top of—and quite a bit above—the otherwise smooth surface, to its destiny as an addition to the ground moraine, thence to be scattered, sooner or later, by the streams flowing into Glacier Bay, silt-coloring that body of water for miles before sinking.

Beyond the medial moraine towers the precipitous face of Tsatia (an Indian name meaning rocky mountain), with Sloko Range beyond, ten to twenty miles away. To the right of Tsatia and several miles away, Llewellyn Mountain, a giant nunatak, with its sharp peaks, cirques, and beautiful, cascading glaciers, is bound to bring into requisition one's binoculars, with a sigh over the fact that it is too far away for a climb unless one is prepared to camp out a night or two.

You look down into a crevasse or moulin and discover that you not only cannot see the bottom, but that you cannot even hear the chunks of ice you throw down strike the bottom. Then you realize that the ice is several hundred feet deep where you are standing; and then, perhaps, you may feel a slight jar under foot, coupled with uncanny grinding and creaking, and horrible dæmon groans sounding up from dungeon depths below,—and you take a more or less hurried leave for *terra firma*.

But you want to go to those seracs. If you are a good walker, take a lunch with you and make an early start. After visiting the seracs you may climb the south peak of Mussen for the view of the névé, which is hidden by the seracs although it is about six thousand feet above sea level. With creepers you can descend safely to the bergschrund, taking care to find a solid carapace on which to leave the ice and ascend the mountain. The higher you go, the more vast and grand is the view, and you feel well repaid even if it is late in the evening when camp is reached.

Atlin Harbor offers sanctuary to not a few ships

Sitting in the gloaming by the cheery camp fire after the evening meal,—the silent, sentinel pines dimly lighted, the black wall of night beyond, the vast, unpeopled, primitive wilderness surrounding,—our thoughts revert to the long ago. We think of the Archean world, the Palæozoic Era, with epochs of volcanic activity and mountain building, the Mesozoic Era with its giant reptiles, the Cenozoic Era, with its progress of mammals and extinction of older species, the Cascadian Revolution, when these very mountains were newly born, the slow progress of Palæolithic and Neolithic man, the too short span of human life, our puny physical strength on the one hand, our wonderful anatomy and intellectual achievements on the other, and finally the great future.

We view with the eye of retrospection this vast work of glaciation, this mighty accumulation of snowflakes, this masterful work of frost and snow and rain. We visualize the majestic moving of the tremendous ice mass as a whole, slowly, surely, unintermittently grinding away the mountain slopes through the ages, carving valleys, making depressions for a most wonderful chain of lakes,—Linderman, Bennet, Tagish, Marsh, Atlin, Surprise, and Teslin, with many smaller ones,—to be the fountainhead of the mighty Yukon River. With the mind's eye we see the ice mass carrying loam and clay for miles, transporting great blocks of granite and porphyry, leaving these as monuments for man to ponder over and thus to learn to read the mighty works of nature. Wonderful ranges of mountains, cut in the most fantastic shapes of slope, of crest, of minareted peaks, almost unbelievable in their architecture and design, add their beauty to the picture. Such impressions we are permitted to enjoy free from the hand of nature, if we only take the time and the pains to look,—and, once we look, we experience a deeper understanding of all that is beautiful and divine in the world, without regret for the few golden moments that have been devoted to the unfolding, developing, and ennobling of the soul within.

Up where Auroras flash on high,
And snowy mountains pierce the sky,
And wintry blasts go charging by,
There the Great High North begins.

Up where the huskies pull and strain
At loaded sled o'er snowy plain,
And glorious sunsets glow and flame,
There the Great High North begins.

In the Great High North, 'neath the tundra's glare,
Hidden for æons, the Gold King's lair
Its millions brought forth in the cold gray air,
Where the Great High North begins.

There summer sings a softer rhyme,
In trembling aspen, groves of pine,
And wandering glaciers gleam and shine,
Where the Great High North begins.

There warm the prospectors' camp fire shines,
'Midst balsam boughs and soughing pines;
There the gray wolf howls and the great loon cries,
As the bright moon glows in the eastern skies;
There, far beyond the last tin can,
Are left the haunts of civilized man.

The camp-fire's smoke curls high aloft,
Through which the starshine peeps so soft;
Amidst such scenes, the soul unfolds,
Expanding as the page unrolls;
Brings back to man his truer soul,—
Brings into sight a better goal,
Unfolds the best that in him lies,—
Unfolds a gleam of Paradise;
For here in the presence of the Great Supreme,
The soul a-worship, detects the gleam
Of Mother Nature's love for you,
A love that thrills you through and through;
A love that crushes future sins,
In the land where the Great High North begins.

SCENES FROM THE ATLIN LAKE REGION OF BRITISH COLUMBIA*

FROM HITHERTO UNPUBLISHED PHOTOGRAPHS

BY

L. C. READ

HIGH FALLS ABOVE MORAINE LAKE

This graceful waterfall, now concealed by a bend in the rock, now emerging to descend precipitously, is one of the many pleasing features of the landscape. Timber line is about 1800 feet above the lake in the foreground

GLACIER BAY

A superb view taken from a vantage point on the bluffs to the south of the bay. It is at Glacier Bay that the traveler disembarks to reach the heart of the region described—a fitting portal through which to enter this land of enchantment

MINTO MOUNTAIN, ATLIN LAKE

From Third Island one sees in the distance the outstanding mass of Minto, known to the Indian as "Keyun," the birch-tree mountain

LLEWELLYN GLACIER

With its snow and ice stretches aglint, this vast, masterful glacier is one of the glories of the region. The photograph is taken from the east side of Mussen Mountain and shows Llewellyn Mountain, the medial moraine, and the seracs

A VIEW OF THE SERACS

These ice pinnacles, known as seracs, rise to a height of from fifty to one hundred fifty feet. The photograph is taken from a distance of about a quarter of a mile

LOOKING OUT FROM DUFF'S ISLAND, IN TORRES INLET

A glorious view is secured from this site of the snow giants that guard the northland. On the extreme left is McCullum Mountain; adjoining it is Sloko Range. The massive mountain in the center is Tsatia, shown also, though from a different angle of approach, on p. 261. On the extreme right, in dazzling raiment, stands Llewellyn Mountain

TSATIA MOUNTAIN

Near the southern end of Atlin Lake, whose waters, ninety miles in expanse, contribute to the mighty flow of the Yukon River, towers Tsatia Mountain, which in the Indian tongue means "the rocky mountain"

The mountain-girded Glacier Bay, viewed from the bluffs above Moraine Lake. In the middle foreground is the formation known as "the Elevator"

A scene on Sloko Lake. At one time this body of water drained into Atlin Lake, but morainic deposits later blocked its outlet and changed its course

At the northern end of Lake Atlin, Hitchcock Mountain, garbed in snows, confronts the elements. Sentineled by the evergreens, at the right of the picture, is Cole's Cabin

From "the Elevator" one is afforded an impressive view of the titanic mountains at the base of which lies Glacier Bay

RANGE SOUTH OF THE WEST ARM OF TAKU

This is at the very edge of the great ice field which extends to the south for about seventy-five miles

THE LIMESTONE RANGE

One of the majestically beautiful features of the eastern side of Atlin Lake is this range. The picture was taken from O'Donnell Road

THE DOME OF THE ICE FIELD
The little ice-bound body of water that appears to the right is known as Cerulean Lake

ATLIN MOUNTAIN

The picture shows the work of nivation on the mountain top. This is a telephoto of one of the heights seen in the illustration on page 253

SUMMER EVENING ON ATLIN LAKE

The poet has asked, "What is so rare as a day in June?" Yet rarer is the charm of a June evening in the northern clime with the calm waters of Atlin Lake stretched out before one in majestic repose

RECENT MOVEMENTS OF SWISS AND ALASKAN GLACIERS

BY

CHESTER A. REEDS *

A NEWSPAPER dispatch of May 24 from Berne, Switzerland, states that certain Swiss glaciers are advancing. Earlier accounts state that the snowfall on the Alps Mountains has been very slight during the last winter and, as the rainfall has been very meager during the spring months, the country is suffering from drought. The level of the water in some of the glacial lakes has been lowered to such an extent that "lake dwellings" of primitive man have partly emerged.[1]

Why should the glaciers advance during a season of diminished snowfall? At first thought this may seem incongruous but further reflection will afford an answer. From previous observations it is known that the slight snowfall of this last winter will not affect the lower ends of the Alpine glaciers until 1961, for normally it takes forty years for a season's fall to pass through the length of the larger Swiss glaciers. In other words, the present advance of the ice tongues is due to the heavy snowfall of 1881. These statements are based on the commonly accepted theory of climatic fluctuations of glaciers in the Alps where for a series of years ice fronts advance or recede slightly in response to variation in snowfall. As the sizes of glacier reservoirs vary, some being large and others small, the amount of snow that each will catch will also vary. Another important consideration is the length of the various glaciers. The shorter ones will respond more readily to increased or diminished snow supply than the longer ones. It follows thus that the termini of some glaciers are advancing while others are retreating or stagnant, not yet having responded to the snowfall of a certain season.

[1]See NATURAL HISTORY, March-April 1921, pp. 172-4

The Alaskan glaciers are larger than those in the Alps, in fact they are the largest in the world except those in the polar regions. Most of the glaciers of Alaska are little known; there are thousands of them; a few hundred have received names but many have never been seen; some have been mapped in considerable detail and studied at different times. The various expeditions of the United States Geological Survey, the Boundary Survey, the Harriman Alaska Expedition, and the Alaskan Glacier Studies of the National Geographic Society by Tarr and Martin have contributed scientific reports of great value.

It is held that the mountain districts in Alaska, together with the climatic conditions, are jointly responsible for the existing glaciation. According to Professors Tarr and Martin,—

"It is the combination of lofty mountains facing a sea coast where warm, humid, onshore winds bring abundant moisture, in a northerly latitude, that gives the Pacific mountains of Alaska from 80 to 200 inches of precipitation yearly. It is the loftiness of these mountains, and the northerly latitude, that cause a large proportion of this precipitation to fall in the form of snow. Therefore, much more snow falls in a winter than can melt in a summer, causing permanent snowfields and great glaciers. The variations in altitude, in latitude, in precipitation, and in direction of slope cause the principal variations in the present size and condition of the glaciers. Most of these variations are associated with differences in the mountains, but it is not certain that the climate is responsible for all the glacial oscillations, nor that the ice tongues are consistently waning."

Especially interesting in this connec-

* Associate Curator of Invertebrate Palæontology in the American Museum

tion is the earthquake theory offered by Tarr and Martin for the abnormal glacier advances in the St. Elias Range near Yakutat Bay. In September, 1899, vigorous earth shakings affected the district and huge masses of snow, ice, and rock were consequently avalanched from the mountains to the various glaciers occupying the valleys. Previous to 1899 the history of the glaciers in the Yakutat Bay district had been one of recession and in most of them the retreat continued to 1905 and in some to 1913.

In 1905 it was noted that the Galiano Glacier had undergone great changes, and from the growth of the alder bushes on the moraine it was inferred that the change took place in 1900 or 1901. The Galiano Glacier, whose response was rapid, is a short glacier only 2 to 3 miles long with steep valley sides and head.

The four glaciers, Haenke, Atrevida, Variegated, and Marvine, were completely changed in 1906. These glaciers are somewhat larger than the Galiano, being 7 to 10 miles in length. The first three are about the same size. The Marvine is probably larger. The transformation which took place was from a stagnant condition to activity, and from smooth to broken surface together with actual forward movement and pronounced thickening of the glaciers. In each case the change took place suddenly and terminated abruptly within one year. Since then ablation has been at work healing the broken ice, which has again relapsed into a stage of stagnation.

One glacier, the Hidden, 16 to 17 miles long, probably advanced in the season of 1907. Previous to 1906 its terminus was in a smooth, stagnant condition, but in 1909 its front was two miles farther down its valley. There had been accompanying spreading on the margins and a noticeable thickening of at least eleven hundred feet.

In 1905 and 1906, the Lucia Glacier, 17 to 18 miles long, showed no sign of past change, but in 1909 its moraine-covered lower portion was greatly crevassed and accompanied by lateral spreading.

In 1910 the Nunatak Glacier, 20 miles in length, began to move and before June its tidal front had advanced 700 to 1000 feet with some thickening. There was practically no lateral spreading because the glacier is confined to a narrow fiord.

Some of the larger glaciers like the Seward and the Hubbard have not yet undergone marked transformation. In all probability they will respond when time enough has elapsed for the impulse to pass from their distant reservoirs, through the long valley ice-streams to their fronts.

Thus, by noting the length of each glacier and the time of transformation, the glaciers of the Yakutat Bay district may serve as a rough chronometer of unusual events, such as earthquakes, which may act with or against the more normal movement of glaciers caused by climatic variations.

The earthquakes which affected this district in September, 1899, were the greatest that have been reported in more than one hundred years in Alaska, a region of abundant earthquakes. Elsewhere in Alaska, there have been no changes, so far as can be learned, analogous to those in the Yakutat Bay district. The Alps, whose glaciers have been studied with greater care and for a longer time than those of any other region, is not a section of abundant, great earthquakes.

The reports of the International Committee on Glaciers state that between 1895 and 1907 the majority of advancing glaciers in Europe and Canada moved forward 10 to 60 feet a year. In exceptional cases a few progressed more than 100 feet, and one, the Vernagt-Ferner of the eastern Alps, 450 feet in a year. In response to the earthquake disturbance in Alaska in 1899 the Haenke Glacier in 1906 advanced more than 4000 feet in less than ten months and the

Hidden Glacier more than 10,000 feet in 1907, but these abnormal advances did not last a year. In Europe the glaciers sometimes continue to advance for fifteen or twenty years when once an advance starts, the cycle from maximum to minimum being thirty-five to fifty years.

Last year the Allalin Glacier near Zermatt, Switzerland, advanced 120 feet; it is now moving at an increased rate and has blocked an important pass. Recently, the Lëtschen Glacier has advanced 270 feet; the Schwanenberg 231 feet; the Biserten 345 feet, and the Lower Grindelwald is moving at the rate of 6 inches daily. In fact, it is reported that nearly a hundred important Swiss glaciers under observation are advancing.

The Roseg Glacier of Switzerland, one of the ice-incased glories of the Alps

A TIGER SHARK

The tiger shark is an undiscriminating destroyer of life in the seas, for it does not scruple to bite big pieces out of other sharks in addition to devouring prey of remoter kin. Turtles, crabs, rays, and porpoises, among other creatures, fall victims to its voracity. Even sea-birds alighting on the waves are not immune to its attack. Among the disgorgings of the shark shown in the picture were numerous feathers, the indigestible finery of some plumaged visitant of the ocean

WHAT SHARKS REALLY EAT*

BY

JOHN T. NICHOLS†

FOREWORD: Popularly all sharks are "man eaters." As a matter of fact, very few are guilty of such misbehavior,—not that sharks seem to have any deep-rooted aversion to man as an article of food, although Doctor Coles thinks that they are somewhat particular as to their diet, but it would appear that in many if not most cases where man has fallen a victim to their voracity, it has been because he happened to be handy. What sharks really eat is set down by Mr. Nichols, who has recorded the observations of Doctor Coles and Mr. Bell.

The illustrations accompanying this article are from photographs kindly supplied by Dr. E. W. Gudger. The hammerhead depicted was harpooned in the harbor of Beaufort, N. C.; the tiger and the nurse sharks were taken at Tortugas, Fla., at the Marine Laboratory of the Carnegie Institution of Washington.—F. A. LUCAS.

SEAS all over the world have their sharks, as they doubtless have had since far back in geologic time, but these marauders are not nearly so numerous in high latitudes or temperate regions as along the sun-baked shores of the tropics. As we go south along our own eastern seaboard, they become abundant at the capes of the Carolinas, where the Gulf Stream hugs the shore for the last time before spreading out to the east across the Atlantic, and here, at Morehead City, North Carolina, near Cape Lookout, Mr. J. C. Bell, of the American Museum's department of preparation, spent some weeks last summer obtaining plaster molds for reproducing sharks for our exhibition series. He was the guest of the Ocean Leather Company, which furnished specimens for and aid in casting. Dr. Russell J. Coles, who was instrumental in arranging for Mr. Bell's trip and who was himself "sharking" off Cape Lookout, also provided specimens. It was Doctor Coles, it may be remembered, who secured the great devil fish or *Manta* which hangs above the fish exhibit in the north corridor of the American Museum. Some excellent material was obtained which will, in due course, be placed on exhibition. More than that, thanks to Mr. Bell, exceedingly interesting observations bearing on the habits of sharks were made.

The tiger shark (*Galeocerdo tigrinus*) is a large species found in all warm seas, and whether considered from the point of looks or habits, the name is most appropriate. It has a blunt head and heavy shoulders. The body tapers back to a long, slender tail, and its sides are marked with dark stripes and spots. This marking is quite distinct in the young, but as the shark grows it becomes less well defined, like a pattern in watered silk, and, it is said, finally disappears altogether. The tiger shark's maximum length is thirty feet, but specimens of the largest size are seldom seen. Its mouth is very large, and is armed with a row of big, flat, cutting teeth quite different in outline from those of any other shark. Each tooth is roughly sickle-shaped with a fluted edge suggesting a patent bread knife and a triangular point at the summit projecting obliquely outward.

This is one of the sharks most dreaded in the West Indies, and, indeed, it seems quite capable of living up to the evil reputation of being a man-eater, although we know of no authentic evidence that it is such. Dr. Coles has written of it in the following words:[1]

"There can be little doubt that the tiger shark regularly preys on other sharks to a considerable extent. During the few weeks that I was watching the fishery at Cape Lookout I examined the stomachs of three young tiger sharks, and in all three I found cleanly bitten pieces of freshly eaten shark meat with skin attached, just as if the chunk of meat had been cut from the side of a

[1] Coles, Russell J., "The Large Sharks of Cape Lookout," *Copeia*, No. 69. 1919.

† Associate Curator of Recent Fishes, American Museum.

The tiger shark has the evil reputation of being a man-eater. Even if its alleged propensity as such be exaggerated, its capacious jaws would have no difficulty in encircling a human victim, a small boy being a particularly manageable morsel

shark. In the largest example, 7 ft. 9 in., in length, caught in my nets June 25, there were eleven of these chunks of shark meat of from one to five pounds each in weight, and they represented *hammerhead*, *sharp-nosed*, and *ground sharks*.

"Additional observations made during the first week of August on three more tiger sharks, each in excess of twelve feet in length, confirm my former observations as to the varied character of their food. In one of them I found a freshly eaten loggerhead turtle, approximating 100 lbs. in weight, which had been bitten through both shells, in three places and the pieces of shell much crushed, yet all parts of the turtle were present.

"Probably tiger sharks will use as food, when hungry, any creature which they find moving in the water, for which reason they must be dangerous as man-eaters; but I do not regard them as nearly so dangerous as a white shark which has once acquired the habit of eating human flesh. While it is not fastidious, I have no evidence as yet that even the tiger shark will eat unclean food, and in my opinion, the sharks which eat garbage or putrid matter are exceptional individuals, which, through some accident, have acquired the habit."

Speaking of a 12½ foot individual, he says: "Stomach contained most varied assortment of food that I have ever found in any shark, consisting of parts of three very large stone crabs, one bird, the small diver called locally water witch, and various unidentified substances."

Mr. Bell examined the stomach contents of more than thirty individual tiger sharks, mostly from nine to twelve feet in length. Of these sharks 76 per cent had been eating such large creatures as sea turtles, other sharks, and large rays and porpoises; 38 per cent had consumed a variety of smaller creatures (crabs, horseshoe crabs, mackerel, shad, and other fish, and in one case a water bird); 6 per cent had swallowed the bones of domestic animals, probably in their rôle of scavenger. That is, it was found that one individual contained among other material beef bones and hair, and a second, landed on the dock still alive, vomited several small mammal bones, among which the leg bones of three sheep have been identified.

Other sharks constituted the largest single item of diet for the tiger sharks examined. The stomach of an individual 11 ft. 3 in. long contained a large piece from the side of the head and gills of an eleven foot hammerhead taken in the net with it. In the stomachs of four tiger sharks taken on July 13 were found black-tip sharks (*Carcharhinus limbatus*) bitten in large pieces, some about in half. An individual 12 ft. 2 in. long had swallowed a large shark of 8 or 9 ft. bitten into seven or eight pieces. An eleven foot individual contained a small hammerhead of about $3\frac{1}{2}$ ft. intact and several parts of other sharks. In most cases, at least, the sharks consumed appear to have been caught in the nets and so to have fallen an easy prey. It is doubtful if so many of them could have been captured in the open, although the evil tiger doubtless carries always with it the will to consume its weaker brethren.

It is more than doubtful if the tiger shark is ever quick enough to capture porpoises in the open, but it must be a very serious enemy to the rather sluggish loggerhead turtles, through the tough shells of which it bites with comparative ease. Several of those which Mr. Bell examined had pieces of big turtle in their "innards," and one large female contained a loggerhead intact. Mr. Bell's observations attest to the ravenous appetite of this shark and the variety of its food. In this particular case, owing to the fact that other sharks were being taken in the nets in large numbers, these made up much of its diet. Ordinarily loggerhead turtles and valuable food fish are probably consumed in quantity.

From the stomach of one of these sharks was taken the tail spine—more than a foot long—of a big horseshoe crab; why a shark should eat creatures about as nutritious as a basket of shavings is a puzzle—a still greater puzzle is why the long and sharp spine did not pierce the walls of the stomach.

A comparatively small series of large cub sharks (*Carcharhinus commersonii*) were examined. Making allowance for their somewhat smaller size, these showed a very similar range of food to that of the tigers—including smaller sharks, rays, the fin of a porpoise, shad, mackerel, and crabs.

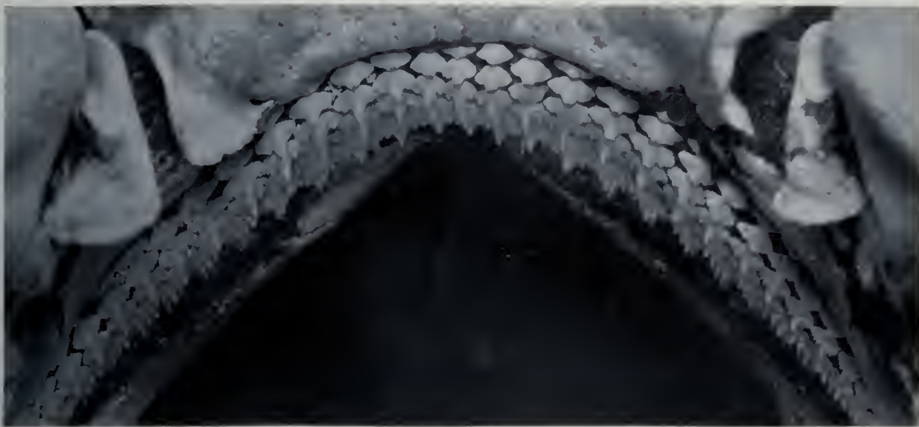
Among the formidable and voracious denizens of tropical and subtropical seas is the hammerhead shark. The eyes of the shark are located at the extremities of the mallet-like prolongations. The object of this peculiar head structure is apparently to function as a bow rudder

Thus it appears that while sharks have an evil reputation, they are far more dangerous to one another than they are to man, and while from man's point of view cannibalism is not considered good form, yet among sharks it may be tolerated as tending to lessen their numbers. And now that man has begun utilizing sharks for food, leather and fertilizer, our sympathies are largely with the sharks.

The nurse shark (*Ginglymostoma cirratum*) is a creature of different make-up from the species we have been discussing. It is a rather slow-moving animal with a

A HEAD-ON VIEW OF A NURSE SHARK

More slow-moving than many other species, this shark must nevertheless be the equivalent of a "do not trespass" sign to many of the smaller swimmers. Its eight or nine feet of length and three hundred to four hundred pounds of weight require many a squid or inkfish for proper maintenance



small, thick-lipped mouth. Its teeth also are small, although each one is sharply pointed, and they are arranged in a sort of pavement, with their points directed backward, all or most of the rows functioning at the same time. In the tiger shark or in the numerically abundant ground shark group to which the cub belongs, only a single anterior row of big, cutting teeth is erect and functional, numerous other rows lying superimposed out of the way behind it, in turn to become erect and functional as the preceding row is worn out and discarded. The nurse shark has an exceedingly tough, resistant hide, so heavily armed with minute bony points as to be difficult of penetration by a harpoon. This hide may furnish some protection against its fierce relatives, at any rate, they do not appear to prey on it, although it is too sluggish to get out of their way. Two nurse sharks between eight and nine feet in length, each weighing between three and four hundred pounds, had been feeding on squid or inkfish, and one of them also contained a little, partly digested shrimp.

One of these nurse sharks was a female, containing twenty-eight eggs,

Equipped with row upon row of sharply pointed teeth, all or most of which function at the same time, the expanded jaws of the nurse shark spell peril for any small creature that is luckless enough to attract the hungry gaze of this shark each about as large as a goose's egg and with a delicate, horny shell. They suggested the tougher-shelled eggs of skates, which are washed up along our shores in great abundance and are called "sharks' eggs" or "devil's pocketbooks" by seaside visitors. Above these there were a large number of smaller eggs ranging from the size of a pea to that of a large-sized marble.

Present-day sharks differ little from those which swam the seas in early geologic time, the first and simplest form of true fishes, and yet it is among the sharks and rays (which are no more than flattened sharks) that we find the most highly developed systems of reproduction in the fish world. In most modern sharks the young attain considerable size within the body of the mother, and the egg and helpless stages, in passing through which other young fishes must face so many dangers in the ocean, are thus protected. This is true of all our eastern, coast-wise species, with the possible exception of the nurse shark. In other parts of the world there are sharks which lay large eggs with tough shells like skates' eggs.

Dr. E. W. Gudger has for years been especially interested in the case of the nurse shark. He believes that the egg of that species, although it has a shell, is never deposited and that its young also are born alive. If this can be proved, we have in *Ginglymostoma* an extremely interesting transition form, for an egg-shell would not be formed unless this genus or its immediate ancestors deposited their eggs.

These are young nurse sharks. The lower of the two fish is placed on its back in order to show the conformation and markings of the under surface. In a still earlier stage numerous spots are found also on the upper surface

FISH AS MOSQUITO DESTROYERS[1]

AN ACCOUNT OF THE PART THEY PLAYED IN THE CONTROL OF YELLOW FEVER AT GUAYAQUIL, ECUADOR

BY

MICHAEL EDWARD CONNOR, M. D.

GUAYAQUIL, Ecuador, one of the oldest cities of the Western Hemisphere, has at no time been noted for the salubrity of its climate. Don Antonio de Ulloa, who visited it toward the middle of the eighteenth century, reported that even then fevers were very common there and, knowing as we do to-day that certain insects are responsible for the transmission of certain diseases, his further comment has especial interest. "Though all these hot and moist countries swarm with an infinite variety of volatile insects," writes the Spaniard, "yet the inhabitants are nowhere so greatly incommoded as at Guayaquil." Writing as recently as 1912 the Right Hon. James Bryce refers to Guayaquil as the pesthouse of South America, the last stronghold on the continent (if one excepts the banks of the Amazon) of the deadly yellow fever.

Today, less than a decade after the denunciation just cited was written, Guayaquil is a city redeemed from the yellow fever peril, which, first recorded in that community in 1740, maintained its hold until May, 1919, when the last case was officially reported. All Ecuador, and not merely Guayaquil, is enabled to take a forward stride as the result of this accomplishment, for the isolation imposed upon the chief port of the country has been an important factor in retarding the development of the wonderful resources of the republic.

How was this improvement in sanitation brought about? The reader familiar with the achievements of our government in controlling disease-carrying mosquitoes at Panama and elsewhere will not unnaturally assume that fumigation, oiling, screening, and the inspection of mosquito-producing containers were the methods resorted to. In Guayaquil, however, partial reliance was placed upon an animal ally of man—a fish so indefatigable in the destruction of the larvæ of the dangerous *Stegomyia* mosquito that through its agency the breeding of this insect in small containers has been reduced from 100 per cent. to less than 2 per cent., a figure not far from complete extermination.

The yellow fever mosquito breeds by preference in fresh-water containers in or near human habitations, and is rarely ever found in pools of water on the surface of the ground and never in the fields or swamps. It is a domestic mosquito and clings to inhabited buildings with tenacity. It does not fly any considerable distance and avoids direct sunlight. The female deposits between one hundred and one hundred fifty eggs at a time. These eggs are deposited on the surface of the water, always in a barrel, tank, tin can, flower vase, broken bottle, or some other receptacle holding fresh water. From each egg there comes a wriggler or larva, which after several molts finally reaches the adult stage and, if it be a female, starts at once to secure a victim from whom to suck blood. Should this victim be ill with yellow fever in the early stages, the mosquito will take up in the blood germs of the disease, which after a period of about twelve days in its body will be injected into the next victim that the mosquito bites.

The water supply of Guayaquil pro-

[1]At about the time that Dr. Connor was engaged in yellow fever control, the Rockefeller Foundation, under whose auspices his work was conducted, also became interested in the rôle played by fish in malaria control. The latter demonstration was conducted by Dr. H. H. Howard (Director for the West Indies of the International Health Board) in Hinds County, Mississippi, from 1918 to 1920. A report of this work is found in Document No. 7486 of the International Health Board, entitled, *Use of Top Minnow (Gambusia Affinis) as an Agent in Mosquito Control.*—THE EDITOR

vides for only forty liters per capita per diem, and this quantity of water is delivered to the people during two hours each day. It is, therefore, absolutely necessary to store water in some sort of container if the household expects to have sufficient to meet its daily needs. The containers used in Guayaquil can be divided into two classes—tanks and other receptacles. Tanks are to be found in the better equipped homes and are permanent fixtures. They have a capacity of from one hundred to five hundred gallons and are provided with valves for the intaking and outletting of water. They are located against a wall or partition, high up to gain head pressure. There are more than 7000 tanks in service at Guayaquil. Other receptacles comprise barrels, oil tins, large earthenware bowls, etc.; the last census made by sanitary inspectors showed more than 30,000 "other receptacles" in actual use.

The problem at Guayaquil was how to conserve the water for a population of 100,000 and at the same time render the containers mosquito-proof, and to accomplish this within as short a time as possible because speed meant a great saving in human lives. The first thought would be to destroy the mosquito breeding places, by doing away with containers. This could be achieved by installing a modern water system carrying an abundance of water which would be available to the people at any hour of the day or night, but this work could not be consummated under two years from the date of its inception and in the meanwhile yellow fever would be killing hundreds. The government of Ecuador has contracted for a modern system of potable water, and the work is being rushed to completion. The problem of controlling yellow fever while awaiting the installation of the water system reduced itself to mosquito-proofing all necessary water containers in the city.

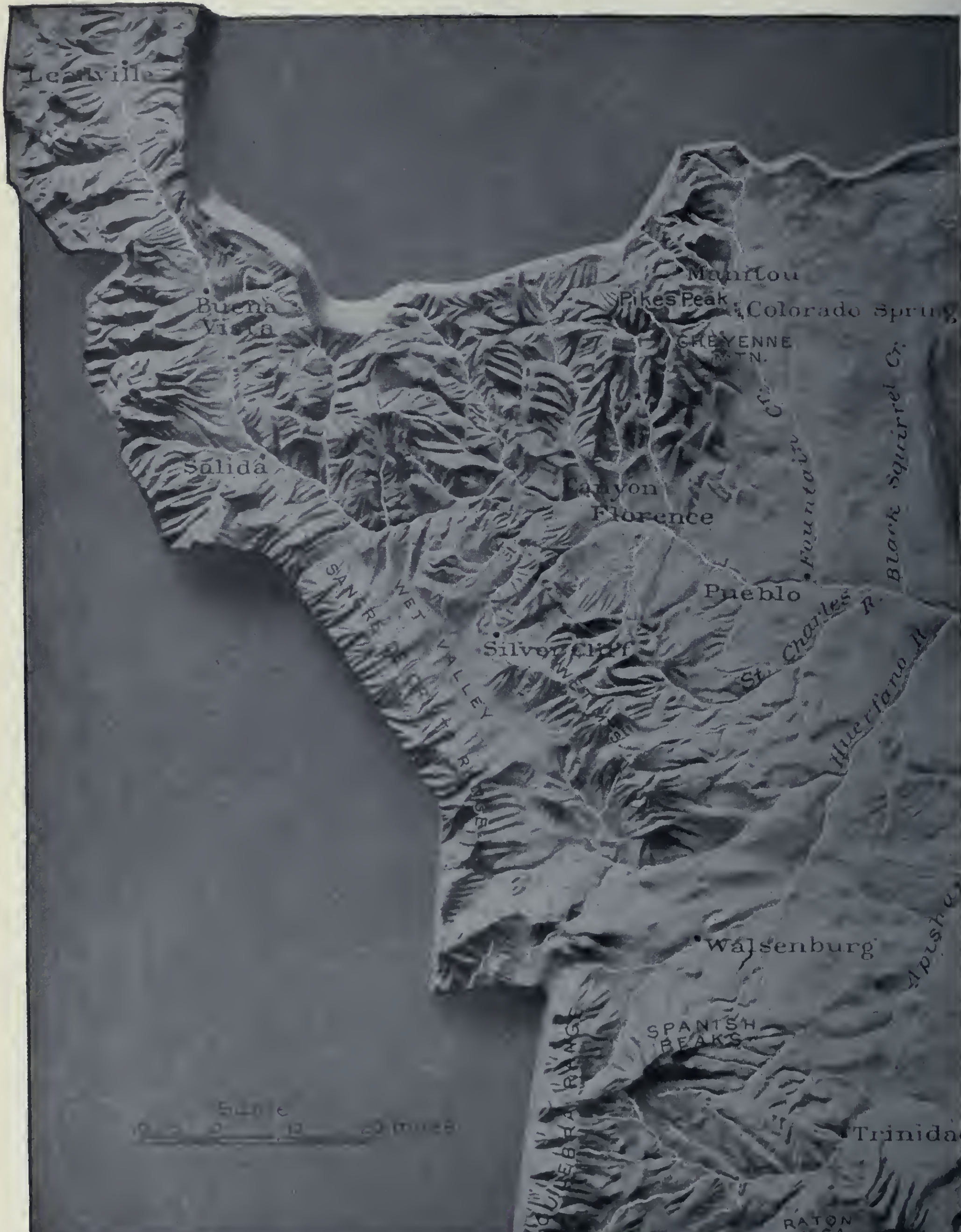
The device used in Cuba and Panama, namely, covering the mouth of the barrel with wire screening and placing a spigot in the lower part from which water might be drawn, was a practical measure in ordinary times and was used in Guayaquil for a short time. But because of the difficulty of securing materials in Ecuador, it was thought best to try the method of straining the water through muslin to separate the mosquito larvæ. This required, however, a great deal of time, and there was always the possibility of contaminating the water through a typhoid carrier in the sanitary squad.

A small fish, commonly known as the top minnow, had been introduced into Ecuador some years before the present campaign started. This fish is found in streams and will consume mosquito larvæ. We experimented with top minnows in fresh water containers but found them unsatisfactory for ordinary receptacles, such as barrels, etc. They would not eat the mosquito larvæ in these containers if other food material was available, and as the water in Guayaquil is delivered to the people untreated, it has with it considerable débris. On this sediment the top minnows lived contentedly. In a glass jar in the laboratory they would readily eat all mosquito larvæ given them, but when placed in a barrel or container, they were less dependent on this food. Again, the top minnow is not a hardy fish, and the concussion produced by dipping a pail into the water barrel was sufficient shock to kill it. The hope nevertheless persisted that a fish with capacity for consuming mosquito larvæ and yet possessing sufficient hardiness to resist rough treatment might be found in the streams near Guayaquil.

The next fish experimented with is known locally as the *huijas*, a variety of perch. This fish is a voracious eater of mosquito larvæ and resists well the rough handling of long trips in pails and cans. With this fish our problem appeared to be solved, but after a few weeks' trial the *huijas* revealed itself as extremely restless and as unwilling to accommodate itself to the small containers. It also exhibited remarkable jumping qualities, rising sometimes three or four feet to free itself from the container. The *huijas* was abandoned for the *chata*, a sardine. This fish possessed all the good qualities of the *huijas* and none of its defects. It had the additional characteristic of spending the greater part of its time on the surface of the water, but when anyone approached the container, it would swim to the bottom and remain there until the cause of its fright was removed. The *chatas* are not plentiful and are, therefore, more expensive to use than the *chalaco*, the next fish tried, which was finally adopted as the most satisfactory for consuming mosquito larvæ and mosquito eggs in small containers. The net cost per fish to the Yellow Fever Service is one-half cent, and this will be reduced as soon as the hatcheries already established come to production.

The method of using the fish for the purpose of mosquito-proofing water containers is simple in the extreme. Contracts are made with local fishermen to deliver so many thousand *chalacos* in good condition at our *bodegas*, where they are placed in a specially prepared well, the conditions of which approximate those of the stream from which the fish have been taken. After a few days the fish are removed to a second well, the water of which is the same as that used by the city. No food, other than that which the fish find in the water, is given them. Sanitary inspectors notify the *bodegas* a day previous to the distribution as to the approximate number of fish they will require for their districts that day. The fish are then taken from the wells and placed in tins or pails and delivered to the inspectors. Instructions have been given to each inspector that every fresh-water container in his district is to be supplied with one fish, regardless of the presence or absence of mosquito larvæ in the container at that time. The public is encouraged, personally, by notices in the newspaper, and by the inspectors themselves, to exercise reasonable care in protecting the fish. The public of Guayaquil has responded in a whole-hearted manner to the requests of the Yellow Fever Service, and many families have in their possession at this time the identical fish which was given them to mosquito-proof their water container nearly eighteen months ago.

More than 30,000 water receptacles have in this way been purged of mosquito larvæ in a relatively short time and at a minimum of expense. With the continued use of fish it is believed that the yellow fever mosquito can be reduced to such small numbers that, should a few cases of the disease be introduced into the community, it would not spread.



DRAINAGE BASIN OF THE ARKANSAS RIVER IN COLORADO

Pueblo and the region about it suffered most through the recent devastating floods, which left in their train death and destitution and spread terror even to regions beyond the reach of their menace

FLOODS IN THE PUEBLO DISTRICT

BY

CHESTER A. REEDS*

THE recent disastrous floods at Pueblo and other Colorado towns in the Arkansas River valley have attracted nation-wide attention. The floods on the Platte River at Denver, Colorado, although less severe, have also damaged property and caused loss of life. These river floods have arisen from torrential rains and cloud-bursts in the headwaters of the Arkansas and Platte rivers. According to the reports of the United States Weather Bureau, the amount of precipitation in inches at Pueblo and Denver was as follows:

	Pueblo	*Denver*
June 2, 1921	.12 inches	.02 inches
" 3, 1921	1.80 "	.08 "
" 4, 1921	2.92 "	2.04 "
" 6, 1921	.08 "	.06 "
Total	4.92 "	2.20 "

The newspaper accounts state that rain fell in this district on June 5 but the Weather Bureau reports the Pueblo record for that date missing; Denver, .42 inches. The annual precipitation for Pueblo and Denver is slightly under 15 inches. It is thus remarkable and unusual for one third of the annual precipitation to fall at Pueblo in the four days mentioned above. On May 31, 1894, Pueblo was swept by a flood similar to that of June 4, 1921.

The question thus naturally arises what peculiar geographical position has Pueblo that the city is subject to sporadic floods of such violent character as those reported in the daily press for the first week of June?

Pueblo and Denver are cities on the western margin of the Great Plains. These plains form a high plateau about 5000 feet above sea level and extend in a north-south direction from the Mexican border well into Canada. They are several hundred miles in width and slope gently to the east. Bordering the Great Plains on the west is the Rocky Mountain tract, which rises abruptly to an average elevation of 10,000 feet. Some of the mountain peaks rise higher, to 12,000 and 14,000 feet above sea level. Pueblo is situated at the confluence of Fountain Creek and the Arkansas River about ten miles east of the main Rocky Mountain front. Just west of Pueblo, however, the Great Plains embay the Rocky Mountain tract for an additional twenty miles so that a huge crescent-shaped amphitheater with a radius of about thirty miles centering at Pueblo lies to the west of the city. It was in this huge receptacle that the greater portion of the 4.92 inches of rain fell during the first week of June and converged upon the city.

Fountain Creek, which enters the valley of the Arkansas River at Pueblo through a narrow defile from the north, is primarily a Great Plains stream about sixty miles long. It drains the Rocky Mountain front about Pikes Peak, Colorado Springs, Manitou, and about twenty miles to the north of those places. Following heavy rains in the mountains at and above Pikes Peak, it becomes a raging torrent throughout its entire course. Most of the water which flooded Pueblo in 1894 came down this stream.

The Arkansas River, which enters Pueblo from the west across the floor and through the mid-portal of the Pueblo amphitheater, rises in the high Rocky Mountain tract about Leadville, Colorado, some 150 miles to the northwest of Pueblo. Many lateral tributaries are received by the river on its way to the Great Plains. The area drained is more than 4000 square miles in extent and is rudely triangular in shape with a 75-mile front facing Pueblo. The

*Associate Curator of Invertebrate Palæontology, American Museum normal rainfall in the mountains is 20 inches while that on the Great Plains is less than 15 inches annually. During the three months of January, February, and March, the precipitation west of Pikes Peak averages 5.1 inches as contrasted with 1.4 inches at Pueblo. The normal annual snowfall in the mountains and on the plains about Pueblo and Denver is 40 inches, normal sunshine 60 per cent., normal temperature 50°, maximum 85°, minimum 15°. Had the precipitation during the first week in June been as heavy in the mountainous sections drained by the Arkansas River as in the Pueblo amphitheatre, the floods would have been far more disastrous than they were. Normally there is a large volume of water in the river passing Pueblo.

Pueblo, a city of 42,908 inhabitants according to the 1920 census, is situated in the valley of the Arkansas River at an elevation of 4675 to 4750 feet above sea level. The normal flood plain of the river, which has been narrowed during the growth of the city, was originally about one half mile wide and divides the city into north and south sections. Except for a narrow strip along the river bank the south section is built on an old alluvial terrace more than fifty feet above the river. Most of the north section is lower, with an average elevation of 4700 feet above sea level. A narrow insular remnant of the old alluvial terrace, which parallels the west bank of Fountain Creek at the confluence forms a bit of higher ground. The northern limits of the city extend into the uplands facing the river some two miles distant. Fountain Creek divides this section into two parts, with the main portion west of this stream and the Grove section to the east.

The transporting power of a large river in flood time is most surprising. It varies as the sixth power of the velocity. Thus if the velocity of running water is doubled, it increases its transporting power sixty-four fold. Swift streams, therefore, have enormously greater power of transportation than sluggish ones. The Arkansas at Pueblo in normal times has considerable water and a strong current, for bridges are necessary, but during flood its velocity and consequently its power may be increased enormously. The chief elements upon which the velocity of a stream depends are its gradient, its volume, and its load of sediment. The steeper the gradient, the greater the volume, and the less the load, the greater the velocity. The average grade of the Arkansas River from Canyon City at the mouth of the Royal Gorge across the floor of the amphitheater to Pueblo is 15 feet to the mile, from Pueblo to La Junta, 8 feet, and from La Junta to the Kansas line, 7.3 feet. The area of the Pueblo amphitheater, with a radius of thirty miles, is 1413 square miles. The recorded rainfall over this surface for the first week in June was 4.92 inches and with one day's record missing, the total may have been 6 inches. Imagine half a foot of water 1413 square miles in area on a grade of not less than 15 feet to the mile, augmented with a very large but unknown amount arising from a mountainous tract more than 4000 square miles in area, pouring through the small end of a huge funnel at Pueblo. It is true a portion of this rainfall may have sunk into the ground and a part evaporated, but it is assumed that far more than one third of it ran off, for it fell, for the most part, on impervious shale rock and during a few days.

It is not surprising, therefore, that whole trains standing in the railroad yards were dashed from their tracks and that bridges were carried away by the onrushing wall of water, which rose up to the level of second-story windows and continued for days. The load of sand, gravel, and mud, besides wreckage of every description, must have been enormous.

Where mountain streams debouch upon a plain, they drop a considerable portion of their load, particularly the large boulders and pebbles. This is due primarily to an abrupt change in gradient, which affects the velocity and consequently the transporting power of the stream. Where the declivities are steep and the streams short, alluvial deposits arise with cone-shaped outline, the base resting on the plain and the top leaning against the mountain. In the next step where youthful river courses are defined the sediments are spread fanwise over the plain at the foot of the mountains. In a later stage of development where the various streams have had time enough to work headward far back into the mountains, to cut deep cañons and to unite, forming the head waters of a large river such as the Arkansas, the change in stream gradient from mountains to plains is not so abrupt as in the earlier stages and fine deposits are strewn for hundreds of miles along the river course.

The present Arkansas River and its tributaries flow in deep and narrow cañons in the mountains, but in crossing the Great Plains their valleys are wide and average about two hundred feet below the surrounding higher lands. Between Pueblo and the mountains the Arkansas valley is bordered in places by cliffs of moderate height, but to the east the side slopes are very gentle.

Extensive deposits of conglomerates, sand, sandstone, gravel, and clay, known as the Monument Creek formation, appear on the high divide between the Platte and Arkansas drainage basins from the foot of the Rocky Mountains eastward. There are two members, a lower one of sand and clays and an upper one of conglomerate and sandstone. They cap numerous buttes and plateaus. These sediments represent fan-shaped deposits of the early Tertiary. Fossil bones of *Titanotherium*, found in the upper member, indicate Oligocene age.

Deposits of loose sand and coarse gravel about two hundred feet thick cover wide areas of the high plains adjoining the Arkansas valley in eastern Colorado and extend westward to the vicinity of Fountain Creek. They have been named the Nussbaum formation and are supposed to be of Pliocene age. Locally the beds consist of loose sandstones or very sandy limestones with carbonate of lime acting as a cement. These beds are of alluvial origin, having been spread where they lie by the flowing water of streams.

Along the Arkansas River below Pueblo appear large areas of alluvium. The thickness of this deposit is from fifty to sixty feet in the central portion of the valley and has a width in the bottom lands from three fourths of a mile to a mile. It consists of fine sands and loam laid down by the river at various stages. During floods coarser material is added, particularly on the lower flats. Similar alluvial deposits constitute the bottom lands along Fountain Creek. Higher terrace levels appear in places along these streams, capped by sand and gravel. The higher deposits represent early, and the lower ones, the present or late Quaternary deposition.

Thus it may be stated in conclusion that, whereas great floods have occurred sporadically at Pueblo since the founding of the city and oftentimes during late geologic periods, they are bound to occur again. The causes are natural and cannot be changed. If the river's course is kept free from unnecessary obstructions and as wide as possible, the danger is not apt to be so great. With city parks along the river banks and strong levees behind them the remainder of the city occupying the low ground may be kept free from floods.

THE GOLDEN AGE OF PERU

BY

HAMILTON BELL

This article serves as an introduction to the high period of Peruvian culture, which terminated suddenly with the Spanish conquest. In a subsequent issue of NATURAL HISTORY Dr. P. E. Goddard will give an account of the gold utensils and precious ornaments of the period antedating the conquest that have come into the possession of the American Museum. The acquisition of the splendid Peruvian collection, including in addition to the objects of gold, interesting textiles, characteristic pottery, and other mementos of the ancient culture, is due, in the first place, to various benefactors, beginning with Henry Villard in 1892 and including the late Frederic A. Juilliard, and in the second place, to the explorer and scholar, Adolph F. Bandeliei.

GOLD, in the Ancient World, has from the earliest times held the first place in the scale of values. The Golden Age was to the Greek the *sumum bonum* of existence. The Christian can imagine no bourne more desirable than the Heavenly City—Jerusalem the Golden. The earliest heroic adventure was the quest of the Golden Fleece. The highest praise that could be given to anything was to call it golden. When currency became a necessity, it was first coined, in Lydia, of gold, which thus became the standard for the world. In the civilization of the Mediterranean gold became the symbol of all wealth and the object of general greed.

Gold was known to the natives of Peru long before the Spanish conquest early in the sixteenth century. It was in use on the coast, in the north among the Chimu and in the south in the Nazca region, before these countries were conquered by the Inca. At present it is impossible to establish earlier dates which are reliable. To the Peruvians gold was a material easily worked, plastic, and imperishable, well adapted for works of utility and art. It seems never to have been employed as currency and probably not even in barter; it was therefore set aside, at least in the Inca period, for use in the temples and palaces.

It was largely this difference in attitude toward the metal which amazed and overwhelmed the Spanish explorers. In Spain the use of gold as currency and for hoarding greatly restricted its employment in the arts. In Peru it was used for the arts only. Just what is the truth about the abundance of gold in Peru and the uses to which it was put is difficult to determine. There are many narratives of the period of the conquest and of the following century but these have never been critically treated. Some of the statements are quite improbable while others, which seem incredible, are so circumstantial and well supported that there is no valid reason for setting them aside.

Among the best authorities is the Inca, Garcilasso de la Vega. He was born in 1540 at Cuzco, the son of a noble Spaniard, a companion of Pizzaro, and of an Inca princess of the royal house, a first cousin of the king, Atahualpa, who was so treacherously murdered by the Spaniards. He spent the first twenty years of his life in Peru, travelled extensively throughout the empire, and recorded what he had heard at first hand from his Inca relatives and the numerous survivors of the conquest, whose language was his own; his narrative is fascinating in its simplicity and frank differentiation of what he had seen and what he had been told. It carries conviction of his honesty and veracity.

His statements are supported by many other contemporary authorities; among whom we may cite as peculiarly worthy of belief, Francisco de Xeres, secretary to Francisco Pizzaro, with whom he set sail from Spain in 1530; he went with Pizzaro to Cajamarca and was present at the capture and execution of Atahualpa. He describes in detail the Inca's treasure and the huge portion of it which, according to the ruler's promise, was brought together for his ransom; he further narrates de Soto's journey to Cuzco, the capital, and Hernando Pizzaro's trip to Pachacamac and Jauja, with the treasures they found in those places. He returned to Seville in 1534 and in the same year printed his narrative.

His own share in the work is recounted by Hernando Pizzaro in a letter to "The magnificent Lords, the Judges of the Royal Audience of his Majesty, who reside in the City of Santo Domingo," which is dated November, 1533, when Pizzaro was on his journey home to Spain with the king's and his personal share of the loot. In further confirmation we have the official report of the notary, Pedro Sancho, giving a full list of the names of those who shared in the ransom of Atahualpa together with the amount of gold and silver each received. There are other confirmatory records.

From Francisco de Xeres we learn that after Pizzaro had massacred two thousand of the friendly and unsuspecting Peruvians and seized the person of their king, the monarch, realizing that the Spaniards were, as Cortez said, suffering from a disease which gold alone could cure, offered in order to ransom himself and his family to collect as much of the precious metal as would fill the room in which he was confined, 36 x 25 feet, as high as he could reach on its walls, probably over seven feet. This proposal was accepted, and messengers were sent to all parts of the kingdom to collect the treasure. The monarch fulfilled his promise faithfully; the ransom in question, when melted down for distribution, amounted to 3,933,000 ducats of gold and 372,670 of silver, a total of $17,000,000 or more in American coinage. When he found that this vast sum would not save him, the Inca offered an additional amount for his life. The conquerors, however, seeing how easily the first supply had been obtained, doubtless felt that the rest could be garnered without his help, and fearing a popular rising in behalf of the unfortunate monarch, murdered him.

An idea of the lavish use of gold under the Incas may be gained from Garcilasso's account of the Temple of the Sun at Cuzco. He says: "It is now the church of the divine Santo Domingo. As I have not the exact length and breadth, I do not give it here." From other authorities we learn that the precinct was about five hundred feet square. It was built of masonry, so well that the remains of its stone walls excite the admiration of all travelers to this day. Garcilasso says it was very lofty. "All the four walls of the temple were covered from roof to floor with plates and slabs of gold. In the side where we should look for the high altar, they placed a figure of the Sun, made of a plate of gold of a thickness double that of the other plates which covered the walls. The figure was made with a circular face and rays of fire issuing from it. . . . It was so large as to occupy the whole of one side of the temple from one wall to the other. . . . This figure of the Sun, when the Spaniards entered the city, fell to the lot of a noble knight, one of the first conquerors, named Mancio Serra de Leguisamo, whom I knew, and who was alive when I went to Spain." He goes on to tell how this knight gambled away this splendid loot at one sitting; and commenting on this one man's share, he says an idea may be formed of the magnitude of the treasure which was found in this one city and temple.

"On either side of the image of the Sun were the bodies of the dead kings, arranged according to priority, as children of that Sun, and embalmed so as to appear as if they were alive, although the process is not known. They were seated on chairs of gold, placed upon the golden slabs on which they had been used to sit. . . . The Indians hid these bodies with the rest of the treasure, most of which has not been brought to light up to the present time. In the year 1559 the licentiate Polo discovered five of the bodies, three of kings and two of queens [and Garcilasso saw them].

"The principal door of the temple looked to the north, as it does now, and there were other smaller doors for the service of the temple. They were all coated with plates of gold. Outside the temple, on the upper part of the walls, a cornice of gold, consisting of a plate more than a yard wide, ran round the whole building, like a crown.

"Beyond the temple was a cloister with four sides, one of which was the wall of the temple [this was probably the court or precinct five hundred feet square]. All round the upper part of this cloister there was a cornice, consisting of a plate of gold more than a yard wide, forming a crown to the cloister. In place of this gold the Spaniards caused a cornice of white plaster to be put up, of the same width, in memory of the former one and I left it there in the walls, which were still standing. One of the halls was dedicated to the Moon, the wife of the Sun. . . . The whole of it, with the doorways, was covered with plates of silver. . . . The image, like that of the Sun, represented a woman's face on a plate of silver. . . . Another of these halls . . was dedicated to the planet Venus and the seven Pleiades and to all the other stars. . . . This hall was covered with silver like that of the Moon, and the doorway was of silver. The whole roof was strewn with stars, great and small. . . . The other hall was dedicated to lightning, thunder, and the thunderbolts . . . and the hall was lined with gold. . . . Another hall, which was the fourth, was dedicated to the rainbow, for they had ascertained that it proceeded from the Sun; and the King's Incas therefore adopted it as their device and blazon, as descendants of the Sun. This hall was all covered with gold. On one side of it, on the plates of gold, a rainbow was very naturally painted. . . .

"The fifth and last hall was set apart for the high priest and for the other priests who assisted in the services of the temple, all of whom were Incas of the blood royal. . . . This hall, like the others, was also plated with gold from floor to ceiling. . . .

Of the five images the Spaniards secured three, which still remain in their ancient positions. They only lost the benches of gold and silver and the images of the moon and stars, which had been pulled out of the ground.

"Against the walls of these temples, looking towards the cloisters, on the outside, were four porches of masonry. . . . The mouldings round the corners and along the inner parts of the porches were inlaid with plates of gold, as well as the walls and even the floors. At the corners of the mouldings were many settings of fine stones, emeralds and turquoises, but there were neither diamonds nor rubies in that land. . . . In two of these porches, built against a side facing to the east, I remember having seen many holes in the mouldings. . . I heard the Indians and ministers of the temples say these were the places in which the precious stones were fixed in the heathen times. The porches and all the doorways opening on the cloister, which were twelve in number, were inlaid with plates and slabs of gold . . . except those of the temples to the Moon and Stars . . . which had their doorways of silver.

"There were within the edifice five fountains of water. . . . The pipes were of gold, and some of the pillars were of stone, and others were jars of gold and silver. . . .

"The garden which now supplies the convent with vegetables, was in the time of the Incas a garden of gold and silver, such as they also had in the royal palaces. It contained many herbs and flowers of different kinds, many small plants, many large trees, many large and small animals both wild and domestic, and creeping things, such as serpents, lizards, and toads, as well as shells, butterflies, and birds, each in its natural position. There was also a large field of maize, the grain they call Qumua, pulse, and fruit trees with their fruit; all made of gold and silver. There were also in the building billets of wood, imitated in gold and silver, and great figures of men, women, and children, as well as granaries, called *pirua*, all for the ornamenting and the majesty of the house of the Sun, their god.

"Every year, on the occasion of the principal festivals, new objects of gold and silver were presented to the temple, so that its wealth continued to increase; for all the silversmiths, dedicated to the service of the Sun, had no other business than to make these things.

"There was also a vast quantity of pots, vases, and jars in the temple. In fine, there was in that edifice no article of any kind which was not made of gold and silver, even down to the spades and hoes for use in the garden. Hence, with good reason, they called the temple of the Sun and the building attached to it *Ccuricancha*, which means a 'court of gold.'

"In imitation of this temple of the city of Cuzco, others were made in the provinces, of many of which and of the house of the Select Virgins, Pedro de Cieza de Leon makes mention . . . though he does not mention all the temples. . . .

"Each *Curaca* (chief) was bound to adorn the temple in his district, in proportion to his wealth in gold and silver, as well as to serve and honor his God as to show respect to his king, who was a child of the Sun, so that all these temples of the provinces vied with that of Cuzco in their platings of gold and silver."

Regarding the temple on the island of Titicaca, in the lake of that name, on which the Sun placed his children, the first two legendary Incas, Garcilasso quotes Father Blas Valera to the effect that the Indians told him that there was so much gold and silver heaped up in it that another temple might have been built of the accumulation without recourse to any other materials. "But," says he, "as soon as the Indians heard of the invasion of their country by the Spaniards, and that they were seizing all the treasure they could find, they threw the whole into the lake."

There were usually fifteen hundred Virgins of the Sun, of necessity legitimate, and of the blood royal, but no rule limited their number; they had for attendants five hundred virgins, and all dwelt together in a convent, into which no one but the queen might penetrate. "All the furniture," says our chronicler, "down to the pots, pans, and jars, were of gold and silver; they had also a garden of gold and silver, like that in the temple of the Sun."

"There were many others like this convent in other parts of the kingdom."

The royal palaces, which were scattered over the vast empire, were walled and adorned with the precious metals within and without. "They did not have tapestries for the walls, for they were covered with gold and silver." Connected with the palaces were golden gardens like those in the temples of the Sun. All the vessels, large and small, for the whole service of the palace, including the kitchen, were of gold and silver. The baths, with the pipes for bringing the water, were of the same precious metals. The Inca usually sat on a stool of solid gold, a *tercia* in height, which was placed on a great square board of gold.

These things were in each royal lodging so that the Inca might not be under the necessity of carrying them about with him. When he died, his palace was left in statu quo, sacred to his memory. All his personal vases, jars, basins, kitchen service of gold and silver, and all his clothes and jewels were buried with him, and his successor began an accumulation anew.

There may be some exaggerations in these accounts, but that gold was freely used for the decoration of temples, for the overlaying of the thrones of the Incas, and for the household utensils of their palaces can hardly be doubted.

The most incredible story of all is that of the golden chain or rather cable which Huayna Ccapac, the last of the great Incas, had made at the birth of his son, Huascar (*huasca*, without the sounding of the final r, means a cable; the Quichua language had no word for chain).[1] The Incas held a stately ceremonial dance in which as many as two hundred or three hundred men and even more participated, grasping hands. On the occasion in question Huayna Ccapac thought to increase the splendor of the function by having the dancers hold instead the golden chain. Says Garcilasso, "I had a special account of this from the old Inca who was my mother's uncle, Paullu Inca before mentioned. I asked him what was the length of the chain, and he told me it was twice the width and length of the great square at Cuzco." He goes at some length and with great detail into the dimensions of this square, which he knew intimately, and concludes that "the chain must have been three hundred fifty paces long, which is equal to seven hundred feet. When I asked touching its thickness, he raised his right arm and, putting out the thumb, said that each link was of that thickness." This chain was concealed on the approach of the Spaniards so that it has never been found; Garcilasso says that it was commonly reported that the Indians threw it into the lake of Urcos, about six leagues south of Cuzco, together with much of the treasure of that city. He gives an entertaining account of the vain endeavors of the Spaniards to drain that lake in 1557.

Unless we are to understand that the chain was merely gilded or contained golden insets, the amount of metal required for its construction hardly allows the story to be accepted. These early published stories of hidden gold and the many still current in Peru must be considered largely as legendary, imaginings prompted by desire. The fact that the golden treasures were concentrated in the palaces and temples made it easy for the Spaniards to gather them up and we may be sure they did not cease their efforts until they were no longer repaid by success. North of Peru, in Ecuador, Colombia, and Costa Rica, objects of gold were commonly buried with the dead and it is still possible to recover them. The location of graves and the digging of the treasure is a regular occupation in many localities. A small percentage of the graves of Peru still yield gold ornaments but not in commercially paying quantities. But this does not discourage either the dreams or the attempts to secure sudden wealth by finding the great Inca treasures.

The conflicts between the civilizations of the Mediterranean and the Andes resulted in the nearly complete destruction of the latter. With it the use of gold in art diminished and now the local interest is not in the skill and beauty displayed by the ancients but in the intrinsic value of the metals or what may be secured for them in exchange.

[1] "There appears to be no truth in the story about a golden cable having been made to celebrate his birth. The story was invented to account for the name. There had long been a cable covered with plates of gold, in use for the performance of dances during the great festivals." (*The Incas of Peru*, p. 241, by Sir Clements R. Markham.)

HOW DIAMONDS ARE POLISHED

BY

H. P. WHITLOCK *

SUPPOSE you were taking a walk somewhere in the middle of South Africa and, happening to glance down, saw at your feet a small, angular, irregular object, clear like glass but with a surface that looked as though it had been smeared with oil. You would probably kick it aside and proceed on your way; and yet this insignificant-looking thing might easily be a diamond of great value.

Diamonds as they are found in the rough state are not impressive. They have none of the magical flashes of light which in the finished stone make them unique among the noble family of gems. It is in polishing that a goodly part of the price of a diamond is acquired; for the art of turning a rough diamond into a glittering brilliant is a long process requiring a superlative degree of skill. There is no better way to appreciate this than to follow the diamond from the mine to the jeweler and see for ourselves just what happens to it.

When the diamonds are taken out of the mine, not by any means are all of them clear and colorless, as a self-respecting diamond should be; indeed only about 25 per cent of the stones found are without some faint color. Of the remainder about one third are of a light shade of color, such as violet, yellow, or brown, and are known as "off-color" stones. The remainder, roughly one half of the total find, are more or less deeply colored and are consequently of no value for jewelry although still usable for diamond cutting and polishing or for facings for rock drills. So we find that at the beginning of its travels the diamond is introduced to the sorter. The sorter is a kind of super-expert on diamonds whose eye has been trained through years of practice to detect the slightest variations in the color of diamonds and to find flaws in the stones with an ease which is little less than uncanny. Safeguarded behind a heavy metal screen, the diamond appraiser sits with a pile of rough stones before him, judging each stone and assigning it to its proper heap.

The first consideration in sorting diamonds is the adaptability of the stone for cutting. Let us assume that the stone whose travels we are following is sorted into the grade known as "close goods," comprising complete, flawless crystals from which fair-sized brilliants can be cut or, to use the trade term, "made." These usually have eight sides or faces, triangular in shape. Next comes a resorting of the "close goods" into eight grades, ranging from blue-white, which comprises the stones of finest quality, to yellow and brown, which are so badly off-color as to be unfit for gems. If our stone has passed the critical test of the sorter and has been placed in one of the higher grades, it is weighed, wrapped up in a parcel with others of its kind, a price per carat is assigned to it, and it is sold to a diamond dealer, and ultimately finds its way to the workshop of the diamond polisher. Here, at the hands of a highly skilled workman, it is destined to be turned into a gem fit to grace beauty or proclaim opulence.

Most of this work is done in Holland, and especially in Amsterdam, which since the fifteenth century has been famous for this industry, in reality an art, but there are, nevertheless, a number of shops in operation right here in our city of New York. Like many other operators who depend for their success on a high degree of manual skill the diamond cutter has few tools, and these are relatively primitive and have changed little since the days of Louis de Bequem, who

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The tools of the diamond lapidary's art are very simple. The little metal cup or "dop," in which the diamond is being placed, as well as the wooden holder which carries it, are of exactly the same shape as those used by the diamond cutters of a hundred years ago

cut diamonds in 1475. The lapidary depends like the violin player on the delicacy of his touch, and like the painter on the accuracy of his eye, and he scorns to use complex mechanical devices to aid him in his difficult task.

The surface irregularities, together with any superficial flaws or dark patches, are first split away from the stone, which breaks naturally along smooth, even surfaces parallel to the natural faces of the crystal. To accomplish this our diamond is firmly cemented to the end of a wooden stick which in turn is made fast in an upright position, and thereupon with the sharp corner of a diamond fragment a deep scratch is made in the surface of the stone. A knife edge is then held in the right position on the scratch, and a sharp blow with a light tool on the back of the knife edge suffices to remove the undesirable flake, leaving the surface bright and very smooth. Sometimes, when the stone is large, it is of advantage to saw it into two or more pieces so as to save as much as possible of the weight in cut diamonds. This is accomplished with a thin disk of bronze, about four inches in diameter, revolving very rapidly and having its edge charged with diamond dust at the beginning of the sawing. As the saw bites into the stone, it keeps recharging itself with the diamond sawdust. It takes many hours for this little "buzz saw" to eat its way through half an inch of diamond, but the finished product is so valuable that a day or so of labor

Like a skilled surgeon the diamond lapidary performs the delicate operation which is known as "slitting." Just the right amount of the stone, no more and no less, must be split away. The intent expression on the face of the operator bears witness to the momentous effect of the slight blow he is about to strike on the steel knife edge which he holds in his left hand

Even the refuse from this operation is valuable and must be saved. As the lapidary rough-shapes his diamonds, rubbing or "bruting" the one on the end of the long stick which he holds under his right arm, against the other on the rapidly turning spindle which is driven by the belt, the dust and fine fragments fall into the little box shown in the centre of the picture. Only the protruding end of the stick is visible in the illustration makes little impression on the cost sheet.

The rough shaping of the diamond is done through an operation called "bruting," which consists of wearing away the corners by rubbing one stone against another. Formerly this was a strictly manual process, the two diamonds being mounted on sticks held in either hand by the lapidary. Even into the ancient and conservative art of diamond cutting, however, some mechanical improvements have made their way, and now in most of the shops a rapidly twirling spindle takes the place of one of the hand sticks. The remaining stick has grown in length to suit the modern method. It is now about two feet long and can be firmly grasped with both hands and held in a rest so that the diamond it bears at its end can be rubbed against its fellow, which is spinning around in front of it.

Having rough-shaped our diamond we now come to the finishing operation, the producing of the facets which give brilliancy and sparkle to it, an operation which is technically known as polishing. The holder of the stone during the polishing consists of a small metal cup on a long stem, which is called a "dop" and much resembles a tulip, which famous Dutch flower may have suggested its shape. A solder composed of one part tin and three parts lead is placed in the dop and heated until soft. The diamond is then embedded in the solder with the portion of the stone on which the desired facet is to be cut placed uppermost and almost completely surrounded by the solder. When the diamond has been properly adjusted in the dop, it is plunged in cold water to cool and harden the solder. Such drastic treatment would cause less aristocratic stones promptly to fly to pieces, but not so with the diamond; the high heat conductivity of this remarkable substance permits it to submit to the sudden change of temperature without there resulting in it even the slightest flaw.

The actual cutting of the facets on the diamond, known as "polishing," calls for the highest expression of the diamond lapidary's art. The stems of the "dops," which bear the diamonds, must be adjusted in the "tongs" with fine nicety. Here again the form of the tools has not changed in a century. The iron "tongs," the wheel and its spindle (shown in the centre of this picture), even the metal pegs against which the tongs are kept in place on the wheel, are the same as those used in Amsterdam and Antwerp in 1821

The dop is now fastened by means of its stem in a heavy iron arm called the tongs, in such a way as to bring the position of the facet to be cut exactly undermost when it is placed in contact with the polishing wheel or lap. The latter is made of soft iron and turns horizontally at the rate of about one thousand revolutions a minute. Diamond dust, mixed with olive oil, is fed to this wheel and the diamond is held in contact with it by weight of the tongs, aided by slabs of lead placed upon the latter. Several hours are required to cut one facet, then the stone is readjusted for another one, and so on until all of the fifty-eight little facets in which lies the secret of the brilliancy of the jewel are produced.

To appreciate the exquisite skill and infinite patience involved in this apparently simple process we have only to look at the gem on our finger, sending forth its magical fires, and to note the symmetry and regularity of shape of each of its tiny, glittering sides. And when we remember that to produce these rainbow-like rays each must have exactly the right tilt with respect to its neighbors, we realize that a cut diamond is not only a wonderful product of nature but a marvelous work of art.

Before the introduction of methods of diamond cutting in the fifteenth century, diamonds, when used in jewelry, were set with four of the eight sides of the octahedron or double pyramid projecting from the setting. This presented the aspect of a four-sided pyramid, and the exposed faces or facets were sometimes polished. The next step in the evolution of the modern form of diamond cutting was the production of a flat "table" on the exposed point by rubbing or "bruting" two crystals together. Thus we have the origin of the table facet as it is known today. In the early seventeenth century when the art of the diamond cutter had somewhat advanced, a more symmetrical outline for the stone was obtained by cutting away the four edges of the pyramid above the setting, which of course necessitated the equal cutting away of the four edges below. This gave eight facets grouped about the table and eight below the "girdle," as the line encircling the stone at the point of the setting is called. At a previous stage in its development a small facet called the "culet," directly opposite the table, had been introduced, so that we have for this cutting, which has sometimes been called the single-cut brilliant, a total of eighteen facets.

Up to this point in the development of diamond cutting, stones were cut for symmetry of outline alone and no attempt was made to utilize the remarkable optical properties of the diamond, which enable it, when properly proportioned in the cutting, to reflect back to the eye most of the light which falls upon it. Toward the close of the seventeenth century Vincenzio Peruzzi, a Venetian, began to cut diamonds on this principle. With this discovery, no longer the lapidary labored solely to produce a maximum weight and symmetry of outline, but he endeavored to combine with these the very essential factor of the brilliancy of the stone. And with increased skill in the art, more facets were added to beautify the form and enhance the radiance of the gem. Sixteen additional "corner facets" above and sixteen below the girdle rendered it rounder and more symmetrical, and subsequently eight extra facets grouped about the table completed the fifty-eight of the modern brilliant.

It is a singular and somewhat significant fact that the historical evolution of the modern brilliant as here traced is precisely its actual evolution under the hands of the diamond cutter. The facets are added to the stone in just the order in which they were developed through the centuries.

THE PITCHER PLANT, *Sarracenia flava*

Though many insects are lured to their death by this plant, from whose nectar-baited pitchers they never emerge, it in turn is victimized by a moth that lives, immune, in association with it. The drooping pitchers here shown have been collapsed by the larvæ of that moth (*Exyra ridingsii*) just before pupating, the collapsed pitcher closing the tube above and giving additional protection to the helpless pupæ

PITCHER PLANTS AND THEIR MOTHS

THE INFLUENCE OF INSECT-TRAPPING PLANTS ON THEIR INSECT ASSOCIATES

BY

FRANK MORTON JONES

IT is most obvious that in the development of the higher plants and of the insects each has had great influence on the other. Floral colors, fragrance, nectar secretion, structure—all the complicated adjustments to secure insect pollination—are matched in the insect world with modified mouth parts, pollen-gathering and nectar-storing structures, specializations of instinct with reference to the utilization of flower products. Even more generally the food-plant relation, usually detrimental to the plant, is of obvious significance and importance to the insect. Thus, by the almost innumerable plant-insect relationships, either both plant and insect benefit or the insect benefits at the expense of the plant.

In rare instances these conditions are reversed; the plant, instead of being eaten, becomes the devourer. These insectivorous plants, representing a unique point of contact between the plant and insect worlds, show resultant complicated adjustments. If a restricted group of insectivorous plants has long been in contact with a restricted group of insects, we may with reasonable certainty expect to find the specialization of the plants as insect traps in some degree met by insect specialization to evade or even to utilize these traps. Do the insect associates of insectivorous plants exhibit any definite change of structure or of instinct resultant from their contact with these plants?

In America north of Mexico we have a number of types of insectivorous plants—notably the sundews, *Drosera*, Venus's-flytrap, *Dionæa*, and the pitcher plants, Sarraceniaceæ,[1] a purely American family containing three genera and nine species. Of the Sarraceniaceæ one genus and species, *Heliamphora nutans* Bentham, has been recorded only from Mount Roraima, on the borders of British Guiana, and in its native home has been seen only a few times by civilized man; one genus and species, *Darlingtonia* (or *Chrysamphora*) *californica* Torrey, inhabits mountain bogs of northern California and southwest Oregon; and of the typical genus, *Sarracenia*, seven species are found in the southeastern United States, only one of these seven, *purpurea*, ranging north of Virginia to Labrador.

The leaves and petioles of all the North American Sarraceniaceæ are modified into hollow structures, or "pitchers," which exhibit many specializations as insect traps. The accuracy of this interpretation of these structures has been questioned from time to time, but no other explanation of them seems to us admissible. Quite generally, by non-botanical observers, their pitchered leaves are classed as flowers. They are all more or less brilliantly colored—striped, veined, or reticulate with purple-red, sometimes on a white or yellow ground. They exhale a fruity or honey-like fragrance. All of them secrete a sweet fluid containing fruit sugar from numerous nectar glands so distributed that insects are enticed to the rims of the pitchers and thence inside. In most species inward directed hairs offer additional guidance. Once inside the pitcher, the insect steps upon the smooth "conducting surface" and is precipitated to the bottom of the tube, from which escape is barred by long, elastic, downward-directed hairs. In some species escape by flight is further discouraged by a series of translucent "windows," which stud the hood on the side farthest from the orifice of the pitcher. The pitchers of all the species, at their

[1] Macfarlane: Sarraceniaceæ, in Engler, *Das Pflanzenreich*, 34 Heft (IV. 110), Leipzig, Engelmann, 1908

THE FIVE TYPES OF PITCHERS OF NORTH AMERICAN PITCHER PLANTS

Purpurea *Minor* *Psittacina*
Flava *Darlingtonia californica*

most active period as insect traps, contain a clear fluid, which in some is purely a plant secretion but which in others, by their structure more exposed to the weather, is usually greatly diluted with rain water. In at least four species this secretion has the quality of quieting or stupefying captured insects, whose struggles usually cease within a very few seconds after capture. In six of our eight species it has been shown that the fluid contains a protein-digesting enzyme, active to extreme dilution; they also invariably contain proteolytic bacteria. The quantity of the secreted pitcher liquor is greatly increased by food stimulation, and from it both liquids and nutrient solids in solution are rapidly absorbed by the pitcher walls.[1]

If further evidence were necessary that the pitchered leaves of the Sarraceniaceæ are specialized insect traps, their efficiency as such would seem conclusive, for especially the larger southern species often capture insects in almost incredible numbers. The bulk of these captures usually consists of Lepidoptera, Coleoptera, Hymenoptera, and Diptera; but all the principal orders of insects are represented, as well as spiders of many species, occasionally mollusks and crustaceans, and even some small vertebrates (tree frogs and lizards) whose remains occur in the mass of captures, which frequently fills the pitcher tube to the height of several inches.

Structurally our eight species exhibit five different types of pitchers. In *Sarracenia purpurea* Linn. the pitcher is wide in proportion to its height; the hood or "operculum" is vertical. The wide mouth is thus almost fully exposed to the weather, and the pitchers are usually full, or partly full, of rain water. In *Sarracenia flava* Linn., *S. sledgei* Macf., *S. drummondii* Croom, and *S. rubra* Walt., the pitchers are tall, slender, more or less tapering and trumpet-shaped; the hood is lidlike, partly overhanging the mouth, and although beating rains sometimes gain access, only the narrow, basal portions of these pitchers normally contain fluid. In *Sarracenia minor* Walt. (*variolaris* Michx.) an overarching, helmet-shaped hood practically excludes rain water. In *Sarracenia psittacina* Michx. the pitchers are recumbent, and the narrow, tubular pitcher orifice is concealed beneath the closed hood, shaped like a parrot's beak. In *Darlingtonia* the pitcher orifice opens upward into an expanded, bladder-like hood, and a cleft appendage hangs from its anterior rim.

In some degree these and other structural differences are explicable as adaptations for the capture of special groups of insects. The captures of all the species, however, are most varied. These captures obviously consist not only of nectar-loving insects attracted by the bright colors, the fragrance, and the nectar bait, but also of many others whose presence cannot thus be explained: carrion-feeding species attracted by the odor of the mass of previous captures, predacious and parasitic insects whose habit it is to search every nook and crevice, insects of blundering flight—locusts and heavy-bodied beetles—which form a considerable proportion of the mass of insect remains. All of these begin to accumulate as soon as the new pitchers open in the spring.

Obviously, then, with their captures including so large a representation of the insect fauna of their habitat; with the plants themselves, sometimes occurring in almost pure stands over considerable areas, yet notably of restricted distribution and habitat; we can scarcely expect to find among their insect captures any significant adjustment to what must be for any given species an occasional and local, rather than a relatively frequent and general, source of danger. These plants, however, in addition to their insect captures have many insect associates. Their flowers exhibit intricate

[1] "The Absorption of Nutrients and Allied Phenomena in the Pitchers of the Sarraceniaceæ" by Joseph S. Hepburn, E. Quintard St. John, and Frank M. Jones in *Journal of the Franklin Institute*, Vol. 189, No. 2, February, 1920.

The low-growing, almost aquatic *Sarracenia psittacina* in times of temporary inundation captures great numbers of water beetles, whose polished bodies are gripped by the densely placed, long, elastic bristles which line its tubes

The exposed pitchers of *Sarracenia purpurea*, usually filled with rain water, often buried to their lips in the deep sphagnum in which they delight to grow, are pitfalls for ground-inhabiting insects, though their captures are by no means restricted to such species. This, the most familiar of our pitcher plants, as an insect trap is less uniformly successful than other species, though at least the narrow tubular basal portions of its pitchers are usually packed with insect remains

Sarracenia minor usually grows in a drier situation than *purpurea*. It has a baited pathway from the ground to the pitcher's rim. Its drier pitchers are often literally stuffed with the bodies of ants

The showy tops and flattened lids of *Sarracenia drummondii* (on right), *Sarracenia flava* (in center), and *Sarracenia sledgei* (on left)—fragrant, nectar-baited, conspicuously raised above the surrounding vegetation—form natural alighting places for the flying insects which largely constitute their prey. Well developed pitchers of these species usually exceed twenty inches, quite frequently thirty inches, in height. The picture of *Sarracenia sledgei* is here reproduced by courtesy of the *Journal of the Franklin Institute*

adaptation to secure insect pollination. The flower, the flower stem, the unripe and the ripe ovary, the fleshy rootstock, each forms the food of one or more insect species, which, however, do not come into frequent or necessary contact with the insect-catching devices of the plant. The pitchers themselves, like many other hollow, vegetable structures, are utilized as homes by certain nest-building Hymenoptera. The mass of insect captures in the pitchers offers too rich a supply of animal food to have been overlooked, and in seven of our eight species we find this material constituting the larval food of sundry dipterous insects—some of them exclusively pitcher-plant insects, and including representatives of the families Culicidæ, Chironomidæ, Mycetophiladæ, Phoridæ, Sarcophagidæ, and Chloropidæ.

Among these insects we find numerous examples of apparent adaptation, of both structure and instinct, to their uniquely dangerous habitat; and the degrees of adjustment to this environment, as exhibited by these insects, are most suggestive of the steps by which it has been obtained. The most unmistakable evidence, however, that the peculiar characters of these plants have been a significant factor, if not the most important factor, in determining the course of the evolution of some of their associated insects, is presented by a little group of noctuid moths belonging to the genus *Exyra* Grote, whose entire life cycle is passed in most intimate contact with these plants.

Of the three species[1] of *Exyra,—rolandiana* Grt., *ridingsii* Riley, and *semicrocea* Gn.,—*rolandiana* is the constant associate of *Sarracenia purpurea*, from Canada to the Gulf of Mexico; *ridingsii* Riley, of *Sarracenia flava*, from North Carolina to southeastern Alabama; and *semicrocea* Gn., the most adaptable of them all, seems equally at home in *Sarracenia rubra*, *S. minor*, *S. drummondii*, *S. sledgei*, and *S. psittacina*, its range extending from North Carolina to southern Mississippi,—probably into Texas with *sledgei*,—for the range of each species seems to be coincident with that of its associated food plant. These three insects exhibit adjustments, common to them all, which relate to the general plan of the insect trap of *Sarracenia*, indicating an association antedating the splitting of the insect group, if not the plant group, into several species; and they show further adjustments, each species to its own food plant, indicating that this process of adjustment has continued, either coincident with the development of the plant species or at least following the insect's association with these plant species. This will become apparent by considering the plant-insect relation stage by stage in the life cycle of the insects.

Magnifications of the eggs of *rolandiana* (topmost), *semicrocea* (middle), and *ridingsii* (lowest)

These eggs are deposited by the parent moths on the inner walls of the *Sarracenia* pitchers, usually some distance below the mouths

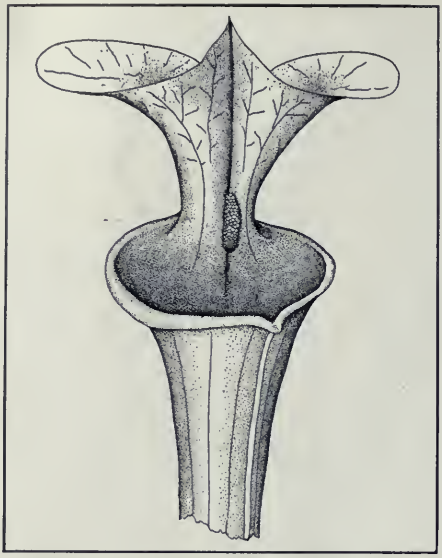
The eggs of *rolandiana* and *semicrocea* are of the usual noctuid type—yellow or yellowish green, polished in texture, dome-shaped, and vertically corrugated; that of *ridingsii* is larger, white, unpolished, much more flattened basally, and shows only faint indications

[1]Four species are recognized in the check list of Lepidoptera. In the opinion of the writer, however, *fax* Grt. and *rolandiana* Grt. are almost certainly identical. The better known name *rolandiana* is retained in this article, for it is possible, though extremely improbable, that *fax* Grt. may be found again as a rare and local species.

of a few broad, shallow, and less regular corrugations. Such a departure from the general type of its group and from that of its own genus would seem to have some significance. As a suggestion, and not as a theory, it may be stated that the great trumpet-shaped pitchers of *flava*, in which these eggs are deposited, in the early season exude an exceptionally abundant nectar bait, which gathers in drops on the hood and throat and runs down the walls of the pitcher, where it evaporates to dryness, leaving a white, sugary incrustation which persists for weeks; and the slightly wrinkled, dull white, flattened egg of *ridingsii* bears resemblance to one of these dried nectar drops. This resemblance can be of use only if it offers some protection. Although ants frequent the pitchers for nectar, and although spiders are often, and small acarids usually, present in the pitchers, the only observed enemy of *Exyra* eggs is a minute egg parasite, a *Chalcis*, which sometimes destroys a very considerable proportion of the eggs of *semicrocea*, but which has not yet been found in *ridingsii*. Would a female *Chalcis* in search of noctuid eggs fail to recognize an egg which departs from its type?

The eggs of *ridingsii* and *semicrocea* are deposited singly; for, as will appear, it is of vital importance that only one larva should occupy a pitcher, and when more are present, one drives out or kills the other; the eggs of *rolandiana* are deposited in groups of five or six up to as many as fifteen, to a pitcher, but only one such lot to a plant. Why? Of all the *Sarracenia* only *purpurea*, the food plant of *rolandiana*, has in its habit of growth a considerable number of pitchers in close contact—usually so close that their shape is distorted by mutual pressure; and from these short, wide pitchers growing thus in dense, interlaced masses, even very young larvæ may scatter and find their way, with a very few seconds' exposure, from pitcher to pitcher. In *flava*, *rubra*, *drummondii*, *sledgei*, and *minor*, the food plants of *ridingsii* and *semicrocea*, the pitchers are taller and much more separated in their habit of growth, so that traveling from one pitcher to another becomes a long and dangerous journey for a small larva—a journey not to be undertaken except under the compulsion of failure of food supply or at the time of pupation. In the one instance it is better for the species that the parent moth should not expose herself by too frequent flight and search for perhaps widely scattered clumps of *purpurea*, for the larvæ can readily change from leaf to leaf before their increasing size necessitates sole occupancy of a pitcher; in the other, flight from pitcher to pitcher, which though not in contact, are usually found in close proximity over wide expanses, is better than the long exposure of a young larva in a journey from one tall pitcher to another. Thus the habit of growth of the food plant determines the egg-laying habit of the associated insect.

In their larval stages these insects exhibit a succession of unmistakable adjustments to their plant habitat. The older larvæ of all three species have the common habit of protecting themselves from the attacks of parasites, spiders, and predacious insects, and to some extent from the weather, by closing the mouths of the pitchers they inhabit with closely spun, silken webs, then of feeding on the inner surface below the webs without piercing or rupturing the walls, which though thus eaten away to a thin, bladder-like condition, provide them with a closed feeding chamber, with perfect concealment and comparative security against intrusion from without. They exhibit but slight diversity of method in spinning the ceiling web. With *rolandiana* in *purpurea*, *ridingsii* in *flava*, *semicrocea* in *rubra*, *sledgei*, and *drummondii*, the fine, close, almost transparent web is spun horizontally across the throat of the pitcher, at



Flava is characterized by a deeply incised groove in the throat of the pitcher. The newly hatched larva of *ridingsii* creeps to this groove and constructs over a portion of it a cradle-shaped or hammock-like shelter of silk and corky frass particles, beneath which it lives for a few days, feeding on the portion of the pitcher thus covered and the immediately adjacent parts. No other *Exyra* constructs such a shelter

Pitchers of *sledgei* which young larvæ of *semicrocea* have converted into closed feeding chambers by girdling.

or slightly below the lips. Accidental tears and punctures of the pitcher walls are also ceiled, broken webs are replaced, and a larva placed in a cut section of a pitcher promptly ceils both ends. In the hooded leaf of *minor*, *semicrocea* sometimes follows the same method, but often curves the web upward and forward into the apex of the hood, or more rarely connects the lateral margins of the hood and the lips with an almost vertical web. In *psittacina*, *semicrocea* simply ceils the small, hidden leaf orifice, thus providing a closed feeding chamber with the least possible expenditure of silk. All these departures from the usual method, made possible in each case by the structural peculiarities of the food plant in which they occur, result in securing a larger leaf area for feeding under the protection of the silken web and in lessening the chance that a failure of food might necessitate a change to another pitcher.

It is beyond the power of a minute, newly hatched *Exyra* larva, however, to ceil the mouth of a large pitcher with silk. The first-stage larvæ of *ridingsii* (the largest species) are, for example, about 2.6 mm. ($\frac{1}{10}$ of an inch) in length, and the flaring mouth of the pitcher of *flava* in which they hatch may be 75 mm. (3 inches) across. At this early age, translucent, almost colorless, half buried in the plant tissue and surrounded by the refuse of their feeding, they are extremely inconspicuous, and within the pitchers they must possess some degree of immunity from the usual enemies of young caterpillars. Where the age and structure of the pitcher permit, however, they adopt further means of defense, as indicated in the illustration above.

The spring generation of *semicrocea* emerges from the egg when many of the pitchers of its food plants are tender and immature—hermetically sealed, spear-shaped tubes, pushing their way up to their full height before the lips of the pitchers open and they begin to function as insect traps. The young larva finding a pitcher in this condition, ensures the continuance of a closed feeding chamber as follows: below the yet unopened lips of the pitcher, on the inside, it cuts one or more narrow encircling grooves—the groove cut by the newly hatched larva is so narrow and thread-like that it can be detected only by holding the leaf to the light. If the leaf be sufficiently tender, the portion above the groove quickly dies, contracts, and hardens, forming a tough, unbroken cap or lid to the still growing and expanding pitcher; and as this cap includes the pitcher's mouth area, a closed feeding chamber is thus created and maintained, providing the insect with food and protection through its most defenseless period; for having fed for some days in the closed chamber thus created, it is then large enough to effect a rapid change, if necessary, to an older and larger pitcher, which it quickly ceils with a silken web. This groove-ceiling is sometimes attempted in pitchers too old to respond, in which case the larva, as soon as may be, resorts to the web-ceiling method, expanded pitchers with ineffective grooves and typical ceiling webs being of common occurrence. The young larvæ of *semicrocea* employ this groove-ceiling method of maintaining a closed feeding chamber, whenever the pitcher conditions permit, in all five of their food plants.

Pitchers of *Sarracenia purpurea* the one normal, the other groove-girdled by the larva of *Exyra rolandiana.* The enclosure thus formed, which in the springtime would be utilized as a closed feeding chamber soon to be destroyed by the rapidly growing larva, in winter constitutes a dry, bladder-like hibernaculum, where the semilethargic larva, in the warmer periods, may do a limited amount of nibbling at the thickened walls without destroying the efficiency of its more or less water-proof compartment

Sarracenia purpurea, probably to a greater extent than any other species, produces new, and consequently unopened, pitchers more or less throughout its growing season, though more abundantly in the spring and late summer; and in these pitchers the young larvæ of *rolandiana* follow identical methods; but with this species the groove-ceiling operation serves for defense through two very different periods of the life cycle. All three *Exyra* pass the winter as larvæ in the pitchers of *Sarracenia;* but as the structure and winter condition of the different pitcher plants are so varied, to ensure shelter and safety through this period of helplessness and enforced inactivity requires very different preparation on the part of the larvæ, and accordingly we find widely different methods in the construction of their hibernacula.

The wide, open-mouthed pitcher of *purpurea*, throughout much of its geographical distribution subject to winter conditions severe enough to convert the water filling its pitchers into solid cores of ice, its low growth and almost aquatic habitat often subjecting it to partial or complete submergence, offers to the hibernating larva of *rolandiana* an apparently difficult problem; but when, in the late summer, a young larva of this species groove-ceils a *purpurea* pitcher and then, preliminary to hibernation, ceases to feed and grow (for the winter is passed as a third-stage larva or younger), the pitcher walls, unmutilated by feeding, thicken and toughen to a

Low in the narrow, tubular, basal portion of the *flava* leaf the hibernating larva of *ridingsii* constructs its winter quarters. In this chamber the larva is well insulated against cold and excessive moisture

leathery consistence and serves as a hibernaculum.

Not all the hibernating larvæ of *rolandiana* find pitchers suitable for the girdling process. Any time from November to May, if we burrow with our fingers into the moss in which *purpurea* is growing, and lift the plants out bodily, in addition to the old and mature pitchers radiating from the apex of the rootstock, we may find one or several small, succulent, pinkish white, unopened leaves, too short to have yet pushed their way up through the surrounding sphagnum; and the slightly nibbled top of one of these immature leaves, with a flimsy, silken web flecked with bits of reddish brown frass closing the tube, is a usual indication of the presence of a hibernating larva. If no leaf suitable for either of these methods be available, the larva descends to the very bottom of an old, dry pitcher, and with silk and refuse partitions off a little, conical chamber in this narrow, lower extremity of the tube.

Ridingsii in *flava* is confronted by a problem quite different. Though taller and more erect, and usually growing in a drier habitat than *purpurea*, the pitchers of *flava* die to the ground in winter, and their flaring upper portions, dry and brittle, are almost sure to be split and shredded by the winter winds. In *flava*, in the late summer, no tender, unopened leaves are available for groove-ceiling, and there are no immature pitchers at the base of the plant. A different method of preparation for hibernation is necessitated by these conditions. The larva of *ridingsii*, feeding freely in the upper part of a *flava* pitcher, fills the lower portion for several inches with fine, corky débris and frass. In this material it constructs an arched chamber often several inches in length—the floor of compacted refuse, for walls the tough, dry, thickened basal portion of the pitcher, the roof a smoothly arched, compacted mass of corky frass and fine refuse strengthened with silk, above which the packed frass may extend for several inches.

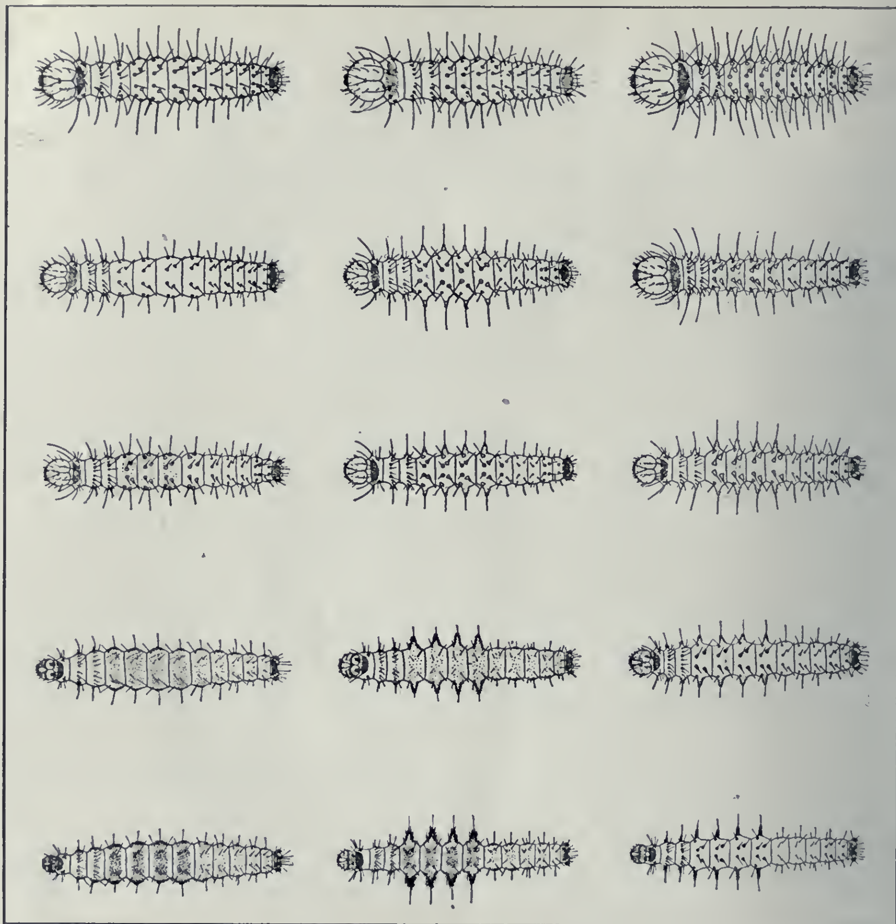
With *semicrocea* the problem of winter survival changes again. In *rubra*, *minor*, *drummondii*, and *sledgei* the pitchers are erect. They usually grow in drier situations than *purpurea* and are thus not so subject to inundation; their leaves are comparatively free from rain water; and some of them remain green and unwithered, or partly so, throughout the winter, thus providing springtime food for the hibernating larvæ, suitable quarters for pupation, and even shelter for the emerging moths long before the spring growth of *flava* is available for *ridingsii*, which, remaining in its hibernaculum until the growth of new pitchers in the spring provides it with fresh food, is thus a month later in completing its transformations; that is, the seasonal history of the food plant determines the time of appearance of the associated insect. In these erect, green pitchers the larva of *semicrocea* prepares its hibernaculum by spinning a dense, opaque web across the tube, usually considerably below the throat, even halfway down; the web is sometimes thickened and made more opaque by the addition of fine, chewed fragments, or it may consist of pure white silk. Beneath this, most frequently as a last-stage larva, *semicrocea* hibernates.

One significant and interesting variation from this method, however, must be noted: in the low-growing pitchers of the almost aquatic *psittacina*, which, though rain-proof, are often subject to inundation, the young larva of *semicrocea* plugs the narrow, tubular entrance of the pitcher with a tough, thick, button-like wad of silk and chewed fragments. This converts the pitcher into a water-tight compartment even capable of withstanding submergence, thus similar in function, but not in origin, to the girdled, bladder-like hibernaculum of *rolandiana* in *purpurea*. In these pitchers the larvæ hibernate at an early age, not later than the third instar. Thus in *semicrocea* the age at hibernation, as well as the character of the hibernaculum, seems to be influenced by the food plant.

The flower buds of *Sarracenia*, formed in the late summer or early fall, are all ready to push their way upward at the approach of spring, with, or even before, the spring leaves, and they shoot up rapidly, sometimes at the rate of an inch a day. The same warmth which starts the flower buds racing upward also arouses the *Exyra* caterpillars in their hibernacula, for the green, succulent buds and expanding blossoms are the favorite spring food of these larvæ. Creeping up the stem, they bore into the globular flower bud, and the overlapping layers of expanding sepals and petals soon hide the entrance hole. In feeding, they avoid the outer layers, web together accidental apertures, and desert these shelters only when the food supply is exhausted, or for pupation. In older blossoms their procedure is similar, except that on entering they close the natural openings of the flower with silken webs or else block off a portion of the interior with such a web, under the shelter of which they demolish the fleshy parts of the flower and ovary. Flowers and buds are thus available only in the springtime, and then for only a fraction of the number of hibernating larvæ.

The behavior of the newly hatched larvæ in immature pitchers, and of older larvæ in open pitchers, has already been described. On leaving their hibernacula in the spring, the larvæ of *ridingsii* and *rolandiana* are of the third instar, ready to feed voraciously and grow rapidly to the time of pupation. For them the groove-ceiling procedure of the newly hatched larvæ would not be effective, for before the groove could produce a closed feeding chamber their voracious feeding would have wrecked the top of the pitcher. *Ridingsii*, creeping out from its dry-stem hibernaculum about April 20 (in South Carolina), finds its food plant, *flava*, in full bloom. If it finds an unoccupied bud or blossom, this provides it with sufficient food to complete its larval growth without further change. At this date the new pitchers of *flava* are slender tubes, pointed and entirely closed at the top, pushing their way up through the dead, dry leaves of the previous season. The larva of *ridingsii*, not readily finding a bud or blossom, creeps up one of these immature, tubular pitchers, and eating a hole just large enough for entrance, creeps inside. This process occupies only a few minutes.

Once inside, spinning a ladder of silk as it climbs the vertical walls, the larva creeps up into the closed peak of the hood, where its first feeding on the inner surface from the apex downward re-



Larval stages, from the egg to maturity, of the three species of *Exyra*, with special reference to the divergent development of *rolandiana* (left row) on the one hand, and *semicrocea* (middle row) and *ridingsii* (right row) on the other. Note in the two species last mentioned the development in the successive molts of the "lappet tubercle," Kappa (IV), and the absence of this character in *rolandiana*. These "lappets" keep their possessors from too intimate contact with the pitcher walls

sults in the drying up and toppling over of the whole upper portion, effectually preventing the pitcher's mouth from opening and ensuring a permanently closed tube which may be maintained in this condition with a minimum expenditure of silk in webbing over accidental openings. *Rolandiana* adopts a similar method in the tender new leaves of *purpurea;* and all intergrades between wide open, older pitchers ceiled with horizontal webs and tender, new pitchers ceiled by feeding and patching may be found.

The larvæ of *Exyra* present some unusual characters for noctuid larvæ, which, excepting the flower-feeding ones and other brightly-colored, exposed-feeding types supposed to exhibit warning coloration, are usually of dull colors, brown or gray, and without horns, prominent tubercles, or a hairy coating. *Exyra* larvæ vary individually from brown to more usually purplish red or even to bright wine-red, and are white between the segments; consequently their colors to a considerable degree match the red veins and mottlings of their food plants. They are all more or less pubescent—*rolandiana* the most, *ridingsii* the least—and they all have the habit, when disturbed, of retreating down the pitcher wall or of releasing their hold and falling to the bottom. If in its descent *rolandiana* is precipitated into the water-filled pitcher of *purpurea*, it is able to support itself on the surface film and wriggle its way to safety; and actual experience with *semicrocea* larvæ in *psittacina* has shown them capable of swimming from plant to plant. Both color and vestiture seem to have been modified, with an intelligible relation between these modifications and the characters of their food plants and the plant habitat.

The larvæ of all three species are strongly constricted between the segments; and two of the three species, *semicrocea* and *ridingsii*, beginning with their first larval molt, develop structures probably unique in this group of insects. These are greatly enlarged, spiny, lateral tubercles—"lappets," they have been called (see illustration p. 308)

What is the office of these "lappets," and why are they possessed by the two species, *ridingsii* and *semicrocea*, but not by the third, *rolandiana?* Undoubtedly they serve to keep their possessors from too intimate contact with the pitcher walls, the portion of the plant's insect trap against which these larvæ are in essential need of protection, for under like circumstances caterpillars of other species frequently become too tightly wedged in ever to escape, and these *Exyra* larvæ have the habit of penetrating to the lowest possible portions of their dangerous homes. It is still more significant that of the three, *rolandiana* only fails to develop these bristly "lappets" or "elbows," for this species, inhabiting the wide, squat pitchers of *purpurea*, has ample room between the walls, in that portion of the pitcher which it habitually occupies.

Whether the last larval food has been an unopened bud, a blossom, an immature, closed leaf, or an open pitcher, all three species of *Exyra* resort to a pitcher for pupation; and with the exception of the hibernated brood of *ridingsii*, for which open pitchers are often not available, they almost invariably select for this purpose a mature pitcher. *Rolandiana* spins a thin, flattened cocoon of pure white silk on the concave inner wall of the pitcher, well above the usual water level; or if the pitcher be a very small one, the cocoon may occupy the whole upper portion, a close, horizontal web serving to ceil the pitcher and to form the upper portion of the cocoon; or else, in an old leaf that contains no water, the cocoon may occupy the extreme bottom of the pitcher, often well hidden under an accumulation of insect remains, frass, and vegetable débris, in a small chamber partitioned off by the silken wall of the cocoon. If any reason for choice among these methods is discernible, it would seem that the first is more prevalent in large, roomy, well-developed pitchers, the latter in small, crowded, distorted, or mutilated ones.

Like *rolandiana*, *semicrocea*, preparing for pupation in any of its five food plants, usually enters a pitcher that has not been mutilated by feeding. A single, significant variation in *semicrocea's* pre-

Before spinning its cocoon of pure white silk (shown above) the larva of *rolandiana* usually crawls to a pitcher of *Sarracenia purpurea* that has not been mutilated by feeding and which shows no outward indication of the larva's presence

Before pupating the *semicrocea* larva closes the pitcher selected, often a considerable distance below the lips, with a ceiling web of denser and more opaque construction than that beneath which it has fed. Just under this web it constructs a filmy, silken cocoon. The tube is often slightly ceiled below the cocoon as well

paration for pupation as pictured above occurs in *psittacina*, whose pitcher has a concealed leaf orifice, small and tubular, hence offering greater difficulty for the escape of the emerging moth. In this plant the larva, before spinning the ceiling web or constructing its cocoon, cuts a large emergence hole in the peak of the hood; that is, *semicrocea* in its four food plants with wide-mouthed pitchers makes no provision for the escape of the moth, and in *psittacina* with its narrow orifice makes provision for that event.

In a mature leaf of *flava*, *ridingsii* preparing for pupation, resorts to entirely different methods: instead of changing to a new pitcher showing no external signs of its presence, it burrows down into the corky refuse of its own feeding, which fills the lower portions of the tube; in and of this material, with little or no apparent admixture of silk, it constructs an evenly rounded, oval cell in contact with the leaf wall on one side, within which it changes to a pupa. It does not ceil the pitcher above, with silk, for usually the top has already been eaten to a thin membrane and is in a more or less collapsed condition, which the larva frequently accentuates, as a preliminary to pupation, by girdling it above the frass level with a deeply cut, encircling groove, causing the whole upper portion of the pitcher to topple over and thus more effectually closing the tube. That is, the groove-cutting habit, employed by very young larvæ of *semicrocea* to produce a closed feeding chamber, and by *rolandiana* of like age for the same purpose, but of perhaps greater importance, to ensure a water-tight compartment for hibernation, reappears in *ridingsii*, a species otherwise barred from the use of this device by the seasonal history of its food plant, as a means of obtaining protection to the pupal chamber.

The hibernating larvæ of *ridingsii* are often ready for pupation before the pitchers of *flava* are open at the top, so that many larvæ of this brood are compelled to pupate in immature, unopened pitchers, and under these conditions they exhibit some habits not always apparent in the later broods. As a result of the larva's having entered and fed upon one of these pitchers, as already described, there has collected in the lower part of the tube a sufficient accumulation of corky frass in which to construct a cocoon. The collapsed and toppled-over upper portion effectually closes the tube above. Below the collapsed portion, but well up in the tube, the larva cuts an emergence hole, large enough for the moth, its wings still moist and flexible, to creep out; lower in the tube it cuts a much smaller hole to ensure drainage if in the pitcher's damaged condition rain water should gain access; just above the drainage hole it closes the tube with an open-meshed web, which permits water to drain through, but serves to exclude unwelcome insects from below; above the drainage hole and below the emergence hole the larva then constructs its usual oval cell of corky frass and changes to a chrysalis.

The presence of these two holes is an infallible indication of the occupancy of the young pitcher of *flava* by the pupa of *ridingsii*. On the pitcher-plant meadows around Summerville, South Carolina, for example, in early May, hundreds of these pitchers may be thus identified, picked, and gathered, each containing a pupa ensconced between the two holes. These outward signs are recognized, too, by a bird—probably a partridge, but not positively identified—which splits the tube between the emergence and drainage holes and extracts the pupa. As was noted long ago by a botanical observer, the pitchers of *minor* are also habitually split open by birds for the insects contained therein; but *semicrocea*, the *Exyra* more frequently occupying these pitchers, by its habitual choice of unmutilated pitchers for pupation, avoids giving outward indication of its presence and is thus to some degree protected against this enemy. *Ridingsii*, constructing its cocoon from the refuse of its own feeding, is debarred from this defense.

Emergence of the moths usually takes place in the daytime. From closed pitchers the moths creep out while their wings are still moist and soft; in open pitchers they rest upon the inner wall of the leaf, above their cocoons, until ready for flight; and their first flight, in fact all their flights, seem to be simply from one pitcher to another. With no apparent structural adaptation by which to overcome the trap structures of the pitchers, their entrance and safe exit seem to depend simply on knowing how. In entering, they alight on the outside and run in over the rim; in leaving the pitcher, they climb the wall, half walking, half flying, and take flight from the rim or from the wide upper portion where there is room for the free operation of their wings. The pitchers are their habitual resting places. Here they sit on the inner walls, heads upward, backing farther down when alarmed or disturbed, flying immediately to another pitcher when driven out, and refusing to leave these shelters when the pitchers are plucked or even roughly handled and carried away. The moths of *Exyra* have been observed to feed upon the

The fact that the pitcher of *psittacina* has no adequate orifice through which the moth of *semicrocea* can escape when it emerges, makes it necessary for the larva before pupating to cut for the purpose a large hole in the peak of the hood nectar secretion of the pitchers, but they do not seem ever to enter the flowers—in fact, *flava* and *purpurea* have practically ceased blooming before the *Exyra* associates of these plants, *ridingsii* and *rolandiana*, have reached the winged stage; so that these insects cannot be supposed to confer upon their plant associates the return benefit of cross pollination.

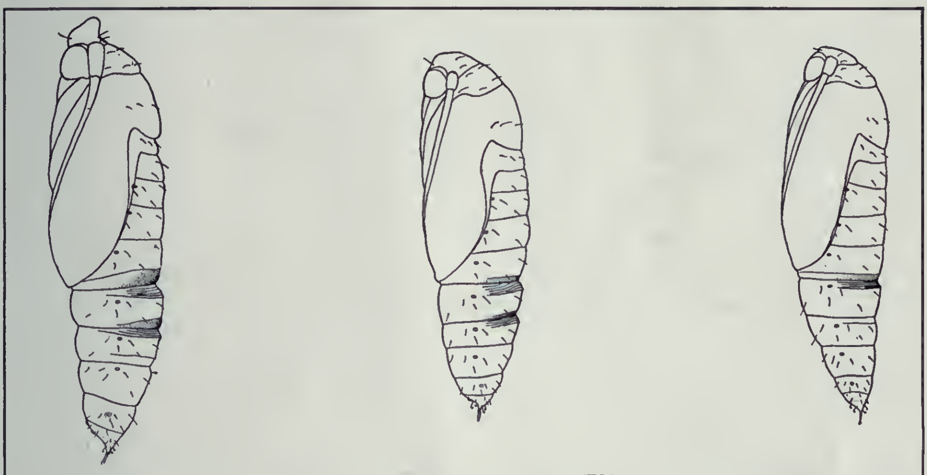
The larva of *ridingsii*, when about to pupate, constructs a cell in the corky refuse of its own feeding. When the cocoon is spun in mature pitchers, emergence and drainage holes, such as are shown in the companion picture, are often omitted.

The exterior of a young pitcher of *flava* with the two orifices made by *ridingsii*, the emergence hole through which the moth will later make its exit above, the drainage hole below. *Courtesy of Entomological News, XXIII, 1907*

The black and yellow colors of *semicrocea* and *ridingsii* and their conspicuous color patterns are probably ancestral, for this coloration seems to bear little if any relation to their association with the pitcher plants, and the very remarkable range of color variation exhibited by these insects does not seem to bear any imaginable relation to their plant habitat, though it may be a direct response to climatic and food-plant conditions. Hibernating larvæ of *ridingsii*, having an abundant supply of tender, juicy food, produce moths materially larger and much more heavily marked, even to the complete obliteration of the yellow areas of their wings, than those of the later broods feeding in dry, parchment-like pitchers in their sun-baked, midsummer condition. A similar range of variation in *semicrocea*, however, is *not* seasonal, and perhaps only the experimental production of these forms, if that be possible, will satisfactorily determine their significance; in *semicrocea* there is, however, a direct food-plant effect on the *size* of the imago (the adult insect), probably resultant from the larval habit of refusing to change from pitcher to pitcher except under absolute compulsion through failure of the food supply; those from the small pitchers of *psittacina* and *rubra*, constantly average smaller than those from *minor* and *sledgei*, and these in turn, smaller than *drummondii*-bred moths.

ish purple tones of its food plant. The departure from the typical coloration of the genus occurs in the one species where this change is intelligible as an adjustment to its food-plant environment.

In a study of this kind there is abundant opportunity for a misinterpretation of some of the observed facts. When we endeavor to translate a document in an unknown cipher, we may easily be mistaken in the individual word; but when we spell out an intelligible and consistent



PUPÆ OF EXYRA

Ridingsii *Semicrocea* *Rolandiana*

The pupæ of the three species are very similar and present the usual noctuid characters, varying individually from pale amber to dark brown, almost black. Of the three species two, *rolandiana* and *semicrocea*, occupy filmy, silken cocoons; the third, *ridingsii*, a densely packed cell of corky frass. Of the three the pupa of *ridingsii* only has its front strongly and acutely produced over the head, the office of this pointed structure being to puncture the impacted wall of its cocoon

Rolandiana, too, exhibits a very wide range of variation, in part geographical, the southern examples usually being smaller and darker than the northern, thus giving rise, apparently, to the extreme form furnishing the types of Grote's *Exyra fax*. Of the three species *rolandiana* only, living in the one pitcher plant, *purpurea*, whose interior is not more or less concealed by an overhanging hood and whose wide pitchers are thus open to view from above, has acquired the purple-red, yellowish red, and black-

message, we have reasonable assurance of the correctness of our work. As we thus review the activities of *Exyra*, we find that some of the characters common to the three species are obviously related to their pitcher-plant environment, indicating a long continued and ancestral association with these plants; but more significantly, that many if not most of their specific differences, both of structure and instinct, are made up of adjustments or adaptations to their respective food plants. Is it not,

THE VARIABLE EXYRA MOTHS

The three species of the genus *Exyra* exhibit a wide range of variation—individual, seasonal, geographic. The two topmost rows are *ridingsii*, the three middle rows *semicrocea*, the two lowest *rolandiana*. *Rolandiana*, which in contrast to the other two species lives in exposed pitchers, is afforded partial concealment through its protective coloration therefore, an inevitable conclusion that food-plant environment has determined the direction and course of their specific evolution?

If it is a "commonplace of evolutionary knowledge" that "among the best known illustrations of divergent evolution are the animals of oceanic islands, ... undoubtedly descended from common ancestors, yet having become distinct through changes which isolation prevented from being ground down to a common level by inter-crossing," then even the present distribution of *Sarracenia* gives further suggestion of the part of the food plant in the differentiation of *Exyra*. The geographical distribution of *Sarracenia purpurea*, from Labrador to the Gulf of Mexico, with no other plants of the genus occurring north of Virginia, places *rolandiana* out of contact with other *Exyra* for perhaps three fourths of its present extreme range. The plant is not generally distributed throughout this territory, but occurs in colonies often widely separated. *Exyra* in its winged stage—its only period of probable distribution—is short-lived, rather sluggish in habit, and weak of flight. These conditions, therefore, permanently separate a great majority of the colonies of *rolandiana* from direct contact with others of the genus and exhibit the conditions which would permit its origin in some food-plant "island" of *purpurea*, where group isolation would be as truly operative as in an oceanic island of the geographer; and of the three species only *rolandiana* exhibits a well marked geographical variation.

Although each species of *Exyra* is associated with certain *Sarracenia* species, usually to the exclusion of all others, any *Exyra* may be bred to maturity in any *Sarracenia;* and in the field, when pressed by failure of the food supply, any *Sarracenia* is recognized by any *Exyra* as a possible food plant. *Darlingtonia*, then, the only North American plant of the family with no *Exyra* associate, in its widely removed habitat suggests a food-plant "island" whose shores no *Exyra* has ever reached.

Food-plant "islands" may overlap or coincide geographically, and yet tend to separate their insect associates. At Summerville, South Carolina, where *ridingsii* is very abundant in *flava* and *semicrocea* in *minor*—these plants growing intermingled—*semicrocea*, hibernating as a last stage larva, finds its early spring food in the green, winter leaves of *minor*, and the moths appear in numbers about April 20; *ridingsii*, hibernating as an early stage larva in dry, dead leaves of *flava*, cannot complete its transformations until the spring growth of its food plant provides it with larval food. It does not leave its hibernaculum until about April 20, and the moths do not appear in numbers until May 20. Thus the spring broods of *semicrocea* and of *ridingsii*, in their mating stage, are separated by about four weeks—that is, the seasonal history of their respective food plants compels the partial isolation of one closely related species from another.

Even within the species we see something of this in process. In southern Mississippi, *semicrocea*, hibernating in *sledgei* as a last stage larva, completes its transformations and appears as a moth in early April. According to observations made in 1910, the spring emergence reached its height about April 10. In the same bog very young larvæ of this species, occupying their water-tight hibernacula in the pitchers of *psittacina*, were observed to awake from their winter lethargy in mid-April, and the first moth was noted in early May. Thus approximately a month intervenes between the appearances of moths of the same species from larvæ hibernating in the two food plants. When first found, especial attention was paid to these *psittacina*-feeding larvæ, for they were so different in age and habit from their fellows hibernating in *sledgei* that another species was confidently expected. The following is a literal transcript of field notes made at the time:

"North side of Biloxi Bay, March 9, 1910. Opened 275 leaves of *psittacina*, gathered at random from plants growing in a very sloppy place, often partly under water or imbedded in wet sand; found three living *Exyra* larvæ, $\frac{1}{8}$ to $\frac{3}{8}$ inch long, in each instance the entrance to leaf strongly plugged by a water-tight partition, the larva low down in the narrow tube; several plugged leaves contained dead (drowned) larvæ."

As far as it is safe to judge by one season's observation, here seems to be in progress a selective process—a rigorous weeding out of all older larvæ, which had weakened their hibernacula by feeding, and of those which had not ceiled their pitchers exceptionally well—essential group-isolation enforced by food-plant characters, and a considerable degree of adjustment to those characters and to habitat.

We have tried to demonstrate, with reference to *Exyra* and *Sarracenia*, that the insects throughout their life cycle exhibit a remarkable degree of plasticity, of adaptability to varying conditions; that food-plant distribution, structure, and seasonal history, encourage or even compel group-isolation among the associated insects, creating conditions favorable to the preservation of divergent characters; that many, if not most, of the specific differences of the insects of this genus find their intelligible explanation as adjustments to food-plant characters; and since so large a proportion of these specific differences do consist of adjustments, specializations, to food-plant environment, how can we avoid the further conclusion, that on these food-plant "islands" there has been a selective process as well, by which advantageous divergences have been preserved to the exclusion of those of doubtful or of negative utility?

A growth of *Purpurea* near Tom's River, New Jersey

TOBACCO AS A CURE FOR AILMENTS

TODAY the use of tobacco is generally conceived of as a pleasant social indulgence, but among the Indians it was, and for that matter still is, smoked for a variety of specific purposes and for ends often contradictory or conflicting. It was used, for instance, to start a war as well as to cement a peace, to inflict bodily injury as well as to undo an injury inflicted, to appease spirits or to win their favor, in undertaking dangerous expeditions, in the ratification of treaties, in confirming sales, in the hunt, in agriculture, in placating the thunder, in petitioning the powers that guard the rain. The smoke of tobacco was a prayer wafted to the gods; a cigarette deposited in a shrine, or snuff sprinkled over the heads of idols, were gifts welcome to the beings that preside over men. In passing a shaman's grave in a canoe, a Tlingit Indian would lower four pieces of tobacco into the sea, saying "Give me luck. Do not let me perish. Do not let the wind blow so strongly on me." The Menomini placed tobacco before grave boxes and sprinkled it as well over rocks and stones of fantastic shape whose origin was attributed to Mä′näbŭsh, the great deity.

One of the more prevalent uses of tobacco was in the curing of disease or, to look at it from the angle of the Indian, in the expulsion from the body of the sick person of the malevolent being or thing responsible for his illness. It does not become us, however, to smile superciliously at this notion of the savage. When tobacco was introduced into Europe, it was widely regarded as curative, and centuries prior to its introduction smoking was prescribed as a medicament for various ailments by such physicians as Hippocrates, Galen, Avicenna, and others. Notwithstanding the relentless war waged on tobacco in the seventeenth century, the belief was by no means uncommon that those in the habit of using tobacco were exempt from disease. It is in conformity with this idea that Pepys, writing under date of June 7, 1665, when the great plague was raging, makes this entry in his diary: "This day, much against my will, I did, in Drury Lane, see two or three houses marked with a red cross upon the doors, and 'Lord have mercy upon us!' writ there; which was a sad sight to me, being the first of the kind that, to my remembrance, I ever saw. It put me in an ill conception of myself and my smell, so that I was forced to buy some roll-tobacco, to smell to, and chaw, which took away my apprehension."

Writing some two decades prior to Pepys, Lord Herbert of Cherbury—

> All-virtuous Herbert! on whose every part
> Truth might spend all her voice, fame all her art!

laments the pollution of his breath by tobacco, "which toward my latter time I was forced to take against certain rheums and catarrhs that trouble me; which yet did not taint my breath for any long time." Even Robert Burton, who, resorting to the extravagances of invective, condemned tobacco taken for pleasure as "a plague, a mischief, a violent purger of goods, lands, health, hellish, devilish, and damned tobacco, the ruin and overthrow of body and soul," strange to say, believed in the medical properties of the "weed."

During the years 1887–88 Mr. James Mooney obtained for the United States Bureau of Ethnology about six hundred sacred formulas set down by the shamans of the Cherokee. The manuscripts are written in the characters invented or rather adapted in 1821 by Sikwâ′ya (Sequoyah), a member of the tribe. These characters were derived from the Roman alphabet but as their adapter did not know the sounds associated with the letters in English, he assigned to them different values in Cherokee, and in addition altered their form to suit his purposes. He devised also about forty new characters.

In not a few of these sacred formulas

the use of tobacco is prescribed. One of the alternate remedies suggested for the ailment quaintly described as "pains moving about in the teeth" consisted of the blowing of tobacco smoke from a pipe placed directly against the tooth or teeth affected. The practitioner treating those who were "painfully sick" retained in his mouth the blossoms of three plants, one of which was *Nicotiana rustica*, or more likely a decoction made of the three. Upon withdrawing his mouth from the afflicted part and ejecting the fluid it contained, there would be found in the fluid, if the credulity of the patient was sufficiently strong or the dexterity of the practitioner sufficiently great, some minute object—pebble, insect, or stick—which the practitioner would point to as the cause of the trouble.

Tobacco was the plant commonly employed to undo or to combat witchcraft. One of the sacred formulas is entitled "to shorten a night-goer on this side." A night-goer was another name for a witch, the Cherokee believing that witches prowl about the dwellings of sick people after nightfall, malignly awaiting the opportunity to slip in and "shorten the occupants on this side" or, in other words, to kill them. The advantage that accrued to the witches was the lengthening of their own span of life through the premature termination of the alloted span of their victims. With the object of beating the evil spirits at their own game the shaman just before dark issued from the forest. Walking deliberately about the dwelling that was threatened, he blew smoke from his pipe toward every trail along which the night-goer might make an approach. Thus the patient was saved.

When a Cherokee was bitten by a snake, a formula prescribed that the shaman should make light of the antagonistic spirit by referring to it disdainfully as a mere frog. In addition, he was required to rub tobacco juice on the wound (which must have been soothing to the victim) or in the absence of tobacco juice, he was to apply saliva. During the process of rubbing he had to walk in a circle about the patient from right to left four times, thereby uncoiling the snake, which makes its circles from left to right. Among the Zuñi smoke from a corn-husk cigarette containing native tobacco was blown over the body of anyone suffering from rattlesnake bite as a supplement to the local treatment applied.

The Pima used cigarette smoke to diagnose the nature of an illness, claiming that he could discern the disease through the fumes. This people entertained the curious belief that when a horse was taken sick, it was because some ill-disposed person had shot a burning coal into its body. The point of entry was located through the medium of smoke. The individual trying to effect the cure would pretend to extract the hot coal by applying his mouth to the afflicted animal, meantime making grimaces that convinced the bystanders that he was indeed being burned. He would then fill his mouth with water and spew out the coal.

In the strangely interesting ceremony practised by the Navajo for the recovery of the sick, it was customary for the invalid, repeating the prayer of the theurgist, to offer to the people of the mountain and rocks and to earth itself cigarettes or tubes containing little balls made of the down of humming birds, corn pollen, and tobacco, lighted through a crystal by the rays of the sun. Live coals were placed before the invalid and over them was sprinkled tobacco so that he might be restored through inhaling the fumes. Even the masks of the impersonators of the gods received in the course of this therapeutic ceremony puffed offerings of tobacco smoke.

The Navajo have a tradition that at one time a young man of their tribe fleeing from Utes entered a cave where there was a fire issuing from four stones colored respectively black, blue, yellow, and white. Near each stone was a bear colored to correspond. The bears demanded tobacco and though at first claiming that he had none, the Navajo at last yielded to their angry insistence. Filling a pipe with tobacco he had taken from the Utes, he handed it to the black bear, who, taking one whiff, just managed to pass it to the blue bear before dropping insensible. The blue bear ventured to puff twice; then, passing the pipe to the yellow bear, he too succumbed. The yellow bear was rendered insensible with the third puff, the white bear yielded to the fourth. Then the Navajo took his pipe and rubbing with it the bodies of the inert animals speedily resuscitated them.

A Cherokee hunter who, having failed properly to prepare himself by fasting, collapsed when taken to view a city located in the center of a mountain, was restored to strength by having his legs rubbed with tobacco and his nostrils stimulated by its fragrance.

Yet be it said that although in the above mentioned instances tobacco was looked upon as curative, its effects were sometimes disastrous or nearly so; witness the following curious test required of the Indian who in Guiana aspired to be a *piai*. To attain this dignity required prodigious fortitude in addition to a strong constitution. The novitiate had to undergo the agonies of thirst and of hunger and tortures of the flesh without protest or complaint. In some localities his skin was slit, in others mats or belts swarming with biting ants were attached to different parts of his body. The green leaves of tobacco were pressed until they had yielded their juices, and this decoction the novitiate was compelled to swallow at intervals during the period of preparation. The great tobacco ordeal occurred, however, on the day of his installation. An eyewitness has recorded that on one such occasion he saw the novitiate swallow "a calabash containing about two pints of tobacco juice." The same observer states that most frequently the novitiate "falls into a swoon, whereupon he is carried to his hammock: if he does not vomit directly after taking this powerful emetic he dies, or at least he is seized with horrible convulsion and breaks out into cold sweats, etc., which all tend to bring him to the grave. But if he survives, he is acclaimed *piai*."

We have noted some of the potencies ascribed to tobacco in the New World; in the Old it was credited similarly with curative powers and because of this was referred to by Spenser in his *Faerie Queen* as "divine tobacco," by the Spaniards as "*santa yerba*," the holy herb, and by the French among other designations as *herbe propre à tous maux*, or remedy for all ailments.—H. F. S.

MR. WALTER GRANGER

Unusually keen in the discovery of minute and inconspicuous forms, and no less expert as a stratigraphic geologist, Mr. Granger is eminently qualified for his coming palæontological field work in Asia

MR. WALTER GRANGER AND THE THIRD ASIATIC EXPEDITION

MR. WALTER GRANGER left the American Museum on May 14 to join the Third Asiatic Expedition, now established in Peking. He is peculiarly well qualified, by nature and training, for the reconnaissance and exploration work among the extinct mammals of eastern Asia. At the age of seventeen, a typical Vermonter, tall, fair-haired, blue-eyed, he entered the Museum service in the department of taxidermy under Jenness Richardson, who also came from Vermont. He commenced work in October, 1890, at the slender salary of twenty dollars per month. In 1894 he took his first western trip to collect mammals for Doctor Allen's department, especially in the region of the Big Bad Lands of South Dakota, which were then being explored by American Museum palæontological parties. The following year he went into the Uinta and Washakie regions of southwest Wyoming, giving half his time to mammalogy and half to vertebrate palæontology, under the able training of Dr. J. L. Wortman. In 1896 he joined the staff of the department of vertebrate palæontology and has since been in charge of the Eocene division, undertaking in successive seasons, no less than twenty trips altogether to the Rocky Mountain region, which have resulted in making the American Museum the richest depository in the world of the life of Eocene times. In 1907 he accompanied Professor Henry Fairfield Osborn on a journey to the Fayûm region of Egypt to hunt for the ancestors of the Proboscidea and, with the aid of Mr. George Olsen, secured a collection which has since proved to be superb. On this expedition many of the small types of animals were discovered that had escaped the eyes of British explorers.

In the intervals between the Rocky Mountain work Mr. Granger has been associated with Curator Matthew in describing the Eocene life of North America, especially devoting himself to the ancestral horses and other small ungulates. When hunting fossils in the field his eye is like that of a hawk in detecting in the distance small and nearly invisible objects. Thus has he become a master in the search for microfauna which have escaped the less vigilant vision of earlier explorers. A catalog of the minute forms of primates, insectivora, and rodents which he has found will fill many pages of fine text. He has become no less expert as a stratigraphic geologist and with Professor Osborn and Doctor Matthew has greatly contributed to the knowledge of the Eocene and Oligocene of the Rocky Mountain region, from which the division of this region into sixteen distinct life zones, each with sharply defined fauna, has been made. On arriving in China Mr. Granger's first duty will be to get in touch with the Geological Survey of China,[1] with its Director, Dr. V. K. Ting, and with Mr. J. G. Andersson, mining adviser to the Chinese Government and curator of the Museum of the Geological Survey of China, who have kindly offered to conduct Mr. Granger over some of the fossil beds already discovered and worked by the Survey of China. In another season Mr. Granger hopes to accompany Chief Roy Chapman Andrews on an expedition into the unknown fossil regions of the north.

Meanwhile the Museum enjoys the hospitality of the Geological Survey of China and is working in fullest accord with Director Ting and Mr. Andersson. It is distinctly understood that the work of the American Museum is of coöperative character, such as is carried on by many private institutions of this country in coöperation with our own U. S. Geological Survey.

[1] See NATURAL HISTORY, January-February, 1921, p. 1.

NOTES

Since the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Life Members: MESDAMES JOHN W. T. NICHOLS, A. A. ZUCKER; MESSRS. JOHN S. PHIPPS, HENRY C. QUINBY, AND WARREN THORPE.

Annual Members: MESDAMES EDWARD DEAN ADAMS, FINLEY PETER DUNNE, WINTHROP DWIGHT, ERNESTO G. FABBRI, C. LAGEMANN; THE MISSES SYBIL KENT KANE, VELMA L. LILLIE, K. T. MOORE, DOROTHY OAK, R. SEED; CAPTAIN CHARLES W. HALSEY; DOCTORS DAVID B. FREUNDLICH, DE WITT STETTEN; MESSRS. CLIFFORD W. ASHLEY, THEODORE H. COOPER, PAUL R. FREISINGER, EDWIN F. GAY, B. B. GIRDEN, EDWARD O. A. GLOKNER, EDWIN L. MEYERS, GEORGE J. OPENHYM, CORNELIUS POILLON, THEODORE PRINCE, EDWIN A. SEASONGOOD, WILLIAM E. TAYLOR, C. H. TUCK, CHARLES ELLIOT WARREN, AND LEWIS BLAIR WILLIAMS.

Associate Members: MESDAMES LEONARD AHL, H. A. AINSWORTH, HORATIO C. ALLEN, E. F. ATKINS, MARY S. AVERY, C. H. BABCOCK, CHARLES BAILEY, A. D. BALDWIN, HANNA E. BELDEN, EMMA BLANCHARD, CHARLES E. BLUE, GIDEON BOERICKE, ELLEN L. BORDEN, LIDIAN E. BRIDGE, CLIFFORD BRIGHAM; THE MISSES AGNES A. ACTON, ORPHA LORENA APP, CAROLINE F. BARR, LUCY B. BLISS, JANE E. BREWSTER, LYDIA M. LABOITEAUX, ANNE MANGOLD, MARGARET JANE SCHMIDT; HIS EXCELLENCY BORIS A. BAKHMETEFF; THE HON. JOB BARNARD; DOCTORS CHARLES MINOR BLACKFORD 2D, RAYMOND C. MOORE, R. A. NEWMAN, ELMER G. PETERSON, H. L. RUSSELL, CHARLES C. STILLMAN, H. GIDEON WELLS, GARDNER F. WILLIAMS; MESSRS. JOSEPH ADAMS, W. L. ALEXANDER, H. W. ALTHOUSE, GEORGE B. ALVORD, CHARLES L. AMOS, EDWIN C. ANDERSON, EDW. E. ARMSTRONG, CLARENCE M. ARNOLD, GEORGE C. ATWELL, GEORGE L. BAKER, J. M. BALDRIGE, ROBERT F. BALDWIN, HENRY C. BALLOU, WILDER D. BANCROFT, ROBERT BATCHELLER, Q. E. BECKWITH, HENRY BENEKE, COGSWELL BENTLEY, C. HERBERT BENTON, JACOB BERGES, GEORGE H. BISSINGER, O. S. BLANCHARD, ELMER F. BOTSFORD, JAMES P. BOYD, F. BRADSHAW, J. WARNER EDWARDS, C. M. HOLMES, EDWIN LINCOLN MOSELEY, ALBERT E. NOBLE, R. A. PORTER, CHARLES P. PRICE, ROY H. SMITH, EMORY W. THURSTON, A. C. WASHBURNE, AND E. R. WOLCOTT.

PRESIDENT HENRY FAIRFIELD OSBORN of the American Museum is spending a few weeks in Europe. One of the purposes of his sojourn is to complete certain chapters on Neolithic man which will find place in an enlarged edition of his *Men of the Old Stone Age*. From England Professor Osborn will go to Scandinavia and later to other countries of the Continent, coming into touch with scientific circles in all of the places visited.

FOR some months past Associate Curator N. C. Nelson of the department of anthropology, American Museum, has been working over an archæological collection from Egypt, northwest Africa, and Spain. As the Egyptian specimens are not accompanied by chronological data, their date must be inferred either by comparing them with the record from western Europe or by studying their surface appearance. Those that have been exposed for a long time have undergone a greater degree of patination than those exposed more recently and in this way the relative age is revealed. The artifacts from Egypt were found on the surface of the desert, while some from northeast Africa and Spain were found in caves. Remarkable as it may seem, there is some agreement between the desert specimens and those obtained from the caves.

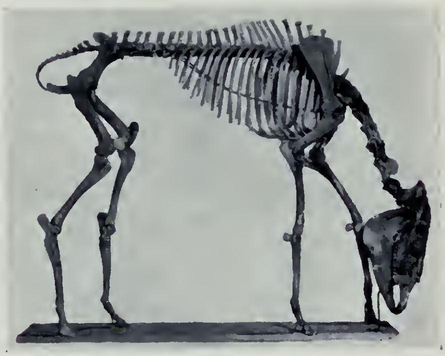
DR. Y. B. TSAI, chancellor of the National University of Peking, China, was the guest of the president and the Board of Trustees of the American Museum on Monday afternoon, June 6. Chinese officials in New York and Washington and the Chinese students of the vicinity were invited to meet the chancellor at tea in the Age of Man hall. President Osborn received Dr. Tsai and his party in the members' room. Dr. Tsai was pleased with the organization of the Museum, its relation to the city, the character of its research and exploration, and its service in educating the public. The Chinese guests were escorted by Director Lucas and other members of the staff through the exhibition halls and were keenly interested in the methods of exhibition used and particularly in the work connected with the schools. The chancellor also expressed his hope for the success of the work which the Third Asiatic Expedition is undertaking in China under the leadership of Roy Chapman Andrews.

IN order to bring the assistance which the American Museum of Natural History offers to teachers, directly to the attention of a large number of young women who will enter upon their work in the New York schools for the first time this fall, a reception was held at the Museum on May 23 for the graduating class of the Maxwell Training School for Teachers. The seniors from the New York Training School were entertained in a similar manner on June 9. On both occasions, President Henry Fairfield Osborn welcomed the guests, speaking of the debt society owes to teachers and of the desire of the American Museum to coöperate with the city's department of public education. Mr. George H. Sherwood, curator of public education, surveyed briefly the activities of the American Museum in the service of the schools. He illustrated with stereoptican views such representative features of the department as the circulating collections, the work with the blind classes, and the docent service. He also gave a demonstration how lantern slide material may be used in the teaching of geography. This was further illustrated with a motion picture of the formation and eruption of volcanoes explained by Dr. G. Clyde Fisher.

At the second reception, the Museum was honored by the presence of Superintendent William L. Ettinger, who expressed the appreciation of the superintendents and teachers for the service the Museum is rendering the schools, and urged upon the graduates the desirability of utilizing in their profession the extensive facilities which the American Museum and similar institutions have to offer. At the close of the hour in the auditorium, members of the staff escorted the teachers through the exhibition halls and especially through the offices of the department of public education, where samples of the various loan collections, including health charts and food exhibits, of the material used in classes for the blind, and of collections circulated in schools and libraries, were displayed. Dr. Hugo Newman, principal of the New York Training School, who was present with other members of the faculty, expressed satisfaction with the educational work of the Museum and his willingness to coöperate with members of the staff in order that their loan material might meet even more completely the needs imposed by the curricula of New York schools. Tea was served in the hall of the Age of Man.

Collections of Alaskan butterflies and fishes will be obtained for the American Museum by Mr. Robert Anderson Pope, a landscape architect and town planner interested in natural history, who left in July for high altitudes in the interior of Alaska back of Anchorage, to be gone until September. Mr. Pope called at the Museum just before leaving New York.

The horse is so closely associated with man that we are apt to forget that his family tree is vastly more ancient than that of the proudest of the human race. While few of us know our forbears beyond a few generations, the horse, thanks to the data supplied by fossil remains, has a named and described ancestry extending back to the dawn of the Tertiary. Visitors to the American Museum are able through the progressive series of specimens on exhibition to visualize the gradual evolution of the horse from a small, four-toed creature in the Eocene to the one-toed, powerful animal that we know today. A gap in the exhibition series was recently filled through the addition of a superb, mounted specimen of *Pliohippus*. This animal represents the earliest stage of the one-toed horses. It is intermediate between the three-toed horses of the Miocene and the one-toed horses (*Equus*) of the Pleistocene. *Pliohippus* is realistically mounted, with lowered head as though browsing. The specimen was secured from the Snake Creek locality of Nebraska, where a systematic search will be conducted this summer for additional material.



This skeleton, *Pliohippus*—an important recent addition to the American Museum's exhibit illustrating the evolution of the horse—represents the earliest stage of the one-toed horses

Another skeleton which has recently left the laboratory to take its position among the palæontological exhibits on the fourth floor of the American Museum is *Trilophodon productus*, one of the long-jawed mastodons, which inhabited the Old World and North America during the Miocene and Pliocene epochs, a few surviving until the Pleistocene. The long-jawed mastodons have the front of the lower jaw extended in a long, spout-shaped process, on which the trunk rests instead of hanging free as it does in elephants. The skeleton is that of a single individual. Thirteen vertebræ, the ribs, the pelvis and sacrum, the left hind limb bones and the heel and ankle bones of the left hind foot are original bone; the missing parts are restored in plaster. In a wall case near by are exhibited the original skull and jaws.

Among the creatures of the past that because of their great size seem rather to have stepped out of some fairy tale than to hold a place in the world of actual things are the great extinct birds, such as the *Moa*, *Æpyornis*, and *Diatryma*.

The last mentioned has just been added to the exhibits on the fourth floor of the American Museum. This bird, a contemporary of the

One of the great extinct, flightless birds, *Diatryma steini*, recently placed on exhibition at the American Museum

little *Eohippus*, or four-toed horse of the Eocene, was bulkier than any ostrich. It had an enormous head and a high, compressed beak unlike that of any living bird. Its wings were so reduced that it was incapable of flight. Remains of this bird are exceedingly rare and until this skeleton was found, it was known only from a few fragments of foot bones found in Wyoming, New Mexico, and New Jersey.

NOTABLE additions to the dinosaur exhibits have been made or are in contemplation. The mount of the running dinosaur *Gorgosaurus*, an impressive representative of these great reptiles of the past, was placed on view some months ago. In August a skeleton in standing pose of the ostrich-like dinosaur *Struthiomimus* will be exhibited. Next winter skeletons of the horned dinosaurs *Triceratops* and *Monoclonius* will be ready.

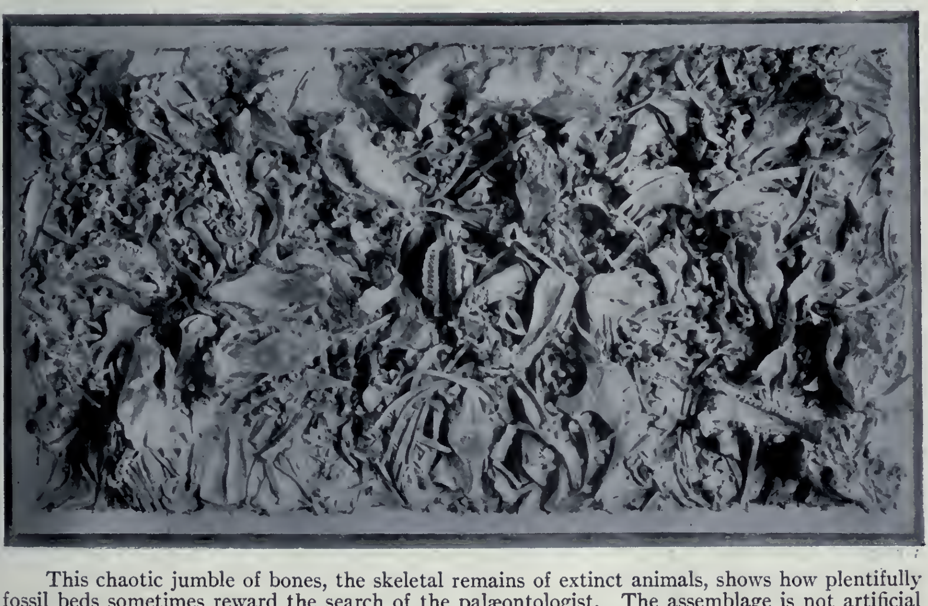
DR. FRANK M. CHAPMAN, curator of the department of birds, returned from England June 22 after a sojourn of one month in that country. His time was devoted primarily to a study in the British Museum of the collections of birds from Ecuador in connection with the preparation of a *Bulletin* on the distribution of birds in that country similar in character to the one already published on the birds of Colombia (*Bull.* XXXVI, Am. Mus. Nat. Hist.). Most advantageous exchanges were also made with the British Museum and with the museums at Tring and Cambridge, resulting in the acquisition of 136 species new to the South American collections of the American Museum and including numbers of co-types and authentic specimens.

During his stay in London Dr. Chapman delivered illustrated addresses on the Museum's explorations in South America before the Zoölogical Society and the British Ornithologists' Club.

A GROUP of distinguished visitors from Sweden, on their return to Stockholm after several months of travel in Argentina, Chile, and Brazil, were welcomed on May 28 to the American Museum of Natural History by President Henry Fairfield Osborn. Mr. Knut Wallenberg, formerly Minister of Foreign Affairs and head of Stockholm's Enskilda Bank, responded to the president's welcome. Director Lucas and other members of the staff conducted the visitors, who were particularly interested in observing educational methods and in visiting to this end educational institutions in this city, through the exhibition halls. The distribution of small, circulating collections among the public schools for use in nature-study classes was a feature of the Museum's work which received especially favorable comment. Mr. Wallenberg was accompanied by his wife, Dr. and Mrs. Johannes Hellner, Mrs. Hellner's sister (Miss Berge), Consul General and Mrs. Joseph Sachs, and Dr. Naukhoff. Dr. Hellner was also a former Minister of Foreign Affairs and is now a judge of the Supreme Court. Consul General Sachs acted as a member of the Swedish War Trade Commission and is president of Nordiska Kompaniet. The party also visited in Washington, D. C., where they were entertained by Mr. Wallenberg's brother, the Swedish Minister to the United States.

ONE of the most impressive exhibits recently installed on the fourth floor of the American Museum is the rectangular block from the Agate Quarry of Nebraska, consisting of a closely packed jumble of fossilized bones and no less than twenty-two skulls of *Diceratherium*, an early rhinoceros. The visitor to the American Museum is so accustomed to seeing the finished mounted specimen on which under scientific guidance has been lavished the care of the preparation department that it is instructive to glimpse the condition of the skeletons when first removed from the earth. The mass containing these skeletal remains weighed at the time of its arrival at the Museum nearly three tons. The resourcefulness of the department of preparation is frequently put to the test. Housewives will be interested to learn that though the usual tools were of service, the most effective appliance in giving the block its present immaculate appearance was a vacuum cleaner, special tubes being fitted into the depressions of the irregular surface of the block to draw forth the dirt therein.

To clean a block of such uneven surface as that shown in the illustration below, required no little resourcefulness on the part of the preparation department of the American Museum, to whose skill it was entrusted upon being transported from Nebraska. A vacuum cleaner, fitted with special tubes to penetrate the cavities and extract dirt, proved very helpful



This chaotic jumble of bones, the skeletal remains of extinct animals, shows how plentifully fossil beds sometimes reward the search of the palæontologist. The assemblage is not artificial but represents a condition of crowding actually encountered. This block from the Agate Quarry of Nebraska is on exhibition on the fourth floor of the American Museum

Prof. C. P. Berkey, of Columbia University, is preparing to join the American Museum's Third Asiatic Expedition, in the spring of 1922, as chief geologist. He has secured a leave of six months from his university duties for the purpose and is fitting himself for this reconnaissance work by studying all the geologic treatises on China, Mongolia, and Tibet. Through correspondence he will keep track of Mr. Walter Granger's preliminary work in palæontology (see p. 321 of this issue), so that by the time he reaches the field, the palæontologist and geologist may be ready to begin their expedition to the north without delay.

Mr. Clifford H. Pope, a member of the Third Asiatic Expedition, will soon join Chief Roy Chapman Andrews in China. Mr. Pope is especially interested in the study of reptiles and fishes and expects to devote attention to these as his share of the work of the expedition. Mr. Pope studied for two years at the University of his native state, Georgia, and completed his course at the University of Virginia, where he was graduated in May, 1921, with the degree of bachelor in biology. He is particularly well prepared for the field work he is undertaking in connection with the present expedition by a summer of practical experience and observation in the Bronx Zoölogical Park, where he gave especial attention to the occupants of the reptile house, as well as by his studies of fish habits made during the summers of 1919 and 1920, under Mr. William Beebe, at the New York Zoölogical Society's Tropical Research Station, Katabo Point, British Guiana. Both Mr. Beebe and Mr. Raymond L. Ditmars, under whose direction he worked at the Zoölogical Park, highly commend Mr. Pope for his energy, sincerity of purpose, and scientific ability. Mr. Pope sailed from San Francisco on May 31 with Mr. Walter L. Granger.

A map of Ecuador has proved essential to the publication of the biological work of the American Museum in the Andean region and is now being prepared under the direction of Curators H. E. Anthony and Frank M. Chapman by Mr. Briesemeister, one of the staff of the American Geographical Society. When completed, it will be the best map of Ecuador extant, for it will embody the results of the latest surveys by the French and the observations of the American Museum's expeditions and of those of other institutions. Curator Anthony is at present working on the British Guiana mammals collected for the Museum by the Tropical Research Station under Director Beebe. When this is completed, he will begin at once to describe the fine collections which the Museum has recently obtained from Ecuador. His observations on the mammals will be a complement to those which Curator Chapman will embody in his volume on the birds of Ecuador and northern Peru.

Dr. William K. Gregory, curator of comparative anatomy, American Museum, is spending the summer in Australia. He is visiting the scientific institutions and coming into personal touch with the scientists of that continent. It is hoped that exchanges of specimens between the American Museum and its sister institutions in Australia can be arranged. Exhibition material so acquired will ultimately find place in the contemplated Australian hall. So great has been the destruction of Australia's interesting animals, owing to the demands of the fur trade, that many are approaching extinction. Dr. Gregory hopes to bring back with him a representative collection of this vanishing fauna. Cordial assistance with a view to facilitating his work has been promised Dr. Gregory by officials at Sydney, Melbourne, and Adelaide. Through the friendly interest of Mr. C. Anderson, director of the Australian Museum at Sydney, the services of an experienced collector and bushman have been secured, who will aid Dr. Gregory in his field work. Mr. Edgar R. Waite, director of the Public Library, Museum, and Art Gallery of South Australia, has given assurance that the Board of that institution will do all it can to facilitate Dr. Gregory's work. Travel through the land will be easier as a result of the kind efforts made with this object in view by Mr. D. Le Souëf, director of the Zoölogical Gardens, Melbourne.

Work has been begun upon the reshaping of the Morgan hall of minerals in the American Museum in accordance with a plan which had its inception over two years ago. The carrying out of this project has been rendered possible through the generosity of Mr. George F. Baker.

By this arrangement not only will the lighting and architectural attractiveness of the hall be much improved, but enough space will be gained to enable the Morgan collection of gems to be installed in closer relation to the minerals, thus securing better correlation between these two collections and better lighting for the gems. The reinstallation of both collections involves the use of a number of new cases and will necessitate the closing of the mineral hall for several months.

Mr. Herbert P. Whitlock, curator of mineralogy, American Museum, is conducting a course on gems and precious stones at the summer session of Columbia University. The object of the course is to create an intelligent and discriminating interest in gems and precious stones and to lay the foundations for a better appreciation of the splendid collections of this kind in New York City.

The first lecture was devoted to diamonds and methods of polishing them, a subject discussed by Mr. Whitlock in the present issue of NATURAL HISTORY (p. 291). The course consists of six lectures and in connection with it there are being used for purposes of illustration colored lantern slides prepared from photographs of specimens in the Morgan hall of gems. Also a series of informal conferences are being held on Mondays at the American Museum. The students meet in the gem hall and have an opportunity to inspect the material referred to in the lecture of the previous day and to ask questions regarding points on which they desire fuller knowledge.

The collection in the American Museum includes practically every known variety of cut stone, in addition to raw gem material of great interest. Some of the examples of precious and semiprecious stones cannot be duplicated anywhere.

THROUGH the generosity of several friends, the newly organized department of entomology at the American Museum has secured a camping automobile for use in field work. This year an intensive study is being made of the pine barrens of New Jersey, the nearest approach to a desert that we have in this region. The department plans to use the car next year for a continuation in Utah and Arizona of the studies concerning geographic distribution that were begun when entomology was included in the department of invertebrate zoölogy, and which have involved field work in Labrador, Florida, a number of the islands of the Caribbean, British Guiana, Arizona, Colorado, Idaho, Wyoming, and other scattered parts of the West.

DR. D. VAN HOVE, Chief Inspector of the Phytopathological Service in Belgium, and Professor Pynaert of the Horticultural School at Ghent, visited the American Museum in May. Dr. Van Hove, whose business it is to prevent the shipment of any diseased plants to the United States, is interested in entomology as well as in horticulture. Dr. Van Hove and Professor Pynaert, who in the brief time at their disposal were conducted through the entomological exhibits by Dr. Joseph Bequaert, pronounced these exhibits the finest they had seen. Recent revision of the laws pertaining to the importation of plants to America is the immediate occasion for Dr. Van Hove's visit to the United States.

IT IS a somewhat singular fact that the Adirondacks, situated in the most populous state of the Union and today an irresistible attraction to thousands, remained for some two hundred years after their discovery by Samuel de Champlain virtually unpenetrated by the white man. The Indian, too, used the region sparingly as a place of sojourn, the existence of only one Indian settlement, and that a temporary one, being definitely known. Pike's Peak in the inaccessible West was ascended by members of Major Long's party nearly two decades before Mount Marcy, the loftiest mountain not merely of the Adirondacks but of all New York State, was scaled. It was actually not until 1872 that Lake Tear-of-the-Clouds, the highest pond-source of the Hudson River, was discovered, secluded in the Adirondacks.

In like manner there has been tardy recognition of the region in literature. While other sections less attractive and interesting have been written up exhaustively, no adequate history of New York State's great natural park had appeared prior to the publication this spring, under the imprint of the Century Company, of *A History of the Adirondacks* by Alfred L. Donaldson. If there has been delay, however, in giving the region its due, it is justified by the final accomplishment, for Mr. Donaldson has written a two volume work that is not merely painstaking and veracious but that has the rarer quality of charm. He has gathered together not only by research through written records but by personal contact and correspondence with those who could shed light, a vast number of interesting facts regarding the early times, the nearer past, and the present. It is in the racy portraiture of those whose lives have been associated with the region that the author particularly excels. Little vignettes like the following of "Old Mountain Phelps," who had ascended Marcy more than one hundred times, abound:

"He was prone to nickname the natural wonders that he loved best. Mount Marcy he always called 'Mercy.' He held it to be the stateliest peak, commanding the finest view in the world. People would sometimes speak of the Alps or the Himalayas as having mountainous merit. But such idle talk annoyed him, and he would squelch it with a sneer. 'I callerlate you hain't never been atop o' Mercy,' he would say, and turn away in disgust. His own joy in standing there he expressed as a feeling of 'heaven up-h'isted-ness.'"

There are graphic chapters on John Brown and the escaped slave settlement in the Adirondacks with which he was associated, on Dr. Trudeau, on Robert Louis Stevenson's sojourn in the region, on Harry Radford, champion of the local wild life and the restoration of the moose, and a host of other characters, in addition to the sketching of events belonging to the history of the region and incidental attention to the scenic attractions.

THE Redwoods Preservation Bill, recently passed by the legislature of California and signed by Governor Stephens of that state, will redound to the advantage not only of the people of the Pacific coast, the principal beneficiaries, but to the citizenry of the whole country, who in increasing numbers are visiting the scenic attractions of the land. Under the terms of the Act, the sum of $300,000 is to be expended for the purchase of stands of the *Sequoia sempervirens* in Humboldt and Mendocino counties, California, for the enjoyment of those who travel along the state highway. It is to be hoped that the enactment of this protective legislation may be but the prelude to securing a federal appropriation for the creation of a great National Redwoods Park. Through the sum at present set apart, the trees most immediately menaced have been saved but double the sum will be required to preserve all the redwoods necessary to maintain the scenic beauty of this highway. The credit for saving from the axe what is not only one of the most beautiful but, on account of its vast age, also one of the most interesting of trees, belongs in no small measure to the Save the Redwoods League of Berkeley, California, which owes its inception to the public-spirited efforts of President Henry Fairfield Osborn, of the American Museum, and to Mr. Madison Grant, of the Board of Trustees of that institution.

On the evening of June 13, the Zoölogical Society of St. Louis celebrated a "zoo night," one of the features of which was the dedication of a fine bear habitat. This society has just completed arrangements for taking 5833 children from the congested district of St. Louis to enjoy a day's outing in its Zoölogical Park.

In connection with the article by Dr. Connor on "Fish as Mosquito Destroyers" (p. 279 of this issue) attention may be called to the fact that, with a view to combating the malaria mosquito, Spain has imported from our state of Georgia, the minnow, *Gambusia affinis*. It is this fish which was used so successfully by Dr. H. H. Howard in Hines County, Mississippi. It is reported that the minnow is adapting itself to its new environment.

As long ago as 1870 Richard Owen described two species of an ancient type of elephant from China, one of which, *Stegodon sinensis*, is said to be found near Shanghai; the other, *Stegodon orientalis*, in the province of Szechuan. In 1885, a still more ancient type of elephant, named *Mastodon sinensis*, was described from Yunnan by Ernst Koken, as part of the large collection obtained by the great explorer Richthofen. Yunnan, which is very rich in ancient mammal life closely similar to that found in the Siwalik Hills of northwestern India, will probably be explored by members of the Third Asiatic Expedition of the American Museum. Of thirty-five kinds of animals described by Koken, twenty-eight are from Yunnan, which is the most westerly province of China, bordering Burma.

In a recent review of the ancient life of China and Japan by Matsumoto and Joleaud, it is pointed out that the third great contributor to the knowledge of the ancient life of this region is Dr. Max Schlosser of Munich. The combined observations of the four palæontologists, Owen, Koken, Schlosser, and Matsumoto, are to the effect that the life of China in Upper Miocene and throughout all Pliocene times was very similar to that of India; the tropical forests were full of primitive elephants known as stegodonts, low-bodied, with long, straight tusks and low-crowned teeth. It was only toward the close of the Pliocene that the higher types of elephants related respectively to the mammoths and to the African elephants, began to appear in China as in India, while the Indian elephant type, the *Elephas indicus* of Linnaeus, appeared in these lands only in comparatively recent times. Relatively recent also was the invasion of China by migrants from North America, including species directly ancestral to the true horses, followed by the deer and animals of the northern forests. Doctor Joleaud thinks that the Pleistocene fauna of Szechuan may be regarded as a real interglacial fauna, while that of Honan corresponds with a real glacial phase. After these phases there appeared in the "loess" of China the woolly rhinoceros, a horse of the modern type, and several species of true deer (*Cervus*), besides the Axis deer, so characteristic of the Oriental regions today. This comparison is interesting because it is in deposits of this age, broadly corresponding with the Chellean of Europe, that we may expect to find the early remains of man in China.

M. Edouard Harlé, engineer and distinguished palæontologist of the Pleistocene of France, has presented his precious collection of Pleistocene fossils to the Museum of Natural History of the City of Bordeaux. This collection of a lifetime, enhanced in value by the donor's numerous researches and publications upon it, comes largely from the southwest of France and includes remains of the northern type of seal, which found its way into the rivers of Dordogne in Pleistocene times; remains of the musk ox of southern France; remains of a monkey contemporary with man, found near Montsaunes; small rodents found in the shelters of Dordogne, which came from the steppes of Siberia during late glacial times; remains of the mammoths from the great deposits near Torralba found contemporary with the Chellean man in Spain and Portugal; the equally rare jaw of a reindeer, found at Santander not far from the grotto of Altamira.

The writer who describes this gift adds: "It is strange to think that, outside of Paris, the only natural history museums of France which are well developed are those of Lyons and of Strasbourg. The chief natural history riches of the country have been concentrated in Paris." This gift to Bordeaux of the rich palæontological collection of Harlé may mark the beginning in France of a movement of decentralization in natural history similar to that which is taking place in this country.

THE Piltdown man, *Eoanthropus*, discovered in 1912 in Sussex, England, appears not yet to have been assigned a secure place in the ancestral series. In the April issue of *Man*, Sir Ray Lankester contributes to the discussion. He has himself found a flint implement on the surface near the gravel pit in which the original finds were made and which he would add to the original Piltdown flints discovered above and below the skeletal remains. His discussion sums up to the effect that "we are not in a position to assume either that *Eoanthropus* manufactured flint implements, or, on the other hand, that he did not do so. To me it seems improbable that *Eoanthropus* had anything to do with flint implements at all, although more likely that he suffered from them rather than that he benefited by their use." N. C. N.

AN EARLY Chellean workshop site alleged to occur in a formation of late Pliocene date (!) precipitated a lively discussion at the meeting of the Royal Anthropological Society on May 3. From *Nature* we learn that the evidence, consisting of a number of ochreous flint implements, cores, flakes, etc., was presented by Mr. Reid Moir, who obtained the same on the foreshore exposed during low water at Cromer, Norfolk. The material is said to be referable to the lowermost stratum of the famous Cromer Forest Bed series, generally regarded as either Upper Pliocene or Lower Pleistocene.

Comments on the geological authenticity of the find varied considerably. Sir William Boyd Dawkins and others declined to accept the evidence as satisfactory. Professor Arthur Keith assumed a neutral attitude. Sir Ray Lankester and Mr. Reginald Smith, however, insisted that Mr. Reid Moir had made out a *prima-facie* case. N. C. N.

MADAME MARIE CURIE, the woman of genius from France, recently made an Honorary Fellow of the American Museum, has had crowded into her all too brief visit to our shores honors and homage such as come only to those whose attainments win spontaneous and universal acclaim. She has received the highest honors from our foremost men of science; no less than ten degrees from our colleges and universities; the precious gram of radium (valued at $100,000) together with mesathorium (valued at $22,000), placed in a costly mahogany box; a gold loving cup, and other substantial gifts. At a reception tendered her in Carnegie Hall, New York, President Pendleton of Wellesley College, announced the award to her of the special Ellen Richards Research Prize of $2000. The National Institute of Social Science presented to her the gold medal of the society, and the Chicago Section of the American Chemical Society bestowed upon her the Wolcott Gibbs Medal. Wherever she went the scientific world turned out to do her reverence. At fête after fête she was the guest of honor and from the speaker's platform the leading men of science in the land paid tribute to her genius.

In New York among the attentions shown her were the reception at the American Museum, described in NATURAL HISTORY for March-April, p. 162; a luncheon given under the joint auspices of the American Chemical Society, the American Electrochemical Society, the Chemists Club, and the American Sections of the Société de Chimie industrielle and the Society of Chemical Industry; a reception at Carnegie Hall tendered by the American Association of University Women; and a dinner in her honor arranged by the National Institute of Social Science.

The principal incident of her sojourn at Washington was the memorable presentation to her of the gram of radium, solemnized with appropriate ceremonies, at the White House. She also enjoyed the distinction while in that city of setting in motion the machinery of the new low temperature laboratory of the Bureau of Mines, which is dedicated to her.

In the high honors shown Madame Curie, not only has womanhood been exalted; not only have two great nations which she represented, the land of her birth and the land of her adoption, been honored, but also things of intellectual and spiritual value have been rightly recognized as of more worth than things of merely material value. Those who looked at Madame Curie beheld a woman of small stature, slender build, and manifestly limited physical strength; a woman of middle age, with pale face, deep-seated gray eyes, intensely concentrated in expression; simple in bearing, unassuming, perfectly poised while receiving the greatest honors the scientific world has in its power to bestow. Yet none who came near her could fail to feel they were in the presence of a truly great personality, even if they had not known the record of her splendid achievements. This woman has had the keen intellect, the moral strength of endurance and persistence in the face of trials extending over a long period of years, and the spiritual greatness of soul when successful in her quest to turn and freely give the hard-won result of all her labors, to humanity. How greatly she prized the radium she gave away is witnessed by the fact that when she was asked a few months ago what she would most like to have in the world, she instantly replied, "A gram of radium under my own control." The women of America have presented her with that gram.

Madame Curie returns to her laboratory in Paris with the good wishes of the nation whose guest she has been. She has already accomplished a work that will put her name among the immortals but her work is not yet done. It is the hope—it is more, it is the conviction,—of our nation, that equipped with the means of pursuing her experiments, she will win new triumphs, extending the bounds of the known and through the application of her discoveries alleviating still further the sufferings of mankind.

We learn from *Nature* of a number of interesting happenings at the fifteenth meeting of the Australasian Association for the Advancement of Science, held at Melbourne in January:—

"Section D. (*Biology*).—It was decided that a resolution be sent to the Premier of South Australia emphasizing the great national and scientific importance of the preservation of native fauna and flora, and congratulating the Government on the legislation recently passed constituting Flinder's Chase, on Kangaroo Island, a national reserve for fauna and flora. Immediate steps should be taken to give full effect to that legislation. The Government is further urged to give full consideration to the unique importance which attaches to the constitution of the whole of Kangaroo Island as a national fauna and flora reserve, as well as to the protection of the land, fresh-water, and sub-aquatic fauna and flora of all the islands in South Australian waters, other than Kangaroo Island, which are actively used for farming pursuits."

The presidential address by Sir Baldwin Spencer dealt with the social organization and racial derivation of the Australian aborigines. It was pointed out that "the remarkable homogeneity of all Australian tribes, even with regard to the details of their social organization, gives no suggestion of outside influence. This homogeneity, existing side by side with the most remarkable differences in skull measurements, customs, beliefs, and arts revealing an extraordinary range of variability, presents a difficult problem quite insoluble on the theory of interactions of various immigrant peoples reaching Australia at different times. The statement of Professor Keith and others that the Australian race might have served as common ancestors for all modern races may be understood on the theory that it is the survivor of such a one that has been isolated for long ages in Australia, and has been practically uninfluenced by contact with other peoples."

An announcement has recently been made by the Harpswell Laboratory for Biological Research that it has transferred its headquarters from South Harpswell, Maine, in Casco Bay, to Mt. Desert Island, where it has been allotted a tract of fifteen acres on Salisbury Cove by "The Wild Gardens of Acadia" corporation. This new site, to be known as the Weir Mitchell Station of the Harpswell Laboratory, has excellent shore frontage and unusually favorable life conditions. The cold waters of the region are extraordinarily rich in both common and rare marine forms, including those of exposed rocky shores, muddy coves, shallow and deep-sea bottom, estuaries, bays, and open seas. Depths of more than one hundred fathoms are found within twenty miles, where there is an abundance of deep-sea species usually accounted rare. The mountainous character of the island, which rises to forested peaks of fifteen hundred feet in the southern half, gives an excellent opportunity for terrestrial life studies, while lakes, streams, and marshes furnish a rich fresh-water fauna and flora. It is a region of unspoiled virgin beauty, and has the advantage of contact with the Wild Life Sanctuary of Lafayette National Park, which is also situated on the island.

The Harpswell Laboratory was founded at South Harpswell, Maine, in 1898 as a summer school of biology, by Professor J. S. Kingsley of Tufts College. It has an enviable record for research and biological instruction. In its new location it is under the directorship of Professor Ulric Dahlgren of Princeton, the well-known authority on bio-luminescence in animals, who will contribute an article on this subject to a subsequent number of Natural History.

One is not apt to associate serious accomplishments with a creature as playful as the squirrel; yet the Forest Service, United States Department of Agriculture, is authority for the statement that to it more than any other agency is due the extension of our valuable black walnut groves. The little creature, providing in time of plenty for the lean period of winter, scurries about the open areas at the forest edges, seeking hiding places in the soil for the nuts it gathers. Not all of these nuts are dug up again. In time those that are overlooked grow to be sizable trees.

The groves thus planted by previous generations of squirrels were drawn upon during the war for the manufacture of gunstocks and airplane propellers. No other wood has proved as suitable for gunstocks as black walnut.

In coöperation with the leaders of various organizations interested in camping and with the commissioners of the Palisades Interstate Park, Teachers College offers each spring a course of instruction for camp directors and camp councellors, conducted by Dr. Elbert K. Fret-

Mr. B. T. B. Hyde, director of scout museums at Kanohwahke Lakes, and one of his assistants, absorbed in the task of making vivaria. The study of live creatures, which, when caught, are housed in these vivaria, is a favorite occupation of the boy scouts at the camp

well. The permanent camp movement has grown greatly in recent years, being but one of several manifestations of a greater emphasis laid on outdoor recreations. Fifteen years ago such camps were conducted by a very few individuals without coördinated effort. Today haphazard undertakings of that character have been replaced by well organized camps for boys and girls, in which trained leadership is provided. It is through such courses as that conducted by Dr. Fretwell that camp directors are developed and the camp organization is perfected.

The plan of this course is most comprehensive. The talent and experience of those engaged in directing camps are offered for the benefit of the students. One of the features of the course is a week spent at Bear Mountain in the Palisades Interstate Park. Here the students find comfortable housing at the inn run under the auspices of the Interstate Park, and gain practical experience in the work for which they are preparing themselves.

The feasibility of establishing a museum for nature study in a camp was demonstrated by Mr. B. T. B. Hyde, the director of the scout museums at Kanohwahke Lakes and director, in connection with Dr. Fretwell's course, of the museum at Bear Mountain. At the latter place he was ably assisted this spring by Professors Sanderson and Frances, of the New York College of Forestry, Dr. Lawrence Palmer of Cornell, and Professor William G. Vinal, of the Rhode Island College of Education. The students were divided into four bands or groups that were led successively by the several instructors on the nature hikes. The material collected was brought to the museum, identified, and prepared for exhibition.

The making of aquaria based on Dr. Palmer's plans was successfully engaged in under Mr. Hyde's supervision and the finished containers were stocked with the aquatic life collected.

The building up of camp museums, a movement initiated by Mr. Hyde, is becoming a recognized activity of summer camps, many of which are now emphasizing this feature. Mr. Hyde is establishing twenty-five camp museums in the Interstate Park this summer.

"NATURAL HISTORY"

JULY–AUGUST ISSUE

Dr. T. A. Jaggar, Jr., volcanologist, director of the Hawaiian Volcano Observatory, has for years lived in close association with the great active volcano Kilauea, studying it, recording its behavior, analyzing its gases and discharges, photographing it in its grand upheavals with ruptured surfaces and flowing lava streams. He will give an account of his "Experiences in a Volcano Observatory," by way of introduction to a splendid series of illustrations of recent volcanic happenings at Kilauea and Mauna Loa.

Mr. Rollo H. Beck, leader of the South Sea Expedition, will contribute an article entitled "Visiting the Nests of Sea Birds by Automobile," in which he gives a spirited account of his observations, under novel circumstances, of the bird life of Christmas Island.

The recently erected Miami Aquarium is winning cordial recognition from those who are aware of the important work it is accomplishing in furthering knowledge of the life of warm seas. An account of this aquarium, written by Mr. John T. Nichols, associate curator of recent fishes at the American Museum, will be one of the striking features of the forthcoming number. The article will be effectively illustrated with pictures supplied in part by Mr. Nichols and in part by Mr. John Oliver La Gorce, secretary and treasurer of the Miami Aquarium Association.

Fishes of Miocene Age found in California are of particular interest in that they represent the immediate ancestors of fishes that are swimming about the seas today. Illustrations of some of these early fishes prepared by Mr. Atkinson, under the direction of Dr. David Starr Jordan, will therefore have exceptional interest.

Too frequently is the spider looked upon as a horrible creature, fit only to be crushed under foot. Mr. William M. Savin, in an article on "The Much Despised Spider—Harmless, Beneficial, Interesting," shows how fascinating a field of study awaits those who will take the trouble to investigate the ways and habits of these creatures. The article is accompanied by unusually fine pictures in color, as well as in black and white, showing different webs and their spinners. That spider silk can be made of service to man—although admittedly the industry has only restricted opportunities—is made clear in an article by Dr. Alexander Petrunkevitch, one of our foremost students of spiders. The spider, however despised by the white man, holds a place of no little importance in Indian mythology, and this aspect of the subject is considered in an article supplementing the two just mentioned.

Among the natural products for which the white man is heavily indebted to the American aborigines, is Indian corn or maize. Two supplementary articles describe the methods of raising and preparing this cereal among the Indians. Mr. Charles W. Mead, assistant curator of Peruvian archæology, at the American Museum, gives a general account of corn culture in South as well as North America; Mr. Henry M. Steece confines his article to a consideration of the agricultural methods applied to this cereal by the Indians of our Southwest.

That trees have an individuality is recognized by every one. The form or outline, the development of the branch system, the conditions of growth, adverse or favoring, are among the factors that give the individual tree a character that differentiates it from its fellows. It is on the structure of trees and their æsthetic appeal that Dr. John W. Harshberger, professor of botany at the University of Pennsylvania, dwells in his article entitled, "The Artistic Anatomy of Trees." This article is accompanied by a series of beautiful photographs and is a noteworthy contribution to the July-August issue.

Having indicated tentatively the articles that are to find place in the July-August issue, it may be in order to cast a glance ahead to the issue for September-October. Without entering into a specification of the articles that are to appear in it, it may be stated that the issue will give emphasis to certain of the west coast countries of South America, with particular stress on the recent acquisition by the American Museum of a remarkable collection of Peruvian gold.

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THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY, EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

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From a photograph supplied through the courtesy of Henry Fairfield Osborn

ENTRANCE TO VALLEY OF IAO, WEST MAUI, HAWAIIAN ISLANDS

Iao Valley is one of the places in the Hawaiian Islands famed for its beauty. Bordered by precipitous cliffs thousands of feet in height, which rise into mountains culminating in the peak Pau Kukui, 5788 feet above the sea, the islanders are wont to compare its scenery to that of the Yosemite Valley. Iao's cliffs, however, are covered with tropical verdure, which adds greatly to their beauty. A needle of rock more than 300 feet high rises abruptly from the floor of the valley within the amphitheater-like basin at its head, nearly five miles from the coast. The mountains are the remains of ancient, extinct volcanoes, which are so old that erosion has removed most of their external resemblance to their more recently active neighbors, such as the great Haleakala, which forms the eastern half of the same island. Wailuku, the chief town of the island, lies in the foreground at the entrance to the valley

NATURAL HISTORY

VOLUME XXI JULY-AUGUST, 1921 NUMBER 4

EXPERIENCES IN A VOLCANO OBSERVATORY*

BY

T. A. JAGGAR, JR.†

THIS is a story of volcano experience at first hand from one who dwells on the border of Kilauea crater. This living with a live lava pit has, moreover, a motive. Geology deals with the collecting of evidence for making out a case to argue before the august tribunal of Science, and that serene but relentless judge is becoming more learned and more critical as she adds centuries rather than years to her tenure of office. Physical science is no longer content that a few good stories of adventure and tales of heart-rending disaster form the subject matter of law books dealing with the treatment accorded by Mother Earth to the human denizens of her islands and harbors. These beings need help; they are building great cities, canals, docks, and traffic ways where only lazy cave men lived before. Property and persons require protection, and the news fresh from China that forty thousand people have lost their lives by earthquake is only a statistical item in a list of similar tragedies. Science demands an accounting, humanity audits the books, and geology must be something better than inspector or detective; it must be a barrister familiar with every phase of terrestrial vitality, knowing figures as well as facts, prepared to call as witnesses the typhoon, the tidal wave, and the volcano.

None of these is as bad as it is painted—least of all the volcano, popularly supposed the worst. Volcano insurance would be a safe risk for any underwriter. The damage is concentrated occasionally, but there are long periods of happy, sunlit days. When I first came to Hawaii twelve years ago, it was possible to frame a tentative schedule for Mauna Loa based on statistics, to state that an eruption would come before 1915; an eruption came in 1914. It was possible to predict that Kilauea and Mauna Loa would show some sympathy, not as tubes full of red-hot liquid, but as gas vents for an underground, glassy froth. Three times in the decade Mauna Loa, the monarch, has vomited great fiery geysers of molten, basaltic foam, and each time Kilauea, the vassal, has led the way with preliminary rising in its pit, which has spurted farther during the great crisis, and has collapsed dramatically at the end. The total period of a Mauna Loa cycle was expected to endure about nine years: 1907 was the year of the last culmination, with minor eruptions before and after; 1916, nine years later, marked the middle event of the recent great series of eruptions. The year 1912 brought the former period to a close, with much turbulent, fiery action; 1921, nine years later, appears to be bringing the present period to its end, and the turbulence in March was fiery enough to satisfy the most sceptical. Now all is low and smoky in the Kilauea pit. There will be recrudescence again and again for a year or more, then a sinking away, a dull year or two, and

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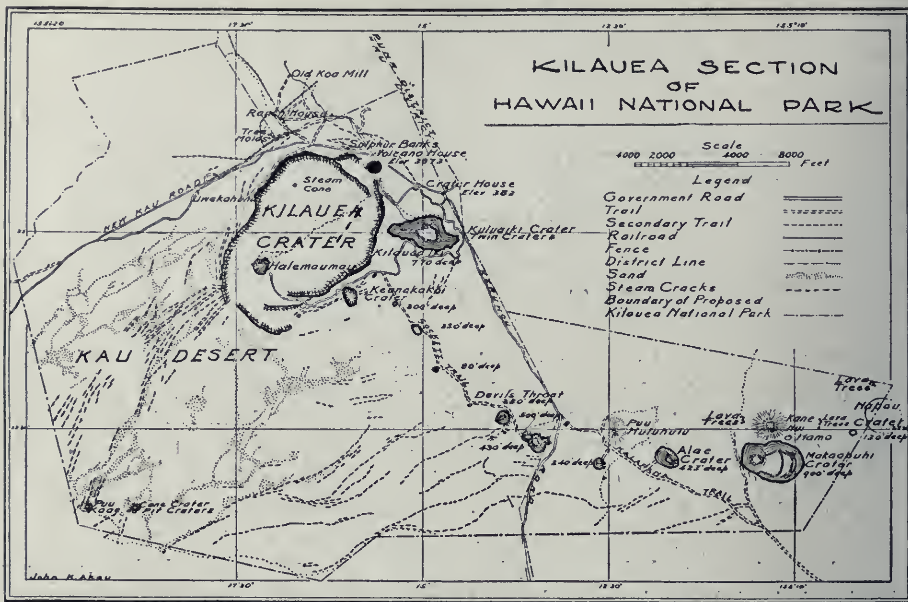
† Director, Hawaiian Volcano Observatory.



The lakes of foaming fiery lava within the crater of Kilauea form the most spectacular exhibit in the Hawaii National Park, if not in the world. The pit of fire, Halemaumau, is inside of the main crater, at the apex of a broad, flat, inner cone. Kilauea is a dome volcano 4,000 feet high, overridden by the lava slopes of Mauna Loa on the west, so that it seems but a spur of the greater, and perhaps younger, slag-heap mountain.

The Kilauea Park and the inner pit itself are both reached directly by automobile from Hilo, the second city of the Territory of Hawaii, and there are excellent hotel accommodations. The distance from Hilo is 30 miles. Within the park there are 15 miles of roads and about 20 miles of trails. As shown on the map, there are a dozen ancient pits within the area of the park, as well as cones, caverns and hot solfataras and a strange desert where lava flows have recently poured out of cracks.

The live pit of Halemaumau is easily accessible and not dangerous. Frequently one can walk to the actual edge of the splashing, fountaining lava lakes, the lava column rising and falling from year to year so that its most distinctive character is ceaseless change. At night the spectacle is full of marvelous color, and the region is a paradise for artists, photographers, and naturalists.

The several sections are under the control of the National Park Service of the Department of the Interior. The United States Weather Bureau maintains the Hawaiian Volcano Observatory, which stands on the brink of the greater crater within the Kilauea Park.

earthquake shocks fewer, but sometimes strong.

When one points to statistics, it is important to have statistics accurate, even if not precise, and to make the measures precise as soon as possible. This takes time and method, hence the founding of an observatory. Volcanoes are not clocks; they do not run on schedule; but Kilauea volcano and its neighbor have followed an accountable law during the last decade, whereas the great human drama which culminated in the eruption of 1914 appears to be rather unaccountable by the doctrines of economics and finance. Volcanoes are not nearly so dangerous as are the pent-up spirits of nations when these rend their restraints.

The Hawaiian Volcano Observatory, like most affairs of science, was the outgrowth of years of talk and planning, advice of engineers, disasters at Mont Pelée, Vesuvius, and Messina. Kilauea in the nineteenth century was casually studied by visitors; now it is steadily studied by resident men of science. We have learned of cycles small and great; of hot gases and their chemistry dominating the heat riddle; of pressures underground released by sun and moon; of a lava column far from simple, more solid and less hot underneath, more frothy and hotter on top; of earthquakes many and small when the lava is high, few and more alarming when the lava is low; of oxidations and dissolvings by air and water which make brand new, hot rock look old in a few days, and analyze the geologist's specimen before he has time to collect it. We have found the ground tilting under our feet in a measure unheard of elsewhere; nay rather, much reported elsewhere, as in Japan during the great eruptions of the north and south islands in 1910 and 1914, but *only at active volcanoes*. Along with the tiltings came tremblings; the poised pendulums of the dark seismograph cellar, timed with good clocks, equipped with slender pens and with beams of light, and writing ceaselessly on creeping sheets so that the whole organism pulses with heartbeats like a thing of life, make record of all these motions. Minute to minute and decade to decade an attended instrument plant replaces the accidental report of the traveller of aforetime.[1]

Such a novelty of method can hardly fail to make discovery. For after all discovery is merely "uncovery" of what is always there but unrevealed. It has been the same story of new and unexpected revelations when we came to survey the glowing lava pools and blowing cones, and to measure the widths and depths of flows and lakes and their hardened margins. Now and then nature marches by leaps. In 1916 and 1919 there were red-letter—or red-lava—days, when in a few hours the column in the pit sank away four hundred feet and more, the ground shook, red-hot avalanches crashed inward; swirling, rushing cascades of fire tumbled into voids, and the red-brown dust boiled up in volutes. Again, while with some Harvard students I was surveying the tidal motion of the lava lakes, taking shots with transit from a tent every twenty minutes for a month, there suddenly burst up through cracks, in the night, a wonderful geyser of liquid lava a few paces behind us. It quietly welled up like an artesian well or an oil gusher, bright orange, dome-shaped, bubbling with burning hydrogen and carbon gas and sulphur, standing fifteen feet high and twenty feet across, and sending a torrent down the slope, which did not stop for three months. Just recently, at the March equinox in 1921, the pit was dull, with lava crusted and sluggish, fifty feet down, fourteen hundred feet across. In one night it lifted bodily lakes, islands, and craggy shores, all inside the pit, and at six o'clock in the morning it was flooding the outer slopes with lava streams which ran a mile; then the reaction due to release of pressure made vast cauldrons of the lakes, with fountains by hundreds, brown gushes of fume, fiery tornado whirlwinds, which threw twenty-pound blebs of live lava a hundred yards away, and the edges were built up into ramparts of black glass. The ground was strewn with clinker and spun glass—the blond "Pele's Hair" of the Hawaiian goddess; butterflies and moths were lured to their death by hundreds.

More virile adventure was offered by the Mauna Loa[2] eruptions: first some "queer" symptoms at Kilauea and a somewhat destructive earthquake; then —again at the equinox, September of 1919 —a sudden gush of fume and fire spume away up on the great flat mountain. Two days of quiet succeeded, but the pack mules were made ready. At midnight was seen a dull, distant glow, far below the first outbreak. Off at day-

[1]The Hawaiian Volcano Observatory is equipped with the following seismometric instruments rebuilt at the station in 1918 for the special needs of volcano research: two Bosch-Omori pendulums, high-speed registration of local earthquakes; one optically recording seismograph for distant earthquakes; one clinograph registering E-W tilting of the ground. A vertical component seismograph was in December, 1918, set up in experimental operation. These are seated on concrete piers in a closed basement room having practically constant temperature, beneath the chief Observatory building near the hotel. Time is referred to a rated chronometer, checked at intervals by wireless signal from the Pearl Harbor Naval Station. The chronometer is lent by the College of Hawaii. Hawaiian standard time (H. S. T.) is 10 hrs. 30 min. slower than Greenwich time.

[2]Mauna Loa, a vast dome 13,675 feet high, reached through forests of Hawaiian mahogany (koa) and tree fern, then up brilliantly colored lava slopes, has a summit crater 3 miles long by 1½ miles wide, with walls 700 feet high. Every five or ten years splendid spectales of lava eruption are staged on the mountain, sometimes from the lower flanks.

There are trails on the Kona side, and also from the southwest, but the usual and best route is with saddle mules from the Kilauea section to Puu Ulaula (9,800 feet), a ride of six hours. Here there is a fully equipped cottage with stables and water supply. From this point on the second day a four-hour ride takes the visitor to the summit crater, where there is water. A right of way within the park connects Kilauea with Mauna Loa, where eventually a road will be constructed. The views are glorious and the chasms, cones, and contorted lavas indescribably chaotic.'

A VOLCANIC FOUNTAIN ON MAUNA LOA

A detailed view, October 25, 1919, obtained by climbing to the edge of the greatest erupting cup on Mauna Loa, the ground covered with red-hot cinder, the fountain shooting 200 feet above the froth pool at its base, and the nearest fragments falling 50 feet away. Gas is the impelling force, the jet coming from a narrower orifice below, churning and shredding the puddle of melt to bright red-hot fragments from six inches to four feet in diameter light, we camped in upland meadows, and after two days of riding and hiking across fearful country, the Hawaiian "aa" or clinkery lava, we came to the great rift. Here fountains were flinging a light, brilliantly glowing pumice four hundred feet into the air from a crack line a half-mile long, building cones and flooding the country with lava flows that meandered within an incandescent flood plain for three miles, as far as we could see. We made bivouac and spent several nights, returning again and again, always finding new, golden, spouting cones and shifting vents. Over the fountains for thousands of feet rose a salmon-colored cloud, and at night a banner of flame below, reddish and yellow and green.

The flood beyond our view ran down through the forest, burned houses and crops and poured for six weeks into the ocean. Odd, unknown, deep-water fish were killed, tidal waves rose on the shores, and columns of steam shot up. The eruption was different from Kilauea in the frothiness, the intense gas inflation, and the enormous gas jets. The color, the lava, the composition of the gases, and the mechanism were essentially the same. The ejection was under high pressure. When this eruption came to an end, warned by what had happened in 1914 and 1916, I expected a sudden sinking at Kilauea. Kilauea had increased its outflows. On November 28 the lava in the pit sank *four hundred feet in an hour*, all the flowing stopped, and within four hours it was six hundred feet down.

The story of these critical adventures is what one expects of a volcano, but the observatory has other work to do. Volcanism is fundamentally an emission of gas. The substances most important are hydrogen, nitrogen, carbon, sulphur, and chlorine, and it is the compounding of these with oxygen in many proportions and in shifting reactions, locking up energy or releasing it, that makes the heat problem of the inside of the earth. Expulsion of gas is going on all the time at volcanic places, whereas expulsion of lava is a subordinate phenomenon. By convection lavas are worked over and over in the furnace, like scrap iron in a foundry. When there are numerous volcano observatories, we shall work out the tonnage of gas and the tonnage of rock produced. The ultimate goal of such stations is to determine the rate of expenditure of energy by the volcano and to find out just what work it is doing. When we know these things, we can tell whether the power is available for man to use and what relation the volcanic output bears to air, water, continents, mountains, earthquakes, and the so-called "crust." Only when a simplified motive is found can limited human powers do a specified piece of work. The simplified motive of the volcano observatory is to study gas.

This work is slow, uphill plodding, which can be done at Yellowstone Park or at Lassen Volcano in California, just as in Hawaii. The composition and reactions of these gases are changing; their effects on the rocks are almost unknown; their heat mechanism is very difficult; their radio-activity is important; their collection for study or spectroscopic observation has never been done properly or in any controlled manner. For all any body knows volcanism as gas-maker may be oozing forth everywhere. The great differences of underground temperature at Calumet and Hecla as contrasted with the Mother Lode in the Sierra Nevada may be dependent in some fashion on subterranean gases. The explanations of granite, of ore deposits, and of a hundred geological riddles hang on this gas problem. Even the laboratory handling of gas is still an infant science, and the field study of the atmosphere is hardly more than a half-century old. Hence it is not remarkable that the field study of the gases in the earth has hardly begun, and it will not be begun until we have more volcano observatories. Here is a subject which obviously is not dependent on great eruptions for its investigation; we do not wait for someone to fire a cannon in order to study gunpowder. Every active volcano when quiet is a fascinating chemical laboratory with gases locked in its lavas, oozing through its fume holes, reacting with other gases and with air and water, and telling the story in cryptic language of what has been, what lies beneath, and what is to come. When the outburst does come, gas chemistry is unquestionably dominant, and every resource of engineering and physical science should be brought to bear on its analysis. There has never been a volcanic eruption which was prepared for with adequate men and apparatus gathered on the spot. Some day the paroxysmal gases of a great eruption will be competently collected or observed with as much *sang froid* as we now observe a transit of Venus.

The gases come from a dough or paste compressed inside the outer shell of the globe. This paste, which geologists speak of as magma, is rigid; when it foams up cracks, we call it a lava flow. The chemistry of that magma is more than half gas chemistry. Oxygen constitutes nearly 50 per cent. by weight of the solid rock we walk upon, and there is as much oxygen in the upper six feet of the earth's surface rock as in the whole atmosphere lying above. The volcanic gases are conceived as dissolved in the compressed paste, and when the pressure is relieved, the gases heat the paste and escape as bubbles. Volcanism is concerned with this paste, its pressures, temperatures, and bubbles. Geologists have studied with microscopes the minerals of the hardened rock, and chemists have produced analyses from such rock which they describe as "composition of the magma," without any knowledge of what gases and salts were long ago removed from the real magma, a very different substance from the skeleton which hardened and dripped with water for centuries. At a volcano like Kilauea one may study surface forms of the hot paste itself, fast oxidizing and losing its gases to be sure, but still subject to experiment before it is wholly transformed.

The active volcanoes of the world offer marvels of discovery to come from boring, gas analysis, water analysis, magma experiments in the field, routine records in relation to time, local studies of ground motions, careful analytical and synthetical work dealing with nature's complex solutions and nature's complex reductions and oxidations. This work cannot be done with transported specimens. The transported specimens are washed-out skeletons. It cannot be done by expeditions, they see too little. The need is for laboratories in the actual volcanic field and for workers with modern apparatus, living there, working there, making their own social group, modifying their experiments in accordance with daily inspiration at all seasons from nature's own demonstration of what ores she is concentrating. She is working with dilute solutions through centuries. These must be reckoned with. She is working *per saltum* magically in a single night. The analyst must be there *on that night*. He will learn more in an hour than he ever dreamt of in years at the university. He may wait in the field a year, soaking in impressions and making preparations, just to be ready for that hour with his spectrograph or electroscope. Meanwhile there is never an idle moment, for the whole landscape is alive, and other problems crowd so fast on the heels of time that his only difficulty will be to keep up. Such is life at a volcano observatory.

A SERIES OF PICTURES OF UNUSUAL INTEREST, SHOWING THE HAWAIIAN VOLCANOES, KILAUEA AND MAUNA LOA, IN THEIR ERUPTIVE PHASES

BY

T. A. JAGGAR, JR.

Director of the Hawaiian Volcano Observatory

CLOSE VIEW OF A NEWLY FORMED CONE

On March 30, 1917, this cone was formed in three hours by lava spatter at the edge of a fountaining lake of melt. The picture shows it at night, the gas explosions flinging out the slopping incandescent stuff, and in the midst a pale flame playing. The camera was only thirty feet from it

HALEMAUMAU, THE LAVA PIT OF KILAUEA

Photograph taken in January, 1918, just before the pit overflowed and destroyed the road terminus. A confusion of towering crags had been lifted amid the boiling lakes, and all of this is the live lava column, all rising together several feet a day. The tipped scarp on the right shows how the crags are built with tilted shores, the paste moving irregularly according to the gas pressure below and the distribution of weight above

A GUSH OF LAVA

Gas is the dominant agent of volcanism. November 2, 1918, there came a sharp earthquake and a gush of lava up through cracks back of the rim of the Kilauea lava pit, making a craterlet right alongside of the horse corral and rest house, and finally burying both under floods of lava

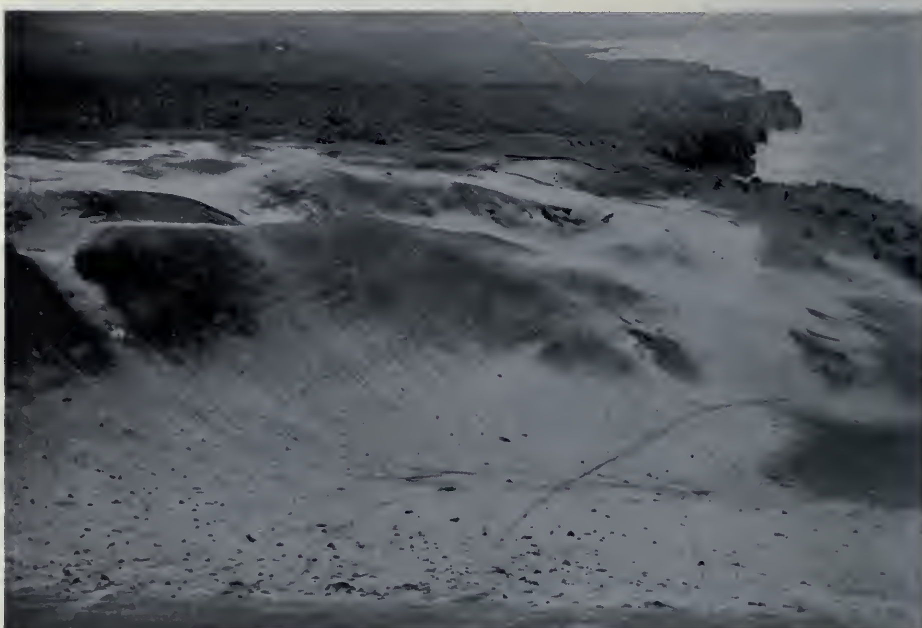
A Surveying Station at Halemaumau.—The weekly surveys at the pit are made from concrete trig stations. On February 21, 1919, the lava had come up level with the edge of the pit, and the ground started smoking and depositing sulphur around this level, circular platform with its central post

A Surveying Station Displaced by Rising Lava.—On February 28, 1919, this trig station had been lifted bodily, tipped back 40° and fractured. A neighboring station had pushed back still farther and fallen over, buried under its own débris. Both were on the edge of the pit on old rock. All of this started on February 25, when a sudden swelling of the stiff paste inside the pit mashed the rim back into a pressure ridge which has been a landmark 20 feet high ever since. In seven hours, the rim of solid rock was tilted back 10°, then came a gushing of liquid lava up the cracks and floods of overflow

One of the Gushers of Molten Lava Which Ended the Sudden Part of the Swelling of February 25, 1919.—The humping of the rim began in the forenoon, and at 5.30 P. M. three of these fountains were feeding outrushing flows. This fountain was just inside the rim of the pit and lasted in this condition for an hour, then gradually subsided with gas sputtering

Liquid Lava Cascading from the Lake.—The lava pit is no less spectacular when it is going down. Great voids form at the sides of the liquid lakes, because the froth lowers some of the wells which honeycomb the hard lava column. Up other wells the liquid is rising, but the two sets lose step, for the lava lakes are shallow and variously blocked by their own shoals. Over these shoals pour cascades, and this picture of June 9, 1919, shows a whole lake tumbling perpetually into a hole at one side which it never fills. This fall continued for ten days

A Stream of Liquid Lava, Alika Flow, Mauna Loa.—From the first day of the Mauna Loa eruption, the flood ran down through the forest and burned houses and ava crops and cord wood, and imprisoned cattle in the clump of trees seen in the background of this picture (October 6, 1919). Here, as in the lava pit of Kilauea, the liquid lava is shallow and subordinate, the vast slow-moving field of clinkery lava, red-hot beneath, is the main glowing product. The torrent silently rushed by, carrying huge lava "snowballs" down its middle every few seconds



Sand Heaps over Lava Where the Mauna Loa Flow Entered the Sea, October 28, 1919.—The hot flood poured for six weeks into the ocean, columns of steam and sand shot up, odd, unknown, deep-water fish were killed, and some people were washed out to sea by the tidal waves. The white coating on the sand is sea salt

Smooth Lava Flow in Motion in the Kau Desert to the South of Kilauea Crater, June 25, 1920.—It is flowing over ancient clinker flows mantled with dune sands. These Kilauea flows followed after the Mauna Loa eruption and lasted eight months, building an immense lava heap along a fracture in the flank of the mountain

Lava Cavern, with Sulphate Stalactites.—In old caverns dating from 1823, in the Kilauea desert lands, sulphate stalactites were found June 25, 1920. Similar but more soluble sulphates were deposited by hundreds of pounds in the hot caverns of the present eruption. The material included alum, Epsom salts, iron sulphate, Glauber salt and lime sulphate. Dripping water made the deposit, and rain water later washed much of it down into the mountain

GLASSY BASALT FORMATIONS

This eruption through cones built up heaps of glassy basalt outside of Halemaumau pit but inside of the greater crater. On February 9, 1921, the lower of two rift cones was an open horseshoe with a bubbling pool inside and a rivulet of the molten matter rushing away

AN "ARTESIAN" DOME

The same location had a renewed and very voluminous outpouring at the equinox, March 20, 1921, and this remarkable photograph is an instantaneous picture of the orange-colored "artesian" dome over the same vent as is shown in the preceding picture. The photograph was taken by running up to the fountain on the windward side with the camera held against the photographer's forehead. Note the pure curve of the mass welling up and the network of expanding bubbles on its surface

SPATTER RAMPARTS AT EDGE OF LAVA LAKE

March 19, 1921, was a day of excitement at Kilauea. Flows were running over on three sides and guards had to be established to keep tourists from going where they would be surrounded by lava flows. The arms of the lava lake, as shown here, resolved themselves into fiery cauldrons with cascades from the rest of the pit rushing in. The edge was built up into spatter ramparts fifteen feet high. Later the uprush of hot gases made tornado whirls

AN EVENING VIEW

Same scene as shown on page 352. In the four days intervening between the taking of the preceding photograph and the magnificent scene here reproduced, the overhanging ramparts of black glass had been built still higher. The lake of boiling lava is seen to be incandescent over its entire surface. The light from it was sufficient to bring out the opposing rim in the photograph

CUMULUS OVER SUMMIT OF MAUNA LOA

A sympathetic gush of hot vapor or some such phenomenon produced a wonderful cumulus over the summit of Mauna Loa on the afternoon of March 19, 1921, while the Kilauea eruption was at its height. In the foreground of this photograph is shown the Kilauea lava lake and the island rising above it. The lakes and crags had come up 50 feet in one night

STALACTITE FORMATIONS

A glowing oven formed after the lava had subsided, April 4, 1921. The stalactites are made of a glass due to secondary melting by gases. The stalactites are from two to three feet long. In the night a banner of flame, too faint to photograph, may be seen. Negative made with deep red filter

A BARRACUDA SWIMMING EIGHT FEET BENEATH THE SURFACE

From the Miami Aquarium Association we have this very remarkable snap shot of a great barracuda (*Sphyraena barracuda*) swimming in the clear water off the west coast of Andros Island. The fish is over a white sand bottom, eight feet below the unruffled surface of the warm, shallow sea, which stretches for miles in every direction and is technically known as the Great Bahama Bank. This fish is more feared by the natives than are sharks, though, as is usual in such cases, stories of its attacking man are vague and difficult to corroborate. It reaches a very large size, there being an unauthenticated report of an individual from the Bahamas, more than ten feet long, but to date no really large one has ever been tested with a steel tape. A barracuda measuring more than five feet has been taken on rod and reel at Long Key

THE MIAMI AQUARIUM*

BY

JOHN TREADWELL NICHOLS†

THE recent erection of a modern, well-equipped aquarium at Miami, Florida, is a matter for congratulation to those who are interested in furthering knowledge of the life of warm seas. The location is a preëminently appropriate one for such an aquarium. The Gulf Stream, sweeping close to the east coast of Florida at this point, gives a decidedly tropical character to the marine life of the neighborhood. At the same time it insures an accessible supply of pure sea water for the tanks of the aquarium, without which it is impossible to keep many of the more delicate fishes and other animals of the tropics for exhibition or for study.

Fishes which wander at the surface of tropical seas far from land are of much the same sort in all oceans; indeed, various of such species are of cosmopolitan distribution, as, for instance, some of the flying fishes. Wherever the trade winds blow, now faint, now strong, under the fleecy cumulus clouds by day and the low, bright stars by night, one may occasionally meet small, wandering schools of the fish called dolphin, preying on flying fishes. This is a graceful, slender species reaching a length of six feet. It may well be the swiftest fish that swims, and its colors at once the richest, most brilliant, and most delicate, playing across its sides like the fleeting shadows of clouds. No less widely distributed is the oceanic bonito, a thickset, rich-meated mackerel, with dark, lengthwise stripes on its flanks. Such widely distributed wanderers are but thinly scattered over the greater part of their range, and concentrated at certain favorable points in the world currents, as the Gulf Stream. The little fishing boats which one sees from Miami beach, bobbing about in the sunlight off shore, where the narrow, coastal shallows give place to the deep blue of the Stream, meet these nomads of the sea, as also the long, slender kingfish—relative of the Spanish mackerel—the big sailfish and spearfish—related to the swordfish—the albacore, bonito, and others. In the afternoon the day's catch is landed at the water front in the center of town. As many sportsmen have their most interesting fishes mounted as trophies, it will repay a student of these big, offshore forms to pay frequent visits to the local taxidermist.

About the coral reefs of warm seas, fishes are found the colors of which are remarkably beautiful and brilliant. A fine collection of such species is one of the features of the exhibitions at the New York Aquarium. The remoteness of New York, however, from tropical waters entails loss in transportation and loss through change of climate and other conditions demanding adaptation on the part of the fish. Because the Miami Aquarium is close to the waters where these fish must of necessity be captured, it contains many striking forms not to be found in aquariums located at a greater distance. For instance, the rock beauty is shown at Miami. Technically this fish is *Holacanthus tricolor*, of the angel fish order. Its colors are masses of contrasting black, and yellow and orange, and this was one of the species chosen to illustrate a discussion on high-colored tropical fishes published by the writer several years ago in the AMERICAN MUSEUM JOURNAL.[1] It is represented in the colored plate accompanying that article. In most of the broad area from Bermuda to Brazil inhabited by the West Indian fish fauna, the rock beauty is an uncommon fish. In the Bahamas,

[1] "The Problem of Bright-Colored Fishes" by John Treadwell Nichols. THE AMERICAN MUSEUM JOURNAL Vol. XVI, pp. 506-511.

*The illustrations used in this article have been supplied with one exception, by Mr. John Oliver La Gorce

†Associate Curator of Recent Fishes, American Museum

on the other hand, it is common, and is there known as the Spanish angel fish. It seems probable that the New York Aquarium by coöperation with its sister institution in the south, the Miami Aquarium, will now obtain this and other desirable species, which it has previously been unable to show to the public of our metropolis. A unique advantage which the Miami Aquarium will always hold for the student of warm-water fishes is its proximity to the grounds where they may be studied in their natural environment. Details of the habits of fish are only to be worked out in an aquarium, yet they can be properly weighed and coördinated only when one sees the fish in its environment, securing its natural food, avoiding its natural enemies, and living its natural life.

When the wind has been favorable for several days the surface drift from offshore is driven into Biscayne Bay to the very doors of the aquarium. It brings young flying fish in their interesting developmental stages and other species, many of which hide in the masses of floating yellow sargassum, or gulfweed.

Using Miami as a base one may cruise southward for material among sheltered channels, keys, and mangrove-bordered lagoons to the sandy shores of Cape Sable and the shallows of the Bay of Florida, all wonderfully rich in marine life. The varied coral reefs of the Bahama Islands, whose fauna is less well known, is within striking distance.

It will be seen that as regards assembling and caring for material, the location of this new aquarium is a favorable one. Its situation on the mainland of Florida and consequent accessibility to the centers of population and to the great scientific institutions of the north, should prove equally advantageous. Each winter a great number of people from all parts of the United States visit Miami. Many are sportsmen, interested in fish and fishing, or yachtsmen, perhaps, on their way to cruise among the keys, and a majority are on vacation, with leisure to ponder on the wonders of the ocean so near at hand. That this public is greatly interested in the life of the sea is evidenced by the large attendance at the aquarium, which thus has an unusual opportunity to do important educational work. At the same time it is close enough at hand to be a convenient field station for the scientific investigator, whose time is often limited. Proximity is an important matter for, at the present day, isolation makes effective research very difficult.

Some of the interesting problems in fishes which the Miami Aquarium will help to solve are local in nature. In spite of the labors of many students, the fishes of Forida, their seasons and migrations, have never been reported upon adequately. We know still less of the rich ichthyofauna of the Bahama Islands, where doubtless species of fishes as yet unknown to science will be found lurking among the intricacies of the corals and the waving sea plumes. No one has as yet determined the spawning grounds and developmental stages of so well-known a game fish as the tarpon. Tarpon have recently been taken with ripe spawn, and the mature egg of this great fish, which is known to reach sometimes a length of 8 feet and a weight of more than 300 pounds, is only $\frac{3}{4}$ mm. or less in diameter! It ought to be possible to hatch the eggs in the laboratory.

Other problems of warm-sea life, however, are world-wide in their bearing, and it is hoped that this new institution will not limit its scope to any local boundaries but will look far out upon the great, sunny ocean which encircles the world, past the Bahamas, the Antilles, and the Sargasso Sea to the coasts of Africa, Malaysia, and the myriad islands of the Pacific. The Gulf Stream itself, so close at hand, is the product of world winds and world currents. The trade winds of the Atlantic which cause the surface water to drift ever westward against the American continent. Thence it escapes to the north through the narrow passage between Florida and the Bahama Islands. A similarity in the warm-water fishes of the Indian and the Atlantic oceans is perhaps traceable to warm currents from the Indian Ocean finding their way westward past the Cape of Good Hope, which extends south only to about the equivalent latitude of Cape Hatteras. There is, to be sure, a cold current from the stormy seas to the southwest which crosses toward southwest Africa, and which must form some barrier to the transfusion of warm-sea life, even though an imperfect one.

The fishes of Florida are known, in the main, from many trips and cruises of longer or shorter duration which have been made in the waters of the state by northern ichthyologists. With the establishment of the Miami Aquarium we have a station whence a watch will be kept on these sunny seas the year round, day in and day out. Interesting things which have previously been missed or overlooked should now be brought to light. Many of the ocean's myriad secrets remain remote and inaccessible through the years. Then by some chance the veil is lifted, making some critical observation possible. If there be no one there to see, a rare chance is lost, for the same combination of circumstances, presenting a similar opportunity, will not occur again for a long, long time.

Mr. Mowbray, director of the Miami Aquarium, had not been on the ground long when several great tuna were taken in nearby waters which he immediately recognized as representing a species never before examined and described by naturalists. The tips of their back and anal fins were greatly prolonged in narrow, band-shaped points, a condition approached but not equalled by a species known from far-away Japan. Save to one familiar with the almost inexhaustible possibilities of the sea, it would have seemed scarcely credible that such a fish should have inhabited the coastal waters of the United States without being discovered long ago. Indeed, this may have been a chance wandering school from some distant part of the ocean little known to students of fishes.

When the writer was in Miami, the director of the aquarium just chanced to gain possession of the mounted skin of a very peculiar and interesting individual of the tarpon, which he permitted us to photograph. It was a small example, only about three feet long, and entirely lacked the extreme hind end of the body, which should have carried the forked tail fin, a tarpon's chief organ of propulsion through the

Courtesy of W. B. Nichols

A tarpon that lacked the extreme hind end of the body. The anal in this specimen projected backward as much as downward and doubtless served as a fairly efficient organ of propulsion in place of the missing forked tail fin water. The finless stump of a tail was turned upward so that its anal, the fin situated posteriorly on the mid-line of the lower surface, projected backward as much as downward. With the anal in such a position it had doubtless been possible for the fish in life to make fair headway by using that fin in place of the missing caudal. The interesting thing about this tarpon is that in overcoming its physical defects it paralleled the evolution of the fish's tail. The tail fins of modern fishes, though now placed symmetrically in the mid-line of the body, are ventral in relation to the notochord, which on dissection is found to turn upward in the tail region. The unsymmetrical tail fin, longer above, of primitive fishes, sharks and certain ganoids, represents a stage in the attainment of a symmetrical tail, the most efficient propeller.

For an outline of the scope, equipment, and personnel of the Miami Aquarium Association, the reader is referred to an article, entitled "Treasure-House of the Gulf Stream," by John Oliver La Gorce, secretary and treasurer of the association, in the January, 1921, number of the *National Geographic Magazine*. Mr. La Gorce is a genuine lover of the ocean, and appreciates keenly not only its grandeur, mystery, and charm, but the economic and philosophic possibilities of a better knowledge of the infinite and varied life it contains. As associate editor of the *National Geographic Magazine* he has been in close touch with the broad educational work that is being done by the National Geographic Society of Washington, D. C., and he sees wide opportunities for educational work by the Miami Aquarium.

We are told that the president of the Miami Aquarium Association, Mr. James Asbury Allison, was prompted through a great interest in sport fishing to make available a laboratory where investigations might be carried on concerning the food value of warm-sea fish, and thus to enlarge the food supply of the country.

Not only will the aquarium seek information of this character through scientific study, but, having ascertained the facts, it will place them at the disposal of the public in popular, understandable form. Mr. Carl G. Fisher, vice president of the association, is identified with real estate improvements on a large scale in the city of Miami. It has been the aim of these gentlemen to establish an aquarium, equipped with the best laboratory facilities, which shall take second place, as a center of interest and of research, neither to the aquarium at Naples nor to the Museum of Oceanography at Monaco. No expense has been spared in erecting a first-class plant. The plan is to make it self-supporting as regards operating expenses and therefore an admission fee is charged. If this plan, which is perhaps somewhat experimental, proves successful, those features of the aquarium's work which meet with popular support will be enlarged and developed. Stagnation, which might creep into an institution that is not situated in a world center and that is at the same time entirely dependent on endowment, will thus be effectually barred. As director, the services of Mr. Louis L. Mowbray have been secured. Mr. Mowbray built and had charge of the aquarium at Bermuda, and later was associated for a number of years with the work of the New York Aquarium. He has had charge of the installation of the complicated tanks and interior equipment of the Miami Aquarium, obtaining and caring for the fishes shown there, already numbered in the thousands. No one has a better field knowledge of the fishes which live about these keys and islands than he, or has been more successful in locating and capturing the rarer kinds. It will, perhaps, be remembered that not long ago he presented the American Museum of Natural History with a large and valuable collection of marine

The Miami Aquarium, located at Miami Beach, Florida, was opened to the public on January 1, 1921. It is erected on the eastern terminus of the Causeway spanning Biscayne Bay

A picture, taken from an aëroplane, of the Miami Aquarium fishes from Bermuda and from Turks Islands in the Bahamas, the rarer and more interesting specimens preserved from several years' cruising, observation, and collecting.

The new aquarium is located at Miami Beach, at the end of the long causeway which crosses Biscayne Bay from the city proper and not far from where the main ship channel opens from bay to sea. Its latitude and longitude are 25° 46′ north, 80° 7′ west. Its exhibition tanks are arranged along corridors in the general form of a Maltese cross with a central rotunda, about fifty tanks each with a visible area of 4x6 feet.

As has been remarked, Miami is very favorably situated for obtaining an exhibition collection of the highly colored fishes found about tropical reefs and channels. These are for the most part taken in fish traps. Through the courtesy of the Miami Aquarium Association and Mr. Mowbray, the writer recently made a trip on the collecting boat "Allisoni," especially designed and equipped for gathering living material. Our destination lay some miles to the southward where narrow, deep channels of clear water ran among shallows and among dense growths of green mangroves so characteristic of south Florida. Fish traps were lowered at especially favorable points, at times in pools where the fishes which it was desired to take could be seen swimming in the limpid water. The common blue angel fish of this part of Florida is *Angelichthys isabelita*, the same species that occurs in Bermuda. The aquarium's collections also contain the more highly colored *Angelichthys ciliaris*, which is common in the Bahamas, for instance among the "sea gardens" at Nassau. Both forms occur at Key West.

A tropical fish fauna is remarkable for the great variety of closely related species which it comprises. Lacking seasonal changes, these warm seas have presented practically permanent conditions for an infinity of time. This has made possible a very delicate adjustment of the fishes to their habitat, and balance between different forms whose habits, though superficially identical, doubtless differ the one from the other in slight but important details. We have here a fascinating subject for investigation, which can be carried on to advantage in the aquarium's laboratories and in the adjacent waters. The investigation should throw light on the laws governing the formation of species and those of marine life.

A considerable knowledge of the habits of fish is necessary to trap them successfully. One must first know where to look for them. To recognize the different species at large in the water is surprisingly easy for a trained eye, but Mr. Mowbray tells us that in some places where a desirable fish occurs and is even abundant, it is useless to attempt to capture it because it will not enter the traps. Elsewhere the same kind may be caught readily enough.

This collecting trip was a most enjoyable affair. A considerable number of the exquisitely blue parrot fish, *Scarus cœruleus*, were obtained. Where we lay at anchor our only competitors in fishing were birds, namely several royal terns, suggestive of the tropic birds of more remote seas. One passed us, closely pursued by a man-of-war hawk, giving an exhibition of speed and adroitness in the air. Once a big loggerhead turtle passed the anchorage, slowly stemming the tide and coming up at intervals to breathe. There was a fine breeze for the return over sunny stretches of water with a well full of fish; we had all the wind we wished to carry full sail to.

The center of our craft was, of course, walled off to form a well into which fresh sea water could freely penetrate from the outside, and here the catch was kept with minimum danger of loss by death while it was being brought home. Incidentally, the very peculiar motion which the "Allisoni" had when under way in a breeze may have been caused

"L'Apache," the yacht of the President of the Miami Aquarium, Mr. James Asbury Allison, which joins forces with the collecting boat in quest of fishes. The yacht is 74 feet by 12 feet, drawing 3 feet, 6 inches, and is provided with two 150 H. P. gas engines. When "L'Apache" is in port, she may usually be found alongside the Aquarium dock

The specially constructed collecting boat "Allisoni" 45 feet in length and provided with an auxiliary motor, has a large well for bringing live fishes back to the Miami Aquarium from distant reefs and channels. It was in this boat that the author made a very interesting and enjoyable trip as a guest of the Aquarium

A SAWFISH ON THE MIAMI AQUARIUM DOCK

Sawfishes are among the most interesting of the creatures that live in tropical and subtropical seas. Their "saw" is an enormous, flat prolongation of the snout, armed laterally with sharp teeth. Specimens about 14 feet in length including the saw are of not uncommon occurrence. The present specimen is intended for the laboratory but live sawfish have been on exhibition at the Miami Aquarium. A female was taken in a net and shown for three weeks in a 36-foot tank. She gave birth to nine young, which, according to a recent report, were all still alive and growing. The mother died on March 3 of the present year, having refused to eat by the mass of free water thus contained within her hull. One would not recommend a trip on a "well"-boat to anyone with a tendency to seasickness.

One of the most interesting creatures placed on exhibition in the aquarium last February was a large female sawfish, measuring 14 feet, 9 inches. She had been there but a few days when she gave birth to a brood of nine young. Sawfish eggs, like those of most of our sharks, hatch within the body-cavity of the mother, and when the young issue into the watery world, they are fully developed replicas of their parents, except that the prongs along the sides of their diminutive saws are set in a protecting membrane. In the spring one frequently comes across little fellows about two feet in length from tip of saw to end of tail, navigating the shallows near shore.

In the popular mind some confusion exists between the sawfish and the swordfish, which are very unlike and entirely unrelated creatures. The swordfish is a big, swift-swimming, offshore, mackerel-like wanderer. Its nose is produced in a long, flat, bony, smooth-edged blade, which it sometimes drives into the timbers of ships with great force. In the waters about Block Island and to the eastward it is the basis of a considerable fishery, swordfish having long been esteemed a delicacy in New England. The swordfishes of the Northeastern States apparently feed at a considerable depth. They are harpooned while swimming lazily and aimlessly about the surface of the summer sea, apparently resting, their tall back fin cutting the surface of the water like that of a shark. Big-game anglers of the Pacific coast sometimes take swordfish on rod and reel trolling at the surface, as they do the Japanese spearfish, known locally as "marlin swordfish," while by them the true swordfish is called "broadbill swordfish."

The sawfish, on the other hand, is a member of the shark tribe. To be more precise, it is an intermediate stage between the shark and the skates, a group of sharklike fishes which have become flattened dorso-ventrally so that they may lie on the sea bottom. Its back is rounded like that of a shark, but its lower surfaces are flattened, and it is found close to the bottom in shallow water. Its hide is quite sharklike, covering the flipper-like fins, as does that of sharks, and similarly reinforced with minute, hard, bony points; it is entirely without scales. Excellent leather can be made from the hide of this fish as from that of sharks.

The sawfish's saw is no less remarkable than the swordfish's sword. Like the latter, it is a bony, flat prolongation of the fish's snout, but it is blunt at the end, and covered by the same skin that envelopes the body. In each margin of the saw are set a series of sharp, flat teeth. The purpose of this remarkable structure is not satisfactorily known. It is a dangerous weapon, which its owner can, and doubtless sometimes does, use in defence. Furthermore, we find casual observations of its being thrashed from side to side effectively in a school of small fish, killing or disabling members thereof, which the sawfish can later pick up at leisure. To judge from its fine, granular, skatelike teeth, however, the sawfish should in the main be a bottom feeder, eating crabs, shellfish, and such hard-bodied animals. The saw may be effective in raking these out of the sandy bottom, but traces of wear sometimes found on it are the only evidence that it is so used.

Our Florida sawfish commonly reaches a length of 14 feet from tip of saw to tip of tail. An excellent cast of an individual of about this size, obtained by the Fabbri Tekla Expedition in 1910, hangs over the second floor entrance to the lecture hall in the American Museum. A sawfish, 14 feet in length and weighing 600 pounds, has been taken on rod and reel at Fort Myers, Florida. One can imagine what a fight it must have put up!

One measuring 17 feet, 8 inches, was harpooned at Cape Sable, Florida, in March, 1918, by Mr. Van Campen Heilner.

The fish department of the American Museum welcomes the installation of this collection of living fishes on the distant shores of Florida. There has already been friendly coöperation between the two institutions advantageous to the department of ichthyology. Our research work is almost entirely with preserved material, which, though itself lifeless, is of the greatest interest for the light it throws on that natural phenomenon, the living fish.

The writer has recently been working on the structure, relationships, and differences of a group of free-swimming, warm-water fishes known as jacks or crevallys. For this purpose the American Museum's collections of fish preserved in alcohol, numbering specimens of various sizes and ages and from different localities, furnished the essential material. However, ten minutes spent before a tank in the Miami Aquarium, where four species of jacks were swimming together, supplied data for this particular research problem, as to life-color variations within each species, and color marks diagnostic of each, which had not previously been obtained. On the same trip this data was verified and extended by the review of a great deal of fresh material brought to the fish market at Nassau, Bahamas.

It will be worth while to make a slight digression and describe the life colors of one of these fishes, on account of their exquisite beauty. The fish in question is the yellow jack, *Caranx bartholomaei*, the "cibi amarillo" of Spanish-speaking islands. When young, it is golden olive with irregular bars of silvery white along its back and belly and spots of the same tint on the side, and it has a diffuse, dusky bar through the eye. This mottled color gives it a low visibility about the drifting sargassum, or gulfweed, where it hides when small; the color is lost as the fish grows larger and swims boldly out into wide stretches of open water. Its general color is now bluish silver, more or less suffused with olive yellow, and with rich blue, purple, and sometimes green reflections, and becomes white on the mid-line below. The top of the head is olive and the mid-line of the back yellow, sometimes an olive yellow, and again an orange yellow. The iris is golden, and the fins grayish and olive yellow.

Dr. E. W. Gudger, of the American Museum, has for several years been especially interested in the remoras, or sucking fishes, which attach themselves by means of an oval structure, with slats like a blind, that is situated on the top of the head and front part of the back, to sharks, turtles, and other large marine creatures, obtaining free transportation in this manner without effort on their own part. The director of the Miami Aquarium is keeping a special lookout, in the interests of Dr. Gudger, for material bearing on the study of this group. Perhaps it will be possible to determine what manner of fishes were the remora's ancestors, something which has never been satisfactorily worked out.

The scope of this aquarium is in no sense narrowed to fishes alone. Indeed, the Miami Aquarium Association's first expedition of moment was to re-locate and study a colony of flamingos, which strange, large, bright-colored, wading birds still nest in the difficult tidal swamps of Andros Island, the largest but least known of the Bahamas. Especial attention is given to the difficult task of keeping in captivity various marine invertebrates. During the writer's visit some basket starfish had just been successfully installed, and an outdoor tank of young loggerhead turtles was of much interest. But the ichthyological side of the aquarium's work is the one which has been emphasized, and quite properly so. Fishes are the class of animals which make up most of the exhibits and which occupy the major part of such an institution's attention.

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BANDED EPEIRA COCOON

The cocoon of the banded epeira *Metargiope trifasciata*, differs in shape from others and may be found in the autumn attached to grasses or low shrubs. After the fabrication of the cocoon, the spider soon passes away

THE MUCH DESPISED SPIDER—HARMLESS, BENEFICIAL, INTERESTING*

BY

WILLIAM M. SAVIN

THE lover of nature who neglects to pay some attention to spiders loses an opportunity for securing much enjoyment. Their abundance, their harmlessness in spite of unfounded fears to the contrary, the ease with which they can be observed, and the great variety of interesting habits exhibited by them, make them very available and profitable subjects for study. As I have said elsewhere: "If spiders did not occur in our fauna, and if the keepers of a zoölogical garden were to bring from some remote part of the world living examples of the little animals that spin from their bodies threads of silk of different kinds, some dry and inelastic, some viscid and elastic, and some, as the hackled band of *Filistata*, of wonderful complexity of structure, and with these threads construct snares of surprising regularity for trapping their prey, the presence of such marvelous animals would attract general attention, and we would make long journeys to see them. Fortunately, however, this marvel can be seen at home by anyone that has eyes and will look."

Comparatively few people study spiders seriously. It is, therefore, a matter for gratification when one appears who not merely observes what has been described in books, but adds to our knowledge of these creatures, as Mr. Savin is doing.—J. H. COMSTOCK.

SOME years ago in the introduction which a well-known naturalist had contributed to a nature book, I was somewhat amazed to come upon a statement to the effect that he had never been greatly interested in spiders but had often wondered how a certain one had managed to stretch a web about his height from the ground across a woodland road. While he but voiced a prevalent indifference to spiders, a little investigation of their habits will show that this attitude is ill-taken, for there are few creatures in small animal life so interesting in their ways and at the same time so beneficial to man, owing to the large number of insects they destroy. Moreover, being carnivorous, they never ruin anything in vegetable life.

The almost universal aversion to them is probably due to an erroneous idea that their bite is dangerous. While the tarantula, a habitant of the south, may inflict serious injury, northern spiders are virtually harmless. It is encouraging to know that their lonely manner of living makes the spiders timid and that, when disturbed, their effort is to get away; nor do they stop to administer a bite before retreating. Should a person happen to be nipped by a northern one, the amount of poison injected is too small to cause injury, even though it is sufficient to kill an insect.

Age and ancestry always command a certain amount of attention. The spiders justly lay claim to an ancient pedigree, for the nascency of the earliest species was in the Upper Carboniferous Period, at the time of the formation of the Appalachian Mountains. Fossil remains of spiders have been discovered belonging to a number of periods of our geological history. The most ancient ones have been uncovered in the coal measures at Mazon Creek, Illinois, and in shale in Upper Silesia. The appearance of spiders antedates by many millions of years that of some of our most wonderful insects, such as bees, wasps, and ants.

Unlike insects, spiders do not undergo metamorphoses. The female lays a mass of eggs around which she fabricates an egg sac or cocoon and when the young hatch, they make their appearance as small but perfectly formed spiders. To reach maturity they need only to grow and to develop certain organs, molting a number of times while doing so.

If the spiders located at the place where they emerged from the egg sac, they would not be scattered enough to prove of great economic value, and although they can live a long time without food, under such overcrowded conditions sufficient nutriment would be lacking, especially when they reached

* Illustrations from photographs by the author.

the adult stage. Their recourse would be cannibalism and that, in course of time, might decimate many species. Nature employs an ingenious device for scattering them, by endowing a great many species with an instinct to migrate by means of ballooning. This is accomplished by the spider's standing in an open place with abdomen elevated, and projecting from the spinnerets a line of silk, which continues to issue until the spider feels the pull on it by the wind. The spider then releases its hold on its support and, clasping the line, is borne away by the wind, hundreds or thousands of feet. In driving along country roads in the autumn, quantities of these lines may be seen floating through the air, bearing spiderlings which are ready to migrate at that time. Often the lines are caught on telegraph wires, fences, and other objects. As a rule, only the very young engage in migration by ballooning and the spiderling usually makes its home near the aëronautic landing place.

In order that the various species may be assured of perpetuation, it is necessary for them to provide a sufficient number of offspring to offset the loss from the many mishaps that befall them. It is quite common for parasites to infest egg sacs, thereby ruining the chance of a prospective family, and spiders that inhabit exposed positions are in constant danger, so much so that but a small proportion reach maturity.

Spiders are greatly reduced in numbers by cannibalism, which is practised while in the egg sac and just after leaving it. All the inmates of the egg sac do not shed their skin simultaneously and those already molted pounce upon those molting later. This requires no prowess, for those casting the skin are in an enfeebled condition. It is not improbable that nature furnishes spiders their food in early life in this way, the large number of eggs caring for cannibalism as well as other losses.

Evidence of the maternal instinct is confined largely to the time when the female fabricates the egg sac. Having performed this task, her mission is ended and among most genera she dies shortly afterward.

In a few genera, the mothers are on hand to welcome their offspring at birth and for a while exercise more or less care over them. The various genera have

Open door of burrow of trap door spider (Ctenizinæ). The burrow and under part of lid are lined with silk. The lid is covered externally with the same material as that which surrounds the burrow, making discovery difficult

The egg sac of the orange garden spider, *Miranda aurantia*, or *Argiope riparia*, as she has come to be called more recently, may be found attached to some herbaceous plant or shrub late in the summer

differently shaped egg sacs, which are placed in a variety of positions for safety. Ordinarily only one is fabricated by a female, although several may be made at short intervals; in such cases, the mother usually keeps them in the web near her.

The pear-shaped egg sac of the orange garden spider (*Miranda aurantia*) is fabricated in the late summer or early autumn and is a masterpiece. These egg sacs are firmly attached to some growing thing, but the spider frequently displays her ignorance of botany by placing them upon herbaceous plants or long grasses, which fall to the ground in winter. Thus the egg sacs are sometimes destroyed, for though virtually water-proof and air-proof, they are not entirely so, as I have found by testing them.

The silk of the covering is like parchment and the deep layer of fluffy, brown silk beneath it keeps the young warm and serves as a playground. It also holds the egg cup in position in the center of the egg sac.

The eggs hatch in a month or so and the young remain within the egg sac until late in the following spring. One egg sac that I opened late in the fall and found filled with young proved very interesting. It was kept in a closed house through the winter and by spring the young were reduced by cannibalism to about one quarter of the original number. In May what was left of the family was placed outdoors on a shrub and late in July there appeared a colony of adult spiders with a handsome dark-brown background and yellow markings instead of the usual black background and yellow. The color change doubtless was occasioned by the fact that the young spent the greater part of their time in an environment different from the ordinary.

In a general way, spiders may be divided into two groups, the wandering and the sedentary. The wandering go from place to place within a limited area, in search of their prey, and with one exception spin no webs. The sedentary localize and during the season may be found on or near webs they have spun, waiting for their prey, the coming of which is, of course, entirely fortuitous. When walking across meadows, one is usually repaid for overturning logs and stones by finding a *Lycosa*, or wolf spider, so called from its manner of stalking prey. Many of these have a burrow, which is often a well-made tubular retreat, lined with silk. From it they wander in the vicinity. At the time of oviposition, the female lays several hundred eggs, which she encloses in a spherical sac, and this is dragged behind her, attached to the spinnerets by silken threads. In about a month the eggs hatch, whereupon the mother opens the sac. The young emerge and climb up her legs on to her back, where they form a many-layered mass, which is carried by her until the brood is ready to migrate, an event that in some species is postponed for seven or eight months. It is not known whether the young are fed by the mother during that period. Fabre advanced the opinion that they are nourished only by the sun's rays. There is a right and a wrong way, however, to introduce them to those rays, as I learned one hot summer day, when photographing a newly emerged family in process of climbing to the mother's back. They were of pin-head size, but owing to their activity, a long exposure could not be given for the picture, so they were placed in the sunlight for a moment. Immediately all fell over dead, numbering over two hundred and fifty. The mother, too, succumbed to the sunlight.

Lycosa and Egg Sac.—After fabricating the egg sac the *Lycosa* drags it behind her, attached to the spinnerets by threads, until the eggs are hatched

Lycosa and Young.—As the several hundred young lycosids hatch, they climb up the mother's legs to her back. She carries them around with her for a considerable period. They do not cover her eyes or legs, leaving her free to wander. So far as is known, the spiderlings are not fed by the mother

If one tries to take the egg sac from the mother, she is greatly disturbed and will fight for it, but after the young emerge she appears indifferent to their fate. One time when I tried to capture a female laden with young, her charges tumbled from her back, but she made no attempt to recover them. Her only thought seemed to be to escape and hide. The little ones were widely scattered and exhibited an interesting phase of instinct by quickly huddling together in layers similar to the mass on the mother's back.

The lycosids, pisaurids, and their allies are considered the best developed physically of the spiders and are fierce fighters. If two of them be placed near each other, it usually means a swift combat and death to one of the antagonists.

Some species of these families are large spiders—over an inch in length—and several of them run on the surface of water. They live for two years or more whereas the life cycle of most spiders is but a year.

Another spider of the wandering type is the crab spider, so named from its general appearance. The front legs of this creature are long and curved inward, enabling it to walk sideways and backward more readily than forward. These spiders are of various colors and are generally found around logs and stones. The most common one and at the same time a most interesting one is the *Misumena vatia*, the female of which is half an inch or less in length and the male still smaller. This species is white or yellow, and frequently has crimson markings along the sides of the abdomen and the region of the eye. It generally locates in flowers, where it

NURSERY WEB OF PISAURID

After emerging from the egg sac the spiderlings remain for several days in a nursery of leaves folded and fastened by silken threads of the mother's spinning. The mother is on guard outside the nursery and seems to depend on her sense of feeling rather than of seeing to protect them. If she rests in a position where the connection between her and the nursery has been cut and an insect is placed in the web close to her, she pays no attention to the intruder

Not always is the crab spider, *Misumena*, engaged in killing useful insects like the bees. It is here seen clutching the butterfly, *Pieris rapæ*, whose well-known green caterpillars are so destructive to cabbages. The grip of the crab spider on its victim is a tight one. In order to take this photograph, the creatures were placed in a jar of cyanide potassium. When taken out, the grip of the spider in death seemed to be as tight as it was in life

It is said that the crab spiders, *Misumena*, always attack a bee so as to affect its nervous system, and that the assault is made in such a way that the bee is unable to administer a sting. The effect of the poison seems to be instantaneous. After the attack the spider sucks the juices of the victim. These spiders do not spin webs to capture their prey; instead, they lie in wait on plants, ready to seize a visiting insect

waits in ambush to attack a visiting bee or other insect. The color is protective, white when on a white flower, yellow on a yellow one. Should it leave a white flower and locate on a flower of yellow color, its color change is effected in less than a fortnight. It has been reported that these spiders assume also colors other than white and yellow.

The Attidæ, or jumping spiders, are mostly small, hairy ones of the wandering type. They are inconspicuous, but some of them are beautifully marked. Their short, stout legs enable them to jump readily. This is one of the families in which the mother is present to care for the young at their birth. Interesting accounts have been written about the males dancing before the females, when courting them. In the autumn, the young Attidæ may be found in nests built by the mother on wild carrot, or other wild flowers, where they locate for the winter.

It is a common occurrence for the orb-weavers to shake their webs when alarmed, but none of them performs to the same extent as the *Pholcus*, which can be kept actively swinging the web for some twenty minutes if it be touched up a bit when about to quiet down.

The female encloses the eggs in an almost invisible sac and carries it held fast in two grasping organs located above the mouth, with which the spider normally clutches and kills its prey.

Of the sedentary spiders, the most common one in our fauna is the grass spider (*Agelena nævia*), which is found on the grass, about shrubs, in the angles of buildings, and in other places. One gets an idea of their abundance, when on a summer morning, following a clear night during which a heavy dew has formed, one notes spread over the grass hundreds of their webs, sparkling with moisture and thereby made visible. In times of drought, the collection of dust upon their webs along roadsides also makes them conspicuous.

The web is sheetlike with some irregular lines above it forming a barrier web, which aids in arresting passing insects and causes them to drop to the sheet. At one side of the sheet a tubular retreat runs downward with an opening below to allow escape. The spider hides in the retreat, facing the sheet and when the insect drops onto it, rushes out and bites it several times. The victim forthwith is carried to the retreat, where the spider feasts upon it by sucking the juices from it.

Some grass spiders appear to possess a habit peculiar to the species. From fear, or from anxiety lest the prey escape, before biting it, the spider will run around it many times in a circle having a radius of about two inches, leaving a drag line behind her as she travels, so that no matter in what direction the insect tries to depart, it will be obliged to pass through the mesh of new lines and thereby become entangled. The spider then successfully attacks it at leisure. The grass spider is readily recognized by the two spinnerets that protrude from behind the abdomen. This is unusual, as the spinnerets, thumb-like organs, are located on the ventral side of the abdomen, near the caudal end, and cannot be seen on most spiders unless that side of the spider is visible.

The silk is liquid within spiders and hardens as it comes in contact with the air. Several kinds of silk issue from the spinnerets and the spiders employ that which is suited to the kind of work that engages them.

Most people have seen the domestic spider (*Theridion tepidariorum*) the web of which is frequently found around the ceilings in houses. When an insect, usually a fly or mosquito, alights on the web, the spider rushes to it and throws over it a sheet of silk, during the flow of which she keeps turning the victim over with her hind legs to swathe it completely. She also gives it a bite and generally drags it behind her to a thicker part of the web, which she uses for a resting station. There she feasts upon it at leisure.

One summer's day at nightfall I found a male visitor of this species on the web of a female and placed a fly on the web. Both rushed for it, but as the male happened to be the nearer, he swathed and proceeded to devour it. The female seemed to be greatly annoyed and pulled

TWO HANDSOME ORB-WEAVERS

Left.—The adult female *Aranea gigas conspicellata*—a variety of *Aranea gigas*—may be found in late summer. It is one of the handsome spiders of our fauna, a symphony in brown and yellow. *Aranea gigas* is an exceedingly variable species whether considered from the standpoint of size, markings, or color.

Right.—The female *Leucauge venusta* is a beautiful spider—green, silver-white, and golden. She is between one fifth to one fourth inch long and one needs to use a magnifying lens to see her full beauty revealed. Her mate is only half as large, but is similarly colored

WEB OF FEMALE ORANGE GARDEN SPIDER

The name "garden spider" seems inappropriate for this spider. Although she is frequently found on shrubs and in gardens, her natural habitat is meadows and marshy places. This spider is known technically as *Argiope riparia* although called until recently *Miranda aurantia*. Butterflies, an occasional cicada, and other insects are found on her web, but her principal food is grasshoppers.

When a luckless creature has become entangled in her web, she rushes upon it, and fastening a swathing band to it, the product of her spinnerets, rolls it over two or three times until it is securely wrapped in its shroud. A quickly delivered bite gives the *coup de grâce*

THE COMPOSITE WEB OF THE LABYRINTH SPIDER

The web of *Metepeira labyrinthea* is of unusual form in that it consists of an irregular network of lines in addition to an incomplete orb. The female encloses the eggs in several egg sacs, formed at intervals during the laying season. The first egg sac is placed near the entrance of the retreat, the others successively in line below it, attached to a stout cord of silk. The support of the egg sacs is made so strong that they hold their position thus suspended notwithstanding the winds of winter and the driving snow at his hind legs for some fifteen minutes while he fought her off as best he could without turning to face her, feasting as he fought. She then became resigned and returned to her former position many inches from him. When I placed another fly in the web, the female promptly ran to it and swathed it. She again returned to her original position, dragging it behind her, but in doing so, she took an indirect route in order to pass the male and gave his hind legs several additional yanks, apparently to apprise him of her good fortune in also securing prey. Fortunately his life was not in jeopardy, for the females of this species are only slightly larger than the males and are more amiable than those of the genera which destroy their suitors even without apparent provocation.

The orb-weavers are the builders of the beautiful webs of wheel-shaped form. Their young build a new web daily, thereby acquiring practice, and some adults spin theirs as frequently, but usually the web is rebuilt only after it is partially or entirely destroyed. Before starting a new web, the old one, excepting the foundation lines, which are considered too valuable to dispose of, are gathered into a small pellet, which is dropped to the ground. In making the pellet the spider uses its jaws and thus the impression is sometimes conveyed that the spider is eating its web.

The female *Verrucosa arenata* is a handsome Southern spider occasionally found as far north as New York City. Some of its habits, as noted in the text, differ from those of other orb-weavers, making it a creature of unusual interest

Sundown is the favorite time chosen for constructing a web; still some genera, especially those that resort to woodland places, often build them in the daytime.

When a web is built on a shrub, the spider often constructs it by running up and down the branches and placing a foundation line between the ends, but in the event that the web is projected across a path, or other opening, the spider stands in an open place with body elevated, back to the wind, and issues a line of silk from the spinnerets until the wind blows it far enough to catch on to some object. This becomes the foundation line and below it the web is formed. The construction of the web usually requires a little less than an hour. The males build webs, but they are usually inferior to those of the females.

The radii are not sticky, and these are used by the spider when passing over the web. The spirals or cross lines are viscous and while having the appearance of being curved, are straight, as are all other lines made by the spider. Viewed under a microscope the spirals, with their globules of sticky matter, are as beautiful as a pearl necklace.

When an insect alights on an orb web, it is caught by the viscid spirals, which hold it until the spider rushes up and swathes it with silk, turning it over repeatedly with her hind legs while so doing. The victim, then wrapped like a mummy, is generally also bitten before the spider takes it to the hub, or retreat, to be devoured.

Some spiders occupy the center of the web, the hub, night and day, others only at night. The latter in the daytime rest in a retreat to one side of the web. Such a spider lies in the retreat, facing the web, with a trap or telegraph line attached to her front legs and running to the center of the web. When an insect alights on the web, the trapline notifies the spider of its arrival.

A few years ago in New Jersey, I found

a southern spider, *Verrucosa arenata*, which is occasionally seen as far north as the latitude of New York City, and so far as I can ascertain, has a unique way, which I have tested several times, of entangling the insect which alights on her web. Instead of employing the usual method of swathing the insect, she sometimes simply used a number of the spirial lines nearest to it to bind it, cutting them from the web, as she carried her victim to the hub, or she held it stationary and used some of the nearby spirals to bind it. Possibly this may have been done to conserve her supply of silk. At other times, when an insect was deposited too unwieldy to bind with the spirals, she swathed it according to the custom of orb-weavers and in doing so, showed that she varied the method for rendering the prey helpless, dependent on the exigency of the case.

In experimenting with spiders to test their behavior in the event of a mishap to the web, I found that when the web was collapsed, no immediate action was taken to dispose of the shattered fabric, excepting in the case of one species, *Micrathena gracilis*, the spiny-bellied spider, which as a rule promptly removed it, although rebuilding was delayed for some time.

Singularly interesting are the habits of the triangle spider (*Hyptiotes cavatus*), so named from the shape of its web. Over forty years ago Professor Wilder first wrote of these remarkable spiders.

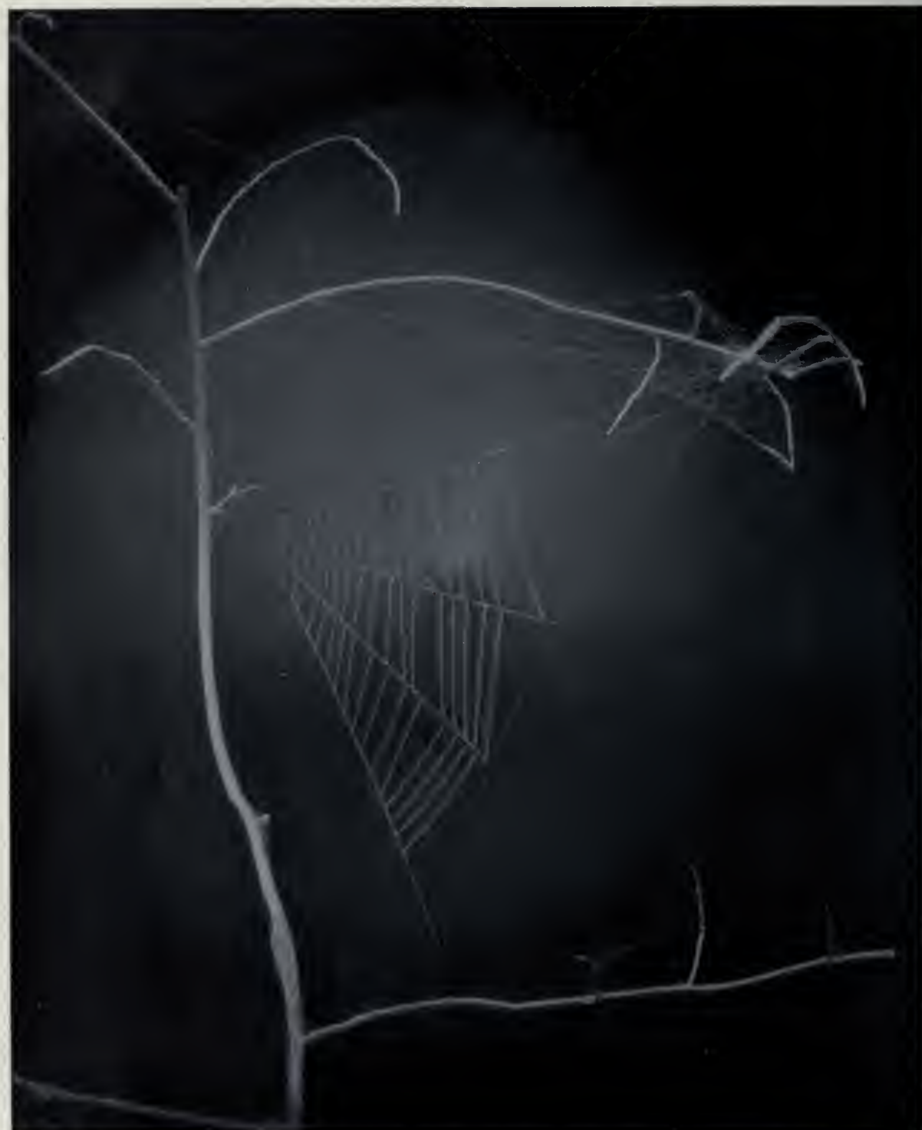
Their common habitat is a pine grove, but they seem partial to dead branches of dogwood trees in the woods and they are found also in other places.

The female is only one sixth of an inch long, and the male about one half her size. This spider, possibly protectively colored, rests back downward against the twig and looks like a light brown bud.

The web is unlike that of any other spider, a segment of a circle of an orb web, frequently smaller than the size of one's hand. There are always four radial lines; these are crossed by from six to twenty-four flocculent ones, thus differing from the orb web the spirals of which have viscid beads. At the apex of the triangle proper, where the radii meet in an irregular way, a trap line extends to the spider's resting place against the twig. This is long enough for a reserve of about three-quarters of an inch and when the spider pulls the web taut, this reserve forms into a coil between the third and fourth pairs of legs. When an insect alights on the web, the spider releases its hold and the web springs forward to the length of this reserve, taking the spider forward that distance from the twig. This causes the web to collapse slightly and the flocculent lines entangle the insect. The spider again pulls the web taut and then slackens it. This is repeated a few times, whereupon the spider rushes toward the prey and as she does so, rapidly pulls the web taut and springs it a number of times—in one instance, I counted thirteen times. On reaching the insect she swathes it in the usual way. After this is done, the bundle is slightly elongate. Sometimes she continues to swathe

The female spiny-bellied spider, *Micrathena gracilis*, is a peculiar-looking creature that, if found off her web, might at first glance not seem a spider at all. The abdomen of the female has five pairs of spines. This spider builds a beautiful web of many radial and spiral lines

it until it is somewhat rounded, turning it over repeatedly to form it so. She then carries it in her jaws to her resting place. When she approaches the twig, as a rule she holds the bundle at a right angle over the line and rounds it further



WEB OF THE TRIANGLE SPIDER

The web of the triangle spider, *Hyptiotes cavatus*, looks like a portion of an orb web, but it is complete. The small spider rests against the twig and resembles a bud. The egg sac of this spider as well as the creature itself is protectively colored to her satisfaction. She then goes to her resting place, where she stations herself, facing the web, and feasts upon her victim.

When experimenting with this spider, it is best to use only small insects, owing to the diminutive size of the web, for large ones would break it, permitting the escape of the prey. Furthermore, the spider is afraid to attack large game. Small ants, such as *Lasius niger*, are about the right size.

On one occasion I found a triangle spider that performed an act of uncommon interest. After she had gone through the usual method of springing the web and swathing the ant and had returned to her resting place to feed upon the ant, I put another ant in the web and she went through the regular performance to the point of swathing it, carrying the first one in her jaws while working. Then, instead of leaving the second one in the web, where she had swathed it, she placed the two together and made one bundle of them, throwing quantities of silk over the packet and turning it over many times until it was well rounded and larger than herself. She took it to the resting place and feasted upon it. The web was so far collapsed that she paid no attention to the third ant that I furnished her.

Generally after she had captured an ant and I had placed one or more additional ones in the web, she simply swathed them and left them in their respective places, but she always carried the first bundle around with her in her jaws when she was working on the other victims. Some other species, when carrying prey about the web, drag it behind them, attached to the spinnerets.

The female orb-weavers are larger than the males. When the difference is slight, both sexes may sometimes be found on the female's web for several days living in amity. In other genera, the female is many times the size of the male, and a person unacquainted with them would never suspect they were congeneric. When this disparity in size exists, the female is, of course, dominant, and in a few genera there has developed a peculiar phase of cruelty, the female easily overcoming and devouring her suitor. Happily this savagery is practised by only a few other creatures, such as the praying mantis. If the female is not ready for the advances of the male when he courts her, she attempts to destroy him. Knowing her temperament, he always approaches her cautiously and retreats hurriedly; he may be obliged to repeat these antics many times before she accepts him. In proportion to their bodies, his legs are longer than hers and they serve him well in his flight, during which he runs away or drops to the ground, as though one of the Furies were after him; yet in her malicious rush for him, he is often overtaken and annihilated.

This strange ferocity is not confined to the orb-weavers. It is found also among some wandering spiders, such as the lycosids, even though these females are not much larger than the males. As these spiders are ground-inhabiting, the male is in even greater peril than the orb-weaver at the time of courtship, for he must depend on his fleetness to make his escape, while the orb-weaver can drop from the web to the ground, where the female does not pursue him.

The largest and among the handsomest of the orb-weavers are the orange garden spider (*Miranda aurantia*) and the banded epeira (*Metargiope trifasciata*) found about bushes, in gardens, meadows, and other places. The males of both genera are much smaller than the females. Sometimes finding a beau lurking around the web of a female, I have placed him on it and usually he has been destroyed. It is not unusual to find four or five males hanging around a female's web, and on one occasion, I discovered eleven awaiting a female banded epeira, which possibly possessed some rare charm in spiderdom. Spiders are polygamous and there is a difference of opinion as to which sex is the more numerous. At any rate, the males mature earlier and as a rule are not seen as late in the season as the females. All male spiders may be readily identified by the bulbs on the pedipalps, which are leglike appendages near the mouth of the spider.

The orange garden and banded epeira spiders remain on the hub of the web day and night and, everything considered, there is probably no other spider that can be studied with such satisfaction as these.

A few visits to the haunts of spiders are likely to prove interesting enough to impel one to wander farther into this alluring field of study and with the investigation one comes into the possession of secrets which nature reveals only to those who diligently search for them.

PAN'S PIPES

The nidus called Pan's Pipes is the work of a solitary wasp, a mud-dauber. Members of the genera *Sceliphron* and *Chalybion* make nests of this general character. Each pipe is stocked with captured spiders, stung and paralyzed by the wasp as food for her offspring. After laying an egg on one of the spiders, the wasp seals the pipe. In due time the grub appears, disposes of the spiders, and after pupation emerges as a wasp. The parent never sees the offspring

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TWO FAMILIAR ORB-WEAVERS

The adult female orange garden spider, *Miranda aurantia*, also called *Argiope riparia*, looks formidable, yet she is harmless to human beings. Her suitor, however, who is only about one fourth her length, may in wooing her lose a leg or two, or even his life, such is her strange ferocity toward him

The adult female banded epeira, *Metargiope trifasciata*, maturing in the late summer, is one of the handsomest spiders of our fauna. She is much larger than the male and, like the female orange garden spider, harbors an unfriendly feeling toward her suitors

SPIDER SILK AND ITS USES

BY

ALEXANDER PETRUNKEVITCH*

In addition to being of service to man as destroyers of injurious insects, spiders furnish the silk used in telescopes and various other optical instruments of precision to indicate by cross lines points in the field of vision The thinly spun but strong silk is particularly adaptable for representing fine lines of this character. The attempt has been made from time to time to utilize spider silk for textiles. About 200 years ago, in France, M. Le Bon obtained spider silk which was subsequently woven into gloves and stockings. This attempt, however, did not result in the establishment of the industry. Réaumur, appointed by the French Academy to investigate the matter, was not hopeful regarding the results to be obtained. One of the difficulties encountered in rearing spiders is that they require insect food, not easily supplied under artificial conditions, and a second difficulty is the impossibility of suppressing their cannibalistic tendencies. Dr. Petrunkevitch's article indicates, however, that formidable as are the obstacles, in one part of the world at least, the attempt to produce spider silk for textile uses has not been abandoned.—The Editor.

FOR many years past the spider silk industry of Madagascar has been mentioned off and on. According to reports the spinner is a species of the genus *Nephila*, a close relative of *Nephila plumipes* of the Southern United States, Bermuda, and tropical America in general, and of *Nephila maculata* of the East. The females alone are employed in the industry, as the males are very small and do not produce silk of sufficient strength or in sufficient quantity. The creatures are kept in special gardens, taken from their webs at regular intervals, placed in special racks and allowed to furnish a certain length of silk thread, which is simply drawn from the spider's spinnerets and wound on a reel. After the performance the spiders are released and allowed to recuperate their health in the garden, as experience has shown that excessive production of silk exhausts them to the point of complete collapse.

The silk produced by this spider is finer, lighter, and stronger than silk derived from the silkworm. Consequently it is also considerably better than artificial silk now so common in the United States. There can be no doubt whatsoever that spider silk would become very popular if its price could compare favorably with the other two kinds of silk. Unfortunately it is exactly this side of spider silk production which makes it unprofitable under usual conditions and makes the spider silk itself an article of luxury. Silkworm culture is not only practicable in the temperate zone of all countries, but has been made possible even in such cold countries as Finland, through the substitution of another food plant for the mulberry. On the other hand, *Nephila* is a distinctly southern genus of spiders and like all spiders requires animal food in the shape of live insects. Breeding of spiders in captivity has never been accomplished with success and even should this ever become possible, labor conditions will counteract advantages derived from transplanting the industry to civilized centers of the temperate zone. Spider silk production will therefore remain a tropical or subtropical industry and then only in countries with comparatively cheap labor. And as long as artificial silk produced from the cheapest vegetable material is satisfactory, common mortals will hardly be tempted to pay more for something that is in no way better looking even though undoubtedly of higher quality.

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SPIDER MYTHS OF THE AMERICAN INDIANS*

IN THE mythology of the American Indians spiders played a rôle that stands in sharp contrast to the attitude of indifference or even repulsion with which the average white man views these interesting creatures. In recognition possibly of the wizardry whereby many spiders spin out of silk supplied by their own bodies the complicated structures with which we are all familiar, certain tribes assigned to the spider a prominent place in their creation myths.

Thus, according to the Sia, there was in the beginning only one being in the whole world, a spider. This spider was the possessor, however, of two little packages from each of which there evolved, in response to his singing, a woman. He continued singing and, as he sang, the world became peopled; animals and birds and all animate things made their appearance. The two women first created were the mothers of all men. From one of them are descended the Indians, from the other the remaining races of the world. The spider also created the cloud, the lightning and thunder, and the rainbow people to serve the people of earth.

Scarcely less important is the rôle played by the spider in the creation myth of the Pima. According to these people a being by the name of "earth doctor" created the world from a little dust, which he took from his breast and flattened into a cake. On this he danced and as he danced, sang. The great world expanded under his feet. This earth doctor made the sky, shaped like the round house of the Pimas, to cover his creation, but the earth shook and stretched, with the result that the sky no longer fitted the thing it was supposed to enclose. Thereupon earth doctor created a gray spider and entrusted to this creature the task of webbing together the ill-adjusted parts of sky and earth. When this task was performed, the earth grew firm and stable.

According to the creation myth of the San Carlos Apache, the big black spider, along with black metal old man, black whirlwind, and mirage, was a primordially existing being. In this myth black whirlwind rubs his hands over his breast and removes some of the cuticle, from which the earth is subsequently made, an action reminiscent of that of the Pima's earth doctor.

Picturesque is the story which the Apache tell of Naiyenzgani, the child of a woman impregnated by a ray of the sun. This youth one time set out in search of his father, the great luminary. As he was going along toward dusk, a spider spun its thread across his path and tripped him. He arose, only to fall again. He was about to persevere in his attempt when he saw, only a few inches away, the head of spider-old-woman projecting from a hole. She succeeded in persuading him to enter her house, and from the cloth which he carried attached to his shirt, she made clothing for the naked spider-girls within. We have here an unconscious forecast of the utilization of spider-silk as a textile, a subject discussed in another article of this issue. The spider-woman is undoubtedly looked upon by the Apache as the inventor of all textile art. Among the Shoshoni the spider was regarded as the first weaver, and as having imparted its accomplishment to the fathers.

The tradition of the spider-woman is fairly widespread in the Southwest—all of the Indian tribes mentioned thus far belong to this region, though some, like the Shoshoni, extend beyond it. She is spoken of at times as the mother, at times as the grandmother of the twin war gods, the children of the sun. The tradition is apparently of considerable antiquity. Among the pottery dug up at Homolobi, one of the early sites of the Hopi, was a food bowl, on the inside of which was designed a spider and on the outside, a

*The writer is indebted to Dr. Clark Wissler, curator of anthropology, and to Dr. P. E. Goddard, curator of ethnology, American Museum, for valuable suggestions in connection with the preparation of this article.

figure of the sun, tending to show that even at that early day the legend of the spider-woman's impregnation by the sun had currency. The spider-woman is an earth goddess; and as the medicine power of the sun presents itself to the Hopi as an eagle, so that of the earth is visualized as a spider.

The embodiment of the spider in Indian mythology is, however, by no means restricted to the Southwest. One of the most spirited legends in which the spider appears is related by the Mohawks. According to this legend, the spider was one of four animals that joined in an adventure to capture the sun, the absence of which had brought darkness upon the world. The sun was espied lying in a tree and the problem presented itself of dislodging it from that place of security. The beaver, one of the members of the party, began gnawing at the base of the trunk, while the spider climbed up and fastened a cord to the top, thereupon descending. When the beaver's whittling had made such headway that the tree could be felled, the spider gave a tug at the cord and down came the tree, catapulting the sun from the leafy retreat. The two animals were, however, deprived of the fruits of their toil, for the hare, another member of the party, seized the sun and bounded off with it. When finally the sun was recovered, the wise decision was reached that it should be the exclusive property of no one but should shine for the benefit of all, and accordingly the sun was hurled up into the sky to begin the journey that it has since faithfully continued.

Knowing how frail, though elastic, is the thin thread of silk that the spider spins, one marvels at the imperviousness to strain with which the imagination of the Indian occasionally endowed it. According to a myth of the Seneca, a certain web woven by a spider across a ball ground was sufficiently resistant to make a lacrosse ball rebound when striking it. According to another myth of the same people, a youth, beguiled into sleeping by the daughter of an enchantress, was borne away by her and left in isolation on a narrow cliff, from which there was seemingly no escape. Above rose a mountain precipitously to a dizzy height, below there was a sheer drop of many hundreds of feet. Similarly placed on other cliffs were youths like himself, some appearing half dead. They had all been victimized by women. Their flesh was being eaten from their bones, and yet they did not die. How was he to escape this lingering torture? Suddenly he remembered that in a dream a spider at one time had offered to aid him should he be in peril. He called upon the spider to fulfill its promise now, and presently, to his intense relief, an enormous spider, large as a man, began to weave a rope, which it let down from the mountain above. This rope was strong enough to support the man; he climbed it to safety and then, with the aid of the spider, rescued one after another the poor wretches who had shared his fate. A legend very similar occurs among the same people. Instead of being exposed upon an isolated cliff, however, the young man is pushed by an old man into the deep hole of a hollow tree trunk, filled with the moldering remains of those who have suffered a like fate. The spider invoked in this tale shows the same alacrity in coming to the rescue but unfortunately the woven ladder which is let down into the tree proves of less resistant fiber than the rope supplied to the victim of the cliff, with the result that before the young man has climbed more than half way, the ladder breaks, precipitating him to the depths from which he sought escape.

According to a tale told by the Arawak, it is not the ascent but the descent that through the aid of spiders is made easy for an escaping Indian. This people tell of a hunter who had captured a vulture—but it was no ordinary vulture, for presently the bird laid aside its feathers and appeared before him as a beautiful girl, who became his wife and bore him aloft above the clouds. For a time all went well. In spite of the attractions of his new surroundings, however, the hunter still felt a loyalty toward those from whom he had been so unexpectedly separated and in time he expressed a wish to revisit his aged mother. This natural request occasioned a most unnatural resentment. The hunter was expelled from the regions above and placed on top of a very high tree abristle with prickly growths. He appealed to the animals to aid him and presently spiders spun cords to make possible his descent.

A beautiful myth prevalent among many Algonkin tribes and the Indians of the Plains is that of the woman who wished the Morning Star for a husband and was taken to the sky. In course of time she fell from grace and was sent back to earth, a spider being delegated to let her down by his web. Among the Plains Indians, especially the Sioux, the web is a symbol of the sky. Its four corners are the four world quarters where the thunders live.

Perhaps a Warrau legend offers the highest testimonial to the resistant quality of spider silk. According to this legend, a woman sought escape from jaguars by climbing with her baby into the branches of a high manicole tree. The ravenous beasts, not to be deprived of their prey, dug fiercely at the roots, loosening the tree's foundations until finally it swayed and fell over. Fortunately, however, its descent was stayed by a huge spider web, in which the woman and her child were caught. The woman's father, a celebrated *piai*, apprised of her misfortune through a dream, found her thus suspended when he went out to search for her.

The Cherokee have a pretty myth regarding the spider, to whom they assign a Promethean rôle. In the beginning there was no fire and the world was cold. In time, however, the thunders placed fire in a hollow tree located on an island. The animals gazed enviously at the smoke that curled upward from this concealed bonfire, knowing that there was warmth and yet at a loss how to obtain it; so they held a council and as a result the raven set out on the quest. He reached the island and the tree, but all that he bore back with him as a result of his adventure was his blackened feathers, which signalize the scorching to which he was exposed. The little screech owl next made the trial. He reached the tree as did the raven but while he was hesitating what to do next, a blast of fiery air arose from the furnace below and nearly burned out his eyes, which are red to this day. Other owls tried in their turn but with no better success; the black snake bears today a covering of sooty scales as a badge of his ineffectual hardihood.

Daunted by the failure of their fellows, the remaining animals managed to find the weightiest of reasons for not venturing to go. Not so the spider, however. She wove a little *tusti*-bowl of her silk and fastened it to her back and set forth on her adventure. She crossed the waters, being capable of running along their surface and of diving into their depths, reached the island, and crept through the grass to the tree. She snatched up a little ember of fire, placed it in her bowl, and returned to the expectant animals.

It would be hard to say what species of spider deserves the credit for this accomplishment. The little *tusti*-bowl attached to the back of the spider suggests one of the *Lycosa* that drag about with them their egg sac attached to the spinnerets. The species *Lycosa riparia* has a range southward of the District of Columbia, which would bring it into the territory of the Cherokee. "It is," quoting Hentz, "aquatic in its habits, always found near or on water, and diving with ease under the surface when threatened or pursued." Whether this be the spider referred to or not, the attribution of the adventure to *Argyroneta*[1] is almost certainly wrong, for *Argyroneta* is a European and Asiatic genus without an American representative.

Not always is the rôle of the spider a beneficent one. According to a Pima legend Morning Green, Chief of Casa Grande, was one time entertaining Chief Tcernatssing and his women. While a dance was in progress in which the women of Casa Grande and the visitors participated, Tcernatssing sang a magic song, enticing all the women to follow him. Morning Green strove in vain to counteract the strength of his magic. Among those whose going he was powerless to prevent was his own wife. To increase the irritation of the deserted chief, his daughter married Tcernatssing and in time gave birth to a son. Then, Morning Green, bent on revenge, sent a spider to inflict a mortal wound on the child. When, however, the boy was at the point of death, Morning Green relented and sent an herb powerful enough to avert the tragedy he had almost compassed.

Lest some one infer from this that the bites of spiders are prevailingly of serious character, it should be added that this episode took place in the Southwest, where the tarantula is found. Northern spiders are practically harmless, as Mr. Savin points out in his article in this issue of NATURAL HISTORY. A possibly injurious southern spider, *Latrodectus mactans*, occasionally reported from northern localities, is so rare in this region that it is negligible.

The Zuñi tell how "old tarantula" entered into conversation with a handsomely dressed youth and asked him whether he would not like to see just how splendid he appeared. To this end the crafty old tarantula persuaded the youth, whose vanity had been aroused, to divest himself of his finery, even to the inclusion of his turquoise earrings and his anklets of sacred white shell, and then himself donned the raiment. "Look at me now. How do I look?" asked the spider as he displayed the garments. The youth, finding the ugliness of the wearer somewhat detrimental to the appearance of the clothes, was not greatly impressed. The spider moved off a bit and, as distance lends enchantment or at least makes repulsiveness less obtrusive, the youth noted an improvement. Still a little farther off moved the spider, pretending that his only object was to gain the youth's approbation, but really intent on getting nearer and nearer to his burrow. At last he had arrived at the entrance. "How do I look now?" asked the wily creature. "Perfectly handsome," replied the youth, but as he spoke, the spider dived into the earth with the stolen finery.

The spider is frequently invoked in the formulas of the Cherokee conjurors to ensnare the souls of those whom they would bring under their evil spells.

One might recount many another myth that has grown up around the spider, tending to show what an exalted place for good or for evil—though mostly, be it said, for good—this creature occupies in the folklore of the Indian. Suffice it to say in closing, that even when treading on a spider, certain Indians will do so only after rather reverent preliminaries. It is said, for instance, of the Teton, one of the tribes of the Sioux, that when a spider crosses their path, they do not kill it in silence. Either to let it escape or to kill it without prayer would bring evil. In the latter case another spider would avenge its death. To forestall such disaster, it is necessary before bringing down one's foot to say, "The thunder beings kill you." The thunder beings enjoy immunity and through thus vicariously making them responsible for the spider's death, the real culprit escapes the punishment that would otherwise be meted out to him.

H. F. S.

[1] Nineteenth Annual Report of Bureau of Ethnology, Vol. I, page 431.

AMERICAN ELM

This beautiful vase-shaped tree (*Ulmus americana*) was photographed near Stowe, Vt. The Green Mountains are in the background. The picture was taken in the month of August and shows the tree in the fullness of its foliage

THE ARTISTIC ANATOMY OF TREES*

BY

JOHN W. HARSHBERGER†

THE artistic anatomy of trees should appeal to a large circle of individuals who are interested in botany, in forestry, in horticulture, in painting, in landscape art, and the beautiful in nature.

We distinguish in architecture the elements which enter into the building. There are the bricks, the plaster, the ornaments, the rafters, the pieces of slate, the tiles, the iron grilles, and other units which must be combined by the builder into an artistic whole.

Trees too have their architectural elements, their different plans of growth resulting in distinctive shapes. The base of the tree trunk may swell out toward the roots, so that an enlarged base is produced. This is typical of trees which grow in swamps with the ground wholly, or partly, covered with water. Enlarged bases may be due to buttresses developed as flying projections and extending outwardly in all directions so that they serve as a pedestal to make the tree more stable. The ceiba (*Eriodendron anfractuosum*) described by Kingsley in his "At Last, or Christmas in the West Indies," is perhaps the best illustration of a tree with a buttressed base. The inhabitants of the West Indies, where the species is native, use the spaces between the flat, extended buttresses as stalls for their horses and cattle. There are two forms of deciduous cypresses in the swampy districts of the southern states. The common cypress (*Taxodium distichum*) has sharp-edged basal ridges, while the other species (*Taxodium imbricarium=ascendens*), usually found in drained swamps, has rounded buttresses.

To be considered at this point are the trees which give off a mass of roots which serve to brace, or prop, them with the weight of foliage and branches above and support them against the mechanical action of the wind. This is noteworthy especially where the trees grow on a steep hill slope, for on the lower side the roots have extended themselves in rounded arches to give mechanical support. Characteristic examples of this kind of root growth are found along the banks of rivers and turbulent mountain streams where the soil has been carried away in freshets.

There are trees with stilt-like roots which elevate the branches and foliage far above the surface of the ground. The screw pines (*Pandanus*) are wonderful illustrations of this kind of root development and so are the red mangrove trees (*Rhizophora mangle*) of the tropical seacoasts. Here the whole system of roots extends outwardly from the base of the tree trunk, which is elevated some distance above the salt-water, which floods periodically the flats of oozy mud on which the flat-topped mangrove trees grow. Many tropical seacoasts, such as our Florida Keys, northern Cuba, and Central America, are fringed with mangrove swamps, which are extending gradually seawards as the impenetrable maze of mangrove roots project in that direction making new soil by catching the mud and floating objects upon which the future mangrove forest will grow.

The banyan tree (*Ficus benghalensis*) is an immense, spreading tree of India which develops aërial roots from its horizontal branches. These roots descend like hanging cables, finally penetrating the ground. Then with age they increase in thickness until they become like pillars. The branches, propped in this way, are able to grow out horizontally very considerable distances away from the parent trunk. A specimen on the bank of the Nerbudda in India covers an almost incredible area, nearly 2000 feet.

* With illustrations from photographs taken by the author

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Red mangrove trees (*Rhizophora mangle*) on stilt-like roots along the shore of Bermuda in June. Seaward-extending mangrove swamps are a characteristic feature of many tropical seacoasts

Hour-glass stems of Bermuda palmetto (*Sabal blackburnianum*) photographed in June

The whole is said to be capable of sheltering 7000 men.

Another fig tree (*Ficus aurea*) is known as the strangling fig. The seeds of this tree fall on the branches of some other forest tree, which serves as a nurse. The seeds sprout on the limb and the roots of the young fig are at first aerial. These aerial roots grow down into the soil in all directions and ultimately completely envelop the nurse tree, which is strangled to death and finally decays away within the surrounding fig roots until the fig tree is left in undisturbed possession of the forest area where its nurse stood originally. The false trunk of the fig shows externally that it consists of many coalesced air roots, for there are many projecting ridges which give the false stem a fluted appearance.

The cylindrical, column-like trunk of palm trees is also a characteristic architectural form. The diameter of a typical palm caudex varies little from its base to its top. This method of growth is determined by the terminal bud, or cabbage, maintaining a constant diameter, so that the stem remains cylindrical in reaching its great height. Some palm stems are so tall and slender in proportion to their thickness that they are termed appropriately flexuous, bending as they do elastically to and fro with the stronger tropical winds. The native Bermuda palmetto (*Sabal blackburnianum*), however, has a terminal bud which under seasonal differences in the rainfall varies its diameter, so that the caudex assumes an hour-glass form. Tall trees of this species show a number of superimposed hour-glasses owing to the variation in the width of the stem.

Barrel-like or bottle-like stems are found in some tropical trees. There is a native of northeast Australia (*Sterculia rupestris*) which has a stem swollen in the middle to the extent of thirty or forty feet in circumference. A small crown of branches with foliage grows out of the top of the gouty portion, which consists of soft and porous tissue. There are bottle palms (*Colpothrinax Wrightiana*), native of Cuba, which assume the same form of stem. A flask-shaped tree (*Dendrosicyos socotrana*) is found on the Island of Socotra.

The bark of trees forms one of the elements which must be considered in connection with the impression which the tree conveys to the mind of the artistically inclined student of forest botany. The upright trunk, or bole, is covered with the protective layer of bark, which is distinctive enough in most trees to become of diagnostic importance. There are some variations in the character of the bark within the same species, but the initiated soon learn to make allowance for such vagaries, usually due to the environmental conditions which were influential when the cork cambium was active in the formation of this protective covering. Bark may be thick or thin, smooth or rough, furrowed or unfurrowed. It may have large plates or small ones. It peels off in papery layers in the yellow birch and the paper birch. It is shaggy with long, bent plates in the shag-bark hickory. The white cedar and California big tree have a stringy bark, while the beech has a grayish-white, tight-fitting one. The persimmons and the dogwood have a bark of square, somewhat elevated, blocks, roughly resembling in consequence an alligator skin, and this kind of bark is found on a western juniper (*Juniperus pachyphlaea*). The shallow furrows in the bark of the western yellow pine (*Pinus ponderosa*) separate the bark into flat, reddish-brown, obliquely placed plates. The edible chestnut (*Castanea*) has long, obliquely running fissures. The bark of the buttonwood peels off spontaneously into large plates, exposing a yellow-white or a greenish, smooth, inner bark. These and the color of the bark have an artistic appeal.

As branches develop from leaf buds formed in the axils of leaves, the primary branching of stems follows the disposition (phyllotaxy) of leaves, which in general

Dome-shaped copper beech at "Awbury," Germantown, Pa. Photographed toward the close of May

Trees in the Arboretum at Aldie, Doylestown, Pa. Left to right, the trees are birch (pyramidal), Colorado blue spruce (spire-shaped), American elm (vase-shaped), maiden-hair tree (conical). The photograph was made in June is alternate, opposite, and whorled. The beeches, chestnuts, oaks exemplify the alternate method; the ashes and maples, the opposite; the pines and spruces develop whorls of short, lateral branches. It is the character of branch development, the relative growth of the main axis contrasted with that of the lateral branches, and the thickness, length, and tracery of the finer twigs, which determine the form that the mature tree assumes. The whorled branching of the cedars, cypresses, firs, pines, spruces, and other coniferous trees with the relatively slow growth of their lateral branches, as contrasted with the rapid growth of the main stem, or leader, produces the steeple-like, or spire-shaped, tree. The cypress tree (*Cupressus sempervirens*), which is a prominent object in Italian and Persian landscapes, is spire-like. So are our red cedars (*Juniperus virginiana*), the white cedars (*Chamæcyparis thyoides*) of our eastern states and several species of western fir trees (*Abies*) found in the mountainous parts of California, Oregon, and Washington. The so-called fastigiate trees, the lateral branches of which are bent upward parallel to the main stem, so that the tree is pointed toward the top, suggesting an exclamation mark, are exemplified by the Lombardy poplar, one form of Irish yew (*Taxus baccata* var. *fastigiata*), the fastigiate tulip tree (*Liriodendron tulipifera* var. *fastigiata*) and similar forms of other exotic and native trees utilized by the horticulturist and landscape gardener.

The weeping, or pendulous, form of trees is worthy of mention in the consideration of the artistic anatomy of trees. The reader will at once recall the most typical of these trees, the weeping willow (*Salix babylonica*), a native of China, with long, cordlike, drooping branches. There are many other weeping trees, as the weeping beech, birch, mulberry, and spruce, to the scientific name of which the varietal name *pendula* is applied. Such trees should be planted sparingly with due regard to surrounding objects and the placement of them in grounds should be studied carefully; and this is true for other trees of unusual form.

The method of branching determines the shapes of the various kinds of trees. The forms of the pitch pine (*Pinus rigida*) have been studied by me.[1] The pitch pine, when growing in dense stands in the forest and under stress of competition for light, develops a central axis with all the branches disposed laterally to it, with the lower branches killed by shading and in many cases broken off, leaving conspicuous stubs. The axis is not always perfectly straight, but may be bent, or inclined, the bending being more or less S-shaped. Other trees are conical. The pitch pine responds to the advantages of free space and branches more frequently until it becomes round-headed. Occasionally the stem forks. This bifurcation may be found at the base of the trees, half way up, or near the top. Such trees are V-shaped or Y-shaped. Another form is that of the candelabra, represented by a tree which has developed with several strong branches in an open space in the woods. Some of the forest patriarchs are of this form.

There are trees of other species than the pitch pine which are round-headed (maple), dome-shaped (copper beech), conical (the half-grown Colorado blue spruce), pyramidal (horse-chestnut), columnar, V-shaped, Y-shaped, tuning-fork-shaped (resulting when the stem bifurcates but the two leaders bend inward toward each other near their tops). Some trees are cushion-shaped, basket-like (mountain pine), candelabra-like (dragon tree), vase-shaped (elm), and umbrella-shaped. The latter form is assumed by a catalpa (*Catalpa bignonioides nana*), when it receives proper horticultural treatment, and this is the form of the mature stone-pine (*Pinus pinea*) of the Italian landscapes. Such

[1]Harshberger, John W.: *The Vegetation of the New Jersey Pine-Barrens*, 1916: 53-56.

Men may with the aid of shears trim certain trees into fantastic shapes, making them formal features of a landscape. The above represents privet so treated at Allenhurst, N. J. The picture was taken in August

Weeping white mulberry (*Morus alba*) on a lawn at Allenhurst, N. J., in August a variety is known in botany as *umbraculifera*. The cauliflower form of tree is exemplified in a species of dragon tree (*Dracæna cinnabari*) and tree spurge (*Euphorbia arbuscula*), both found in the Island of Socotra.* The traveler's tree (*Ravenala madagascariensis*) with its large, long-stalked, two-ranked leaves is fan-shaped with its leaves arranged like the outspread feathers of a peacock's tail.

Where trees are subjected to the stress of the weather, as at the seashore and on mountain tops, they assume well-known and characteristic forms which are the result of the impress of the various environmental conditions to which the trees are exposed. At those localities where the pine barrens approach the sea, as at Spring Lake, New Jersey, or the salt marshes, as at Barnegat Pier and Somers Point, the trees become reduced in size. Here they become wind-swept and one-sided. One of the usual forms is the bisected tree, where one side fails to develop, owing to the action of the wind and the sand blast in removing the buds on the exposed side of the tree. Another is the bush, or shrub, form (sheaf tree), which produces freely a number of clustered stems, more or less wind-blown. At the edge of the pine forest near the sea, low, prostrate, wind-swept trees are found, their top branches inclined, arched, or bowed in a direction away from that of the prevailing wind. Enos A. Mills describes and illustrates such twisted trees in *Country Life in America* for January, 1920 (pp. 58-59). Such trees grow at timber line in the wind-swept regions of the Rocky Mountains and other mountains of the world. They are bent, battered, and lopsided. Sometimes where the conditions are unusually severe, they crouch down behind some protecting boulder.

Gardeners can alter the form of some trees at will by the use of the pruning shears. Trees thus trimmed into desired shapes lose their individuality and become architectual or sculptural elements, expressing the will of man. This is called topiary work. We have the best examples of such topiary work in Mr. Hunnewell's grounds at Wellesley, Massachusetts, and in England at Levens Hall and Elvaston Castle. There is a portrait at Levens Hall of M. Beaumont, professor of the topiary art to James II, who constructed the gardens under the direction of Colonel Graham. They seem to have been begun about the year 1701 and have the quaintest charm in the trim and grotesque shapes of the clipped trees, the result of the care and attention of the *topiarius*. "It is an ideal and grotesque world we enter. Fantastic forms rise in yew, strange and remarkable, as far as the eye can reach, a peacock here, a huge, umbrella-like construction there, an archway, a lion and a crown, a helmet bigger than any man could wear and a host of other such creations, all shaped out of the 'ductile yew,' except that some of the smaller adornments are in box."

It is important in studying the artistic anatomy of trees to examine the tracery of the ultimate branches and branchlets, in other words to investigate the spray. This can be done best during the winter months when the trees are in the leafless condition. It may be said in general that the mode of growth in the spray corresponds with that of the larger branches. We find in the oak that the spray breaks out at right angles, or nearly so, in a series of long and short shoots, giving an abrupt ramification for which the oak is characteristic and disposed so as to give the spray a flat, horizontal appearance. In the ash the spray runs in a series of irregular parallels, because of the opposite method of branching. The spray of the elm forms a series of acute angles with the parent branch, as the branchlets come off on alternate sides, and the result is a tree which is vase-like in its general form.

*Karsten, G. and Schenck, H.: *Die Vegetationsbilder*, 3te Reihe, Heft 5, Tafeln 25 and 29, 1899.

A big white oak (*Quercus alba*) on the bank of Mantua Creek, N. J., in March. Circumference 19 feet, 6 inches

A nearer view of the same tree

The tracery of the beech against the sky line is exceptional, as the ultimate branches are divided up again and again into smaller branchlets, so that the tree has an airy gracefulness owing to the repeated subdivision of the branches into finer and finer twigs. These seem to blend with the background of the sky, especially if the sky be covered with fleecy clouds. Owing to the gray color of the twigs, the crown of the leafless tree has, seen against such a background, a hazy, misty, or nebulous appearance.

The Kentucky coffee tree stands at the other extreme, as far as its ultimate branches are concerned, for the whole branching system is open and the end-twigs are stiff and sturdy, not terminating in very fine subdivisions, as in the beech. The generic name *Gymnocladus* is expressive of the naked branches without a terminal bud and with very small lateral buds and destitute of smaller lateral twigs. The birch, when standing alone, has often an outline that is graceful and regular, for its smaller twigs are of a uniform thickness, either upright or weeping. The native dogwood (*Cornus florida*) with its rounded top has a characteristic manner of branching, for the ultimate branches are arranged in a cruciate fashion, four branches arising from the same point and spreading outwardly. Each twig of the cross is terminated by a flat, rounded bud covered with four silvered bud scales, which by growth become ultimately the attractive white bracts of the flowering period.

The twigs of the horse-chestnut are few and start without interlacement. The twigs are vertical, for they support the broad, compound leaves, and if the larger boughs are drooping, as they sometimes are, they invariably bend upward in a graceful curve at their extremities. The curves are in strong contrast to the sharp angles formed by the twigs. The circumference of the tree is greatest at half its height, and this is due to the fact that central branches spread to the longest distance away from the trunk.

The homely charm of an apple orchard appeals to most nature lovers. The topmost boughs of the apple tree grow out horizontally, thus bringing about the flattening of its crown. The branches diverge in a curious, zigzag fashion. Where the forks remain intact, they mark a stage in gradation from bough to branch and from branch to twig, but where the fork has been mutilated, there is an abrupt change from greater branch to lesser branch. These twists and unexpected angles are conspicuous, because the line of the vigorous new shoot is normally simple and upright.

Our account of the macroscopic (naked eye) anatomy of trees might be carried to the more intimate details, such as the leaf scars, lenticels, and dormant buds, the examination of which is aided materially by magnification with a hand lens. Recently several exhaustive works have appeared on this phase of botanical study. By it one is able to identify shrubs and trees in their leafless and flowerless condition. During the winter months, profitable field excursions can be made to gather and compare the different kinds of buds formed by our cultivated and native shrubs and trees, and if this study is prolonged into the spring months, the bursting of the buds, the development of leaves, and the opening of the flowers become a fascinating investigation.

A word should be said in closing regarding the planting of trees with a view to securing the most pleasing effects. The beauty of a group of trees does not consist in numbers, nor in placing together in a group trees of a great many different kinds. Rather there should be a studied attempt so to plant the trees that the reason for their growth at each particular spot in the plantation is self-evident. They must be related to contour lines of hills and valleys and disposed with reference to the rivers, lakes, rocks, pathways and roadways, houses and outbuildings of a place to produce a unification of the design. The trees may be

Umbrella catalpa (*Catalpa bignonioides nana*) at Allenhurst, N. J., in August

Wind-swept red cedar (*Juniperus virginiana*) on the lawn of a house in Allenhurst, N. J. Photographed in August planted to produce the beautiful and the picturesque. The trees of a lawn, in order to keep their natural shape, must be protected against cattle, for soon browsing lines are found, which will efface the beauty of many fine lawn trees. "Clean, smooth stems, fresh and tender bark, and a softly rounded, pyramidal, or drooping head, are characteristic of a beautiful tree."

Round-headed trees are appropriate for introduction in highly cultivated scenery. They are not suitable for groups if used to the exclusion of other trees. Spire-shaped trees should not be planted in large tracts or masses, because of their monotonous appearance. Their general expression is spirited when planted singly or when scattered. They produce the most desirable effect among rocks and on very irregular surfaces, and especially on steep, rocky slopes. They may, however, be used to advantage elsewhere. A tall larch or two, or a few spruces rising out of the center of a group, give it life and spirit and add greatly both by contrast of form and color to the force of round-headed trees. Drooping trees, if mixed with other trees, lose their individuality. They show to advantage at the borders of groups or along the boundaries of plantations. Occasionally, a weeping beech, or a weeping spruce, may be planted on a lawn near the entrance lodge of a fine demesne with satisfactory result.

The distinctive shapes of trees, given emphasis against a background of clear sky or softly blending with it as the clouds gather or the evening light grows dim, are an unfailing source of inspiration to those who have the artistic sense.

Root system of a white oak (*Quercus alba*) photographed in early November along the road bank at Ithan, Pa.

YOUNG FAIRY TERN

Perched upon a nest of the lesser noddy (*Megalopterus melanogenys*) this young fairy tern (*Leucanous albus*), unable to fly, sat quietly while I took its picture. Adult fairy terns are pure white, and are frequently seen a hundred miles away from their island homes, fishing with sooty terns on the open ocean

VISITING THE NESTS OF SEABIRDS BY AUTOMOBILE[1]

BY

ROLLO H. BECK*

WE WERE located in Papeete, the well-known Tahitian port in the South Pacific, where we purposed beginning a study of the bird life of the numerous islands that are sprinkled over the map of that portion of the earth's surface. Our first intention was to work the nearby islands of the Society group, but after Tahiti itself had been partly explored, we heard that the trading schooner "Moana" had been chartered to go up to Christmas Island, some twelve hundred miles to the northwest from Papeete, to carry supplies to the forty-odd Tahitian natives who, under a French manager, are engaged in extending the miles of coconut groves that are being developed there and in making copra. This news altered our plans. I called on the head of the company that leases Christmas Island and secured his permission to collect any birds that we might want. In addition he generously told us to make use of his residence on the island and of any equipment it contained, to the inclusion of the automobiles. Automobiling to the nests of seabirds gave promise of a new experience. I was fortunate, too, in being able to arrange with the owners of the "Moana" to have the vessel linger at the island a few days longer than the four that would answer for the discharge of the company's business.

Some days later we started on the two months' trip by way of the Marquesas Islands, where a part of the cargo was to be landed and a portion of the inward cargo loaded. Our first view of Christmas Island was of two or three little sand hills in the distance, and was obtained several hours after we should have been at the center of the island according to the morning observation of the captain. Discounting the astronomical calculation, we were sailing along to the westward, knowing by the increasing number of seabirds that we were heading in the right direction and by the noon observation of the sun that we must be very nearly in the latitude of the center of the island, the unknown strength and set of the current being a factor, however, that might divert us to the northward or to the south.

The westward trend of the long shore line led us at first to think that we were sailing along the northern coast but just before dark the mate climbed to the masthead and reported land ahead and on the starboard bow; we knew then that we were sailing into the dangerous bight on the eastern side of the island. On account of the strong current on this side a sailing vessel in a light wind has little chance of beating out of this bay, into which it may have headed inadvertently, for the entrance is wide and the low coast, but a few feet above sea level, is visible for only a short distance. We trimmed sails and started the motor, heading out to the north northwest and the next morning after navigating south southeast a few hours, we picked up the land again and sailed into the anchorage where the famous navigator Captain Cook first dropped an anchor on Christmas day, 1777.

We were rowed ashore the morning after our arrival at six o'clock and, as we landed at the wharf, found the island Ford and a dark-skinned chauffeur awaiting our pleasure. Primarily we were bound for a pond where migratory ducks sometimes stopped but really we were out for a day's collecting trip in a style that left nothing to be desired. On other tropical islands I had collected several of the species of birds we were to

[1]Article and illustrations copyrighted by Rollo H. Beck, October, 1921.

*Leader, Whitney South Sea Expedition.

see but never had my field work been carried on in the *de luxe* manner that this trip afforded. Red-footed boobies, *Sula piscator*, I had visited on the Revilla Gigedos Islands off Mexico, after climbing through cactus and thick grass to the plateau on which they were nesting; blue-faced boobies, *Sula dactylatra*, had darted their yellow beaks at me from more than one of the dark lava cliffs of the Galapagos Islands off Ecuador; as for the piratical frigates, or man-of-war birds, a species of *Fregata*, their aërial evolutions had interested me around Cocos Island, famed for its pirates' treasure, as much as their amorous performances had amused me on various other Pacific and West Indian islands. Sooty terns, *Sterna fuscata*, to the number of thousands, I had seen on lonely Clipperton Island, which lies so far southwest of the coast of Mexico that the customs officials at Acapulco, where we once called to put ashore two guardians of the phosphate company's property on the now deserted atoll, knew not of its dependency to their own republic!

To see all of these, however, from the front seat of the ubiquitous Ford in the course of a morning's drive was a thing I had not anticipated when starting for the island a month before. As little did I dream, years previous, when tramping wearily over the tundra along the shore of Bering Sea in Alaska, trying to collect a few specimens of the bristle-thighed curlew, or following the far-reaching whistle of the golden plover in a vain search for the whistler's nest in that same northern region, that I would one day sit comfortably in an automobile and collect the same birds while driving along a tropical speedway with boobies and frigate birds calling out their harsh or gurgling greetings as we passed their bulky nests along the roadside—but so it was.

A short stretch of elevated coral rock near the settlement had to be paved and the handiest material happened to be coconut leaves. At low speed the Ford went along over this piece of road very handily and after that it was good going nearly the whole distance of twenty miles or more; though at one or two isthmus crossings the sharp coral rock looked dangerous for tires, the new casings we had brought from Papeete were affected but little by the trip.

For a couple of miles after leaving London, the port settlement, the road winds in and out through the long series of coconut groves, and the marvelous skill of the chauffeur in dodging the large fallen coconuts which dotted the roadway gave constant cause for thankfulness on my part. The smaller nuts, when hit, were usually struck a glancing blow that rolled them to one side—and how the land crabs scurried! Many of the crustaceans, at the approach of the machine, dodged into holes or out of the narrow track without pausing, but occasionally one would stop to raise his threatening claws as the rushing car drew near and this show of defiance would delay him long enough in the wheel rut to endanger his life or at least to put a few legs in jeopardy.

At the last clump of coconut trees the car stopped and the chauffeur, getting out, climbed a leaning tree to drop a dozen nuts, the milk of which would quench our thirst during the day. Then, after descending, with a sharpened stick that protruded from the ground he rapidly stripped the husks from the nuts and we went on our way.

A half mile to our left was a great, sooty tern rookery with hundreds of birds circling above it and over our heads and from all directions terns were flying to or from the colony. The young birds were just hatched and as we walked through the tract, they sought shelter under every grass root and bunch of sticks that littered their nesting ground. Many of the nests were in patches of straggly shrubs about five feet high and to rise out of these was often a difficult task for the parent birds. As I made my way along a narrow path through the colony, a flapping flock of birds would precede me, strongly reminding me of a like experience when walking through the dense colony of rockhopper penguins on Cuchon Island, one of the Falkland group in the South Atlantic.

From the coconut groves our road led to the southward over a level plain sprinkled with low bushes; trees grew here and there. Had our trip been for game birds only, we would have had good shooting at the golden plover that rose, often within easy range, on either side of the car, but being in search of larger and rarer material, we were content with a half dozen bristle-thighed curlew, which, after being skinned for specimens, served as the principal dish for the next day's dinner. It is believed that these birds, which were first described from Tahiti, nest in Alaska and migrate over the thousands of miles that separate Alaska from their winter home in Polynesia. On the other hand, the Hudsonian curlew, which also nests in Alaska, keeps to the mainland in its southern flight and during the winter time is found commonly in California.

We often encountered red-footed boobies sitting on their bulky nests of dry sticks and at last selected a nest, low down, to photograph. In some cases we found the boobies sitting on empty nests but usually eggs, and in rare instance young birds, were present.

In the lower bushes, sometimes but a foot or two above the ground, we would occasionally sight the loosely built nests of the frigate birds and several times passed shrubs with three or four of the red-pouched males sitting with extended wings and heads pointed skyward toward some soaring female that might be called to closer approach by the grotesque spectacle. When fully distended, the pouches resemble in size and color the toy balloons so desired by little children and when a bird was driven

Sitting quietly on nests in the bushy trees of Christmas Island, the red-footed boobies (*Sula piscator*) would often be passed unseen. If they happened to be facing directly toward the passerby, however, their white breasts would usually reveal their presence among the leaves

Usually the red-footed boobies fly when confronted by a human visitor, but sometimes they continue to sit closely, and rely upon their strong, sharp bills to repel intruders

from his perch with his pouch full of air, he often found it difficult to carry the load properly and would sway and turn all sorts of ways to maintain his balance. Males seemed greatly to outnumber the females at this place and when a bird, male or female, was scared from its nest, as likely as not a strange male would swoop down from above and settle contentedly on the egg while the rightful owner made vicious lunges at the intruder though without success in dislodging him.

At one place in the roadway we came to a blue-faced booby (*Sula dactylatra*) sitting on its two eggs. This species, while usually laying two eggs and hatching them, never, in my observation of dozens of nests, brings more than one of the young to maturity. I have on two or three occasions seen the older and stronger of two downy birds in a nest pecking away at its younger companion and believe that on account of its advantage in age it is able to drive the younger bird from the nest and thus secure for itself all of the food brought by the parents.

As a rule these birds nest near the shore but, in addition to nests so located, we saw two or three during the day near the center of the island, with one or both of the snowy-plumaged owners sitting or standing near by. This species and a black-headed relative in another part of the island always place their nests in a slight hollow in the ground while the red-footed booby selects a bush or tree in which to build its rough nest. The chauffeur drove the car within a few feet of sitting birds of the three nesting species and I took pictures of all three as a reminder of a unique collecting trip.

After crossing one rocky piece of road a puncture occurred, and while the chauffeur was replacing the tire, we walked on ahead and routed out from a thick bush a large black cat, the descendant probably of some tabby from one of the several ships wrecked on the eastern shore of the island. A shot as it sneaked away through the bushes saved the lives of some of the island birds. The cat may have found food, too, among the abundant crab population that flourished everywhere.

About eleven o'clock we stopped in the shade of a small, isolated group of coconut trees near which the ducks were supposed to be, but not finding them, we waded out, over a narrow isthmus covered with two feet of water, to an islet in the lagoon and there came upon numerous nests of a species of shearwater under little tufts of grass, which grew at one end of the island. Eggs as well as downy young were found and sometimes pairs of birds sitting in little hollows sheltered by the grass from the sun's rays; circling over the island were more of the birds, differing in this respect from many species of their family which only visit their nests at night, remaining miles away at sea during the daytime.

The young, when nearly ready to fly, are very fat and are taken for the grease that their bodies yield—eight birds producing a kilo of excellent grease for cooking, I was told at the settlement. The tender flesh of the young is esteemed by all the natives; in fact, we found the flesh of the old birds quite palatable, for one evening on shipboard some of the bodies skinned for specimens were served for dinner and no one refused the second helping.

The Christmas Island shearwater (*Puffinus nativitatis*) which, like all its kind, lays but one egg, frequently nests under dead coconut leaves. In the absence of coconuts it seeks shelter from the tropical sun under dense grass or shrubs

The short-billed petrel (*Æstrelata parvirostris*) a common bird at Christmas Island, selects nesting sites similar to those of its neighbor, the shearwater. This bird chose a young coconut as a shelter from the sun's rays while incubating

We did not sample the tough old boobies, several of which were shot at sea as they flew across the bow and were picked up with a net as we sailed along, but when we reached the island, the young ones were highly recommended to us and one of several gawky, immature birds we saw in a pen at the settlement was presented to us later on in the shape of a pâté as the first course of our Sunday dinner. This bird, prepared by the lady of the house in her French style, was as fine a dish as could be desired, both the captain and I agreeing it excelled the tinned meat of fancy name we had with coffee each morning.

On a point of the island where the shearwaters were nesting we shot a ruddy turnstone, a bird common on the Atlantic seaboard of America but much rarer on the Pacific coast of America, where it is replaced by the black turnstone, a near relative. A few of the turnstones evidently join the flight of golden plover, wandering tattlers, and bristle-thighed curlew that wing their way to the widely scattered islands of the Pacific Ocean in order to sojourn there while winter obtains in the Northern Hemisphere, for I saw three or four others during our stay at Christmas Island.

That some species of birds, at least, have a sense of direction far superior to that of man seems certain when one watches them at sea off their nesting grounds. Sooty terns from the Marquesas, Christmas, and Starbuck islands, to cite examples that I have been watching within the last month, range regularly one hundred fifty miles from their nesting colonies. The two islands last mentioned are but a few feet above the surface of the sea and hardly visible for more than twenty miles to fishing birds. Although probably less than half the birds do their fishing at a distance of more than twenty miles from their nests, the fact that we can see flocks of from ten to three hundred birds so engaged one hundred miles or more from an island shows that a reasonable flying distance from home presents no obstacle. That the darkness of night has no perceptible effect on their goings and comings is evidenced by their creaking cries, which one can hear at night as they pass the ship, whether one be far at sea or anchored but a few miles from their nesting grounds. Even dense fog, drizzly rain, and darkness combined do not prevent seabirds from finding their nests as is proved by the fact that several kinds of petrels and shearwaters select dense forests on high oceanic islands in which to dig their burrows and then go to them only at night.

The turnstones, tattlers, plover, and curlew that visit the islands of the Pacific Ocean must cross nearly two thousand miles of water before being able to alight on land, and present an interesting question to students of migration. Could one trap and mark one hundred or two hundred birds on an island and then trap a goodly number of the marked birds on the same island the following season, after their return flight from Alaska, it would clear up one or two disputed points in regard to migratory habits.

On our return trip in the afternoon over the morning's route we observed many more birds in the air than we saw in the forenoon. The young red-footed boobies and frigate birds particularly seemed to enjoy watching us travel along, and certain oddly marked birds could be singled out as they circled and sailed around us for several miles and swooped in their flight, finally winging their way back to their roosting places.

Sooty terns, the flight of which at our noon camp had borne off to the southeast, indicating another colony in that direction, changed their course as we approached the north end and headed northeast to the great colony which extended for nearly two miles at the northeast corner of the island. Curlew and plover were flying in small flocks to other feeding grounds along the lagoon shore and as we passed the tern colony and entered the coconut grove, birds were flying everywhere, the greater number being sooty terns, thousands of which were still circling over their nests with continual additions to the throng from those returning from sea. A mile to the eastward scores of boobies and frigate birds could be distinguished circling over the low bushes in which their nests were placed.

Slowing down as we neared the settlement with its pavement of coconut leaves, we noted a little kokikoko, *Conopoderas æquinoctialis* (a warbler-like bird, the only land bird on this island), flit from its perch and fly across the road to a clump of bushes, where a couple of old nests could be seen among the withered leaves in the center of the thicket.

This completed the list of birds and nests observed that day, but two days later we took a sailboat and went to one of several small islets in the lagoon, where the nesting birds were principally under the bushes, grass, or dead coconut leaves. On the islet we saw many nests of the handsome red-tailed tropic bird, the two central tail feathers of which are in such demand for decorative purposes by milliners. The taking of these two feathers from the bird has none of the ill effects on this species that in years past attended the securing of birds' plumage for the headgear of ladies in the United States; it is as simple and harmless a process as going out by candlelight and pulling the two longest tail feathers out of the family rooster. In the case of the tropic bird the victim is on the ground, and if asleep, as is frequently the case, the collector walks up and with a sudden pull removes the two feathers. The bird will probably open its eyes and then, as the collector walks on, close them again and go to sleep. If awake, the bird may cackle a bit as the collector approaches, and cackle again as he maneuvers for a position out of reach of the bird's bill, which is long, pointed, and extremely sharp at the cutting edge.

In many parts of its wide range the noddy tern (*Anous stolidus*) nests on cliffs along the seashore, but on Christmas Island the single egg is usually laid on the sandy soil under a shady tree or shrub

Dangling a red bandanna handkerchief in front of the bird with one hand and dexterously extracting the feathers with the other, I found to be a very efficient method in the two or three cases where the soiled breast feathers made the birds undesirable as specimens. The manager of the company said the easiest method is to pin the bird's head to the ground with a forked stick while plucking the feathers, but I think the average American Audubonist would concede that, theoretically at least, less liability of hurting the bird's sense of dignity—though his sense of feeling would be equally affected by either method—would be incurred through the dangled bandanna.

As to leaving the nest when a man comes near, whether the bird be sitting on an egg or merely retaining ownership of the nesting spot, that is a thing it never considers, evidently believing its snapping bill to be as efficacious in driving the human intruder away as it is in forcing the retreat of the heavy clawed land

Sooty terns (*Sterna fuscata*) remained with their newly hatched young even when the Graflex was pointed at them in plain view. Unlike many land birds they do not trouble to remove the egg shell from the vicinity of the nest after the chick has hatched

The handsome red-tailed tropic bird (*Phaëthon rubricaudus*) lays a single, heavily marked egg under some shrub or tree, where it sits sleeping during a good part of the period of incubation. If this photograph is examined closely, the long central tail feathers of the bird can be seen crabs that are its only other source of annoyance on the lonely isle.

Just what revenue is derived from the feathers I did not learn, but that the birds are protected as a valuable asset by the lessees of the island is evidenced by the fact that the laborers are charged five francs for each feather the manager finds them surreptitiously purloining. On this little islet, which was called Motu Tabu, meaning forbidden island, the feathers of the tropic birds and young shearwaters were the two valuable articles produced, both of them being gathered by the manager, the feathers for sale and the shearwaters for food and grease. Of the shearwaters there were three kinds nesting within a few feet of one another, and at a certain spot near by we found another member of the family, a smaller petrel, making four of the tube-nosed birds breeding within a radius of twenty feet,—a closer juxtaposition of nesting species of the same family than I remember seeing elsewhere. I noticed, however, that on the same islet, containing perhaps three acres, there had nested earlier in the season four species of terns,—two of these in the same trees, a third under the trees, while distant only a few yards under the clumps of grass the fourth, a beautiful little gray tern, laid its single egg. On Cooks Island in another part of the lagoon three other species nest, making seven kinds of terns that can be observed in one day, and I am not sure that they do not all nest upon Cooks Island alone.

To a bird lover Christmas Island offers an unusual opportunity for the study of nesting habits of rare shearwaters and petrels, but as a schooner calls but once or twice a year, few will care to make the trip. We spent eight days at the island and regretted that circumstances would permit us to stay no longer for, though I have seen many colonies of seabirds and expect to see a few more before leaving this part of the Pacific, I do not expect again to ride to the birds in their rookeries in an automobile.

Photographing an unperturbed blue-faced booby (*Sula dactyatra*) at close range

IROQUOIS WOMAN POUNDING MAIZE INTO MEAL
Photograph showing elements of a group on exhibition in the American Museum

INDIAN CORN OR MAIZE

BY

CHARLES W. MEAD

INDIAN corn or maize (*Zea Mays* Linnæus) belongs in the long list of foods, fruit, and medicines that were unknown in Europe before 1492. Mention of a few items from this list makes one realize something of the magnitude of the contribution which North and South America have made to the world in the form of agricultural products and their derivatives. Potatoes, sweet potatoes, tomato, manioc (tapioca), cacao (chocolate and cocoa), pineapple, cocaine, quinine, and tobacco constitute a part of this contribution.

After the discovery of America by Columbus maize quickly spread to other parts of the world, and today it is in the foremost rank of the world's foods.

The exact location of its origin is uncertain. It has usually been ascribed to the highlands of Peru; but some recent studies indicate that it may have developed from wild grasses in the Maya region of Central America, or according to others in southern Mexico.

In prehistoric times the regions of the most intensive cultivation of corn were the eastern half of the United States and the West Indies, the region of the cliff dwellers in the Southwest, down through Mexico and Central America into South America, where it extended well into southern Chile.

Most prehistoric peoples buried food with their dead, and such of their belongings as it was thought would be useful to them in a future life. Their burial places, many centuries old, yield our collectors a great variety of corn. This is particularly true in the case of Peru, where in a large part of the country the soil and climate are very favorable to its preservation. The Peruvian collections in the American Museum contain nine or ten different varieties, and so far as outward appearance goes, many of the ears might belong with last year's crop. I am often asked if I have ever planted this corn. There is a wide-spread belief that although it is one thousand years old or more, it will germinate and grow. One has but to prick one of the fairest kernels with a pin and shake it to have the contents come out in fine dust. The germ is gone. Imagine a salesman telling a farmer, a prospective customer, that the seed corn he is offering him is a thousand years old.[1]

In no part of America was anything in the nature of a plow used. Various forms of pointed sticks, sometimes sticks with broad blades, prepared the ground for the seed. In the western parts of both North and South America the stick was usually provided with a foot rest for driving it into the earth. In the northwestern section of Peru a sort of spade was common, consisting of a heavy, chisel-like blade of copper with a socket into which the stick was forced.

East of the Mississippi a hole was dug, and a few grains of corn were placed in it and covered with fine earth. Later a hoe was used to draw the dirt up around the young plants, resulting in "hills" of corn. These hoes resemble an adz with a blade of wood, stone, antler, or bone. Although various animal manures were used, the most wide-spread custom was to place small fish in the hill with the seed, and along the New England coast the alewife or herring was kind enough to arrive just in time to be planted with the corn.

The newcomers soon learned that the young maize plants grew better if the earth was banked up around them (hilled), and the Atlantic colonies took over the Indian hoe together with the entire maize complex. When the seed was introduced into the Old World, the cultivation was carried on in conformity with the methods prevailing there.

Irrigation on a large scale existed only

[1]In this connection the reader is referred to a note regarding "mummy wheat" on p. 436 of this issue.

in Mexico and Peru. The Peruvians irrigated their fields by means of aqueducts from rivers at a considerable distance. These ancient works show such engineering skill that they excited the wonder and admiration of all the early chroniclers. One of the best preserved is near Chimbote on the northern coast. The region surrounding the extensive ruins is barren and desolate. The ancient population irrigated it by means of an aqueduct from the River Santa, sixteen miles distant. The greater part of this fine work still exists and it is computed that it has a capacity of supplying sixty million cubic feet of water daily.

The milling of corn by primitive methods was a slow and laborious process and occupied a large part of the time of the women. One method of reducing it to meal was common everywhere, that of grinding between two stones. The shelled corn was placed on a flat stone. The woman knelt beside it with a stone muller, held in both hands, which she forced forward and backward over the grain until it was reduced to the required degree of fineness. The other common method was by mortar and pestle. An ingenious device found only in Peru and Bolivia consists of a flat stone upon which the corn was placed and a large, heavy, flat stone which had been rounded on its grinding edge. The grinding edge was set on the corn and the work done by simply rocking the stone back and forth. This method requires much less expenditure of strength than when the metate and hand stone are used.

Mr. A. F. Bandelier, while collecting in Bolivia for the American Museum, excavated such a mill from a prehistoric burial place. Mrs. Bandelier, who accompanied him, tried the experiment of grinding some coffee with it. She found that it did the work so well and with so little exertion on her part that for some

Metate and hand stone

In Peru and Bolivia this ingenious grinding device is used

months she used it every day to grind their morning coffee.

Our eastern Indians frequently employed a wooden mortar and pestle. For the mortar they took a section of a tree trunk about two feet long and about twenty inches in diameter. The hollow in the upper end was produced by burning. A small fire was made in the center, and after it had eaten its way to a depth of half an inch or so, it was brushed off, the charred wood was scraped out, and another fire was kindled. This continued until the mortar was ready for use. Some tribes did not use the upright mortar, but instead burned the depression in the log as it lay on the ground. The pestle was generally about four feet long, roughly cylindrical, and much smaller in the middle where it was grasped by the hands. It was made of hard wood and the object of having the ends so much larger than the middle was to give it sufficient weight to crush the corn.

The early colonists have described in detail numerous ways in which the Indians prepared maize for food. I have taken the following recipes from the *New York State Museum Bulletin*, No. 144, by Arthur C. Parker. So many authorities, and their opinions of each dish, are cited by Mr. Parker, that for want of space I have decided to omit them all, and to refer any one particularly interested in the subject to his very valuable work.

Leaf bread tamales. This dish was prepared from green corn. Kernels were cut or scraped from the cob and beaten to a milky paste in a mortar. The paste was patted into shape and laid in a strip on one end of a broad corn leaf, the free half of which was then doubled over the paste. Thereupon it was covered with other leaves, tied, and dropped into boiling water. When ready, it was eaten with sunflower or bear oil.

Baked green corn. Corn scraped from the cob was beaten to a paste in a mortar. The paste was put into a vessel and covered with leaves. Cold ashes were thrown over the leaves; a small fire was kindled under the vessel, and glowing charcoal placed on the ashes at the top.

Boiled green corn. This is simply corn on the cob familiar to us all.

Succotash. This was made much as it is at the present time. Corn cut or scraped from the cob was thrown into a pot of beans which had been nearly cooked, and the two ingredients were then cooked together. Salt and grease or oil were added. In certain parts of New England hulled corn has been called succotash.

Boiled corn bread. The corn was first boiled from fifteen to thirty minutes in a weak solution of lye made of hardwood ashes, until the hulls and outer skins were loosened and the corn looked white and swollen. Thereupon it was thoroughly rinsed to free it from any trace of lye. Large loaves were made and plunged into boiling water, and cooked for nearly an hour. Sometimes such a loaf was baked in hot ashes, over which a roaring fire had been built.

Early bread. Before the corn was thoroughly dry in autumn it was plucked. The unhulled corn was mixed with water and beaten in a mortar into a paste. Loaves were molded by hand and boiled. This bread was especially valued as a food for invalids.

Dumpling. A mass of corn meal was moistened with boiling water and quickly molded into cakes in the closed hand moistened in cold water. The dumplings were then dropped, one by one, into steaming water, and were boiled for half an hour. Dumplings were frequently cooked with boiling meats or game birds.

Hominy. For a family of five persons a quart of corn, four tablespoonfuls of water, and some white ashes were pounded in a mortar until the hulls began to come off easily. At this point the pounding of the pestle was quickened and ceased only when the corn had been broken into coarse pieces. The corn was then sifted by means of a basket used as a sieve. The hominy passed through and was put into a bowl; the residue of uncracked corn was pounded again. The mass was then tossed with a peculiar motion in a bowl or basket. This tossing caused the lighter chit to rise to the top, while the heavier portion stayed at the bottom. The hulls and chit were thrown out by hand or by the use of a fan made of a bird's wing. One part of the meal was mixed with eight parts of water, and boiled for two hours.

Hulled corn. This was made of some soft corn, treated as corn for bread. It was washed until free from skins and hulls, and then put in cold water and boiled for four hours, at the end of which time all of the kernels would have burst open. Small chunks of meat and fat were thrown in the boiling liquid and sometimes berries. Several canning companies now put up hulled corn under the name of entire hominy.

Samp. Corn was treated as for bread, except that it was not beaten so fine. Berries or meat were mixed and cooked with samp. Any variety of corn that would hull easily answered the purpose.

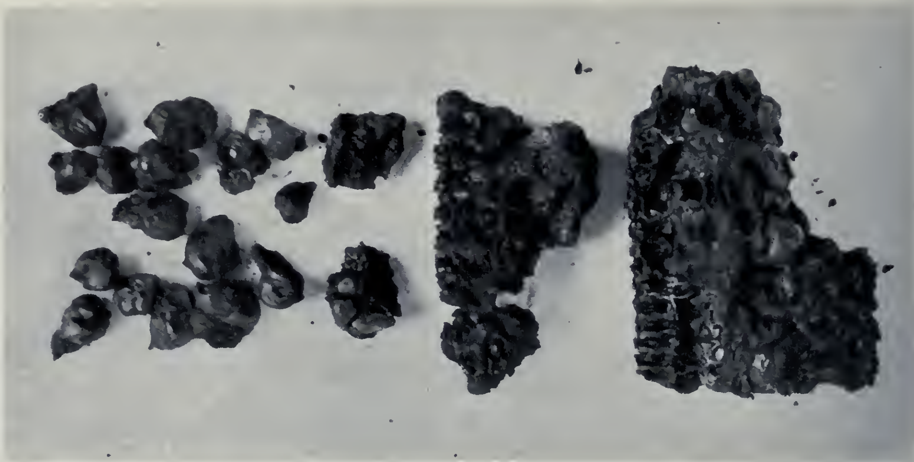
Reading these recipes brings to mind some of our familiar dishes. We now buy our corn ready ground, and cook with gas or electricity instead of by a fire in the open. The result, however, is much the same.

Corn furnished both victuals and drink to the early Peruvians. From it they made a kind of hard bread. A favorite way of preparing it was to parch it and reduce it to meal. This the Peruvians carried on journeys, in bags, and when hungry, they took a little of it with a swallow of water. These bags are often found in graves with the mummies. The present Peruvian Indians are as fond of this food as were their ancestors many centuries before the coming of Pizarro. Garcilasso de la Vega, the old Inca historian, tells us: "They make a kind of Hasty-Pudding called *Api*, which was a great dish amongst them, and which they ate with much delight: but this was esteemed high feeding, and was not common at every meal."

When Pizarro began the conquest of Peru (1532), the common drink of the country was a sort of beer made from maize. The grains were soaked in water until they sprouted. They were then ground, boiled, and stored away until fermentation set in. When the Peruvians wished to make a particularly fine brew, the kernels were chewed by the old women instead of being ground between two stones.

It is the testimony of the Pilgrim Fathers and those in the plantations in Maryland and Virginia that without maize their settlements would have ended in melancholy tragedies. Time and again corn supplied by their Indian neighbors saved them from starvation.

Corn from pre-Columbian grave in Peru



Charred corn from pit in prehistoric communal dwelling on mesa north of Los Alamos Cañon, New Mexico

CORN CULTURE AMONG THE INDIANS OF THE SOUTHWEST

BY

HENRY M. STEECE *

THERE are few growing things that have shown a greater adaptability to the varied conditions of soil and climate incident to a wide range than has corn. In the issue of NATURAL HISTORY for January, 1918, there appeared an article dealing with Mandan corn, grown in the Upper Missouri area. The present essay has to do with corn as grown in the arid Southwest, where the necessity of reaching soil that contains the requisite moisture has led not only to deep planting but to certain adaptations in the corn itself.

Because the Indian of the region is so dependent on the corn harvest, many religious ceremonies are connected directly or indirectly with this cereal. These observances for reasons of space are not considered in this article, the emphasis of which is on the agricultural phases of the subject.

—THE EDITOR.

AGRICULTURE was in a relatively high state of development when the Spanish explorers of the sixteenth century first came in contact with the natives of what is now our Southwest. The ruins of many ancient irrigation ditches, canals, and reservoirs indicate that an extensive area was under cultivation. That corn was widely grown is shown by the discovery of whole ears and cobs and grinding boxes made of stone slabs in the cliff dwellings of the Mesa Verde region of Colorado and the Cañon de Chelly in Arizona. The cavate lodges of the Pajarito plateau and the communal dwellings of the Puyé Mesa in the vicinity of the modern pueblo of Santa Clara, New Mexico, yield much evidence of the antiquity of corn culture in the upper Rio Grande region.

Castañeda of Coronado's expedition mentioned the finding of large quantities of corn in the Galisteo Valley stored in underground chambers. His attention was attracted to the method of corn culture and the grinding of the grain with the mano and metate, both of which differ but little from the practices of the present day. When Antonio Espejo penetrated the country in 1583, he found cornfields irrigated by the waters of the San José at Acomita, fourteen miles from the pueblo of Acoma.

Writing toward the middle of the seventeenth century, Alonzo de Benavides relates that the culture of maize by

* United States Department of Agriculture.

the Navajos was so extensive as to suggest the tribal name: "Apaches de Nauajò," *i. e.*, Apaches of great fields.

Corn and meal furnished excellent mediums for trade between the inhabitants of the different pueblos and the nomadic Apaches, Navajos, Utes, Kiowas, and Comanches. Men carried large quantities of meal on their backs far to the east, traveling for days until a band of hunters was encountered, when exchange was made for deer- and buffalo-hides. While exploring a railroad route to the Pacific in 1853, Lieut. A. W. Whipple met several parties of Pueblo Indian traders from Santo Domingo with burros heavily laden with corn meal. They had come as far east as the present Texas "panhandle," where they remained for nearly a week in search of the Kiowas and Comanches.

At the present day as in the time of the *conquistadores* corn and its cultivation assume a big place in the life of the Indian of the Southwest. Beans and squashes were also raised, but the Indian's chief food products consisted of corn. Maize was easily cultivated, yielded well, and was very nutritious; when dry, it was not injured by heat or cold. It could be preserved in a cache or cave for long periods, was easily gathered, and for food use required but little preparation.

The region occupied by the Pueblo and Navajo Indians in northwestern New Mexico and northeastern Arizona is a vast, arid table land ranging from five thousand to eight thousand feet in altitude, now and then broken by great mountains and wide cañons. With the exception of the Rio Grande, Rio Puerco, San Juan, San José, and Little Colorado, there are few streams furnishing water for irrigation. The precipitation of this section of the country ranges from ten to fifteen inches annually, July and August being the months of greatest rainfall, and the heaviest snows occurring in the winter months of December, January, and February.

The Indians are dependent on streams and washes for the water supply of the corn crop as the normal rainfall of the region is far too light to sustain the plants through the growing season. Where no stream of size is available, the Navajos, Hopis, and Zuñis select a sandy flat in the flood plain or wash of a large arroyo, cañon, or river, for the cornfields. The members of two or more affiliated clans will throw up earthen banks or borders to the height of two or three feet enclosing tracts about one and one half acres in area. A family often holds the same field year after year, indicating the boundaries with a fence, footpath, or heaps of stones. Ditches are constructed in such manner that when the floods of the melting mountain snows fill the arroyos, the water flows to the fields and the small tracts enclosed in the borders are completely immersed by the flood waters. The water penetrates the sandy soil to a depth of five or six feet, where it is held in reserve to supply the plants during the drought of May and June.

Where the Pueblo villages are situated near rivers as large as the Jemez, San José, or Rio Puerco, the water is conducted to the fields by means of rude systems of irrigation. During the spring months a plentiful supply is usually available, but at other times the flow of water is comparatively small. The Pueblo Indians, however, have made the most of their opportunities by combining their efforts and constructing dams of brush, stones, and mud to divert the water from the river into broad, shallow canals and thence to the field laterals, borders, and furrows. The fields, which vary in size from one half to two or three acres according to the land of the pueblo, the strength and importance of the clan, the number of individuals in the family, and the water supply, are flooded early in March or April, in order that the seed bed will be in good condition when the corn is planted.

The planting season begins about the

time of the emergence of the leaves of the cottonwood trees and the new grass, and under a waxing moon. When the Zuñi notices the new growth of the weed, *Hăsuski* (coyote-leaf; *Croton texensis*), he feels that the danger from a late frost is past and corn planting time is at hand.

The Indian now goes to the field, accompanied by his wife, who carries the

Hill of corn at Zuñi Pueblo, New Mexico. The clump included thirteen stalks and suckers

bag of seed corn carefully selected from the crop of last year. He has a straight branch of greasewood with one end slightly pointed, or a stick about three feet long, preferably a branch of piñon provided with a stub of a limb projecting out at a right angle from six to twelve inches above the point or blade. Selecting a spot near the border of the plot, he pushes his stick into the sandy soil to a depth of several inches, taking care to make but a small opening in order to preserve as much of the soil moisture as possible. His wife drops from ten to fifteen kernels into the hole, which she carefully closes and covers with a skillful movement of her foot. After the first hill is planted, the man takes two steps forward and repeats the process of planting and covering until the end of the patch is reached. He now determines the second row by taking a good, long step to the right or left of the first row and continues planting until the field is completed. By the use of this system of planting the hills are generally spaced about four or five feet apart and the rows about the same distance.

If the field is to be irrigated, the seed is not planted deeper than four or five inches, but, where the Indian depends on the summer rains for the next application of water, he will drop the corn at least a foot below the surface. Mr. Guy N. Collins found that the varieties grown by these Indians possess two special adaptations: "(1) A greatly elongated mesocotyl that permits deep planting and (2) the development of a single large radicle that rapidly descends to the moist subsoil and supplies water during the critical seedling stage."

When water is fairly plentiful during the growing season, the Indians use methods similar to those of the white man. In some localities the field is planted by using a pony plow to cut a slice eight inches wide and four or five in depth. Seed is dropped in every fifth furrow in hills about two steps apart and then covered by the next round of the plow. At Laguna and surrounding villages the fields are frequently barred off similar to the check rowing practiced in the corn belt; the hills are spaced about six feet apart throughout and with six or seven plants to the hill. The old method followed at Laguna provided for rows from seven to eight feet apart with the hills at intervals of four feet in the row, and from ten to fifteen plants to a hill.

In the past, ceremonies that were thought to bring increased yields were held in connection with the planting, but today corn fields are seldom planted in this way. Edward Becenti, a Navajo of Kaĭcháske near Tohatchi, New Mexico, informed the writer that in former years the farmers of his tribe often began the planting in the middle of the patch. The first few hills were laid out in the form of a constellation of stars called *Dıl-yĕ-hi* (the Pleiades). The remaining hills of the field were then planted from this group in all directions. Another Navajo ceremonial farm, *dăăkĕ′ nahasbâsi*, noted by the Franciscan Fathers at St. Michaels, Arizona, was planted in the form of a helix with the several rows wound sunwise. While the planter faced the east, the first hills were located in the center of the field, followed by others a step or two east, south, west, and north of the central hill in the order named. The second row was continued from the northern hill so as to encircle the five hills first planted, the men and women planting being careful to advance in succession, but never outside of the helical line once begun. The winding continued, increasing the periphery of each circle until the twelfth had been reached when the final hill was in an exact radial line with the eastern hill of the original five.

Soon after the corn germinates, the Pueblo Indian throws up earthen banks with the hoe or plow, dividing the field into small borders enclosing from three to six rows ten to sixteen hills in length. This division is very necessary to the economical use of water. In some of the southern villages water is applied soon after planting to hasten germination. Where the supply of water is limited, the corn is irrigated when the stalks are about one to two feet in height and again while tasseling. If water is plentiful, the Indian is apt to curtail his yield by over-irrigation. Flooding is the method usually followed in applying water, but the réal or furrow system is equally well known. In order to curtail the loss of moisture through baking and checking of the soil after irrigation, the Indian gives the field a rather crude cultivation before and after irrigation with a hoe fashioned from an old shovel. In some fields much of the labor of hoeing is eliminated by the use of the one-horse cultivator or the bull-tongue plow. Thinning is seldom practised by any of the Indians of this region as too many of the stalks are lost through cultivation, insects, and adverse weather conditions.

Agricultural implements of the natives of Laguna Pueblo. The hoes are fashioned from old shovels and provided with handles of piñon

Navajo corn fields receive but little attention after planting, although often three or four savage-looking scarecrows are left to defend the patches from the ravages of the crows. As the chief industry of the Navajo is herding his numerous flocks, he can spare little time for cultural operations in his corn. During the latter part of June a day is generally set for hoeing, and the family

The Heppatinna.—A Zuñi shrine in the midst of a large Indian cornfield. This structure is consecrated to the center of the earth over which spot it is supposed to stand

A Navajo's corn crop, Chin Lee, Arizona.—The Navajos cultivate an extensive area in the wash of the Rio de Chelly at the mouth of Cañon de Chelly and of Cañon de Muerto carefully removes the weeds from the corn patches. If the herds are small and good grazing is obtainable near the permanent home, more care is given the fields and the corn is hoed first when about two feet in height and again when beginning to tassel.

The American hoe is now used almost universally, but the Franciscan Fathers state that in the early days two types of wooden implements were very common. The "eitherside" hoe (*aǐtsā́ji be-hĕ́gŭdi*) was a straight hoe made by hewing down a piece of wood about a foot long to the thickness of one half inch, one end beveled on both sides, and a small hole provided at the center with a grip near the end. When in use, the hoe was grasped by the right hand so that the four fingers passed through the opening in the end and the thumb of the left hand through the smaller hole in the center. Taking a sitting position, the farmer scraped the hoe forward, cultivating within the radius of his reach. The "side-hoe" (*nābĕ́hegŭdi*), also made of wood, was used in a standing position with a scythe-like motion. It consisted of a curved blade to which a wooden handle was secured with a thong of elk. The handle was grasped in the left hand while the thumb and forefinger of the right hand were passed through a thong attached to the back of the blade.

Unlike the Navajo, the Hopi must spend much of his time in the field. Very soon after planting he keeps a close watch on the hills to make sure that the first leaflets are not cut by the blowing sand or injured by the grub worms. Where the fields are subject to a wide sweep of the winds, often a hedge of brush is built on the windward side of the patch to stop the sands, and sometimes the farmer places a stone or small pile of sticks by the side of each hill for protection.

Although insect pests are found in every Indian's cornfield, the yields are not greatly affected by their depredations. The cutworm and wireworm cause some damage while the stalks are yet small, but the farmer pulls the sand away from the hill and kills the trouble-makers with his heel. The corn-ear worm is ever present and is difficult to combat successfully. Often the Indian will tear open the husk of the ripening ear and crush the worms found within between his horny thumb and forefinger.

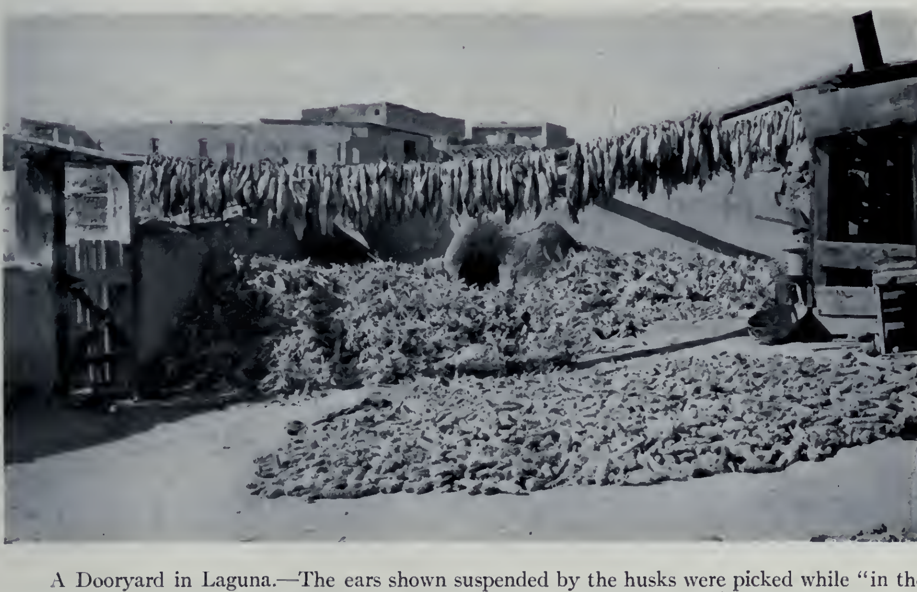
The Pueblo Indians gather the ripened crop during the period from September 25 to October 15 after the melons and squash have been taken. The governor of the village decides the date for the corn harvest, and in the conservative pueblos, such as Santo Domingo, San Felipe, Tesuque, Taos, and Nambé, his proclamation is obeyed. In the more enlightened communities—Laguna, Acomita, and Isleta—the individual owner removes the corn from the field when he considers it mature. The ears are "slip-shucked" (snapped from the stalk with the inner husks remaining adherent to the ear) into sacking aprons and bags by the men and hauled to the village in

Hopi Indian of the First Mesa demonstrating his method of corn planting. Polacca, Arizona

Laguna Indian husking corn into a sacking apron. This field was carefully cultivated and produced a good crop

Pima Granaries at Sacaton, Arizona.—Oat or wheat straw is woven into a coarse basketry in the form of a capacious chamber for the storage of corn and other grain. The walls and cap are fortified with adobe mud

Corn drying on the house tops at San Felipe Pueblo, New Mexico. When dry, the ears are carried below and stored



A Dooryard in Laguna.—The ears shown suspended by the husks were picked while "in the milk," and roasted, and are being dried in this manner for winter use. The dome-shaped structure in the background is the Pueblo oven, commonly used by the Indians and Mexicans in the Southwest

Field of Hopi corn and melons at the foot of the First Mesa, Polacca, Arizona. These crops were produced without irrigation

Exterior view of the Kiva of Sichumovi.—The kivas or estufas are underground rooms in which the secret fraternities hold their ceremonials. Note the corn piled about the entrance wagons with sides enclosed by cornstalks and branches of cottonwood. At the village the ears are piled in the plaza in front of the owner's dwelling or in his yard.

The corn is husked clean by men, women, and children, a family often helping their relatives after the work on their own crop is completed. The ears are sorted as to quality into several grades or lots, and the corn of different colors is kept separate as far as practicable. After husking, the ordinary ears are spread to dry on the roofs or platforms constructed of cottonwood poles and branches. In pueblos like Laguna and Isleta, having houses surrounded by yards enclosed with adobe fences, the ears are dried on the hard packed earth. This is not practicable in villages with few fences, such as San Felipe and San Juan, as the hogs that run at large would soon devour the season's crop. When the corn has dried in the open air, it is taken into the house and stacked in the storeroom in piles like cordwood, sorted as to color and quality.

While the husking is in progress, each person lays aside for seed such ears as meet his approval, leaving three or four of the husks attached. After all of the corn has been husked, the head of the house makes long braids of the seed ears of each color by weaving the husks left adhering. The color varieties of corn grown by the several Pueblo groups include the red, blue, yellow, white, black, and many-colored or variegated corn; also pink, dark red, blue-spotted, gray, and blackcap. Red, blue, yellow, white and black soft, and sweet corns have been noted in the fields of the Navajos. The braids, often containing as much as one hundred pounds of ears, are dried in the open air and then suspended from the beams of the ceiling or swung over a rope or wire in the storeroom.

The standards followed in seed selection are purity of color, large ears, and early maturity, ears with large kernels having the preference over those possessing smaller grains. Seed is often held over to the second spring on the supposition that the older seed possesses greater vitality than new seed. In some pueblos the older generation objects to the importation of seed corn from other pueblos and villages, feeling that the corn of a community is such an intimate part of their life that it should not be mixed. But in other pueblos, men will be found who make special efforts to secure seed from distant sources, claiming that the imported seed grows better and larger corn.

The Navajos follow practically the same methods during the harvest as do the other Indians of the region. The ears are snapped or "slip-shucked" in the fields and hauled to the corrals to be husked clean and dried. The best ears are separated and saved whole for seed, no particular standard beyond size and color being set. A good large ear with all of the kernels of the same color or evenly spotted and mottled seems to be the Navajo's ideal in seed selection. A few people braid the seed ears, although most seed is simply sacked for preservation. As soon as the poorest ears are dry, they are thrown on a wagon sheet, a few at a time, and the grain shelled with a large stick or club. Grain shelled in this manner is used largely for horse feed or for sale. The sound ears not required for seed are hand-shelled and sacked, and if the family is living in a cabin or adobe house, the sacks of grain are piled in the storeroom for future use. When living in tents or hogans, the Navajos often store shelled corn in underground pits (*nûkï*) or caches. These pits are holes of various sizes dug in the ground in the shape of a wicker bottle, lined with the inner bark of the cedar, and the opening roofed with cedar poles laid close together and covered with sticks, slabs of rock, and dirt to complete concealment. In the pits the grain remains sweet and free from mold for a long time.

After the husking is completed, the stalks in the field are cut with sickles, hoes, or axes, and the fodder hauled to the village or permanent dwelling and stacked on platforms over the corrals to be fed to the horses during the winter. Many of the Pueblos bring the whole stalks to the yards of the village for husking, especially where the fields are some distance from the homes. Many uses are found for the husks: for cigarettes, as binding material for the various ceremonial objects of the dances, and in much of the basketry. The Navajo frequently mixes the husks with mud and employs the plaster thus made in covering the walls and roof of his hogan. Cobs are used as fire lighters and as fuel when wood is hard to obtain.

Grain standing in the field and the ears retained for seed belong to the man, but as soon as the ears are husked, the ownership passes to the woman, who uses or sells the grain as she sees fit. She allows her husband such corn as he needs for his horses, but he must secure her permission before he can sell any or make presents of corn to strangers or needy persons. This custom is observed by the members of practically all of the tribes in the region.

Corn enters into the composition of so large a number of foods that a complete inventory of Indian cookery would be a difficult task. Mr. Walter Hough enumerates fifteen kinds of paper bread, three kinds of mush, five of shortcake, eleven of boiled corn, four kinds baked or roasted in the coals, two cooked by frying, four stewed, and eight of cooked shelled corn, making a total of fifty-two prepared by the Hopis alone. When one considers the great diversity of the corn preparations devised by the Indian as compared with our own few dishes, he readily sees that the white American has much to learn with regard to the use of this valuable cereal.

Courtesy of the U. S. National Museum

Hopi Bread Makers.—The two maidens, characterized by the dressing of the hair in whorls, are engaged in reducing to meal the ears of corn in the basket. The married woman in the corner mixes the meal with water and wood ashes, giving it a gray color, and whips the mixture to a thin batter. Her companion spreads the batter on the baking stone with a dexterous sweep of her hand. After baking a few moments, the *piki*, or "paper" bread, is removed and piled on the floor to dry. One writer has aptly said that in appearance it resembles "the material of a hornet's nest"

CONTRASTED METHODS OF TEACHING GEOGRAPHY

EVER since the remote days when Hecatæus of Miletus wrote his *Periodos* and thereby earned for himself the title of father of geography, the science that has to do with the phenomena of the earth's surface has proved a fascinating pursuit to mankind. When the blight of the Middle Ages fell upon scientific inquiry in Europe, the Arabs kept alive the spirit of learning, and among the translations that appeared in Arabic were the works of Ptolemy. With the coming of the Renaissance, geography re-emerged to take advantage of all that the era of discovery had to offer.

Geography links itself with many different interests. Its subdivisions, including mathematical, physical, political, historical, and commercial geography, indicate how many are its points of contact. It must accordingly hold an important place in any scheme of education.

The textbooks of half a century ago for the most part taught geography by rote. We open a typical geography of that period and on the first page encounter the following:

1. What is Geography?
   Ans. A description of the surface of the Earth.
2. What is the surface of the earth?
   Ans. It is the outside part.
3. How is the surface of the Earth divided?
   Ans. Into land and water.
4. How much of the earth's surface is land?
   Ans. About one-fourth.

Our eye glances down a subsequent page and stops at the question:

18. How is the Ocean divided?
    Ans. Into five great parts, likewise called Oceans.
19. Which are the five Oceans?
    Ans. They are the Northern, Southern, Atlantic, Pacific, and Indian Oceans.
20. What other names have some of the Oceans?
    Ans. The Northern is often called the Arctic, and the Southern, the Antarctic, and the Pacific Ocean is sometimes called the South Sea.
21. Into what other parts is the water divided?
    Ans. Into Seas, Archipelagoes, Bays, Gulfs, Sounds, Straits, Channels, Lakes, and Rivers.
21. What is a sea?

And so on through page after page.

The function of textbooks of this character was to hammer facts into often unreceptive crania. They did little to dispel the illusion that study is necessarily a task. They made slight attempt to engage the interest of the pupil; they asked questions instead of stimulating him to ask them. It is true that the conscientious pupil carried away with him an equipment of facts, but they were often facts that had sunk into his head because of their dead weight and not because their vividness flashed an ineffaceable picture on his mental vision.

The one advantage that can be claimed for the old-time methods is that the pupil acquired a more definite knowledge of the location of places and the boundaries and relations of countries to one another than he does under the more interesting methods of today.

A sharp departure from geographies of the old type is one entitled *Human Geography* by J. Russell Smith.[1] The child picking up this book will be fascinated by its story interest. Facts are not conveyed to him as disassociated frag-

[1] Professor Smith, who holds the chair of economic geography at Columbia University, has divided his *Human Geography* into two parts, which will be published successively by the Winston Co. of Philadelphia. Book I, entitled "Peoples and Countries," now in readiness, is to be followed at some time in the future by Book II, entitled "Regions and Trade."

ments but in a flowing narrative that brings before his eyes people and animals and plants from widely separated parts of the globe. The concrete replaces the abstract. The child is made to think rather than merely to memorize. Incidentally, be it said, for the illustrations that add interest to the pages of the book the author has drawn to some extent upon natural history material in the possession of the American Museum.

How little a map really means to a child! It is a mere symbol, without any clue to the physical features of the regions represented. The colored areas conjure up no picture. The Arctic snows may be represented by the same shade of pink as the verdure of the tropics. Dr. Smith makes us realize that there are distinctions. He invites his reader to step aboard an automobile at a designated place on the east coast and then heads for a destination on the west coast. You journey through the plains, cross rivers, climb mountains, traverse deserts. You see the changing country as you go. And after that, when you are asked to retrace the trip on the map, you supply what the map fails to reveal.

The author never neglects to keep within the range of comprehension of the pupil, moving always from the familiar to the less familiar. Perhaps the contrast between the two methods of teaching cannot be indicated more effectively than by printing below on the left of this page a citation from the textbook of fifty or more years ago, which attempts by question and answer to define latitude, and in juxtaposition to it on the right of the page Dr. Smith's way of stating the same thing.

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130. What is latitude?
A. It is distance from the Equator either north or south.

131. How is latitude divided?
A. Into north and south latitude. All countries situated north of the Equator, are in north latitude and those south of it, are in south latitude.

132. How is latitude represented on maps?
A. By lines drawn across the map from side to side. These are called parallels.

133. How is latitude numbered?
A. The numbers are marked on the sides of the map, at the ends of the lines of latitude.

134. How is latitude counted?
A. In degrees from the Equator toward the poles, from 1 to 90.

135. How can you distinguish be-

LATITUDE, LONGITUDE AND ZONES

31. **Telling Where Places Are.**—How do we tell someone where a house is located in a city? First we need a starting point of some kind. In the city of Washington this starting point is furnished by two streets which cross each other, one going east and west, and the other going north and south.

Name these streets. All that part of the city north of East Capitol Street and east of North Capitol Street is called the Northeast. The streets with number names run parallel to North Capitol, and the streets with letter names run parallel to East Capitol. The houses

tween north and south latitude?
A. If the numbers increase from the bottom toward the top of the Map, it is North Latitude; but if they increase from the top to the bottom, it is South Latitude.

136. On Map of the World, No. 1, Eastern Hemisphere. In what latitude is Europe?
A. N. Le.

137. In what latitude is Australia?
A. S. Le.

138. In what latitude is Africa?
A. Partly in N. and partly in S. Le.

139. In what latitude is Asia?
A. N. Le.

140. On the Western Hemisphere. In what latitude is North America?
A. N. Le.

141. In what latitude is South America?
A. N. Le. and S. Le.

142. What latitude have places on the Equator?
A. They have no latitude, for latitude begins on the Equator.

143. What is the latitude at the Poles.
A. It is 90 degrees, which is the full extent to which latitude is carried.

144. What is the meaning of the word latitude?
A. It means breadth; it was applied long ago to distances north and south, because the world was supposed to be much less in extent in that direction than from east to west.

145. Do the degrees of latitude vary in length?
A. They are nearly all alike, being about $69\frac{1}{4}$ miles each.

In consequence of the earth's being flattened at the poles, the degrees of latitude increase slightly in extent in going either north or south; but $69\frac{1}{4}$ miles is a fair average of their extent.

in the block from East Capitol Street to A Street have numbers below 100, those between A and B Streets have numbers beginning with 100, and so on, each block beginning with a new hundred. The same thing is true of the house numbers on the streets with letter names. Therefore a house numbered 220 Third Street, N.E., must be on Third Street between B and C. Thus we can locate a house in Washington by number, street, and section.

In much the same way we locate a city, a lake, or a river, that is, by giving its distance north or south from the equator and its distance east or west of some particular place.

32. **Latitude.**—If you look at the map you will see some lines running across the map. All parts of each line are the same distance from the equator. These are called *parallels* and are used as a means of telling how far a place is north or south of the equator. The distance from the equator to the North Pole or from the equator to the South Pole is divided into ninety equal parts, and each part is called a degree of latitude. A degree of latitude equals about seventy miles. Each parallel on the map marks a certain degree of latitude, or distance from the equator. Twenty degrees north latitude means twenty degrees north of the equator. Twenty degrees south latitude means twenty degrees south of the equator. How many miles north or south would that be?

Photograph by C. L. Dewey

CARL E. AKELEY

Sculptor, inventor, big game hunter, and explorer, photographed as he departed on his fourth expedition to Africa

CARL E. AKELEY AGAIN PENETRATES THE AFRICAN JUNGLE

THE VETERAN HUNTER OF BIG GAME, WHO VISIONED AND PLANNED THE PROPOSED ROOSEVELT AFRICAN HALL OF THE AMERICAN MUSEUM, IS STUDYING AND HUNTING THE GORILLA IN ITS NATIVE WILDS

BY

DOROTHY S. GREENE

IT IS only a few months since the country was surfeited with novels and plays which, though widely varied in plot, always reached the same terminus,—"And then came the War." The world of fiction, quick to sense the public's first irritation and fatigue, has shifted once more to scenes of normalcy and peace time. Unfortunately, however, it takes more than imagination, pen, and paper to replace the interrupted achievements of the world of reality on a pre-war basis. Many undertakings which were making long strides toward completion in 1914, today stand arrested by the force of circumstance, and only one by one can they fall back to their natural places in the march of progress. The more urgent must be given place first.

In 1914, Mr. Carl E. Akeley had laid before President Henry Fairfield Osborn and the Trustees of the American Museum his plan for a great African Hall which should give a comprehensive picture of the African fauna. Years of hunting and exploration in Africa, of modeling the wild animals as he saw them in the jungle, and of perfecting the art of taxidermy, made him the one man for whom such a conception was possible. The Trustees appreciated the opportunity and the plan had been immediately approved for execution as far as funds might be available. That work might be begun on the habitat groups intended for the new hall and that men might be trained to carry on the work, one of the old North American mammal halls, rechristened the "elephant studio," because Mr. Akeley had been engaged in mounting a group of elephants there since his return from Africa in 1911, was retained for his use. Here, to make his conception more concrete, Mr. Akeley had completed a model of the future African Hall.

This model represented a great unobstructed hall, 60 x 116 feet, in the center of which stood a statuesque group of four African elephants, flanked at one end by a group of black rhinos, at the other by a similar group of white rhinos. Both on the ground floor and in the gallery, with windows seeming to open upon them, were arranged habitat groups, of the African fauna with typical accessories and panoramic backgrounds. The long and arduous task of mounting the central elephant group had been begun but was interrupted when Mr. Akeley left his usual pursuits to add the service stripes of the Army to the service stripes of the jungle.

Now or never the African Hall must become a reality. Twenty-five years ago with innumerable specimens at hand, its development would have been an impossibility because methods of museum exhibition were far too crude. Twenty-five years hence it will be equally impossible. The inroads of modern civilization are bringing the Age of Mammals to a close in Africa, its last stronghold, and unless specimens for mounting are secured at once, they never will be.

It is for this reason that the expedition into the gorilla country which Mr. Akeley has just begun is of such immediate importance. Because of many characteristics similar to those of the human race, the gorilla is of especial interest for scientific research and for exhibition purposes, and this particular species of ape, always scarce and limited to a comparatively small area, is rapidly becoming extinct. If Mr. Akeley is able to secure specimens from which the life history of the gorilla can be studied and told in scientific records and in a habitat group, he will have performed another great service for science.

Entering Africa from Cape Town, Mr. Akeley and his party will travel west and north over three thousand miles into the Kivu country, the home of the gorillas. Although a very devious route, this long journey by rail through Bulawayo, Victoria Falls, and Katanga, by boat along the Lualaba River and into Lake Tanganyika, will be most advantageous in that it affords an opportunity for a general survey of South Africa and for the collection of data invaluable in the planning of the African Hall. An exact and detailed knowledge of African life in all phases is required for the execution of animal groups and also for the series of bas-relief panels in bronze which will be placed in a frieze above the floor groups and along the balcony to illustrate the life of the native tribes of Africa in their relations with wild and domestic animals. With the aid of a motion picture camera, which Mr. Akeley has designed especially for his work in the field and which facilitates wild animal photography, because it can be operated noiselessly and in dark places, he will be able to add greatly to the fund of information gathered on three previous African expeditions.

The Roosevelt African Hall,—for naturally and appropriately, since the death of the Trustee of the American Museum who was most interested in the preparation of African exhibits and who had himself shot one of the elephants for the central group, the proposed plan has come to be known as the Roosevelt African Hall,—is a project which will put in permanent and artistic form a complete record of fast disappearing animal life and give a comprehensive view of the topography of Africa. It is a project which will exemplify the life work of Mr. Akeley who combines the genius of the sculptor with the courage of the explorer and who has created an art which he still modestly calls "taxidermy." If this project can now be pushed forward as before the War and finally completed, the American Museum of Natural History will have set the standard for museum exhibitions of the future.

A model of the projected Roosevelt African Hall. The splendid elephant group flanked by rhinos illustrates Mr. Akeley's marvelous gift of representing the lifelike pose, the dash and ferocity of the creature of the jungle

"TERRITORY IN BIRD LIFE": A REVIEW[1]

Mr. H. Eliot Howard, who is already well known for his detailed studies on the life histories of the British warblers, has been devoting years of patient research and observation to an interpretation of many of the more obscure activities of common birds during that most important cycle in the events of the year—the period of reproduction. The result—proving conclusively that a painstaking worker with an original mind can take a seemingly well-worn subject and upon it cast new light—is a stimulating book in a much neglected field, the forerunner, let us hope, of many others.

It has long been conceded that during the breeding season a given pair of birds will assume rights over a certain territory and will drive away others of their kind. This holds true even when the species is highly gregarious during the winter. In contrast to these are other species of birds even more gregarious during the breeding season than during the winter, nesting in such densely packed colonies that the human observer is amazed that the individual can find its egg among so many thousands.

Such facts in the life histories of the common British birds are familiar for every species; nor does Mr. Howard claim to add anything to our knowledge of any particular species. What he does is to advance a theory, founded on careful observation, which accounts not only for the differences in the life histories of any two species, but also for any radical change of habit in a species at various seasons of the year. In his view "territory" is the key to successful reproduction. The chaffinch wanders in flocks over the country during the winter, a highly gregarious bird. Should this flock nest in a colony, the competition for food would be infinitely more severe, the parents would be forced to go farther afield in search of food, and the delicate young, which require constant brooding, during an absence of the parent might be fatally exposed to heat, cold, or rain. Consequently, the male, the first to feel the sexual impulse, leaves the flock late in winter, selects a territory where he is found almost continuously, and advertises his presence by his song, which begins at this time. He drives off other males and invites each female to remain until at length he secures a mate. The size of the territory which a species selects is in direct relation to the type of food which it requires and the abundance of that food. An acre is ample for a chaffinch; a few hundred yards along a river bank provides a kingfisher with sufficient minnows and shiners for his family; but a peregrine falcon requires many square miles of barren moor to insure an adequate supply of grouse and hares.

The guillemot is a good illustration of a colonial nesting species. Its habit of nesting on the ledges of cliffs well-nigh eliminates enemies which might destroy the young. Because such cliffs are few, every foot of available space must be utilized. A corollary is that the male requires no song to attract the female—she can only repair to the same cliff; hence, the species is practically voiceless. The young are not delicate or helpless at birth. They require but little brooding, do not have to be fed often, and the parents, therefore, have plenty of time to scatter over the neighboring ocean where there is an inexhaustible supply of food. There is no need, then, for a greater territory than a few square feet; in fact, should each pair appropriate an area twice as large, the number of breeding pairs of guillemots about Great Britain would be reduced by half.

It remains to add that the book is favorably printed, and the plates, depicting the combats of various species in defense of their territory, are by two artists of eminence and are up to their usual standard.

Ludlow Griscom.

[1]*Territory in Bird Life.* By H. Eliot Howard. With illustrations by G. E. Lodge and H. Grönwold. 8vo. pp. 301. New York, 1920. E. P. Dutton & Co.

NOTES

As Natural History goes to press announcement comes of the death on August 29, near Cornwall-on-Hudson, of the revered Honorary Curator of the Department of Mammalogy, Dr. Joel Asaph Allen, whose term of service in the American Museum, dating from May 1, 1885, exceeded in length that of any member of the present scientific staff.

To his keen intellectual application and unstinting devotion of time and effort are due in no small measure the prestige enjoyed by the departments of mammalogy and ornithology, which, at the time Dr. Allen joined the Museum and for many years thereafter, were embraced in a single department.

Up to the very end and notwithstanding severe strains on a physique none too strong, his virile mind retained its interest in natural things. In addition to his ardent work at the Museum, which included not only the responsibilities of his curatorship but also for many years the editorship of the scientific publications, he was for seven successive years (1883-90) the President of The American Ornithologists' Union, the founding of which in 1883 was due in part to his instigation. For twenty-seven years he was the editor of *The Auk*, the journal of this organization. He served for several years as Vice President of the New York Academy of Sciences and for a number of years as President of the Linnæan Society of New York.

Dr. Allen was a prodigiously prolific writer. A few years ago he compiled his bibliography, and the list of his writings, exclusive of hundreds of minor reviews and many unsigned editorial paragraphs, embraced more than 1400 titles.

At a meeting of the faculty of the American Museum, held on August 29, the following Resolution was adopted:

Resolved, That the members of the faculty of the American Museum of Natural History, learn with profound regret and sorrow of the death of their associate, Dr. Joel Asaph Allen, and wish to give expression to the affectionate regard which they had for him as a man, and of the high esteem in which he was held as a scientific associate. Coming to the Museum in the early period of its history as a research institution, for thirty-seven years Dr. Allen gave himself devotedly to his labors as curator and editor, rendering to the Museum and to science service of lasting and inestimable value.

Since the last issue of Natural History the following persons have been elected members of the American Museum:

Annual Members: Mrs. J. H. Burton; Miss Velma L. Lillie; Doctor Joseph B. Weighart; Captain Charles W. Halsey; Messrs. George R. M. Ewing, Alaquah Flood, B. B. Girden, A. Augustus Healy, and Walter Pels.

Associate Members: Mesdames P. P. Beals, Editha S. Campbell; the Misses Mateal Allen, Orpha Lorena App, Lydia M. La Boiteaux, Margaret Jane Schmidt, Lee Van Rossun; Doctors Leon Ashley Peek, M. W. Strealy, Lilian Welsh; Messrs. Frederick D. Ames, Orin S. Bacon, Jr., John T. Baker, Ed. T. Barden, James D. Black, Robert Larned Blackinton, W. L. Buckland, E. T. Cresson, Jr., Clifford Cronk, Grosvenor Ely, Charles F. Flory, J. Hase Mowrey, Emory W. Thurston, Louis Weber, and E. R. Wolcott.

President Henry Fairfield Osborn has recently received the following letters,—the one from Petrograd, informing him of his election to honorary membership in the Société Paléontologique de Russie, the other from Bologna, telling him of his election as a corresponding member of the Royal Accademia delle Scienze dell' Istituto di Bologna, Classe di Scienze Fisiche:

"It is with great satisfaction that I inform you, that the Russian Palæontological Society, founded in 1916, has elected you as honorary member on February 18, 1921.

I remain respectfully yours,
Nicholas Yakovlev.
President of the Society."

"The Section of Physical Sciences of this Royal Academy joins in testifying to the high and general esteem which you, illustrious Professor, have earned with your learning and your love for the development and advancement of the Sciences, and has, by unanimous vote, taken at the special meeting of the 17th instant, adorned its roster of Corresponding Members with your name.

Accept the official attestation of this act, which the Section extends to you through us in the attached diploma which we have the honor to send you with the desire and hope of receiving your frequent and learned communications.

On this first and appreciated occasion, we have pleasure in extending to you our greatest respect.

The Secretary, Ercole Giaismini — The President, G. Ruggi."

One of the most important desiderata of the American Museum, a specimen of the African shoebill stork, has been supplied through the courtesy and energy of Mr. Irving K. Taylor, who obtained a specimen during his visit to the Sudan district, Africa, in 1920-21.

This is the first specimen of this bird to reach the Museum and probably the only others in the United States are the four secured by the Roosevelt Expedition. The bird is confined to a limited part of the Sudan and Congo region, is quite rare, and is protected in the greater part of its habitat. We hope to give an illustration of this specimen as soon as it is mounted. It is a bird of somewhat doubtful affinities, being considered by some as a stork-like heron and by others as a heron-like stork, the authorities finally compromising by assigning the bird to a family of its own.

In addition to the shoebill, Mr. Taylor secured for the Museum a much desired series of skulls of the African crocodile, including one remarkably fine and large specimen. This should have come from a creature at least 15 feet long, but it is a well-known fact that the largest animals shrink before a tape line or a two foot rule, and unfortunately Mr. Taylor measured this specimen and records its length as 13 feet 10 inches, which is still a pretty good size for a crocodile. The teeth of this species are unusually sharp and strong and the jaws remarkably powerful; looking at them one can appreciate Mr. James P. Chapin's statement that the danger to human beings from the man-eating sharks amounts to nothing in comparison with the destruction of man and other animals by African crocodiles.

The American Museum possesses a remarkable collection of fossil crocodiles and alligators, accumulated during the western explorations of the last thirty years. During the past few months Dr. C. C. Mook has published, preparatory to describing the fossil forms, a series of articles in the American Museum *Bulletin*, dealing chiefly with existing crocodilians. These are the first fruits of his researches on this rather neglected group of reptiles, which played a more important part in the life of former geologic times than it does today. The crocodiles, the broad-headed alligators and caymans, and the slender-snouted, fish-eating gavials are the surviving remnants of a once numerous group, which inhabited the rivers and seas of all parts of the world.

In attempting to clear up the relationships of the extinct species, Doctor Mook soon found that the skeleton characters and relationships of the existing species were very imperfectly known, and he had to study the modern forms before he could clear up the affinities existing between the extinct species. Through the courtesy of the National Museum, the Museum of Comparative Zoölogy, the University of Michigan, and other institutions, he was able to get together almost every species of modern crocodilian and to obtain a clear idea of their relationship.

The second portion of the research will deal with the evolution and geological history of the crocodiles of the Tertiary Period (Age of Mammals), especially of the American species. Crocodiles were quite common in the Eocene formations of Wyoming, and alligators are found in the Oligocene and Miocene of South Dakota and Nebraska. No careful study has been given, however, to the fossil species, and their relations to the Tertiary crocodilians of Europe and elsewhere has not been cleared up. This portion of the research is but partly accomplished as yet and is to be followed by a study of the more ancient crocodiles of the Mesozoic (Age of Reptiles), as represented in the American formations. The Mesozoic crocodiles were much more numerous and varied, including several marine groups. Besides the gavial-like kinds with long, slender snout there were several river and shore-dwelling crocodiles of large size and with heavy, broad skulls, and other swift, sea-going kinds with forked tail and little or no bony armor. Many fine skeletons of these are to be seen in European museums; but much less is known about the American crocodiles of the Age of Reptiles.

The interesting article on "Snakes that Inflate," contributed by Mr. G. Kingsley Noble to the March-April issue of NATURAL HISTORY (pp. 166-171), has come to the attention of a correspondent at the Crow Agency, Montana, who comments on the fact that a terrorizing attitude of the character described by Mr. Noble is assumed also by the bull snake. "For the past forty years," says this observer, "I have seen these snakes that had fled our sight, but this summer one was found coiled in a path and hissing like a gander. On closer approach it struck and at intervals repeated it. I teased the snake to ascertain the length it could strike and never did that length exceed eighteen inches and generally it was about a foot. At each intake of air about half its body was considerably distended. This was all a bluff intended to terrify a possible enemy. Teasing failed to move the snake, so I passed on." The reference to the bull snake's "hissing like a gander" recalls the fact that this habit has earned the snake, in some parts of the country at least, the designation of "goose snake."

Upon receipt of the letter from the Crow Agency, Mr. Noble dissected one of the bull snakes, preserved in alcohol, in the collection of the American Museum. He found the dorsal membrane of the trachea not distensible or specialized for inflation as in the case of the species discussed by him in the article. The inflation which the correspondent records must, therefore, have been due to the filling of the lung with air and would necessarily have been less formidable than in the other species mentioned.

Through the courtesy of Mr. F. H. Haines the American Museum's department of entomology, which includes in its scope the spiders as well as the insects, has recently obtained several live specimens of the water spider (*Argyroneta aquatica*). Although this spider is an air-breathing creature, it spends practically all of its existence in the water. It is able to breathe beneath the surface by virtue of a bubble of air, bright as a globule of quicksilver, which is retained in the long hairs that cover the spider's abdomen.

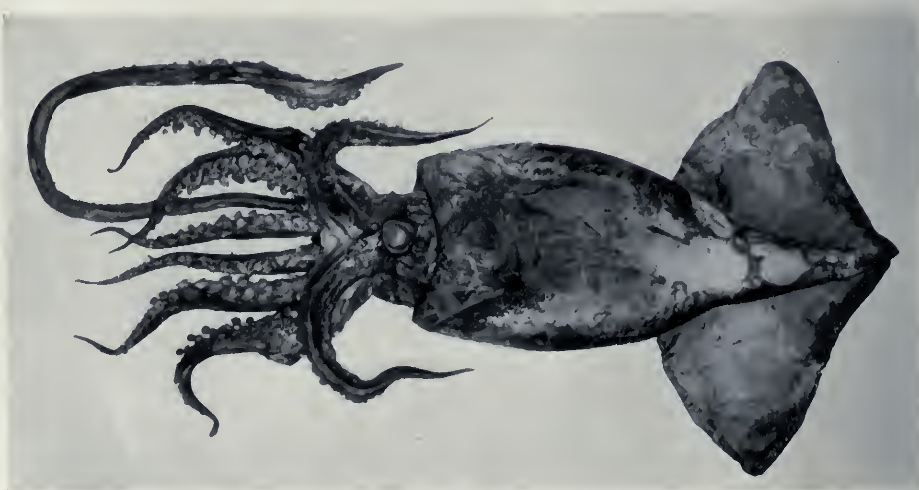
The nest-building operations of this spider are most interesting. It fashions a closely woven, silken dome on a water plant some distance below the surface and thereupon proceeds to fill this structure with air. For this purpose the spider rises in the water, raises its abdomen above the surface, and then quickly submerges it again to carry below the precious air bubble imprisoned in the hairs. When it reaches the silken dome, it releases within it the captive bubble, and by repeating the operation, gradually creates a little air-filled tent in which it takes its rest. It has been stated that the young of this species save themselves the trouble of nest-construction by utilizing the empty shells of water snails, which they float by filling with air.

The genus *Argyroneta* has but a single species, which is distributed throughout Europe and North and Central Asia. In the Old World it is often seen in aquaria; the specimens sent to the American Museum have been placed in a cylindrical glass bowl for observation.

Mr. James P. Chapin, assistant curator of African birds in the American Museum, sailed for Europe on August 18 for the purpose of rounding out his studies of the birds of the Congo, preparatory to issuing a *Bulletin* on this subject. He will go first to Berlin, where he will come in touch with Dr. Anton Reichenow and Dr. Erwin Stresemann, and later to Munich to consult with Dr. C. E. Hellmayr. Other continental places included in his itinerary are Vienna, Marseilles, Paris, and Brussels. On November 9 he will be the guest of the British Ornithological Club at London, where he will probably deliver an address on the Congo birds. He will return to America toward the end of November.

Though interesting stories of prowess and resource might be related in connection with the acquisition of many of the specimens in the American Museum of Natural History, it is not often that a creature is obtained in so unexpected and unusual a way as the rare species of squid, *Sthenoteuthis pteropus*, which recently reached the Museum. Apparently recorded only twice before, the last previous capture dating back to 1876, this curious animal, which because of its interest and rarity would have justified a painstaking search on the part of the student of marine life, was accommodatingly washed aboard a large ocean liner during a heavy storm. To Captain George Biggle of the S. S. "Caronia" of the Cunard Line the Museum is indebted for this valued donation.

It was when the "Caronia" was a day's sail out of Queenstown and approximately in latitude 51°30′ north, longitude 15° west, that it received this strange visitor, whose presence must surely have created considerable commotion on shipboard even if one accepts with caution the perfervid accounts of its capture which appeared at the time in certain newspapers. One journal, not to minimize the impressiveness of the creature, assigned it a length of fifteen feet. The actual size is remarkable enough without resort to fantastic exaggeration. From the tip of its tail to the end of its tentacular arms, the animal



This rare squid, a formidable monster of the ocean, was washed aboard a trans-Atlantic liner during a storm, creating no little excitement on shipboard. It is today preserved in the collections of the American Museum measured 159.5 cm., or about 5 feet—by far the largest specimen of its species thus far reported.

Equipped in life with eight tentacles of approximately equal length and two long tentacular arms, it must indeed have been a formidable antagonist. The tentacles are armed with rows of pneumatic suckers, cylindrical in shape, on the inner surface of which is a ring of horn bearing denticles, or serrations, that by sinking into the prey reënforce the action of the suckers. The tentacles are grasping organs conveniently surrounding the mouth, which is provided with a parrot-like bill of horn. It is with this sharp instrument that the actual work of destruction is done. The small more or less round area below the tentacles that in the full-length picture on page 434 is conspicuous by its brightness is the siphon, which is an organ of propulsion, enabling the creature by the intake and subsequent ejection of water to swim through the sea, the protruded siphon being curved backward and the water expelled in that direction if forward progress is desired and vice versa if a retreat is contemplated.

The specimen taken in 1876 was captured off the north coast of Bermuda. Squids are more commonly associated, however, with the North Atlantic than with subtropical waters. The giant squid, another genus of the same family to which the species under consideration belongs, has been found off the Banks of Newfoundland engaged in battle with sperm whales. The common squid, *Loligo pealii*, is abundant along the North Atlantic coast, where it is largely used by fishermen for bait. Among the Japanese a kindred species is used as food. A Mediterranean species, *Sepia officinalis*, is the form from which the sepia of commerce is derived. All of these, as contrasted with *Sthenoteuthis pteropus* and with the giant squid, are of relatively small size, varying from one to two feet in length.

An article containing a more detailed description of *Sthenoteuthis pteropus*, is being prepared for issue in the *Bulletin* of the American Museum by Mr. Roy W. Miner, associate curator of lower invertebrates. Under the direction of Mr. Miner work is about to begin on a model of this squid, which will be placed on exhibit during the coming year. Data have been gathered and sketches made for the purpose.

The mouth of the squid is surrounded by tentacles that, grasping out for prey, supply it with food. The dark object protruding from the mouth is the bill of horn with which the creature destroys its capture

THE work of the department of public education, American Museum of Natural History, is showing a gratifying growth. There was an increase in all activities during 1920 and the present year gives every indication of even more substantial accomplishment. Mrs. Ruth Crosby Noble, assistant curator, who is in charge of the work among the blind, had fifty-seven classes up to June, 1921, as against fifty classes during the entire previous year. The lantern slide distribution, in charge of Mrs. Grace Fisher Ramsey, assistant, totalled 106,000 slides for the first five months of the present year. The number of slide borrowers for six months of 1921 was 1000; for twelve months of 1920, 1700.

DR. WILLIAM K. GREGORY, curator of comparative anatomy in the American Museum, has been received with great cordiality by the scientific circles of Australia, which continent he is visiting with the twofold purpose of arranging for exchanges of specimens and of collecting in the field. He writes with appreciation of the hospitality accorded him at the Australian Museum in Sydney and particularly of the kindness shown by Dr. T. S. Dixon, its president; by Dr. Charles Anderson, its director; by Mr. Charles Hedley, who "has been our general adviser and constant friend"; and by other members of the staff.

Dr. Gregory has been much impressed by the many unique and priceless specimens on exhibition at the museum. There is a remarkably well preserved skull and jaw of a primitive squalodont (an extinct whale) from Tasmania, which awaits scientific description. An excellent cast of this skull and jaw has been promised to the American Museum. The aboriginal human skeletons, some of them representing unusual phases of dentition, were of particular interest to Dr. Gregory, and he speaks enthusiastically, too, of the splendid collections of fish, reptile, and mammal skeletons.

As a preliminary to his contemplated collecting trip Dr. Gregory took a jaunt with Prof. L. Harrison, of the local university, and "in a little while," he writes, "we collected cystignathid and hylid frogs, nearly limbless skinks, and saw the tracks of arboreal marsupials."

Dr. Gregory's collecting trip is a timely undertaking. A delay of a few years would have been costly, for the native Australian fauna, one of the most interesting in the world, is rapidly disappearing, due in part to the unequal combat it is waging against such introduced creatures as the rabbit, fox, rat, and dingo, in part—it is the more serious part—to the ruthless destruction of the fur hunter. That Australia is awakening to the seriousness of these devastating agencies is gratifying; it would seem excess of zeal, however, to apply restrictions to the collecting for museums, a movement that has recently been agitated. All the Australian mammals in all the museums in the world are but a drop in the bucket compared with those disposed of at a single sale held in St. Louis, the great fur market of the United States, in February, 1920, on which occasion no less than 500,000 Australian opossum skins were sold. A few months later in the same year a lot of 400,000 was placed on sale in the same city, which, with London, New York, and to a smaller extent Toronto, is largely responsible for the recent grand-scale destruction of mammalian life that has taken place. It has been calculated from a compilation of the fur sales in these and other centers of distribution that in 1919 no less than 1,133,917 skins of the smaller Australian marsupials were sold throughout the world. In 1920 the figure rose to 2,070,349, and for the first six months of the present year the sales had exceeded 775,000 skins.

It is probably seldom realized by the wearers of costly furs what an appalling destruction of wild creatures is involved in the manufacture of such apparel. According to an article contributed by Dr. William T. Hornaday to the March issue of the *Zoölogical Society Bulletin* no less than 80 skins are required on the average for the making of a mink wrap, 200 skins for a squirrel coat, 280 to 300 for a black mole coat. A Siberian ermine wrap may contain 300 skins, a striped skunk jacket 90 skins.

Dr. Hornaday believes that this wild orgy of slaughter, if maintained, is destined in a very few years to wipe out the interesting mammalian life of the globe. Far regions are being scoured for creatures that a little while ago would not have been considered marketable, but which today, with the growing scarcity, command a price. Even the domestic cat is requisitioned and under the euphemistic designation of "genet" ekes out a rapidly dwindling supply of pelts. A few years hence, if the slaughter keeps up, there may be no more fur-bearing creatures and incidentally no more furs.

Natural History welcomes the appearance of the first number of *The Australian Museum Magazine*. This museum, located at Sydney, was incorporated as long ago as 1853 and prior to that time had its affairs administered by a committee. It has zoölogical, palæontological, ethnological, and mineralogical exhibits, with especial emphasis in each of these groups on Australian representatives, not to mention historical and numismatical sections of more limited extent. Prior to the appearance of the magazine the publications of this museum were confined to reports, memoirs, records, and catalogues, intended primarily for specialists in the various branches of natural science. The purpose of the magazine is to reach the general reader and to familiarize him through nontechnical articles with the different divisions of natural history. In this connection, the collections of the museum will receive the emphasis to which they are entitled. One of the features contemplated by the editor, is a series of articles describing the best methods of collecting and preserving animals, and of recording observations on animal life.

A number of changes have recently been made in the scientific staff of the Australian Museum. Dr. C. Anderson, M. A., who has been mineralogist since 1901, succeeds in office the late Director Etheridge. Mr. A. Musgrave fills the vacancy caused by the death of Mr. W. J. Rainbow, entomologist, and Messrs. J. R. Kinghorn and E. le G. Troughton, second-class assistants, have been promoted to be first-class assistants, the one in charge of reptiles, birds, and amphibians, the other of mammals and skeletons.

In connection with the article by Mr. Charles W. Mead, entitled "Indian Corn or Maize" (p. 409 of this issue) it may be well to refer to the widespread belief, founded on published statements, that wheat taken from the wrappings of mummies more than a thousand years old has germinated. The fact is that these accounts were based either on fraud or upon mischievous attempts to obstruct the search for truth. It was a simple matter for fakers to secrete wheat grains in Egyptian tombs and to reveal them, with feigned surprise at the discovery, to the credulous tourist. When the purchaser planted the seed and germination ensued, the vitality of "mummy wheat" seemed to be vindicated. Sometimes, however, the faker dug his own pitfall, as in a cited instance where the cereal found in association with the mummy was not wheat but maize,—a grain which became known to the Old World only with the discovery of America. Carefully conducted experiments to test the germinative powers of wheat have been made by Unger and by other Egyptologists with well preserved seeds of undoubted antiquity, but in no case have the results been other than negative. The vitality of wheat grains is lost in a very few years.

Claims of marvelous longevity have been made for seeds other than wheat. It is said that raspberry seeds found in a Celtic tomb some seventeen hundred years old and the seeds of black medick, cornflower, and heliotrope discovered in Roman tombs of the second and third centuries, have germinated. Such statements must be viewed with caution Referring to the "incredibly long period" during which the seeds, especially if properly guarded from moisture, of certain species of plants preserve their capacity for germination, Kerner and Oliver state in *The Natural History of Plants*, Vol. 1., pp. 51-52: "If after ten years such seeds are transferred into moist earth, the protoplasm in the majority of cases begins to bestir itself and to move, and the embryo grows out into a seedling. After twenty years, perhaps, only about five per cent of the seeds preserved would germinate. The rest are not stimulated by damp earth to further development; their protoplasm no longer possesses the power of augmenting its volume by absorption of matter from the environment, or of developing a definite form, but is disintegrated by the influx of air and water and breaks up into simple compounds. After thirty years hardly one of the seeds would sprout. . . . . Gardeners express the fact by saying the capacity for germination becomes extinct in from twenty to thirty years."

Though the vitality of mummy wheat is an exploded myth, the cereals taken from ancient graves throw interesting light on the antiquity of some of our food stuffs and the method of their preparation. There have recently been presented to the American Museum the mummies of two prehistoric Chilean Indians, an adult and a child, the gift of Señor Recaredo Amengual, Intendente of the Province of Tarapaca, Chile, to whom the Museum is under obligations for many other valued contributions. The mummies were taken from a grave on the outskirts of Pica in the interior of the Province of Tarapaca and among the interesting objects disinterred with them was a bag filled with popcorn, as fresh in appearance as though but just roasted by a street vender. Thus a method of preparing corn that we are apt to associate with a modern picnic or a visit to the circus turns out to have antedated the coming of the white man; indeed among the west coast Indians of South America a specially shaped dish with a depression in the center for the reception of the grains and an attached handle for the comfort of the holder was used in popping corn.

This cereal was not the only object of interest taken from the grave. Close to the surface of the earth was found a parrot placed on a broadly spread, woolen blanket that extended the length of the grave. According to Indian tradition the mission of this parrot was to communicate to the deceased the news of the world from which death had severed him. We have here, then, a curious inversion of the function of the modern medium: it is the dead who through this agency learn of the living, not the living who thus establish communication with the dead.

In addition to the cereal already mentioned and other grains which were intended to support the interred on the journey to the land of eternity, there was a large earthenware jar in which water was placed as refreshment for the trip. The grave contained many other articles of earthenware, wood, wool, and straw, among them being ornaments, wearing apparel, weapons, and even musical instruments. All of these have been presented to the Museum.

In the region from which these mummies were taken, there is no surface indication of the existence of graves. To locate a burying place the searcher must drive a crowbar here and there into the earth. Where the ground proves resistant, there is nothing to be discovered, but if by chance the implement penetrates without great difficulty, a tomb is almost certain to reward the search. After burying their dead with the objects required for their welfare, the Indians filled up the void with loose sand, which even today, after the lapse of centuries, is of a different degree of compactness from that of the surrounding earth.

The department of lower invertebrates has recently secured through Mr. J. R. Tomlin an excellent collection of shells, consisting of 132 named species from the Loyalty Islands and Singapore. The department has also come into possession, through a bequest of Dr. Titus Munson Coan, of a collection of land snails from Hawaii with accompanying data. These snails, with strongly contrasted bands, are of the family Achatinellidæ and were collected during the years 1851-54, by Dr. Coan, who was born in Hawaii. Snails gathered so long ago are of no little importance, as they may possibly throw light on evolutionary changes since effected. The land snails of Hawaii differ from valley to valley and thus offer opportunity for an interesting study complementary to the monumental work by Dr. Henry E. Crampton on the genus *Partula*, showing the effects of similar segregation in Tahiti.

The most complete collection of Hawaiian land snails is in the Bishop Museum at Honolulu. Dr. Montague Cooke, curator of the Pulmonata in that institution, has found the American Museum's collections of Hawaiian shells of great interest. He has not only thoroughly revised them and brought them to date but he has agreed to amplify and complete them through exchanges from his own collections and those of the Bishop Museum.

THE migrations of birds, while offering unexplained problems, are well-known phenomena; the migrations of butterflies, on the other hand, are occurrences with which the average man is comparatively unfamiliar. In the initial number, bearing date of April, 1921, of the *Australian Museum Magazine*, reference is made to a large-scale migration of the white caper butterfly, *Anaphaeis java* var. *teutonia* (a member of the family Pieridæ to which our common white cabbage butterfly belongs), that took place during November, 1920, in the neighborhood of Sydney, Australia. Similar swarms occurred in New South Wales in 1894, 1903, 1906, and 1909.

In October, 1919, a very noteworthy migration of the yellow butterflies, *Catopsilia statira*, took place in Trinidad. These insects were seen flying, sometimes singly, one or two a minute within the sight of the observer, sometimes to the number of several hundreds during the same interval of time, and sometimes in great clouds of thousands, so dense as to interfere with the progress of a motor car. The rapidity of their flight was no less remarkable than their number. At one time when they were flying over a football field of known dimensions, the opportunity was offered of timing with a stop watch the speed with which eleven butterflies crossed it. An average of their flight-speeds indicated a rate of seventeen miles an hour. It has been estimated that migrating butterflies of the species *Callidryas eubule*, observed in British Guiana in 1917, attained a rate of from twelve to sixteen miles an hour flying across the wind.

In his *Jungle Peace*, p. 158, Mr. Beebe states, speaking of the interesting occurrences at his Biological Experiment Station in British Guiana:

"Even at midday one might sit at a window and take notes continuously of lesser happenings, while now and then something of such note occurred that one could only watch and wonder. This might be a migration of sulphur butterflies, thousands flying steadily toward the southeast, hour after hour, day after day."

Mention should be made of the fact that it is believed by many entomologists that the thistle butterfly, *Vanessa cardui*, migrates every year from the Continent to the British Isles. It has been observed flying at night toward the English coast in the face of a head wind.

In the United States migrations of the monarch butterfly (*Danaus archippus*) have been frequently noted. In the early fall isolated individuals, as well as large groups, sometimes vast swarms, of this familiar flier, conspicuous by virtue of the basic red color on the upper side of its wings, move southward. Their flight has been traced along the coast of Long Island westward toward the mainland, thence to be continued in a southerly direction. The Long Island insect routes have been found to coincide with the local bird routes, and according to Mr. Howard J. Shannon[1], who contributed an interesting article on this subject to *Harpers Monthly* in September, 1915, "suggests the probability that such parallel movements are in the nature of a general law." The migrations of the monarch are of particular interest in that a return flight of individuals takes place from the south in the spring. These bedraggled pilgrims have been observed coming with tattered wings to reëstablish the northern population. Where do they sojourn during the months when their summer habitat is encased in snow? This is one of the many puzzling questions connected with insect migration that still await solution.

Among the most striking exhibits in the hall of insects on the third floor of the American Museum is a gathering of monarch butterflies during the migrating season. Over one thousand specimens are shown clustering on the leaves and branches of an oak tree. The exhibit is based on actual observations. In fact, much larger assemblages of monarchs have been reported. In the *Canadian Entomologist* for April, 1916, Mr. R. P. Dow tells of coming upon a swarm of the monarch at Rockaway Beach, Long Island. "They were numb with cold and easy to pick as blackberries. A day's work would have included not less than, say, 20,000 of them."

In striking contrast to the normal abundance of this species, it should be noted that during the past three years it has been of very limited occurrence in the neighborhood of New York, only an occasional isolated individual having been observed. This circumstance adds but another perplexity concerning the activities of this interesting insect.

MR. GEORGE K. CHERRIE, inveterate collector in the tropics of America, who has to his credit more than thirty trips made in the interests of science to the southern continent, and who was the companion of Roosevelt in the exploration of the River of Doubt, sailed on June 18, for Ecuador, to supplement the work he accomplished there in 1920 in coöperation with Mr. H. E. Anthony, of the department of mammalogy, American Museum. Mr. Cherrie is accompanied by Messrs. Gill and Tate, the former being engaged with Mr. Cherrie in the collecting of birds, the latter devoting himself to the obtaining of mammals. Later in the season Mr. Cherrie will extend his field work to Peru.

DR. P. E. GODDARD, curator of ethnology, American Museum of Natural History, has

[1]For an interesting account of the migrations on Long Island not only of the monarch but of other species as well see an informing article entitled "Autumn Migration of Butterflies" by Howard J. Shannon in the AMERICAN MUSEUM JOURNAL for January, 1917, pp. 33–40.

THE MONARCH BUTTERFLY MIGRATING

This exhibit on the third floor of the American Museum illustrates a gathering of monarchs during their southward flight in the fall. More than 1500 butterflies, 600 of which were collected by Miss Almeda Johnson, are assembled in this exhibit, which is based on observations made by Mr. G. H. Sherwood, at Clinton, Connecticut, and by Mr. H. J. Shannon at Easthampton, Long Island. Each insect had to be mounted especially for the purpose,—a task requiring no little skill and patience on the part of Mr. Charles Wunder, to whom this work was entrusted. The accessories were made and assembled by Mr. W. B. Peters. Vast as is the number of butterflies represented in this exhibit, even larger gatherings have been noted in nature been visiting the Indian reservation located at Fort Berthold, North Dakota. On this reservation are gathered remnants of three tribes, the Mandan, Hidatsa, and Arikara, the last mentioned a Caddoan people closely related to the Pawnee. All of these Indians are known as builders of earth lodges. The Arikara had not erected any for so long a time, however, that the recent completion by them of such a lodge was regarded as an event to be celebrated with a full accompaniment of time-honored ceremonies. The lodge was dedicated to Professor Melvin R. Gilmore, curator of the State Historical Society of North Dakota, and it was at his invitation that Dr. Goddard attended in order to make a record of the ceremony. Miss Gladys A. Reichard, assistant in anthropology at Columbia University, collaborated with Dr. Goddard in securing the ritual. Dr. Goddard took with him a moving-picture camera to put on record the dances and ceremonials that were engaged in, and a phonograph for the registering of the songs. These adjuncts are invaluable, for the poses and nervous responses of an Indian during the performance of a ceremony are made real through the moving-picture camera, while the inflection of the voices can be conveyed only through some such medium as the phonograph.

Hidatsa Village in 1868.—The low, earth-covered lodges are obscured by the poles of drying-frames. (Morrow photograph reproduced by F. N. Wilson and published in *North American Indians of the Plains* by Clark Wissler)

Dr. Hiko Matsumoto, who until a few weeks ago was studying the Fayûm collection of Proboscidea in the American Museum, recently received the Imperial Institution Prize, one of two highly valued prizes of the Imperial Institution of Science and Literature of Japan. This award is bestowed on contributions to the science and the literature of the world, and Doctor Matsumoto's work on the Ophiuroidea, an echinoid group known as brittle-stars, received this recognition His works on the subject are entitled *New Classification of Ophiuroidea, with Descriptions of Some New Genera and Species* and *Monograph of Japanese Ophiuroidea, Arranged According to a New Classification.* Doctor Matsumoto's new classification is based upon anatomical studies of all the principal genera of this class and has been accepted in the United States and France. He spent nine months working in the American Museum and during that period completed a revision of the Proboscidea and Hyracoidea collected by the American Museum Expedition to the Fayûm of Egypt in 1907. From America he went to England to continue his studies at the British Museum, where the original collections of the wonderful mammals of the Fayûm are preserved.

Dr. Clara Barrus, literary executor and authoritative biographer of the late John Burroughs, asks that all persons owning interesting letters from Mr. Burroughs communicate with her at Woodchuck Lodge, Roxbury, New York. All letters sent will be promptly copied, or extracted from, and returned to the owners.

The whole of the Hawaiian volcano district has passed under the control of the National Park Service and an appropriation of $10,000 has been made by Congress to defray the expenses for the year. This is an amount too small to enable those in charge properly to do the things that should be done in the district, and it is to be hoped that, made aware, through articles like that of Dr. T. A. Jaggar, Jr. in the present issue, of the immense importance of this region to science, more adequate funds will be voted in subsequent years. Interesting discoveries are constantly coming to light in this region, which while of primary significance to the volcanologist, is not without importance also to the anthropologist. In the Kau Desert, far to the south of Kilauea, was found an old Heiau, or temple, overlooking the ocean, and near it interesting petroglyphs. Recently word reached the American Museum that there had been discovered "a very remarkable series of ancient footprints in the lava district of Kau." These will be protected from possible injury by the casual tourist.

The first session of the new Institut International d'Anthropologie was held under the presidency of Prince Roland Bonaparte at Liége, Belgium, during the closing days of July. This is the first anthropological congress of an international character that has gathered since the war and is auspicious also in being accorded the patronage of the Belgian government. The program of work was divided into eight sections, as follows: physical anthropology, prehistoric archæology, comparative ethnography, criminology, eugenics, religion and mythology, linguistics, and psychology and sociology. Included in the program were excursions to the Campignian deposits of the Province of Liége, to the Upper Paleocene of Martinrive, to the camp station of Hesbaye, to the Neolithic stations of Sainte-Gertrude, and a visit to the archæological museum at Namur. The proposed aim of this new association, in which a number of American archæologists are enrolled as members, is to help unify and improve all phases of anthropological technique.

Dr. Willard G. Van Name, assistant curator of the department of lower invertebrates, American Museum, has recently been appointed assistant secretary of the Executive Committee on Natural Resources, which is a union of the committees appointed by the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science. The purpose in organizing this Executive Committee is "to promote, by scientific effort and through education, the most reasonable use of our natural resources for the economic, industrial, and social development of the country." It will advise, coördinate, and strengthen existing organizations formed in the interests of conservation, to the end that the most effective results may be obtained.

The dependence of man on the forests is so obvious as to be a truism. To them we are indebted for the chair we sit upon, the newspaper we read, the table from which we eat, the floor on which we tread, the very roof over our heads. They regulate the stream flows and thereby prevent disastrous floods. Their restful beauty restores the harassed souls of men. And yet, our forests are being destroyed at an alarming rate,—destroyed not merely by the axe to supply more or less legitimate needs but, without any compensating consideration, by fires that in the majority of cases are preventable. In the five years ending with 1920 the total loss from forest fires exceeded $85,000.000. The area burned over during that period totaled 56,488,000 acres, an area greater than that represented by the New England States together with all the forested region of the state of New York. This destruction was caused by no less than 160,000 fires, more than 60 per cent of which, due to human agencies, could have been prevented through the exercise of proper precautions. Not only has there been material loss, human lives have not infrequently been sacrificed too. In the great Minnesota fire of 1918 nearly a thousand persons were burned to death or suffocated. As much as $2,500,000 is annually expended for the detection and suppression of forest fires; of this sum more than $1,000,000 is spent by the Forest Service of the United States Department of Agriculture, the remainder by the states and by private individuals. It is obvious that the exercise of greater care and vigilance on the part of all citizens would admirably supplement the fire prevention work that is being done and so assist in conserving an indispensable product.

Through an unfortunate oversight for which Natural History takes full responsibility, credit was not given to Dr. W. R. Taylor for the attractive picture of "A growth of *Purpurea* near Tom's River, New Jersey," which appeared on page 316 of the May-June issue. Natural History on behalf of itself and of Mr. Frank Morton Jones, author of the article "Pitcher Plants and Their Moths," in connection with which the illustration was used, desires to make grateful acknowledgment of Dr. Taylor's courtesy.

The department of herpetology, American Museum, has recently secured through the efforts of Mr. Barnum Brown, of the department of invertebrate palæontology, a magnificent collection of reptiles and amphibians from a particularly interesting section of Africa. Except for the herpetological specimens secured by the American Museum Congo Expedition under the leadership of Mr. Herbert Lang, this collection represents the largest acquisition the department has ever obtained from that continent.

Other departments, too, have been benefited by Mr. Brown's collecting. Among the specimens he shipped to the Museum are approximately 50 fish, about 600 crustaceans, mollusks, and echinoderms, and some 500 insects.

A fine series of fossil invertebrates was also contained in Mr. Brown's shipment. Some of the fossils are very ancient, representing the remains of organisms which lived in the Devonian period of the Palæozoic. Most of them, however, are more recent and come from the Jurassic period of the Mesozoic. They include many genera of ammonites, almost every specimen belonging to a distinct genus, and a large number of brachiopods, pelecypods, gastropods, and echinoderms, the entire fauna ranging in age through the Middle and Upper Jurassic and possibly down into the Lower Jurassic. The collection is valuable biologically because it contains many new species, and stratigraphically because it will fill in one of the gaps in the geological column. It is by this process of gathering new data in regions which have been little studied that we obtain our knowledge of the extent of ancient lands and seas and of the distribution of the marine faunas of the past.

Another recent example of splendid interdepartmental coöperation is the collection made for the department of herpetology by Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere and leader of the American Museum Expedition to Ecuador. Notwithstanding the large claims which his field work in mammalogy made upon his time and energy, Mr. Anthony succeeded in bringing back with him from South America an extremely interesting and well-preserved series of reptiles and amphibians.

The American Museum is such a large institution that specialization in field work has been the rule. General collecting is still the chief method in smaller institutions such as the Museum of Comparative Zoölogy in Cambridge. The work of Mr. Anthony, as well as that of Mr. Brown referred to in the previous note, demonstrates to what excellent advantage a specialist may turn his leisure moments. A similar spirit of coöperation is inspiring the members of the American Museum's Third Asiatic Expedition under the leadership of Mr. Roy Chapman Andrews, and there is good reason for believing that they will secure a series of specimens representative of all phases of the animal life of the region visited.

Two papers that supplement one another appeared in a recent issue of the *American Anthropologist.* They are contributed by Dr. P. E. Goddard, curator of ethnology in the American Museum, and by Mr. Louis R. Sullivan, assistant curator of physical anthropology in the same institution. In his paper on "The Fossa Pharyngea in American Indian Crania" Mr. Sullivan shows that the fossa pharyngea—a rare structural feature if one considers the world as a whole—occurs with rather high frequency in certain crania from our Southwest and from Mexico. The distribution of these crania corresponds quite closely with the area occupied by the Uto-Aztecan linguistic stocks and by the culture of the Basket-maker. Doctor Goddard in his paper, entitled "The Cultural and Somatic Correlations of Uto-Aztecan," states that Mr. Sullivan has established "a definite physical group having a common line of inheritance, and points out some of the problems which an extension of Mr. Sullivan's investigations may solve. "With a physical type definitely correlated with Shoshonean speech it ought to be possible to determine whether any considerable number of such a physical strain were incorporated in the Shoshonean-speaking Hopi villages. If a definite physical type can be established for the stone-house-building peoples of the San Juan drainage it should be possible to trace the movement of the people themselves as well as their culture. This is especially promising since types of pottery of definite geographical and temporal sequence have been established." To arrive at his conclusions Mr. Sullivan examined no less than 2517 crania in the collections of the American Museum.

The peculiar geographical distribution of the various species of penguins (Sphenisciformes) is explained by Dr. Maurice Boubier[1] by reference to the movements of the Antarctic ocean currents. This avian family, originally of the south polar regions and adapted to cold-water conditions, now extends to the Galápagos Islands on the equator, off the west coast of South America; to Rio Grande do Sul in southern Brazil (about 30° south latitude); to Walwich Bay or Cape Frio on the west coast of Africa (about 16° south latitude); and to about 22° south latitude on the western coast of Australia. They are notably absent along the eastern coasts of Australia and Africa, and on the eastern coast of South America extend nowhere nearly so far north as on the western.

The explanation, according to Doctor Boubier,

[1] M. Boubier, "La distribution géographique des manchots (Sphéniscidés) et son interprétation géophysique." *Revue Française d'Ornithologie*, 11e Année, No. 126-27, 1919, pp. 131-36.

is to be sought in the distribution of currents derived from the great Antarctic circumpolar drift. This travels from west to east and where it impinges upon the continents north of Cape Horn, the Cape of Good Hope, and Cape Leeuwin, Australia, it is deflected northward along the western coasts of the three southern continents to form the Peruvian, Benguela, and West Australian currents, respectively. There is also a cold current hugging the eastern coast of Argentina and Uruguay. Not only do these cold currents maintain a low surface temperature in the sea in these localities, and also probably assist in reducing the air temperature (the isotherm of 20° centigrade roughly limits the distribution of penguins), but, what is more important, they transport an enormous mass of Antartic plankton on which the birds feed. The organisms constituting this plankton live only in the cold waters, so that when the currents become warmed by traversing tropical seas before returning south (as along the eastern coasts of the southern continents), they lose their Antarctic plankton. Penguins are accordingly absent along these coasts.

As pointed out by Dr. R. C. Murphy, who has devoted special attention to the effects of the Humboldt Current, these statements, while correct as regards the main thesis of penguin distribution, nevertheless tend to perpetuate a common error: The low temperature of the currents in question is due not to the transportation of surface water from high latitudes, but solely to the *upwelling* of cold bottom waters. This upwelling, for reasons proceeding from the eastward rotation of the earth, is very marked, and very uniform, along great stretches of the western continental coasts. The vertical circulation brings to the surface a vast abundance of food in the form of the remains of organisms which had previously settled to the bottom over wide areas of the ocean. Thus the low temperature and the plentiful primary nutritive resources combine to make suitable life conditions for the kinds of crustaceans and other creatures upon which penguins feed. The conception of great oceanic "rivers," bearing northward the cold water and living cargo of Subantarctic seas, is quite erroneous. The currents are at best very slow moving compared with rivers, for instance. The organisms that inhabit them do not originate in the far south, except perhaps in an evolutionary sense, but are born, live, and die, in the latitudes where they are found. It is not, in short, that the currents carry individual organisms across the temperate zones and into the tropics, but, rather, that the vertical circulation produces life conditions in narrow littoral belts which resemble those of the Antarctic and Subantarctic seas. These belts, which are mostly on the western coasts of the continents, are therefore inhabited by Antarctic or Subantarctic groups of animals, of which the penguins are but one striking example.

"NATURAL HISTORY"

SEPTEMBER–OCTOBER ISSUE

South America,—land of strange contrasts, of desert wastes and tropical abundance, of sky-piercing mountains and low-lying jungles,—is a region to which interest is bound to turn increasingly. Its little-traversed areas are a tempting field for the naturalist; its native tribes offer rare study material for the anthropologist; its ancient west coast civilization, the consummation of pre-Columbian culture, has an abiding glamour even when viewed with the calm eye of science, unaided by the colored glasses of romance. It is this west coast region that will have especial emphasis in the issue of Natural History for September-October.

The leading article is devoted to the wonderful collection of Peruvian gold that has recently come into the possession of the American Museum. One is wont to associate gold exclusively with the Incas but other peoples of this interesting region also employed the precious metal for the fashioning of utensils and ornaments. The gold described is of the Chimu kingdom and includes water vessels and plates, hair ornaments, and impressive breast plates large enough to extend from shoulder to shoulder if worn by a man. These treasured acquisitions are described by Dr. P. E. Goddard, curator of ethnology, American Museum, who recently visited the site of their discovery. The article is accompanied by illustrations in color, making more graphic the beauty of form and of workmanship that these objects evidence.

Owing to the contrasting conditions of aridity and extreme moisture encountered as one moves from the west coast of South America to the Oriente, or eastern slope of the Andes, the diverse life zones resulting are of particular interest. Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, who returned not many months ago from his expedition to Ecuador, contributes a vividly written article regarding the influences of temperature and humidity on the distribution of plant and animal life in the region visited. The article is illustrated with unusual photographs.

A valuable contribution to the ornithology of South America, issued under the title of "*The Distribution of Bird Life in the Urubamba Valley of Peru*," by Dr. Frank M. Chapman, curator of ornithology in the American

Museum, is reviewed by Dr. Robert Cushman Murphy, associate curator of marine birds. In the work specified Dr. Chapman presents a report on the birds collected by the Yale University–National Geographic Society's Expeditions to the region indicated.

The fauna of the Andes includes few creatures so interesting and at the same time so perplexing as the marsupial frog, the female of which carries her eggs about with her in a pouch that is located on her back. How do the eggs get there? Does the male assist his mate in placing them in this curious receptacle? These are questions still awaiting an answer; but a great deal of light on the habits and ways of these amphibians is shed in the course of Mr. G. Kingsley Noble's article entitled "A Search for the Marsupial Frog,"—a search that yielded many other desirable creatures in addition to the animal that was the especial object of pursuit. The expedition with which Mr. Noble, who is assistant curator (in charge) of herpetology, was connected, traversed a region full of varied interest, the diverse scenes of which have fortunately been registered with rare fidelity by Mr. Noble's camera. A selection from these photographs constitutes a fine pictorial series supplementing the article.

Another section of the Andean region is delightfully described by Dr. Edward W. Berry, who made a trip *a loma de mula* from La Paz, the highest capital in the world, to the eastern rain-forest slopes of the Andes of northeastern Bolivia, a region known as the Yungas and rightly characterized by Mr. Berry as "a veritable naturalist's fairyland." Striking pictures of the Andes accompany this article.

Having glimpsed in these several narratives representative sections of the west coast, the reader is next taken along the Rio Negro, one of the confluents of the Amazon, to sojourn among the copper-skinned Caboklas, who, notwithstanding the evil reputation that some writers have given them, befriended and treated with generous hospitality Mr. William T. LaVarre, who for several months lived among them and who in a brightly written article recalls the impressions of that sojourn.

Tapioca, one of the products for which the world is indebted to the Indians of South America, is a food with which most people are familiar, yet regarding the derivation of which few can give the correct answer. In an interesting article Mr. Charles W. Mead, assistant curator of Peruvian archæology in the American Museum, supplies information regarding the nature of tapioca and the method of its preparation.

The Second International Congress of Eugenics gathered at the American Museum of Natural History during the last week in September. It was attended by scientists from all parts of the world, eager to exchange views on a subject of all-eclipsing importance. Several foreign governments sent their diplomatic representatives. No phase of eugenics was overlooked in the thoughtful and informing addresses that were delivered in the course of the session. The exhibit conducted in connection with the Congress was a feature of unusual interest. It is the hope of Natural History to accord due space to these activities in its next issue.

Dr. Joel Asaph Allen, who recently died, rich in accomplishment as in years, was the dean of the faculty of the American Museum, in the interests of which he labored devotedly. Appreciations of his personality and his work are in course of preparation.

With the recent visit to this country of Madame Curie, radium is more than ever a subject of general interest. This miracle-working mineral, in many respects the supreme marvel of nature's storehouse, is to most people a baffling enigma. To convey essential information regarding radium—the minerals in which it is found, the way it is produced, the uses to which it is put—Dr. George F. Kunz, president of the New York Mineralogical Club and research associate in gems of the American Museum, some months ago directed the installation of a radium exhibit in the Museum, which attracted the attention of all those who visited the institution. That the instructive data presented in this exhibit may be placed on record, Dr. Kunz is preparing an informing article, accompanied by illustrations, describing the exhibit and its significance.

A series of pictures of Miocene fish, restored under the direction of Dr. David Starr Jordan, has especial interest in that these fish are the immediate ancestors of certain marine fish of today.

"Glimpses of the Home Life of the Saw-whet Owl" is the appropriate title of an article contributed by Messrs. Robert B. Rockwell and Clark Blickensderfer. Readers of Mr. Rockwell's "Trials and Tribulations of a Nature Photographer," which appeared in the issue of Natural History for March-April, 1920, will appreciate the fact that no effort has been spared in depicting this interesting owl, which long eluded the most painstaking search of the authors. The photographs illustrating the article give an intimate picture of the behavior of the young birds and their parents in the family circle.

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THE JOURNAL OF THE AMERICAN MUSEUM

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GOLD OBJECTS OF PRE-SPANISH MANUFACTURE RECENTLY UNEARTHED ON THE COAST OF PERU. ABOUT ONE-EIGHTH ACTUAL SIZE

NATURAL HISTORY

VOLUME XXI SEPTEMBER-OCTOBER, 1921 NUMBER 5

PERUVIAN GOLD OF THE CHIMU KINGDOM[1]

BY

PLINY E. GODDARD*

THE American Museum has recently secured one of the most striking collections of gold that have been found in Peru since the days of the Spanish conquerors. This collection, consisting of twelve gold objects, was offered for sale in New York City in the summer of 1920. Its importance was evident at a glance. The objects were large and impressive and some of them, though paralleled in other substances, quite unknown before in gold.

Among the ones familiar were three plume-shaped pieces evidently intended for wearing in a headband. The Museum already possessed quite a number of these plumes in both gold and silver, ranging from four to eight inches in length. In the Heye collections at the Museum of the American Indian is a similar one attached to a headband of gold. The three specimens recently acquired are, however, much larger, one of them being $5\frac{7}{8}$ inches wide and $17\frac{1}{2}$ inches long.

Also intended evidently for ornament are three pieces which may be considered breastplates. They are large enough to reach from shoulder to shoulder of a fair-sized man. Two of them are especially interesting from the fact that they are made more ornamental by the use of alternating bands of light- and dark-colored gold.

Thin disks of gold, sometimes with a central prominence, suggesting a breast, and evidently worn suspended on the chest, are quite common from pre-Spanish tropical America. There are several excellent examples from Costa Rica in the Keith collection. The four plate-shaped objects in the collection acquired by the American Museum are presumably of this sort although it is not impossible that they were used as plates. They are thicker than the usual breast ornaments and the decoration on them is similar to the border on the two water vessels described below. This might indicate that they belong together as food-serving vessels of some potentate. The plates fall into two pairs, identical except for the variations always characteristic of normal free art. They are $8\frac{1}{2}$ inches in diameter with a border nearly an inch in width. Each has two holes evidently made and used for the suspension of the objects.

The two remaining articles are almost certainly utilitarian in their conception. They have the form of the well-known water jars with a combined handle and spout. Similar vessels are known in Peru in silver but there are none in North American museums and no others anywhere in gold. The ornamentation of these vessels consists of interlocked fish designs of the kind well known on cloth. There is also a running border of z-shaped design. The borders of the disks or plates have a similar design. On two of the plates these run in one direction and on the other pair, in the opposite direction.

[1] To Charles W. Mead, Assistant Curator of Peruvian Archæology, the author is indebted for many of the facts and conceptions contained in this article, some of which were supplied by him ready-made and others absorbed in years of pleasant intercourse.

* Curator of Ethnology, American Museum.

There were taken from the same place where the objects were found ten or eleven of these plates, all closely similar, seven of the breastplates, and six of the plumes. It is believed that three of the plumes and three of the breastplates have been broken up and melted. The whereabouts of five of the plates, besides the four the American Museum possesses, is known.

The material of which these objects are composed is an alloy of gold, silver, and copper, varying somewhat in proportions but averaging about 60 per cent gold, from 20 to 30 per cent silver, and from 6 to 20 per cent copper. One of the breastplates with alternating bands of light and dark metal gave interesting results upon analysis. The yellower metal was 80 per cent gold, 13 per cent silver, and 7 per cent copper, while the lighter bands were 47 per cent gold, 44 per cent silver, and $8\frac{1}{2}$ per cent copper. Such alloys are fairly hard and cannot be beaten with the same ease as purer gold.

It appears that these objects were first cast in a prepared mold and then finished by hammering, and perhaps retouched with an engraving tool. Only by bringing the material to, or close to, the melting point could a union be obtained between the strips of light and dark metal in the two breastplates. The combined handles and spout of the two water vessels were made into a tube by approximating the two edges and applying heat and probably also by the use of a lower alloy to act as a solder.

Of particular interest are certain imperfections. One of the breastplates has a patch about an inch square inserted so as to be quite noticeable. The upper part of one of the water vessels has a hole which has been imperfectly filled with a patch of gold beaten in. The upper part of the spout is inserted into the joined spout-handle without trimming below, thereby not only wasting metal but impeding the flow of the water.

These objects were found in Peru by treasure seekers who accidentally set fire to a mountain-side covered with a plant which received its moisture from the fogs and mists on a rainless coast. When the fire had died down, the objects were seen on or projecting through the sand on the side of this ridge. They seem to have slid down from above, where they may have been left inadvertently or intentionally hidden. The writer, on visiting the locality, nearly two years after the objects were found, had the good fortune to witness the recovery of a plate identical with those in the Museum collection except that it was covered with a patina that gave it a beautiful russet color, marred by a few black spots. The objects in the Museum collection had been crudely cleaned except for certain inaccessible parts.

The method, that of casting instead of hammering, the fish design, the shape of the water vessels, and the alloy all indicate that the several objects were made on the northern coast of Peru.

It is usual to speak of our American Indians as living, when the continent was discovered by Columbus, in the Stone Age. This conception is only partly correct. It is true that north of Mexico metals were but little used. There are only two metals, copper and gold, which are found in any considerable quantity in a pure state. It happens that there is a considerable supply of free copper in the region of the Great Lakes, on the north Pacific Coast, and also near the Arctic Ocean along the Coppermine River. The Indians in the south and the Eskimos in the north had discovered the art of pounding this copper into useful tools. In the region of the Great Lakes in particular a great many excellent celts and chisels of the pre-Columbian period have been recovered. Gold objects of undoubted pre-Columbian date have been found rarely. A few pieces are known from Florida but it is possible that they reached this region by trade from the countries farther south. The Indians north of Mexico did not understand the art of smelting and alloying metals.

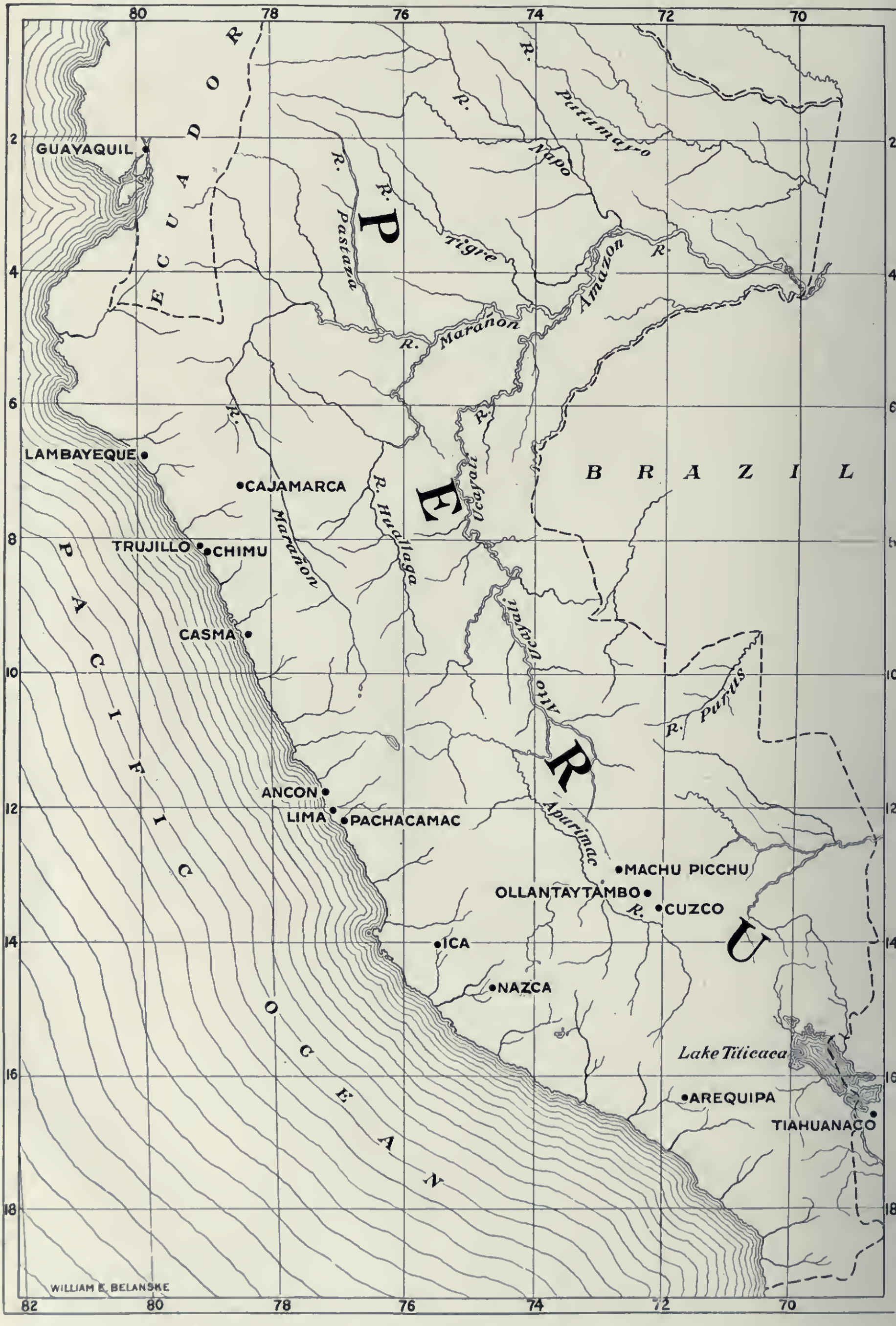
For the great region south of our border along the Pacific Coast to Chile the story is a different one. That is, of course, the region in which civilization had reached its highest stage at the time America was discovered. Here maize, beans, squash, pumpkins, the potato, cassava, cotton, and many other plants had been domesticated and in many places raised most efficiently by the aid of irrigation systems requiring great industry and considerable engineering skill. In the southern portion of the same territory the llama and alpaca had been tamed and made useful to mankind. Many of the arts were highly developed. Of special importance was the development of architecture. There are ruins in Peru showing most wonderful precision in the cutting and fitting together of huge stones, which were often transported many miles and placed in position in the walls of temples and fortresses, and this accomplished without the aid of animal or mechanical power. The Maya of Central America and Yucatan left behind marvelous examples of grotesque sculpture in stone.

Of scarcely less importance was the high development of pottery throughout this whole area of tropical America. Both in the modeling and decoration great technical skill and fine feeling for form and color were displayed. In the matter of textiles the work of the early Peruvians has never been surpassed either in the fineness and variety of the weaving or in the colors acquired by dyeing.

It is not surprising, then, that the people in this particular region had made considerable progress in working with metals. Gold seems to have been generally common in the sands of the coastwise streams. Its sparkle undoubtedly attracted the eye of the people and, when it was found to be easily malleable, its use in the arts was appreciated. It may be that copper was also first found in its pure state. By the time the Spaniards entered the region, however, considerable progress had been made in taking silver and copper ore out of the rock of the mountains and reducing the metals by means of blast furnaces. Two methods seem to have been employed in smelting; one was the use of a small pottery blast vessel, around which a number of men gathered with long copper tubes and blew upon the fire until the required heat was secured. A second method, spoken of in the early accounts, employed blast furnaces, which were located on the mountain-sides, where the strong prevailing winds furnished the necessary blast. Work of this sort undoubtedly had been in progress on the slope of the mountain ridge where the gold objects forming this collection were found. The drifting sand on the lower part of this ridge is fairly covered with small pieces of porous slag. In one place a furnace was found consisting of a pit in the ground, lined with fire clay and containing a quantity of ashes.

When once the metal had been secured by smelting, its fabrication into objects of art and utility was accomplished by several methods. The simplest was no doubt that of merely beating the metal into the required shape. This is fairly easy to accomplish, especially when the metals are pure and soft. We have from Peru a great many pieces of sheet metal evidently made by this method. By far the greater number of these were perforated and attached to the clothing worn by the living or buried with the dead. In many cases these pieces were decorated by having designs beaten into them. Perhaps the most noteworthy examples of beaten work in the American Museum collections are the cups of silver and gold representing a human face, usually with a very prominent nose. These are made in one piece without a seam.

The art of casting was well understood.



MAP OF PERU SHOWING THE PLACES OF ESPECIAL ARCHÆOLOGICAL INTEREST

We have a full description of the methods employed in the early Spanish reports from Mexico. The same methods were undoubtedly used in the entire region southward to Chile. A core was usually made of powdered charcoal and clay on which was laid a surface of wax molded and engraved to provide whatever form and decoration were desired in the finished object. Over this a shell was made of clay and charcoal. The molten metal was then turned into a small opening which had been provided through this shell, the wax melted and ran out, and the metal took its place. The Keith gold collection in the Mexican hall of the Museum shows many beautiful examples of casting according to this process. In one of the cases there will be found the cores used by the metal workers. The best examples of Peruvian casting are the small human images, undoubtedly idols, and the figures of llamas, also used ceremonially. Some of these have silver and gold combined by inlaying.

The effect of mixing metals to produce alloys was understood. There have been many speculations concerning the supposed lost art of hardening copper by various peoples in America and the Mediterranean region. An investigation of this subject, carried on a few years ago by the American Museum, resulted in finding that a large proportion of the copper implements from Peru were intentionally alloyed with tin. The bronze so produced was much harder than pure copper and much more serviceable for use in tools. Precision in the control of the alloying apparently had not been acquired, for the percentage of tin varies considerably, being on the average 7 per cent. Dr. Rivet has recently published analyses of many metal objects, particularly from Colombia and Ecuador. These show varying alloys of copper, silver, and gold. The results of the analyses of the objects forming this collection are, therefore, in strict keeping with what is known of the accomplishments of the pre-Spanish people of the South American region at the time when we may suppose that the objects were made.

By some process not as yet understood they were able to apply a very thin coating of gold to objects made of baser metals. The result is similar to our plated ware, but the method employed must, of course, have been entirely different. One of the experts who examined this collection was of the opinion that the disks or plates are so coated with a richer alloy. Many examples of these coated objects will be found in the Keith collection.

Perhaps the art of joining metals is the most difficult of all. Great progress has been made in our own day in the matter of electrical welding and the soldering of such difficult metals as aluminum. It has often been denied that the Peruvians had a knowledge of soldering. Many years ago Mr. Charles W. Mead, of the Museum staff, discovered solder used in joining the two halves of spherical beads of undoubted pre-Spanish origin. The solder, however, is not of the soft variety in use at the present day but simply a sufficiently different combination of the metals to secure a lower melting point. Such a knowledge of soldering and alloying must have been possessed by the manufacturers of the water vessels and the banded breastplates previously described.

We have in this collection not samples of the treasure of the imperial Incas about whom there has been so much glamour and romance, but examples of the very high and important civilization of the Chimu. These people of the coast, ruled over by the Chimu kings, wore exceptionally fine textiles, produced the most wonderful modeled and painted pottery, and built of clay imposing structures. From one of their great pyramids Don Garcia Gutierrez de Toledo took vast treasures in gold and silver; the share of the king, amounting to $1,250,000 in American money, was one fifth of the total, and indicates that the value of this acquisition must have been more than $6,000,000.

This big find of treasure, as well as the ransom of Atahualpa, the last reigning Inca, amounting to $17,000,000; the precious metal taken from Cuzco, said to exceed in value this ransom; and all the remaining treasure secured by the Spaniards soon after their coming to Peru, have disappeared, probably by way of the melting pot. Objects of personal ornament buried with the dead are still frequently recovered. Since the wonderful golden objects described above have found a permanent resting place where they will remain examples of the skill and art of the ancient Peruvians, the question naturally arises whether there are still other metal objects representing forms and types not now known which have so far escaped the treasure seekers. It seems possible that such is the case. It is highly important that they should either be discovered by representatives of museums, or, being discovered by others, that they should be immediately transferred to a museum for safe-keeping. It is encouraging to note that the Peruvian government has recently decreed additional protection against the devastation wrought by treasure seekers and is preventing the exportation of archæological objects except to well-established museums. May we not look forward to a revival of interest in the archæology of Peru?

Designs from textiles showing the interlocked fish motive of the gold water vessels

WATER VESSELS WITH COMBINATION SPOUT AND HANDLE ARE COMMON FROM THE NORTH COAST OF PERU, BUT MADE OF CLAY INSTEAD OF GOLD. THE PLATE-SHAPED OBJECTS WERE PROBABLY WORN ON THE BREAST AS A DECORATION

452a

Hafted stone hammers used by copper miners in Chile in pre-Spanish times.—The handles are of pliant green wood bent double over the heads of the hammers and fastened to them by thongs of llama hide

PREHISTORIC MINING IN WESTERN SOUTH AMERICA

BY

CHARLES W. MEAD*

THE American Museum has just received the "mummy" of a prehistoric copper miner from Chuquicamata, Chile, the gift of Guggenheim Brothers. It was exhumed in 1914 while a cross-cut was being cleared out in their mine.

A poncho, several stone hammers, and wooden shovels, or scrapers, were found with it; but the workmen who dug it out were not interested in these things and they were not preserved.

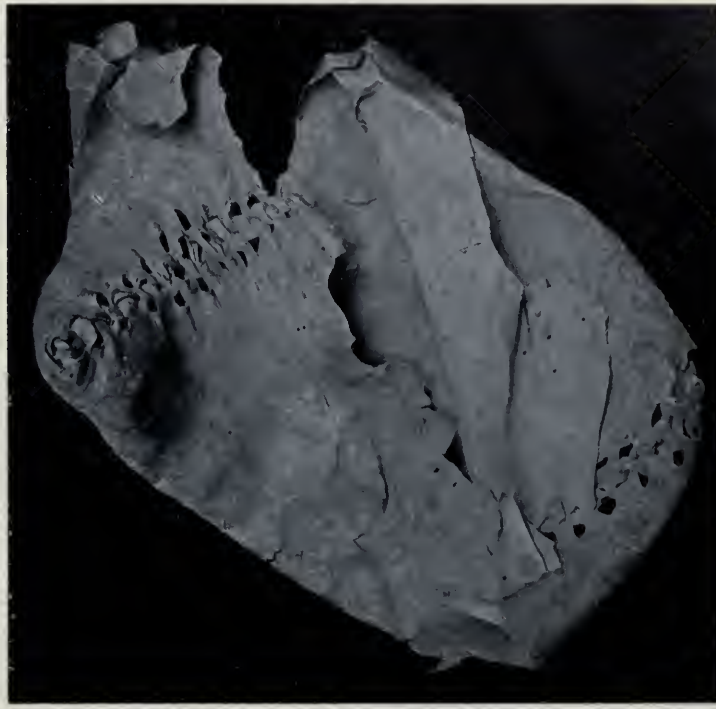
This ancient miner is now installed in the Peruvian hall of the American Museum, near our other Chuquicamata mummy, which was obtained through the generosity of the late J. Pierpont Morgan. The mummies were found in different parts of the same mine.

The exact time at which these miners lived and worked is unknown, but in all probability it was before the expedition of Almagro into Chile, 1535–37, as the implements found with them are primitive. We know that all over the western coast region the Indians discarded their own mining tools and adopted those of the Spaniards as soon as they came in contact with the invaders.

In prehistoric times the copper miner of Chuquicamata simply burrowed into the sides of a hill for a distance of perhaps a dozen or twenty feet to obtain ore, which he used in the making of his implements and ornaments. He found the copper in the form of blue or green sand (atacamite), which can be easily reduced. This he scraped up from the cleavage faces of the rocks and put into skin bags or baskets. He was able to collect a sufficient quantity with his stone hammers, wedges, and scrapers, as the ledges had been shattered by earthquakes centuries before his time.

The metallic ores used by primitive man in the region under consideration

*Assistant Curator of Peruvian Archæology, American Museum



DIFFERENT RECEPTACLES USED BY THE CHILEAN MINERS FOR CARRYING COPPER ORE

On the left are fragments of baskets of varying size devoted to this purpose; above is the torn remnant of a llama skin bag that was similarly employed. All of these objects were recovered from the mine that yielded the entombed Indians and were in close proximity to one of them were those which outcrop or occur near the surface of the ground. These are commonly oxides and carbonates, which are easily reduced to metal by the "hole in the ground" furnace. Evidences of pre-Spanish mining are numerous, showing that no very deep shaft was attempted. They either dug a pit of moderate depth or tunneled into the side of a mountain a short distance to reach a horizontal vein.

GOLD: Many of the quartz lodes of gold-bearing ores were formerly worked by the Incas or their predecessors as the remains of their old workings show. These excavations are often of considerable extent, but do not go below the oxidized zone. Finds in these works show how the gold was extracted. The crushing was done on a large, hollowed-out block of granite with a heavy rocking stone, three or four feet in diameter. To operate this rocking stone required the labor of more than one man. The present Indians make use of such a prehistoric "stamp" whenever they find one. The early historians tell us that in the dry season the Indians covered a part of the beds of streams with stones to arrest the particles of gold brought down by floods during the rainy season. On the return of the dry season the gravel between these stones was washed or panned and the gold obtained.

Before the coming of Pizarro the Peruvians had reached a very high degree of skill in working gold. They were familiar with the arts of casting in molds, hammering and soldering, and produced many forms of vessels that for excellence of workmanship and beauty of lines have never been surpassed. The American Museum's collections show that they made head bands, shawl pins, masks, human and animal figures, and a great variety of ornaments.

SILVER: Garcilasso says the Indians formerly had great difficulty in melting silver ore. They were unable to make it run until they discovered that when mixed with lead it yielded more easily. From time immemorial the Indians founded their metals in clay furnaces, called *guayras*. These furnaces were about three feet high, nearly square, and larger at the top than at the bottom. Sometimes copper tubes, through which the miners blew, answered for bellows, but the best results were obtained when the *guayra* was placed on some high point of the mountain where a strong wind was blowing. About 1540 the Spaniards began working the wonderfully productive silver-lead mine of Potosi. They soon found that the wind blast was superior to the bellows they were using and adopted the Indians' method. Many have written of the beauty of the spectacle of hundreds of these furnaces burning on dark nights on the highest points of the hills.

The mines of Potosi were not known to the Incas, but those of Porco, not far distant, seem to have been one of the chief sources of their silver supply. Silver is probably the most prolific mineral of Peru, and the mere enumeration of localities where it is mined today or has been in times past would fill this number of NATURAL HISTORY from cover to cover.

COPPER AND BRONZE: The prehistoric peoples of Peru mined and used a large quantity of copper in making their implements. Before the time of the Incas they had discovered the art of making bronze. They found that by smelting with the copper some tin ore (cassiterite), a metal resulted that was far superior to copper for their implements. With such crude methods as they used it was impossible to secure any uniformity in the amount of tin in their bronze. Analysis of 171 objects of copper and bronze, in the American Museum's collections, found in the ancient Peruvian graves, shows that the bronze pieces average between 6 and 7 per cent of tin.

In this connection it may not be out of place to call attention to a very popular error. We often read in books and

Hammer and wedges.—The wedges were driven by means of hammer blows into the cracks and crevices produced in the rocks by the oft-occurring earthquakes of the region. The powdery atacamite left after the prying away of a fragment of stone, rewarded the miner for his labor. This atacamite was the only form in which copper was available to the Chuquicamata in pre-Columbian times

magazines about the "Lost Art of Tempering Copper" as practised by the ancient Peruvians. Quite a number of persons, intent on rediscovering this lost art, have come to the American Museum to study our specimens of "tempered copper." The fact is that the Peruvians never had such an art; their tempered copper was bronze.

Quicksilver: This metal was well known to the Indians in pre-Columbian days. They worked the mines, however, only for the vermilion, which was used for paint. They did not learn the use of mercury in connection with mining until after the arrival of the Spaniards.

Tin: Although Bolivia now rivals the Malay Peninsula in the amount of tin produced, it does not appear that this metal was employed by the Indians in prehistoric times otherwise than by combining it with copper for the making of bronze implements. No vessels or other objects made entirely of tin have been found in the ancient graves.

The rich tin mines of Bolivia extend from the shores of Lake Titicaca southward nearly to the northern boundary of Argentina. In this section have been found the mines worked by the Indians in prehistoric times, many of which were later worked by the Spaniards.

Tin found in Bolivia is mostly in the form of cassiterite. The Indians could also easily have collected considerable quantities of cassiterite from the sands of many of the Bolivian rivers, by washing. In these sands it generally occurs in semi-rounded nodules and is easily reduced.

THE PHYSICAL CHARACTERISTICS OF THE TWO PREHISTORIC CHILEAN MINERS

BY

LOUIS R. SULLIVAN*

The bodies of the two Chilean miners referred to by Mr. Mead in his article on "Prehistoric Mining in Western South America" are in such a condition as to make it possible to describe fairly accurately their physical characters and racial relationships. These two bodies are natural mummies. The mummy presented by Mr. Morgan is infiltrated with copper and the body is preserved in great detail. Even the contours of the muscles remain. It is evident that the individual was a well-developed adult man in the prime of life. The mummy that is the gift of Guggenheim Brothers is a naturally dessicated

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body flexed at the hip and knee joints. It also is the body of an adult male in mid-life.

The sitting height of the latter mummy is about 78 centimeters. From our knowledge of the relationship of this diameter to stature it is almost certain that the height of this individual when standing was about 156 centimeters, or 5 feet, 2 inches. The skull is deformed by occipital flattening, which results in a very short head. The cephalic index is approximately 89. The face is very wide, the maximum transverse diameter reaching 150 millimeters. The hair is black and coarse, approaching the average Indian type.

The prostrate position of the mummy that Mr. Morgan donated enables us to measure the stature directly. The individual was approximately 157 centimeters, or 5 feet, 3 inches, tall. The occiput of this individual was also flattened. The feet are particularly well preserved and are very small and well formed. The length of the foot is less than 14 per cent of the stature, which is much smaller than the average proportion.

The two individuals were undoubtedly Indians, very much like the natives of this region at the present time, who are short in stature, much shorter in fact than a great majority of the American Indian groups. Mr. Mead informs me that tribally they are very likely to be Araucanians or a closely related tribe. The Araucanians are described by Bürger[1] as of medium stature, generally corpulent, with short hands and small feet and a large rounded (brachycephalic) head. The face is broad with slight prognathism. The forehead is low and flattened. The nose is broad and flat, the eyes small, the mouth large, and the lips thick. As nearly as we can reconstruct their physical appearance from their remains, there is every reason to believe that Mr. Mead is correct in saying that the mummies were probably Araucanians.

[1]Bürger, Otto: *Acht Lehr-und Wanderjahre in Chile*, Leipzig, 1909.

These shovels, or scrapers, were used in collecting atacamite. The upper one has a stone blade; the lower one is of wood

THE CLOUDS ON WHICH THE THIRSTY ANDEAN FORESTS DEPEND

The heavy forests of the tropics are often referred to as "rain forests" and sometimes as "cloud forests." Along the western and southwestern slopes of the coastal Andes of Ecuador it is not difficult to learn the reason for these names. Here, at certain seasons of the year, great banks of cloud are formed along the base of the mighty cordillera, the winds constantly piling up the masses of billowy vapor until, as far as the eye can reach, there is an undulating sea of white. All day these clouds may struggle to climb up the slopes, gradually mounting with the heat of the sun until late afternoon finds the aërial ocean ready to flow over the lofty passes. Then it is that opposing winds and curious cross-currents of air are made manifest. The main bulk of the clouds climbs irresistibly toward the northeast; an upper, detached stratum of fleecy whiteness is hurled back by the contrary wind of the higher zones; vagrant gusts slip through the passes, in a moment's time drive all the clouds from some valley, and then, confronted by the opposing winds, turn straight upward and issue as geysers, piercing upper and lower strata alike. It is these clouds which nourish and support the vast forest belts of the tropical, subtropical, and temperate zones. In the cool of the morning the moisture condenses and drips from the trees like rain; when later in the day the clouds begin to climb, the wraithlike streamers of mist which fill the forest spaces leave a dewlike frosting upon every leaf and bough

Mount Chimborazo, the loftiest of the Ecuadorian Andes

FROM HUMID FOREST TO SNOW-CAPPED HEIGHT IN ECUADOR

BY

H. E. ANTHONY*

ECUADOR is a most fascinating region to the Northerner no matter what may be his special field of interest. For one who finds enjoyment in the observation of native peoples, there are many subjects, ranging from the civilized Quichuas to the primitive Jivaros; for him who takes delight in wonderful scenery and exotic forests, there are countless opportunties for rapture; finally, for the student of natural history, Ecuador is a veritable treasure house of material and data. One of the most important phases of the work of the naturalist in Ecuador is the determination of the life zones and the distribution of life, while the fact that there are well marked life zones is one of the first things borne in upon the observing traveler.

It has been found by naturalists that the distribution of animals and plants is governed very largely by the operation of climatic factors, the principal ones being temperature and humidity. Conditions of geological environment being favorable, animals will inhabit a given region provided the conditions of temperature and humidity throughout the year produce an environmental complex to which they are adapted. This means that any large area may be mapped out, when all the data are at hand, into different zones or strips, each of which is characterized by an index factor, a more or less annual constant, made up of temperature and humidity. In each of these zones will be found forms of life, so long accustomed to this constant, so well adapted to this particular type of environment, that they are at once seen to be distinct from the forms in adjacent zones. This harmony with environment is seen throughout the scale of organized life, and the sum total of the plants and animals of one zone is invariably and obviously distinct from that of any other. However, some types of organisms have a great range of adaptability, and an animal so favored may be found living in several different zones. In general, those forms which are most susceptible to environmental conditions, often the most highly specialized forms,

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are the best zone markers, and we find their distribution quite sharply defined.

Ecuador presents a great diversity of conditions, and has well marked life zones, so well marked that even the casual traveler must note them, whether or not he be able to interpret the significance of what he sees. However, it is not always easy even for the student of life zones, much less for the casual traveler, to determine exact boundaries between the zones, because very often one zone merges insensibly into its neighbor, and there is a broad meeting ground between the two. It is this feature of the problem which makes the work in Ecuador of rather a different nature from researches in most of the South American republics. Ecuador lies in a unique geographical position, extending from sea level to more than 20,000 feet above it, astride the equator (a position of great significance with regard to winds and ocean currents), with great rivers flowing on the one hand into the Pacific, on the other into the Atlantic, and located along a portion of the Andean chain where a complex topography prevails. All of these factors must be taken into consideration, for they exert great influence upon the distribution of all forms of life in Ecuador, not excepting man himself.

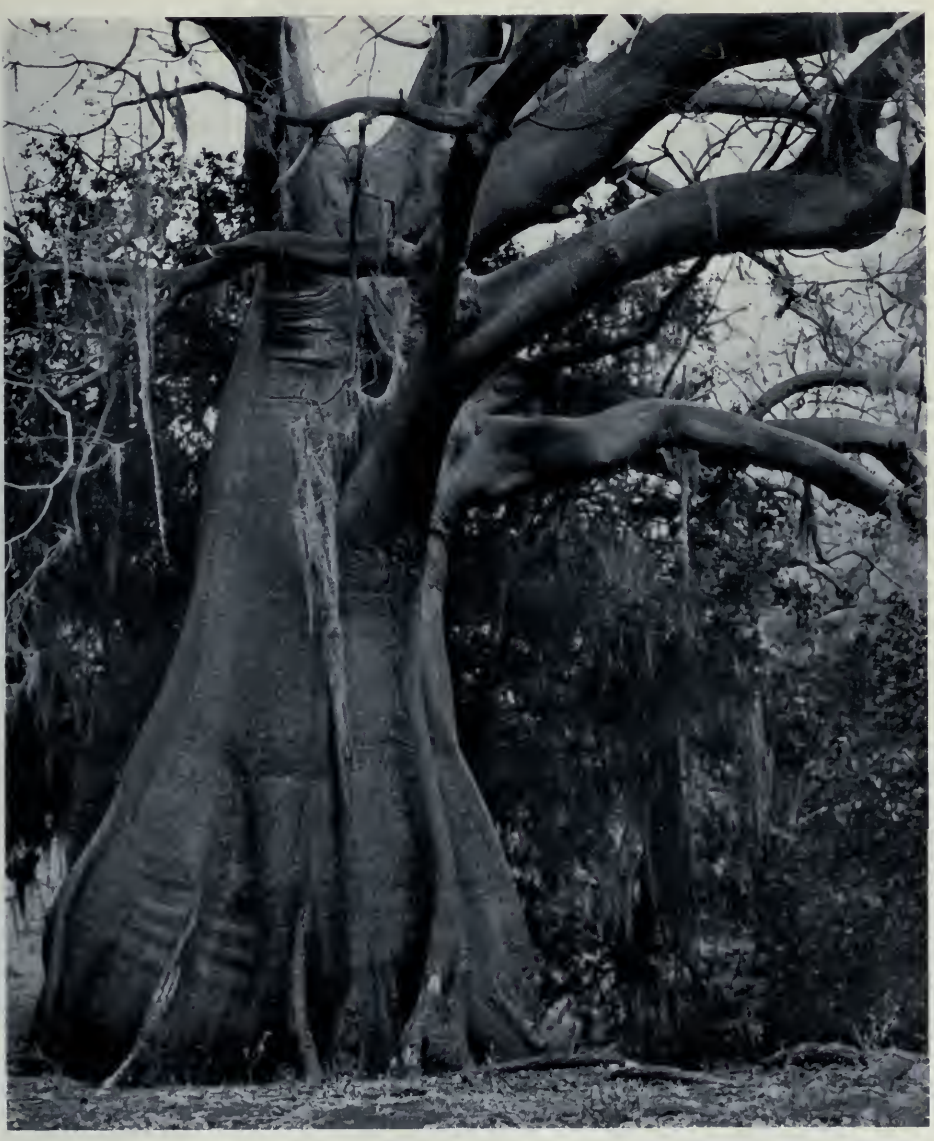
The winds along the western portion of Ecuador have a prevailing southern or southwestern origin. Farther to the south it is these same winds that produce desert conditions along the coast of Peru, but in southern Ecuador heavy forests make their appearance and the winds are rain-carrying, rather than drying, winds. Just why there should be this great difference in the nature of the wind is not perfectly clear, but it is undoubtedly a question that is bound up with the ocean currents.

The cold Humbolt current sweeping up from the south chills the landward breezes that cross it, with the result that the moisture content of the wind is very low when the continent is reached. When the wind passes over the warmer land and its temperature rises, its capacity for holding moisture being correspondingly raised, it draws up whatever moisture is available, thereby producing a vast strip of desert. This desert terminates about the southern border of Ecuador.

The winds in the eastern part of Ecuador come throughout the year from the east and carry an abundance of moisture. The Inter-Andean region may be reached by winds from either side, more or less robbed of moisture by their passage over the high mountains, and here the question of local topography and exposure is most important.

Keeping in mind this very general outline of the principal factors influencing the distribution of life, let us consider the life zones of southern Ecuador. The limits of these zones may be approximately fixed at certain altitudes. Thus, all of the land from sea level to about 5000 feet above sea level may be considered as the tropical zone; from 5000 feet to 9000 feet as the subtropical zone; from 9000 feet to 12,000 feet as the south temperate; from 12,000 feet and above as the paramo zone. These limits vary somewhat with local conditions so that there is an overlapping of the altitudinal extent of one zone on to the extent of the next zone, if any very great area is under consideration.

The tropical zone is very extensive, including almost half of Ecuador. Accordingly as the rainfall is heavy or light, it may be treated as the humid tropical or arid tropical zone. The humid tropical zone is one of the most characteristically "South American" zones; that is to say, the Northerner will see in this zone more than elsewhere those features that are foreign to his eyes. It is a zone of vast forests, where plant life flourishes and luxuriant vegetation makes an impenetrable jungle. The principal trees of the forest are large and grow to great heights, some of them branching out to form vast canopies of leaves. The names of these trees are legion, but among the most conspicuous are the varieties of wild fig and



One of the large, green-barked *Ceiba* of the Casanga Valley, in the arid tropical zone. The "cotton" from the pods of this tree is used under the name of "Kapok" as a stuffing for mattresses, pillows, etc.

of the silk-cotton or kapok. Others are the so-called cedar, rubber trees, ivory-nut, and many species of palms.

Most of the larger trees grow to a respectable height before sending out branches and, because such heavy structures need to be well anchored, they have developed wonderful root systems. Some of the fig trees and the *Ceiba* have far-flung roots that stand up above the ground as mighty ribs, and run up on the trunk several feet to form wide, thin flanges. Other trees have roots that twist out, like the arms of a gigantic octopus, to seek a distant hold and in their twists and turnings form a host of hiding places for prowling marauders.

Under the taller trees may be seen

great numbers of less aspiring growths that fill in the gaps and catch the scant sunlight that is permitted to filter through the leaves above. Over all the trees, large and small, is a great collection of climbing vines or lianas, called *bejucos* in Spanish. These vines are of all sizes from threadlike filaments to ropelike creepers the size of a hawser. They hang down from the limbs in straight falls, they loop over from one tree to another, or sometimes come down to the ground to make a snare for the feet of the unwary.

Everywhere, along the limbs or on the trunks, are to be seen parasitic plants, such as the orchids and bromelias. These are epiphytic plants, sending their roots into crannies in the bark, but drawing their food from the air. The widely spreading boughs of the large forest trees serve as cradles to hold great masses of fallen leaves, rotted bark, and insect-carried material, and upon such a foundation orchids and beautiful ferns thrive, with the result that the trees seem in themselves miniature forests.

Upon the ground there is a tangle of low shrubs and other vegetation similar to that aloft. Ferns grow in huge masses, thick moss covers the fallen logs and stones, tough bushes and miscellaneous growths fill in the gaps, and render it necessary for one to hew out a path in order to penetrate the jungle.

The finest type of jungle is rather dark and gloomy in aspect, because of the dense screening of leaves, but there is in reality little lack of color. The foliage is a rich, dark green; numerous trees have brilliant blossoms and many of the orchids are exquisite bits of color.

Blooms of the arid tropical zone.—The showy purple orchid (on the left) grows not in damp, moist nooks, but out in blazing sunlight; the waxy white flower (on the right) is the blossom of a good-sized tree

The humid tropical zone is a realm of life *par excellence* and probably in no other zone is there such a number of species or of individuals. Conditions are favorable for animal life, since there is an abundance of vegetation with all that this implies in the way of food; hiding places and cover are on all sides, and there is plenty of water. The jungle is acrawl with the lower forms of life; countless multitudes of ants work night and day, the long, clean-swept paths of the leaf-cutting ants being seen everywhere, while dense waves of carnivorous ants periodically sweep over large areas. Termites, the so-called white ants, build huge nests on the limbs of trees and riddle dead timber. Brightly colored butterflies of great size float lazily through the upper regions by day, while more sober-hued, but even more marvelously colored, moths make their appearance at sundown. Frogs frequent every little brook course and damp spot where fallen leaves give them cover, vociferous at night or on overcast days, and beautiful in their colors of clear green with markings of yellow or red. Lizards and snakes, while not often seen, nevertheless lurk in suitable localities and the brilliant coral snake, with bands as precise and conspicuous as if they had been painted on with a brush dipped successively in red, yellow, and black, is a not uncommon sight. A rarer snake is the huge anaconda, which may reach a length of as much as fifteen to twenty feet and a girth of astonishing dimensions.

Birds are present in great variety, the number of distinct forms being more than three hundred. Many of them would occasion little comment if seen in northern woods, but there are hosts of others utterly unlike anything in the north. Noisy parrots, gaudy macaws, grotesque toucans, showy hangnests or caciques, and many others are found in the forests of this zone, and are among the most conspicuous denizens. Life and color are added by the flashing plumage of humming birds, trogons, tanagers, and the cotingas.

The mammals are more secretive and difficult to observe; nevertheless, in time a great many species may be noted. The most prominent mammals are the monkeys, among which first place is given to the large howler, whose reverberating roar is a voice worthy of the jungle, and as characteristic as is the voice of the

The bristling cactus is the only green plant safe from the ravenous domestic goats which are found in some parts of the arid tropical zone

One of the redeeming features of the arid tropical zone is the unobstructed vista one may have of distant ranges, snowy clouds, and serpentine trails writhing off into the horizon

coyote on our western plains. The sonorous voice of the howling monkey seems fairly to shake the air when heard at close range.

The arid section of the tropical zone differs as much from the humid section of this zone as does day from night. It is a region of intense sunlight and open spaces, a region of little rainfall and of hot, parched plains and hillsides. There is an extensive strip along the coast of southern Ecuador which lies wholly within the arid tropical zone, and, wherever river valleys open up long vistas from the coast eastward into the interior, this zone has penetrated and the same desert conditions prevail.

In some districts the aridity is intense, but the section throughout is characterized by a lack of moisture for the greater part of the year. The flora is all of drought-resisting types, of which the cactus is the best example. Cacti of many species, from the flat-leaved *Opuntia*, or prickly pear, to the tall columnar forms, which spread out to cover considerable area, are found in the arid tropical zone of southern Ecuador. Occasionally a thornless *Opuntia* is seen, but by far the greater number of cacti are well provided with thorns. Equally thorny are the tangles of mesquite, which form perhaps the largest masses of vegetation in this section of the zone. Along the scattered watercourses, where streams struggle for a precarious existence, may be found gallery forests of small, deciduous trees, which have a general appearance very similar to that of the deciduous groves of New England. The finest floral species of these regions are the species of desert-loving *Ceiba*. One species in particular, a huge, green-barked tree is found in numbers along the Rio Casanga and is almost the only beautiful feature in an unattractive, sunbaked valley.

Despite the forbidding aspect of the arid tropical zone, inhospitable to the traveler who rides through it, mile upon dusty mile, under a pitilessly blazing sun, organized life may be found there in comparative abundance, wherever local conditions favor a concentration. Such conditions are encountered along the watercourses and a surprisingly large number of living creatures may be found frequenting the region.

The invertebrates are numerous, and often, as in the case of the ants, a great source of annoyance. The lower vertebrates thrive in such places, and lizards find congenial homes on the hot sands and sun-baked soil. Puffy toads spend the day secreted in seemingly inadequate hiding places, but with sundown hop out into the open to gulp down night-moving insects.

The birds in the aggregate may represent many species, but as a rule make only a poor showing of individuals. The group of flycatchers is well represented and one of them, the vermilion flycatcher in his flaming garb, furnishes the most brilliant spot of color in this region of burnt-out tones. Swifts, in twittering bands, dash along aërial lanes and find congenial home sites in the rotted cavities of the *Ceiba*. A noisy black and white jay, with the descriptive native name of "chaca-chaca," is a most characteristic bird of the arid tropical zone. The birds most apt to attract attention, however, are the ovenbirds and cactus wrens. The ovenbird takes its name from the domelike nest it builds of mud, which sun-bakes and forms a perfect miniature of the larger ovens made by the natives. The bird itself, slightly smaller than a robin, has a strident, ringing call and is not timid about using it. The most extraordinary vocal performance of any bird I heard in Ecuador was rendered by the cactus wren. It was a rapid jabbering of harsh, discordant notes, seemingly without much attempt at following any set pattern, and sounding as if the bird were seized with an inordinate desire to clear its throat and tell all it knew in as few seconds as possible. A very familiar aspect is given to this assemblage of bird life by the presence of mocking birds and doves very much like those of our Southwest.

The mammals, for the most part, confine themselves to the areas near the watercourses. Here various small rodents live upon the vegetation, and predatory mammals come hither to live upon the rodents. Opossums of several species follow along the streams, and a small doglike carnivore, resembling very much a small coyote, is an abundant resident. One of the most beautiful, as well as the most conspicuous, mammals is a fine, large tree squirrel, about the size of the eastern gray squirrel but much more strikingly marked, and with a very long, broad tail. These squirrels are only found where shrubs and trees afford them a suitable environment.

Beginning at an approximate lower level of 5000 feet the subtropical zone supplants the tropical. In Ecuador it appears to be entirely of the one character, humid, so that there is no need to divide it into the two sections of arid and humid. The subtropical is a forested zone and the splendid development of the trees to be found in it is exceeded only by that in the zone below. The character of the jungle has changed somewhat, and while it is a change that is very apparent to the observer on the spot, it is not easy to bring out by words the many points of difference. Generally speaking, the trees themselves are somewhat smaller while the undergrowth is more open and the jungle is not so dense. Parasitic plants are abundant and apparently thrive as well in the subtropics as at lower altitudes. Possibly one of the most noteworthy differences is the greater abundance of the tree ferns in the subtropical zone. These beautiful growths are a very conspicuous feature of the forests at this elevation, and their graceful lines, combined with the delicate tracery of their fronds, would call forth admiration from the dullest of beholders.

WHERE FERNS LUXURIATE

The subtropical zone is the home of ferns, among which the tree fern stands preëminent. It rises above its lesser brethren of the ground level and thrusts its head up among the hanging mosses of the forest. It is always of robust, vigorous growth. In color the fronds are a strong and pleasing green while in outline they are grace itself

A MASSIVE LIANA-DRAPED FIG TREE

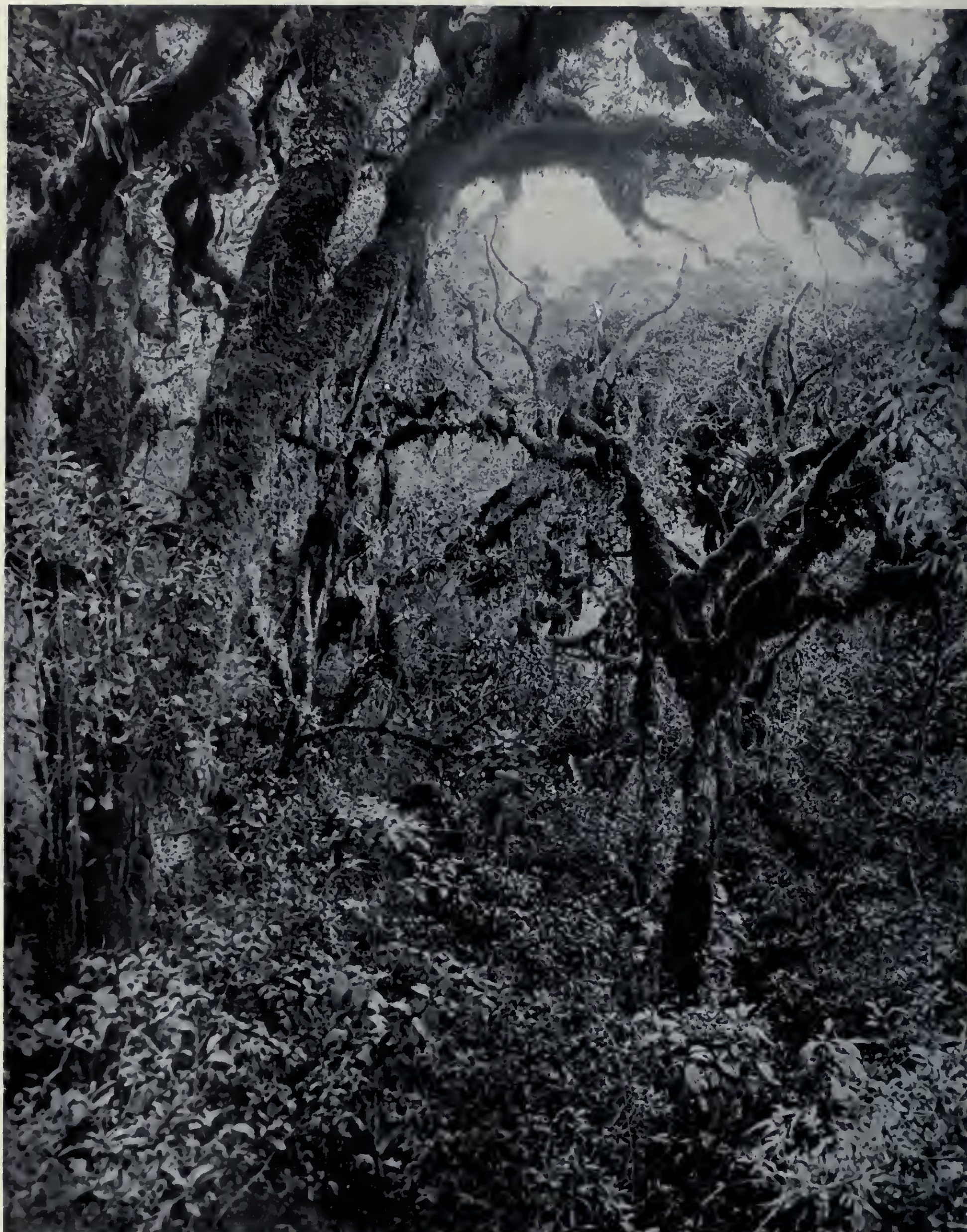
Wild fig trees of many different species grow in the subtropical zone, some of them veritable forest giants, huge at the base and branching out overhead to give the shade of half a dozen ordinary trees. The trunk near the ground is fluted and ribbed where the flange-like roots run up, forming many a deep crevice and hollow in which creatures may lurk—spiders, scorpions, or even opossums—and everywhere the drooping lianas and persistent air plants seek to hide the bark

CLOUD-DRENCHED SLOPES

The subtropical zone, in southern Ecuador, lies on the flanks and along the lower ridges of the Andes. It is a cloud-swept region, and daily the dense banks of clouds which sunrise finds piled about the base of the range lift and slowly mount up, drifting through the tree tops and often drenching the forest as thoroughly as would rain

A TYPICAL SCENE IN THE ARID TEMPERATE ZONE

The temperate zone has its greatest extent along the Inter-Andean region. In the arid section of this zone the rainfall, though light in comparison with that of the humid zones, occurs in heavy showers and storms of considerable intensity, when the bare mountain slopes are gashed and eroded by muddy torrents, and the normally shallow rivers overnight become roaring barriers of foam-flecked water too dangerous to ford. The trails over these stretches follow down the desolate, burned-up valleys for a distance and then, more often than not, turn aside to climb some mountain rampart



A FOREST OF THE HUMID TEMPERATE ZONE

So well watered are the forests of this zone by the mists and clouds which filter through them that every trunk and bough is deeply overgrown with green moss. The trees are lower than those of the subtropic zone and are very apt to be widely branching, a condition which creates dark, gloomy aisles under the trees. When the damp white mists drive through the forest, all life is silent and the spaces under the trees become doubly dark; at such times one is likely to feel very much alone as he walks over the yielding mosses which carpet the ground

The animal life is quite similar to that of the tropical, and, as a matter of fact, most of the species have been originally evolved from ancestors that migrated up from the lower zone. For a great many species the subtropical is the zone of greatest abundance, but most of the comments made on the life of the tropical will apply equally well to that zone.

Leaving below us the subtropical, we encounter a zone where conditions more nearly approximate those under which most of us live in the North. This is the south temperate zone and should be treated under the two sections of arid and humid. It is extensive and takes in most of the Inter-Andean region, the region of cereal growth and cultivation. Because of the elevation, from 9,000 feet to about 12,000 feet, the temperature is cooler and crops such as wheat, barley, alfalfa, etc., are raised.

The forests of the humid temperate zone are the culmination of the mighty growth that begins at the basal plain. The upper limit of forestation is reached in the temperate zone, and, even at the lower limit of the zone, it will be noted at once that the size of the trees has greatly decreased. The tangled character of the jungle is not lost, however, and the trees in many places show a tendency to flatten down and branch widely, with the result that a perfect canopy is formed overhead and damp, dark forests result. The winds of this region are heavily moisture-laden, and the fogs that drift in through the trees nourish mosses and bromelias, which cover the trunks and limbs in profusion. So closely associated is this forest with exposure to the moist winds that the upper limit follows lines that, from their geographical contour, are seen to be established primarily by the direction and nature of the wind.

In this forest one finds a great abundance of life, but with the number of species less than in the lower zones. It is a relief to discover the scarcity of some forms, such as the ants and mosquitoes, but a disappointment to learn that the monkeys do not relish the cold nights of the upper elevations. Birds are the most frequently seen of all the classes of life and the assemblage is made up of species essentially South American, such as the parrots, with a plentiful sprinkling of species that would look at home in northern woods, such as the robins and woodpeckers. The birds oftenest noted are the noisy parrakeets, the brilliantly colored tanagers and cotingas, the somber wood hewers, humming birds in great variety, guans, blue jays, robins, and ant thrushes.

Mammals have become scarcer with the ascent into the temperate zone, although a long list may be made up of the mammals known to frequent this zone. Squirrels are rare in the upper stretches of forest, but terrestrial rodents, rats and mice, may be trapped there, while many forms, such as the coatimundi and brocket deer, may follow up to the limit of the forest. One of the most interesting denizens of this colder zone is a small opossum, *Cænolestes*, whose ancestry is shrouded in mystery and whose characters make him appear as a relic of an ancient world. This animal looks like a greatly enlarged shrew and has habits very much like those of a shrew.

The arid south temperate zone in its extreme manifestations has little to commend it. It embraces great stretches of hopelessly barren, God-forsaken, hillsides and valleys where one may ride for miles without seeing a green plant, or may skirt sheer slopes of eroded mountains which are incapable of supporting highly organized life. The trails north and south along the Andes pass through much of this territory, and to the traveler this type of country becomes tiringly monotonous. Wherever man is struggling to wrest a livelihood, one sees long fences made of the century plant or *cabuya,* the robust leaves of which brighten up the dusty landscape with refreshing green. *Eucalyptus* trees have been introduced and are seen in graceful

Parts of the arid temperate zone are so desolate and so uninviting that they appear to be unfinished bits of Nature's handiwork. The valley of the Rio Udushapa has been torn out of the mountains by the rushing river and is wild in the extreme

groves, which look out of place in the region. A variety of native cherry produces an abundance of bright fruit to attract the robins, but to the traveler the fruit is a delusion and a snare.

The upper limits of this zone often include great sweeping grass plains, known as *pajon* to the native. On these plains and in the bushy ravines adjacent, it is possible to encounter rather more mammals and birds than throughout most of the arid section of the zone.

Hares, resembling our "cottontail rabbit," and a big, black and white striped skunk are common here while white-tailed deer and a fair-sized "coyote" represent the larger animals.

The uppermost zone is the paramo, and it begins at the upper limit of cultivation, generally about 12,000 feet, including at the other extreme the snow-clad peaks of northern Ecuador.

The paramo zone is open country, since it lies above the tree line, but here and there low shrubs may find shelter and give relief to the barren hillsides. From the view point of the collector, the richest sections of this zone are the

Rolling green meadows are found even in the paramo zone, the high wind-swept area of the Andean uplands

vast rolling plains, cut up by an occasional ravine. On these plains, green grass grows the year around and they have in consequence the aspect of beautiful meadows. The rainfall is copious and, with an abundance of moisture, such plant life as can resist the elevation thrives exceedingly. Clear, cool streams drain the region and there is a tendency toward the formation of marshes. At certain seasons the winds are strong and, because of the humidity, very piercing, while ice often forms overnight. Snow, except above 15,000 feet, is rare.

This zone presents the greatest possible contrast to the other zones, not only in the very apparent details of temperature, elevation, and degree of forestation, but also in the character of the life found there.

Invertebrates are scarce and only to be found upon search; there is none of the obtrusive activity seen in the lower zones. Snakes and lizards are equally scarce, but the amphibians find conditions very much to their liking. Frogs and toads of several species are numerous, and one of the most characteristic animals of this zone is a small, very dark green frog found everywhere in the green grass. This frog moves so slowly that it gives one the impression that it is either very senile and decrepit, or else that it has just come off a cake of ice and is numbed to the very bone. It moves each leg most deliberately, does not hop, but steps awkwardly out, one leg at a time, displaying a white under surface to the hand and foot in marked contrast to the dark back.

Many splendid birds make their home in the paramo zone, among them the Andean jacksnipe, Andean teal, Cayenne plover, king vulture, and condor. The condor, with his great wingspread, and impressive, majestic flight appears in perfect keeping with the vast distances and unrestricted vistas of this open zone. The Cayenne plover, with a clarion call and a dashing quality in its flight, portrays equally well, although in a different manner, the spirit of freedom so manifest in this zone, at the very top of the world with only the blue sky above it. Ranging extensively in the paramo zone and also coming up from the temperate are the tapir,—largest of the South American mammalia,—the spectacled bear, the white-tailed deer, and the Andean "coyote."

As was pointed out in the beginning, local conditions and topography influence greatly the limits of these zones. A mountain ridge may be a barrier to winds and as a result one may pass at a step from humid forest into arid conditions without any gradual transition and if only one cares to use his eyes, he may find something of interest everywhere.

THE MARSUPIAL FROG

This Andean batrachian receives its name from the pouch on the back of the female. In this pouch the young are reared until an advanced stage in their tadpole existence. In the upper figure a tadpole may be seen at the orifice of this pouch nursery, which greatly distends the skin of the parent's back.

The male (lower figure) is smaller and differently colored from the female. Such sexual dimorphism is rare among frogs.

Both of these batrachian portraits (about natural size) were made in the laboratory of the expedition at Huancabamba

A SEARCH FOR THE MARSUPIAL FROG

BY

G. KINGSLEY NOBLE*

With photographs by the author

IMAGINE a hundred-odd adobe huts scattered about haphazardly on a rising in the coastal deserts of Peru, a white dust thick upon the gray walls and reflecting back a scorching sun. Our first impression of Sullana was not pleasing. It did not seem possible that such stifling atmosphere could support life. But, hidden from view, beyond the mesa lay the fertile Chira valley, one of those narrow, life-giving arteries which cross the coastal plain and serve to connect the interior of Peru with the outer world.

We had come to Peru to make a zoological and anthropological reconnaisance of one of the least known portions of the country. Our expedition, sent out jointly by the Museum of Comparative Zoölogy and the Harvard School of Tropical Medicine, had selected Sullana as a base for a start into the interior. Our plans were not to make a mere dash across northwestern Peru, but rather to seek out regions especially favorable for study. Of problems we had many, but those which concerned me most were centered on the life histories and habits of the reptiles and amphibians, especially the remarkable frogs of the Andean region.

We had already made the acquaintance of several Peruvian hotels and were not anxious to stay longer than necessary at Hotel Oriental. It was, however, the twenty-eighth of July, which in Peru corresponds to our Fourth, the day that Miranda and Bolivar agreed upon Peruvian freedom. What loyal Peruvian would help us secure mules on such a day? Every hut had its banner of red and white hanging from the thatch over the door. The banners, at least, made us think it was auspicious for the inauguration of a Harvard expedition.

In spite of the banners, however, fate was contrary. *Arrieros* could not be had at any price. We would have to wait until after the *fiesta* which would last—probably as long as the *aguardiente* (liquid refreshment). It thus happened that we came to know something of Sullana and the green valley beyond, in which the whole life of the coast at that point is concentrated.

The dense thickets along the edge of the Chira River afforded hiding places for many lizards. There were several genera of long-headed teiids, among them *Dicrodon*, a very little-known creature of nearly the same color as the sand. I soon became absorbed in a colony of burrowing owls, in a flock of parrakeets, *Aratinga rubrolarvatus*, and finally in a great mocking bird, *Mimus longicaudatus punensis*, which could catch lizards much faster than I. The mocking bird usually perched on a cactus stub waiting for some *Tropidurus* or other lizard to jerk its head nervously up and down in the fashion common to these creatures. Then the bird would make a swoop, which nearly always spelled disaster for the unfortunate lizard. It was not long, however, before I devised a way of beating the mocking bird at its lizard-catching game.

The quickest way of determining exactly what forms of reptile or amphibian life exist in a region is to scour the country with what I called "frog hounds." These are boys of various ages who, when encouraged and directed, resolve themselves into a system of prying hands. Such a unit moves across the country like a great amœba thrusting forth pseudopodia in all directions. Every log, stone, and brush pile in its path is engulfed, the reptile and amphibian life assimilated, and the residue of inorganic

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We arrived at Sullana, our first base, on the Peruvian Independence Day, and found the town bedecked with banners

Two of the "frog hounds."—The boy on the left carries a blowgun and a quiver of bamboo arrows. The snakes were secured with this native weapon

Our dash across the traditional bandit region was begun before sunrise. The two men wearing Panama hats formed our military escort; the other two are members of the expedition

fragments strewn behind it as it moves. It is useless, and sometimes dangerous, if not controlled and coördinated. Once in Panama, I saw such an amœba of my making demolish in its enthusiasm an entire fence around a church to secure a single lizard three inches long.

It is not always a simple procedure to create such an organism. Boys are not always to be had, and again, they may not be easy to train. At Sullana, I found no trouble, however. With my frog hounds unleashed, specimens soon flowed in by hundreds. One day in the hotel, when trying to count the catch of several boys at once, one of the collectors dropped his bag and his entire booty for the day went scurrying across the hotel floor. The boys pounced upon the darting streaks like a pack of beagles. But they were not quick enough, for one, a large *Tropidurus,* was soon beyond their reach and at the open door. Just at this moment, a tame mocking bird, which had been contemplating, from a religious picture on the wall, the confused dispersal of reptiles and the tumbling mob of boys, darted forth and in a flash gulped down the unfortunate lizard just as it was about to cross the threshold to freedom.

It was a week later that we finally started on our way toward the cordillera. It was then that we first learned the inconvenience of being important. The subprefect was in duty bound to insure our safety against outlaws. We would have to leave at midnight, with a heavy guard and without impedimenta. The success of an expedition is often dependent on one's equipment, and it was only after much urging from the subprefect that we finally entrusted our prospects to twelve burros and two boys, leaving them to start off across the desert by a different and longer route than the one we intended to take that night.

We lay down early that evening to secure a little sleep but with indifferent success, for a pair of cactus wrens, *Heleodytes balteatus,* nesting close by, scolded raucously until long after dark. It was half past four in the morning before the guard arrived with much stamping and subdued whispering. In a moment we were in the saddle and out of the patio, although we knew well enough that the late start would bring us to the bandit country in broad daylight. We carried only our rifles and an *alforja* (saddlebag) of necessities. Still, it was an infinite relief to be on the way.

The first glint of dawn revealed the fact that our guard consisted of but two soldiers. Neither seemed particularly concerned about the outlaws. As we cantered along side by side, one soldier confided to me that he was a sergeant. This was informing, for he wore a panama hat and a pair of dilapidated trousers. In fact, the only evidence of his authority were two or three tarnished buttons still clinging to his coat.

We were following the south bank of the Piura River. After leaving Tambo Grande, habitations became more numerous. I use the word habitation to indicate a thatch roof mounted upon four sticks without walls of any sort. We saw whole families, women, babies, chickens, guinea pigs, all living together under such shelters. Dogs were ubiquitous and great Caracaras, *Polyborus cheriway auduboni*, walked haughtily about the clearings. It was a novel sight for me to find these great falconids strolling about the clearings with the chickens.

We rode into Chulucanas just in time to find the *comisario*, who was about to start on a trip to Morropon. As two armed guards were to accompany him, we bade farewell to our own escort and joined his party. This change of escort was a decided improvement from the standpoint of the picturesque. Our new guards wore military caps, around the edges of which were tucked long white cloths, which fluttered in the wind as the guards rode, recalling to mind picture-book figures of Arabian horsemen. The *comisario* was most unmilitary in appearance. Still, he did everything to make our journey a pleasant one. He repeated the only two words he knew in English—"bottoms up"—over and over again, even at most inappropriate times.

On leaving Salitral, the trail steepens and climbs out of the Piura valley. It strives to hold to the summit of each

Even our riding mules experienced considerable difficulty in following the trail, which for many miles was broken into these transverse ruts by the feet of mules that had passed over the trail before ours. The mule is standing up in the middle of the trail ridge and in this way avoids the valleys, which were choked with vegetation. We were riding along the spurs of the outer range of the Andes. The trail zigzags back and forth, seldom attaining a height of eight thousand feet. It may thus be said to be one of the lowest routes, although by no means the most passable, across the western cordillera.

It was late in the afternoon of the fifth day after leaving Sullana that we reached the summit of the cordillera and started the descent of two thousand feet to the town of Huancabamba. It was there we had planned to meet our equipment and make our first station in a survey of the region.

Our first act upon reaching Huancabamba was to select a house which would be our laboratory for the following month. Fortunately one of the largest houses in the town was available. This was a two-story, ten-room residence with a beautiful garden and patio. We finally agreed to pay $2.50 a week for rental. Señor Sidio was so delighted with the bargain that he insisted on our dining at his own home. That evening we commenced our Huancabamba diet: beans, floating in an oily liquid, rice, goat meat, and coffee. During the days that followed, eggs were occasionally substituted for the goat meat, but the floating beans were always present.

The trail to Huancabamba zigzagged back and forth with innumerable short turns. Our expedition at this point is attempting to pass a pack train of oxen coming from the opposite direction

Huancabamba lies on a slope overlooking a mountain torrent. The country on either side is steep and barren. Still, there are pockets of less dry areas and in these we found tropical animals and plants. Huancabamba seemed to be the mingling point of several diverse biotas. Bananas and cacti grew side by side. Spotted sandpipers were nearly always to be found along the water's edge, while two species of parrots loudly proclaimed their presence among the few trees which clung to the sides of the valley. My traps yielded opossum and skunks similar in outward appearance to those we find in New England. Still, the dominant facies of the fauna seemed tropical, although much out of place in such a barren region. It came as a distinct shock one day to find *Peripatus*, that lowly progenitor of the tracheate arthropods, under stones along a roadway. I had always associated *Peripatus* with tropical forests. The shock was not an unpleasant one when the *Peripatus* proved later to be a new species.

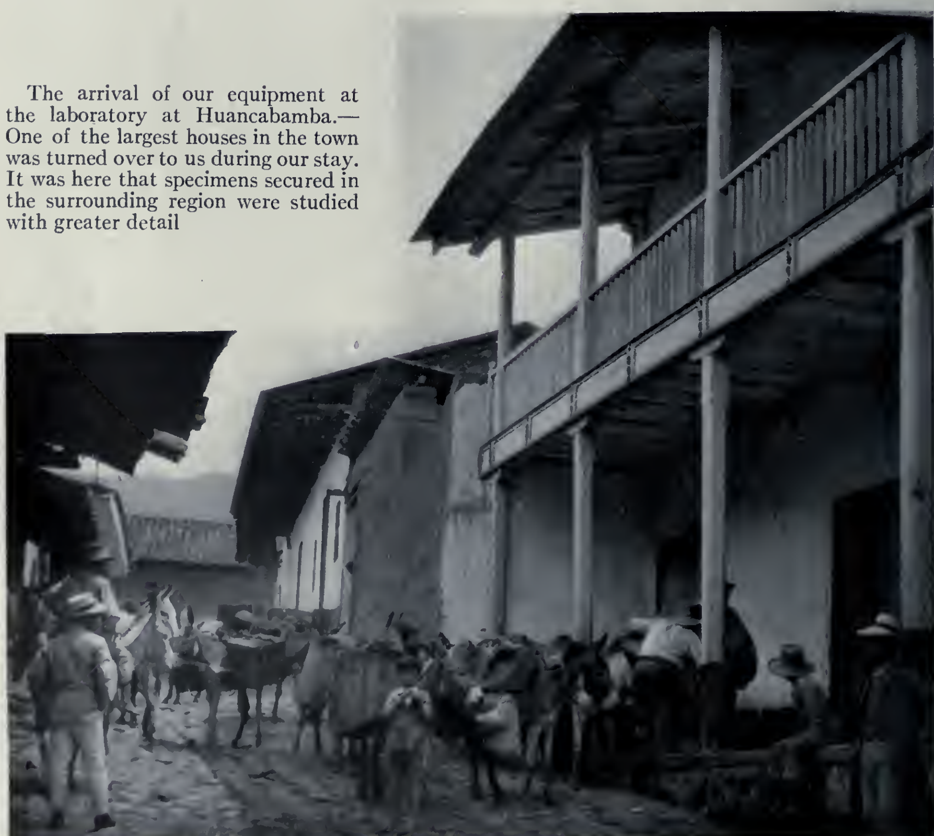
It should be emphasized that at

Huancabamba there was no standing water, no ponds, lakes, or even streams, nothing but the torrent which rushed madly down the valley. We had come to Huancabamba especially to secure data on the life histories of amphibians. Frogs and toads, as we know them in the north, require ponds and marshes in which to lay their eggs. Nevertheless, in pondless Huancabamba, there were frogs, and these of several species. The first frog we caught was a large *Eleutherodactylus*, new to science. This creature probably maintained its nursery, as do the other members of the genus, in the moist spaces between the leaves of some of the bromeliaceous plants. The developing young have no gills, or tadpole mouth parts, but maintain a broad tail which acts not as a locomotory but as a respiratory apparatus. The little froglets undergo their entire development within the egg capsule and do not break the gelatinous envelope until they have assumed nearly the adult form.

A little later, I came upon my first *Phyllobates*. A little rain water had collected in the ruts in one of the roads and was seeping out across a meadow. Several of these diminutive frogs were transporting their families of tadpoles to the deeper portions of the puddle. It is apparently only the male which carries the offspring. They were adhering in threes, fives, or even larger groups, to the back of the parent merely by the suckers of their mouths. Still, they did not release their hold until placed in a container.

By far the most interesting of these extraordinary frogs of the Andes, is one which has long been known as the

The arrival of our equipment at the laboratory at Huancabamba.—One of the largest houses in the town was turned over to us during our stay. It was here that specimens secured in the surrounding region were studied with greater detail



marsupial frog. The female is provided with a pouch in which she carries the eggs until well developed. The taxonomist who first bestowed a scientific name on the marsupial frog must have closed his eyes and conjured up the image of a kangaroo or other marsupial, for he called the frog *Gastrotheca*. As a matter of fact, the theca, or pouch, is not gastral at all, but dorsal. Still, according to rules of priority which obtain in scientific nomenclature, the frog must continue to bear its inappropriate name.

Many fascinating problems in the life history of the marsupial frog have remained for years unsolved. Very little is known about the frog itself, its pouch, its egg-laying, the manner in which the eggs reach the pouch, the period of incubation—or gestation, shall we call it. I experienced a thrill when my "frog hounds," in tearing down a stone wall, unearthed a great green tree frog with the skin of its back swollen out by its treasure of eggs. It was then that I decided to turn every effort toward unravelling, if possible, some of the life problems of the marsupial frog.

There is one and only one way of delving into the home life of a frog: that is to steal upon him at night when his amorous calling betrays his place of hiding. With an electric flashlight the task is easy, for the frog seems to be as little concerned over one's presence as he is over the fireflies which flit across his world. His calling, love making, nest building, may be examined in as great detail in the open as is his structure in the laboratory. It was obvious that, if we were to inveigle the marsupial frog into revealing any of his great secrets, it would have to be done at night.

The next evening I started off alone toward a banana patch where I had heard the previous evening the hammering of a dozen carpenters. There was something about the quality of the hammering which told me the "carpenters" were not human. I thought of the carpenter frogs which come to our Jersey pine barrens in the spring. These are of a different family and their hammering has a clattering, less deliberate ring. The New Jersey "carpenters" always sounded to me like a crowd of boys laying shingles, while the clear, measured clap of these hammerers could be compared only with that of a skilled workman.

First, I followed an old *agave*-grown wall, and then another stone wall running to the banana field. It was a different world at night. My light fell first upon a giant centipede, more than eight inches in length, putting into service everyone of its many legs for a rapid escape up the trail. Numerous jewels shone on the periphery of the light. Some of these on investigation proved to be nothing but drops of water, others of a deeper glow were the eyes of spiders. A little farther on a glimpse of two close-set headlights, followed by a creature's wild rush through a thicket, told me that I had disturbed an opossum in its nocturnal wanderings.

The hammering became much louder as I approached the banana patch. I realized that the hammerers were not all in the banana plants; some were in the old stone wall, and others in the *agave* plants. I started toward one of the performers, but another calling nearer at hand turned me aside, and before I had fairly well started, it seemed much easier to run down a third. It was only after I had concentrated my entire attention on the pounding of one of these Huancabamba "carpenters" that I had any success at all, and then it seemed so easy. The performers were not the least disconcerted by the spot light. It is only the male marsupial that calls. Oddly enough for a frog, he is very differently colored from the female, being much gaudier, with stripes of fawn across his green back. Not all marsupial frogs are so exquisitely marked. These Huancabamba specimens proved later to be a new species.

Even before I reached out and picked

THE HOME OF THE MARSUPIAL FROG

The Andes of northern South America are the habitat of many curious frogs and toads, which have adapted themselves in many peculiar ways to this bleak environment. The majority of them have abbreviated their tadpole existence while others have dispensed with it entirely. The marsupial frog, although a tree frog, prefers the barren slopes of the cordillera to the heavily forested regions of the Amazonian lowland

A NAMELESS RAVINE

The country for miles about our base at Huancabamba was scoured for marsupial frogs. Only a few trails cross this country and one soon gets into difficulty on attempting short cuts. "Frog hounds" proved indispensable here

The intelligent leader of our expedition.—The mules depended upon this packless burro to pick the best way around a difficult part of the trail

up my first "carpenter" as he hammered with greatly distended vocal pouch, I was aware of a sweetish, mustelid odor which seemed to arise from all sides. It was such a pungent odor that I did not suspect it came from the marsupial frog. Most of our northern frogs and toads have little, if any, odor, although the mink frog, to be sure, received its name from its smell. But never had I heard of a frog that rivaled a weasel in the strength and sickening sweetness of its odor.

It was not a difficult matter to seek out with my light a number of these male performers. It was otherwise, however, with their silent mates. It was only by chance that I came upon them. Most of these were already carrying their load of offspring in the pouch on the back. In our laboratory the pouches were opened and the tadpoles examined in detail. They were very different from our northern tadpoles, which depend upon their own efforts for their early success in life. Each tadpole was surrounded by a great allantois-shaped structure. It could hardly be called placenta, for this structure was within the egg capsule. The allantois proved on more careful examination to consist of two greatly expanded sheets of gill tissue which surrounded the embryo just as two hands might surround a ball. It was obviously the respiratory apparatus of these papoose tadpoles. It did not seem likely that food substances could be transmitted through the structure, especially as these substances would have to pass through the gelatinous egg capsule. Furthermore, each tadpole was heavily supplied with yolk.

In the laboratory we raised these tadpoles, watched them pull their great bell-shaped gills into their operculum and emerge into the outer world as well advanced larvæ. Still, it remained a mystery where the marsupial frogs intended to deposit their aquatic, even if well advanced, offspring. The only puddle of sufficient size at Huancabamba was a cistern which caught the rain water from one of the streets. In this depression, not three feet across, we found a number of metamorphosing marsupial frog larvæ. But surely all the offspring of the Huancabamba "carpenters" could not survive in such a place.

Every night for a month I searched for marsupial frogs along the stone walls radiating from the banana patch. It was almost impossible to find them in any other situation, so well did they conceal themselves. However, the outstanding query in my mind concerning the life history of these creatures remained unanswered. How did the eggs get into the pouch? Did the male assist the female in putting them there? All the females above a certain size possessed a pouch, which was absent in the metamorphosed and sexually immature females. I concluded that the pouch, once formed, was never lost. Females with eggs in the oviducts possessed a pouch. But how was the pouch formed? Was it formed before the female laid her eggs for the very first time? The pouch in its most incipient stages was supplied with a remarkable series of blood vessels. We traced the development of the pouch from a heavily pigmented depression in the skin of the back to a thin colorless sack lying immediately below the skin of the back and occupying the entire dorsal lymph space. Such sacks were always filled with eggs and richly supplied with capillaries. The microtome later gave us an intimate knowledge of the exact structure of the sack; by dissection we determined the arteries which supplied its wall. The greatest problem of all, however, how the sack is actually created, remains a mystery even today. We never found a pair in the act of laying the eggs. We never discovered a sackless female in embrace. Finally, the calling became less frequent, perhaps only one or two would call all evening. We realized at last that the chief problem would not be solved that year.

We passed on to the east, to months of hard riding and pleasant hunting in the *montaña* of the Oriente. There were many evenings of searching with the flashlight, of running down new voices that called in the night. The frogs were all new to me and some proved later to be new to science. Their voices were fascinating and we found fresh problems at every hand. But no new problem was quite so interesting as the old. The chief problem of the marsupial frog remains unsolved. Some day we shall go back and solve it.

We bade farewell to the land of the marsupial frog and passed on to the east

PAGES FROM THE PHOTOGRAPHIC JOURNAL OF THE HARVARD PERUVIAN EXPEDITION*

BY

G. KINGSLEY NOBLE

JUANITA

This little girl was not very successful as a lizard catcher but she could smile gloriously, and sometimes she brought us eggs from her parents' *hacienda*

*Except where noted otherwise, the photographs were taken by the author.

Every necessity and the few luxuries which come in or leave the interior of northwestern Peru must be carried on the backs of animals or men. On several occasions our expedition narrowly escaped losing some of its mules

An approaching shower forced us to seek shelter in a *hacienda* near by

WHERE THE CORDILLERA AND THE COASTAL PLAIN MEET

It seldom rains in the coastal deserts of Peru and one crosses innumerable dry ravines. The mule is looking eagerly in the direction of Chongollape

QUERECOTILLO IN THE WESTERN CORDILLERA
The boys are washing a catch of frogs in the stream or gutter in the middle of the street

Photograph by W. L. Moss

An oven at Huancabamba.—Several families baked here. These community ovens were made of adobe and brick

Preparing cocoa.—The beans are ground up on this crude metate, sufficient water is added to make a paste, and a very unappetizing cake is patted into shape by hand

A boa constrictor in the Oriente.—A large bat which we later removed from the œsophagus of this specimen probably accounted for its sluggish actions while being photographed

Photograph by W. L. Moss

Pre-Incan ruin near Huambos.—A hilltop entirely overgrown with vegetation proved on close investigation to be the site of an ancient city. The puma is a common motive in pre-Incan sculpture and art

THE BETTER-CLASS HACIENDA OF NORTHWESTERN PERU

Stock raising proves more profitable than agriculture in much of this region. The large organ cacti in the foreground were not very common along our route

THE MARAÑON AT BELLAVISTA

The valley of the Marañon above Tutumberos is decidedly barren except for the cane and the dense thickets that crowd the river banks. The pack mules are trained to plunge into the water and swim across with little urging

LA PAZ WITH ILLIMANI IN THE BACKGROUND

ACROSS THE ANDES TO THE YUNGAS*

BY

EDWARD W. BERRY[1]

TOURISTS, meaning thereby those who follow rail routes, get little of the fine flavor of foreign lands, and this is especially true in the Andes, although the trip from Lima over the Western Range on the Oroya Railroad is well worth the time and expense from New York to Callao. Similarly the circuit from Mollendo across Titicaca to La Paz and down to the coast at Arica or Antofagasta takes one through a strange world. Even though Lake Titicaca be traversed at night one sees the Cyclopean ruins of Tiahuanaco, or Tihuamacu, as the Indians of the region call it, and the highest and strangest capital in the world, where trolley cars jog llama trains and where one passes figuratively "from Greenland's icy mountains to India's coral strands" every twenty-four hours the year through. The trip over the trans-Andino from Santiago to Buenos Aires carries one comfortably through marvelous scenic wonders, past the highest peak in South America, and, to add to its attractiveness, has at each end of the line a beautiful Parisian metropolis.

Really to appreciate the vast piles upon piles of peaks that overhang the Pacific in unbroken ranges for a distance of 4500 miles from the Spanish Main to the Strait of Magellan, one must travel, however, "*a lomo de mula*" and put up in the *tambos* or *posadas*, which, in their lack of comforts, are much like Oriental khans.

I find little appreciation of the strange climatic conditions that were brought about when, some few thousands of years ago, the rugged backbone of South America lifted its gigantic mass across the equatorial zone in the path of the trade winds. All of Colombia, Ecuador, Peru, and Bolivia are in the equatorial zone. Why, then, someone questions, should there not be perpetual warmth? You mention the marrow-chilling nights of the Peruvian or Bolivian mountains, and are asked why the traveler does not build a wood fire. Simply because there are no forests in these arid uplands.

There are compensations, however, for water vapor does not dim the vision, either of man or of the most ordinary of cameras, and throughout the winter season, extending from May to October, one may count on the brightness and warmth of the god of the Incas. To be sure, above 16,000 feet one may expect some clouds and snow squalls, particularly along the eastern mountain rim that separates the high plateau from the Amazon plain.

I had but four experiences in passing from everlasting snow to tropical lowland. Each was entirely unlike the others, and I can enthusiastically imagine spending several years in winding down each of the valleys that open out into the basin of the Amazon. Perhaps one's judgment is colored by weeks of sojourn in the uplands, with their Tibetan climate and environment, and possibly each neophyte should be obliged to pass his vigil on the heights before entering the paradise of the eastern valleys, and this he will certainly do, no matter which way he comes.

Travelers' itineraries, with a record of miles made, of towns with strange names passed, and similar notes taken along the trail, are unmitigatedly boresome and not to be compared with the marvelous adventures of Sir John Mandeville or other works of fiction. Nor is the impressionistic style applied to an exotic land entirely satisfying. I should like, however, to take my readers on a short journey from

*George Huntington Williams Memorial Publication No. 8. The photographs, except where stated otherwise, were taken by the author's colleague, Prof. Joseph T. Singewald, Jr.

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HUAYNA POTOSI FROM THE ALTAPLANICIE

La Paz across the Eastern Andes to the wonderland but one Martian stride away —an airplane could make it in an hour or two—and this is especially interesting since it leads to the most attractive part of Bolivia, and to a region which ere another decade has passed, will be accessible by rail. Think not, however, of twentieth century fliers—railroading in the Andes multiplies the mule's speed of a league-an-hour by three.

La Paz—the present seat of the government, in the words of "*La Capital*" of Sucre—has a charm that it is difficult to explain. Its plaza is small, the cathedral is unfinished, the government buildings are not imposing, and the legislative hall has a most disproportionate metal tower; there are none of the Moorish architectural bits that make Potosi so notable, and the museum is small and crowded. La Paz offers none of the usual sights that guide books like to emphasize, nor has it special attraction for the artist or the historian. Nevertheless, time cannot erase or dim the deep impression that La Paz makes.

I suspect that this lies largely in its unusual situation and the sudden and unexpected first sight of the city, backed by the most magnificent peak in the world. If one's first view were obtained from the back of a mule coming up the La Paz valley, or even from the train that runs from Arica, the impression would not be so startling. Seen, however, from the old trail and carriage road leading from Huaqui on Lake Titicaca, which is practically the route of the recently constructed Huaqui-La Paz Railroad, nothing can compare with it. Many have commented on this. A score and a half of miles from Huaqui the railroad reaches Viacha, a cold, bleak, windswept place 12,605 feet above sea level, now marked by the imposing antennæ of the powerful Bolivian wireless station. Here converge the recently opened railroad from Arica on the Pacific, some one hundred miles to the west, and the railroad from Antofagasta, some four hundred miles to the south.

The station swarms with Indians and Cholas, half-breeds of various degrees, selling *empanadas*, or meat pies, and other unappetizing things, as well as oranges and rather fine, yellow, native bread. From Viacha the train winds slowly to the northeast, ascending through a stony, moderately hilly country directly toward the Cordillera Real, or royal mountain chain, and no range is more appropriately named. All of the peaks are glacier-covered, the most prominent being Huayna Potosi, or young Potosi, in its conformation recalling the Matterhorn but of more imposing height. To the right of Huayna Potosi is the magnificent mass of Illimani, somewhat suggestive of a grown-up Mont Blanc, for it towers more than 21,000 feet as against Mont Blanc's height of 15,782 feet.

Noonday approaches with no sign of La Paz and we are heading directly for the very broken and bare foothills of the range when we come to a halt at the Alto at considerably more than 13,000 feet. Nearly 1500 feet below us lies La Paz, straggling along the narrow stream of that name, and looking very petite when viewed from above—like a museum model, with its plazas and mellow adobe coloring and warm red-tiled roofs. Unfortunately, corrugated iron is rapidly replacing the Spanish tile, and although doubtless the former withstands the frost far better, it is infinitely less picturesque; and there has been much building in La Paz in the last few years. The motive power down into the *cuenca*, *barranca*, or hollow in which La Paz lies is electric and the way very devious. The unwary stranger who would walk finds the impression from above misleading, for the only level streets are those paralleling the narrow stream, all the others are frightfully steep, and slippery because of the small cobbles, and very difficult to those unaccustomed to the altitude.

One wonders what accident led to the

A BEGGAR IN LA PAZ

A CHOLA IN THE LA PAZ MARKET

growing-up of a large town at this particular spot. It is true the winds are less sharp than on the Alto, where a young gale usually starts about noon and blows until nightfall, but why live in this region at all, for the city itself at the bottom of the hollow is still the highest capital in the world—2000 feet higher than Quito, 3330 feet higher than Bogota, a mile higher than Mexico City, and even 300 feet higher than Lhasa in Tibet.

Most Andean towns have their origin, when not purely Indian, in early colonial avariciousness. The stream, Chuquiaguillo, which comes down from Aillaico to the north contained placer deposits of gold, long since unprofitable; then there was the stream itself—an unfailing stream is always a desideratum in an arid region; and then, too, the age-old Indian trails converged here and passed over the range to the fertile eastern valleys, one going up, the other down the River La Paz.[1]

With three railroads, the seat of the government, and the best trails to the tropics, La Paz has become, in modern times, the most important business center as well as the largest town in Bolivia. It was founded, at least on paper, by Mendoza in 1548 because of the gold of the stream bed, and was called the Pueblo Nuevo de Nuestra Señora de la Paz in commemoration of the reconciliation between Pizarro and Almagro. At the close of the war of independence in 1825 it was rechristened La Paz de Ayacucho in honor of the last decisive battle of that protracted struggle. It was a most unimportant place during colonial days, being entirely eclipsed by Oruro, Colquechaca, and Potosi—the three main sources of Spain's wealth. In fact, Potosi, the most important of these, was in 1595 probably ten times the size of any other city in the New World.

At the present time La Paz has between 80,000 and 100,000 inhabitants and much commerce. At least three-fourths of the population is, however, of Indian or of mixed blood—no other large city in the Americas contains such a large proportion of aborigines. It has been the seat of government since 1898, the old Spanish capital of Sucre, a far finer place in every way, being hidden away in the eastern mountains. Because of this there is much jealous feeling in the older and more purely Spanish towns of the south and east. Although the see of a bishopric since 1605, the cathedral, started a few years later on the main plaza, is still unfinished. It has some fine stone carving, but at the rate of progress of the past ten years, it will be another three hundred years before it is finished.

La Paz has little of the air of antiquity that is so captivating in Potosi or Sucre; in fact, charming bits of architecture are entirely lacking. Some exceedingly pretentious modern dwellings are to be seen along the Alameda, or Prado, that stretches down the river for a mile or more and is lined with *Eucalyptus* trees, those Australian immigrants which have thrived better in Latin America than have the immigrants from Spain. In fact, the finer residential part of the town is drifting rapidly down the valley,—every hundred feet nearer sea level being appreciably more comfortable,—and the whole way to Obrajes, three miles to the southeast, is practically built up.

When the sun shines, La Paz is comfortable, but one is wretched after nightfall and becomes a sun worshipper, following the example of the Incas. There is no artificial heat, there being no fuel except *taquia*, or llama droppings, which are used only for cooking or the limited industrial purposes. The traveler in the Andes becomes greatly impressed with the relativity of time. After the day's work one kills time waiting for the belated unlocking of the hotel dining-room, and after having eaten *comida*, if one has no social engagements, tries to read or write by the dim electric lights; at last, on consulting one's watch, fully expecting it to be midnight, one is

[1]A small Aymará hamlet by the name of Chuquiapu was here before the Spaniard.

astounded to find it is only half past eight.

Indian boys meet arriving trains, swarm into the cars, and, seizing every available piece of luggage, make off with it unless forcibly prevented. The transfer agencies are Indian *cargadores*—animated bundles of rags, singularly weak at carrying even the smallest article except on their backs. There they can manage anything up to two hundred pounds or more and of any bulk. They squat on the ground and tie themselves to a heavy wardrobe trunk by means of the omnipresent rope of llama wool, knotting it over their chest. Assisted to their feet, they will carry such a load indefinitely over the roughest sort of road. While riding a handcar near Cochabamba I once narrowly missed running over an Indian with a load of cornstalks, as big as an American load of hay, tied on his back. He was trudging along the railroad embankment and saw us in time to get off the track but not soon enough for us to clear the load which was sent, with its carrier attached, rolling to the bottom of the embankment. It was one of the funniest sights imaginable, for each time the Indian came up on the crest of a rotation, he flung his arms and legs about in a manner suggestive of a fly stuck on a pin.

La Paz is dominated by Illimani, which raises its huge, granitic, ice-covered bulk to the southeast, and in the clear air appears to overhang the city although really twenty-four miles away. No peak that I have ever seen is so impressive unless it be Sorata, on Lake Titicaca. El Misti at Arequipa is perhaps more graceful, but grand is the only adjective properly descriptive of Illimani. Mont Blanc from Geneva is faintly suggestive of it but dwarfish in comparison and farther away in a less clear atmosphere. The name Illimani, we are told, comes from Hila umani, he who has much water, and the Achachila, or spirit of the mountain, is still worshipped by the outwardly catholicized Aymarás as well as by the discerning traveler.

Your native loves to bargain in true Oriental style and it takes several days to arrange for mules for a trip over the range. Although all travel has been on foot or mule back since the Spanish conquest, one would suppose that mules had never before been hired by anyone. Your *arriero* knows the country "like the palm of his hand," he tells you, and you contract at so much a day for each mule, he to furnish fodder. Later you discover that he is a brother-in-law or second cousin of a native and comes perhaps from southern Peru and has never been over the trail. Likewise you discover that he is without funds for the purchase of fodder.

Some bright morning you make a start—if you are lucky, it will be within an hour or two of the appointed time. Our *arriero* we christened "penny ante," which was the phonetic rendering of his Indian name. He walked during the trip and could easily out-distance his antediluvian, pack-sore mules. The trail, or *camino real*—*real*, meaning royal, is in this case official and not descriptive, although the road was really not bad—wound its way northeasterly up the valley through a stern and harsh, vast and gloomy, broken country toward the storehouse of the God of the East Wind. By noon we had reached the divide (*la cumbre*), where some day a railroad will cross the pass to the eastern tropical lowlands. Already the rails are laid to this point and grading is going on beyond. Your *arriero* or Indian *cargador* always erects a cross at the pass if material is available, or scratches one on a rock nearby. In the absence of material he goes through the magical rite of adding a stone or two to the huge cairns that testify to the passing of the aborigine to and fro for centuries.

The cross, like the mounds of stones, is to appease the spirits of the mountains and not, as one might innocently suppose, the result of the conversion of the

THE HEAD OF THE UNDUAVI VALLEY

natives. In fact, as nearly as one may fathom the inner thoughts of the Indian, the god and the saints that the early Church brought him are of the same breed as those of his own pantheon, only possibly more powerful, and all the deities are considered in the plowing or harvest festivals, or in house building. Almost invariably the gable of the Indian house will have a row of small wooden crosses interspersed with representations of the native gods rudely cut out of some packing tin or gasoline can.

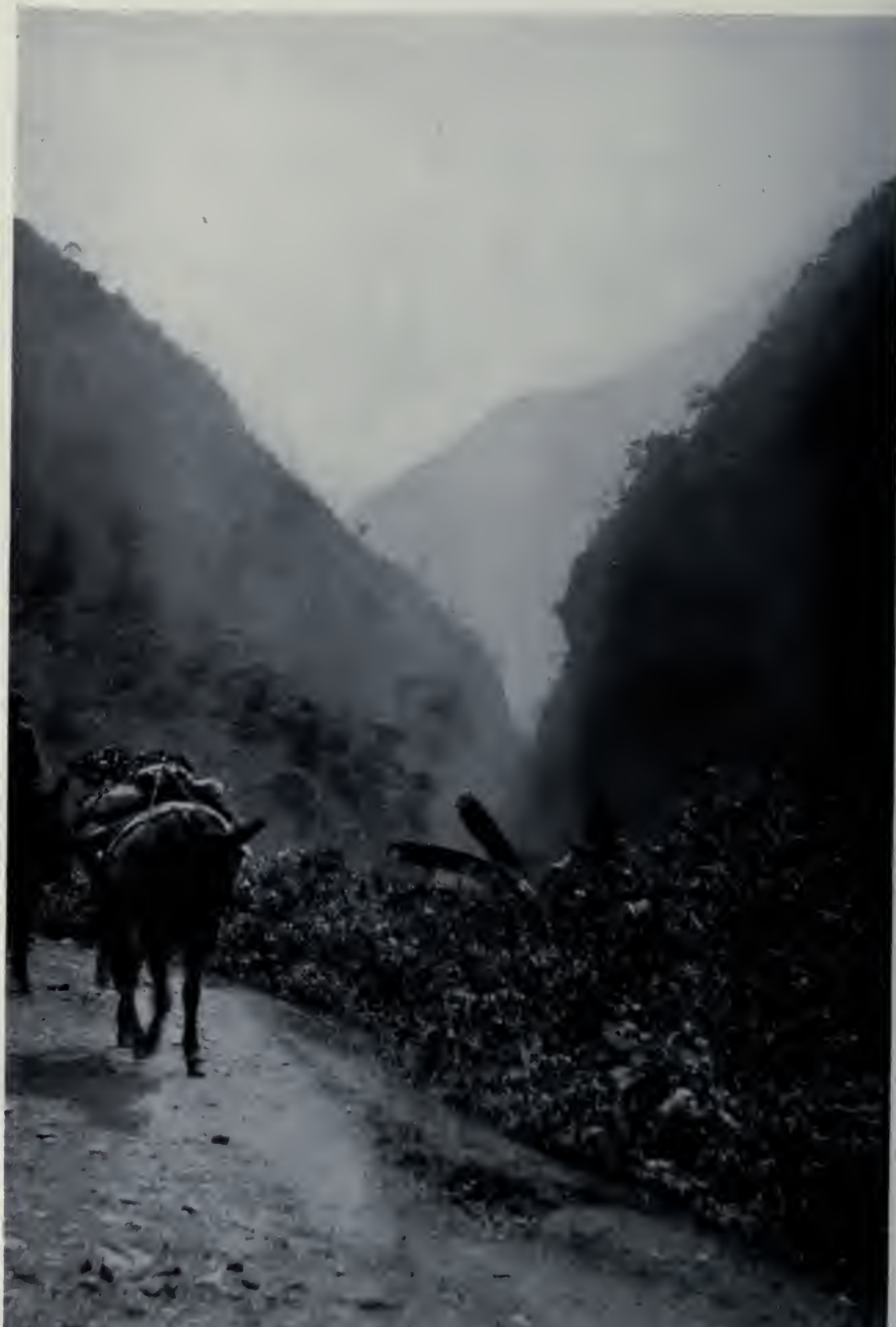
The mountains here are of the usual forbidding appearance, but on so vast a scale that one gets no glimpse of the higher, glacier-covered peaks to the north and south. The pass is low for this part of the Andes, being only 15,275 feet—the Zongo Pass, next to the north beyond Chalcaltaya, is 17,139 feet. The usual association of granitic cores with high mountains makes the Paleozoic slates of the Unduavi Pass seem strange, and although it is a commonplace of geology, I could never get quite used to finding sedimentary rocks with marine fossils 16,000 or 17,000 feet above sea level.

All of the eastern valleys get much rain from the moisture-laden trade winds that sweep over the Amazon basin. These valleys are narrow and deep, for the gigantic mountains that flank them are geologically very young and there has not been time for the carving out of mature valleys in Nature's workshop. The trail descends to the eastward rapidly, zigzagging down the shale slopes to the Rio Unduavi, so steeply that by the mid-afternoon you reach the *posada*, or inn, of Pongo. "Pongo" is the Quichua for rapids and every river along the eastern Andes from Colombia to Bolivia has its Pongo; hence there are more Indian towns of that name than there are Washingtons in the United States. The *tambo* of Unduavi, which we reached toward dusk, would not receive us, for, coupled with their native lack of hospitality, the proprietors were quartering many of the better grade of workers on the right of way of the prospective railroad.

We rode on to the custom station a few miles beyond, where the Aduana del Coca, grudgingly and after much argument, assigned us to a dark and dirt-floored room. We had made the fatal mistake of leaving La Paz without the miracle-working letters of recommendation from the Minister of Fomento, consequently we could neither beg, buy, nor steal any food. We played dummy bridge till midnight and then tried to sleep in the chill, rare, night air, but this was impossible and we were compelled to walk the floor until dawn to keep from freezing. The cold is vouched for by the fact that a single candle of ordinary size lasted from nightfall to dawn.

The Aduana, or custom house, is conveniently located in a narrow defile at the head of a switchback, and as the indispensable coca of the highland Indians comes up this way the government derives considerable revenue from impost duties. As many as five hundred cargo mules pass up in a single day. Coca is raised in vast quantities in the moist, moderately low, mountain valleys to the east. The tree is a low evergreen and the leaves, the source of cocaine, are dried and baled or packed loose. No Indian is ever without an enormous cheek-bulging cud, added leaf by leaf with an occasional bit from a banana-like object made of potato meal and wood ashes. Whether the effects of coca-chewing are deleterious or not it is difficult to say. It may have a slightly dulling effect. Its use is not extensive among Spaniards if *mestizos*, or half-breeds, are excepted, and I tried it without appreciable effect other than a very slight warding off of the pangs of hunger or fatigue.

After our frosty night and unsuccessful attempt to get a breakfast and after the *arriero* had gone through his usual antics of tossing a poncho over the head of each antediluvian mule and fussing an hour or more in adjusting the saddles so as to



THE UNDUAVI VALLEY LOWER DOWN

conceal the pack sores, we were off. The trail simply plunged headlong downward. In an hour's riding the Indian habitations changed to airy bamboo structures surrounded by banana thickets. The air assumed a humid, earthy smell, a smell such as can be encountered in our northern latitude only in the orchid house of a botanical garden. The mountains became densely wooded to their tops. Warm mists hung in the air and made photography difficult. The trail blossomed magically. Wild begonias and fuchsias ran riot, for this is their original home, and myriads of ferns clothed every bit of rock—elk horns, drynarias, gleichenias, and a hundred other kinds. In the valley bottom, where the rushing river left them room, were thickets of *Canna* twenty feet tall, and great numbers of the most graceful plant that grows, the tree fern, reaching to heights of from thirty to forty feet.

We were in the country that I suppose physical geographies call *selvas*—the eastern rain-forest slopes of the Andes. More correctly it is known as the *Montaña*, all the way from Colombia to where it ceases south of the Tropic of Capricorn. The precise call it *Ceja de la Montaña*, or eyebrow of the mountains. In northeastern Bolivia it is called the Yungas; it is especially widened here to a breadth of upward of two hundred fifty miles and is a veritable naturalists' fairyland.

Elsewhere in the mountains one descends from glaciers and passes through a zone of cacti and bromeliads—this is the succession south of Cochabamba. In the Yungas you drop at once from ice into subtropical luxuriance. All of the valleys are incredibly narrow and tortuous—the average gradient for the first fifteen miles was 485 feet to the mile. Ever and anon a slender waterfall comes down sheer from a height of several hundred feet. You fill your lungs with air containing real oxygen and renew your youth. However miserable and filthy the Indian towns of the low country, life is bearable in warmth and air, and the easier conditions of life are conspicuously reflected in the character of trails and dwellings.

Before noon we arrive at the Finca El

Courtesy of the Pan American Union

A typical Yungas scene

Chaco, which is also a *posada* where guests can obtain accommodations. Dozing on the veranda, one seems to have been transported back to the Garden of Eden. A clear mountain brook, in which ducks disport, runs close to the house, and pigeons loiter about to pick up any chance crumbs from our outdoor meal. Sleek pigs waddle about. It is a striking anomaly that in the mountains, where fats would seemingly be indispensable, you never see pork even in cured form; all the meats are lean mutton, llama, or goat, and not even butter is to be had except in tins and is very old and correspondingly strong. The garden of El Chaco abounded in magnificent roses and poinsettia growing among oranges, coffee, papaw, and pepper trees.

The charm and romance of the uplands emerge only through the haze of memory, but one is eager again to face the hardships and cold of the trail in order to sit on the porch at El Chaco and wash down the Indian bread and soft-boiled eggs with a good quality of native beer.

Our journey did not end here, but it may well be concluded at the pueblo reached toward dusk—Yanacachi. Here in the river bottom, which is several hundred feet below the town, may be seen troops of monkeys as well as toucans of the ridiculous beak. Scorpions lurk under the stones and vampire bats are the nightly pest of the pack mules. Small palms are scattered among the wild peppers, lianas, and tree ferns, and all of the insect pests of the tropics along with the most magnificent palms of the world are only a long day's ride down the valley.

Here the climate is delightful, and it is always summer, and yet if one had a large naval gun, one could point it up the valley of the Rio Chojlla, which joins the Rio Unduavi at Yanacachi, and splinter the ice on the summit of Mururata, which towers to 18,980 feet at the head of the former valley.

On down, the Rio Unduavi becomes the Rio Tamanpaya and joins the Rio La Paz and eventually the Beni in the rubber country, finally reaching the Atlantic by way of the Amazon. The trail winds down past Coripata to the head of navigation on the Beni, through potentially the most productive region, as well as the most delightful, in all Bolivia.

The stable at El Chaco

BIRD LIFE IN THE URUBAMBA VALLEY: A REVIEW*

BY

ROBERT CUSHMAN MURPHY[1]

DR. FRANK M. CHAPMAN'S recent paper on the bird life of the Urubamba Valley represents the fulfillment of a request with which he was honored by the authorities of the Yale University–National Geographic Society's Expeditions in the Urubamba region of Peru. The field work of these expeditions, under the direction of Professor Hiram Bingham, included not only archæological investigations but also a survey of the physical conditions and biological resources of the area, the task of making collections in vertebrate zoölogy being entrusted to the well-known naturalist, Mr. Edmund Heller.

Since it is the policy of Dr. Chapman (and one which he holds equally for his associates in the department of ornithology) to undertake no faunal work without personal reconnaissance in the region concerned, the two institutions which had conducted the Urubamba explorations generously provided for an additional journey through the valley of the river during July, 1916. On this short expedition Dr. Chapman was accompanied by his son and by Messrs. George K. Cherrie and Harry Watkins. The specimens collected by both the Heller and the Chapman parties, together with subsequent collections by Watkins alone, numbered 1833. Upon this material, as well as upon the observations of Dr. Chapman, the admirable field journal of Mr. Heller, and the publications relating to earlier ornithological collecting by Whitely, Kalinowski, and others, the present paper is based.

Mr. Heller's geographic notes, of which fourteen sections are quoted in the paper, deserve particular mention. Rarely is an author undertaking a faunal report fortunate enough to have at his disposal such an illuminating record of topography, geology, climate, vegetation, and general biotic environment from his precursor in the field as was Dr. Chapman in this instance. It is difficult to choose from Mr. Heller's contributions, but the following brief description of life conditions in the Occobamba Valley, which is confluent with the Urubamba, may serve as an example:

> Well down in the Occobamba Valley, at a point where the forested country meets the grassy uplands, we established our camp, at a spot called Tocopoqueyu The camp was pitched in one of the terraced fields on the west bank of the creek, at an altitude of 9,100 feet. During our sojourn here in July the weather was bright and warm during the day and cool at night, but seldom bitter or windy. The country has a peculiar physical aspect, owing to one side of the valley, the eastern, being clothed by a dense forest, and the opposite, or western, being the very antithesis; that is, grass-covered and dry in character. The forest edge is definitely bound by the stream margin, which is lined by a growth of alder and willow trees. The alders here form a considerable part of the forest, and such as are found growing at a distance from the stream have widespread crowns and a grayish appearance seldom seen in riverside trees. Other forest trees are Eugenias, or cloves, Escallonias, and a large bay tree of the genus *Myrica*. Bamboo, as usual, forms a dense undergrowth in the forest.
>
> The direction and constancy of the prevailing winds here seem to offer an explanation for the extraordinary difference in vegetation on opposite sides of the valley. The moist breezes coming up the valley from the hot lower montaña country are mist-laden and confined to the eastern side, along which the mist hangs, leaving the western side open, sunny, and dry. The fauna partakes of this divided character also, the forested side being the haunts of such marsupials as *Oriolestes*, *Peramys*, the pygmy opossum, *Didelphis*, and many species of forest rodents. On the west side we find white-tailed deer, coyotes, skunks, and rodents peculiar to the grassy Andean Zone. The country rock is granite, cliffs of which are exposed for several miles on the western side.

The aim of the Urubamba paper is to extend our knowledge of the distribution of bird life in the complex Andean region. The plan is therefore similar to that fol-

**The Distribution of Bird Life in the Urubamba Valley of Peru.* By Frank M. Chapman. Bulletin 117, U. S. National Museum, 1921.

[1]Associate Curator of Marine Birds, American Museum

This photograph of the Occobamba Pass, taken at an elevation of 13,800 feet by Mr. Edmund Heller, shows the character of the puna zone, the name applied to the high, treeless area of this region of South America. In the foreground are two representatives of an animal that has been associated time out of memory with Peru

lowed in Dr. Chapman's Colombian monograph, although the treatment is necessarily more provisional. The annotations in the list of 380 known species, which represent probably less than eighty per cent of the avifauna of the area, are mostly brief and conservative, emphasis being placed primarily upon (1), exact determination of each species or race; (2), precise location of the collecting station; (3), distributional status of each form. A distributional summary reveals that the Urubamba region is inhabited by a nearly equal number of species characteristic of the tropical and subtropical zones (115 and 105 respectively), while 63 belong to the temperate zone, 74 are representative of the puna or paramo, above timber line, 15 are of general distribution on the continent, and 8 are migrants from North America. Dr. Chapman finds that the life zones and their bird fauna agree substantially with those determined by him in Colombia, the only notable discrepancy being shown by the puna zone. In Peru this uppermost stratum of life occupies a much more extensive surface than in Colombia; it lies, moreover, nearer the low south temperate and subantarctic, pampean stretches from which it presumably derives its fauna. For these reasons the puna bird life is more varied than that of corresponding altitudes in Colombia. Other factors also serve to make life conditions of the puna zone more subtle and involved than those of the north Andean paramo. Dr. Chapman writes:

The Puna of Peru corresponds to the Paramo of Colombia. Both regions lie between the upper limit of arborescent vegetation and the lower limit of snow. On the eastern Andes in the Urubamba region, this is approximately between the altitudes of 12,500 and 15,000 feet, limits which agree with those we found to exist in the Central Andes of Colombia.

Faunally, however, where insufficient rainfall prohibits forest growth, the Puna Zone reaches a much lower level. . . . At Ttica-Ttica (altitude 11,900 feet), near Cuzco, it completely inosculates with the upper border of the arid Temperate Zone. The two zones are here distinguished by the presence or absence of bushy vegetation, a difference controlled wholly by water supply. Much additional field work is required to determine the interrelations of these zones. Since the bird life of the Puna has been derived largely from the South Temperate Zone in Patagonia it may prove to be desirable to characterize the Puna as an Andean Temperate and apply a new name for the forested and bush-

Santa Ana Valley on the lower Urubamba, the altitude of which is 3500 feet, is representative of the arid tropical zone. This photograph was taken by Frank M. Chapman, Jr.

grown Zone which I have here termed Temperate. This problem, however, can not be treated from a local standpoint nor indeed do data as yet exist for its solution.

In Colombia the flora of the Paramo with its frailejons and other striking species, is so characteristic that no difficulty is experienced in distinguishing Temperate Zone savanna from the Paramo above it. But the uniformly grass-covered plains and slopes and the marshes of the Puna afford no such obvious boundaries.

No doubt, however, can exist as to the origin of the Puna avifauna. Suited only for the needs of plain, marsh, and water-inhabiting species, Puna bird life has been largely derived from the vast area of plains, marsh, and lakes which, without topographic barrier, bounds it on the south and extends nearly to the southern limits of the continent.

The South Temperate Zone ducks and grebes find a suitable home on the Puna lakes, where they are represented by permanently resident races, while the oven-birds (Furnariidae) and finches of Patagonia find congenial haunts and climatic conditions on the high Andean tableland.

Both the importance and the difficulties of zoölogical work in the rich, productive, wet temperate forests are concisely stated by the author in his introduction:

Heller's work in the forests of the humid Temperate Zone at timberline (approximate altitude 12,500 feet) is of special importance. This zone has been previously explored in Peru only in the district about Maraynioc in the Eastern Cordillera somewhat north of the latitude of Lima, where von Tschudi, Jelski, and Kalinowski secured a surprising number of distinct new forms. The rainfall which produces the forest characterizing the humid Temperate Zone is also, in a measure, responsible for our ignorance of its life. The rain creates not only forests, but also rivers, and the river valleys form the natural sites for the trails which connect the highlands and lowlands. When the collector, in following these trails, reaches the region of Temperate Zone forests, his path is far below them and he thus passes under a zone of exceptional interest. I had this experience in the Eastern Andes of Colombia between Bogotá and Villavicencio; while Kalinowski, who collected during several years in the Urubamba region, appears not to have worked in the forests of the humid Temperate Zone, though he lived within a few miles of them.

The avifauna of the tropical zone proves, as might be expected, to have its affinities with that of Amazonia and tropical South America in general, but the penetration of the subtropical zone into the mountain chain, by way of the Urubamba Valley, is highly significant, and

FORESTS OF THE SUBTROPICAL ZONE IN THE URUBAMBA CAÑON

On the ridge in the foreground, 2000 feet above the Urubamba River, is Machu Picchu, first made known to the modern world by Prof. Hiram Bingham, who is of the opinion that it was probably built by the "Megalithic race" that preceded the Incas. These splendid ruins include palaces, temples, baths, and about 150 houses. San Miguel Bridge at an altitude of 6000 feet, a base of both the Heller and the Chapman expeditions, crosses the Urubamba River a short distance below the point shown in the lower left-hand corner. The photograph was taken by Prof. Hiram Bingham lends itself well to comparison with conditions elsewhere:

The remarkable stratum of life which lies approximately between the elevations of 5,000 and 9,000 feet on the eastern slope of the Andes and extends from Bolivia to Venezuela makes a fold or loop up the Urubamba Valley. In the lower valley its inferior limits merge with the upper border of the humid Tropical Zone in one unbroken sweep of forest; at Santa Ana they are coextensive with the cloud belt below which grassy, treeless slopes reach to the floor of the tropical valley, while from a short distance above San Miguel Bridge (altitude 6,000 feet), at the foot of Machu Picchu, almost to Torontoy, the forests of the Subtropical Zone reach the shores of the river, whence, in places, they extend upward to merge with those of the humid Temperate Zone.

Above Santa Ana the Subtropical Zone is first encountered on the western side of the valley at Idma, and from this point forest extends into the Temperate Zone.

Birds have been collected in the Subtropical Zone of the Urubamba Valley only at Idma and in the Machu Picchu district. From these localities 105 species have been secured which may be considered as zonally representative. Comparison of the results of our work with those of Kalinowski's indicates that this number fairly represents the fauna. It does not, however, fairly represent the fauna of the Subtropical Zone of Peru, since in Colombia we obtained 230 species which were distinctively subtropical. The data at hand, therefore, do not warrant a comparison of the bird life of the Subtropical Zone in Peru and Colombia, but they do show the remarkable uniformity of the life of that zone, a fact to which I have previously called attention. Thus, of 77 genera secured by us in the Subtropical Zone of the Urubamba Valley, no less than 74 also occur in this zone in Colombia; the genera *Knipolegus*,[1] *Phylloscartes*,[1] and *Thlypopsis*[2] being the only ones absent from Colombia. Of the 104 Urubamba species contained in these genera, 57 are common both to Peru and Colombia.

No less interesting are conditions in the temperate zone, with its two sharp climatic aspects—the arid and the moist—and its interdigitation with the life zones both above and below:

The Temperate Zone has both a humid and an arid section. The former is found on the more easterly ranges of the Andes, on which are condensed the moisture-bearing winds from the Atlantic. Here well-developed forest reaches an average altitude of 12,500 feet. Above this altitude lies the Puna The line between the two may be abrupt or the two may merge by an upward extension of bushy-grown areas, the latter forming the arid portion of the Temperate Zone. Heller writes that the forest at Cedrobamba (altitude 12,500 feet) "stops as abruptly as if cut by a knife" and is succeeded by the grassland of the Puna.

At other localities, notably inner valleys with comparatively low rainfall, the Temperate Zone is characterized by a scrubby vegetation restricted largely to the borders of streams, up which the arid portion of the zone extends finger-like projections well into the Puna Zone.

Conditions of this kind can be understood only by one who has observed them in the field. They can not be expressed by the most careful labelling of specimens. A collection from Ttica-Ttica (altitude 11,900 feet), for example, contains a mixture of forms apparently not susceptible of zonal interpretation. With such characteristic species of the Puna as *Upucerthia pallida* [1] *Geositta tenuirostris*,[1] *Agriornis solitaria insolens*,[2] *Muscisaxicola rufivertex*,[2] etc., there are presumably associated *Anaeretes flavirostris*,[2] *Serpophaga cinerea*,[2] *Elaenia albiceps*,[2] *Saltator albociliaris*,[3] *Diglossa brunneiventris*,[4] etc., but in the field it was found that the first group was largely restricted to the grassy slopes, while the second was found only in the narrow fringe of bushes at the borders of streams.

The collection from Cedrobamba contains a similarly confusing assemblage of Temperate and Puna Zone forms, the occurrence of which within a restricted area is explained by Heller's description of the striking conditions which exist at that locality. The upper limit of the Temperate Zone, therefore, coincides with the upper limit of tree or bush growth, and this may often be at a higher altitude than the lower limit of the succeeding or Puna Zone.

On the eastern slopes of the Andes the lower limits of the Temperate Zone correspond with the upper limits of the Subtropical Zone, and although forest may stretch continuously from timberline to the Amazonian plains, the limit between the two zones is here uniformly about 9,000 feet. Where, however, lack of rain prevents the development of the forest which so strongly distinguishes the Subtropical Zone, the Temperate Zone in its arid phase may descend much lower. In the Urubamba Valley it reaches Torontoy at 8,000 feet and on the treeless Pacific slope of the Andes it actually descends to sea level. The influence exerted by the Humboldt current must, however, be taken into consideration here, an inquiry which would lead us far beyond the scope of this paper.

The assemblage of species characterizing the Temperate Zone is intensely interesting. Being either tree or bush-inhabiting, it is clear that they must have had their geographic origin in tree or bush-grown regions. The humid South Temperate Zone is separated from the district under consideration by 1,500 miles of treeless country, which has proved an effective barrier to the northward extension of the forest-inhabiting species of southern Chile.

It seems evident, therefore, that the avifauna of the Temperate Zone can have originated only in the forested regions lying below it, and in its parrots, humming birds, toucans, trogons, fly-

[1]Flycatchers.
[2]Tanager.

[1]Ovenbirds.
[2]Flycatchers.
[3]Finch.
[4]Honey creeper.

catchers, tanagers, and honey creepers it is evident that we have the highly differentiated descendants of tropical forms.

The area occupied by the Temperate Zone is by no means so large as that of the Subtropical Zone and the number of species inhabiting it is correspondingly small. But analysis shows that the bird life of the Temperate Zone is more distinct than that of any other zone.

Of especial significance is the comparison of the bird life of the temperate with that of the puna zone. Although these lie side by side, it is shown that the birds of the temperate zone have descended from tropical ancestors while those of the puna find their geographical origin in the plains of Argentina and Patagonia. The former have therefore been subjected to the influences of the wide climatic differences existing between the tropical and temperate zones while the latter have found in the puna a climate not radically different from that in which it is assumed they originated. As a result of these contrasted conditions it is shown that 55 per cent of the genera and 80 per cent of the species of the temperate zone are endemic, that is, have evolved into new forms since entering the temperate, while only 7 per cent of the genera and 55 per cent of the puna zone species are peculiar to that zone.

Dr. Chapman therefore concludes that the evolution of a species is determined less by the time and distance by which it is separated from the ancestral stock than by the degree of environmental change to which it is subjected.

The form of Dr. Chapman's paper is a model for articles relating to the fauna of imperfectly explored fields. Following the introductory remarks are a review of previous work, a synopsis of the collections, and a well-illustrated account of the numerous stations at which specimens were obtained, the data for altitude and for topographic and zonal position being cited with all possible precision. This may be considered as the geographic section of the paper, of fundamental interest to workers in many branches of science, and, indeed, to all who are concerned with transportation in Peru. The next seventeen pages are devoted to a discussion of the life zones, in which maps and tabulated analyses of species and genera support conclusions of much importance to all students of geographical distribution, whether of birds or of other forms of life. Then eighty or more pages are given up to the list of birds known to inhabit the Urubamba region; and in this section the taxonomic ornithologist finds data of a fellow specialist to be confirmed, revised, or extended. Finally there is the index, which, according to the editorial custom of the United States National Museum, is limited to names of localities and the technical nomenclature of animals and plants.

JOEL ASAPH ALLEN, 1838-1921

AN APPRECIATION

BY

HENRY FAIRFIELD OSBORN
President of the American Museum of Natural History

THE first fifty years of our history as a scientific institution has the personality of Dr. Joel Asaph Allen as its central figure, in the same sense in which the foundation of the American Museum centers around the personality of Professor Albert S. Bickmore. The two men supplemented each other perfectly. Both enjoyed the inspiration of Louis Agassiz. Bickmore had the gift of inspiring a high-minded group of citizens to plan a museum unprecedented in scale and to make it thoroughly American in name and character. Allen had the gift of instilling the scientific spirit throughout the institution and of giving it scientific rank. When he came to the American Museum in 1885 as curator of mammals and birds, the day of pure scientific research in mammalogy and ornithology had hardly dawned.

Not only was he inspired with Agassiz' spirit of research, but the story of his boyhood years, between 1838 and 1858,[1] shows that he was born a naturalist and field observer, and was full of ambition as a writer. As early as 1858 he aspired to write a story of the "Birds of New England." It was this triple character of field collector, of observer, of indefatigable note-taker and writer, together with an invincible determination to publish, guided by unerring judgment and untiring energy, that placed him at the early age of twenty-four in the forefront of the younger zoölogists of America. He rounded out his field work with readings from Humboldt, Lyell, Dana, and Gray, thus broadening the base of his pyramid of life work to include geology, mineralogy, and botany. Agassiz was charmed with his genial nature and selected him as companion on his expedition to Brazil (1865-66), which laid the practical foundation for his direct observations and subsequent researches on South American mammals and birds. The Middle West, Florida, the Great Plains, the Rocky Mountains, the Yellowstone, opened before him in successive years (1867-82), and the physical courage needed in the Wild West of those early days was an important factor in the development of his innate moral and intellectual courage and fearlessness.

Spencer F. Baird was the second great personal influence in his life. At the Museum of Comparative Zoölogy, Cambridge (1871-85), he became thoroughly grounded in museum technique, which qualified him for his thirty-six years of service in the American Museum, where his most distinguished senior colleague was Dr. Daniel Giraud Elliot, his most distinguished junior colleague—a man of his own training—Dr. Frank M. Chapman.

From 14,300 birds and mammals all told in 1885, the collections rose to approximately 246,700 birds and mammals as enumerated at the close of the year 1920. But this numerical monument, great as it is, is less exceptional than the intellectual monument of thirty-seven volumes of the *Bulletin* and four volumes of the *Memoirs* of the Museum, with a total of 21,368 pages, all of which passed through the editorial hands of Doctor Allen between the years 1885 and 1917 inclusive. To speak of his genius as an editor means that in all this time hardly a single error escaped his unerring eye and that while firm as adamant both for principle and accuracy, never an author, young or old, came under his editorial influence without feeling a deepened sense both of respect

[1] *Autobiographical Notes and a Bibliography of the Scientific Publications of Joel Asaph Allen*, written at the urgent request of the President of the American Museum and published in 1916.

JOEL ASAPH ALLEN
1838-1921

and of affection. Allen's own contributions to the *Bulletin* and *Memoirs* numbered hundreds of pages, devoted to hundreds of new species and genera; but above all this, the superlative standard maintained by him at the greatest personal sacrifice enabled us to place our publications beside those of any institution in this or any other country without fear that the American Museum's reputation would suffer in comparison. That is why we are justified in saying that Doctor Allen was the central figure of our first fifty years of scientific development.

There have been, perhaps, other men of equal erudition and equal productive power, but we doubt if in the whole history of zoölogical science there has ever been a man with such warmth and generosity of character, such simplicity of nature, such quiet enthusiasm, who so endeared himself to all his colleagues, young and old, and who so lived as to inspire universal affection as well as reverence. Would that such a personality might have remained immortal in our midst. But such immortality is denied. May his host of students and successors erect a monument of work carried out in his spirit of accuracy and with his kindly and generous attitude.

"To think like Man, and yet like Nature to abide—
This double boon to Man and Nature is denied—
. . . .
The Gods alone enjoy."

A LIFE OF ABUNDANT ACCOMPLISHMENT

BY

FRANK M. CHAPMAN

Curator of Ornithology, American Museum

DR. JOEL ASAPH ALLEN, dean of the American Museum's scientific staff, departed this life at Cornwall-on-Hudson on August 29, 1921, in the eighty-fourth year of his age. For thirty-six years he had served the Museum with a devotion and singleness of purpose which made his duties as curator of the department of mammals and birds, and editor of the Museum publications, labors of the heart as well as of the mind.

Physically far from strong, he ever made demands upon his powers to the limit of their ability to respond. How many times at the end of the day I have seen him lean back in his chair on the verge of complete exhaustion! But if the flesh was weak, the spirit was ever willing; and stimulated by never-failing love of study, which acted like some elixir of life, he has left behind him a marvelous record of achievement.

Dr. Allen was born at Springfield, Massachusetts, July 19, 1838; and he came into this world endowed with that inherent interest in nature which is the priceless heritage of the true naturalist.

His immediate ancestry affords no clue to the origin of his distinctive tastes; they were not exhibited by either of his two brothers, but with him, in spite of far from favorable conditions, they were not to be denied. Without ever having seen a book on natural history, or ever having met a naturalist, he showed an instinctive impulse to collect and preserve specimens of birds and, in proof that such collecting was not merely the gratification of a desire to acquire, he weighed, measured, described, and named his specimens. The boy of thirteen gave evidence of the breadth of his interests by collecting and studying in addition to birds, also mammals, reptiles, fishes, shells, insects, plants, and minerals; and this was done in the spare time left after the conscientious discharge of duties on his father's farm.

The sale of his collections to the Wilbraham Academy supplied him with sufficient funds not only to complete his studies at that institution but, in 1862, to enter the Lawrence Scientific School as a special student under Louis Agassiz. There he formed one of a remarkable group of young naturalists, including Alpheus Hyatt, Edward S. Morse, A. S. Packard, F. W. Putnam, and A. H. Verrill, who afterward were to exert wide influence upon biological research in this country. This formed the beginning of an association with Agassiz and the Museum of Comparative Zoölogy, which lasted, with some lapses occasioned by ill health, for the succeeding twenty years.

In April, 1865, he sailed for Rio Janeiro with Agassiz and a group of assistants, including Charles Frederick Hartt, the geologist, and William James, later the eminent psychologist. After collecting for some weeks in the region about that city, Dr. Allen became one of a small party detailed to visit the northern provinces of Brazil. The journey was made by mule and canoe and involved greater hardships than Dr. Allen's physique could endure. After about three months, during which he secured many specimens of birds, mammals, and fishes, he left the expedition and started for the coast at Bahia, a journey which required nearly two months.

With some difficulty he secured passage for Boston on a 300-ton brigantine and on December 15, sailed from Bahia with several cases of birds, mammals, mollusks, and geological specimens, and six or eight barrels of fishes, reptiles, and other vertebrates in alcohol. After a favorable voyage the latitude of Cape Hatteras was reached January 21; but here a storm was encountered which eventually forced the ship to take refuge in St. Thomas, east of Porto Rico. When it finally anchored off Woods Hole, Massachusetts, ninety days had elapsed since the departure from Bahia.

A short period of recuperation on his father's farm restored Dr. Allen's health sufficiently to permit him again to take the field and, in 1867, he collected in various branches of natural history in the upper Mississippi Valley. In October of that year he returned to the Museum of Comparative Zoölogy where, in 1871, he was made curator of the departments of birds and mammals.

In the winter of 1868-69, an expedition was made to the St. John's River in Florida, where material was gathered which formed the basis of the classic memoir "On the Mammals and Winter Birds of East Florida, with an Examination of certain assumed Specific Characters in Birds and a Sketch of the Bird-Faunæ of Eastern North America," a paper which at once stamped its author as one of the leading zoölogists of this country.

In April, 1871, Dr. Allen extended the field of his labors as a collecting zoölogist to the Great Plains and the Rocky Mountains, returning to Cambridge the following January with 200 skins of mammals, 60 skeletons, 240 additional skulls (mostly of large species), 1500 bird skins, more than 100 birds in alcohol, a large number of nests and eggs, together with fishes both recent and fossil, mollusks, insects, and crustaceans. Among the mammals was a large series of buffalo, collected, at the risk of attack by hostile Indians, near Fort Hays, Kansas, where, Dr. Allen writes, buffaloes were so numerous that on one occasion "they darkened the plains to the west of us as far as the eye could reach." A little more than a year after returning from this arduous and successful expedition, Dr. Allen was invited by Professor Baird, on behalf of the Smithsonian Institution, to assume charge of the work in vertebrate zoölogy of a party of naturalists which was to be attached to the military expedition acting as escort to the surveyors of a proposed line of the Northern Pacific Railroad.

The escort of 1400 troops under General Custer had several conflicts with Indians who followed the expedition so closely that opportunities for zoölogical collecting were seriously curtailed. Only a small part of the region traversed, however, had previously been visited by a naturalist, and much information was gained concerning the general character and faunal affinities of the region. This information was subsequently included in Dr. Allen's published reports. This was Dr. Allen's last important expedition, his field work being concluded so long before that of most naturalists now living was begun, that few, even of his colleagues, realized the extent of his experience as a collecting naturalist, the difficulties he encountered, or the success he achieved.

From 1876 to 1882, Dr. Allen devoted himself largely to laboratory research, working in part for the Museum of Comparative Zoölogy, Cambridge, in part for the United States Geological and Geographical Survey. During this period he produced his monograph on *The American Bisons, Living and Extinct*, and also an 800-page history of the North American walruses, sea lions, and seals. As a result of overwork, his health failed, and in 1882 he was obliged to discontinue his studies. A return to the field was not, however, followed by the expected recuperation, and several years elapsed before he could do a full day's work in the study.

Dr. Allen was now recognized as one of the world's leading zoölogists and, when the Trustees of the American Museum decided to make this institution an organization for research as well as exhibition, it was fitting that they should offer him the important post of curator of mammals and birds. With the acceptance of this position by Dr. Allen in May, 1885, the Museum entered upon a new phase of its history. Prior to this time the small scientific staff had devoted its efforts largely to the exhibition halls; not one volume of the *Bulletin* containing the results of original investigation had been completed, the research collections of birds consisted of about 3000 specimens, and there was no study collection of mammals.

While Dr. Allen fully appreciated the great importance of properly prepared exhibits, by nature and by training he was more deeply interested in original investigation than in the more popular phases of natural history, and he never failed to urge upon the Museum authorities the necessity of building up the Museum's research collections. Even on his deathbed this was often, in periods of delirium, the foremost thought in his mind.

It followed, therefore, that shortly after he became connected with the Museum the great Lawrence collection was purchased. To this were soon added the Elliot humming birds, the Scott collection from Arizona, and the Herbert Smith collections from Brazil. These formed the foundation of the present study series of about 150,000 specimens, which, with the Dwight and Sanford collections, make the Museum's department of ornithology one of the best equipped in the world. Meanwhile, the study collection of mammals was growing steadily until today it numbers approximately 50,000 specimens, every one of which has been acquired since Dr. Allen came to the Museum. The increase in the departmental staff kept pace with its material growth and at present the personnel of the departments of mammals and birds is doubtless larger than that of the corresponding departments in any other museum.

Every moment not required for executive or editorial duties Dr. Allen devoted to the study of the collections acquired by the Museum, and to the preparation of papers on them. This work was prosecuted not only at the Museum but, when ill health prevented him from coming to his office, also at home. The results of these researches, published chiefly in the *Bulletin* of the Museum, are contained in some 23 papers on birds and 168 on mammals, and include descriptions of 49 species and subspecies of the former, and approximately 675 of the latter.

The service rendered to the Museum by Dr. Allen was, however, not restricted to his office as curator. From 1885 to 1918 he acted as editor of the Museum publications, a post which he was especially qualified to fill. To an inborn editorial sense he added excellent taste in questions of typography, and to his supervision is due in no small measure the high standard set by the Museum publications.

When Dr. Allen came to the Museum, the first volume of the *Bulletin*, as previously stated, had not been completed and not one of the *Memoirs* had appeared; when he resigned his editorship, the *Bulletin* was in its thirty-seventh volume and the *Memoirs* on zoölogical and palæontological subjects numbered twenty-two. Practically all this material and much besides, passed through Dr. Allen's hands, and only one with experience in work of this character can appreciate the demands it made upon his time and strength. Often for days together he devoted himself to the revision of manuscript and the reading of proofs, with the thoroughness which characterized all that he did.

Dr. Allen was the virtual author of *The Code of Nomenclature Adopted by the American Ornithologists' Union*, a document which has had wide influence on nomenclatural procedure, and his experience in this special field won him a place on the Commission for Zoölogical Nomenclature of the International Congress of Zoölogy, which he held from the formation of the Commission in 1910 to the time of his death. His deep insight and logical, fair-minded consideration of involved questions arising in this science of names will be missed by his *confrères* on this commission, as well as by his associates in the Museum.

Dr. Allen's retiring nature, his absorption in his studies, and his lack of strength, combined to prevent him from taking an active part in the life of the scientific world beyond the Museum walls. But second only to his duties at the Museum was his interest in the affairs of the American Ornithologists' Union. He played a leading part in the organization of this society, acted as its president for the first eight years of its existence, and was a member of its Council at the time of his death. For thirty years he was editor of its official organ, *The Auk*, wrote, as has been said, a large part of its *Code of Nomenclature*, and saw three editions of its *Check-List of North American Birds* through the press.

Dr. Allen was also a founder of the original Audubon Society, and took an active part in the conduct of this organization and of its successor, the National Association of Audubon Societies, from the inauguration of the movement for bird protection in 1885 to the end of his life. For a number of years Dr. Allen was a member of the Council and vice-president of the New York Academy of Sciences, as well as president of the Linnæan Society, but the demands on his strength by each day's labors and the attractions of an exceptionally happy home life, combined to prevent him from attending evening functions.

This brief epitome of the activities of Dr. Allen is in large part based on an autobiography which, at the urgent solicitation of President Osborn, Dr. Allen reluctantly prepared in 1916.[1] But although he tried to write of himself with the fairness and conscientious regard for truth that marked all his studies, he was too modest to realize the importance of the place he occupied in science, and particularly in the life of the

[1] *Autobiographical Notes and a Bibliography of the Scientific Publications of Joel Asaph Allen.* Published by the American Museum of Natural History, 1916. 8vo. 215 pages, 1 plate.

Museum. Possessed of an exceptionally well-balanced mind and sound judgment, he brought these qualifications to bear on any question with so total a disregard for self-interest that the personal equation was largely eliminated and one could be certain of receiving from him an opinion in which the various factors involved were considered solely on their merits. His counsel therefore was sought not alone by his immediate associates but also by members of other departments of the Museum, and in conferences and committee meetings his advocacy of a cause generally assured its success.

This entire lack of anything approaching egotism was the fundamental trait of Dr. Allen's nature. As a student he was distinguished by his ability to concentrate and, so long as his strength lasted, to apply himself persistently to the task before him, wholly oblivious of his surroundings. Possessed of a calm, equable disposition, he was never irritated, and with endless patience followed the clues of a nomenclatural problem or the systematic relationships of a specimen. His interest in his own work was never too great, however, to prevent him from having an interest in that of others; one could go to him for light on some problem with the assurance of receiving his whole attention; and a novice was treated with the same generous consideration he extended to his colleagues. To the writer Dr. Allen was a friend and teacher rather than superior officer. To work under his direction was an invaluable privilege.

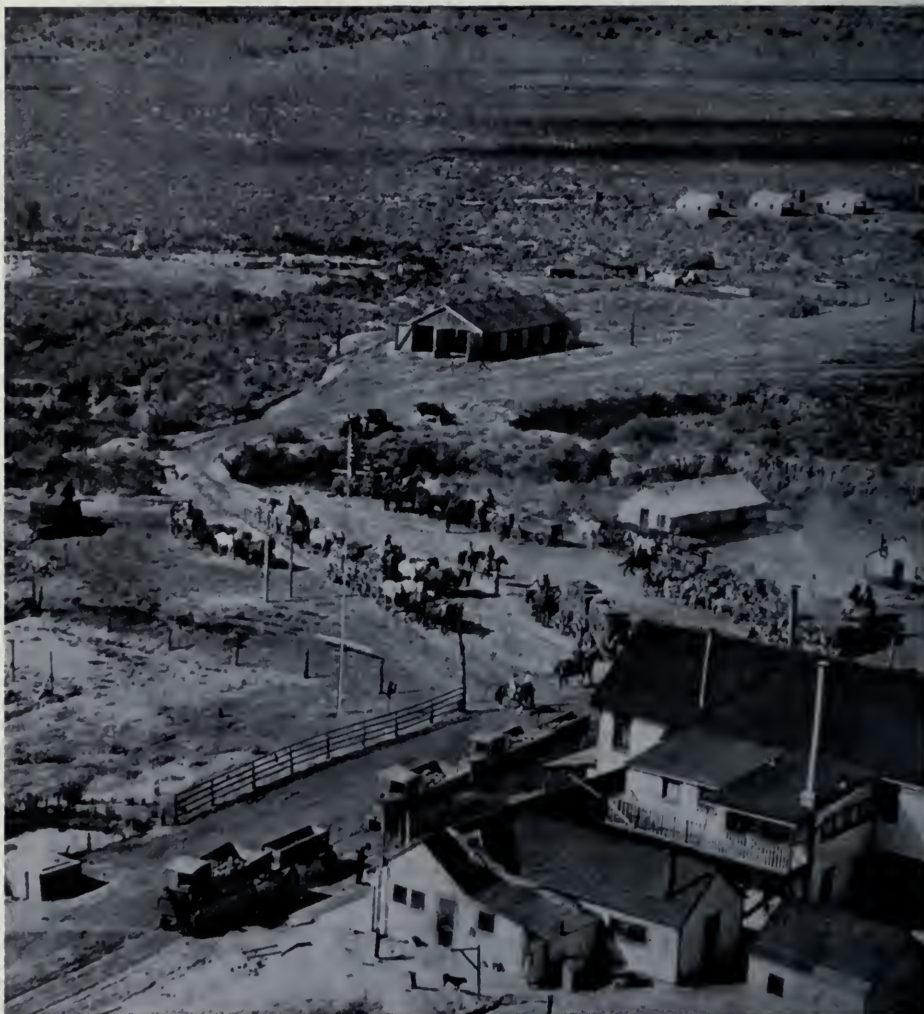
When specialists in research happen to enter the same field simultaneously, there is apt to develop competition born of intensity of interest, which does not always result in harmonious relations, but although Dr. Allen had a number of what to others would have been aggravating experiences of this kind, I do not recall ever hearing him say one unkind word of a fellow-scientist. Slovenly, inaccurate, or unwarrantably speculative work he never hesitated to criticize vigorously and unsparingly, and when need arose, he wielded a pointed pen, but with the author of the work itself he might reason with fatherly kindness.

Few men have lived a happier life than Dr. Allen, or one more removed from the turmoil of the world. In 1874 he married Mary Manning Cleveland, of Cambridge, Massachusetts, who died in 1879, leaving a son, Cleveland Allen, now in business in New York City. Within a year after coming to the Museum he married Susan Augusta Taft, to whose devoted care he largely owed the measure of health which enabled him so continuously and effectively to pursue his museum duties.

From boyhood to within a few weeks of his death, Dr. Allen was enabled to gratify and develop his inherent interest in the study of nature, and far from diminishing, his love for his profession increased. In the last month of his life, as he was eagerly discussing the prospects of receiving valuable additions to our collections, he remarked, "I'm just as enthusiastic over my work as I ever was."

Many honors came to him. His name was on the membership roll of the leading scientific societies of the world; he was a member of the National Academy of Sciences, an honorary member of the New York Zoölogical Society, the Zoological Society of London, and the British Ornithologists' Union. He was awarded the Walker Prize by the Boston Society of Natural History and a medal by the Linnæan Society of New York. His true reward, however, was the joy of achievement, the knowledge of work well done, the approbation of his colleagues, and the opportunity unremittingly to continue his labors.

The vital spark which was his heritage from an unknown past, and which lighted his way from boyhood to manhood, remains inextinguishable in the example of a life of pure, unselfish devotion to the cause of science.



Courtesy of the Standard Chemical Company of Pittsburgh

A DISTRIBUTING CENTER FOR RADIUM ORE

Many are the modes of transportation employed in bringing to the refining plant the hundreds of tons of ore required for the production of a single gram of radium. First the ore is gathered in the mountains and borne on the backs of burros and mules over the rough trails to the mill. Thence the concentrated ore is carried in wagons and motor truck trains to the railroad, and finally there is the long transcontinental journey from Colorado to the refining plant in Pennsylvania

RADIUM—THE SUPREME MARVEL OF NATURE'S STOREHOUSE

AN ACCOUNT OF THE RECENT EXHIBIT AT THE AMERICAN MUSEUM, OF THIS ENIGMATICAL SUBSTANCE AND ITS USES

BY

G. F. KUNZ AND G. FAILLA

IN HONOR of the visit to this country of Madame Curie there was on view for several months at the American Museum a comprehensive radium exhibit, which in a graphic way made clear to the layman the ores from which radium is obtained, the methods applied in extracting and testing it, and the uses made of this most wonderful of substances. The collection of minerals containing radium and thorium was the most complete that has ever been shown at one time. Many specimens were taken from the splendid Morgan collection belonging to the American Museum, and others were loaned by members of the New York Mineralogical Club. The minerals occupied two large cases and were carefully arranged. There were some very rare and even unique specimens. The beautiful large crystals especially attracted Madame Curie's attention when she visited the Museum.[1]

In the collection there were several specimens of pitchblende from Joachimsthal, Bohemia, the ore from which radium was first extracted. The ore, however, which today supplies most of the radium produced is carnotite, named after Marie Adolph Carnot, Director of the École des Mines of Paris, and brother of the late President of the French Republic. It was he who first analyzed carnotite in 1899.[2] The chief sources of supply of carnotite ore are found in southwestern Colorado and southeastern Utah. The ore occurs rather plentifully, but its radium content is much lower than that of pitchblende. Ores rich in carnotite have a canary-yellow color. In general the carnotite forms part of the cementing substance between sand grains, so that a very large quantity of material has to be handled in the process of concentration.

A very interesting specimen of carnotite was kindly loaned by the Radium Company of Colorado. It is probably the humerus of one of the Sauropoda or amphibious dinosaurs, of the genus *Morosaurus* from the Morrison Formation or an equivalent, which would bring it at the dividing line between the Jurassic and Cretaceous periods. The infiltration of carnotite can be seen clearly at one end of the bone from which a small piece has been broken off. The other end still shows the bone structure. The dinosaur bone was found in the Paradox Valley, Colorado.

It has been estimated that since 1911, when the first uranium radium-bearing minerals were mined in this country for radium, ore carrying 186.5 grams has been mined and shipped to reduction plants. From this ore about 125 grams of radium have been extracted in this country. Some of the ore was sent abroad before the World War and from this probably not more than 10 grams were extracted. The remainder of the radium which the ore contained may be regarded as lost because of the imperfect methods of extraction that at first prevailed, some plants not being able to secure more than 50 per cent of the radium in the ore. It is further estimated that about 25 per cent of the radium so

[1]It is worthy of remark that Madame Curie has expressed herself to be very anxious to obtain radium minerals which contain no thorium, and thorium minerals which contain no radium, so that she may carry still further her studies in radioactivity.

[2]Marie Adolph Carnot (born January 27, 1839; died in Paris, June 21, 1920) was an Académicien Libre of the Académie des Sciences, elected in 1895. He was a commander of the Légion d'Honneur. Carnotite was first described by C. Friedel and E. Cumenge in the *Comptes Rendus de l'Académie des Sciences* Vol. 128, p. 532 (1899), and in the *Bulletin de la Société Minéralogique française*, Vol. 22, p. 26 (1899).

Up the rocky trails, into the mountain fastnesses of Colorado, climb trains of patient burros, to return laden with carnotite, the principal ore from which radium is derived

far extracted in the United States has been used on watch faces, or on signs, etc., principally during the war, and that only from 80 to 90 grams have been available for physicians and in hospitals. In Europe the depletion of the radium supply was proportionately as great as in the United States. In view of this it is regarded as probable that the world's stock of radium does not exceed 100 grams. Although in weight this is equivalent to only 3.53 ounces, the value of this quantity of radium is $10,000,000. By way of contrast, gold worth $10,000,000 would weigh 14.8 tons. The ratio of value is, therefore, as 1 to 150,426.

Dr. Hamilton Phillips, Professor of Mineralogy, Princeton University, obtained the first American carnotite ore in 1902, separating the first radium of strength in December, 1902. This ore was then sent to Stephen T. Lockwood, of Buffalo, who formed the Welch-Lofftur Uranium and Rare Metals Company, and this company separated radium in 1903. The quantities of radium thus obtained are now in the United States National Museum.

Radium was first produced in this country from carnotite ore on a commercial scale in 1913 by the Standard Chemical Company of Pittsburgh. Since then several other companies have been formed to extract the precious metal. The gram of radium presented to Madame Curie by the women of America was supplied by the above-named company,[1] which had produced up to June, 1921, 74 grams of radium element.

The exhibit included photographs and explanatory labels supplied by the company, describing the process required to produce Madame Curie's gram of radium from the time the ore was taken out of the mines to the delivery of the finished product. Briefly, the process is as follows: the carnotite ore is mined together with a great deal of worthless rock. It is sorted by hand, sacked, and hauled down to the roads by burros. Then it is taken to the concentration mill and is considerably reduced in bulk before being shipped to the extraction plant. Here the carnotite ore is treated with chemicals to remove all barium and radium salts. The ore concentrate contains about ten parts per billion of radium and about one-half per cent of barium salt. The solution of radium and barium is treated with sulphates to precipitate an insoluble raw sulphate of radium, one ton of the material containing about one gram of radium. From this about one thousand pounds of pure barium-radium chloride are obtained. No single chemical operation is capable of removing the tiny quantity of radium from the huge amount of accompanying barium salt. From this point on, the purification process consists of fractional crystallization as first used by Madame Curie. Finally, a tiny pinch of nearly pure radium

[1]The mahogany box containing the gram of radium was designed by this company. It is one inch thick, and the case within has a lead lining 1½ inches thick, nevertheless 5 per cent of the gamma rays penetrate the walls. The radium was hermetically sealed in ten glass tubes of one-tenth gram each.

bromide is obtained which at first resembles powdered sugar. On standing in a sealed tube the salt acquires a brownish color and loses some of the bluish phosphorescent glow.

It is rather remarkable that the process of purifying radium today is essentially the same as the one used by Madame Curie when she discovered this new element. But the additional difficulties overcome in the commercial extraction of radium from carnotite ore are not to be minimized. An idea of the magnitude of the process can be formed from the following figures: to produce the barium-radium chloride containing one gram of radium it takes 500 tons of milling ore, 500 tons of chemicals, the power from 1000 tons of coal, 10,000 tons of purified and distilled water, and the labor of 150 men for one month. In addition, the process of fractional crystallization, which is carried out by expert chemists, requires five weeks' time. The final measurements of the amount of radium extracted are made about four weeks after it has been sealed in glass tubes, for it takes thirty days for the activity of the sealed radium to reach its maximum value. Before the radium is sold it is shipped to the United States Bureau of Standards, Washington, D. C., where it is remeasured and a certificate of its activity is issued. From the time that the ore is mined to the final measurement of the radium more than six months elapse.

On account of the laborious process of extraction, radium is the most expensive substance known. One gram of radium costs \$100,000, one gram of diamond \$3,000, one gram of platinum \$2.41, and one gram of gold \$0.66½. By reason of its scarcity and its high cost, the practical applications of radium at the present time are limited. During the war it was used rather extensively in the manufacture of luminous materials for gun sights, dials of nautical instruments, etc. Now only a small part of the total production is used in luminous materials. The employment of radium for this purpose is in deference to its property of causing some substances to emit fluorescent light. Phosphorescent zinc sulphide, when mixed with a tiny quantity of radium, will emit a characteristic greenish yellow light for many years. This is the substance used on watch dials. Radium has also the property of changing the color of many substances when allowed to remain in proximity to them for some time. In the exhibit were included many minerals which had been affected by radium, showing the change of color produced by irradiation for a longer or shorter period. This subject has been studied very carefully by Dr. Cornelius Doelter, of Vienna, and he has found that minerals of the same species, but from different localities, acted differently in relation to the change of color. In his opinion a change of color by the radiation is only caused in such minerals as owe their natural color to the presence of a pigment, and among these it is necessary to establish a distinction between those which are colored by isomorphic admixtures and those which are colored by colloid pigments. In the former case the coloring is stable, and therefore, whether by heating or irradiation there is little change in color; those of the latter class, however, which owe their coloring to an unstable pigment, are easily changed in color by radium rays, and also by the Roentgen rays and ultra-violet light.

As to the rapidity of the color change, Dr. Doelter found, as might be assumed, that this depended upon the strength of the radium preparation employed. In his own work he used the exceptionally large quantity of 1½ grams of radium chloride. With smaller quantities a similar color change took place, but somewhat more slowly. To establish a series illustrating the rapidity of change, he took as a standard the intensity of the coloration after a definite period of exposure, and this gave him the series: Kunzite, halite, sapphire, fluorite, topaz, jacinth, quartz. Employing a different test, that of the first appearance of a

RADIUM MINERALS

An impressive feature of the recent radium exhibit at the American Museum was the collection of minerals containing radium and thorium,—the most complete ever presented at one time. This picture shows a section of the mineral exhibit. Of particular interest are the three radiograph negatives of the name Curie, which were produced,—the topmost by carnotite, the middle one by torbernite, the lowest by autunite. The radium radiations affect a photographic plate in the same way as do light rays

THE USE OF RADIUM IN HOSPITALS

This shows a section of the exhibit installed by the Memorial Hospital of New York City to explain the various devices required to make radium applicable in the treatment of disease. Some of the elements of this exhibit, shown here in miniature, are seen in enlargement in the subsequent pages of the article change of color, the experimenter found that, in the examples he tried, halite from Wieliczka was the mineral which exhibited the earliest change of color; then came fluorite from Cumberland, followed

Henri Becquerel, who, as the discoverer in 1896 of radioactivity, paved the way for the discovery two years later of radium itself. In recognition of his eminent service to science he was in 1903 awarded the Nobel Prize jointly with Pierre Curie

successively by a Brazilian topaz, a barite from Cumberland, a sapphire from Ceylon, a Kunzite, and lastly a quartz from Maderanertal.

The first radium the Museum of Natural History owned was presented in 1903 by Dr. Edward Dean Adams, who subsequently also presented to that institution the splendid series of pictures showing phases in the eclipse of the sun; this radium was utilized by Dr. G. F. Kunz, in collaboration with Dr. Charles Baskerville, for the study of phenomena of phosphorescence in minerals.[1]

The largest and most valuable consignment of radium that has ever been moved at one time was lately brought to London from the Joachimsthal region in Czechoslovakia by Professor Soddy, of Oxford University. This consignment consists of two grams of the precious substance, and is the first shipment made under the business arrangement recently arrived at between the Imperial and Foreign Corporation of London and the government of Czechoslovakia. It was deposited for safe-keeping at the Foreign Office. This radium, valued at £70,000 (about $260,000 at the present rate of exchange) is loaned to England for fifteen years by Czechoslovakia for purposes of scientific research.

The most important application of radium is in medicine. At the present time nearly all the radium produced is devoted to therapeutic purposes. It is of happy augury that this wonderful new element should be dedicated to the alleviation of human suffering—the highest purpose for which it could possibly be used. It is a remarkable coincidence that Henri Becquerel, who discovered the property of radioactivity accidentally, should have found out also by chance that radium affects living tissue. Soon after the discovery of radium by the Curies, Becquerel carried about with him in his vest pocket a small amount of the precious salt enclosed in a glass tube, so that he might show the new substance to his friends. Some time later a burn developed in the skin directly under the pocket in which the radium had been. This, taken in conjunction with similar effects which had been observed, led to the use of radium radiations for the treatment of cancer.

Photograph taken through 15 cm. of lead by means of radium, showing the great penetrability of the gamma rays of this wonderful substance

[1]G. F. Kunz and Charles Baskerville, *Science*, 1903, p. 769.

The remarkable properties of radium are due to its radioactivity. In all other respects it behaves like a chemical element and is closely related to the metal barium. While, however, it may be said to be an element, it has the property of transmuting itself into an entirely different element, which in turn also disintegrates. The complete transformation series is shown in the following table:

ELEMENT	RADIATION EMITTED	HALF VALUE PERIOD
Radium	alpha	1730 years
Radium emanation	alpha	3.85 days
Radium A	alpha	3 minutes
Radium B	beta + gamma	26.7 minutes
Radium C	beta + gamma	19.5 minutes
Radium C′	alpha	0.000001 second
Radium D (Radio-lead)	slow beta	15.83 years
Radium E	beta + gamma	48.5 days
Radium F (Polonium)	alpha	136 days
Lead		

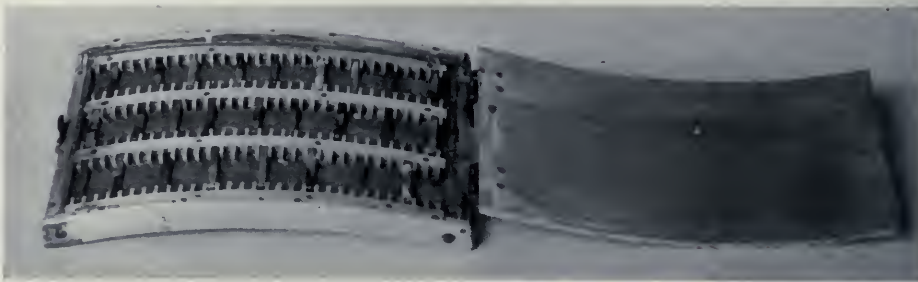
Each change is accompanied by the emission of energy in the form of radiation, of which there are three distinct types designated alpha, beta, gamma. The alpha rays are positive particles of electricity traveling at very high speed, which become helium atoms when they collect two negative particles of electricity, or electrons, each. The beta rays are electrons traveling at still higher speeds than the alpha particles. Some beta particles have nearly the velocity of light, which is 186,000 miles a second. The gamma rays, like X-rays, consist of electromagnetic waves, in which they are identical with light, but their wave length is very much shorter than that of light and even shorter than that of X-rays. The alpha rays are very easily absorbed by matter, $\frac{1}{10}$ mm. of glass being sufficient to stop them. The beta rays are much more penetrating, some being capable of traversing 2 mm. of lead. Finally, the gamma rays are extremely penetrating, for their presence can be detected even through 25 cm. of lead. The radiant energy emitted by radium has been measured: it is 133 calories an hour. Therefore a given amount of radium can melt its own weight of ice in less than three-quarters of an hour, and it is capable of doing this indefinitely.

Courtesy of the "Scientific American"

Monsieur and Madame Curie, to whose genius and devoted labors the world is indebted for one of the greatest discoveries of all time

The energy which one gram of radium liberates during its life is 2,900,000,000 calories, while the energy produced by burning 1 gram of coal is 8000 calories. It is very important to remember, however, that radium gives off its energy at a very slow rate, which cannot be altered by any means at our disposal, while coal can be burned rapidly or slowly at will. Furthermore, the burning of coal is a chemical reaction in which carbon and oxygen combine to form carbon dioxide, while the emission of energy by radium results from the transformation of the radium atoms themselves into different atoms. The process of disintegration of radium proceeds at such a slow rate that it has been calculated that after nearly 2000 years there will still remain half of the initial amount. Yet the radiation emitted is so powerful that it is able to bring about marked changes in many substances.

When radium is employed for therapeutic purposes, it is not used as a drug. The physiological effect which it is capable of producing is due to its radiation and therefore it is not even necessary to bring it into intimate contact with the diseased tissue. Radium produces its effect at a distance by means of the invisible

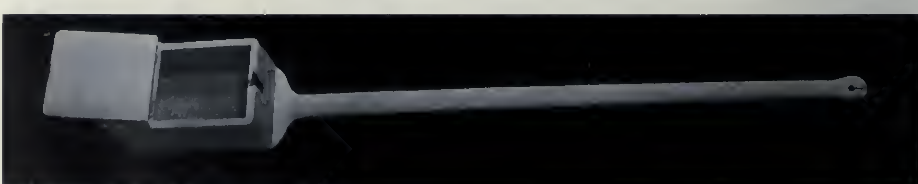


Radium applicator used for the treatment of deep-seated tumors. It is always applied at a distance of several centimeters from the skin. Only the very penetrating gamma rays are utilized in such cases. They pass through 2 mm. of brass before reaching the patient

rays which it emits. Of course, the closer it is to the tissue, the greater will be the effect, just as the closer we are to a lamp, the more light we receive. Of the three types of radiation which radium sends out, ordinarily only the beta and gamma rays are available for treatments. The alpha rays, being very easily absorbed by matter, cannot force their way through the walls of the radium containers and in any case they could not affect an appreciable thickness of tissue. Both beta and gamma rays can be resorted to when the diseased tissue extends to the surface, but only the very penetrating gamma rays can be used to influence a deep-seated growth without irreparable injury to the skin. In this case the radium is enclosed in a metal container of sufficient wall-thickness to absorb the beta rays. The metal acts as a "filter" through which the penetrating gamma rays pass substantially without loss, while the beta rays are completely absorbed.

There are two ways in which radium is employed for the treatment of patients: (1) the radium salt—usually the sulphate—is kept in sealed containers (tubes, hollow needles, etc.,) which are applied to the patients; (2) the radium, in the form of bromide or chloride, is dissolved in water and the gas emanation, which results from its disintegration, is collected in small glass tubes, which are then used for treatments. On account of the complicated apparatus necessary for the collection and measurement of the emanation, this method is used only when relatively large quantities of radium are available. It has, however, many advantages, as it is inherently more flexible and has a wider range of application. All large institutions using radium have adopted this method.

In the exhibit at the American Museum both methods were represented. Dr. Robert Abbe, of New York, who was one of the first physicians to use radium in this country, contributed to the exhibition some applicators in which the radium tubes are placed for different treatments. He supplied also a number of casts showing different cancerous growths in their natural sizes and colors before radium treatment and the subsequent results. These casts indicated very strikingly the healing power of radium. In some cases the growth had disappeared

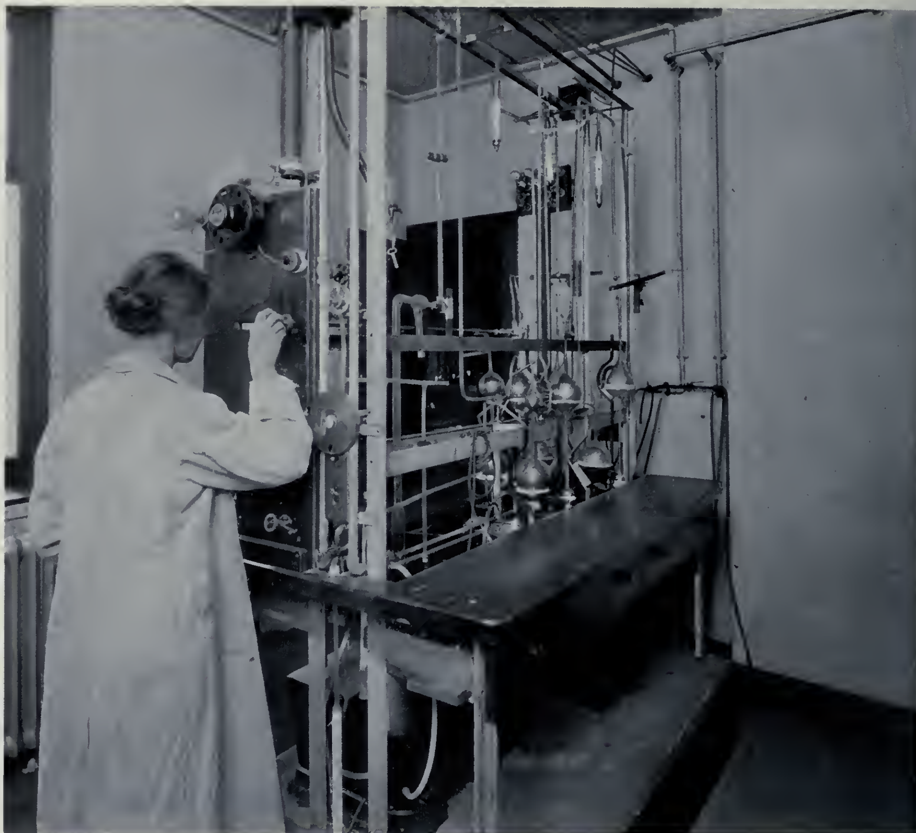


Box used for carrying radium applicators from one part of the Memorial Hospital to another. Note the long handle, a protective device to keep the holder out of proximity with the radium without leaving even a scar. In Dr. Abbe's collection there were also many objects of historical interest, such as a tube containing some of the first radium brought to this country, a spinthariscope, an electroscope used by the Curies, and the first quartz piezo-electric measuring instrument made by Professor Curie. This was later bestowed upon the College of Physicians of Philadelphia by Dr. Abbe, the formal presentation being made by Madame Curie on the occasion of her visit to that city.

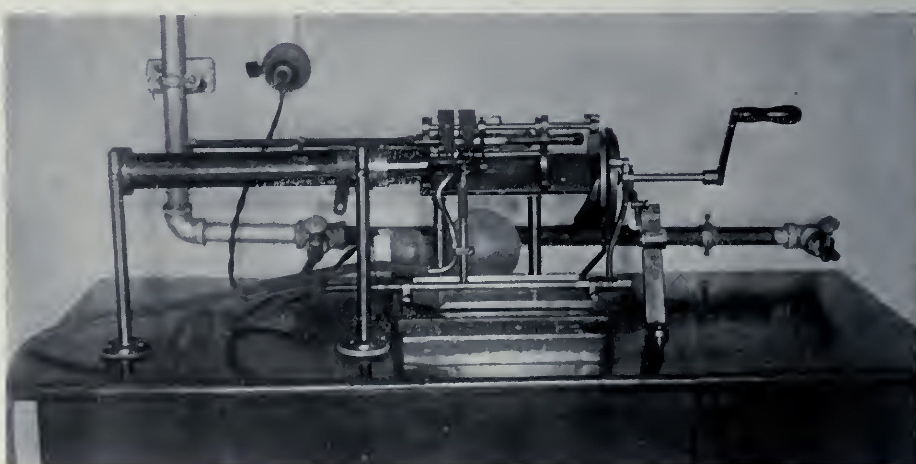
The Memorial Hospital of the City of New York prepared a large exhibit illustrating all phases of the radium work from the collection of the emanation to its use for therapeutic purposes. This institution is devoted solely to the treatment of cancer and allied diseases and has made an extensive study of the cancer problem. Radium is one of the most successful agents which the Memorial Hospital staff has adopted to combat cancer. It is gratifying to know that through the enthusiasm and generosity of the late Dr. James Douglas, a former Trustee of the American Museum, the Memorial Hospital has in its possession the largest quantity of radium of any public institution, namely, four grams. When the work was first started at the Memorial Hospital in 1914 with a small amount of radium, the available knowledge of the effect of radiation on cancer was very limited. It was necessary, therefore, to develop a rational technique and the concomitant armamentarium. Steady progress was made in the methods of application at the same time that the supply of radium increased at the rate of 100 milligrams a month. Today the Memorial Hospital stands as the leading institution for radium therapy.

The four grams of radium are kept in a lead-lined steel safe, within a fireproof vault. Four small glass flasks containing the radium in solution are joined to one glass tube, which in turn is connected with the intricate glass apparatus used for the collection of the gas emanation produced by radium. The apparatus is exhausted thoroughly by means of a vacuum pump and is kept as free of air as possible. On account of the decomposition of water under the influence of the radium rays, a very large amount of gas is mixed with the minute quantity of emanation which is to be collected in tiny capillary glass tubes. It is necessary, therefore, to separate the emanation from the "impurities." This is accomplished

Applicators for irregular growths. They are made of dental modeling compound, and the emanation tubes are distributed evenly over the surface to be treated

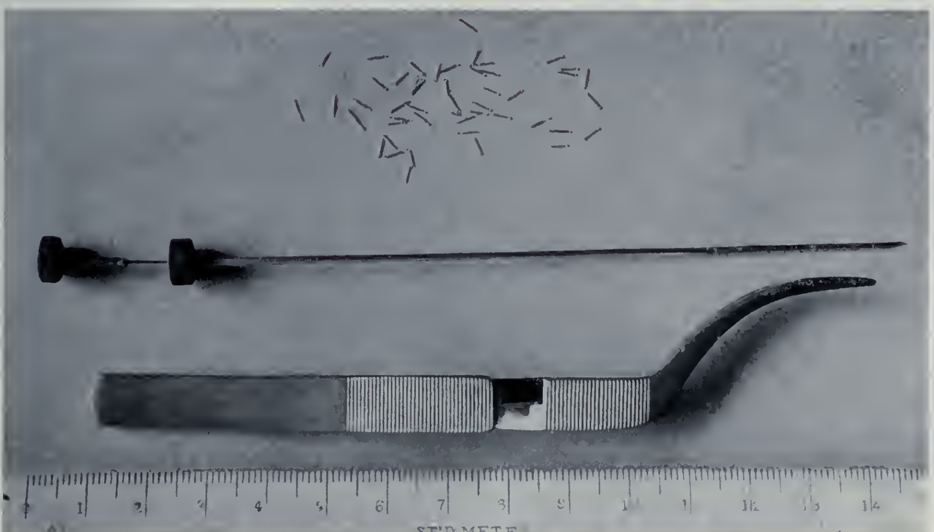


This intricate apparatus is used at the Memorial Hospital for the purification and collection of radium emanation. Note that the operator stands in front of a lead screen which protects her from the rays emitted by the (invisible) radioactive material at the other end of the apparatus. The remote control attachment here shown is necessary only when the emanation from a large amount of radium is to be collected. During 1920, there were collected with this apparatus, 200,000 millicuries of emanation

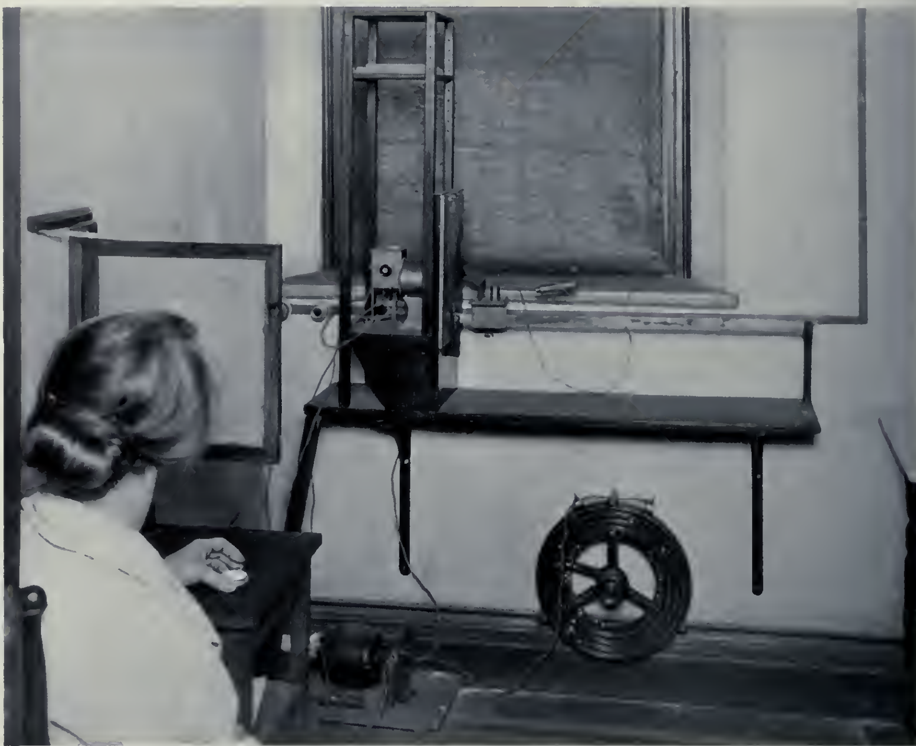


This machine was made at the Memorial Hospital to divide a long glass capillary tube containing radium emanation into a large number of tiny tubes. By turning the crank, the tubes are sealed off one by one. During 1920, this machine made 20,000 of these tiny tubes by chemical means, the gases being transferred from one part of the apparatus to another by means of suitable mercury pumps. Finally the emanation is forced into a capillary tube about the size of an ordinary pin and is sealed off by fusing the glass tube with a tiny gas flame. This tube is then divided into two or three parts and each is placed in a silver container. The latter can be used in the same manner that tubes containing radium salts are used. The beta and gamma rays, needed for treatments, being emitted only by Radium B and C, are identical in the two cases. The only difference is that the radiation from radium tubes remains practically constant in value while that from emanation tubes decreases in intensity at a fairly rapid rate. The amount of emanation in a tube is expressed in millicuries, a unit adopted in honor of Madame Curie. The gamma radiation from one millicurie of emanation is the same as that emitted by one milligram of radium element. If we have a tube containing 100 millicuries of emanation, the amount will have decreased to 83.5 mc. in 24 hours, to 69 mc. in two days, to 50 mc. in 3.85 days, to 25 mc. in 7.7 days, and so on. In other words, the amount of emanation decreases at the rate of 16.5 per cent in 24 hours. For this reason, when the emanation method is used,

Technician at the Memorial Hospital preparing a radium applicator. Note the thick lead-lined, cast-iron protector, and the long forceps used for handling the tubes



The tiny glass tubes containing radium emanation are inserted into cancerous growths by means of a hollow steel needle and plunger. The tube is placed into the needle by means of the forceps shown and is then discharged into the diseased tissue. No attempt is made to recover the glass tubes, for they become "extinct" after two or three weeks



This instrument, a gold leaf electroscope, is used at the Memorial Hospital for the accurate measurement of radium. The image of the gold leaf is projected on a screen at a distance of three feet and the rapidity of its motion is determined with a stop watch. The radium or emanation to be measured is placed on the shelf or in the v-shaped support on the iron rail. The rays go through three-fourths of an inch of lead before reaching the electroscope proper and discharging the leaf. Other conditions being the same, the faster the leaf is discharged the larger the quantity of radium present

there is always available a supply of tubes of various strengths. Furthermore, the tubes can be made of different values initially.

A method of application which is not possible when radium salts are used, consists in the insertion in a tumor of tiny glass tubes containing about one millicurie of emanation. The tubes are buried in the tissue by means of a hollow needle with a plunger and are left in place indefinitely. After two or three weeks their activity is practically negligible and as foreign bodies they are harmless. By this time, however, the tumor has been affected by the radiation. This method of treatment, which has been found to be very effective, has been developed to its present efficient state at the Memorial Hospital. A large number of tubes is used in this manner every day. Their preparation made necessary the construction of a special machine which cuts the tubes rapidly, thus decreasing to a negligible amount the exposure of the workers.

The success of a treatment depends to a considerable extent on the administration of a proper dose of radiation. Therefore it is necessary, in the first place, to know the strength of each tube of emanation. The weight and the volume of the gas are extremely small and it would be impracticable to base the measurements on either. Advantage is taken, however, of the electrical properties of the radiation and electrical measuring instruments are used. A gold leaf electroscope is very convenient for this purpose. The leaf is charged so that it stands out from its support. The radioactive material placed at a distance from the electroscope "ionizes" the air, that is, makes it a conductor of electricity, and consequently the charge from the leaf is carried away. The leaf then falls back to its initial position at a rate depending on the amount of radium or emanation in the specimen being tested. By measuring with a stop watch the time it takes the leaf to travel between two fixed points, it is possible to calculate the amount of radioactive material in the specimen. In practice the motion of the leaf is observed either with a microscope or by projecting it on a ground-glass screen. Ordinarily, the rays used to affect the air in the instrument pass through two centimeters of lead. Special electroscopes have been constructed capable of measuring $\frac{1}{50,000,000,000}$ gram or $\frac{1}{1,300,000,000,090}$ ounce of radium.

When a great many tubes have to be measured in one day, it is impracticable to use an electroscope. A convenient measuring instrument for more rapid determinations consists of a very sensitive galvanometer which measures the electrical current produced by the emanation in a suitable ionization chamber. This is the method used in measuring the tiny tubes which are later inserted in tumors. These tubes are so small that it is quite difficult to handle them. The apparatus, therefore, is so constructed that each tube is picked up with long forceps only once in the process of measurement. An idea of their size can be obtained from the fact that 30,000 of them weigh only one ounce. The total amount of radioactive emanation they would ordinarily contain weighs only 0.00018 of a gram or 0.000006 of an ounce.

Of great importance is the protection of radium workers from the radiations. This problem has been considered carefully at the Memorial Hospital, where it is particularly important on account of the large amount of emanation to be handled, and safety measures have been adopted from the inception of the work. The tubes are handled always with 30-cm. forceps. Applicators are prepared behind lead-lined, cast-iron blocks, especially designed to protect the most vulnerable parts of the body. The emanation apparatus is so constructed that the operator stands behind a lead plate at a considerable distance from the active part. Measuring instruments have been designed with the same end in view. It should be remembered that it is not dangerous to be in proximity to

Instrument used to measure the radioactivity of "bare tubes." A very sensitive galvanometer measures the electric current produced in the ionization chamber by the rays. The beam of light serves as the pointer for the galvanometer. The tube to be measured is dropped through the upper funnel into a small box on a silk ribbon which carries it in the chamber when the crank is turned. The beam of light then is deflected according to the strength of the tube

Radium emanation containers. The smallest one is the glass tube in which the emanation is sealed. It can be placed into any one of the metal tubes shown. The latter serve the purpose of "filters," allowing some of the rays to go through and absorbing the others. They are made of platinum, lead, silver, or aluminum, according to the exigencies of the treatment

The receptacle in which Madame Curie's radium was handled just before it was ready for the glass tubes in which it was delivered to her. (The photograph shows exact size of receptacle.)

After 500 men had worked more than six months with over 500 tons of ore and 10,000 tons of distilled water, 1000 tons of coal and 500 tons of chemicals, they had a quantity of radium that just thinly covered the bottom of this dish

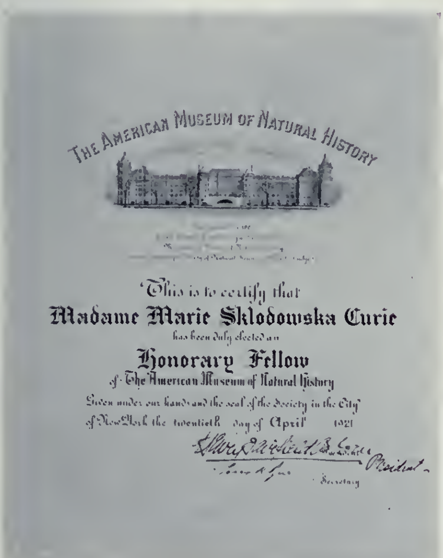
even a large amount of radium for a short time, or to be near a sufficiently weak source for a long time. Also the emanation, as soon as it is collected, is inactive, for the penetrating rays are emitted by Radium B and C, which accumulate gradually for three hours. These facts form the basis of the protective measures taken. The effect of a strong source can be decreased as much as we please by surrounding it with a sufficient thickness of matter, usually lead. The greatest trouble is experienced in making new technicians avail themselves of the protective devices provided. This is due to the fact that no immediate effect results from overexposure to radium rays. It takes usually more than a week for a visible effect to develop and sometimes even four or five weeks. If radium burned like an incandescent body, the problem of protection would be very simple.

A word should be said about the difficulties of radium therapy. In spite of the large amount of work done in this field, the present knowledge of the effects of radiation on cancer is more or less rudimentary. The main difficulty is that very little is known about the biological action of radiation. The necessary information cannot be obtained from the treatment of patients but must come from careful experimentation with the aid of the physical and biological sciences. Even now, however, radium is known to be of unquestionable benefit to several definite groups of patients for whom there was practically no hope of recovery or even improvement before the advent of radium. It is certain that through the efforts of such institutions as the Memorial Hospital of New York City, the Huntington Hospital of Boston, and others, the field of usefulness of radium in the treatment of this terrible disease will be greatly enlarged. The late Dr. James Douglas fully realized the importance of the experimental research in the development of radium therapy, for, in addition to the radium previously mentioned, he donated to the Memorial Hospital a well-equipped laboratory building.

Space does not permit the description of the many pieces of apparatus and the instruments of the Memorial Hospital exhibit. An idea of the amount of work this institution is doing in the field of radium therapy may be gathered from the following figures: In 1920, 1656 new patients were treated, 2224 new and old patients were admitted to hospital beds, 28,525 days of treatment were given to these patients, 23,400 visits were made to the hospital by old patients for examination and advice, about 35 per cent of the above days of treatment were given without cost to the patient. From the radium in solution 200,000 millicuries of emanation were collected, 20,000 capillary tubes were made and measured, and 2672 radium applicators were prepared for the treatment of patients.

In conclusion, a few words may be said about the place of radium in the treatment of cancer. The following statement is taken from the Memorial Hospital exhibit: it has been proved that radium is a reliable agent for the cure of accessible cancers in their early stages. It is of great value as a palliative agent in advanced forms of the disease. At present it cannot control widely extensive cancers. Therefore, the importance of the early recognition of this disease is emphasized more than ever.

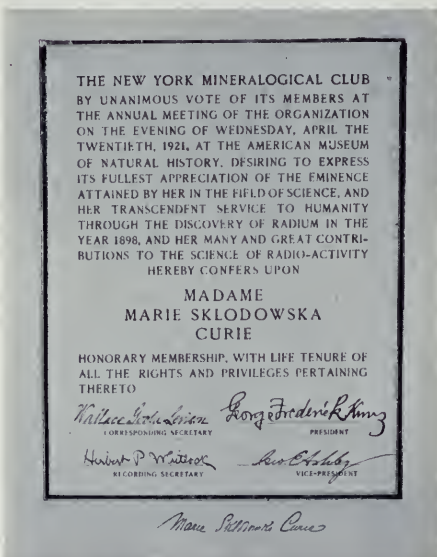
During October a week was named "Cancer Week." A convention of surgeons and others held meetings in the course of which cancer and the application of radium were discussed. Some surgeons claim that no cures have been made with radium; others, that there have been cures. The general consensus of opinion seems to be that radium should be used only by physicians who themselves are thoroughly conversant with its properties and application.


The American Museum of Natural History

This is to certify that
Madame Marie Sklodowska Curie
has been duly elected an
Honorary Fellow
of The American Museum of Natural History
Given under our hands and the seal of the Society in the City of New York the twentieth day of April 1921

President

Secretary


THE NEW YORK MINERALOGICAL CLUB BY UNANIMOUS VOTE OF ITS MEMBERS AT THE ANNUAL MEETING OF THE ORGANIZATION ON THE EVENING OF WEDNESDAY, APRIL THE TWENTIETH, 1921, AT THE AMERICAN MUSEUM OF NATURAL HISTORY, DESIRING TO EXPRESS ITS FULLEST APPRECIATION OF THE EMINENCE ATTAINED BY HER IN THE FIELD OF SCIENCE, AND HER TRANSCENDENT SERVICE TO HUMANITY THROUGH THE DISCOVERY OF RADIUM IN THE YEAR 1898, AND HER MANY AND GREAT CONTRIBUTIONS TO THE SCIENCE OF RADIO-ACTIVITY HEREBY CONFERS UPON

MADAME
MARIE SKLODOWSKA
CURIE

HONORARY MEMBERSHIP, WITH LIFE TENURE OF ALL THE RIGHTS AND PRIVILEGES PERTAINING THERETO

CORRESPONDING SECRETARY — PRESIDENT

RECORDING SECRETARY — VICE-PRESIDENT

During her recent visit to America, Madame Curie was the recipient of distinctions from the foremost institutions of learning in the land. The American Museum conferred Honorary Fellowship upon her and the New York Mineralogical Club made her an Honorary Member

THE MADAME CURIE RADIUM FUND

WHAT IT REPRESENTS AND HOW IT WILL BE APPLIED

BY

GEORGE F. KUNZ

THE Marie Curie Radium Fund represents a splendid accomplishment on the part of the women of the United States, among whom was collected in large part the sum devoted to the purchase of the gram of radium recently presented through President Harding to the discoverer of that miracle-working substance. Mrs. William Brown Melony,[1] to whom so large a measure of credit is due for the success attending the collection of this fund, has just communicated full details of the result of the campaign organized for the purpose.

Mrs. Melony reports that through the concerted efforts of those interested in the matter, Madame Curie was able to return to France with her gram of radium and with $22,000 worth of mesothorium as well as other valuable ores; the total value of her precious package was $162,000. In addition to this she had in cash from awards of scientific societies the amount of $6884.51.

There is now left in the Equitable Trust Company the sum of $60,000. Recently a prominent American undertook the collection of an independent fund of $50,000 to be applied to the purchase of equipment for Madame Curie's laboratory and, in case this amount is raised, the $60,000 on deposit will be released for the establishment of a trust fund, the income of which is to be given to Madame Curie as long as she lives. It has been proposed that at the termination of her life, the income from the trust be used to pay the expenses of two American students in chemistry and physics at the Sorbonne.

A legitimate source of pride is the fact that from this radium fund in the Equitable Trust Company, raised largely by women, not a cent was deducted for the expense of collection; what small expense there was has been defrayed by two American women. On July 15, 1921, Mrs. Edward Dwight Pomeroy, Treasurer of the American Association of University Women, Chicago, forwarded to the Equitable Trust Company a check for $1529.19, thereby completing the contribution of this Association to the Marie Curie Radium Fund.

Under date of September 22, 1921, Madame Curie applied to Herbert C. Hoover, Secretary of Commerce, for advice as to the disposal of $8000 sent to her by Americans as a contribution to the fund for the purchase of the gram of radium. As these contributors appeared unaware that the radium had already been purchased and donated to Madame Curie, she wished to know what should be done with the money. Possibly it could be added to the special fund proposed.

The radium presented to Madame Curie was bought from the Standard Chemical Company of Pittsburgh which made the lowest price in a closed bid. The fairness of this offer made possible a larger residuum of money for purposes kindred to that for which the fund was originally raised.

It was a brilliant thought of Mrs. William Brown Melony to induce Madame Curie to come to America and to arrange on her behalf and in so splendid a manner the public testimonials, in the form of receptions, lectures, and visits to our great institutions, that signalized Madame Curie's sojourn in America. Mrs. Melony was aided in her work by a very efficient committee which coöperated with her in every way.

[1]On November 12 Mrs. William Brown Melony was informed through the Prince de Béarn et de Chalais, Counselor of the French Embassy, that the French Government had conferred upon her the decoration of the Chevalier de Legion d'Honneur, in recognition of her work in connection with the Marie Curie Radium Fund and her services on behalf of France during the war. The decoration was bestowed upon her by the Honorable Aristide Briand at the home of the Honorable Gaston Liebert, Consul General of France, on Thanksgiving Day, November 24, 1921

RECENT ACTIVITIES OF EUROPEAN ARCHÆOLOGISTS

BY

N. C. NELSON*

THE Great War, one would suppose, might have put an end for a time, at least in Europe, to anything so apparently unimportant as the pursuit of archæological studies. Many of the younger investigators sacrificed their ambitions on the field of honor; and economic and political stress since the guns became silent would seem to call for activity along strictly "practical" lines. Nevertheless, only a few months ago the Prince of Monaco assured us that the young men of France were rallying to the cause of archæology, were making all sorts of personal sacrifices and suffering real privations in order to prepare themselves to continue the work. Indeed, some of the nations of Europe, perhaps partly as a result of the war, are looking more closely than ever into the questions of their racial constituencies, and some are basing their appeal for progress and nationalism directly on the facts developed by prehistoric archæology. "Behold the splendid accomplishments of your ancestors," say the Scandinavian educators, "and be proud enough not to let your cultural heritage suffer."

Archæology also appears to serve mankind in a still broader capacity. Everywhere of late years familiar voices have talked despairingly of the whole future of human progress. Wallace, the great naturalist, strange to say, was one of the first to express these gloomy forebodings. But during and since the war several books have been published, one in Spain, one in France, one in England, and two in America, all reviewing the long story of man's ancient achievements. It is possible that some of these writers themselves did not find the future sufficiently promising and for satisfaction turned instead to a contemplation of the glorious past. Whatever the motive, there can be no doubt that such recent books as Mr. Wells's *Outlines of History* and Professor Tylor's *New Stone Age in Europe* are excellent antidotes for the depressing influence of times like the present, for they serve to show that human prehistory has been one long succession of crises and that, nevertheless, general progress has been fairly continuous. And if this has been so throughout the uncounted centuries of the past, why despair of the future?

It is not, however, to justify prehistoric archæology by showing the practical application of its results that these lines are written. It is rather to call attention to the fact that archæological research is actually going on in Europe, the evidence being two interesting papers that have recently appeared. One of these papers deals with a racial question, the other is concerned with a question of culture, and both are deemed sufficiently important for brief exposition.

THE CRÔ-MAGNON MAN IN SWEDEN

That the tall, narrow-skulled people of present-day Sweden are direct descendants of the highly gifted, narrow-skulled Crô-Magnon men of Palæolithic France and central Europe is the opinion expressed by Oscar Montelius of the National Museum, Stockholm. His views on this and related topics are set forth in the April number of the *Antiquarian Journal* of London and were called to the attention of President Henry Fairfield Osborn by Mr. Randall MacIver. The article, unfortunately, is too brief to be convincing; but a statement of such importance coming from one of Europe's foremost veteran archæologists compels attention.

*Associate Curator of North American Archæology, American Museum

Montelius, accepting as his starting point the recent scientific determinations of Baron De Geer with respect to the duration of Post-Glacial times, concludes that 20,000 years have elapsed since the last great ice cap, covering northwestern Europe, began to retreat northward. In its wake followed the flora and fauna typical of central Europe during the height of the Glacial period; and the Crô-Magnon man, dependent for thousands of years upon this fauna, very naturally followed in pursuit. It is estimated that he arrived in southern Sweden about 15,000 years ago.

The evidence in support of this view consists of a number of typical Solutrean flint implements found not only in Sweden but in Norway and Denmark as well. Other implements of flint and bone resembling those of the Azilian-Tardenoisian period of France are also described and illustrated as coming from Sweden; and the Maglemose and Brabant cultures of Denmark, though somewhat local in character, are generally regarded as belonging on the same French horizon. Finally, the culture of the shell-mound people of Denmark, and also of some of the early coast dwellers of Sweden, is, as has long been known, identical with the Campignian period of France, the stage which marks for us the true beginning of the Neolithic Age in western Europe. In brief, there would seem to be in the Baltic countries, as in France, an uninterrupted cultural development from Solutrean times to the present.

No direct proof is offered by Montelius that it was, in fact, the Crô-Magnon man who brought these cultural traits to the Baltic shores. It is pointed out merely that the stature and skull form of the Crô-Magnon man—said to be the only inhabitant of central Europe during the Upper Palæolithic—were much like those of the present Nordic stock, typical especially of the central inland districts of the Scandinavian peninsula. The connection between these two peoples receives further confirmation through the fact that archæologic and linguistic studies in Sweden both indicate, it is said, that no other people ever inhabited the southern and central portions of the region mentioned. Thus the oldest skulls discovered are held to be dolichocephalic, and the geographic place names are considered to be of Swedish derivation.

All this is extremely interesting, even if open to some criticism. Different national groups seem ever more ready to claim relationship with the wonderful prehistoric cave-artists of France, even the French themselves. And something of an artistic inheritance doubtless did pass northward, to flare up in a unique manner during the early Bronze Age. But to the writer it does not appear clearly established that central Europe during the Upper Palæolithic was inhabited exclusively by tall, narrow-skulled people. Moreover, the oldest skulls recovered from the tumuli of Scandinavian countries distinctly indicate, according to Retzius and others, the presence of at least a small percentage of the broad-skulled type. It has been shown that this type, or race, has been steadily increasing in numbers but its origin has never been cleared up. This does not, to be sure, seriously militate against the essential correctness of Montelius' view—a view which, it may be recalled, was advanced by the late Professor Steensby of the University of Copenhagen more than ten years ago. Steensby at that time recognized in the composite Danish populations not only Nordic, Alpine, and Mediterranean types, in accordance with Ripley's classification of European races, but he announced the presence of two other types which he declared were none other than modified descendants, the one of the Crô-Magnon race and the other of the Neanderthal race!

We may well wait for further details in confirmation of these conclusions.

Meanwhile, one of the anomalies that for years confronted the visitor to the national museums of Stockholm and Copenhagen has been cleared up. Sophus Müller and the other conservative archæologists of Denmark, in their labels and guidebooks have assigned a possible date of 6000 years to their oldest antiquities. Montelius, on the other hand, has boldly claimed 15,000 years or more for the Scandinavian antiquities on exhibit in Stockholm. The explanation of the difference, though possibly stated somewhere in print, was never made evident to the visitor of the respective museums. As the argument is not closed, we may still hesitate to accept either extreme of date; but in view of the archæological evidence now presented, and in view also of the continually widening perspective of archæological time, we run little risk in leaning heavily toward the opinion of Montelius.

THE LOWER PALÆOLITHIC INDUSTRY OF NORTHERN FRANCE

Complementary, as it were, to the above brief paper by Montelius on the Upper Palæolithic, there has come to hand another equally important and more lengthy article on the Lower Palæolithic, which originally appeared in *L'Anthropologie* for 1920, under the title "The Most Ancient Industry of St. Acheul." It is a study based primarily upon the notes and collections of the late Monsieur V. Commont, the well-known student of the archæology of the Somme Valley. The paper, however, besides being in part minutely descriptive, advances a number of novel theoretical and speculative considerations of great interest.

The writer, Monsieur André Vayson, is a new entrant into anthropological circles with new and positive ideas. His viewpoint or mental background appears to be geological, a fact that should insure him a hearty welcome. He knew Commont before the war; and during its progress, while stationed with his regiment at Amiens, we may suppose that he was inspired by Commont's inordinate zeal, as well as by his sad fate. At any rate, Monsieur Vayson has since acquired Commont's collections and he lately wrote President Henry Fairfield Osborn, of the American Museum, that he was planning to devote his entire time to the study of geology and prehistory. The circumstance seems most fortunate.

The story of the Somme Valley, which is the story also of a large part of northern France and much of Belgium, as well as of southern England, has been told many times since the days of Boucher de Perthes and Sir Charles Lyell. Vayson tells it again and with notable modifications. Briefly summarized, he writes that the Somme River during late geological times has carved in the solid chalk formation composing the region a broad U-shaped valley measuring about fifty-five meters in depth. The orginal chalk slopes of this valley are today covered with a heavy alluvial mantle of clay, sand, and gravel—ancient stream ballast which from time to time has been left stranded on the high banks as the river cut its channel deeper and deeper. Thus regarded, the portion of the mantle nearest the top edge of the valley, or, in other words, nearest the plateau level, is the oldest. The time required for this cutting process mounts into thousands of years—no one can tell how many.

Our particular interest in the time element arises from the fact that nearly forty meters of this valley-cutting process was effected in the presence of man. This is certain because flint objects of human production are found in the old stream detritus covering the chalk slopes up to that height. In the same alluvium, together with the implements, are found also the fossil bones of animals, in part of Pliocene affinities. These animals are now either totally extinct or their representatives have migrated to other lands where a warmer climate prevails. In the gravels and débris above the forty-meter level, on the other hand, there are no signs of human industry and no fossil fauna (p. 447.)

This much perhaps is already familiar to the reader. But the author next proceeds to question the origin of the barren mantle material above the forty-meter level. Whereas hitherto this mixture of débris has been regarded as ancient river ballast, Monsieur Vayson believes it should be considered as wash directly from the plateau above. More startling still is his denial of the old idea that the alluvial mantle mounts the valley slopes by a succession of terraces and that these terraces are in some way to be correlated with the successive advances and retreats of the glaciers. His view is that there are no true terraces. This must seem disappointing to those who would infer from the relation of the flint implements and the supposed terraces that man was present in western Europe during the second, if not also during the first, interglacial period.

Coming to the cultural aspect of the Somme Valley problem, Monsieur Vayson contributes equally novel and revolutionary ideas. First of all, he concludes from the occurrence and the generally uninjured condition of the worked flint objects found in the alluvium that they lie for the most part exactly where they were left by human agencies. In other words, he believes that early man has had his camps and his workshops directly on the river bank from the time when the river flowed thirty or more meters above its present level. This seems reasonable enough, though it is not easy to imagine how implements left on the river bank could have been buried under more than seven meters of river ballast without themselves being shifted about.

The whole inventory of worked flint objects found associated with the warm fauna in the alluvial mantle covering the lower valley slopes the author labels with the broad designation "Chellean." He specifically denies the alleged occurrence of a Mousterian industrial phase accompanied by a warm fauna (p. 449). In the same manner he disposes of the lately much talked of "Pre-Chellean" stage. In brief, Monsieur Vayson, while giving due credit to Commont for his painstaking labors, is not disposed to accept his detailed stratigraphic determinations. All this may be correct in the main, but certainly it leaves the beginnings of culture for the Somme Valley hanging, as it were, in the air.

This last statement is emphasized also by the author himself, who takes the position that the Chellean industrial stage is a comparatively advanced one. It is so far advanced technically and æsthetically that we must necessarily assume a Pre-Chellean stage of more primitive character. We seem, in short, to know much less about the real beginnings of human culture than for some time we have been in the habit of thinking we knew.

The remainder of the paper is taken up with an intensive study of the worked flints as such. The author divides these morphologically into two great groups: (1) those chipped on one face, and (2) those chipped on both faces. He proposes in this way to get rid of the noncommittal term *coup-de-poing*. From the functional point of view he divides all the "instruments" proper into a *sharp-edged* and a *sharp-pointed* series. By close examination of the edge or the point of the numerous Somme Valley specimens, he finds that many of them show wear and polish due to usage. This wear in many cases indicates what portion of the tool was used, the angle at which it was held, and to some extent suggests the general purpose which it served. Monsieur Vayson concludes, for example, that the enigmatical *coup-de-poing* was employed not with a striking movement, but with a pressure movement such as is used in cutting and scraping. This would appear to settle the long-standing dispute as to whether these instruments were tools or weapons. In general, the author regards the Chellean inventory of implements as having been used largely in wood-working.

The paper concludes with a more or less theoretical discussion of man's primordial needs, the possible methods of producing implements, the various possible forms, and the possible modes of hafting the forms devised. The reasoning is partly *a priori* and partly from analogy with practices of modern aborigines. Altogether, viewed from this side of the Atlantic, it seems the sort of paper that ought to start some lively discussion.

PROFESSOR V. COMMONT

In concluding these notes on the recent archæological activities in Europe, it seems hardly proper to take leave of the Somme Valley problem without paying our respects to Professor V. Commont. This gentleman was to France what Dr. Charles C. Abbott or Mr. Ernest Volk was to America, the zealous yet patient investigator, giving all his leisure hours for many years to one specific locality. Stated in other terms, Commont was France's Boucher de Perthes of the present century. It was he who, after the brilliant de Mortillet had abandoned the St. Acheul station as "impure" or impossible to straighten out scientifically, reëstablished its reputation by prolonged systematic investigation. A busy teacher in the École Normale of Amiens and with little or no financial support from outside sources, he set out to accumulate sound data from all the gravel pits within his reach and he kept up the task for all of fifteen years. Doubtless but for the war he would still be collecting. With him, as with Piette and several other French archæologists, collecting was the labor that made life most worth while.

It is not for the writer to tell Professor Commont's complete story. A pilgrimage was made to St. Acheul with great expectations the year before the war, but unfortunately the master was away from home at the time. What happened to him since is not entirely clear. Monsieur Vayson writes that he succumbed a victim of the German invasion; but this statement appears to be true only in a limited sense. Amiens and its suburb St. Acheul, as we know, were subject to bombardment at least twice, and apparently during the first advance Commont fled to Abbeville. His valuable collections, through some special governmental dispensation, were later rescued practically intact. Probably, however, the shock and privations incidental to such an experience took off many a brave worker.

Commont increased our knowledge by large, carefully made collections. He made a series of sequence determinations which, whether right in all respects or wrong, reëstablished the scientific value of the gravel deposit studies. He did more than anyone else to stimulate English archæologists to a study of the Thames Valley gravels, which have yielded results in many points identical with those of the Somme. Lastly, Commont wrote and published not a few of his discriminating observations. The work he accomplished will live after him and has already borne fruit.

PERSONNEL OF THE SECOND INTERNATIONAL CONGRESS OF EUGENICS

THE Second International Congress of Eugenics, which assembled at the American Museum of Natural History, September 22-28, was exceptionally well attended by scientists from all parts of the world. Many foreign societies and universities were represented by delegates especially designated and, in addition, no less than sixteen governments appointed representatives. These governments included those of far-off Siam and near-by Canada; Belgium, Czecho-Slovakia, Denmark, and Norway, among European Powers; and in South and Central America: Brazil, Chile, Costa Rica, Cuba, Guatemala, Nicaragua, Peru, Salvador, Uruguay, and Venezuela. Four delegates were sent by the United States Public Health Service and eleven of our states had present delegates who had been appointed for the purpose by the respective governors of those states. On the day before the opening of the Congress President Henry Fairfield Osborn, of the American Museum, and Mrs. Osborn returned from their European trip, the one to preside over the Congress, the other to preside over the Ladies' Committee of Reception and Entertainment, in the absence of Mrs. E. H. Harriman, who was detained in the West.

JON ALFRED MJÖEN
Director of the Winderen Laboratorium of Christiania and delegate of the Norwegian government to the Congress

As the result of two years' preparation, in which many forces were united and all worked together with the best of good will, the Congress was an astounding success. Major Leonard Darwin and all the other delegates who took the long and expensive journey from the other side of the ocean, as well as those who had come a shorter distance, were impressed with the arrangements, and one and all declared that the Second Congress marked a new period in the eugenics movement.

From the opening session of the Congress in the great auditorium of the Museum, through the opening of each of the four sections in the Hall of the Age of Man, to the closing session on the afternoon of September 28, interest was not only sustained but kept increasing. At first inclined to regard the Congress with levity, the press of the city took it more and more seriously, until finally the chief and most striking passages in the more important addresses by men like Major Darwin, Dr. Lucien Cuénot, Dr. G. V. de Lapouge, Dr. Jon Alfred Mjöen, Dr. Lucien March, among the foreign speakers, and the outstanding statements in the addresses of American speakers such as Dr. Raymond Pearl, Dr. Ales Hrdlička, President Osborn, and others were widely spread through the press of the country.

Dr. Jon Alfred Mjöen, director of the Winderen Laboratorium of Christiania, who attended the Congress as the delegate of the government of Norway, is devoting his life to the eugenics movement. He is the author of the volume *Race Hygiene*, published in 1914, which sums up the movement in the Scandinavian countries, and is also editor of the new journal, *Den Nordiske Race, Tidsskrift for racebiologi og folkeforskning*, which will publish full popular accounts of the recent Congress. The fact that the distinguished Swedish sociologist, Pontus Fahlbeck, has shown that there is a perceptible racial decadence in Scandinavia, lends moral earnestness to Dr. Mjöen's life mission. To the forthcoming volume of the *Proceedings* of the Congress he will contribute two papers, one on the causes of racial decadence in Sweden and Norway, the other on the inheritance of musical ability. During the coming winter he will continue his studies on the determination of musical ability with *confrères* in Freiburg, in Vienna, and perhaps in Budapest. A matter of special interest to biologists is that the son of August Weismann, the author of the dictum of the continuity of the germ plasm, is a man of extraordinary musical ability.

The Norwegian government is contemplating a survey of racial hygiene, as the eugenics movement is termed in Norway, and in connection with the proposed undertaking Doctor Mjöen will journey during the three summer months of 1922 in northern Norway, continuing his studies of race crossings between the Swedes, the Lapps, and the Finns. The Lapps are supposed to be inured to a northern climate and were selected by Nansen as helpers in his famous journey across Greenland. They proved, however, to be far inferior to the Norwegians in endurance, and before the journey was over the Norwegians were obliged to do all the sledge-pulling, in which Otto Sverdrup proved to have an endurance even surpassing that of Fridtjof Nansen himself. It will be interesting to readers of NATURAL HISTORY to recall in this connection that Roald Amundsen, another great Norwegian explorer and an Honorary Fellow of the American Museum, presented that institution with one of the three sledges which attained the South Pole.

One of the most delightful of the addresses before the Congress of Eugenics was that delivered by Dr. Lucien Cuénot, delegate to the Congress from the University of Nancy, France. Dr. Cuénot is distinguished as one of the naturalists who immediately after the re-discovery of the principle now known as the "Mendelian law of heredity," commenced original research to prove its correctness. Doctor Cuénot expressed himself as especially pleased with the Darwin hall of zoölogy and with the three halls of vertebrate palæontology. He also admired the restorations of extinct animals made by Mr. Charles R. Knight under the direction of Honorary Curator Osborn of the department of vertebrate palæontology. On the advice of Curator Matthew, a full set of bromide enlargements of these restorations is being prepared and will be presented by the American Museum to Dr. Cuénot for the Museum of Nancy. When leaving America on the S. S. *Paris,* Doctor Cuénot wrote President Henry Fairfield Osborn:

I deeply appreciate your kind words and the gift that you are proposing to make to Nancy, of photographs of your restorations, which are admirable in all respects. I leave America with deep regret on October 5, and I shall not have the opportunity, I fear, of seeing Dr. Matthew; I am fairly conversant with your palæontological literature, but I shall be very happy if you will send me in the future your publications and those of Dr. Matthew on this subject. I have always derived much profit from a reading of them.

Dr. G. Vacher de Lapouge, the delegate from Poitiers and leading authority on racial anthropology, also sailed on the *Paris* October 5. He leaves a complete set of his writings to enrich the section devoted to anthropology in the library of the American Museum. Of the three French speakers, Doctor de Lapouge took the most despondent view as to the future racial prospects of France, inasmuch as he feels more keenly than his *confrères* the loss which France has sustained through the World War and through the previous wars and persecutions which have so altered the original racial balance of the French as discovered and commented upon by Cæsar. Perhaps the fact that Doctor de Lapouge himself is of the fair-haired, blue-eyed Nordic race, which has suffered the greatest depletion, may influence his opinion somewhat. Dr. Lucien March, honorary director of the Statistique Générale de la France, who delivered the opening address in the section of the Congress devoted to Eugenics and the Human Family, sailed on the same steamer with his French *confrères.*

Major Leonard Darwin and Mrs. Darwin also left this country October 5, sailing on the *Adriatic.* Major Darwin's address on the opening night of the Congress, as well as the addresses of President Henry Fairfield Osborn and Dr. Charles B. Davenport, delivered on the same occasion, will long be remembered by those who attended the gathering. Subsequently Major Darwin gave a thoughtful address on "The Field for Eugenic Reform" before that section of the Congress devoted to the consideration of Eugenics and the State. Mr. Albert Govaerts, representing the Belgian government, remains for several months of study in the Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, before returning to Belgium.

Among the honored guests of the Eugenics Congress was Dr. Robert S. Woodward, ex-President of the Carnegie Institution of Washington, who wrote to President Osborn under date of October 8:

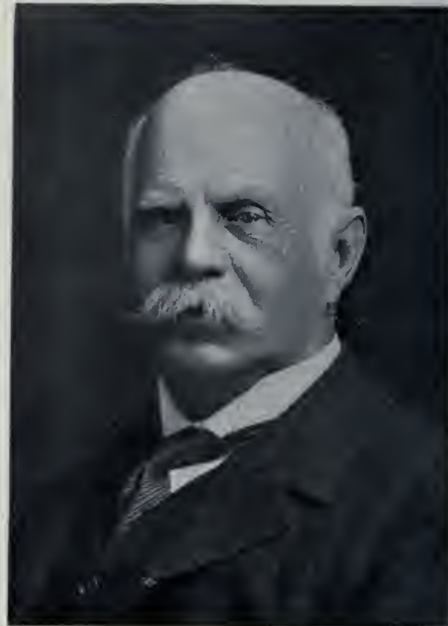
It was my intention to write you before this time to congratulate you, and through you, the staffs of the Museum, on the admirable staging of the Second Eugenics Congress in your establishment. It was a warm place on the first evening for high and hard thinking, but the fine series of addresses and the subsequent reception made attendance, even of an old farmer, well worth while. . . . To one who finds it difficult in these times to discover the brighter tints of the dawn of the immediate future of our race, the cheerful optimism of the younger members of the Congress was quite inspiring. And the Congress as a whole afforded a manifestation of altruism in all respects remarkable, though it is probable that few members adequately appreciate the time essential to work out the reforms and improvements now so clearly visualized. Perhaps we shall be able to note the progress of these and other terrestrial interests, 500 to 1000 years hence, while spending the summer on the Companion of Sirius, or some hotter star in accord with our deserts.

Steps have already been taken to secure the

Courtesy of the "Journal of Heredity"

LUCIEN MARCH

Honorary Director of the Statistique Générale de la France, who delivered the leading address in Section II, devoted to Eugenics and the Human Family



Courtesy of the "Journal of Heredity"

MAJOR LEONARD DARWIN

President of the Eugenics Education Society of Great Britain and the leading exponent of the eugenics movement in the United Kingdom

prompt publication of the addresses and scientific papers presented before the Congress, as a companion volume to *Problems in Eugenics*, the title given to the *Proceedings* of the First International Congress of Eugenics, held in London in 1912 and published by the Eugenics Education Society. A publication committee has been appointed consisting of the following individuals: Charles B. Davenport, chairman; C. C. Little, who served as secretary of the Congress; Clark Wissler, curator of anthropology in the American Museum; President Henry Fairfield Osborn, *ex officio*. The volume will contain, first, the general addresses of the opening session, followed by the opening address of each section and by the scientific papers, in their entirety or in abstract, of each section. It will conclude with an appendix setting forth the principal features of the exhibition, which was regarded by all as of great importance. Authors of papers who have not already sent in their manuscripts, or abstracts, should address them to Dr. C. C. Little, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, New York.

NOTES

SOUTH AMERICA

The American Museum is primarily indebted to the liberal provision of its late Trustee, Mr. A. D. Juilliard, for the collection of Peruvian gold objects described in the leading article of this issue. During his trusteeship Mr. Juilliard took a special interest in South American anthropology, as a result of which the Museum received some rare Peruvian collections. The Nazca collection, purchased from Dr. Gaffron and presented by Mr. Juilliard in 1914, consisted of 693 pieces, including textiles, featherwork, and valuable examples of Nazca pottery. It is believed that this is the largest Nazca collection in the world. A second noteworthy collection presented by Mr. Juilliard was made in Ica by Señor Manuel Montero. One hundred twenty pieces—textiles, silver ornaments, musical instruments, and pottery—were embraced in the Ica collection. Of these the Peruvian textiles, among which were ten large, shawl-like garments, now worth $1000 apiece, are probably the most remarkable. In view of the fact that Mr. Juilliard during his lifetime was so steadfast a patron of South American anthropology, it is especially fitting that the ancient gold objects from Peru, a striking addition to the anthropological treasures deposited in the Museum, should have been purchased through the income of the A. D. Juilliard and Helen C. Juilliard bequests.

Through the generosity of Mr. and Mrs. William M. Baldwin, the American Museum has come into possession of various interesting ceremonial garments of the Indians of Paraguay. The most gorgeous of these is an article of apparel resembling the war bonnet of our northern Indians. Its foundation is of cloth, but the cloth is well-nigh concealed by a dense covering of parrot, rhea, and hawk feathers, in which the brilliant greens of the parrots' plumage predominate. A bunch of scarlet feathers tipped with iridescent green and blue surmounts this striking garment, which, in addition to covering the head, mantles the shoulders and extends well down the torso. Another article hardly less interesting is an apron made of the skin of a wolf (*Canis jubatus*), reinforced with cloth at one end. To this end are attached feathers of different hue, some of which, hung by braided cords of vegetable fiber, dangle like tassels.

Among the objects presented are six cords tied together at one end. Each of these cords is solidly encased for the greater part of its length in a thick, smooth, cylindrical layer of plumage and terminates at the free end in a slightly fanlike grouping of feathers. Among the Karaja Indians of North Central Brazil similar feathered strings are worn pendent from the ear, over which they are looped. It is probable that in Paraguay a like custom prevails. A short, straight, slender stick to which have been firmly bound by means of a spiral of cord numerous small, curling green feathers placed at intervals, may have been used as a hair ornament. A headband of rhea feathers and a gray cloth belt, ornamented with a double row of short, brown lines, complete the objects embraced by this gift.

Mr. George K. Cherrie, who has recently been collecting in southern Ecuador, on behalf of the American Museum's department of birds, has had in the course of his eventful life adventures ranging from guerrilla warfare, when he was a participant in an insurgent movement against the Venezuelan dictator, Castro, to the hunger and hardship experienced when penetrating untrodden regions of South America with Colonel Roosevelt. He has so often come through the perils of the wilderness scatheless that Providence seemed to be especially vigilant in warding off the dangers that again and again threatened him. It was a distinct shock, therefore, to receive word that he had been wounded in the right arm through the accidental discharge of a shotgun, and that the wound was so serious as to necessitate his return to America. He sailed for Colon, bound for these shores, on October 27.

ASIA

The Third Asiatic Expedition of the American Museum, under the able leadership of Mr. Roy Chapman Andrews, is beginning its important work in China with every promise of success. Cordial interest in the undertakings of the expedition has been manifested by Dr. Yen, Minister of Foreign Affairs, and by other members of the cabinet in Pekin. Dr. V. K. Ting, director of the National Geological Survey of China, and Dr. J. G. Andersson, mining adviser to the Chinese government and curator of the Museum of the Geological Survey of China, have given invaluable aid. Mr. Andrews' plans for his own work and for that of his associates represent painstaking thought and should result in valuable achievements.

According to word recently received from him, he had returned from a short collecting trip into the Eastern Tombs forest and beyond. This forest is being cut down so rapidly that in a year there will be little left standing and at least a dozen species of mammals and birds which live in it will become entirely extinct. Mr. Andrews' timely trip has preserved, for the purposes of scientific study, specimens of this doomed fauna. The fish, reptiles, and amphibians collected by Mr. Clifford H. Pope, who accompanied Mr. Andrews on this trip, have already reached this country. In a letter written September 7, after his return to Pekin from this expedition, Mr. Andrews gives a more detailed description of his own work and that of Mr. Pope.

"Pope and I had a trip to the Eastern Tombs forest. It was cut short by unprecedented rain; in fact, in three weeks, we had only four days of dry weather. Although the trip netted only about 100 mammals, we obtained something over 1400 fish, reptiles, and batrachians. These have already been dispatched to the Museum by American Express, for Mr. Pope was especially anxious to have a critical report from the Museum in regard to their preparation. The trip was designed particularly to give Pope and three of my new Chinese assistants training in the work that is to come. I am now sending Pope into a very interesting region of the Yangtze Valley on a trip by himself. He should make a large collection of fish and reptiles. I have employed a Chinese artist, who will go with him and will make colored paintings and drawings of the specimens while they are fresh. This is something that has never been done in China before, and I believe will be of great value."

This letter was written as Mr. Andrews was on the point of penetrating southern Shensi, a province lying westward of Chihli in which Pekin is situated. Political disturbances in Shensi had prevented an earlier visit to this interesting region, which holds out special promise to the collector. Here Mr. Andrews expects to obtain a group of takin (*Budorcas*), a genus of remarkable hollow-horned ruminants, the closest relatives of which appear to be the serows of the Himalaya region. A picture of a takin was shown in Natural History for September-October, 1920, in connection with the article "The Discovery of the Chinese Takin," by Malcolm Playfair Anderson. Upon the completion of the trip to Shensi Province, Mr. Andrews plans a trip to the Saigon regions of Indo-China, where game is particularly abundant. This trip should yield many prospective groups for the proposed Asiatic hall of the American Museum: the gaur (gigantic jungle cattle that are among the most characteristic and spectacular of Asiatic mammals), tiger, sambur (a large deer), thamin (a deer the antlers of which have long, curved brow tines), as well as a variety of monkeys. With regard to the expedition into Shensi, Mr. Andrews wrote on September 7:

"I expect to have a rather hard trip after takin, for the country is extremely rough and it will be very cold at an altitude of 12,000 feet where we have to hunt. I am taking with me on this trip a mining engineer, by the name of Collins, who is a famous hunter in China and knows Shensi well. It would have been rather foolhardy to have gone alone, for there has recently been a local war in that region and the mountains are full of Chinese soldiers who have deserted and become brigands. We are very likely to have a brush with them, but still I don't think our real danger is as great as when one crosses Fifth Avenue at 42nd Street. I hope to get a complete group of takin and to make a reconnaissance of the mountains in which they are found in preparation for a rather extensive zoölogical campaign there. The National Geological Survey of China has come to the conclusion that these mountains form a divide in the palæontological fauna and we are anxious to know how far that same faunal division extends in regard to the living mammals, birds, and reptiles."

A cable from Pekin, dated November 4, indicated that Mr. Andrews was once more safe at headquarters.

The palæontological work of the Third Asiatic Expedition has made good progress under the leadership of Mr. Walter Granger, who has had the heartiest coöperation from the National Geological Survey of China. A visit has been undertaken to two sites in eastern Szechuen, which the Survey believes will yield rich results. Mr. Granger will also explore the numerous caves known to exist along the banks of the Yangtze Kiang. This river was undoubtedly a great highway of travel in early times, as it is today, and there is reason to believe that in these caves will be discovered human remains of great scientific interest. Mr. Granger has as his companion Mr. James V. T. Wong, an able young Chinaman, who speaks English fluently and who has demonstrated his ability in field work. Of this party Mr. Andrews says, "Walter Granger is well on his way to Szechuen and should be arriving at his collecting locality within a very few days. He has the finest personnel that it is possible to secure in China. He went off full of enthusiasm, and will, I believe, get some valuable material."

Another accomplishment of the expedition is the establishment of ideal headquarters in Pekin. An equipment room and laboratories, well adapted to the requirements, had been completely fitted out by September 1 and will enable the expedition to conduct its work on a big scale.

The most recent word from Mongolia indicates that conditions will be favorable for the expedition into that territory next year.

Members of the American Museum will be glad to know that after two years of geological work in the field in connection with the discovery of oil, Mr. Barnum Brown rejoined the Museum's staff on August 1 and soon thereafter reported to President Osborn in Paris for duty. He has never, in fact, been out of touch with Museum interests, because while in Cuba he made splendid collections in invertebrate palæontology, which are now being worked up by Miss Marjorie O'Connell, and in Africa he collected and sent

A Tibetan shrine recently installed in the American Museum through the courtesy of Mr. Alexander Scott. Second only to the interest which these objects have as an embodiment of the religious beliefs of the seclusive Tibetans is that of their intricate and delicate workmanship

to the Museum invertebrate palæontological, zoölogical, and ethnological material. At present Mr. Brown is bound for southern Asia to visit all the great localities where remains of Primates, especially man, have been found or are likely to be found; namely, in Burma and in the Siwalik and the Bugti Hills of India. He takes with him the good wishes of all his British friends who have worked in these fields and he hopes to enjoy the coöperation of the Geological Survey of India, and particularly that of Doctor Pilgrim. His journey is made possible by the generosity of Mrs. H. C. Frick, who has placed at the disposal of the Trustees of the American Museum a fund to be devoted especially to exploration in southern Asia. Mr. Brown is one of the most enterprising and courageous of all our explorers, and both of these qualities are needed to overcome the difficulties that he is sure to encounter when he comes in contact with the natives on the frontier lines of British rule in India.

A TIBETAN SHRINE

Notwithstanding the fact that Colonel Younghusband and his army crossed the Himalayas and marched into the sacred precincts of Lhasa well-nigh twenty years ago, Tibet still remains a land penetrated but little and filled, therefore, for the average man with the enchantment of the unknown. When one realizes how dominant is the influence of the lamas in this land and how strong the religious emphasis, it would seem that no single object from Tibet could be more representative or of greater interest than one of its shrines. Visitors to the American Museum are afforded the rare opportunity of viewing such a shrine, with all the sacred objects associated with it, which has been placed on temporary exhibition in the tower of the hall of the living tribes of Asia. Flanked by sacred banners, guarded by lion- or dog-like metal figures that defiantly occupy the steps leading to the altar, with a prayer mat spread invitingly for the worshiper, and the figure of Padma Sambhava, "The Lotus-born one," dominating all, this shrine is indeed a thing to arrest the eye.

The sacred objects exhibited represent a part of the collecting of Mr. Alexander Scott, a British artist, who for twenty-six years made his home in Darjeeling, India, which is on the highway to Tibet. To his kindness the American Museum is indebted for permission temporarily to install the shrine. Mr. Scott, whose interest in Tibetan and Indian archæology is of long standing, had won his way into Tibet even before the expedition of Younghusband took place in 1903–04. Mr. Scott was particularly fortunate in gaining the friendship of the lamas, or priests, and one of these, named Dousand Up, took the unusually enlightened attitude that the Tibetan religion should be known to foreigners, in order that they might see and understand its beauties and philosophical significance. Through this priest, who to his other accomplishments added a knowledge of English, Mr. Scott gained valuable information.

As an indication of the confidence reposed by the lamas in the judgment of Mr. Scott, he was on one occasion asked to rearrange an altar which he had criticized as being too overcrowded. He promptly introduced the changes which he thought desirable and not only escaped censure for so doing but actually won the lamas' grateful approval, which manifested itself in the bestowal of gifts.

The first object to arrest one's attention when viewing the shrine is the finely wrought bronze image of Padma Sambhava, the face of which is completely coated with pure gold, highly burnished. Padma Sambhava is a familiar image in Tibetan shrines for, according to Lieutenant-Colonel L. Austine Waddell in his volume *Lhasa and Its Mysteries*, there is given to this religious teacher by the generality of lamas a place higher than Buddha himself. This distinction he enjoys doubtless as the founder of the lamas.

When visiting the monastery of Chatsa on the flank of Chumolhari, which had harbored only one white man other than himself since the days of Warren Hastings, Lieutenant-Colonel Waddell noticed that in the most popular temple first place was given to a gaudily painted image of Padma Sambhava. It is worthy of mention that the picture of the saint which he reproduces in this connection, has associated with it the symbols that find place also in the image of Padma Sambhava that occupies the shrine at the American Museum. To begin with, there projects from the headdress of the saint an upward-pointing vulture's feather, signifying that as the bird from whose body it was plucked is the most aspiring of fliers, so the doctrine of this "guru," or religious teacher, is the loftiest and most spiritual. In his slightly raised right hand he holds the thunderbolt, symbol of divine protection and the life eternal. Reposing in his left hand is a skull used as a bowl. Into this bowl was poured blood or "amita" ("sweet dew," the beverage of supernatural beings), signifying blessings, and recalling the fact that, horrible as is this conception, our European forefathers, at least in the person of Alboin, the Lombard king, did not scruple to quaff from drinking vessels as repulsive, even though the content was wine instead of blood. Against the left shoulder of Padma Sambhava leans a trident, the prongs of which represent Lust, Anger, and Sloth, which the saint has overcome.

At each end of the shrine stands a large, elaborately ornamented brass lamp of sacred character and on a ledge lower than that which supports the central figure are many little images, some of gold inlaid with turquoise and lapis lazuli. Some of these are images of Krishna, probably left by Hindus, who reverence him and are disposed to make gifts to his temples.

Over the steps guarded by the brass dog- or lion-like figures is stretched a Ming prayer mat at least four hundred years old. A low, carved stool, studded with turquoise and coral, stands in the foreground and bears a sacred book wherein, in letters of gold on dark blue parchment, are recited the praises of Buddha.

The most precious object of all is a native carpet,—one of the three Tibetan carpets known to exist and all of which are today owned by Mr. Scott. These carpets have had an interesting history. Sent originally from Tibet as tribute to the first Sikh Maharajah, Golab Singh, when he was installed over Kashmir, they were in time placed in the palace Tosha Khana, or storehouse, in Kashmir, where they lay for nearly one hundred years. At length they were placed on public auction, in Sringagar, where one of them was bought by Mr. Scott. The other two he later obtained from two Indian noblemen, who had purchased them on that occasion.

Most of the other objects assembled in the shrine were also obtained in India, having been brought there by members of a Chinese expedition which had been sent into Tibet after the British army under Colonel Younghusband had evacuated Lhasa.

AFRICA

A CABLE dated October 4 announced the safe arrival at Kigoma on Lake Tanganyika of Mr. Carl E. Akeley and his party, consisting of Mr. and Mrs. Herbert Bradley, of Chicago, their six-year-old daughter, Alice, and Mr. Akeley's secretary, Miss Martha Akeley Miller. All members of the party are well and the date of the cablegram would indicate that their progress will enable them to reach the gorilla country, the mountainous region north of Lake Kivu, on schedule time.

General Smuts, Prime Minister of the South Africa Union, who with Mr. Akeley's party arrived in Capetown on August 30 aboard the *Kenilworth Castle*, evinced great interest in the expedition and in view of its scientific character, assisted them greatly, putting their equipment and luggage through the customs without the payment of duties. After four days in Capetown, Mr. Akeley and his companions departed northward on the Cape to Cairo Railroad, making brief sojourns at Kimberley on September 4, at Bulawayo on September 6, and at Victoria Falls from September 7–9. Their plan, according to letters received from Victoria Falls, was to proceed to Elizabethville by rail. There they were to take river boats or canoes for several hundred miles up the Lualabo River, and then travel once more by rail to Albertville, where they were to board a lake steamer for the northern end of Lake Tanganyika.

The arrival of the party at Kigoma on the eastern shore of Tanganyika on October 4 indicates that the expedition probably began its real work among the Kivu hills about the middle of October.

AUSTRALIA

Dr. William K. Gregory, curator of comparative anatomy, American Museum, has returned from his recent trip to Australia, where through purchase of specimens, arranged exchanges, and work in the field, he laid the foundation for a fine collection representative of Australia's past and present fauna and of its aboriginal life, that will ultimately find place in the contemplated Australian Hall.

Mr. Ellis F. Joseph, of Sydney, who is well known to the staff of the New York Zoölogical Society for the many rare and interesting mammals he has brought to the Park from Australia, was of great service to the members of the expedition. Through his efforts, Mr. Harry Burrell, also of Sydney, and known for his field studies of the life habits of marsupials, accompanied Dr. Gregory and Mr. Raven on their first collecting trip in the mountains of "New England" in New South Wales. Through Mr. Burrell's influence, they also were entertained as the guests of Mr. Clifford Moseley, upon whose station (ranch), eight miles east of Ebor, they had the opportunity of collecting a fine series of kangaroos (*Macropus giganteus*) and numerous flying phalangers and small insectivorous marsupials. Mr. Jim Wilson, another friend of Mr. Burrell, placed his remarkably detailed knowledge of the habits of the marsupials at the disposal of the Museum representatives. The party were thus enabled to secure in this region not only splendid exhibition material but also a series of skins and skeletons for the department of mammalogy, and many preserved specimens for dissection of the muscles, etc., by the department of comparative anatomy. Incidentally, the collectors found it a thrilling sight to see the kangaroos making their enormous leaps on the sunny hillsides, and the flying phalangers skimming from tree to tree in the moonlight.

Birds were very numerous and abundant, but very few were collected during the early part of the trip, as it was felt to be more important to secure the mammals first.

Specimens have been secured from this region for a kangaroo group, showing four or five kangaroos in full flight with a pack of dingoes, or native wild dogs, in pursuit. The latter will be shown in the act of separating one of the kangaroos from its fellows. They will be represented as leaping from the side at the hips of their victim in an endeavor to upset it.

The prospects of Mr. Raven's securing during the coming year a large and representative series of Australian marsupials are excellent, and arrangements have already been made for him to collect in various localities in Queensland, New South Wales, and Tasmania. Through the courtesy of Dr. Gerrit S. Miller, curator of mammals in the United States National Museum, Mr. Charles Hoy, who has been collecting in Australia for that museum during the past two years, placed all his hard-won knowledge and experience unreservedly at the service of his American Museum colleagues.

As the available time was very limited, Dr. Gregory left Mr. Raven after a three weeks' stay in camp, and went on a tour of the principal cities of southeastern and southern Australia, and Tasmania, where he established personal contact with the leading museums and museum officials, and gave a series of lectures entitled "Australian Marsupials and Why They Are Worth Protecting," "Glimpses of Evolution," and "A Review of the Evolution of Human Dentition." The last named lecture was delivered at the Fourth Australian Dental Congress, at Adelaide, of which Dr. Gregory was made an Honorary Member.

It would be difficult to acknowledge in detail the very numerous and important courtesies received by the members of the expedition from Australian colleagues and friends. Among those who coöperated most actively, however, may be especially mentioned Mr. Charles Hedley, and Dr. Charles Anderson, of the Australian Museum; Professor Lancelot Harrison, of the University of Sydney; Mr. Ellis S. Joseph and Mr. Harry Burrell, of Sydney; Mr. E. C. Andrews, government geologist of New South Wales; Mr. Heber A. Longman, director of the museum at Queensland; Sir Baldwin Spencer, Mr. Kershaw, and Mr. F. Chapman, of the National Museum at Melbourne; Mr. Edgar Waite, director of the South Australia Museum at Adelaide; Mr. H. H. Scott, curator of the Victoria Museum and Art Gallery at Launceston, Tasmania; Mr. Clive E. Lord, curator of the museum at Hobart; and Professor T. T. Flynn, of the University of Tasmania, Hobart.

Word has recently been received from Mr. H. C. Raven, the field assistant of Dr. William K. Gregory in Australia, regarding the progress of the work in that continent. Mr. Raven writes that a little while ago a large gum tree was cut down and in a hole in the trunk was found a little female *Acrobates*, a genus of arboreal marsupials. She had four very small young in her pouch. Later a male *Acrobates* was also secured. The collection of specimens of the kangaroo, *Macropus giganteus*, of which several were secured during Dr. Gregory's sojourn in Australia, has been enriched through the addition of two adult females, each with young in the pouch. Additional *Petauroides*, flying phalangers, have also been taken.

The paucity of the animal life, even in places where normally one would expect an abundance, is well indicated by the meager results obtained on a trip which Mr. Raven made into the region beyond Point Lookout, a place only a few miles distant from Ebor. The most prized creature taken on this trip was a fine specimen of *Hydromys*, an interesting rodent, the stomach of which contained the flesh and parts of the chewed-up fin rays of a fish that had probably measured four or five inches in length. In addition there were taken a couple of *Phascologale swainsoni* and the skulls of a species of *Bettongia* and of a species of *Potorous*. The detachment of the skulls of these marsupials from the bodies, which apparently had been devoured, is probably another evidence of the destructive activity of the dingo, which, introduced into Australia by man, has wrought havoc among the native fauna by its murderous attacks, thus supplementing as an agent of destruction, the ubiquitous rabbit, whose penetration of the feeding grounds has seriously curtailed the food supply of the native animals.

Mr. Raven adds: "Down in the gorge there are traces of dingoes everywhere and I think that in a comparatively short time they will wipe out everything else down there except the rats that live under the roots and the birds that live in the trees."

Mr. Raven contemplates shifting his collecting ground to a place near Hernani and Tyringham, where, it is reported, opossums, two or three species of wallabies, and dingoes are common.

ANTHROPOLOGY

Mr. Earl H. Morris, in charge of the work on the Aztec Ruin in New Mexico, writes under date of October 24, that while clearing away the surface débris in the vicinity of the "painted room," which was found in June, 1920, a new chamber with ceiling intact came to light. Though beautifully preserved, the chamber seemed upon entrance utterly barren. To test the depth of the débris, Mr. Morris thrust a shovel into it. The blade struck a piece of wood, which upon investigation proved to be a digging stick. It developed that beneath the floor just south of the blocked door that once gave access to the painted room, had been buried a man of unusually large stature, whose skeleton measured 6 feet 1 inch as it lay in the earth. The skeleton, which is two-thirds extended, was covered from the thighs to the crown of the head with a coiled basket plaque about three feet in diameter. About the body were found six pottery vessels, two knives, half a dozen bone awls, an implement of antler, and two planting sticks. It is probable that further search will reveal additional relics. The Archer M. Huntington Survey of the Southwest, organized in 1909, has made possible investigations of great scientific value in that region. It is through Mr. Huntington's generosity that the work of Mr. Morris is being carried on.

In addition to the work accomplished on the Aztec Ruin, Mr. Earl H. Morris has been studying other sites within access. A week late in August, was spent in the upper La Plata Valley, in a search for graves of the early pre-Pueblo aborigines. Twenty-eight burial spots were found, containing in addition to skeletons no less than forty-two pottery vessels. The crania recovered from these graves were all pronouncedly dolichocephalic and showed no deformations. The pottery, among which corrugated ware was wholly lacking, was, generally speaking, crude and sparsely decorated.

From September 12 to October 21 inclusive, Mr. Morris carried on excavations in the Navajo Reservation. Four extensive groups of ruins were visited and the locations of two others were ascertained from the Indians. In addition, between twenty and thirty isolated sites were noted. Most of the digging undertaken was in refuse mounds, which with few exceptions were rich in yield. Skeletal material and pottery to the extent of approximately 475 catalogue entries were recovered.

From the time of the first pottery makers to the abandonment of the San Juan drainage by Pueblo peoples, occupation of the territory within a mile of the A. J. Newcomb trading post, where Mr. Morris made his camp, was nearly, if not completely, continuous. Consequently here, in a limited area, the ceramic chronology of the San Juan territory is more thoroughly epitomized than in any other known locality. Not only will a thorough examination of the ruins within this circumference confirm the stratigraphic order of the principal ceramic periods previously recognized, but it will make possible the localization of certain transitional types, the chronological position of which Mr. Morris has not as yet been able to establish.

In the mounds partially excavated three classes of crania were found: undeformed, dolichocephalic, scaphoid skulls, superficially identical with those of the Basket Makers, and those of the early pre-Pueblo peoples exhumed in the La Plata Valley; undeformed specimens, shorter than the preceding and unlike anything Mr. Morris had previously seen; and deformed crania, strongly flattened in the occipital region, or in occasional instances obliquely distorted, these being the cranial forms for all periods subsequent to the pre-Pueblo. The possibility, then, is revealed of determining the nature and significance of the change in head form which came about between the time of the Basket Makers and that of the Pueblo.

About eight miles eastward from the site where this year's digging was done, there are unusually extensive slab houses dating from early pre-Pueblo time. They are situated on low hill tops or in little valleys on the outskirts of a cluster of ragged sandstone mesas, in the cliffs of which there are shelters favorable for human occupation. It is the belief of Mr. Morris that Basket Maker remains are to be found in these shelters and also remains that will bridge the gap between Basket Maker and pre-Pueblo, thus settling the now open question as to whether or not the Basket Maker culture was parent to that of the true Pueblo.

So interesting has been the preliminary examination made by Mr. Morris that it is to be hoped the continuation of these investigations may be made possible at an early date.

Monsieur V. Forbin, of the French periodicals *La Nature* and *L'Illustration*, has kindly supplied the following notes, drawn from his experiences among the Indians of Central and South America, by way of comment upon certain articles that recently appeared in Natural History:

While reading the interesting article of Mr. Hamilton Bell on the "Golden Age of Peru," memory took me back to the years of my youth, passed in the interior of Colombia. I used to "rough it" with *guaqueros*, individuals who make a living at hunting in the mountains for *guacas*, or Indian graves of the pre-Columbian period. Several times they happened to dig up, in my presence, among the usual pottery, small balls of pure gold (*granos de rosario*), finely striated.

All the *Indios bravos* (non-civilized) of Colombia have kept in memory their ancestors slaughtered by the Spaniards for the sake of gold, and they consider the yellow metal as a cursed thing. Twenty-five years ago, I had the good luck to pass a few months among the Cuna-Cunas, a tribe living in the virgin forests of the interior of Darien, and to be the first white man welcomed in their beautiful villages. Having been adopted as a member of the tribe, I discovered that the children were taught to look upon gold as the worst enemy of their race. On pain of death, they were forbidden to pick up nuggets in the creeks. When any member of the tribe saw such a nugget, his duty was to roll a big stone over it.

Apropos of "Tobacco as a Cure for Ailments," the following experiences may be of interest:

When sojourning among the Cuna-Cunas, mentioned in the paragraph above, I noted that they had no idea of pipe, cigarette, or cigar, and, for a time, I thought they did not know even the existence of tobacco. Later on, I was invited to a "chicha," a fête held in honor of the puberty of the high chief's daughter. About two hundred guests of both sexes were seated along the walls of a huge hall. Before the dancers started, two Indians walked solemnly around the hall, one offering to each person a tiny cup of corn-wine, the other holding in his hand a bundle of dry tobacco leaves burning slowly. Stopping in front of a guest, the man carrying the tobacco leaves filled his mouth with smoke, which he blew gently into the guest's face. I was told that this was a kind of religious ceremony the aim of which was to purify the guests.

Among a neighboring tribe, the Chocoes, who are very fond of strong, black, American tobacco, I witnessed a strange custom, somewhat akin to that H. F. S., the author of "Tobacco as a Cure for Ailments," records about the Indians of Guiana. When a Choco has lost something valuable, he tries to enlist the aid of a young man by promising him a suitable reward. He induces him to drink a very small quantity of wild (native) tobacco juice mixed with that of another plant. The man soon falls soundly asleep. After about fifteen minutes, he awakes suddenly, jumps up, shouting fearfully, and rushes through the jungle. During his sleep, pieces of strong rope had been tied to his elbows. Two men grasp these ropes to prevent him from falling into cañons or creeks, and accompany him on his mad run. At last he stops, panting, on the spot where the lost articles have been hidden or buried, and an antidote is forced into his mouth. He falls asleep again for half an hour or so; when he awakes, he is still dizzy, and unable to remember what has passed. In the case alluded to, I saw the young Indian starting on his wild run, drawing along with him the two strong men who held the ropes, but I could not follow them, and verify whether he did really recover the lost things, though I was told later on that he did.

Tobacco juice from a wild species is used also among the Indians of the Cordillera in Chiriqui, not far from the Costa Rica border, for "magic" purposes. The men who drink it fall into a trance, and relate loudly their visions of monsters, devils, and *enanas* (female pygmies). I have witnessed very strange scenes of that kind.

ARCHÆOLOGY

President Henry Fairfield Osborn, of the American Museum, calls his recent journey to Europe a Neolithic tour because in undertaking it he desired to study the New Stone Age in the same way in which he studied the Palæolithic, or Old Stone Age, during his tour of 1913. Accompanied by Mrs. Osborn, he sailed on the *Olympic* on July 16, with a passport viséd by six governments, and successively visited England, Norway, Sweden, Denmark, Belgium, and France.

A week in England included a day at the site of the discovery of the Piltdown man in Sussex and two days on the east coast, where Pliocene man has at last been found in England, a truly epoch-making discovery. In Norway Professor Osborn was delightfully received and entertained by Dr. Jon Alfred Mjöen, who was prevailed upon to attend the Second International Congress of Eugenics that recently assembled at the American Museum. In Sweden the principal host was Baron De Geer, who was received in the American Museum with such distinction last year. Baron De Geer has fixed the date of the arrival of man in Scandinavia with great precision. In pursuit of data bearing upon the history of man in Europe during the New Stone Age, Professor Osborn visited the museums and collections in Stockholm, Copenhagen, Liége, Brussels, and Paris.

Much in need of recreation, Professor Osborn accepted the invitation of the Prince of Monaco to visit his camp in the high Pyrenees, not far from the Spanish frontier, where the Prince is making a national game preserve, which is already full of chamois and to which he hopes to add the ibex. This respite was followed by the resumption of New Stone Age interests in the central Pyrenees region, including a visit to the wonderful caverns, *Les Trois Frères*, discovered by the Comte de Begouen two years ago and named for his three sons. A visit was paid also to the cave of the Tuc d'Audoubert, discovered in 1913, which more recently has revealed the famous pair of bisons sculptured in clay. Then a trip was made northward to Toulouse and westward to Bordeaux to see the remarkable ancient sculptures of the man and woman from Laussel, believed to be 25,000 years old, in the collections of Monsieur Lalanne, who has just presented beautifully executed casts thereof to the American Museum. Four days were given to the museums of Paris, especially to the ancient museum of palæontology in the Jardin des Plantes, where the newly discovered skeletons belonging to the Neanderthal race were objects of particular interest. From Paris Professor Osborn went to the Megalithic region on the southern coast of Brittany centering around the little coast town of Carnac and the neighboring Gulf of Morbihan, to see the most wonderful collection of monuments of the New Stone Age. Here the hosts were M. Louis Marsille, of the charming little museum of Vannes, and Monsieur Rousic, of the museum of Carnac. Fortunately a Brittany *pardon* (a religious and agricultural fête) was in progress, and the windows of the inn at Carnac overlooked the little town square and ancient village church where the peasants flocked to early service.

After three memorable days in this attractive region Professor and Mrs. Osborn took a small, American-made motor car, a Dodge, directly north across Brittany to the old fortified town of St. Malo, on the northern coast of Brittany, thence to Mont St. Michel on the border between Brittany and Normandy, which is the most remarkable monument of mediæval times in the world, and on through Avranches to join the *Olympic* at Cherbourg September 14 for the homeward journey.

Professor Osborn's object in undertaking the Neolithic tour was not only to study the ancient Neolithic territory, which is chiefly in Northern France, Denmark, and Scandinavia, but also with a view to enlarging and enriching the American Museum's collection of European archæology, which is now under the able care of Mr. N. C. Nelson. A few materials were actually brought back and there is promised a great deal more, which in the end will enable the American Museum to present the complete prehistory of the early cultures of our ancestors of Western Europe. The Old Stone Age, as the readers of NATURAL HISTORY know, is left out of American history almost entirely because American archæology begins, or is generally believed to begin, with the early Neolithic, or New Stone Age; hence the importance for the history of early man of the data supplied by Europe.

ASTRONOMY

A HIGH scientific honor was accorded Miss Annie G. Cannon, of the Harvard College Observatory, this spring when the famous old University of Groningen, Holland, awarded her the honorary degree of doctor of science. This degree was granted to Miss Cannon in recognition of her work in astronomy, especially the preparation and publication of the Henry Draper Catalogue, a catalogue of stellar spectra in nine massive volumes. An earlier work, dealing chiefly with the stars that vary in light, had already brought her recognition as one of the world's authorities on variable stars. Her more recent work has been the study of the spectra of stellar bodies, and the Harvard system of stellar classification which she uses has now become the international standard. The Henry Draper Catalogue, which classifies according to their spectra all the stars in the sky brighter than the eighth magnitude, was begun in 1911 in collaboration with the late Professor E. C. Pickering. Six volumes have been published, but the last three, although complete and available to scientists in manuscript form, have not been printed, due to lack of funds. Miss Cannon is a native of Delaware and a graduate of Wellesley College. She received the honorary degree of master of arts from Wellesley and that of doctor of science from Delaware College. For a number of years she was the treasurer of the American Astronomical Society and she is now an honorary member and one of the councillors of the American Association of Variable Star Observers. The Royal Astronomical Society of England made her an honorary member a few years ago.

BIOGRAPHIC

CHARLES DARWIN's birthplace, according to the *London Times*, has been sold. It has been known in the family as the Mount House of Shrewsbury. The purchase includes the famous Darwin Walk, a wooded, terraced promenade high up above the Severn River. It is said that its future use is to be for the Office of Works to house a body of clerks. It seems a pity that this birthplace of birthplaces could not have been acquired as a national monument.

EDUCATION

"America's Making," the great festival and exhibit which was presented at the 71st Regiment Armory from October 29–November 12, to illustrate immigrant contributions to our national life during three centuries, afforded yet another opportunity for the American Museum of Natural History to coöperate with the state and city departments of education. Under the leadership of Dr. John H. Finley, Superintendent William L. Ettinger, and Associate Superintendent William McAndrew, 900,000 adults and children from every branch of the public school system of New York took part in this pageant designed to bring about "an abatement of racial animosity and a promotion of actual good will among citizens of all races." President Henry Fairfield Osborn was a member of the advisory council and later of the general committee. Dr. G. Clyde Fisher, associate curator of the department of education, American Museum, who represented the president during the latter's absence abroad, has also been serving since last January on the English section of the general committee.

All of the public schools of Greater New York prepared patriotic demonstrations of their own, the best of which were repeated at the Armory. In this connection frequent appeals were made to the Museum for the loan of materials and for advice. So far as was possible these requests were complied with. Where costumes and other material were not replaceable and therefore could not be loaned, they were made available for copy or reproduction. The department of anthropology was able to be of especial assistance in the loaning of ethnological specimens, while Dr. Fisher has advised with teachers regarding the carrying out of their pageants. The Museum has also loaned motion picture films, lantern slides, exhibition cases, and natural history material.

ENTOMOLOGY

The origin of the many strikingly beautiful colors of flowers has been explained on the ground that they enable bees and other insects the more easily to find the flowers, in order that, from the standpoint of the insects, nectar may be obtained and, from the standpoint of flowers, pollen may be carried from one flower to another, thus enabling the second flower to set fertile seed. Certain recent experiments, however, tend to show that insects are color blind. In that case why and how did the colors of flowers originate? This question is one of several that is being considered by The National Research Council's Committee on the Biological Relations Between Flowers and Insects. This Committee, which consists of a botanist, Dr. J. Arthur Harris, of the Carnegie Institution; an entomologist, Dr. F. E. Lutz, of the American Museum; and a physicist, Prof. F. K. Richtmyer, of Cornell University, a specialist in color vision, held a meeting at the American Museum extending over two days, November 3 and 4. This Committee contemplates a searching investigation of this interesting subject, which will involve field work and experiments extending over a period of years.

The thrill of discovering new species is experienced far more often by the entomologist than by his co-workers in other branches of zoölogy, for though there are 500,000 recorded species of insects, vast numbers scattered over the surface of the earth still remain to be captured and described, and what the final formidable total of distinct species may prove to be, we cannot venture at present to predict—indeed, it is even rash to assume that a field seemingly so inexhaustible can ever be recorded completely. Making due allowance, therefore, for the fact that the collector in a region worked over only to a limited extent may legitimately expect the capture of new species, results that are little short of amazing are sometimes attained.

The Epeoline bees collected by the American Museum's entomological expeditions to the Rocky Mountain region, under the leadership of Curator Frank E. Lutz, were recently sent for identification to Prof. T. D. A. Cockerell, of the University of Colorado, who has made so many notable contributions to our knowledge of the bees. Of the Epeolines, which are inquiline bees, there had previously been known from Colorado only twelve species. Thanks to the captures made by the American Museum's expeditions there are now thirty-four species recorded for the state. In other words, the known Epeoline bees of Colorado have been nearly trebled through the efforts of Dr. Lutz and those who from time to time have collected in association with him. Of the twenty-two species new to Colorado that were captured by the expeditions of the Museum, about 70 per cent are also new to science. Professor Cockerell writes: "the Epeolines constitute the most remarkable series of these bees which has ever reached my hands in a single consignment,"—a tribute the full value of which may be appreciated when consideration is given to the fact that for the purpose of identifying bees few are called upon to the same extent as is Professor Cockerell.

That devices similar to the gas mask have their peace-time uses is indicated in a series of moving pictures recently shown at the American Museum, based on films supplied by the United States Department of Agriculture. The series illustrated the most effective methods of controlling the cotton-boll weevil.

Predominant among these methods is that of driving a horse-drawn dusting machine, laden with poison, through the infected fields. As the vehicle moves along, clouds of the powdery exterminator are puffed out from pipes with which the machine is provided.

To make certain that only those creatures marked for destruction shall suffer injury, the drivers of the team wear protective masks. The horses have bags over their mouths so that they may be prevented from chewing the poison-dusted leaves.

This method of coping with a ruinous insect pest is very efficacious, as is indicated by the contrasted yield of acres so treated as against the scant crops from fields that have not had the benefit of such protective measures.

HERPETOLOGY

A LITTLE more than a year ago Mr. Raymond L. Ditmars, curator of reptiles, New York Zoölogical Society, while climbing Black Rock Mountain in the Berkshires, Massachusetts, came upon one of the most startling sights of his career as an assiduous collector and student of snakes. There, sunning itself at the base of a ledge, was an albino rattlesnake—for all the world as though sculptured in marble. Before Mr. Ditmars could recover from his surprise and capture the reptile, it had glided from view. A year later, however, the specimen was taken and when it arrived at Bronx Park a red letter day was blazoned on the calendar of zoölogical happenings. Not long, unfortunately, was the snake destined to enthrall visitors to the reptile house. Whether from constitutional weakness or because it languished for the wild freedom of which it had been deprived, the snake showed signs of failing and all the expedients resorted to in order to restore it proved vain.

The dead snake has been sent to the American Museum and will be preserved as an acquisition of unique interest, for there is on record no other instance of an albino specimen of the timber, or banded, rattlesnake, although albino specimens of the milk snake, garter snake, and palm viper have been exhibited, in addition to the rattlesnake mentioned, at the New York Zoölogical Park. Albino specimens of Typhlopidæ, a family of burrowing snakes, have been reported. In certain cases, at least, the interpretation placed upon their lack of color would appear, however, to have been erroneous, for the skin of these snakes seems to be opaque and accordingly, if a specimen is captured at a time when it is about to shed its skin, it has a whitish appearance that is the result merely of a transitory and not an innate condition, the underlying skin, as distinguished from the loose epidermis, still retaining the normal coloration.

Among certain mammals albinism is not uncommon. A deliberate breeding of albino specimens has, at least in the case of the rabbit, the mouse, and the rat, produced white-furred and pink-eyed individuals. On Grand Island, off the southern shore of Lake Superior, Mr. George Shiras, 3d, has established the nucleus of what may ultimately grow into a herd of white deer rich enough in numbers to justify transplanting to other areas. In the American Museum there are on exhibition several albino mammals, notably two specimens of Virginia deer, a doe and a buck. The former, from Balls Island, South Carolina, the gift of Mr. Archibald Harrison, is pure white and illustrates complete albinism. The latter, from Nova Scotia, is interesting because it shows traces of the usual coloring, especially on the head. In a neighboring case on the third floor of the American Museum are shown albino specimens of the Canada porcupine, the gray squirrel, the red squirrel, and the European mole.

AFTER relating an instance of a toad hopping its way back to its home at Saugus, Massachusetts, from Sommerville, Massachusetts, where it had been taken, Mr. F. H. Sidney, in an article entitled "The Homing Instincts of the Hoptoad" in *The American Angler* for October, 1921, tells of a tame toad which has lived in his garden at Wakefield, Massachusetts, for ten years. Recently Mr. Sidney tagged this toad with his initials and placing it in a box, took it with him to Boston on the 10:30 P. M. train from Wakefield and then to Charlestown, one mile out from Boston, where at the foot of the Perkins Street footbridge, he set it free. The toad, Mr. Sidney says, blinked at the glare of the arc lights for a few seconds, darted out his tongue and caught a mosquito or two, then turned sharply about and headed for Wakefield, taking long jumps on the homeward way. Mr. Sidney followed him for about a hundred yards, the toad going straight ahead without hesitation. Mr. Sidney left Boston the next morning at seven and arrived at his home in Wakefield at about eight. At half-past eight a dusty little toad appeared, dragging a tag behind him. Without any apparent ill effects, the toad had hopped ten miles from Charlestown to Wakefield.

The rate of progress reported is indeed astonishing, almost to the point of incredibility, and the total distance traversed would seem to establish a record for toads.

In the *American Naturalist*, Volume XXIII, November, 1890, Edward Tatnall, of Wilmington, Delaware, gives evidence regarding the homing instinct of toads. He introduced a few into his cellar for the purpose of having them kill slugs. In a few years the toads became more of a nuisance than the slugs had been, so he had a number of them, probably a hundred, sent to his greenhouses. They were taken there in covered receptacles. The first day they were to be seen almost everywhere, but were restless and excited. The second day very few were to be found. On the third day none was in evidence. Mr. Tatnall was convinced they found their way back. No toads, except a single one at a time had before been seen in the yard adjoining the cellar, and the appearance of a large number simultaneously with the disappearance of a similar number from the greenhouses points to that explanation. The bee line traversed was about a third of a mile. He writes, "We have proof of a similar instinct in the cat, carrier pigeon, four-weeks-old pig, land tortoise, and almost every bird; why not the toad?"

ICHTHYOLOGY

The Reverend Harry R. Caldwell, who only recently sent to the American Museum a large collection of mammals, as reported in the March-April issue of Natural History, page 211, has just completed an expedition in the interests of the department of ichthyology among the mountain streams of the lower Min River Basin. With a following during a part of the time of as many as thirty helpers, he worked over four streams in widely separated regions, taking specimens of practically everything obtainable in their waters. The work was done at elevations considerably above the Min River Basin and in some instances above series of falls. About five hundred specimens were secured as a result of these efforts, which, it would seem, are the first ever made to secure anything approaching a complete series of specimens from these waters.

Through the good offices of Mr. George H. Sherwood, curator of public education, the American Museum has recently secured a set of jaws and numerous teeth of the sand shark, *Carcharias taurus*. The shark, a female, from which these jaws were taken, measured no less than 8 feet, 10 inches, and weighed, it is estimated, 250 pounds. In the coastal waters of the Carolinas sand sharks frequently reach this size but in northern waters such a length is unprecedented. Previous captures near New York have rarely exceeded 5 feet.

The shark was captured on August 25, 1921, by Capt. Charles Hurd, of Clinton, Connecticut. Captain Hurd had set his gill net at the mouth of Clinton Harbor, expecting to secure menhaden to be used as bait for lobsters. Instead, the shark became entangled in the gill net and was subsequently drawn up to the gunwale of the boat. Still alive at that time, it put up a vigorous fight but was finally despatched by two or three blows from a large hickory club, which Captain Hurd carries in his boat for just such emergencies.

The teeth of this species deserve a word in passing. They are slender and of a glistening white, rather suggestive in these respects of the teeth of a cat. Each tooth has two small cusps at its base. In this combination of characters, the teeth of the sand shark differ from those of all other sharks. The creature is probably exclusively, certainly preponderantly, a fish eater.

Dr. William K. Gregory and Mr. Harry C. Raven, of the American Museum Expedition to Australia, had opportunity on their trip to that far-off continent to stop at Honolulu, where in company with Mr. Louis R. Sullivan, of the department of anthropology, they visited the Aquarium, which is famous for its reef fishes. The wrasses, parrot-wrasses, triggers, and butterfly fishes which are exhibited there in great profusion recalled the related forms from Bermuda but were even more brilliantly colored, and seemed, on the whole, more lively. They included many freakish forms, such as the Moorish Idol (*Zanclus canescens*), the long-snouted "Hinalea" fish (a wrasse), and the "Akilolo" (*Julis pulcherrima*), another wrasse with very numerous intensely opalescent blue spots on the dark background of the body. There were a number of these "Akilolos" in one tank swimming about very actively. "As we approached," relates Dr. Gregory, "one of them suddenly emerged from the sandy bottom where he had been lying buried, and immediately another made a dash at him but missed him. Then began a chase of dazzling quickness and intricacy. The two fishes flashed back and forth, up and down, dodging and turning like a couple of brilliantly colored flies, and it seemed a marvel how they steered clear both of the rocks in the center and of the sides and bottom of the tank. After some seconds the pursuer succeeded in nipping and breaking off parts of the dorsal fin of his victim, evidently damaging the latter's steering gear and causing him to tilt and wabble in his course. The pursued then dived into the sand, covering himself completely. The aggressor hung around awhile, nosing about and evidently waiting for another chance to attack, but after returning to the spot several times, finally gave it up.

"From the viewpoint of comparative anatomy this incident is instructive, because it affords an example of very complex actions, having the appearance of being guided by intelligence, but controlled by a brain which entirely lacks the highly developed 'cerebral hemispheres' of mammals and birds."

In the September issue of *Copeia*, "published to advance the science of cold-blooded vertebrates," appear an article on "Species of Northwest and Atlantic Caranx," by Mr. John T. Nichols, associate curator of recent fishes, American Museum, and "Notes on the Morphology and Habits of the Nurse Shark, *Ginglymostoma cirratum*," by Dr. E. W. Gudger, associate in ichthyology, American Museum.

Mr. Nichols states that seven species of the genus *Caranx* have long been recognized as "occurring on our Atlantic seaboard and in the West Indian region." He then gives in detail the technical differences, the range, and the colors in life.

Dr. Gudger in an entertaining article tells us of the first known use of the term "nurse," or "nurse shark," in Dampier, who in a narrative under date of 1675 refers to them. Dr. Gudger writes, "the nurse is a short-snouted shark, broad in the shoulder parts, but tapering rapidly to a lanky tail region," etc. He further tells us, "the mouth of the nurse shark is small, in an 8-foot specimen, with a gape (either vertical or horizontal) of 4 or 5 inches, and the jaws are filled with small teeth." In the 8-foot specimen before him the teeth were in ranks of 33, 7 or 8 rows deep in the upper jaw and 8 or 9 in the lower. The food of the nurse shark, in keeping with its tooth-structure, is mainly confined to invertebrates, squid, shrimps, "craw fish," short-spined sea urchins, and "probably the more thick-bodied and succulent algæ." The article contains other interesting matter in regard to the structure and habits of the nurse shark.

MAMMALOGY

Lately the American Museum has come into possession by gift and purchase of some exceptionally fine specimens of rare African antelopes.

Mr. George A. Chamberlain has been most liberal in presenting one of the finest trophies he secured in Portuguese East Africa in 1920. It is a specimen of the most beautiful of all antelopes, the inyala (*Tragelaphus angasi*), and came from the Panda Circumscription in the Inhambane District, Mozambique. The facts that the inyala is known to be extremely wary, and that such an exceptional specimen is proverbially difficult to secure testify to the fine sportsmanship of Mr. Chamberlain. Fortunately the inyala was killed in October when the animal's coat is at its best. The gift was doubly welcome because it represents an antelope entirely new to the Museum collection and because this buck, the length of whose horns is twenty-one and a half inches, rates with the best records known.

By rare good luck, just a month after Mr. Chamberlain's gift was made, the Museum secured four other specimens (two pairs) of these rare antelopes through the kindness of Mr. A. K. Haagner, so that now only a fawn is needed to make possible the installation of an exhibition group.

Particularly handsome are the horns of the greater koodoo (another African antelope) presented to the American Museum of Natural History by Mrs. Josephine B. Cook, on behalf of her late husband, Mr. DeWitt D. Cook. The curves and other characteristics are well pronounced. The horns are the finest in the Museum collection.

Regions with dense woods, interrupted by many glades and scattered thickets never too far from the water, are the real habitat of the inyala. Of course, being nocturnal in habits, they have a natural dislike for sunshine, and the dense vegetation furnishes plenty of shade, ideal concealment, and, if necessary, a safe refuge.

When disturbed during the daytime they, like the bush bucks, utter a series of hoarse barks as they cautiously shift from place to place. Similar grunts are also common in the mating season. During the night, all observers agree, they wander and frolic about in the open, their real sporting ground, along the edges of which they leisurely browse until dawn puts them to rout. As with most nocturnal antelopes, solitary bucks are not uncommon, although pairs, sometimes with a fawn, are usual. No more than five have been observed together.

The range of the inyala extends in suitable places from Zululand north, through Portuguese East Africa, to Nyasaland and Rhodesia. It is said that it reaches westward even to Angola.

A fine buck stands about 3 feet 8 inches high at the shoulders and is crowned with beautiful, lyrate horns the tips of which are light colored. The inyala has a delicately modeled head, with white on chin, muzzle, forehead, cheeks, and ears. The dark gray and brown body, marked by a few light, transverse stripes, rests upon slender, pale ochraceous-buff limbs having dark fetlocks and hoofs. A dark mane reaches from the throat to the breast and along the belly to near the hind limbs. A partly erectile, dark and white crest runs from behind the ears along the back into the handsome, long-haired tail. A wisp of hair decorates the elbows and a heavy fringe the front of the thighs down almost as far as the hock. Most unusual is the shaggy mane on the buttocks. This extravagant ornamentation of white and dark, long-haired fringes is unique among antelopes. A charming sight is an inyala buck suddenly bounding across a wind-swept, open place with all his shaggy hair gracefully floating and his bushy tail in air.

The hornless female is much smaller and much lighter in color than the male, with a brilliant, bright chestnut body marked with a dozen or more white, transverse stripes from shoulder to buttocks. Great dissimilarity in appearance of the sexes is also found in bush bucks and sitatungas.

The koodoo belongs to the group of tragelaphine antelopes that includes also the bush bucks, sitatungas, bongos, and elands. Nearly all of these antelopes are browsers, avoiding the open plains; the elands alone contain true grazing types. The koodoos are divided into two groups: the greater and the lesser koodoos. The latter occur only from Abyssinia through

Somaliland, southward in some of the drier regions to near Tabora, a station on the Dares-salaam-Tanganyika Railway.

On the other hand, the greater koodoo (*Strepsiceros strepsiceros*)—represented by Mrs. Josephine B. Cook's gift—ranges in eastern Africa south of the Sahara from Abyssinia to the Cape, and occurs to the westward in Angola. Considering the relatively great uniformity of the African savannah region, the greatly scattered distribution of the greater koodoo in this wide area shows well what a very distinctive and peculiar type it is among antelopes. Hilly, often stony, places, generally in the neighborhood of water, where trees are more abundant and heavy thickets or scattered clumps of bushes offer ample opportunity for concealment, are its favorite haunts. Under such conditions it even occurs in regions otherwise known as arid, a fact which has strengthened the belief that it thrives only in certain localities. The occurrence of these koodoos in regions far distant from each other and their great elusiveness have proved strong protective agencies, not only during such disastrous visitations as the rinderpest in the early nineties, but also as regards the inroads made by hunters.

Small groups of from five to eight members might be considered a herd; the greatest number ever recorded together was a band of about thirty, seen by that careful observer, the late F. C. Selous, near the Upper Umfuli River, in Rhodesia.

The adult male koodoo is one of the largest of African antelopes, attaining a height of five feet at the withers. From the standpoint of size, a mule furnishes a good comparison. In majestic appearance and graceful elegance the bull, with its immense, spiral horns, flowing throat-mane, and handsomely striped sides, surpasses all other antelopes. The horns are among the most coveted trophies, and those measuring more than forty inches in a straight line from tip to base—the horns presented by Mrs. Cook to the American Museum measure $41\frac{3}{8}$ inches—are considered exceptionally fine. The Ngami Lake region north of the Kalahari holds the record with a pair $48\frac{7}{8}$ inches long in a straight line. Many of the record horns were undoubtedly secured from solitary old bulls, which had been forced to give up their gregarious life.

The female koodoo is much smaller than the male, and is without mane or horns, the few records to the contrary with regard to the latter only prove the rule. In color the female is more conspicuous than the bull with his generally brownish gray coat bearing from four to eight white transverse stripes.

ORNITHOLOGY

Valuable educational work is being done by the National Association of Audubon Societies among the children of the country, upon whom in years to come will devolve the responsibility of vigilantly upholding all that this association has achieved for the protection of bird life. Since the inauguration of the Junior Audubon Clubs no less than 1,674,743 sets of bird-study material have been supplied to children enrolled in these clubs. As the children pay nearly half the expenses incurred in this distribution, it is evident that the bird-study material is reaching groups that are eager to have it. Large as is the total of recipients, however, it would have been larger except for the fact that nearly 15,000 children had their fees returned to them during the past two years because the funds of the association were not sufficient to meet this additional demand.

PALÆONTOLOGY

Mr. Albert Thomson, who has been exploring the Snake Creek beds of western Nebraska in the interests of the American Museum, reports the finding of many specimens of the late Tertiary. These include five skulls of the three-toed horse, six skulls of Carnivora, and the skull of a deer, of an alligator, and of a giant snapping turtle respectively. In addition, great numbers of palates and jaws, and about "a million" teeth have been recovered. A fuller account will appear in the next issue.

The large group of ground sloths and glyptodonts has been reinstalled on the fourth floor of the American Museum. The group has been placed behind glass and artificial lights have been so arranged as to show it to best advantage. It now occupies the center of the south side of the Age of Man Hall, and makes a very attractive exhibit, not only illustrating a marvelous extinct fauna, but also showing how much can be done with fossil skeletons by proper posing, grouping, and lighting, to make them tell an interesting story.

There are eight skeletons in the group as it stands. Five of them are ground sloths, gigantic extinct animals related to the modern tree sloth of Brazil. Three are glyptodonts, great, mail-clad creatures related to the modern armadillos. All of these belong, in spite of their very different appearance, to a single order of mammals, the Edentata, which had its headquarters in the South American continent.

All the edentates, living and extinct, have powerful claws well adapted for digging, and it has been supposed that the gigantic ground sloths used their claws to dig around the roots of trees in order to drag them down and feed upon the tender foliage of their tops. The group embodies this concept: the largest of the skeletons, the great *Lestodon*, is reaching up on the trunk; of the three skeletons of *Mylodon*, the common ground sloth, one is actively digging at the root, another is standing on its hind legs

Ground sloth and glyptodont group at the American Museum.—When prehistoric man first reached South America, he found it inhabited by a number of strange animals, among which some of the most remarkable are included in this group, which has recently been reinstalled on the fourth floor of the Museum. The eight skeletons belong, notwithstanding the differences of their appearance, to a single order of mammals, the Edentata. The five skeletons encircling the tree trunk are those of ground sloths, extinct South American animals related to the modern tree sloth of Brazil. They are posed in the act of laying low a tree so that they may feed on its foliage. The animals represented on the right of the group are glyptodonts, huge extinct relatives of the existing armadillos of Central and South America. The modern armadillo has a carapace with moveable plates so that he can roll into a ball for protection against enemies. The glyptodonts had a solid bony carapace and could draw the head and neck within it after the manner of the tortoises. The edentates evolved in South America during the Tertiary and invaded North America as far as southern United States

ready to grasp at one of the branches, a third is coming around to aid in the digging. The fifth skeleton, standing to the left at the back, is the *Scelidotherium*, or long-headed ground sloth. Of the three glyptodonts the largest and most complete is the *Panochtus* of Argentina, one of the largest and most characteristic kinds of these massively armored beasts. Near it are the carapace of a Mexican glyptodont, *Brachyostracon*, and a partial skeleton of *Glyptotherium*, a smaller form from Texas.

Except for the two last, all these skeletons are from the Pampean formation of Argentina and are part of the Cope Pampean collection, purchased in 1902 for the American Museum by a number of the Trustees. Various other specimens of this fine collection are exhibited in adjacent cases, notably the skeleton of the *Smilodon*, or saber-tooth tiger, and that of the Pampean deer.

PUBLIC HEALTH

A RECENT book on *The Eugenic Prospect* by the eminent English publicist, Dr. C. W. Saleeby, contains a striking tribute to the anti-tuberculosis campaign in the city of New York. Dr. Saleeby, in reviewing the statistics prepared by Health Commissioner Copeland in regard to the reduction of tuberculosis, states that no other city in the world can show comparable results during the present century or any previous period. It is of special interest to those associated with the American Museum to remember that one of the principal features in the campaign for the prevention of tuberculosis, which has brought such brilliant results, was the exhibit held twelve years ago in the halls of the American Museum, an exhibit which attracted more than a million visitors and was the inspiration for the development of a permanent department of public health in the Museum itself.

CONSERVATION

READERS of NATURAL HISTORY will recall the beautiful article "Sequoia—the Auld Lang Syne of Trees" that appeared in the issue for December, 1919. This article, together with that by Madison Grant, entitled "Saving the Redwoods," published as a *Bulletin* of the New York Zoölogical Society in the same year, was spread br-adcast over the state of California, a copy being sent to every member of the State Legislature, to the heads of all the lumbering corporations of California, and to the leaders of the conservation movement in all parts of the United States. This propaganda, however, was only part of a movement which originated in 1917, leading to the formation in 1918 of the Save the Redwoods League. The League has grown rapidly, completing the year 1920 with more than four thousand members from all parts of this country. It is now under the en-

ergetic direction of a group of Californians, headed by John C. Merriam as president and Joseph D. Grant as chairman of the executive committee, with J. C. Sperry as councilor of the League, Robert G. Sproul as secretary-treasurer, and Newton B. Drury as executive secretary. The central office is The Library, University of California, Berkeley, California.

This summer one of the Trustees of the American Museum, Mr. Madison Grant, made his fourth tour through California, Oregon, and Washington, in the interests of the League, and addressed large and enthusiastic meetings in all three states. Extensive reserves of the redwoods have already been made through gifts of members of the League and appropriations of $300,000 by the Legislature of the state of California. Many tracts are still threatened with destruction, but one of the most obvious signs of the movement is the lull in the demand for redwood lumber and the willingness of the owners of redwood forests to consider reasonable offers for their property. Experts believe that the surpassingly beautiful grove of trees on Bull Creek Flat, Humboldt County, California, is not only the most marvelous group in California, but in all probability the most marvelous group which has ever existed in the whole history of the forests of the world. These giant redwoods of Bull Creek Flat are colossal in diameter and vigorous in their foliage because of the depth and character of the soil in which they have been imbedded for thousands of years. Mr. Grant is quoted as saying to the owner of this lumber tract: "You cannot destroy these trees; public opinion will not allow you to do so. You must accept a reasonable offer. The people of the country are determined that this, the finest grove which has ever existed, shall not be destroyed."

On August 6, a grove of redwoods in Humboldt County, California, was dedicated to the memory of Col. Raynal Cawthorne Bolling, who died in the performance of duty not long after America's entry into the Great War. No fitter symbol of perennial energy and lofty endeavor could have been chosen than these green-clad, aspiring trees that rise to such magnificent heights,—rooted in earth yet of the fellowship of the stars. Among the oldest of living things, time-defying, of immemorial antiquity and destined to outlast generations yet unborn, what could better symbolize immortality? Bolling Memorial Grove will bring peace as well as inspiration to those who repair to it as to a shrine. The Save the Redwoods League has bought forty acres of timber land adjoining it, thus throwing a protecting cordon of trees around a spot that will be forever sacred.

In a recent issue of *Science* Dr. F. B. Sumner, joint chairman of the Committee on the Preservation of Natural Conditions, of the Ecological Society of America, makes a forceful plea, in the first place for the establishment of one or more national organizations whose duty it shall be to coördinate the activities of those groups and organizations that are devoting themselves to the protection of wild life and of natural scenery, in the second place for a larger participation on the part of scientific men, and particularly biologists, in the movement to preserve our fauna and flora in their natural condition. The committee of which Dr. Sumner is joint chairman solicits the coöperation of scientific societies, museums, universities, and research institutions, and requests that their officers, to expedite matters, indicate to the committee what assistance they or their organizations are prepared to render. Among the forms that such assistance might take Dr. Sumner instances: moral support of the Ecological Society's conservation activities, the inclusion in the programs of scientific societies of occasional papers, lectures, or even symposia on conservation, advice as to lines of activity which the committee might profitably undertake, and financial assistance. Dr. F. B. Sumner's address is Scripps Institute, La Jolla, California.

OTHER MUSEUMS

The Bernice P. Bishop Museum of Honolulu, Hawaii, has just issued among its *Occasional Papers* the "Report of the Director for 1920," in which a survey is given of the multiple activities and the many accomplishments of that institution during the year in question. The American Museum is keenly interested in the work of its sister institution far off in the Pacific, as is evidenced by the fact that it has been coöperating with the Bishop Museum in several important fields of investigation, and that no less than three members of its scientific staff have been honored with appointments also on the staff of the Bishop Museum,—Dr. Clark Wissler as consulting anthropologist, Dr.Henry E. Crampton as research associate in zoölogy, and Mr. Louis R. Sullivan as research associate in anthropology.

Dr. Wissler's counsel has been of great value in the organization of the Bayard Dominick Expedition, one of the major undertakings of the Bishop Museum.

To make possible the continuation of the studies pursued by Dr. Crampton during five previous expeditions made to the Society Islands, Cook Islands, Tonga, and Samoa, the Bishop Museum generously supported Dr. Crampton's recent expedition to the Western Pacific and in the Report expresses the conviction that the survey "is likely to result in collections and publications that will significantly increase existing knowledge of the distribution, ecology, and evolution of Pacific island fauna." To the March-April issue of NATURAL HISTORY Dr. Crampton contributed a particularly interesting account of his "Journey to the Mariana Islands—Guam and Saipan," a group visited in the course of his expedition. In the October issue of *Asia* additional photographs taken by Dr. Crampton in this region appear under the heading "Native Factors in Pacific Problems."

A systematic study of the Hawaiian race, involving on the part of Mr. Sullivan, who undertook the investigation, the examination, and in a number of instances also the photographing, of many thousands of individuals, has yielded weighty results for somatology. The Whitney South Pacific Expedition, in which the American Museum and the Bishop Museum are jointly interested, is still actively gathering data that will form the basis of extended research in the bird life of that area of the world.

THE largest habitat group in the world is that of the Biologiska Museet of Stockholm, completed in 1908—a panoramic building designed to show the entire fauna and flora of Scandinavia. There is a basement, a main floor, and a gallery. Visitors enter by a winding stairway leading to dark central platforms looking out upon a circular painted background which extends around the interior wall of the building on the three levels. Every aspect of the Scandinavian fauna is shown—arctic, boreal, and temperate, as well as the various habitats—terrestrial, aquatic, arboreal, and fossorial. The Museum is extremely popular, and as the admission fees are low, it affords an admirable model for museums in small cities, which could be imitated to great advantage.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Fellow: MR. ABRAM G. NESBITT.

Life Members: Mesdames CLIFFORD V. BROKAW, LAWRENCE L. TWEEDY, JENNIE E. B. WEBSTER; the Misses ELIZABETH VERNON BRONSON, IDA T. L. SCHWARZ; Messrs. J. V. AGUILERA, EDGAR B. BRONSON, JR., WILLIAM M. SAVIN, AND J. H. TOWNE.

Sustaining Member: MR. LYMAN P. HAMMOND.

Annual Members: Mesdames F. MALCOLM FARMER, HENRY HOPKINS, LOWELL LINCOLN, JR., FRANCIS G. LLOYD, A. R. MOFFIT, GEORGE L. NAUGHT, CLARE E. PRENTICE, H. SCHWEITZER, ALBERT STERN, T. D. THACHER, WILLIS D. WOOD; the Misses CORA BALDWIN, ELINOR A. BOLLES, ELIZABETH G. CHAPIN, ESTHER J. LEWIS, GLADYS A. REICHARD; Doctors JOHN L. CARVER, MAURICE LENZ, HELEN C. PUTNAM; Messrs. ANCELL H. BALL, F. K. BARBOUR, JOHN EDWARDS BARBOUR, EDWARD LYMAN BILL, L. W. BOWMALL, JAMES P. CAHEN, HOWARD R. CLARK, R. C. CONKLIN, W. PALEN CONWAY, WM. EDWARD DETJEN, F. N. DOWLING, A. W. EATON, M. W. FEINGOLD, HENRY FIELD, FRED. F. FRENCH, KERMODE F. GILL, FRANK W. GRATZ, H. D. HALSEY, JAMES H. HEROY, MORRIS KELLER, T. T. MCCABE, HOWARD S. MOTT, CHARLES K. OVINGTON, ROBERT INSALL RAIMAN, EDGAR C. RUST, CECIL F. SHALLCROSS, ERNEST L. SMITH, MAURICE SWITZER, OWEN WINSTON, and the ACADEMY OF THE SACRED HEART.

Associate Members: Mesdames B. DE BALAN, EDWARD A HAUSS, REGINALD MCKENNA, the Misses ETHEL J. ANGUS, LOUISE P. FORD, CAROLYN WAMBACK, MURIEL E. WHALLEY; Doctors HENRY S. CONARD, F. C. GRANGER, FRANK G. HARTMAN, R. C. PETRIE, F. W. SEWARD, JR.; the Reverend JOHN H. APPLEBEE, the Reverend MANFRED P. WELCHER; Professor PAUL M. REA; the Honorable ROLLAND H. SPAULDING; Messrs. HARRY ASHBROOK, FREDERICK D. BARSTOW, RALPH C. BEAN, HAROLD B. BENDER, WILLIAM RAWLE BROWN, ARTHUR HEMING, RICHARD E. KMENTT, ERNEST KNAEBEL, RICHARD MERRILL MARBLE, W. ORMISTON ROY, CYRUS A. RUSSELL, BENJAMIN F. SMITH, J. DARRELL SMITH, GERALD B. WEBB, JR., and the CAMBRIDGE-HASKELL SCHOOL.

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THE JOURNAL OF THE AMERICAN MUSEUM

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Portrait of J. Reid Moir, archæologist of Ipswich, who has discovered in beds of Pliocene age positive evidence of the existence of man with a knowledge of the use of fire and the ability to fashion flints

Portrait of E. Ray Lankester, veteran zoölogist surviving from the great Victorian age of British science, who has encouraged the work of Moir and lent his authority to the human origin of the Upper Pliocene flints

NATURAL HISTORY

VOLUME XXI NOVEMBER-DECEMBER, 1921 NUMBER 6

THE PLIOCENE MAN OF FOXHALL IN EAST ANGLIA

BY

HENRY FAIRFIELD OSBORN

The progress of prehistorical studies has been very marked since Professor Osborn's "Palæolithic tour" of 1913, when materials were gathered for *Men of the Old Stone Age*. Consequently, as a vacation tour in the summer of 1921 he planned to visit many of the prehistoric centers in western Europe which were not visited during the tour of 1913: first, East Anglia, the scene of the most remarkable palæontological discovery of recent times, namely, of Pliocene man in Britain; second, the Sussex home of Piltdown man; third, the New Stone Age region of Scandinavia—Norway, Sweden, and Denmark—the home of our ancestors of 12,000 B. C. Thence Professor Osborn traveled across the early Neolithic region of Belgium and France to the Pyrenees to see two newly explored caverns on the estate of the Count de Bégouen; thence to Bordeaux to view the most ancient sculptures of Laussel; thence northward to Brittany to examine the comparatively recent Neolithic and bronze culture of four thousand years ago. The impressions made by this tour will be written down in six successive articles in NATURAL HISTORY beginning with the articles in the present issue.

THE discoveries by J. Reid Moir of evidences of the existence of Pliocene man in East Anglia open a new epoch in archæology in which the southeastern corner of Great Britain is destined to play a very important part. In their bearing on human evolution these discoveries are no less revolutionary, because they bring indubitable evidence of the existence of man in southeast Britain, man of sufficient intelligence to fashion flints and to build a fire, before the close of Pliocene time and before the advent of the First Glaciation, which opens the Pleistocene or Quaternary history of man. That is, we have at last in the Foxhall flints found proofs of the existence of real *Tertiary man*.

Other discoveries, made both before and since that of Foxhall, will form, if fully authenticated, an unbroken chain of evidence. The geologic order of occurrence of these vestiges of man as shown in the geologic table (p. 566) is as follows:

(3) Giant Flints of Cromer, Lower Pleistocene, found in 1920.

(2) Foxhall Flints of Ipswich, Upper Pliocene, found in 1919.

(1) Pre-Crag Detritus of Ipswich, Rostro-carinates, etc., reported in 1909.

THE ALLEGED PRE-CRAG HUMAN INDUSTRY UPPER PLIOCENE

As evidence of the most ancient industry in the so-called "detritus-bed" below the Pliocene Red Crag of Suffolk, there were first found by Moir in 1909 a number of beak-keeled implements called "rostro-carinates" (from *rostrum* = beak and *carina* = keel). These Lankester and Moir believe to represent artifacts of a still earlier stage than either those of Foxhall or of Cromer. Of the men that produced the flints Moir writes:[1]

"The pre-Crag people . . . had an abundance of flint of very fine quality, in the form of nodules, with which to work, but the more or less rounded surfaces of nodules did not afford a satisfactory striking-platform, and so they had to learn to provide themselves, by flaking, with a flat surface upon which blows could be struck with precision. . . . The ventral surface of the rostro-carinate formed by the removal of a large flake from the original flint nodule, represents the natural flat surface of tabular flint, and in both cases blows were delivered on each side of this flat surface . . . . in the rostro-carinate the keel or gable seems to have been the desired object."

[1]Moir, J. Reid, *Pre-Palæolithic Man*, 1920, pp. 1-67, Pls. I-XXIX.

	Advances of the Great Scandinavian Glaciers into Northern Europe	Succession of Flint Industries and Human Races
	Postglacial Time	*Aurignacian-Magdalenian* Industry, Cro-Magnon Race
Quaternary——Pleistocene	IV. FOURTH GLACIAL TIME	*Mousterian* Industry, Neanderthal Race
	3rd Interglacial Time	*Acheulean* Industry, (1) warm and (2) cold
	III. THIRD GLACIAL TIME *2nd Interglacial Time*	*Chellean*, warm mammal fauna of northern France and England. The Chellean Industry, announced in 1846, is now regarded as beginning (*pre-Chellean* phase) in *2nd Interglacial Time*
	II. SECOND GLACIAL TIME *1st Interglacial Time*	No trace of human industry thus far discovered in France in this very long period of geologic time. The *Heidelberg* (Germany) and *Piltdown* (England) races and associated primitive industrial flake flints are referred to this period
	I. FIRST GLACIAL TIME	(3) **Flint Industry of Cromer**, Norfolk, England
Tertiary	UPPER PLIOCENE TIME	(2) **Flint Industry of Foxhall**, Ipswich, Suffolk, England
		(1) **Pre-Crag Industry,** Ipswich, Suffolk, England

According to Moir the rostro-carinate of the sub-Red Crag has evolved from two antecedent stages, followed by four succeeding stages in the last of which the rostro-carinate pattern almost disappears. In his valuable treatise on *Pre-Palæolithic Man*, just cited, Moir describes his theory of the early evolution of the flint industry. Moir herein maintains that the Piltdown man—the *Eoanthropus* of Smith Woodward—was of Upper Pliocene age and possibly the maker of the earliest types of flints thus far discovered, namely, those of Foxhall. This opinion will serve to introduce the second article of this series, namely, on the Piltdown man.

THE UNDISPUTED FOXHALL INDUSTRY OF RED CRAG TIME

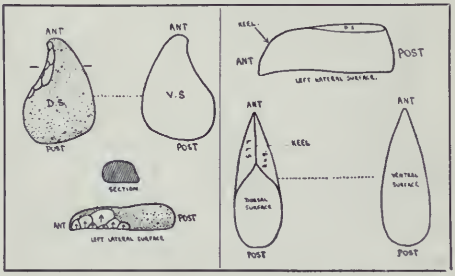
Proofs which have rested hitherto on the doubtful testimony of irregular eoliths generally considered by archæologists as not of human manufacture, now rest on the firm foundation of the Foxhall flints in which human handiwork cannot be challenged; these proofs have convinced the most learned and most conservative expert in flint industry in Europe today, namely, Abbé Henri Breuil of the *Institut de Paléontologie Humaine.*

This discovery of man in Pliocene time delights the present writer for a personal reason, namely, because it tends to render somewhat more probable his prophecy made in April, 1921, before the National Academy of Sciences at Washington that one of the great surprises in store for us in science is the future discovery of Pliocene man with a large brain. At present, however, we know nothing of the brain weight and little of the degree of intelligence of the man who fashioned the flints of Foxhall near Ipswich. In this connection may now be narrated another of the remarkable incidents in the prehistory of man, namely, the story of the "human jaw of Foxhall."

The possibility that there may exist a human jaw of the same geologic age as the Foxhall flints has recently been pointed out by the Ipswich archæologist, J. Reid Moir.[1] He calls attention to a paper, long forgotten and almost lost sight of, which appeared in the *Anthropological Review* of 1867, entitled, "The Fossil Human Jaw from Suffolk," by R. H. Collyer, M.D.,[2] on page 221 of which occurs the following statement:

"At the instigation of Vice-Admiral Sir Edward Belcher, C.B., I was induced to exhibit to the Ethnological Society of London in April 1863, a fossil or coprolite human jaw, which was found by the workers employed in excavating coprolites near Ipswich, Suffolk. The jaw was purchased from the finder by Mr. John Taylor, druggist, of Ipswich, for the sum of 2*s*. 6*d*., who called my attention to it at the time, 1855. . . . The specific gravity [of the jaw bone] is much greater than that of a recent bone of the like size, it being infiltrated throughout its entirety with oxide of iron, and the surface presents peculiar metallic lustre. . . . I have now every reason to believe that this 'coprolite jaw' is the oldest relic of the human animal in existence, as its condition corresponds in every respect with the coprolites in whose contact it was found."

The history of this jaw, as narrated by Moir from Doctor Collyer's original paper, reads like a romance. Collyer was an American physician resident for many years in London. A man of exceptional intelligence, he became convinced that the jaw was a true fossil and that its geologic antiquity could be established beyond question. Like the Piltdown skull of 1911 the Foxhall jaw of 1855 had been found by workmen. In their search of fertilizing material, the jaw was recovered in a roadside dump; it was presented to Collyer in 1857. Collyer visited the quarry where the material was procured and noted that the quarry was *sixteen* feet below the surface. During the succeeding decade he took the very steps we should take today by submitting the jaw for examination to the leading experts of England and France. In 1857 he showed it to Quekett, curator of the Royal College of Surgeons, and on Quekett's suggestion, to Richard Owen, the leading comparative anatomist of Great Britain, who kept it two years without expressing any opinion. In 1859 Collyer submitted it to the geologist, Prestwich, the first British authority to support Boucher de Perthes' discovery of Chellean man in France. Four years elapsed, during which appeared Sir Charles Lyell's work on *The Antiquity of Man* (1863), which led Collyer to take the jaw to Huxley, at the time foremost advocate of evolution and subsequent author of *Man's Place in Nature*. Later, at a meeting of the Ethnological Society (April, 1863), at which were present the great geologists Charles Lyell and Roderick Murchison, and the palæontologist, George Busk, the latter stated that Collyer's specimen was "the jaw of some old woman, perhaps from some Roman burial ground," a statement he withdrew subsequently. Huxley, who was present, called on Coll-



Left—J. Reid Moir's interpretation of the most primitive stage in the flint industry, with seven small flakes struck off the left lateral surface. One third natural size. After Moir, 1920, Pl. V

Right—J. Reid Moir's interpretation (1920) of beak-keeled rostro-carinate implement of Lankester. One third natural size. After Moir, 1920, Pl. IV

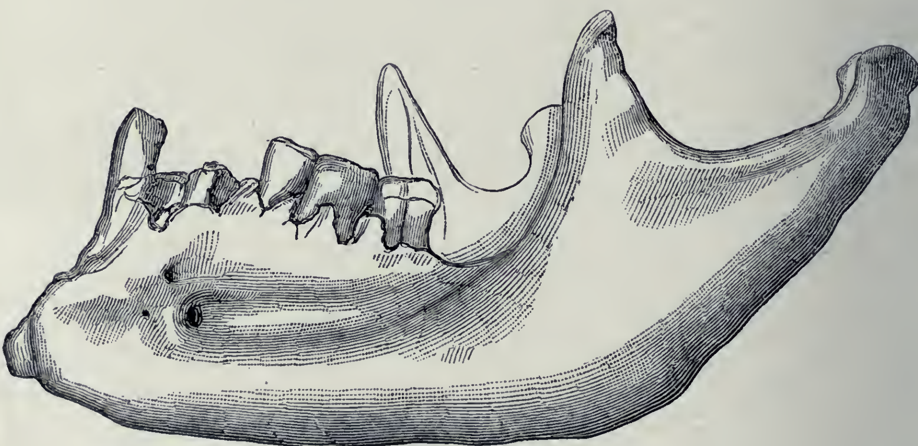
[1]Moir, J. Reid. "Further Discoveries of Humanly-Fashioned Flints in and beneath the Red Crag of Suffolk." Reprint *Prehist. Soc. East Anglia* for 1920-1921, pp. 1-42, Pls. I-III, V, Figs. 1-45A.

[2]Collyer, Robert H. "The Fossil Human Jaw from Suffolk." *Anthropological Review*, Vol. V, No. XVII, April, 1867, pp. 221-229.

yer the following morning and pronounced the jaw to be a "most extraordinary specimen"; finally, however, Huxley wrote (May, 1863) to Collyer that the jaw bone showed "some peculiar characters," which, however, did not appear to him to be in themselves adequate to lead him to ascribe the bone "to an extinct or aberrant race of mankind, and the condition of the bone is not such as I should expect a crag fossil to be." Undiscouraged by Huxley's adverse opinion, Collyer submitted the jaw to the palæontologists, Hugh Falconer and Busk, who took it to Paris for submittal to Quatrefages and other French anatomists. Busk modified his original opinion and wrote (July, 1863) that he regarded the jaw as of "very great antiquity."

In brief, Collyer submitted his "coprolite jaw" to every great geologist and comparative anatomist of the time, but the results were mainly negative, probably *because the shape of the jaw was not primitive* and the degree of mineralization was not such as positively to prove it a fossil. He had a chemical analysis made which showed that the jaw was largely mineralized, but retained 8 per cent of animal matter; as to the degree of fossilization, Busk, agreeing with Huxley, wrote ". . . of course, without any relation as regards age with the fossil bones of the coprolite beds; it is of *very great antiquity*."[1]

With our present knowledge and experience, it is difficult to understand why these great geologists and comparative anatomists did not immediately visit the spot from which the jaw was recorded, establish or disprove its geologic age, and endeavor to ascertain whether there was any reasonable doubt as to its actually having been found at the spot indicated. But Collyer was left alone with his discovery. He dis-



The alleged "coprolite jaw" attributed to the *sixteen-foot* level of the Red Crag deposits near Foxhall as figured by Collyer in 1867. Reproduced same size.

The best record of the alleged find is in a letter dated November 13, 1866, to Dr. R. H. Collyer from Mr. John Taylor, the original purchaser of the specimen from the workman in 1855: "From what I could learn at the time, from the agricultural labourer of whom I bought it, it came from the coprolite pit on the farm of Mr. Laws at Foxhall, about four miles from Ipswich, and was thrown out at Mr. Packard's manure factory with the coprolite from a cart or tumbril, and from thence was brought to me to secure a glass of beer. . . . There is no doubt the bone was obtained at some depth . . . as I know the pit had been open for a considerable time when it was found."

[1] On this question Moir reports that, on chemical analysis, it is found that some of the Red Crag bones contain as much as 6½ per cent of organic matter as compared with the 8 per cent reported in the Foxhall jaw.

appeared from scientific meetings and at the present writing we have no further record of either the enterprising doctor or the alleged Foxhall jaw. From inquiries instituted by Moir, it appears that Collyer was a graduate of the Berkshire School of Medicine, formerly at Pittsfield, Massachusetts, and a personal friend of the American craniologist, Doctor Morton, of the Academy of Natural Sciences of Philadelphia, with whom he corresponded about the jaw. It is hoped that, following up these clues, it may be possible to trace the history of Doctor Collyer after 1867, and furthermore that there may be a possibility of our recovering the lost Foxhall jaw.

It would be hazardous for the writer even to express an opinion as to whether this jaw is of Pliocene age. The imperfect figure reproduced on the opposite page shows it to be different from the two most ancient jaws we know, namely, those of the Piltdown and Heidelberg men, for it apparently had a prominent chin. It is possible that the mineralization of the jaw was due to deep intrusive burial. To settle these questions the *jaw must be traced and found*. Even if the jaw proves to belong to *Homo sapiens*, Doctor Collyer's paper has suddenly become a classic because it has led to the long awaited discovery of Tertiary man, which may now be described.

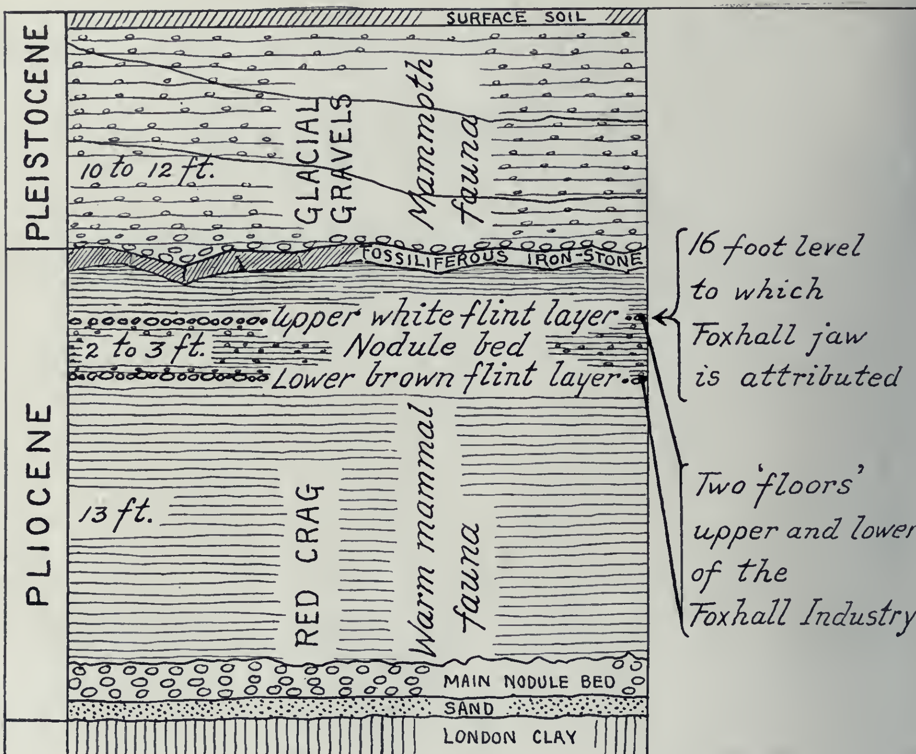
THE SIXTEEN-FOOT FOXHALL LEVEL

It remained for Moir, half a century later, to unearth Collyer's paper of 1867, to vindicate his entire procedure, and above all to rediscover the actual *sixteen-foot* level at Foxhall in which Doctor Collyer believed the jaw was located. "I found to my surprise," writes Moir, ". . . the occurrence of a nodule-bed lying in the [Red] Crag itself . . . and that this nodule-bed rested at a depth of sixteen feet below the surface." The exact correspondence, so far as depth from the surface is concerned, between the nodule-bed mentioned by Collyer and that described in a Survey Memoir,[1] enabled Moir to trace the quarry to Mr. Laws' farm, mentioned by Collyer as in the parish of Foxhall. Moir continues: "I decided to investigate the nodule-bed. . . . *My investigations have resulted in the discovery of a definite occupation level at this horizon, containing cores, flakes, flint implements, and a number of stones exhibiting crackling and other evidences of having been subjected to the action of fire.*"[2] It thus appears that Collyer's notes on the sixteen-foot level of the quarry, by attracting the intelligent and energetic archæologist of Ipswich, led to what we have described as the opening of a new epoch in archæology. To support this strong statement, let us compare the geologic age of the Foxhall flints with that of the flints discovered in 1846 by Boucher de Perthes at Chelles on the Marne River, France, at a geographic point approximately 230 miles southeast of Foxhall, England, the two localities in Stone Age time being united by a broad and fertile land connection. The most ancient of the Chellean flints are of much more recent time than those of Foxhall, because the greatest antiquity assigned to them by geologists is that of mid-Pleistocene time, whereas the Foxhall flints occur in the Upper Pliocene *before the beginning of Pleistocene time*. Thus the long interval of Lower Pleistocene time separates the Foxhall from the Chellean, during which the upper and middle river terraces of France and England were formed and important changes in the mammalian life occurred.

The makers of the Foxhall flints had their 'floor' or 'atelier' very near the shore of the North Sea in Pliocene time. The 'floor' is not in the base of the Red Crag but in the center of Red Crag sand deposits partly of river and partly of marine origin, which mark a very long

[1]"The Geology of the Country around Ipswich, Harleigh, and Felixstowe." *Mem. Geol. Surv. United Kingdom* (explanation quarter-sheets), 1885.

[2]The italics are supplied by the author of the present article.



Diagrammatic section of the pit where the Foxhall Industry and "Jaw" were discovered. Modified from Moir, 1920-1921, p. 12, fig. 3. (See photograph on opposite page)

period of time and a very gradual change of climate in this part of England from warmer to cooler conditions. In the lowest levels of the Red Crag is found the warm Pliocene fauna of the three-toed *Hipparion* horse, the tapir, the short-jawed mastodon, the hippopotamus, and the roe deer, while in the upper levels occur the remains of a newer temperate fauna of true horses (*Equus stenonis*) and of the southern mammoth (*Elephas meridionalis*). Mr. Moir writes, August 11, 1921, apropos of a visit to the locality by Professor J. E. Marr, the geologist of Oxford University: "There is no question as to the Pliocene age of the Foxhall levels—so long as you continue to regard the Red Crag as Pliocene. But the 'floors' at Foxhall occur *in* the Crag, not at the base as in the case of the ordinary detritus bed." From the ground level at the Foxhall Quarry occur the following beds:

RECENT	A.	Surface soil, 6 inches to 1 foot in depth.
QUATERNARY	B.	Stratified "middle" glacial gravel 10-12 feet in thickness.
TERTIARY	C.	Fossiliferous iron-stone bed, 6-9 inches in thickness.
Pliocene Red Crag	D.	**Red Crag** sand, horizontally stratified, 2-3 feet in thickness.
	E.	**Sixteen-foot layer of Collyer.** Black band with many casts of shells and *flint implements*, flint flakes, also "coprolites" and fossilized [Red Crag] bones, 2-3 inches in thick-

Western face of the pit at Foxhall Hall in which the Foxhall industrial flint layers E and G were discovered, with the most ancient evidence of the use of fire by man.

Red Crag (continued)

ness. [See handle of shovel shown in the illustration.]

F. *Nodule-bed* or gravel pit, horizontally stratified, containing coprolites, but *almost devoid of flints*, and 2-3 feet in thickness. [This is the bed quarried for fertilizing purposes, in which it is alleged that the "*Foxhall jaw*" was found.]

G. **Lower black band,** not quite so well defined as "E," containing dark-colored, worked flints. [See bottom of measuring rod shown in the illustration.]

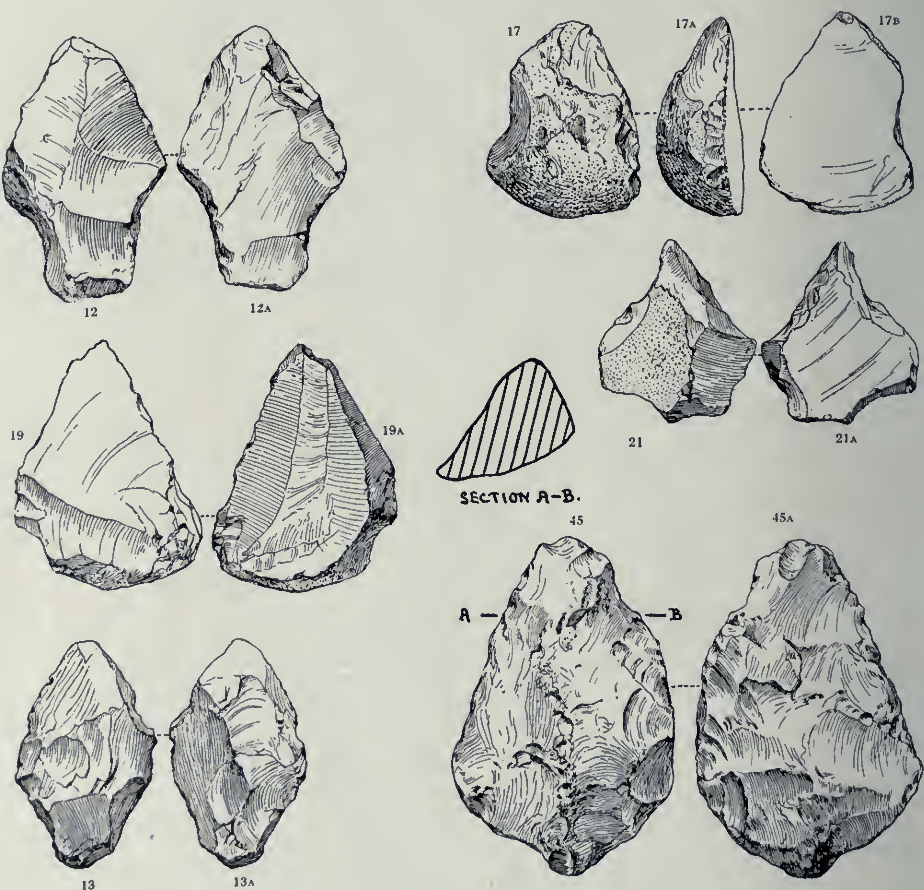
It is the level "E" which Moir describes as "*a definite occupation level . . . containing cores, flakes, flint implements, and a number of stones exhibiting crackling and other evidences of having been subjected to the action of fire.*"[1] It is these flints, discovered by Moir and identified as of human origin by Abbé Breuil, which firmly establish the existence of Pliocene man in Britain. That this was a working 'floor' is indicated by the presence of the flint cores and flint flakes with the flint implements themselves. The débris of this flint-working site appears to point to a time during the laying down of the Red Crag deposits, when for a short period, geologically speaking, a land surface in the form of a shore line existed at this site. The majority of the humanly flaked flints from both the upper and the lower levels, namely, "E" and "F," appear to belong to the same industrial stage. It may be, also, that after a more or less prolonged occupation of level "F," the incursion of the waters of the North Sea in late "Red Crag"

[1]The italics are supplied by the author of the present article.

time caused the ancient flint workers to abandon their working site. Later, however, they returned to the same spot and worked on the upper surface of the nodule-bed, two or three feet in thickness. Finally, the upper floor was in its turn sunk below sea level and covered by a further deposition of marine sand and shells.

CHARACTER OF THE FOXHALLIAN FLINTS

These flints are unlike those of the Chellean or pre-Chellean of France—they are chiefly fashioned from flakes and not from the "cores." Moir supposes that the almost pure white color is due to prolonged surface exposure of the 'floor,' because the flints lack the dark mahogany-brown coloration characteristic of the detritus layers beneath the Crag; only a few flaked flints of this dark color have been found. The known typical implements of the sixteen-foot



Five kinds of flint implements from the sixteen-foot 'floor' at Foxhall and one from the sub-Crag of Bramford. After Moir, 1920–1921.

12, 12A.—Two views of pointed flint implement flaked on the upper and lower surfaces and with constricted base, from sixteen-foot level of Foxhall pit. Primitive arrowhead type, which may have been used in the chase.

13, 13A.—Primitive (?) *coup de poing*, flaked on both sides, from Foxhall.

17, 17A, 17B.—Three views of an implement of the scraper type, known as the *racloir*, from sixteen-foot level of Foxhall. An implement which may have been used in preparing skins.

19, 19A.—Two views of a primitive *pointe* from the sixteen-foot level of Foxhall.

21, 21A.—Borer (*perçoir*) from sixteen-foot level of Foxhall.

45, 45A.—From sub-Crag, Bramford pit. Primitive (?) *coup de poing* or 'hand stone.'

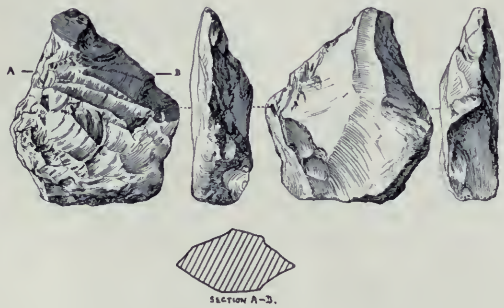
level (p. 572) are not unlike those of much less antiquity than the Red Crag. Moir describes the flint tools and weapons as less coarse than the mahogany-brown specimens in the lower level. They include hafted specimens, side scrapers resembling the *racloirs* of early Mousterian time, a number of arrowhead-like *pointes*, also borers and scrapers of the ordinary type. A number of calcined flints are also found. Only one specimen of a "rostro-carinate" implement, of indifferent manufacture, was found during the excavations at Foxhall. Moir's praise of this industry is relative, but how shall we *explain* what the author terms "workmanship of a high order" in Upper Pliocene time, so long before what has always been regarded as the primitive industry of Chelles? Only, it appears to the writer, by reforming our ideas of the antiquity of man; by preparing our minds for the discovery of still more ancient man and for a very early separation of human races as well as of industries.

Such openness of mind is rendered necessary by Moir's discovery of the *giant flints of Cromer*, of more recent geologic age than those of Foxhall, products of an industry of very different character and possibly the work of a different race.

GIANT FLINTS BELOW THE FOREST BED OF CROMER

Fifty miles east of Foxhall is the ancient city of Cromer, now a popular seashore resort with a long and beautiful beach, stretching below high bluffs of sand and gravel surmounted by rolling downs, where at low tide is exposed one of the most famous mammal deposits in the world, long known to palæontologists as the *Forest Bed of Cromer*. The writer had the privilege of examining the fossils collected by Mr. A. C. Savin, of Cromer, who for years past has hurried to the seashore at every period of exceptionally low tide in order to collect from the rich harvest left by the erosion of the sweeping tides. The rich mammalian life of the "Forest Bed" is more recent than that of the Red Crag: the short-jawed mastodons (*M. arvernensis*) and other south temperate forms are extinct; the two great elephants of Lower Pleistocene time, the "southern" and the "straight-tusked," have arrived in East Anglia; the Etruscan rhinoceros lingers. It is perhaps to hunt these monsters that a giant flint industry is developed of which 'floors' are discovered at Cromer and at Sheringham five miles to the northeast.

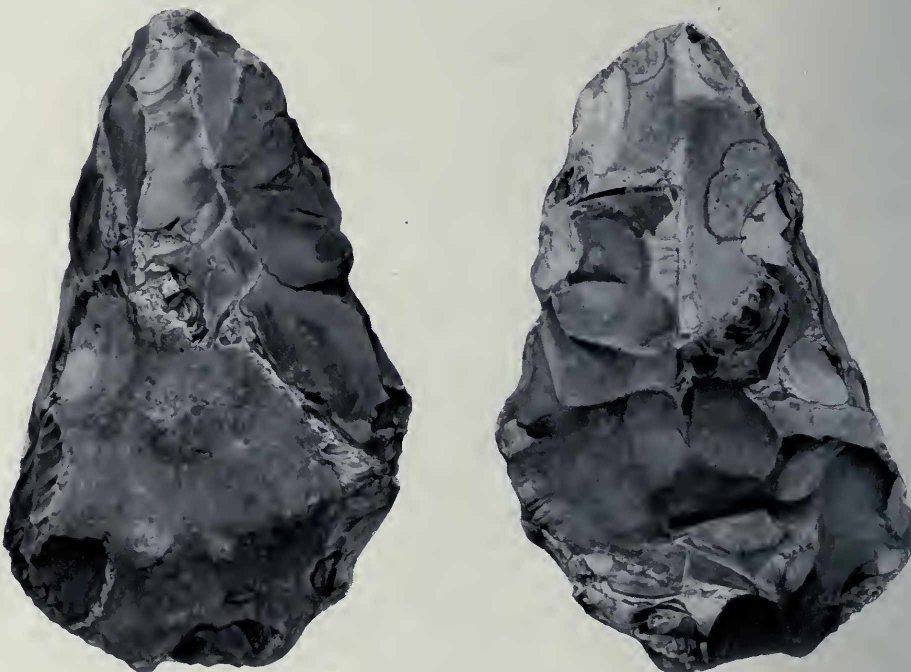
These flints were first mentioned by



An implement geologically older than any from Foxhall, found in the sub-Red Crag deposits of Bramford, which J. Reid Moir (November 21, 1921) considers very similar in appearance and technique to the flint implements found with the Piltdown skull. After pen drawing by E. T. Lingwood
One third natural size

Sir Ray Lankester,[1] who has in recent years described the large "beak-keeled" implements which he terms rostro-carinates. The human origin of these rostro-carinates is disputed by some archæologists; it is denied by others such as Abbé Breuil. What Lankester terms his *test* rostro-carinate was seen by the writer in the British Museum and has been figured. Lankester, moreover, has given the strongest backing to Reid Moir's excavations and researches, culminating in his advocacy of the human origin of the "Forest Bed" giant flint implements, of which he writes[2] (1921, p. 166):

"The second is the most remarkable among a great number of very large worked flints, recently discovered by Mr. Reid Moir below the forest-bed at Cromer in such a position as to indicate a workshop or flint-workers' 'floor'—of an age anterior to that of our river-terrace gravels. . . . The largest of the worked flints from this newly-discovered 'floor' weighs 7 lb. 6 oz., is 10 inches in length, $5\frac{1}{2}$ inches broad and at the 'butt' end is 4 inches thick. It has a rostrate form, a relatively flattened ventral surface and is richly worked all over by large coarse flaking of indubitable human origin. It presents a marked resemblance—both in general form and in the character of the flaking of its surface—to the Selsey rostrate as well as in its great size and weight. The point to which I wish to draw attention in regard to these three unusually large and heavy flint implements, is that they belong to a very early period, antecedent to that of the familiar tongue-shaped and



Two views of one of the giant flint implements found at low water at Cromer, resembling a giant Chellean *coup de poing*. One third natural size. After a wash drawing by E. T. Lingwood kindly forwarded by J. Reid Moir (November 21, 1921) for reproduction in NATURAL HISTORY

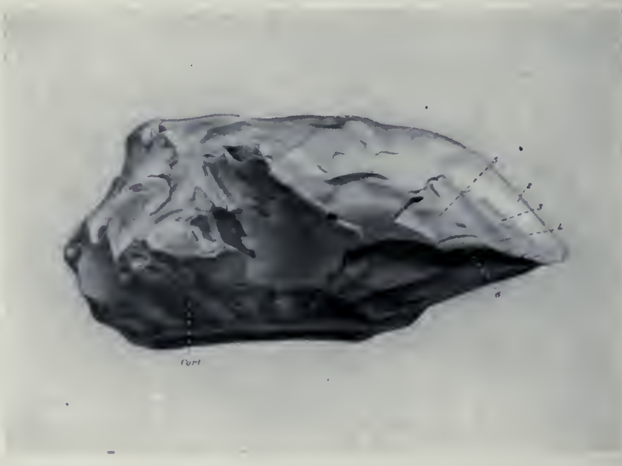
[1]Lankester, E. Ray, "On the Discovery of a Novel Type of Flint Implement Below the Base of the Red Crag of Suffolk," . . . *Phil. Trans.*, B, April, 1912. Vol. 202, p. 332.

[2]Lankester, E. Ray. "A Remarkable Flint Implement from Selsey Bill," *Proc. Roy. Soc.*, B, Vol. 92, 1921, pp. 162-168, Pls. VIII-XI.

Cliffs of Cromer. The Forest Bed deposits are found at low tide all along this beach. The 'floor' where the Cromerian industry occurs is just beyond the pier, near the horizon (upper picture). Since the 'floor' is below the Forest Bed, it is best shown at extremely low tide

ovate implements of Chellæan and Acheulæan age. . . . The early age of these big implements is consistent with the hypothesis that they were made and used by an early race of men of heavier build than that which succeeded them and produced the abundant ovates and tongue-shaped implements of our terrace gravels. Whether made by an exceptionally big race or by men of the modern size, the use of heavy big flint implements, such as the two which I have here cited, presents a problem. If used merely as hammers or as club-heads they would be unwieldy and would not require any special shaping—such as would give precision to a smaller implement. The only suggestion I can offer as to their use besides that of 'pounding' or breaking into the cavities of the bones of large animals in order to extract marrow, brain, etc.—is that they were employed either affixed to a handle or held by the two hands for the purpose of breaking a hole in the ice on the surface of a lake or marsh pool. Fish come to such openings in the ice and are then readily speared or captured."

While at Cromer, the writer examined these flints, which have been collected at low tide in very large numbers and unfortunately are being somewhat scattered among amateur collectors. This supposed sub-Forest Bed 'floor' should be guarded as a *national monument*, because *if* the human origin of these flints is incontestably proved, the 'floor' will at once become one of the *most famous spots in the early history of Great Britain.* Only the most expert archæologist and student of flint mechanics and lines of fracture is competent to express an opinion. If proven authentic beyond dispute, these ancient stations will rank like Chelles and Le Moustier as types of two new human cultures—which may be known respectively as **Cromerian** and **Foxhallian**.



The large "Selsey rostro-carinate," right lateral surface. After Lankester, 1921, Pl. 10. This is a sub-Red Crag implement, more ancient in age than Foxhall.

Lankester defines the ideal rostro-carinate as an implement with broad posterior region, narrowed anteriorly to a quasi-vertical cutting edge. This anterior narrow edge is strongly curved and gives the implement the form of the beak of an accipitrine bird. The form of this region of the implement may also be compared to that of the prow of a boat (the boat being turned keel upwards). If the implement is held with the prow or beak to the front, there are observed an upper or dorsal plane, a lower or ventral plane, a right lateral and left lateral surface, a posterior surface or stern, and an anterior surface.

Cort.—An area of cortex or original bark of the nodule.

2, 3, 4.—Scars whence ribbon-like flakes have been struck; scars *3* and *4* are noticeable for the conchoidal transverse rippling of the flint.

5.—The scar of a broader flake, parallel to *2, 3, 4*, which is truncated by the well-marked conchoidal scar, *6* of another shaping-flake

THE DAWN MAN OF PILTDOWN, SUSSEX

BY

HENRY FAIRFIELD OSBORN

EOANTHROPUS, the 'dawn man' of Piltdown, has had a battle royal for recognition by the scientific world. Since the first fragments of his skull were reported in 1911 by the geologist, Charles Dawson, and first made known to the scientific world in 1913[1] by Dawson and Arthur Smith Woodward, the latter Keeper of Fossils in the British Museum, the contest of opinion has been long and heated and at times acrimonious. Over a few fragments of skull bone, three teeth, and a portion of the jaw, the wise anatomists of Great Britain, of western Europe, and of the North American continent have expressed opinions of every variety.

The writer's peace-loving friend, Smith Woodward, started the fracas by giving these fragments the name *Eoanthropus*, signifying 'dawn man,' and thereby committed himself to the idea that here was a new genus of man quite distinct from the genus *Homo* and the antipode of the species *Homo sapiens* to which we belong. To the ideas of the other extreme, Marcellin Boule, the French palæontologist, resolutely adhered, namely, that the fragments do not represent a 'dawn man' at all, that they belong to the same genus *Homo* as ourselves, that the species may be known as *Homo dawsoni*, that it is of relatively recent geologic age, namely, of the Third Interglacial period and Acheulean culture phase. Moreover, Boule joined a chorus of American and German opinion that the jaw does not belong with the skull, but is that of a chimpanzee, and that the skull itself in brain capacity is that of a relatively recent type. This opinion has been reaffirmed by Boule in his great work of 1921, *Les Hommes Fossiles*,[2] in which all the discoveries of fossil human remains are reviewed from beginning to end in the most searching manner, and in which the chronologic succession of the human fossil types is clearly set forth on the forty-ninth page.

Thus the 'dawn man' has shared a fate similar to that of Neanderthal man, first discovered by some workmen in 1856 and described by Schaaffhausen in 1858—especially through the skull-cap, thigh bones, and other skeletal fragments—and received with almost universal scepticism. The Neanderthal man was regarded as a feeble-minded modern by the high German authority, Virchow, and was treated very lightly even by Darwin in his great work, *The Descent of Man*, published in 1871, although the geologist Lyell (1863) had recognized him as an intermediate form between man and the apes. Huxley, however, (1863, 1864) did not recognize the Neanderthal man as the missing link, his opinion being as follows (1864, p. 588): ". . . there is no ground for separating its possessor specifically, still less generically, from *Homo sapiens*. At present, we have no sufficient warranty for declaring it to be either the type of a distinct race, or a member of any existing one; nor do the anatomical characters of the skull justify any conclusion as to the age to which it belongs." When we recall the fact that the 'Gibraltar skull' of a female Neanderthaloid had been known since 1848, we may say that the Neanderthal man was under a cloud of suspicion for nearly forty years, that is, until 1887, when the discovery was made of two Neanderthal skeletons and skulls in a grotto near Spy, not far from Dinant, Belgium. It was these Spy relics, which seem to agree exactly with the Neanderthal skull top and with

[1]Dawson, Charles, and Woodward, A. S. "On the Discovery of a Palæolithic Human Skull and Mandible in a Flint-bearing Gravel overlying the Wealden (Hastings Beds) at Piltdown, Fletching (Sussex)." With an Appendix by Prof G. Elliot Smith. *Quart. Journ. Geol. Soc.*, London, Vol. LXIX, 1913, pp. 117-151, Pls. 15-21. *Ibid.*, Vol. LXX, 1914, pp. 82-99.

[2]Boule, Marcellin. *Les Hommes Fossiles. Éléments de Paléontologie Humaine.* Paris, 1921, pp. i-xi, 1-491, figs. 1-239.

Fig. 1. All that was found of the fractured Piltdown skull, during the years 1911–13, from which the complete skull was restored as shown in Figs. 2a, 2b, 3a, 3b, 14.

A, B, C, D, skull fragments found by Dawson and Smith Woodward in 1911, 1912. *E*, jaw fragment found by Dawson in 1912. *F*, canine tooth found by Father Teilhard de Chardin in 1913. *G*, nasal bones found by Dawson in 1913. *H*, single worked flint found near original skull fragments by Smith Woodward. Jaw one third natural size; other fragments a bit larger than one third (distorted somewhat by camera.)

subsequent discoveries in other localities, that firmly established the Neanderthal race as one of the most important, and now by far the best known, of all fossil men.

Trinil man, the *Pithecanthropus erectus* or 'erect ape-man' of Java, is still suffering under the same uncertainty. The original discovery, singularly parallel to that of Neanderthal man, consisting of the skull top, a thigh bone, and two grinding teeth, has remained unique evidence for the past thirty years. Strenuous efforts to discover more material on the banks of the Bengawan River, where the original remains were recovered by the Dutch army surgeon, Eugen Dubois, in 1891, have been unavailing. A singular misfortune has attended the Trinil man in that for some mysterious reason Dubois, the discoverer and possessor of the remains, has never made them fully known to science. There are riches of knowledge and information locked up in those four fossils which could be released through the application of the most modern methods of research, but which are held back. The anatomists of the world have implored Doctor Dubois to publish all the information in his possession, or to subject these precious documents to the examination of other men—but in vain. In the meantime, renewed ef-

Fig. 2a. Original restoration of Piltdown skull (lower) made by Smith Woodward in 1913; one fifth life size. Skull of South African Bushman (upper), exhibiting the contrast between *Eoanthropus* and *Homo* type in the forehead region, also in the angulation of the jaw. After Osborn, *Men of the Old Stone Age*, Fig. 67

Fig. 2b. Three views of the Piltdown skull as reconstructed by J. H. McGregor, 1914; one fifth life size. This restoration includes the nasal bones discovered in 1913 and the canine tooth also discovered in 1913, which were not known at the time of Smith Woodward's reconstruction of the same year. (Upper) profile view; (lower left) front view; (lower right) view of the top of the cranium. After Osborn, *Men of the Old Stone Age*, Fig. 68

Fig. 3a. Piltdown skull with left half removed to display the extreme thickness of the bones and the shape of the brain. As restored by J. H. McGregor, 1914; one fifth life size. After Osborn, *Men of the Old Stone Age*, Fig. 69

Fig. 3b. Restoration of the head of Piltdown man; in profile, based on the reconstructions shown in the above figures. After a model of 1914 by J. H. McGregor; one fifth life size. After Osborn, *Men of the Old Stone Age*, Fig. 71

forts will be made to discover in Asia additional remains of the same geologic age, especially by the expeditions that are being sent out by the American Museum of Natural History through the funds of the Third Asiatic Expedition.

May these efforts be crowned with success! May Dubois reveal the secrets in his possession! If so, we shall probably confirm his original opinion that the *Pithecanthropus* is of Upper Pliocene age; that it possessed the straight femur of a biped-walking type and not of a tree-climbing type—thus corroborating the specific appellation *erectus*; that the brain is far larger than that of any kind of anthropoid ape, and that the skull possesses distinct resemblances to that of the Neanderthal race of men—in brief, that *Pithecanthropus* is related, even if indirectly, to one of the great lines which gave rise to the true human species.

The history of anthropology does not include any story of exploration, discovery, and research more worthy of recognition and praise than that connected with the 'dawn man.' Arthur Smith Woodward, who took a very bold step in originally proposing the Piltdown man as belonging to the new genus *Eoanthropus*, has not stopped to reply to any of his critics; he has left this to some of his colleagues, who have replied with considerable warmth, while he himself has been unremittingly engaged for the past seven years in endeavoring to secure material to confirm his original description and estimate of the characters of the 'dawn man.' The locality, which the writer will describe presently from his own recent visit, July 26, 1921, presents exceptional difficulties, chiefly because the Piltdown gravels are almost exactly of the same color as the fossils which they contain; the fossils are thus extremely inconspicuous. From prolonged experience in fossil hunting during the past forty years in various parts of the world, the writer can truthfully say that he knows of no locality where fossil remains are so indistinguishable from the matrix in which they are found. Under these conditions the discovery of the original fragments of the skull was all the more creditable; the subsequent finding of the jaw fragment by Dawson marked the turning point in the whole history of the discovery; the finding of the canine or eye tooth by Father P. Teilhard de Chardin indicated an almost hawklike vision; finally, the unearthing of the two minute black-colored nasal bones of the 'dawn man' was almost a miracle.

Alongside the roadway leading to the Manor House, where the original find was made, the workings, 150 feet in length and 10 feet in width, have been carried on at intervals for ten years. Every pound of Piltdown gravel has been gone over minutely, or sifted, under Dr. Smith Woodward's immediate supervision. Openings have been made on the other side of the hedge, revealing the same Piltdown gravel and the same superposed layers as shown in our section (Fig. 7) without the discovery of another fragment of bone. Only during the season of 1921 was there a cut made beneath the adjacent roadway within a short radius of the very spot where the bones of the skull and jaw lay. The rewards of this exhaustive and exhausting work, which throughout has required infinite patience and persistence, have been few and far between, but sparse as the new evidence is, it has all been in the direction of gradual confirmation and strengthening of the original Dawson-Smith Woodward discovery—a discovery of transcendent importance to the prehistory of man.

Scepticism as to the association of the chimpanzee-like jaw with the skull was very widespread. In the original description Smith Woodward himself proclaimed the resemblance of the jaw to that of a chimpanzee. The present writer was one of the American school of sceptics who finally reached the opinion that this was an instance of the accidental association of two wholly unrelated fossils. It would have been difficult to dislodge this opinion, so widely entertained in Europe and America, but for the overwhelming confirmation afforded to Smith Woodward by the discovery, announced in 1917,[1] of the remains of a *second Piltdown man*, not in the original quarry but at another exposure of the Piltdown gravels about two miles distant, a discovery made by the original finder, Dawson. If there is a Providence hanging over the affairs of prehistoric men, it certainly manifested itself in this case, because the three minute fragments of this *second* Piltdown man found by Dawson are exactly those which we should have selected to confirm the comparison with the original type, namely: (1) a first lower molar tooth, (2) a bit of bone of the forehead near the right eyebrow, (3) the middle part of an occipital bone of the skull. Both the grinding tooth and the eyebrow region are absolutely distinctive. Placed side by side with the corresponding fossils of the first Piltdown man they agree precisely; there is not a shadow of difference. As shown in the accompanying photograph published by permission of Dr. Smith Woodward, the two grinding teeth differ only in respect to age. The first Piltdown man was more advanced in years and the teeth were more worn; the second Piltdown man was younger and the teeth were unworn; but they present precisely the same characters.

Fig. 4. *A*—side and top views of jaw of first Piltdown man, with first and second lower molar teeth in place. *B*—side and top views of first lower molar tooth of second Piltdown man. About three fourths life size

Smith Woodward very quietly published this confirmatory evidence without, however, alluding in any way to his critics or yielding to the natural temptation of writing, "I told you so," a phrase which would certainly have appeared from a less patient and dignified pen. Seeing is believing, and the writer eagerly looked forward to a return to the British Museum after so many years of absence and to the opportunity of examining these precious documents, an opportunity which was most cordially extended to him by Doctor Woodward. After attending on Sunday morning, July 24, 1921, a most memorable service in Westminster Abbey, a building which enshrines many of the great of all time, the writer repaired to the British Museum in the afternoon to see the remains of the now thoroughly vindi-

[1]Woodward, A. S. "Fourth Note on the Piltdown Gravel with Evidence of a Second Skull of *Eoanthropus dawsoni*." With an Appendix by Prof. G. Elliot Smith. *Quart. Journ. Geol. Soc.*, London, Vol. LXXIII, 1917, pp. 1–10, Pl. I, figs. 1, 2.

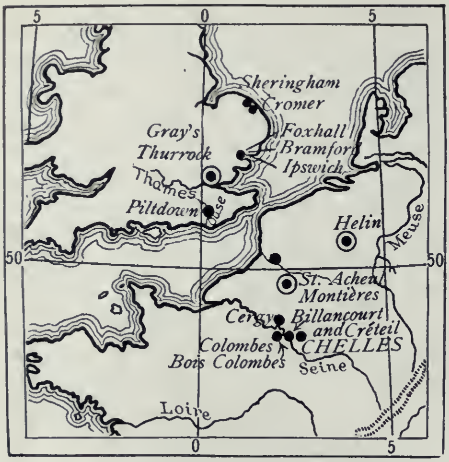
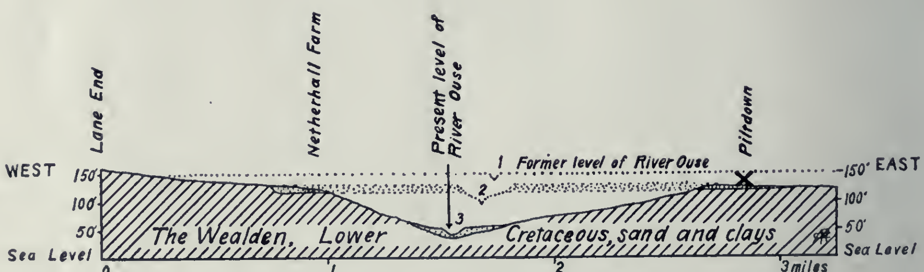


Fig. 5. Most Ancient Stone Age Sites of England and France from East Anglia to Chelles. East Anglia—Norfolk, Suffolk, Essex, and Sussex—with the chief localities, Piltdown, Foxhall, and Cromer, in which the most ancient evidence of man on the earth has recently been discovered

cated 'dawn man' of Great Britain. From a steel fireproof safe, these few precious fragments of one of the original Britons, which had been preserved in this manner from the bombs thrown by German aviators, and which will probably be thus guarded from thieves for all future time, were taken out and placed on the table by Doctor Woodward, so that full and free opportunity was given for the closest comparison and study. At the end of two hours, in which also worked flints and a large implement of cut *Mastodon* thigh bone were examined, the writer was reminded of an opening prayer of college days, attributed to his professor of logic in Princeton University: "Paradoxical as it may appear, O Lord, it is nevertheless true, etc." So the writer felt. Paradoxical as it appears to the comparative anatomists, the chinless Piltdown jaw, shaped exactly like that of a chimpanzee and with its relatively long, narrow teeth, does belong with the Piltdown skull, with its relatively flat, well formed forehead and relatively capacious brain case!

First, however, let us look over the ground of the original Piltdown discovery, as the writer was privileged to do in company with Doctor Smith Woodward and Dr. H. M. Ami, Canadian geologist, to whom he is indebted for certain of the accompanying photographs.



Geologic Section of the Ouse River Valley at Piltdown England

Fig. 6. Piltdown Common lies between two branches of the River Ouse, about 35 miles south and slightly to the east of Gray's Thurrock, the Chellean station of the Thames. To the east is the plateau of Kent, in which the flints described as 'eoliths' were discovered by Benjamin Harrison about 1870. The Piltdown gravel containing the Piltdown skull underlies the Piltdown Common, a well-defined plateau of large area lying about 80 feet above the present level of the main stream of the Ouse. Kennard believes that the Piltdown gravels are of the same age as those of the 'high terrace' of the lower valley of the Thames, namely, the 90–100 foot terrace; this would make the Piltdown industry much more ancient than the Chellean, which belongs on the 30 foot terrace. Clement Reid also holds that the Piltdown gravels are of First Interglacial age, equivalent to the 90-100 foot terrace, long prior to the arrival of the Scandinavian glacier in Great Britain. Dawson in his original description also broadly assigns the Piltdown skull and jaw to the first half of the Pleistocene epoch.

×—Piltdown on (1) the former level of the River Ouse, which has since descended to (2) lower levels and (3) its present level

Piltdown on the Ouse is not very far from the famous Chellean stations of the ancient Somme and Marne rivers of France and not many miles south of Gray's Thurrock on the Thames. To the north, in ancient East Anglia, were the stations of the Foxhallian and Cromerian industries, described in the previous article, and the site of the discovery of the alleged Foxhall jaw. It is, therefore, altogether natural from the geologic standpoint to compare the three or four true flints which have been found with the Piltdown man with those of the earliest Chellean station on the Somme and of the *Champ de Mars* near Abbeville, described by d'Ault du Mesnil, and of those of Foxhall, to the north, recently described by J. Reid Moir.[1] While this article is in press, the latter comparison is actually being made.

The Anderida forest of Roman invasion times, formerly covering the Piltdown Common, is thus described by Elton:[2]

"The great marshes were still unbanked and open to the flowing of the tide . . . and several hundreds of square miles were covered by the dense forest of Anderida. This forest must at one time have covered most of south-eastern Britain. . . ." This is otherwise known as the forest of "Andredesweald," the name Weald being given to the Wealden clay.

Many thousand years earlier, flowing through a warm temperate forest, was the ancestral River Ouse, transporting the Piltdown gravels, which, although of very moderate thickness (20 inches to 2 feet) at the widest part, spread out like a fan or river delta beneath the Common over a considerable area and are instantly recognized by the dark brown, compact sands and pebbles, which are sought by road-makers for their excellent road-building qualities.

[1]Moir, J. Reid. "Further Discoveries of Humanly-Fashioned Flints In and Beneath the Red Crag of Suffolk." *Prehist. Soc. East Anglia*, 1920–1921, pp. 1–42 (reprint), Pls. I, II, III, V, Figs. 1–45A.

[2]Elton, Charles, *Origins of English History*. London, Quaritch, 1882, pp. 106

In approaching the famous site one passes over a rolling open plain covered with patches of heather, now serving as a golf course. On the horizon are the elevated North Down and South Down overlying bluffs of flint-bearing chalk, which, in turn, are superposed on beds of Wealden age, as shown in the accompanying sketch (Fig. 8). At Piltdown meandered the ancient Ouse, and the gravels were subsequently covered with four layers, as shown in the sketches made by the writer. It is necessary, however, to take a bird's-eye view of the ground from above in order accurately to locate the very spot where

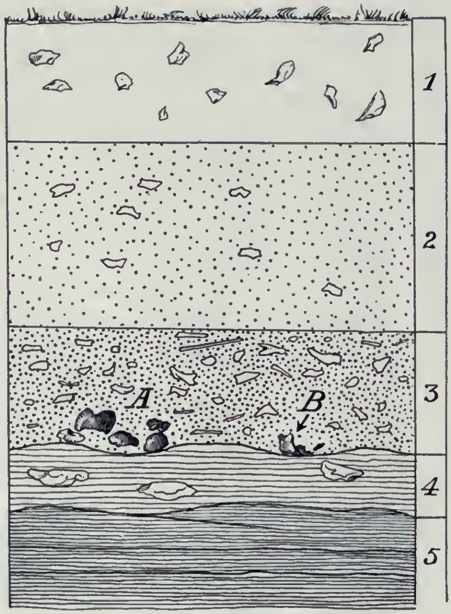


Fig. 7

1. Recent humus and surface soil, with scattered flints, 12–20 inches.

2. Pale yellow sandy loam with gravel and *Neolithic* flints and pottery, 2 feet 6 inches.

3. Piltdown gravel containing remains of the skull (A), jaw (B), and teeth from the lower level, also worked flints and rolled water-worn fossils, probably of Pliocene age. 18–20 inches.

4. Pale yellow clay and sand with scattered potato-shaped flints unworked. The bone tool implement was found at the bottom of this layer, 10 inches.

5. Undisturbed strata of Lower Cretaceous (Wealden age), over the surface of which flowed the stream bearing the clays and Piltdown gravels

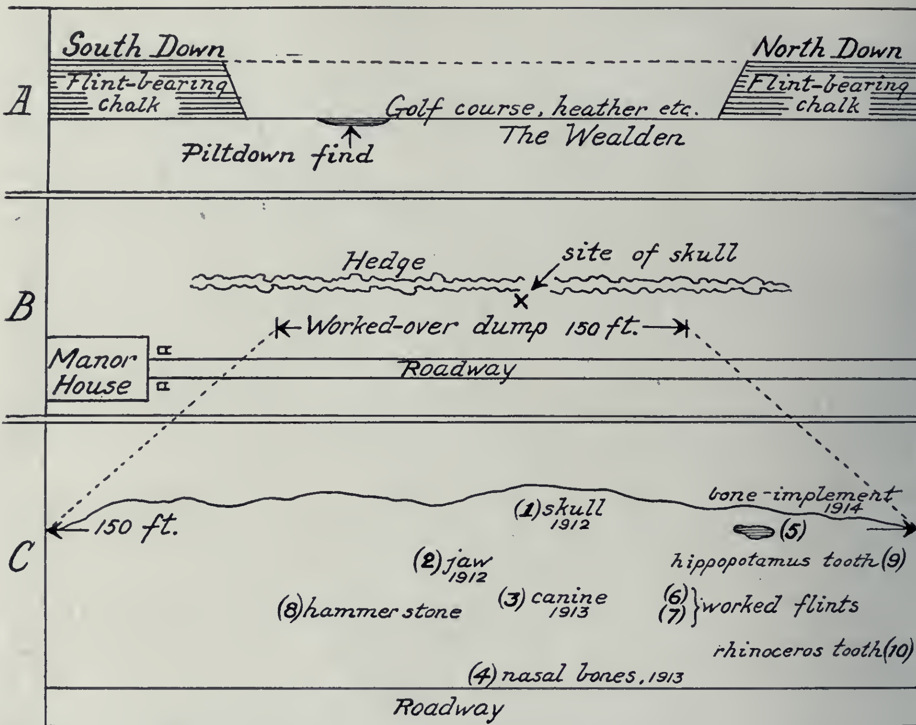


Fig. 8. Sketches by the writer (1921) showing the Piltdown workings. *A*—General relations of the "Downs" to the Piltdown find. *B*—The Piltdown gravel workings from 1912 to 1921. *C*—Relative location of some of the principal finds. Skull and jaw parts found near together. (1) Skull fragments in the workman's dump, (2) jaw, (3) canine, and (4) nasal bones, picked out of the undisturbed gravel near by, (5)–(10) flints and fossil bones scattered

the skull was found and to appreciate the immense amount of work that has been done since 1911 in searching for additional evidence.

Even during the past summer, without any subvention or state aid, Dr. Smith Woodward has been quietly continuing his work and he wrote October 24, 1921: "I did a little more digging last month, but without result."

It will be recalled that the working of this Piltdown gravel pit has been going on for many years. The successive order of discovery is approximately as follows:

1911 (reported)

Unusually thick human parietal bone was found by Dawson.

1911 (autumn)

Dawson picked up another and larger piece of bone belonging to the forehead region of the same skull and including a portion of the ridge extending over the left eyebrow.

1911–1912

At various times there were found by Dawson and Smith Woodward rolled or abraded flints, known as 'eoliths,' also rolled or abraded remains of the hippopotamus, the rhinoceros, and of a stegodont proboscidean, *claimed to be of greater age* than the Piltdown gravels, possibly of Pliocene Red Crag age.

At various times also there were unearthed (1) a Palæolithic *hammer-stone* (see Fig. 8, No. 8) found in the undisturbed gravel, (2) freshly worked flints, discovered by Dawson in the Piltdown gravel dump (Fig. 12), and (3) the flint found by Ray Lankester. These flints are extremely important, because they are of the same geologic age as Piltdown

Fig. 9. Type of locality where the Piltdown skull fragments were found. Dr. Smith Woodward and Mr. Charles Dawson washing gravel in search for more fragments and teeth; a workman standing on the exact spot of the original discovery, where a monument will be placed. Enlarged from a film made in the year 1912, under the direction of Dr. J. Leon Williams, who presented to the American Museum the Williams collection of prehistoric crania

man and can be compared with those of Foxhall and of the pre-Chellean of the Somme.

1912

Dawson and Smith Woodward began systematic search. All material was looked over and carefully sifted; it appeared that the whole or greater part of the human skull mentioned above had been scattered by the workmen, who had thrown away the pieces unnoticed.

One Sunday evening the blow of a pick caused the right half of a jaw to fly out of the undisturbed bottom of the gravel bed. The fore part of the jaw had apparently been cut off by the long previous blow of a workman's pick. A yard from the jaw an important piece of the occipital bone of the skull was found.

1913

A single right lower canine tooth, apelike, was unearthed by Father P. Teilhard de Chardin, the French anthropologist.

A pair of minute nasal bones were found, also the turbinal bones of the nasal region.

1914

A bone implement, partly shaped at one end out of a proboscidean thigh bone, was discovered in the clay layer beneath the gravel.

1915

Discovery by Charles Dawson of fragments of second Piltdown man, two miles distant from original pit.

1915–1921

Annual visits and continued exploration, excavations, and sifting of materials, not rewarded by any further discovery, by Smith Woodward.

It is now generally agreed that Osborn and McGregor were mistaken in placing in the upper jaw the canine tooth, discovered by Father P. Teilhard de Chardin in

1913; that the canine belongs with the right lower jaw and in so far is confirmatory of the union of the jaw with the skull. Consequently the photograph (Fig. 14) of the right side of the skull, with the canine in place, represents the latest opinion[1] as to the reconstruction of the skull. This reconstruction involves especially the size and weight of the brain through the determination of the median line of the top of the skull or the location of the so-called sagittal suture, as clearly shown in Fig. 2b. Brain size is one of the points about which has raged the greatest controversy. It is interesting now briefly to recall:

1913

Smith Woodward estimated the brain size as 1070 cubic centimeters.

Arthur Keith, the distinguished comparative anatomist, maintained that when the skull was properly reconstructed, the brain capacity would be found to equal 1500 cubic centimeters.

Elliot Smith and Smith Woodward maintained that the brain measured nearly 1300 cubic centimeters, equaling the size of the smaller human brains of

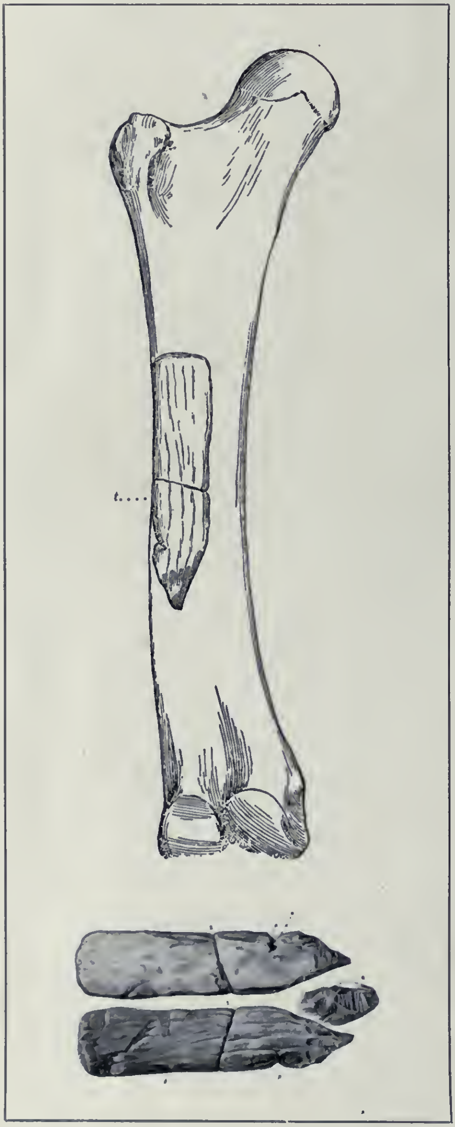


Fig. 10. Partly shaped bone tool cut from the thigh bone of a mastodon or mammoth, discovered in the clays underlying the Piltdown gravels by Smith Woodward in the year 1914,—a partly finished tool which may have been designed for purposes of hide dressing. One twelfth natural size. After Smith Woodward

Fig. 11. Rolled flints termed 'eoliths' found by Dawson in or near the Piltdown gravel pit. After Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 66. One half actual size.
Borer type (above)
Curved scraper (below)

[1]A recent comparison of the single canine tooth has convinced Doctor Gregory, Doctor Hellman, and the writer that it most nearly resembles the *right lower canine* of a female gorilla of relatively small size. It is very unlike a *human canine* in form and proportion. The doctors still disagree, for Doctor McGregor, another expert, feels strongly (December 15, 1921) that the identification of the Piltdown canine is a very uncertain matter.

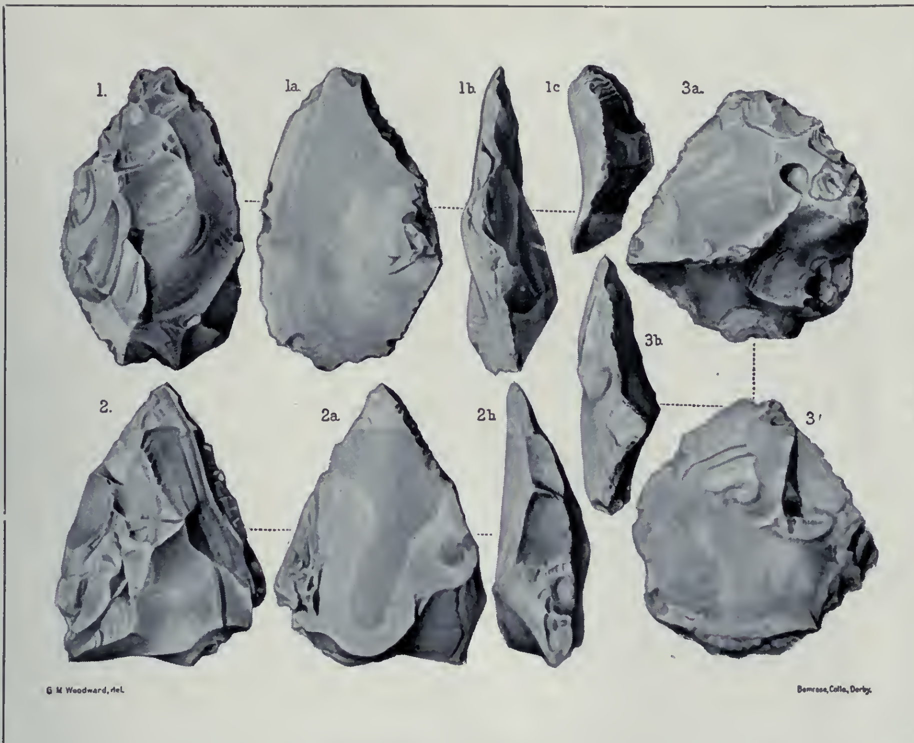


Fig. 12. Three freshly chipped triangular and oval flints found by Dawson, in the Piltdown gravel, fashioned out of flint nodules split in two and flaked on one side only with *very coarse marginal retouch*, similar to that of Foxhall flints. Nos. 1, 1a, 1b, 1c and 2, 2a, 2b are nearly one half actual size; Nos. 3, 3a, 3b nearly one quarter actual size. Reproduced after Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 60

Fig. 13. A single worked flint of very primitive type found by Dawson in the same layer with the original parietal and frontal fragments of the Piltdown skull. Reproduced after Dawson. After Osborn, *Men of the Old Stone Age*, Fig. 65

today and surpassing that of the Australians, which rarely exceeds 1310 cubic centimeters in the male and 1154 cubic centimeters in the female.

1914

J. H. McGregor reconstructed the skull with a cranial capacity of 1300 cubic centimeters, a figure exactly similar to that arrived at by Elliot Smith and Smith Woodward.

Although we await a memoir on the characters of the Piltdown brain by Dr.

Fig. 14. The second and most recent restoration of the Piltdown skull by Dr. Smith Woodward, in which the nasal bones appear in place and the canine is inserted in the right half of the lower jaw, the position to which Dr. Gregory is inclined to assign it. One fifth natural size

Elliot Smith, the greatest British authority on the primitive brain of man, it is not probable that the final estimates of the brain weight will be materially altered, nor may we expect in the near future any great additions to our knowledge of either the skull or the teeth of the 'dawn man.' Inasmuch as a century of exploration in what may be called the pre-burial period of man has yielded the remains of only five individual specimens nearly or remotely related to man, the probability of finding additional fossils is rather remote. This greatly intensifies the interest of the important discovery of the Foxhall man described in the preceding article and renders the more pressing the location of the lost jaw which is attributed to the Foxhallian stage of industry.

IS THE PILTDOWN INDUSTRY RELATED TO THAT OF FOXHALL?

The first archæologist to make this suggestion was J. Reid Moir in his extremely interesting memoir, *Pre-Palæolithic Man*, published in 1920,[1] wherein he remarks: "If the author, as a practical flaker of flint, had been shown Dr. Smith Woodward's reconstruction of the Piltdown skull and jaw, and had been asked what sort of flint implements in his opinion such a very primitive semi-human creature would be capable of producing, his answer would have been 'the very primitive edge-trimmed flints generally known as eoliths.' . . . The ill-defined cones of percussion, and rough, heavily-truncated flake-scars of the Piltdown specimens stamp them indelibly as the work of pre-palæolithic man. . . . For the only implements found in the 'human' stratum and in intimate association with the Piltdown individual were the primitive edge-trimmed flints generally described as eoliths. . . . This particular type of implement represents, as has been shown in a former chapter, the earliest efforts of man to deliberately shape flints to his needs." He further points out that there would not appear to be any valid geological reason why the lower stratum of the gravel at Piltdown should not be a Pliocene deposit overlain by gravelly strata of more recent date, inasmuch as the Piltdown bones were found at about 120 feet above the present sea level and approximately 80 feet above the present level of the River Ouse, Sussex.

To test this significant statement, let us place side by side the published figures of the four flints actually found in the Piltdown gravels which hitherto have

[1]Moir, J. Reid. *Pre-Palæolithic Man*, 1920, pp. 1–67. Pls. I–XXIX.

Fig. 15. *A*—View of Piltdown Common showing at the right the hedge, at the side of which is the Piltdown gravel pit where the Piltdown skull was discovered. *B*—Roadway leading to Manor House, beside which the discovery was made. *C*—Manor House, at the end of the gravel road, the owner of which is deeply interested in further explorations beneath the roadway. *D*—Arthur Smith Woodward (right) and the present writer (left) standing on the heap of Piltdown gravel immediately above the spot where the skull was found. At this point it is proposed to erect a monument in memory of Piltdown Man

been broadly described as of pre-Chellean type (that is, earliest Chellean type), and four flints selected from those recently figured by Moir in his Foxhall collection, and see how they compare in the state of workmanship which they represent. In the writer's opinion, which is not that of a professional archæologist, the resemblance is very close indeed. It will be observed, even by the amateur, that both the Piltdown and the Foxhall flint implements are (1) fashioned from large flakes struck off from the side of the flint nodule, (2) that the outer or convex side of the flake is roughly worked with a varying number of blows, and (3) that there are a few solid core implements.

The five-fold *purpose* of the industry in the Foxhall mind seems to have been (as shown in the foregoing article page 572): First, to fashion pointed flake implements, which could be fastened to wood and used in the chase, for example, rough spearheads (page 572, numbers 12–19); second, somewhat larger pointed core implements, which could be used in the chase or in combat—crude anticipations of the *coup de poing* (page 572, numbers 13–45); third, flaked implements dressed on one side, with cutting edges, which could be used in bone or wood carving; fourth, oval convex implements suggesting the rostrocarinate as well as *grattoirs*, flat on one side, which could be used in the dressing of hides for clothing (page 572, number 17); fifth, a borer (page 572, number 21) for use in making holes in wood or bone. Hammer-stones used in the flint-flaking industry have been found at Piltdown only. All five of these types have been found at Foxhall, but only *three* in Piltdown, namely, the rough spearhead, the hide-dresser, and the hammer-stone. The *coup de poing* of pre-Chellean and Chellean times, namely, the 'hand stone,' fashioned from the flint nodule core itself, is foreshadowed in the Foxhall cores (page 572). Thus Moir's contention that the Foxhall Pliocene industry is prophetic of the Pleistocene industry of much more recent Chellean times appears to be well sustained. It follows that the identification of the Piltdown flints with the Foxhall flints, if it can be made by placing the implements side by side, may enable us to settle one of the remaining points of doubt about the 'dawn man,' namely, his geologic antiquity. Anatomists now agree that *Eoanthropus* is of a very ancient type, altogether such as we should expect to find at the very beginning of the Quaternary age of man or even in the Tertiary. The present writer came to the following conclusion in 1914[1]: "It seems reasonable, therefore, to interpret the Piltdown skull as exhibiting a closer resemblance to the skulls of our human ancestors in mid-Tertiary times than any fossil skull hitherto found." It was only the Piltdown flints, at that time mistakenly compared with those of pre-Chellean time, which led the writer to believe that the Piltdown man belonged in the Middle Quaternary, an opinion which he is now prepared to abandon.

In conclusion, the writer desires not only to recant his former doubts as to the association of the jaw with the skull, but to express his admiration of the great achievement of his life-long friend, Arthur Smith Woodward, in making the discovery and in finally establishing beyond question the authenticity of the 'Dawn Man' of Piltdown. We have to be reminded over and over again that Nature is full of paradoxes and that the order of the universe is not the human order: that we should always expect the unexpected and be prepared to discover new paradoxes. The confirmation of the reality of the Piltdown man as a veritable 'dawn man' must be followed by renewed and determined effort to fix more precisely his *geologic antiquity*, about which there has also been a great difference of opinion and on which the discovery of Foxhall man, described in the preceding article of this series, may have some bearing.

[1]Osborn, H. F. *Men of the Old Stone Age, Their Environment, Life, and Art.* New York, Scribner's, 8vo., Nov. 24, 1915, 545 pp., Pls. I–VIII, 268 text figs. Third Edition, 1918, pp. i–xxviii, 1–559, Pls. I–VIII, Figs. 1–275, map.

DID THE INDIAN KNOW THE MASTODON?

AN ACCOUNT OF THE DISCOVERY IN MISSOURI OF A BONE BEARING AN INCISED ELEPHANT-LIKE FIGURE

BY

JAY L. B. TAYLOR

Mr. Jay L. B. Taylor, a civil engineer of Pineville, Missouri, recently announced in *Science* the discovery of a number of decorated bones in a rock shelter, known locally as Jacobs' Cavern, situated on land that Mr. Taylor acquired not long ago in the extreme southwestern part of the state. One of these pieces of worked bone is of unusual interest because, as shown in the photographs accompanying this article, it bears a figure resembling a mastodon or a mammoth. In order to make this discovery known, Mr. Taylor has contributed the following brief narrative of his find. Last August, Dr. Clark Wissler, curator of the department of anthropology of the American Museum, visited Mr. Taylor and examined his collection and the cavern from which it came. At Mr. Taylor's request he has commented upon the cavern and the significance of the find.

Although the bone bearing what is presumably a mastodon or mammoth was found in April, 1921, the cavern containing it has been a site of interest to anthropologists for nearly two decades. In 1903 this cavern, which is only one of many rock shelters in the Ozark Mountains offering traces of prehistoric man, was excavated in part by Dr. Charles Peabody and Mr. Warren K. Moorehead of Phillips Academy, Andover, Massachusetts, who thereby directed attention to the archæological treasures of this region. In this excavation Mr. Taylor, then a young man, assisted and thus laid the foundations of an interest in prehistoric archæology that was later strengthened by the studies he pursued at Phillips Academy and that has been turned to such fortunate account in connection with the find below recorded. The photographs accompanying this article, as distinguished from the line cuts, were supplied through the courtesy of Dr. V. C. Allison.

LAST October the writer published in *Science* a brief notice of the discovery of engraved bones in the Ozark country near Pineville, Missouri. This announcement has brought many inquiries from interested readers, which I have thought could best be answered by a statement of the circumstances and conditions attending the discovery and by the reproduction of photographs and drawings showing the nature of the finds.

The discoveries were made in conjunction with my friend, Mr. Vance Randolph. Shortly after he became a resident of Pineville, I found that we had a common interest in prehistoric remains and I accordingly invited him to call at my ranch and examine Jacobs' Cavern and the collection I had taken out of it. On April 17, 1921, he visited me for the purpose and after he had inspected my collection, I took him down to the cavern. As we had in mind only a vague plan of casual and general inspection, with no intention whatever of conducting an extended exploration, we carried no digging implements. Upon entering the cavern Randolph's attention was immediately attracted by the numerous bone fragments strewn over the floor and we spent considerable time passing our fingers through the débris, bringing to the surface other bone fragments and occasional flint chips, and in discussing such points of interest as occurred to us. Thus it was that prodding around in the floor at random, we at last proceeded to examine a heap of débris at the rear of the cavern. [The reader is referred to the diagram accompanying this article. The region examined is below the upward-extending, finger-like fissure].

The dirt, ashes, and small stones here deposited in considerable quantity had originally reposed beneath the overhang of the rear wall of the cavern [the section on the diagram that resembles somewhat a bent thumb thrust into the solid area.] This débris had only recently been thrown out—some of it by hunters, tourists, and the like, I suppose, who dug through mere curiosity, and some by myself in an unsuccessful attempt to reach the extremity of the overhang. Flung out at random, this débris had piled up until it covered the stump of a stalagmite, the top of which had been shot off with dynamite—an operation that had been performed without my knowledge or consent.

Diagram of Jacobs' Cavern

In the absence of markings established in the exploration of the cavern in 1903, I rely wholly upon my memory of that exploration, in which I participated, and upon my familiarity with the cavern and with the map shown in Bulletin No. 1, "Exploration of Jacobs' Cavern," Department of Archæology, Phillips Academy, Andover, Massachusetts, 1904, by Charles Peabody and Warren K. Moorehead, when I identify this mutilated stalagmite as No. 4 on the above mentioned map.

An extremely wet season last spring resulted in the precipitation of considerable moisture through the fissure. In fact, on the day when Randolph and I were making our investigations there was a miniature stream of water dripping from the stalactite which hung directly over the stalagmite stump, while from other points along either side of the fissure other small streams dripped or trickled down upon the accumulation which had come from beneath the

A glimpse of the interior of Jacobs' Cavern.—The stalagmite stump, from the pothole of which engraved bones were recovered, is not shown but lies directly back, and to the right, of the large light-colored stone on the extreme right of the picture. This stone is itself one of the fragments of the dynamited stalagmite. The large stone, in a corresponding position on the left of the picture, is a slab that has fallen from the roof of the cave. To the left of this slab, in an area not visible in the picture, was sunk the shaft to which Dr. Clark Wissler makes reference in his letter at the close of the article

OBJECTS OF HUMAN WORKMANSHIP FOUND IN JACOBS' CAVERN

These line drawings were made by Mr. Vance Randolph, the co-discoverer, on the evening of the day that the objects were unearthed. This pictorial record is a valuable piece of evidence, for disintegration of the bones speedily set in and ultimately all were thus destroyed except the topmost bone, which, however, is most prized of all, for this is the bone that bears upon it the engraved elephant-like figure

On the walls of some of the European caverns, like that of Combarelles and of Font-de-Gaume, are representations of mammoths, proving that these creatures were known to early man in the Old World. What seems to be evidence that in the New World, too, early man knew the mammoth or the mastodon is furnished by the incised figure on the recently unearthed bone represented above

over-hang, until in most places there was more or less mud and muck. Having finished groping around in this mud, I turned to wash my hands in the stream of water falling toward the stalagmite. The volume of water was, however, insufficient to remove the mud and I started, accordingly, to scoop out a small basin that would impound enough water for my use. But in doing this I uncovered the calcaneum bone [represented by Fig. 5, p. 593] of a ruminant, and having casually wiped away the mud, as we had been doing with the bones taken from the muddy area, I was surprised to find that the lower end had been perforated. Having assured myself that the perforation was apparently of human origin, I called Randolph's attention to it and to the fact that I had never before found such a specimen in the cavern. Digging farther we found that the top of the stalagmite had been shot out in the form of a pothole of possibly two gallons' capacity, and from the mud and water in this we soon took three other perforated calcanea, a perforated and notched spinous process of a dorsal vertebra, a perforated metatarsus, a portion of a perforated and engraved humerus (bearing the "mastodon"), of ruminants; a small slotted and notched scapula, evidently of a rodent. In addition to these bones our collection included a mussel shell with two perforations.

Naturally our chief interest centered about the "mastodon," for we straightway concluded the carving was supposed to represent this creature, and after we had somewhat recovered from our excitement we took the bones down to the creek and gave them a thorough wash in clean water.

Every specimen was apparently sound and at that time there was not the least evidence, so far as we could ascertain, of disintegration. Feeling, however, that we had made a discovery of more than ordinary importance, and that the bone bearing the "mastodon" must necessarily be of great age, we discussed the advisability of making drawings and photographs of the specimens and finally concluded to adopt such measures in order to have a record of our findings in the event that they might through some unforeseen chance be lost or destroyed. Accordingly, late that same evening, Randolph made line drawings, natural size, of each piece. I regret that I neglected to have photographs made immediately but can excuse such neglect to a slight extent by explaining that further examination of the bones did not create in me much apprehension as to their condition.

Another view of the bone showing additional carvings. This bone was rescued from threatened disintegration by being boiled in hot paraffin. It was subsequently incased in a block of paraffin and kept thus until it could be inspected by Dr. Clark Wissler, of the American Museum. The finding of this bone should be a stimulus to further systematic investigation of the floor of Jacobs' Cavern

Subsequent desultory exploration failed to result in further similar discoveries if one except that of another perforated metatarsus, which I picked up a day or two later, probably some three feet from where the other bones had been found.

In the interim it had occurred to me that possibly I had been made the victim of a hoax. Amateur archæologists—professionals, too, for that matter—are regarded in this locality as legitimate prey upon whom to foist all sorts of fakes and "relics." The bones were apparently as sound as could be when I placed them in my cabinet. This puzzled me because I knew that if a prehistoric artist had actually made the carvings with the idea in view of depicting a "mastodon," at least that particular bone must necessarily be of great age and should, therefore, be quite fragile. Furthermore, as these bones had come from such a restricted area, having probably all been thrown out together from under the overhang, I was not long in concluding that they had probably at one time formed a necklace and were, therefore, practically of the same age.

Both Randolph and myself communicated with various institutions in attempts to secure professional opinions concerning our find. The officials of several such institutions replied by suggesting that the bones be donated to their own museum and some requested permission to publish an account of the discovery. However, I declined all requests for permission to publish and insisted that nothing be given to the press at that time. I had no desire to be severely ridiculed if the "relics" proved to be fakes, nor did I wish to foist any frauds on the public. I felt, however, that the scientific world was entitled to a full account of the discovery in the event that competent authorities pronounced the handiwork as of genuine prehistoric origin, and I anxiously awaited the arrival of Doctor Wissler, who, I had been advised, would try to examine both the cavern and the bones about the middle of August.

Meanwhile, professional duties had prevented me from making frequent examination of my collection and when I did at last find time to re-inspect it, I was dumfounded to observe that disintegration was rapidly destroying my latest acquisitions. I immediately coated them with hard oil—the only thing at hand which in my opinion would exclude the air—but this failed to harden as it does on lumber, and disintegration progressed apparently unchecked. Having been advised by professional authority to use hot paraffin, I telephoned Randolph to hurry out to the ranch and to bring with him some paraffin. That afternoon he gave the remaining bone a thorough boiling in that preservative. A short time afterward I encased the bone in a block of paraffin, where it remained until melted out for Doctor Wissler's inspection on August 18. When this bone was freed of its paraffin envelope, a few small fragments broke off around the perforation but in the main this bone appeared to be fairly well preserved.

Along with the bones the mussel shell also completely disintegrated, so that at this time, of the nine objects mentioned, only the perforated and engraved humerus remains.

My loss of these specimens was, however, compensated for in a manner by the relief I felt concerning the origin of the handiwork displayed on the humerus. It seemed, and so appears to me yet, that recent carving would be impossible on a bone so old that disintegration would result soon after exposure to the air. Personally I feel that up to this time developments justify my faith in the genuineness of the handiwork. However, I do notpretend to be more than the veriest amateur and if competent scientific examination disproves my conclusions, I shall be only too glad to admit my error in judgment.

In corroboration of the above I quote a statement prepared at my request by Mr. Vance Randolph in November, 1921, and mailed from the University of Kansas:

"On April 17, 1921, I was a guest at the Taylor ranch, and Mr. Taylor showed me the collection in his den. I expressed a desire to see the cavern itself, and we went down and began to scratch about with sticks along the northeast wall. Mr. Taylor soon dug up a mussel shell with two round holes in it, and a few minutes later, fumbling about in a little wet spot under a roof-drip, I unearthed a piece of bone about 4½ inches long, notched, pierced, engraved, and polished [represented by Fig. 2 p. 593.] Mr. Taylor then sat down beside me, and we clawed with our fingers in the ice-cold mud and water until we had altogether 8 pierced, polished bones, one of which bore the engraving which we thought resembled a mammoth or mastodon. These bits of bone were all found very close together (a 15-inch circle would have enclosed them all, I think) and between 4 and 12 inches below the surface. A few inches lower we struck a solid rock, which Mr. Taylor said was the stump of a stalagmite that had been blasted off some years before. We washed the specimens in a little creek, and that evening measured them and made several sketches of each.

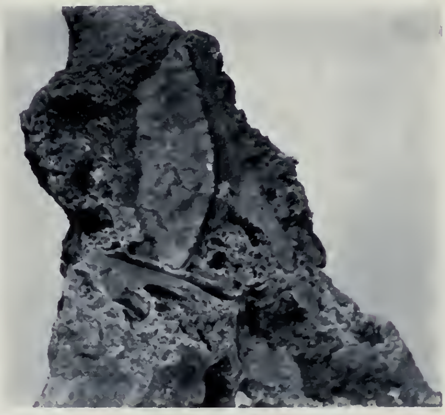
"Some three weeks later Mr. Taylor told me that 7 of the bones had completely disintegrated, and that he had coated the one bearing the mastodon carving with varnish. On June 13, 1921, Mr. Taylor had the specimen photographed, and immediately afterward we boiled it for two hours in hard paraffin. Later on Mr. Taylor embedded it in a solid block of this material, in which it remained until Dr. Clark Wissler visited the cavern Aug. 17, 1921."

I have the privilege of submitting the following memorandum from Dr. Clark Wissler who visited the cavern in response to my invitation:

"The opportunity afforded me by your hospitality to examine the carved bone found by you and the privilege of exploring further in the cave, in the company of Mr. Randolph, Dr. Vernon C. Allison, and yourself, is greatly appreciated. Jacobs' Cavern has long been known to us through the report of Peabody and Moorehead and has frequently been cited as one of the possible type stations for early man in America. It is, therefore, of unusual interest to know that this site is by no means exhausted, but still rich in data. The question your find raises is whether the person who made the sketch on the bone that has been preserved saw a mastodon or mammoth. This cannot be answered positively, but the probabilities of the case can be estimated. In the first place, the work is of the primitive stamp and such as we might expect from the hand of an American native. It so happens that upon these bones at least three attempts were made to represent living forms, ap arently by the same artist. Two of these forms have the distinctive lines of elk and deer, while the lines of the third characterize elephant kind. This favors the interpretation that an elephant, mastodon, or mammoth was intended.

"At once the objection will be raised that the bone is recent. Though the mastodon and the mammoth are characteristic of Pleistocene time, it is not known when they became extinct; for all that is known to the contrary, these great mammals may have held out to within three thousand years ago. Thus, the artist could have seen one of these animals and still have lived under modern conditions. No one in authority seems now prepared to deny that man was in America three thousand years ago. In other words, there is nothing zoölogical that makes your interpretation improbable. We must, therefore, turn to the cavern itself.

"It appears that this bone was found in the present surface of the cave, but approximately five feet of deposit were taken out by Moorehead in 1903; hence, this bone is older than anything found by him. When we recall that both Peabody and Moorehead were impressed with the great age of what they removed, the evidence is again favorable to your interpretation. Also, there are still in the cavern almost five feet of deposit, in the main clay, through which you were so kind as to sink a shaft in my presence. This excavation indicated the presence of man's handiwork in all parts of this deposit, one piece of worked stone being found at the very bottom of the shaft, lying flat upon the original stone floor of the cavern. One must conclude, therefore, that there are remains in the cavern that are of even greater age than the bone in question.



A fragment of the dynamited stalagmite found in the cavern with an implement of early man imbedded in it. From time to time stalagmites have in this way carried down to the present the records of the past. A stalagmite containing the preserved impressions of moths' wings was some months ago discovered in the Cheddar district in England. Each layer of the stalagmite showed a number of these fossils, and it has been assumed that the wings were rejected by bats while feeding upon the insects

"In general, then, I regard this site as one of the most important yet discovered and one demanding further investigation. Regardless of what may ultimately prove to be the significance of this carved bone, you have made a discovery of great promise. I assure you of my appreciation of your confidence, in extending an invitation to make further excavations in this deposit and its surroundings.

"So, pending the examination of the site, as indicated above, no further comments seem necessary. The writer will do everything he can to further this investigation to the end that the complete story of Jacobs' Cavern may be revealed. It is to be hoped that at last we are on the trail of early man in America."

URUS AND BISON

BY

W. D. MATTHEW*

THE American Museum has recently acquired a fine skull and jaws of the urus, or extinct wild ox of Europe, and an incomplete fossil skull of the almost extinct European bison. These valuable fossils were obtained from the Cambridge Museum of Zoölogy in an exchange arranged through the good offices of the curator, Mr. C. Forster Cooper, who was one of Dr. William K. Gregory's palæontological students, and who since his return to England has been a very good friend of this Museum.

The remains of the gigantic wild oxen are not uncommon in Europe. The finest specimens have been found in England, in the draining of old marshes or fens, especially in the eastern counties, in clay pits and bogs, less often in caves. The skull acquired by the Museum is from Burwell Fen, near Cambridge. A fine series was found in the Ilford brick clays in Essex, of which the largest skull now in the British Museum, is 914 mm., or about three feet in length. Other fine skulls and skeletons have been found in Germany, the Netherlands, France, and Italy, as far north as Scandinavia, as far east as central Russia.[1]

The name, *Bos primigenius*, was given to the fossil species of wild ox many years ago by Bojanus. This animal has been commonly regarded as a subspecies or race of the domesticated cattle, representing in a general way, at least, the primitive stock from which our domestic cattle are descended, and as being the urus or aurochs of Roman and mediæval writers. The earliest historical account of the urus is given by Cæsar in his *Commentaries on the Gallic War*. He found them, or more likely heard of them, in the great Hercynian forest, which in his day stretched from Switzerland to the east and north across central Europe. As Cæsar's account appears to be the basis of most of the later references to this animal, and as it is an interesting example of the natural history of his time, it is worth while to give a translation of the entire passage,[2] which reads as follows:

"This Hercynian forest, mentioned above, extends for a width of nine days' journey made with light equipment, for in no other way is it possible to reach the end of it or to know the distance traveled. It begins at the territory of the Helvetii, Nemeti, and Rauraci, and stretches along the Danube valley to the country of the Dacians and Anarti; thence it swings to the left away from the river country and on account of its vastness reaches to the confines of many nations; nor is there anyone in this part of Germany who claims either to have attained the borders of this forest even in a sixty days' journey, or knows where it ends. Many kinds of wild beasts exist in it which are not seen elsewhere; among which those that differ most from others and appear most worthy of note are the following:

"There is an animal that looks like a deer, and bears a single horn on the middle of its forehead, between the ears, longer and straighter than the horns which we know. From the top of this horn branches like palm leaves spread out widely. The male and female

[1]NEHRING. 1896. *Landwirtsch. Jahrbuch*, Vol. XXV, p. 915 (1896).
WILCKENS. 1885. "Die Rinder des Diluviums und der Pfahlbauten." *Biol. Centralbt*, V. 79–95, 109–123.
LYDEKKER. 1898. *Wild Oxen, Sheep and Goats of All Lands.*
LYDEKKER. 1903. *Mostly Mammals.*
WINGE. 1904. "Om jordfundne pattedyr fra Danmark." *Vidensk. Meddel. naturh. Foren. Kjob.*, pp. 286, 299, pls. xii, xiii.
WINGE. 1906. "Om Uroxen fra Vig." (with N. Hartz). *Aarb. Nord. Oldkynd. og Hist.*, 1906. pp. 225–236, pl. i and 2 text figures.
DUERST. 1904. "Die Tierwelt der Ansiedelungen am Schlossberge." *Archiv. f. Anthrop.*, N. F., Bd ii, s. 241–257 u. Tafeln.
BOULE. 1910. *Les Grottes de Grimaldi*, t. I, fasc. iii, pp. 234–236.
PAVLOW. 1906. "Etudes sur l'Hist. Pal. des Ongulés, pt. ix, Sélénodonts Post-tertiaires de la Russie." *Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg*, viiie Série, Vol. xx.

[2]*Commentaries on the Gallic War.* Book VI, chapters 25–28.

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are alike in appearance and have the same size of horns.

"There are also what are called Alces. These are very much like goats as to their form and their dappled skin; but they are somewhat larger, have no horns, and their legs have no knuckles or joints; they neither lie down to sleep nor, if by accident they fall down, can they arise and get on their feet again. They use trees for their resting place; against these they lean, and thus reclining only a little they take their sleep. When the hunters discover from the tracks the places where they are thus accustomed to rest, they either loosen all the trees at that place about the roots, or cut the trunks nearly through and leave them standing. When the animals come according to their custom to take their rest, their weight topples over the weakened trees, and they fall down along with them.

"The third of these animals is the kind that is called urus. These are in size a little less than elephants, in appearance and color and form they are bulls. Great is their strength and great their swiftness; they spare [refrain from attacking] neither man nor beast whom they have perceived. These they [the Germans] take pains to catch in pits and kill. With such labors they harden their young men, and exercise them in this kind of hunting; and he who has killed the largest number, the horns being exhibited as proof, receives great praise. But they are unable to tame them for domestic use, even when caught young. The horns differ widely in size, form, and appearance from those of our domestic cattle. They are diligently sought after, ornamented with silver bands around the rims, and used for cups at their most magnificent banquets."

Cuvier[1] identified the first of these three animals as the reindeer. Possibly it was; but if so, Cæsar must have misunderstood the accounts given him of its characters; and it can hardly be taken any more seriously than the unicorn or the lamia. The second animal, which he calls Alces, is usually regarded as the elk; but except for the name the

[1]*Ossements Fossiles*, 3e Ed., t. IV, p. 57.

description is quite at variance with the real European moose or elk.[1] It is quite likely indeed that Cæsar's account is the real source of the mediæval tradition that the elk had no joints in the legs. Pliny repeats it, along with some other even more impossible stories,—that it was so swift that it could not be caught except in the manner recited; and that its nose was so long that it had to run backward all the time for fear of breaking it off against the trees,—and it seems much more likely that the jointless leg story was handed down via classical and monkish tradition in writing than that it came through early Teutonic folklore channels.

The third animal, the urus, has much more appearance of authenticity. If it was, as generally supposed, the same as the prehistoric *Bos primigenius*, its size is considerably exaggerated. Cæsar had perhaps seen the gigantic horns, and from that judged of the size of the animal. Whether the name urus was a Latinized form of an old Teutonic name, auer-ochs or ur-ochs, which survived also and independently in Teutonic speech and tradition until we pick it up again a dozen centuries later in mediæval records, or whether the mediæval aurochs is not rather a Germanized form of the Latin name for the beast, handed down not through Teutonic but through classical and monkish tradition, is not easy to decide. The later accounts, both Roman and mediæval, are obviously borrowed in part, if not wholly, from Cæsar's statements. It is said by some classic writers[2] that the animal was exhibited in combats of wild beasts in the Roman arena; but if so, it is singular that those who have recorded

[1]It is, in fact, nothing more than another "fabulous monster," as Alice would call it. The explanations current, that "Cæsar saw only the female" and that "the length and awkwardness of the elk's legs suggested their having no joints," are quite unable to make real natural history out of the account. Cæsar did not profess to have seen the animal, but his informants did profess to be familiar with it. And while the moose has long legs and some awkwardness of gait, it does not look in the least as though the legs had no joints. I may add that the story is found in much older Greek authors, and if I remember rightly, taken by them from Persian sources.

[2]Pliny, *Natural History*.

the fact had no further knowledge of the animal than they would have obtained from Cæsar's *Commentaries.* The statement may be explained by the fact that in later classical and mediæval times the urus was confused with the European bison and with the "bubalus," properly speaking the Indian buffalo, but also applied to a large African antelope. In the *Nibelungenlied* we hear of the hero Siegfried slaying the urus in a great hunt at Worms:

Darnach schluch er schiere einen Wisent und einen Elch
Starker Ure vier und einen grimmen Schelch.

Here again the name follows closely the term used by Cæsar, and since the animal is not mentioned (so far as I know) in the older and more authentic Scandinavian sagas, where, if surviving in Germany at this time, it should surely have also found place and mention, one may suspect that the urus has slipped into the *Nibelungenlied* along with various other fragments of classical tradition which the poem embodies. Without going into any detailed, critical examination of the "historic" records of its survival, we may conclude provisionally that Cæsar's account is the only classical one that need be taken seriously. While the other animals that he associates with it must be dismissed as mythical, the description of the urus was apparently based upon some real knowledge of the animal, probably of the gigantic horns. These might well account for his exaggeration of the size of the creature itself. The skulls in some British examples of the *Bos primigenius* are nearly three feet long and the horn cores not only long but exceedingly massive, with a peculiar curvature, outward, upward and inward, unlike the comparatively slender, spirally-twisted, out-pointed horns of the modern long-horned Spanish breeds from which our Texas long-horns are derived. The fossil skeletons, however, are not so gigantic as one would suppose from the size of the skulls and horns. They are not much if at all larger than some large modern domestic breeds.

Cæsar's account has been confirmed in an interesting way by the excavation a few years ago in Swabia of two statuettes of Roman age, representing the bison and the urus respectively.[1] So at least Lydekker reports; but an examination of Fraas's paper shows that there was no real evidence either of the Roman age of these statuettes, or that the one identified as aurochs (urus) really represents that animal rather than the domestic species.

If the urus survived in the German forests to the time of Cæsar, there is no inherent improbability in its surviving ten or fifteen centuries later. The later classical and mediæval references to it can hardly be cited, however, as conclusive proof that it did so. Some are mere references by name, and have no more significance than some modern poet's mention of mermaids or fairies. Such references do not mean that the writer actually believes in their existence, still less that he has seen them or knows of their existence. It is ridiculous to cite such casual allusions as scientific evidence of the survival of the urus at the time of the writer. Other notices show internal evidence of being merely based upon Cæsar's description. They convey the same items of information about the urus—no more—and are couched mostly in the same words and phrases. Such precise agreement is like the unduly close agreement of the testimony of two witnesses in a case at law. It does not serve to confirm the truth of their story but indicates that it is not independent witness, the stories having been agreed upon in advance, or one copied from the other. Mediæval records, it must be remembered, were written mostly by monkish writers, or by those who had been educated in the convents. All these writers, religious or secular, were more or less familiar

[1]Fraas. 1899. *Fundberichte aus Schwaben.*

THE URUS OR EXTINCT WILD OX CONTRASTED WITH THE MODERN COW

The urus or aurochs (the upper skull) was undoubtedly hunted by prehistoric man in Europe, stone weapons having been found imbedded in, or associated with, fossil skeletons of this animal. It may even have survived into historic times, for it is mentioned by Cæsar in his *Commentaries on the Gallic War*, and with more evidence of authenticity than is shown in his fantastic descriptions of certain other wild animals. The skull of the urus above depicted, now on exhibition on the fourth floor of the American Museum, presents a more massive appearance than that of the domestic cow, reproduced below it, but it is an exaggeration to assume, as does Cæsar, that in size these extinct oxen were "a little less than elephants"

THE EXTINCT EUROPEAN BISON COMPARED WITH THE MODERN AMERICAN BISON

Compared with the extinct *Bison priscus* of Europe—an incomplete skull of which, recently acquired by the American Museum, is shown in the upper part of this plate—the modern American bison (represented by the lower skull) is a degenerate creature. The skull of the extinct European bison was taken from the older Pleistocene gravels of Great Barrington, near Cambridge. At that period of geologic time, hippopotami, straight-tusked elephants, and other species of a warm, temperate climate ranged far to the northward through England, France, and Germany. Notwithstanding the impressive spread of horns in this extinct European bison, the finest development is reached in the species from the Pleistocene of North America with the Latin language and literature, and inherited the classical traditions. Most of their natural history was learned from Pliny, who in this instance copied from Cæsar. Their references to the urus and bison, or ur-ochs and wisent as they would Germanize the words, may well have been based upon that Roman tradition, with respect to the facts as well as the words, rather than upon any real contemporary evidence. This is so obviously true with respect to many other matters that they have put upon record, that one may be excused for declining to class such "records" with the unmistakable facts of actual specimens.

There is one mediæval record which is really authentic, eye-witness testimony. Baron Herberstain in 1550 published a book on his travels in Muscovy, in which he describes and figures a race of wild cattle, which he calls the aurochs or urus, as existing in the great forests of Poland. He obtained and brought home specimens, and there is no question that his description and figure refer not to the bison but to a race of wild cattle. If the animal he describes is identical with the fossil *Bos primigenius*, as is believed by Nehring, Lydekker, and other authorities, it would finally settle the question of survival. Herberstain's figure, however, is not characteristic. It might represent a small-horned and small-headed *primigenius*—and many such specimens have been found in eastern Germany and Russia, where the prehistoric race did not attain such magnificent proportions as it did in England; or it might represent a feral race of cattle, like the wild cattle preserved in certain English parks. The color of Herberstain's aurochs was black; the park cattle, still existing at Chillingham, Chartley, Lyme, and one or two other localities in Great Britain, were white. Although they were generally regarded a century ago as being descendants of the urus, it has been shown that this is impossible, because in the first place they are an albino race and in the second place there is pretty clear evidence that the aurochs had become totally extinct in England before Roman times, and finally they have no characteristic resemblance to the prehistoric *Bos primigenius*.

Of actual relics or specimens showing the survival of the urus into the historic period there appear to be very few if any. Buffon describes two aurochs horns as preserved in his time, one at Strassburg, the other at Saverne in Alsace. The first, because of its slenderness and spiral curve and for other reasons Nehring dismisses as probably the domestic species; the second he thinks probably really was *primigenius;* but both have disappeared since the French Revolution; and a pair of horns, traditionally of the urus, which used to be carried in processions in the canton of Uri, Switzerland, have also disappeared. In fact, there is not, according to Lydekker, a single authentic relic today of an aurochs killed within the historic period.[1]

The numerous Roman remains in Great Britain have been carefully studied, and no trace of the urus is found among the animals recorded therein. It must, therefore, have been extinct or practically so within the areas of Roman occupation, although it is abundantly found in the preceding prehistoric stages. In Scandinavia it is found abundantly with the Stone Age remains, but is absent in the succeeding Bronze, Iron, and Mediæval stages of culture. In Germany and France it is in general also confined to the Stone Age remains, but there is at least one specimen, a skull described by Nehring from Bromberg, which probably dates as late as early Mediæval time, and if correctly identified as *Bos primigenius*, would prove the late survival of this species. Here also there is considerable doubt as to the identification.

There is no question that the wild ox was hunted by prehistoric man. A skull from Burwell Fen has a stone weap-

[1]Lydekker, 1903. *Mostly Mammals*, p. 295.

MODERN EUROPEAN BISON

One of the probable victims of the Great War and its aftermath—a victim whose extinction has been heralded so little that there is still a lingering doubt as to its actual accomplishment,—is the European bison, which, at least up to the time of the war, had survived in the forests of Lithuania and the Caucasus. If the reports of its extinction in the wild state are well founded, the only living representatives of this animal are the few that are caged in zoölogical gardens. The fine picture shown above is one of many impressive photographs of animals contributed by Mr. Gambier Bolton, F. Z. S., to a volume entitled *All About Animals, for Old and Young*, published by George Newnes, Ltd., of London on buried in its forehead; a skeleton from Vig in Denmark has both fresh and old wound-scars on the ribs and with it were found three stone spear-points; these are but two out of many instances of this kind. While thus abundant in the earlier and later Stone ages, it seems to have disappeared before the spread of civilization, surviving as a wild animal only in the great forests of central Europe.

If, as Nehring, Lydekker, and other authorities maintain,[1] this species was really the ancestor of our domestic cattle, it has of course survived in a reduced and degenerate form. If, on the other hand, the successive races that have invaded western Europe brought with them their own domestic animals, instead of attempting to tame the wild cattle that they found inhabiting the country,[2] we may better regard the urus of western Europe as an extinct species, or race of *Bos primigenius*, that reached its finest development in western Europe in prehistoric times, and became extinct without affecting to any great degree the blood of the domestic races of cattle, which would be derived from distinct geographic races or subspecies inhabiting eastern Europe or Asia. In this respect it would parallel, as Owen has observed, the bison of America, which has disappeared before the white invaders without being to any extent domesticated or influencing the blood of the domestic cattle that they brought with them. Owen's view seems to me far more probable. The invading tribes from Neolithic times onward certainly had domesticated cattle, and it would be much simpler and easier to bring them along than to undertake over again the processes of taming and selective breeding from wild races.

Against this view that the prehistoric invaders of Europe brought with them their domestic cattle from their original eastern homes, it has been objected that there are no true taurine wild cattle in Asia, the wild races being all of the bibovine or zebu group. This is true today, but it is significant that in the Pleistocene of India has been found a fossil species of this taurine group, *Bos namadicus*, closely allied to the urus and our domestic cattle. This fact indicates that the taurine group did inhabit Asia in the Pleistocene and there seems to be every probability that domestic cattle are derived from it rather than from the wild aurochs of western Europe. The latter, then, would be a wild species or race that reached its finest development in prehistoric times, in Great Britain, France, and Germany, survived probably to Roman and possibly to Mediæval times in the forests of central Europe, but is now wholly extinct.

The incomplete skull of an extinct European bison obtained from the Cambridge Museum and alluded to at the beginning of this article, has the horn cores nearly perfect and finely preserved. This specimen is from the older Pleistocene gravels of Great Barrington, near Cambridge. Unlike the urus, the European bison still exists, in a wild or half wild state in the Caucasus,[1] and in various private or public parks and zoölogical gardens; but the modern species is a degenerate descendant of the great *Bison priscus* of the Pleistocene. It is a near relative of the American bison, somewhat less striking and peculiar in its characters, and like the urus it was common throughout Europe in prehistoric times. This is the bison of the Romans, the wisent of early Mediæval times; and it appears that after the disappearance of the true urus, the name of aurochs (auerochs = ? ur-ochs) was transferred to the bison, which is very commonly but mistakenly called by that name.

While the true wild cattle reached

[1]Nehring. 1896.
Lydekker. 1898. *Wild Oxen, Sheep and Goats of All Lands*, pp. 15–18.

[2]Owen. 1846. *A History of British Fossil Mammals*, pp. 491–515.
Duerst. 1904. *Archiv. f. Anthropologie.*

[1]That is to say, it was existing in the Caucasus before the Great War. It is reported that all the Russian bison have been killed off since the war.

their finest development in western Europe in the magnificent urus and never reached the New World, the largest and finest bisons are the species from the Pleistocene of North America, especially the great *Bison regius*, whose head is in the American Museum collection and whose splendid proportions are depicted by Mr. Knight in the mural painting in the Hall of the Age of Man.

The skull of *Bison regius*, the great, long-horned bison of the Pleistocene of North America, which is shown in the upper part of this plate, is believed to be the largest and most complete skull of this animal that has ever been found. It is exhibited on the fourth floor of the American Museum. The spread of the horn cores, from tip to tip, is 5 feet, 10 inches. By way of contrast there is reproduced in the lower part of the plate the skull of the existing American bison. The *Bison regius* inhabited the United States during later Pleistocene time, along with the mammoth, the mastodon, and the great ground sloths

RAINS OF FISHES

BY

E. W. GUDGER*

DO FISHES fall in rain from the sky? To this question both the layman and the scientist are well-nigh unanimous in giving a negative answer. Recently a level-headed business man and experienced angler grew almost indignant at being asked such an absurd question, and at least one scientific man of my acquaintance has expressed himself equally strongly.

My attention was first called to this subject about eleven years ago on reading De Kay's account quoted on p. 612 of this article. It was again forcibly called thereto on my perusing McAtee's excellent article (p. 617), in which a considerable number of falls of fishes is recorded. And lastly, my work during the last two and a half years as associate editor with Dr. Bashford Dean of Volume III of the *Bibliography of Fishes*, now being brought out by the American Museum of Natural History, has, with the completion of the latter part of the synoptic index, brought to my hand all the known literature on the subject. This is herein set forth in the form of chronological excerpts, that the reader may have the evidence before him.

THE ACCOUNTS

Our first and oldest account of a rain of fishes is found in *The Deipnosophists or Banquet of the Learned* of Athenæus of Naucratis in Egypt, who flourished at the end of the second and the beginning of the third centuries, A. D. This learned work, first published in 1524, is a compilation of extracts from more than eight hundred classical authors, most of whose works are no longer extant and would be forever lost but for the book of the Deipnosophists. It is written in the form of a dialogue, and in Volume II of Yonge's translation, in a chapter entitled "De pluviā piscium," we read on p. 226:

"I know also that it has rained fishes. At all events Phœnias, in the second book of his *Eresian Magistrates*, says that in the Chersonesus it once rained fishes uninterruptedly for three days, and Phylarchus, in his fourth book, says the people had often seen it raining fish."

The next account is contained in a letter from Robert Conny published in the *Philosophical Transactions of the Royal Society of London* in 1698. Conny did not see the phenomenon nor specimens of the fishes, but had his account from a person who seems to have had his confidence. The account in question is as follows:

"On Wednesday before Easter, Anno 1666, a pasture field at Cranstead near Wrotham in Kent, about two acres, which is far from any part of the sea or branch of it, and a place where are no fish ponds, but a scarcity of water, was all overspread with little fishes, conceived to be rained down, there having been at that time a great tempest of thunder and rain; the fishes were about the length of a man's little finger, and judged by all that saw them to be whitings, many of them were taken up and shewed to several persons; the field belonged to one Ware a Yeoman, who was at that Easter-Sessions one of the Grand Inquest, and carried some of them to the Sessions at Maidstone in Kent, and he shewed them, among others, to Mr. Lake, a bencher of the Middle Temple, who had one of them and brought it to London, the truth of it was averred by many that saw the fishes lie scattered all over that field, and none in other the fields thereto adjoining: The quantity of them was estimated to be about a bushel, being all together."

In Volume V of Hasted's *History of Kent*, published in 1798, just one hundred

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years after the preceding, is found the following account of the same fall:

"About Easter, in the year 1666, a pasture field in this parish, which is a considerable distance from the sea or any branch of it, and a place where there are no fish ponds but a scarcity of water, was scattered over with small fish, in quantity about a bushel, supposed to have been rained down from a cloud, there having been at that time a great tempest of thunder, hail, wind, etc. These fish were about the size of a man's little finger; some were like small whitings, others like sprats, and some smaller like smelts. Several of these fish were shown publicly at Maidstone and Dartford."

Raphael Eglini, in the *Wittenbergischen Wochenblatt* for 1771, reports an alleged rain at Cotbus on the midnight of September 2-3, during a heavy thunderstorm. He did not see it, but a number of the fishes, 5-6 inches long, which were said to have fallen, were sent to him. Although the account was attested by various friends, Eglini was doubtful. He suggested that these fish, if identical with those found in the neighboring streams, might have been carried to Cotbus by a waterspout or an overflow. Here, in the third recorded account of a fall of fishes, it may be noted that the correct explanation of the cause of the phenomenon is alleged.

In a later number of the same journal for the same year, Eglini discusses the accounts of this same *Fischregen* supplied by other correspondents. One of these had collected some of the fish at Luckau, a near-by point, which he sent to Eglini. These Eglini found to be specimens of a trout found in the Mark and in Schleisen (but by inference not very near Cotbus); whereupon he at once pronounced the matter as incredible, especially as he had a letter from another gentleman who was out in that very storm and saw no fishes fall with the rain.

John Harriott in 1809 recounts, presumably from his own observation, the following phenomenon:

"In a heavy shower of rain, while our army was on the march, a short distance from Pondicherry, a quantity of small fish fell with the rain, to the astonishment of all. Many of them lodged on the men's hats; when General Smith, who commanded, desired them to be collected, and afterwards, when we came to our [camping] ground, they were dressed, making a small dish that was served up and eaten at the general's table. These were not *flying fish*, they were dead, and *falling* from the common well-known effect of gravity; but how they ascended, or where they existed, I do not pretend to account. I merely relate the simple fact."

In the *Annals of Philosophy* for 1816 is found the following account, in a section presumably from the pen of the editor, Thomas Thompson:

"In Prince of Wales Island, in the East Indies, the inhabitants usually catch the rain-water in tanks placed on the tops of their houses. Frequently these tanks are completely dry for weeks together. When the rainy season comes, they are speedily filled with water. Some fishes are found swimming about in this water, which gradually increase, and acquire the length of several inches. I have been told that the same thing happens in Bengal. These fishes must come down with the rain. It is a matter of some curiosity to be able to explain the source from which these animals are derived. . . . My information was obtained from an East India Captain, who assured me that he had seen the fishes frequently, though he was ignorant of their name, and could not describe their appearance with sufficient precision to enable us to make out the species."

In Rees's *Cyclopædia*, Volume XXX, 1819, under the heading, "Rains—Preternatural," it is stated that after a very heavy storm, which blew down trees, houses, etc., the streets of a town near Paris were found covered with fish of various sizes up to five or six inches long. Everyone agreed that they had fallen from the clouds brought in by heavy winds. It was noted later that fish ponds in the neighborhood were empty of all but large fish, the small ones having presumably been carried out over the city.

We next come to the classical account given in 1823 by Alexander von Humboldt of the eruption of Mt. Carguairazo, north of Chimborazo, which in 1698 covered the surrounding country to the extent of about forty-three square miles with mud and fishes. Furthermore, he tells us that seven years before the event referred to, the volcano Imbaburu had thrown out so many fishes that these on decomposing caused a fever which devastated the town of Ibarra. The fish in question was a singular catfish to which was given the name *Pimelodus cyclopum*. The causes active here were, however, entirely different from those producing the other rains of fishes referred to in this article, the agencies being earthquakes and volcanic eruptions, which hurled the waters of lakes with their fishes high into the air.

In the *Edinburgh New Philosophical Journal* for 1826 are found several accounts of falls of fishes in Scotland. The first is a reference to Andrew Symson's "Large Description of Galloway," which was written in 1684 but not published until 1823. Symson says that a shower of herring was seen to fall in Galloway some sixteen miles from the sea but not far from the water of Munnach. He did not see this himself, but says that it was reported by credible witnesses and that some of the fish were said to have been carried to the residence of the Earl of Galloway and exhibited to him.

Next are the accounts, by the Rev. Colin Smith, of Appin, of falls in Argyllshire, Scotland, which read as follows:

". . . the testimony of many has enabled me to ascertain that a shower of herring fell in Lorn, about the year 1796, yet I have not met anyone who could inform me of the particulars concerning it.

"In the same district, and near the same place, on a small eminence above Melford House, a shower of herring fell in 1821, in every respect so large and good, that the tenants by whom they were found were induced to send some of them to their landlord, then residing in Edinburgh. In regard to the state of the weather, I could learn no more than that it was exceedingly boisterous; while the hill on which they were found is exposed to the southwest wind, which blows along Loch Milford, an arm of the sea in which herrings are frequently found.

"In the month of March, 1817, strong gales of wind from the north were experienced in Appin. Upon the evening of the second day of their continuance, rain fell in abundance; and next day being very warm and sultry, some children observed a large quantity of herring-fry scattered over a moss a little to the northeast of the ferry of Shien. There might have been about three barrels or more of these, and measuring from 1½ to 3 inches in length. Now, the place in which they were found is only 300 yards north of Loch Creran, an arm of the sea running east and west, from which several supposed the fry must have been raised. The wind, however, being from the north, renders this a seeming impossibility; and it may, perhaps, be more safely concluded that they must have been ejected from the Linnhe Loch, another arm of the sea, extending southwest and northeast, about 3 miles north of the place in which they were found. A range of moorland, about 300 feet above the level of the sea, intervenes; but it is easier to suppose the cause which originally elevated these fry to be so powerful as to carry them this height and distance, than that they should obtain a course contrary to the general body of air. They exhibited no appearance of being bruised by the fall."

The last account in the *Edinburgh New Philosophical Journal* for 1826 is from a man named Arnot, who told the editor, Robert Jameson, that in 1825 a shower of herring fell near Loch Leven in Kinross-shire, the wind at the time blowing strongly from the Frith of Forth. Hence it was concluded that they were blown out of the Frith, carried by the wind across Fifeshire, and let fall in the vicinity of Loch Leven.

There is also said to be an account of a rain of fishes in the *Inverness Courier* of April, 1828, but it has been impossible to verify this.

In 1828, a short account was published in the *Gentleman's Magazine* of a rain in Ross-shire, Scotland. The full account follows:

"As Major Forbes Mackenzie of Fodderty, in Strathpeffer, Co. Ross, was traversing a field on this farm, he was surprised to find a considerable portion of the ground covered with herring fry, of from three to four inches each in length. The fish were fresh and entire, and had no appearance of being dropped by birds, a medium by which they must have been bruised and mutilated. The only rational conjecture that can be formed of the circumstance is, that the fish were transported thither by a waterspout—a phenomenon that has before occurred in this county, and which is by no means uncommon in tropical climates. The Frith of Dingwell lies at a distance of three miles from the place in question, but no obstruction occurs between the field and the sea—the whole is a level stretch or plain—and waterspouts have been known to carry even farther than this. Major Mackenzie has forwarded a small quantity of the fish to the secretary of the Northern Institution."

Chronologically the next account is from America, namely Cambridge, Maryland. J. E. Muse tells in 1829 of a ditch dug one mile from the river and in land ten feet above water. This had no connection with any body of water and for ten days after being finished remained dry. Then came a week or ten days of heavy rain which filled the ditch and in the ditch were found hundreds of small sun perch and jack perch from four to seven inches long. The author has no explanation, but it would seem that a "rain of fishes" is the most reasonable supposition and hence the account is included here.

The next account takes us to the South Sea Islands, and is recorded in the *Polynesian Researches* of that keenest-sighted of all the missionary observers of natural history in the South Seas, William Ellis. In the first edition of his invaluable work (1830), in Volume II, p. 285, is the following account of an observation made at some one of the Society Islands, probably Tahiti itself:

"Connected with the fresh-water fish, a phenomenon is often observed for which the natives are puzzled to account. In the hollows of the rocks and in other places, to which they suppose that the sea and the river never gain access, and where the water collected is entirely what falls from the clouds, small but regularly formed fish are sometimes found. The people have frequently expressed their surprise at finding them, and appeared to wonder how they ever came there. They call them *topataua*, literally, rain-drop, supposing that they must have fallen from the clouds with the rain."

There are now to be recorded a number of accounts from India, where it would seem this phenomenon is not unusual. The first, published in 1833, is from the pen of James Prinsep, long the secretary of the Asiatic Society of Bengal and a scientist of the utmost credibility.

He states that concerning the phenomenon of fish falling fom the sky, he was absolutely incredulous until "I once found a small fish, which had apparently been alive when it first fell, in the brass funnel of my pluviometer at Benares, which stood on an isolated stone pillar, raised five feet above the ground in my garden." He then records a similar happening on a much larger scale, which was communicated by a Mr. Cameron, who took the pains to have the depositions of ten native witnesses taken and attested before a magistrate. The shower of fish referred to took place on February 19, 1830, near the Nokulhatty factory, Zillah Dacca, Jelalpur, India. All agree as to the place, month, day, and hour; the discrepancies in the individual recitals are such as are to be expected from ten witnesses who were not in collusion. These accounts, omitting all irrelevant statements, will now be given *seriatim*. Two of the ten witnesses reported jointly, their statement being embodied under 1:

1. "That on Friday, in the month of Phalgun [on the ninth day,] at 12 o'clock P. M., the sky being cloudy, there was a slight rain, and a number of fish of different kinds and sizes fell from heaven; we took some of these fish and retired home."

2. ". . . I perceived a *boduli* fish, large about one cubit, fall before me from the sky; after which I went further, and found another fish of the same size, lying upon the ground. I picked up these two fish and proceeded forward; and as soon as I arrived at home, I found, to my great surprise, that many persons had likewise collected fish, and carried along with them."

3. ". . . the clouds being gathered together, began to rain, and a little after, many fish, large and small, began to fall from the sky. I picked up some of them and carried to my house, but I did not like to taste any of them."

4. ". . . while I was sitting in the front part of my cottage, I observed a *mirgal*, and some other fish, *bodulis*, etc., . . . of different size, fall from the sky. I picked up about five or six of these fish to satisfy my curiosity, but afterwards threw them away, and did not eat them at all."

5. "I had been doing my work at a meadow, where I perceived at the hour of 12 o'clock, the sky gather clouds, and began to rain slightly, then a large fish touching my back by its head fell on the ground. Being surprised, I looked about, and behold a number of fish likewise fell from heaven! they were *saul, sale, guzal, mirgal* and *boduli*. I took 10 or 11 fish in number, and I saw many other persons take many—then I returned home, I looked at heaven, and I saw like a flock of birds flying up, but these my perceptions were not clear enough. Amongst these fish, many were found rotten, without heads, and others fresh and perfect; and amongst the number which I had got, five were fresh and the rest stinking and headless."

6. "While I was sitting in my own house, I perceived a number of fish fall from the sky, some of them on the roof of my cottage; one of them was large, about one cubit, and three seers[1] in weight."

7. "When I was at work in a field, I perceived the sky darkened with clouds, began to rain a little, and a large fish fell from the sky. I was confounded at the sight, and soon entered my small cottage, which I had there, but I came out again as soon as the rain had ceased, and found every part of my hut scattered with fish, they were *boduli, mirgal,* and *nouchi*, and amounted to 25 in number."

8. ". . . as I was coming from the fields, I saw a number of fish spread on the bank of a nálá. I picked up six of them, viz. two *boduli*, two *mirgal*, and two *nouchi*, besides these there were many other fish of numerous kinds, and they were witnessed by many persons who were there. Some of these fish were fresh, but others were rotten and without heads."

9. "I sat down near the door of a workman's cottage; it was then precisely 12 o'clock, when a drizzling rain began to fall; and at the same time, two *boduli* fish fell down from heaven. I soon got up and marched on, and in midst of the road, saw several other fish fallen before me. I picked up some of these fish—but one named Banchha Ram Chung forbade me, saying, 'Do not touch these fish; you do not know what fish they are, and how they have fallen here.' Listening to him, I threw away all the fish, and went away."

In the following year a writer signing himself "S" records in these words a fall of fish at Futtehpur, India, on May 16 or 17:

"At noon . . . a blast of high wind, accompanied with much dust, . . . came on; the blast appeared to extend in breadth about 400 yards. . . .

[1]A seer, or ser, is a little over two pounds.

When the storm had passed over, they [the zemindars and others, who reported it to him] found the ground, south of the village, to the extent of two bighas,[1] strewed with fish, in number not less than three or four thousand. The fish were all of the *Chalwa* species (*Clupea cultrata*) a span or less in length, and from one to one and one-half a seer in weight; when found, they were all dead and dry. *Chalwa* fish are found in the tanks and rivers in the neighborhood. The nearest tank in which there is water is about half a mile south of the village. The Jumna runs about three miles south of the village, the Ganges 14 miles north by east."

The next account is found in the "Extracts from the Minute-Book of the Linnæan Society" of London. The account was read before the Society on June 15, 1830, but was printed in 1833, in Volume XVI of the *Transactions*. Verbatim it reads:

"[There was] Read an extract of a letter from Mrs. Smith, dated Moradabad, July 20th, 1829, to a gentleman in Somersetshire, giving an account of a quantity of Fishes that fell in a shower of rain at that place. Many were observed by Mrs. Smith from the window of her residence, springing about on the grass immediately after the storm. The letter was accompanied by a drawing taken on the spot, which represents a small species of *Cyprinus*, two inches and a quarter in length, green above, silvery white below, with a broad lateral band of bright red."

At the meeting of the British Association for the Advancement of Science in 1840, Colonel Sykes read a letter from a Captain Ashton located at Kattywar, government of Bombay, India, referring to the fall of fishes recorded by Harriott in 1809.

There is now to be given the brief account written by De Kay in 1842 which first interested me in the phenomenon of the rain of fishes and which ultimately led to the writing of this paper. De Kay says that "in the summer of 1824, a number of these fish [*Batrachus*, now *Opsanus tau*] were found in the streets of New York after a heavy shower." He adds that these little fish are carried up by whirlwinds or waterspouts, and that they are very tenacious of life.

In 1849, Thompson mentions a number of falls previously referred to in this article and then records, without citing his source of information, that in Argyllshire, Scotland, in the little island of Ula, after a heavy rain there were found scattered over the fields a number of small herrings, all perfectly fresh, and some scarcely dead; furthermore, that a fish, ten inches long, together with smaller ones, fell at Boston, Massachusetts, on June 30, 1841, and that in July of that year a shower of fish and hail occurred at Derby, England; that in 1829 at Moradabad, India, numbers of a species of *Cyprinus* fell; that on September 20, 1839, a number of living fish about three inches long rained down at a place twenty miles south of Calcutta.

Dr. Buist[1] in the *Bombay Times* of the year 1856, after discussing rains of fishes in various parts of the world says that in 1824 fishes fell at Meerut on the men of Her Majesty's 14th Regiment, then out at drill, and were caught in numbers. At Allahabad in 1835, there was a fall of fish during a heavy storm. No particulars are given, but it could not have been a case of æstivation or migration, since the fish were found dead and dry after the passage of the storm. Again at the Sunderbunds, about twenty miles south of Calcutta, on September 20, 1839, there fell in a heavy squall a number of small, live fish about three inches long. These were not scattered over the country but were found in a long, narrow, and fairly straight row.

Buist records two other significant

[1]A bigha is about one-third of an acre.

[1]This citation is found in Tennent (q.v.) and has not been verified by the present writer.

falls. In 1850, on July 25, there was at Kattywar a tremendous deluge of rain: thirty-five inches fell in twenty-six hours; twenty-seven inches in twenty-four hours, and seven and one-half inches in one and one-half hours. This brought with it so many fish that the ground was literally covered, and some were even found on the tops of haystacks. And two years later at Poonah, after a heavy rainfall, multitudes of fishes were picked up on the cantonment grounds, which were situated a full half-mile from the nearest stream. All these falls noted by Buist are alleged to have been accompanied by heavy wind and rainstorms.

Boll in 1858 quotes a newspaper account of a heavy storm very like a waterspout that broke over Lake Plauer in Mecklenburg and the neighboring country. This storm tore great holes in the hills and filled these with water in which were found on the following day numerous small, living fishes and crustaceans. Boll also quotes the *Monatsschrift von und für Mecklenburg* of 1795 (p. 310) to the effect that a similar heavy storm in the year 1795 passed over Lake Müritz, scattering fishes on the pasture and cultivated land adjoining. I have not been able to find the *Monatsschrift* in America and have not been able, therefore, to verify the citation.

In the *Proceedings of the Boston Society of Natural History* for 1859, Volume VI, there is noted a letter from Prof. O. P. Hubbard, of Dartmouth College, in which he gave an account of a fall of fish at a town in Vermont, that occurred during a sudden squall of wind accompanied by rain, and he furthermore stated that this was but the last of a number of similar instances which had come to his notice.

Tennent in his *Natural History of Ceylon*, published in 1861, records a number of instances of falls of fishes in India and Ceylon. Some of these have been noted already. Broadly speaking, he says that in Ceylon it is the general belief that the heavy bursts of the monsoon bring falls of fishes, since fishes of small size are frequently found in hollows along the roads and in depressions previously dry and sunbaked. Speaking specifically, he states that on one occasion he saw a violent shower fall on the road just ahead of him, and that when he got there, he "found a multitude of small silvery fish one and one-half to two inches in length leaping on the gravel of the high road, numbers of which I collected and brought away. . . . The spot was about half a mile from the sea and entirely unconnected with any water course or pool." Such evidence as this from so eminent a student of natural history as Sir J. E. Tennent is absolutely incontrovertible.

Next he quotes a Mr. Whiting of Trincomalee, who claimed that he had often been told by natives of such rains of fishes and that on one occasion he was taken to a field "which was dry when I passed over it in the morning, but which had been covered in two hours by a sudden rain to a depth of three inches, in which there was seen a quantity of small fish. The water had no connection with any pond or stream whatever." On another occasion a Mr. Cripps, of Galle, wrote him that he had seen fishes taken from hollows in the land which in the dry season were completely devoid of moisture. Since there was neither running water nor tank near by, Mr. Cripps was convinced that "either the fish or the spawn from which they were produced must of necessity have fallen with the rain." As these fish were found *immediately* after the rain, it could not be claimed that either the fish themselves or their ova had been imbedded in the earth and had awakened from æstivation, moreover, the earth to a depth of from twelve to eighteen inches is ordinarily baked as hard as a brick, precluding the possibility of their being imbedded.

Perhaps the most widely known and,

because of the standing of its recorder as an ichthyologist, the most authentic case, is that made known by the Count de Castelnau in 1861. A careful translation of his account is given below. There was an earthquake followed by a tremendous rain at Singapore on February 20, 21, and 26, 1861. To this de Castelnau makes allusion and then continues:

"When the sun came out again I saw numbers of Malays and Chinese filling their baskets with fish contained in the pools formed by the rain. They told me the fish had 'fallen from heaven,' and three days later, when the pools were all dried up, there were still many dead fish lying about. I found them to belong to the *Clarias batrachus*, which can live a considerable time out of water, and even move to some distance on dry land. As they lay in my courtyard, which is surrounded by a wall, they could not have been brought in by the overflowing of a torrent, nor is there any considerable one in the neighborhood. The space covered by these fishes might be about fifty acres. They were very lively and seemed to be in good health. I have particularly remarked the singular occurrence of the fish, having already, during my stay at the Cape of Good Hope, had occasion to mention to the Academy the fact of several new species of fish being found after an earthquake. Is it permissible to suppose that a waterspout, in passing over some large river of Sumatra, had drawn up the fish and carried them over? It is not without diffidence that I venture this hypothesis."

An account of this phenomenon also appeared in the *Zoölogist*, 1861, Volume LI, and P. Harting gives the same data in *Album Natuur*, 1861. Both of these credit the data to Castelnau, but not so the anonymous writer in *Das Ausland*, 1861, 34. Jahrgang.

In his book published in 1864, Charles Tomlinson recounts a number of instances of falls of fishes. He gives at greater length the account of a fall near Calcutta in 1839, previously referred to by Buist. This is so circumstantial that it is reprinted in full.

"About two o'clock P. M., of the 20th inst. (September, 1839), we had a very smart shower of rain, and with it descended a quantity of live fish, about three inches in length, and all of one kind only. They fell in a straight line on the road from my house to the tank, which is about 40 or 50 yards distant. Those which fell on the hard ground were, as a matter of course, killed from the fall, but those which fell where there was grass sustained no injury; and I picked up a large quantity of them, 'alive and kicking,' and let them go into my tank. The most strange thing that ever struck me in connection with this event, was, that the fish did not fall helter-skelter, everywhere, or 'here and there'; but they fell in a straight line, not more than a cubit in breadth."

Tomlinson also gives without indication of source a detailed account of a fall of fishes in Scotland, which is reproduced in full.

"Still more recently a fish shower happened near Aberdare. The following passage purports to be the evidence of John Lewis, a sawyer in Messrs. Nixon & Co.'s yard, as taken down by the Rev. John Griffith, vicar of Aberdare and rural dean:—'On Wednesday, February 9th, I was getting out a piece of timber for the purpose of setting it for the saw, when I was startled by something falling all over me, down my neck, on my head, and on my back. On putting my hand down my neck, I was surprised to find they were little fish. By this time I saw the whole ground covered with them. I took off my hat, the brim of which was full of them. They were jumping all about. They covered the ground in a long strip of about 80 yards by 12 yards, as we measured afterwards. That shed (pointing to a very large workshop) was covered with them, and the shoots were quite full of them. My mates and I might have gathered buckets full of them, scraping with our hands. We did gather a great many—about a bucketfull—and threw them into the rain pool, where some of them now are. There were two showers, with an interval of about ten minutes, and each shower lasted about two minutes, or thereabouts. The time was eleven A. M. The morning up-train to Aberdare was just then passing. It was not blowing very hard, but uncommon wet; just about the same wind as there is to-day (blowing rather stiff), and it came from this quarter (pointing to the S. of W.). They came down with the rain in a body like.'

"The Rev. Mr. Griffith adds, that 'such is the evidence. I have taken it for the purpose of having it laid before Professor Owen, to whom, also, I shall send to-morrow, at the request of a friend of his, eighteen or twenty of the little fish. Three of them are large, and very stout, measuring about 4 inches. The rest are small. There were some, but they are since dead, fully 5 inches long. They are very lively.' A number of these fishes were exhibited for several weeks in the Aquaria house of the Zoological Society's Gardens, in the Regent's Park, London."

Boll records (1868) the following instances of fish falling at certain points in Mecklenburg: at Steuer on July 25, 1795; at Kratzburg, on May 28, 1828; and near Dölitz, Pomerania, June 9, 1868. He says that in each case numbers of small fishes were found, and in one case fairly large ones, and that in the first two instances the rain was accompanied by a waterspout.

A similar occurrence is reported in 1873 by Franz Buchenau in the following words:

"Bremen, May 24. About five o'clock day before yesterday afternoon in the vicinity of Eystrup a great number of fishes fell on and beside the railroad embankment during a storm. They were little so-called whitefish. The appearance of these unaccustomed guests is connected with a waterspout, which, as was later reported to the railway directors here, arose apparently at the same time from the Steinhuder See about four miles distant."

The following account of an alleged fall of fish scales is given here because it is allied somewhat to the present subject, and because its omission might seem somewhat serious in view of the title of the article. The account and the disposal of it are given in Professor S. F. Baird's own words (1875).

"It is stated that during a heavy thunder-storm near Lake Providence, Louisiana, a number of small bodies were found on the ground, immediately after the shower, scattered along the shore of the Mississippi River for a distance of forty miles above the lake; as many as half a bushel being collected around one house. These, on being submitted to critical examination, proved to be the scales of the common gar-fish of the South (*Lepidosteus*). The species inhabits the shallow, muddy waters of the South and sometimes attains a length of five or six feet, and is especially characterized by being enclosed in an almost impenetrable coat of mail (the scales in question), so compact as almost to resist the penetration of a bullet.

"It is very difficult to give credence to this story; as the gar-fish are not particularly abundant, and the method of aggregation of so large a number of detached scales would be a problem extremely difficult of solution. Perfectly authentic instances are on record of small fish, shells, etc., being taken up in storms and scattered over the earth; but when it comes to special portions of fishes which weigh from 5 to 50 lbs. each, the draft upon one's faith is rather too severe."

An anonymous writer in *Das Ausland* for 1878 records, on the authority of the *Toronto* (Canada) *Globe*, a fall of fishes which is said to have taken place in Canada through the action of a tornado. The account was vouched for by a teacher, who reported that living young herring were found scattered over dry ground for a space of three-quarters of a mile.

The next account, comparatively recent in date and very clear in statement, is by Thomas R. Baker, (1893).

"During a recent thunder-storm at Winter Park, Fla., a number of fish fell with the rain. They were sunfish from two to four inches long. It is supposed that they were taken up by a waterspout from Lake Virginia, and carried westward by the strong wind that was blowing at the time. The distance from the lake to the place where they fell is about a mile."

Perhaps the most extraordinary case of all is that related by one Hermann Landois, whose narrative was written in 1896:

"Herr Joseph Grimberg in Essen on the Ruhr wrote me on July 27 as follows:—'During yesterday's hail storm there fell a hailstone the size of a hen's egg, in which an enclosed fish was found frozen. The storm lasted about ten minutes. . . . The fish was picked up in my presence so that there can be no doubt of the fact. The fish is a crucian carp . . .' about 40 mm. long. This fish has up to this time been observed in Westphalia only in enclosed waters. The fish must have been lifted up from a pond or pool into the clouds by a whirling storm and there frozen into a hailstone."

The *Monthly Weather Review* for June, 1901, contains the interesting account from Mr. J. W. Gardner, volunteer weather observer at Tiller's Ferry, South Carolina, U. S. A., that "during a heavy local rain about June 27, there fell hundreds of little fish (cat, perch, trout, etc.) that were afterwards found swimming in the pools between the cotton rows in [an adjacent] field."

The last account but one to come to hand was given before the Berlin Society of Naturalists on July 20, 1841, but was not published until 1912. It is very detailed and is here given practically in full.

"Herr August gave an account of a rain of fishes which occurred during a heavy thunderstorm on the night of June 29–30, 1841, in Uckermark on the estate of Herr von Holtzendorff-Jagow. . . . Suddenly at two o'clock in the night (30th of June), a heavy rain began to fall, and continued so violently for the best part of an hour that the place was flooded deeper than the oldest inhabitants could remember [ever having seen it]. On the evening of June 30 the shepherds brought back with them to their huts collections of small fishes to feed their ducks with. They said that a high, fallow field which was used for a sheep pasture was entirely covered with these fishes. [They said that] during the day more than sixty storks and an innumerable number of crows had eaten their fill there and that the new-formed rain pools were filled with large numbers of these fishes. The owner of the estate, who did not hear of this until July 1st, was not able to go to the place and see for himself until July 2nd. He found that there were still a great many fishes in the places indicated. The largest of these were five inches long. The little pools in which the fishes were happily swimming about, had apparently been formed during the storm and had no connection whatever with any other body of water that contained fishes. The extent of the surface on which the fishes were found covered a length of two hundred paces and was fifty paces wide. The length agreed with the conjectured course of the thunderstorm.

"All investigations indicated that without any doubt these fishes were brought to this spot through the air. It is remarkable that such a whirling waterspout did not leave any other traces of damage done by the wind, especially as no particularly strong wind was noticed in the night; on the contrary, rain fell perfectly quietly, but in enormous quantity. In other low-lying places which were much more deeply covered with water and with meadow brooklets which connected them with ponds and lakes, no traces of fishes were to be found.

"The fishes, for the most part young, which were sent in by Herr Holtzendorff at the same time that this account was written were of varieties often found in our country, such as: pike (*Esox lucius*), perch (*Perca fluviatilis*), Plötze (*Cyprinus rutilus*) and stickleback (*Gasterosteus pungitius*)."

The last account, a brief notice, is from McAtee's paper previously referred to. He quotes Mr. A. N. Caudell of the United States Bureau of Entomology, that on one occasion after a hard shower Mr. Caudell's mother at her home in Indiana had found a live minnow in the rain water held in the hollow of a chopping-block at the wood pile.

THE CREDIBILITY OF THESE ACCOUNTS

Omitting Humboldt's account of the fall of *Pimelodus cyclopum* in hot water ejected from volcanoes in South America, since that fall has an entirely different origin and causation, there are herein enumerated forty-four distinct accounts of rains of fishes. These phenomena, when grouped under the countries where they occurred, show the following distribution: United States, 7; Canada, 1; England, 1; Scotland 9; Germany, 8; France, 1; Greece, 1; India, 10; Ceylon, 3; Malaysia, 2; South Sea Islands, 1. Surely such a large array of accounts from eleven different regions of the earth, ranging from the eastern part of North America, across western and southern Europe, touching southern and southeastern Asia, and ending in the South Sea Islands, should be credible on the bare setting forth of the facts.

Another circumstance tending to establish the credibility of these accounts is the fact that they are published in books and journals differing greatly in character. The books include works on meteorology, travel, history, and natural history; the journals are mainly devoted to natural history, but published in widely separated parts of the world, and while some of them are well known, others are comparatively obscure. A perusal of the accounts given above (most of them verbatim excerpts) must convince the reader that those who made efforts to review the literature,—Thompson, 1849; Tennent, 1861; Tomlinson, 1864; and McAtee, 1917,—had only limited knowledge of the considerable literature devoted to this subject. This is plainly due to the fact that the accounts were published in widely scattered and little known books and journals and that even as late as McAtee's paper no complete bibliography of the literature of fishes was available for any one desiring to weigh all the facts.

Now it cannot be maintained that all the accounts noted are of equal credibility. Some are mere hearsay, some are hearsay pretty well attested (i. e., matters of general knowledge in the community) and some are recorded by scientific men, who in certain instances apparently saw the fishes fall, in other instances found them immediately after a hard rain covering ground ordinarily dry,—that is ground far removed from swamps and streams. To proclaim disbelief in the phenomenon of rains of fishes, to refuse credence to accounts so widespread in time and space, so thoroughly corroborative, would in the mind of the writer be indicative of an inability properly to evaluate evidence.

As a matter of fact but two authors have endeavored to deny the credibility of such phenomena. The first of these is Eglini (1771), who in his first account (See p. 608) seems to have doubts, but on the whole accepts the fact on the assumption that it is the action of a waterspout. In his second account, written in the same year, he quotes a "scholar in Luckau who saw it," and who sent him specimens of the fish. However, because these fish apparently were not such as occur in the neighboring streams, and because he received a negative report from a "learned gentleman of Lausitz," he brands the reputed fall as a deception. The "learned man" in question was out on the evening of the storm until eleven o'clock (the storm occurred at midnight), sat at an open window almost all night, and finally was again in the open early in the morning, without seeing the least trace of fishes. "Therefore I may affirm with certainty that the whole proceeding said to have occurred with this storm is a lie." However, he omits to say whether or not he explored the *whole* area of the track of the storm, and apparently he declares the matter a lie because he found no fishes in the vicinity of his own home.

The only author who has endeavored to controvert some of the numerous accounts given is W. Sharpe (1875). After quoting Tennent's personal experience given above, he endeavors to explain it away by alleging that the fishes are left stranded from an overflow, or are caught migrating from one point to another. He says that no scientific man has ever seen a rain of fishes, nor have fishes ever been caught in rain barrels, and finally that they are always found alive whereas, if rained down, the fall would kill them.

In answer to this it may be said that no scientific man has ever had a rain of fishes fall on him, nevertheless the testimony of Tennent, Castelnau, and others cannot be explained away. As to the second point, let us recall that Prinsep found a fish in his pluviometer standing on a pedestal five feet above ground, and that Mrs. Caudell found one in the hollow of a chopping block at least eighteen inches above the ground. As to the fact that the fishes are commonly alive and are not killed by the fall, as Sharpe thinks they should be, the retort may be made that all fishermen know that fishes generally succumb slowly to falls and blows, and that if the fish fell on grassy lands, the shock would be much decreased. However, numbers of those found were actually dead.

THE EXPLANATION

Omitting Humboldt's account of the fall of catfish in South America, for which an explanation has already been indicated, four explanations offer themselves for the appearance of fishes accompanying heavy rains. The first of these is that the fishes might have been migrating overland from one stream or pond to another. Now migratory fishes are of but few kinds, and are found only in a few countries. Of the countries noted above such an occurrence might take place only in India, Ceylon, or Malaysia. But the accounts of the falls of Indian fishes are so definite and circumstantial as to rule out this possibility. Again, many of the falls have taken place in northern countries, where there are no migratory fish, and finally many of the fish rained down are marine forms.

Furthermore, the fishes might have been left behind by overflows as alleged by Eglini, but there is nothing in the accounts given to lead one to such a conclusion. More plausible is the conjecture that the fish may have been æstivating and have been awakened by the coming of the rain. This might apply to Ceylon, India, and Malaysia, where there is a prolonged dry season, but during the dry season the earth becomes thoroughly baked, and even in swamps and tanks is hardened to the consistency of sun-dried bricks to a depth of from fifteen to eighteen inches. In view of this fact a mere thunderstorm or even a heavy downpour would not soften the ground sufficiently to release the imprisoned fishes. Then again many of the falls recorded have been on high and dry fields, upon the sand of parade grounds of military cantonments, and upon the enclosed compounds of residences. A careful perusal of the reported rains of fishes in Ceylon, India, and Malaysia, will eliminate the explanation based on the awakening of fishes from summer sleep due to the falling of heavy showers.

There is left to us but one other explanation,—the action of heavy winds, whirlwinds, and waterspouts. Practically all those who have described rains of fishes have noticed that these were the accompaniments of thunderstorms or monsoon rains with their heavy winds, or of waterspouts. One who has witnessed the activities of a whirlwind or who has seen the wreckage left in its path will have no difficulty in believing that such a whirlwind or even the heavy winds accompanying a hard storm could pick up and transport to some distance objects of such light weight as small fishes. Furthermore, anyone who has witnessed the tremendous power of waterspouts, such as are common for instance in southern Florida, will agree that such a spout passing over shallow water, would certainly pick up the small fishes swimming therein and, drawing them up into the clouds, would carry them over the country to drop them some distance away. This is the only explanation that can account for the Indian fall as a result of which fishes were found in a comparatively straight path only a few inches wide, extending over a considerable stretch of country. These fishes must have fallen from the whirling lower end of a funnel-shaped spout after the pillar had broken in two, as is often the case. Again, no other explanation can account for a fall concentrated on a comparatively small area, as was that noted by Castelnau at Singapore.

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ERWIN S. CHRISTMAN AT WORK ON THE MODEL OF "BRONTOTHERIUM"

Mr. Christman's untimely death, on Nov. 27, 1921, has deprived science of the service of an artist whose work was characterized not only by creative vision but by fidelity of detail. The model of the head of *Brontotherium* is one of the many striking and scientifically accurate restorations of extinct animals which he made during his twenty-one and one half years of devoted service as draughtsman, artist, and sculptor, in the department of vertebrate palæontology of the American Museum

Christman's models of the first and last of the titanotheres: *Eotitanops*, the small animal at the right, and *Brontotherium*, its gigantic descendant.

These models, which were worked out by Mr. Christman under the direction of members of the scientific staff, illustrate his exceptional skill in fusing the results of patient investigation along many lines into a consistent whole, and in inspiring the "dry bones" of science with the vitality and movement of living animals

ERWIN S. CHRISTMAN, 1885-1921

DRAUGHTSMAN, ARTIST, SCULPTOR

BY

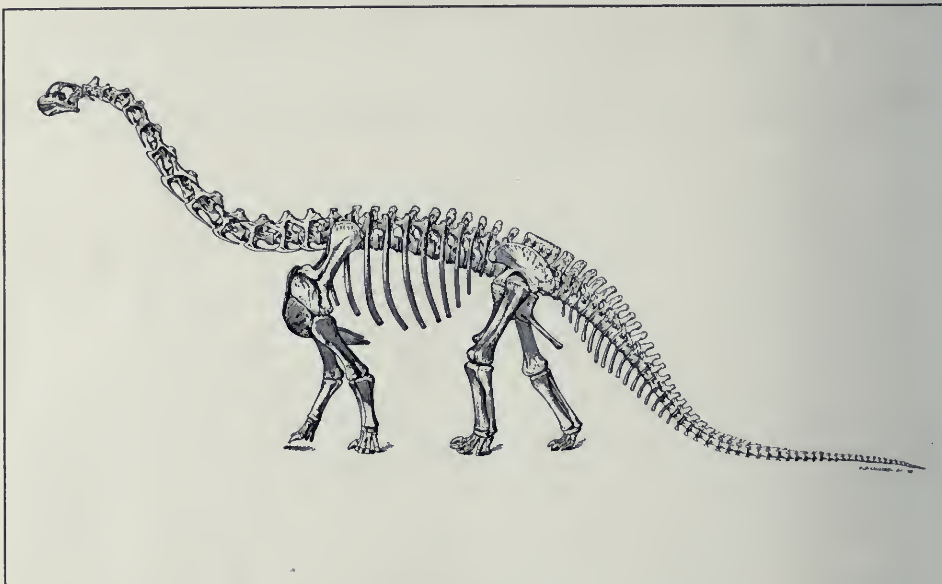
WILLIAM K. GREGORY*

ALTHOUGH Erwin Christman of the American Museum died at the early age of thirty-six, he left behind him a splendid record of twenty-one and one half years' service, through the medium of art, to science and education. He came to the Museum when he was still in knickerbockers and began at once to make a trial series of drawings of mammal skulls in the department of vertebrate palæontology. From the first he worked under the immediate supervision and direction of Professor Henry Fairfield Osborn, who devoted much time and thought to the boy's technical training and succeeded in inspiring him with a fidelity to truth and beauty which showed increasingly as the years passed. His early work revealed a keen sense of light and shade and of perspective, but at first he could hardly catch the subtle unevenness and individuality of the contours of teeth and bones. However, as his studies in the Art Students League and at the National Academy of Design progressed, his lines became surer and gained in accuracy. For some years "Erwin," as he was affectionately called in the department, concentrated upon wash drawings and eventually produced his superb figures of the teeth of titanotheres and other extinct mammals. Of late years he worked largely in pen line, gaining constantly in clearness and simplicity of presentation and finally completing a wonderful

*Curator, Department of Comparative Anatomy, American Museum.

series of drawings of the remains of various dinosaurs, especially *Tyrannosaurus* and *Camarasaurus*. He early showed a strong inclination for work in the round, and the hall of vertebrate palæontology contains many excellent models and restorations made by him, including the magnificent series of titanothere heads, the stirring models of the race horse Sysonby, of the giant dinosaur *Camarasaurus*, and of *Brontotherium*.

with unending patience and enthusiasm the elaborate construction of the backbone of this monster, making hundreds of drawings of the separate vertebræ, correcting the distortion of the crushed bones, and supplying in dotted lines the probable appearance of missing parts as deduced from comparison with other specimens. The *Camarasaurus* bones—the remains of several individuals—were found in a quarry, scattered in almost



Christman's pen drawing (greatly reduced in size) of the skeleton of the gigantic dinosaur, *Camarasaurus*. From the Memoir on *Camarasaurus* by Professor Henry Fairfield Osborn and Dr. Charles Craig Mook.

This drawing and the model of the same animal shown on the opposite page were the crowning achievement of Christman's years of work in drawing the scattered and often crushed fossil bones of this dinosaur

Christman was not only an accurate draughtsman and modeler, he was also a highly intelligent and sympathetic assistant to the members of the scientific staff in working out difficult problems of reconstruction. His model of *Camarasaurus*, for example, is the culmination of a series of operations extending over many years and involving numerous special investigations in which he took an active part. Under the guidance of members of the scientific staff he studied

hopeless confusion. As the individual vertebræ are too heavy to be handled easily, and literally too big to be studied closely in series, Christman's drawings afforded the means of making effective comparisons of the vertebræ with others of the same animal and with homologous vertebræ of other individuals. After the probable associations of vertebræ with each other and with the appropriate girdle and limb bones had been worked out, Christman made a new set of drawings on a smaller scale of every part of the completed animal. Each of these drawings he then carefully cut out with scissors and fastened to flexible copper wires. The model of the whole vertebral column was then laid out on a black background and adjusted to similar models of the ribs, girdles, limbs, and skull. By means of this flexible model various possible poses of the skeleton were represented and photographed. After a certain general pose of the skeleton was agreed upon, Christman constructed a plasticene mannikin of the skeleton, accurate in proportions and mounted on flexible lead wires. The next step was to determine the location of the principal muscle masses of the girdles, limbs, and body. This again was a by-product of previous studies of the musculature of reptiles and mammals and Christman showed his usual intelligence and skill in adapting this knowledge to the special problems in hand. Thus he produced one of the most successful of all restorations of dinosaurs yet made.

Similarly the working out of the restorations of the titanothere heads involved, in each case, the making of accurate reconstructions of the skull and lower jaw, the determination of the areas of origin and insertion of the principal muscles of the face, jaws, and neck, as well as the decision as to the most probable form of the mouth and lips. The methods adopted in modeling these heads are partly indicated in the figures on page 625.

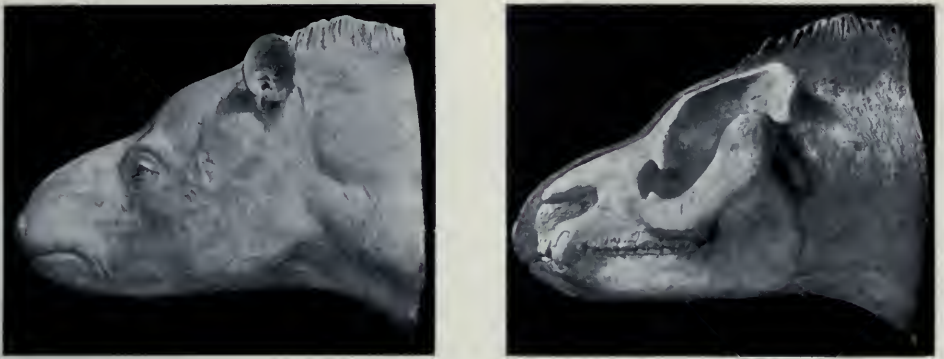
With the same conscientious exactness he also worked out the designs for the principal group exhibits of extinct animals. The ground sloth group and the asphalt group in the hall of the Age of Man, and the partly finished *Tyrannosaurus* and Miocene water hole (*Moropus*) groups, are his most important achievements in this line. All these

Christman's model of the *Camarasaurus* is one of the most successful of all restorations of dinosaurs yet made.

The close study of recent reptiles which the artist undertook has contributed to the lifelike appearance and suggestion of ponderous movement of the monster. The model is, however, far from being a mere composite of features borrowed from recent reptiles; it has an individuality of its own. One reason for the authentic effect is that the restoration is based upon the carefully worked out studies of the skeleton described in the text

GALLOPING HORSES

This inspiring group in bronze was a by-product of Mr. Christman's studies on the anatomy of recent horses. The original is the property of Professor Henry Fairfield Osborn



Christman's models of the skull and head of an Eocene titanothere, *Palæosyops*.—The reconstruction of the skull is based upon a study of numerous specimens, no one of which is sufficiently well preserved to show all the specific characters of the animal. Such an accurate model gives the correct placing of the ears, eyes, nose, and mouth, and the probable position of the principal muscle masses of the neck, head, and face

groups except the last, before being constructed in the large, were worked out not merely as sketches but as carefully measured and studied miniature models.

Thus in many ways Erwin Christman was an invaluable factor in the scientific and educational work of the department of vertebrate palæontology and, as his experience was unique, there is literally no one in this country or abroad who can fill his place.

Christman was a strong, consistent character, rich in the most attractive human virtues, such as kindness, modesty, and fidelity. Highly musical and of a sensitive temperament, he sometimes overtaxed his nervous endurance; but his love of outdoor life and his labors in building up a charming home in the country for his family made him strong in body and kept him young and playful in spirit. He died suddenly of appendicitis on November 27, 1921, leaving a widow and three children. The deep sympathy of all the Museum staff goes out to them.

ON GUARD

With her round head thrust out of the nest hollow in a dead yellow pine, the little owl gravely surveyed the visiting strangers. Owls of this species usually occupy deserted woodpeckers' holes or other excavations

GLIMPSES OF THE HOME LIFE OF THE SAW-WHET OWL*

BY

ROBERT B. ROCKWELL AND CLARK BLICKENSDERFER

STUDENTS of the Great Outdoors will all agree that the most delightful experiences with wild creatures usually occur at the most unexpected times and under the most unusual conditions, and such was our experience with the saw-whet owl, *Nyctala Acadica.*

The accommodating authors of standard ornithological textbooks have generously scattered these interesting little owls from southern Canada across the United States and far south into Mexico; and local authorities on Colorado birds have even gone further and conveyed the impression that the saw-whet was a rather common resident of the lower mountains of the state. All of which may be true if the whole truth were known, but when after nearly twenty years of roaming over mountain, hill, and valley in quest of new bird friends we had failed to come upon even a hint of the presence of the little fellows, we became convinced that the saw-whet owl, in so far as Colorado was concerned, was a myth.

Then came our first big surprise. The scene was a deep cañon-like ravine, drained by a small, clear stream flowing into Clear Creek Cañon at a point about five miles above the town of Golden. The bottom of the ravine was barely a dozen yards wide, with mountains rising abruptly a thousand feet or more on each side, clothed with a scattered growth of yellow pine. The course of the little stream was bordered with a beautiful growth of Douglas fir, Colorado blue spruce, and numerous varieties of handsome shrubs. Truly it was a spot dedicated to solitude and natural beauty.

Our day had been a lazy one, spent in renewing old acquaintances among the birds, with no thought of additional discoveries, as we had worked this country over thoroughly in preceding years. In our stroll up the ravine we came to an ancient stump of a giant Douglas fir, weather-beaten and decaying, but with a likely-looking cavity in one side—just the place to find our old friends, the red-shafted flickers. So we rapped indifferently on the old stump, fully expecting to enjoy the flash of brilliant red wings as mother flicker, answering our knock, suddenly decided that discretion was the better part of valor. Instead, to our amazement, after repeated knocking, out popped the little round head and blazing yellow eyes of an owl, and our surprise was doubled when we realized that our new friend had no ear tufts. What could it be? Not a screech owl, because that little pal of ours had ear tufts and was gray. This new friend had none and was brown! Then we tried to recall almost forgotten descriptions of owls that might fit—Richardson's, pygmy, ferruginous pygmy, flammulated screech, and elf. One by one they were discarded as impossible, and then it dawned upon us that here at last we had discovered our myth—the saw-whet owl.

Sitting there in the entrance to the cavity barely five feet from us, her big yellow eyes ablaze, very much awake and equally unafraid, she made a very comical picture, reminding us of a tiny gladiator challenging us with her great eyes to mortal combat. She sat perfectly still, watching us closely with an expression on her funny little face (if the term is permissible) of mingled surprise and indignation. Not until we started noisily to climb the stump did she deign to move, and then she launched herself awkwardly into the air and with rapid, weak, and irregular wing-beats fluttered to the lower limbs of an over-

*Photographs by the authors

Roused by repeated knocking, the occupant of what seemed a flicker's nest at last came to the entrance to confront the rude disturbers of her tranquility, and great was their surprise to note that the bird was an owl

hanging evergreen a few feet away and from there watched subsequent proceedings with a lively though silent interest.

We begrudged the moments spent in climbing the seven feet of stump to the entrance of the nest and when we did get a peep, we found to our disgust that the cavity was too deep for us to see the bottom and too small to admit our arms, so to our regret we had to cut away part of the rotting wood. When this was done, we hauled triumphantly forth one of the scrawniest, most woe-begone little creatures imaginable, with a great homely "nose," heavy, awkward feet, and a puny body covered with soiled whitish down. Its eyes were not yet open, and the feeble neck seemed unable to carry the weight of its abnormally large head and beak, so that it lay flat in our hands, apparently quite helpless, but uttering frequently a soft, musical little "cheep" not unlike that of a freshly hatched chick. After examining it for a moment we replaced it in the nest and then discovered that the cavity also contained three very dirty, blood-stained eggs, which had originally been white, and which were apparently about ready to hatch. After descending the tree, we watched the parent bird for some minutes at a distance of not more than a dozen feet. During this time she repeatedly flew from the dense shade of the pine, where she first sought refuge, to the nest, but at our least movement of approach she would pop out of the cavity and flutter back to the sheltering pine. At last we regretfully departed for fear the eggs might chill. We had left the stump but a few feet behind when the little mother fluttered back to care for her treasures.

A week later we called again to get better acquainted, and found the old stump lying prostrate. Three bedraggled little corpses told an eloquent tale of another forest tragedy, but the bereaved mother was nowhere to be found. To this day—and that was on June 11, 1917—we have a creepy feeling that we were in some unexplained way criminally responsible for the catastrophe.

Our second meeting with these owls was fully as surprising as our first. About thirty members of the Colorado Mountain Club were enjoying the Annual Bird Study Trip in the Wildcat Point country. This area, which lies about twenty-five miles south of Denver, consists of a high plateau, its western edge bordered by rim rock and broken by deeply eroded ravines and valleys the waters of which descend abruptly into Plum Creek drainage area about five hundred feet below. The slopes of these valleys support a scattered growth of fine yellow pines with numerous Douglas fir in sheltered spots on the slopes with northern exposures.

The day, save for a large migratory flight of piñon jays, had been a disappointing one for the would-be bird students. On our way back to the waiting automobiles we clambered over the rim rock and started down the steep

AT WORK

The picture shows the specially designed twelve-foot tripod and the mirror (on an adjustable tripod top) to reflect sunlight on the shady side of the tree. This picture also gives a good idea of the country in which the nest discovered on May 9, 1918, was located

INTENTLY WATCHING THE PHOTOGRAPHER

Driven from her nest, the owl took refuge in a pine tree near by and gave the photographer the opportunity to secure this characteristic picture slope through the fringe of pines that skirted its base. In so doing our path led directly under a large dead yellow pine. We happened to be the last of the party and as we passed this tree, we made our discovery—the round, fluffy head of a saw-whet snugly framed in an old woodpecker hole about ten feet above our heads. We called the entire party back to where we stood in full sight of the owl and told them to locate a bird within a few feet of them. Thirty pairs of excited eyes, after several minutes' search, failed to locate the bird and when she was pointed out to the party, bedlam broke loose (a large proportion of the party were ladies).

In spite of all the noise the brave little mother gazed forth calmly from her retreat and not until the ascent of the tree was begun did she seek safety in flight. She fluttered to a pine tree near by with rapid but rather awkward wing-beats, with the crowd in wild pursuit. Once in the deep shadows of the pine, she apparently overcame her fear and permitted us to come within a few feet of her. One of the party almost touched her with his hand before she again took flight and disappeared in a thicket of firs where we were unable to locate her.

Three days later, on May 12, 1918, we returned to the nest site without the crowd, and loaded down with our photographic equipment we toiled up the steep hill. As before, the mother bird greeted us at the entrance to her home and we took the first of our series of pictures of her in this position. After taking these photographs we climbed the tree and carefully cut out a piece below the entrance hole to permit a good view of the interior. An examination of the nesting cavity, which was about ten inches deep, revealed four soiled white eggs lying on an accumulation of chips, bits of rotting wood, and other débris, without any evidence of an attempt at lining the nest. The eggs were apparently far advanced in incubation, so, after carefully nailing the piece of the trunk back into place, we hurried away to give the mother an opportunity to return to her eggs.

The location of this nest was so unusual as to be worthy of comment. All authorities agree that this species is essentially a bird of the deep forest; that the nests are invariably located in shady spots in heavy timber and usually close to running water or swampy ground. The tree in which this nest was located was on an exposed slope commanding a wide view of the adjacent country. The surrounding timber was sparse; the nesting cavity faced directly south into the bright sunlight and was unshaded except for a single overhanging dead branch; and the immediate surroundings were very dry. The nearest stream was fully half a mile distant and there was not even a trickle of spring water closer at hand. Taking everything into consideration, the nesting site differed altogether from the typical locations described by the various authorities on the subject.

On June 5 we again returned, and to our delight found four tiny birdlings apparently only a few days old, identical in appearance with the one we had seen the preceding year. We were immediately impressed with the striking difference in size of the four babies, the largest being fully twice the size of the smallest. This substantiated the statements of various writers that the eggs of this species are laid at intervals of two or three days and that incubation begins as soon as the first egg is deposited. We had fully intended to photograph the little fellows, but when we removed them from the nest, they seemed so weak and frail, and showed such evident discomfort in the hot sun, that we lost heart and hurriedly replaced them in the nest without taking the coveted pictures.

Our fourth visit on June 16 was especially interesting. The youngsters had begun to take an active interest in life, and photographing them was rather strenuous work. The hot sun seemed to wilt them, unaccustomed as

The difference in size of the young is accounted for by the fact that the parent bird lays the eggs at intervals of two or three days, with a resulting irregularity in the time of hatching

they were to its rays after days spent in their dark retreat. They could keep their eyes open only a few moments at a time, and when exposed to the sun's rays for any length of time, they closed their eyes, opened their beaks, and panted violently, making anything but fast, instantaneous photography impossible. "Posing" all four at once kept us both busy. One or more were always moving, the larger ones crowding the smaller ones out of sight or focus; and one satisfactory negative was our total reward for this hard day's work. At this stage of their development the soft, white down was being rapidly replaced by coarser, brown pinfeathers, giving the nestlings a decidedly bedraggled and unkempt appearance. They were able to hold up their heads but could stand erect on their feet only a few moments. The note was still an insignificant, soft little "cheep," although they were silent most of the time while being handled.

On June 23 the birds were fully one half the size of the parents; the general color was much more brownish (the

Indifferent to their appearance, conscious only of the discomforts of exposure to the sunlight, these nestlings exhibited little interest in the proceedings of the photographer and disarranged themselves as promptly as they were posed. Managing four of them, as in the picture at the top of the page, required both patience and skill. Both photographs were taken on June 16

NESTLINGS OF THE SAME BROOD

These pictures, taken on June 23, one week after those shown on the preceding page, indicate not only the progress made in the interval but also the difference in the feathering of the first-hatched members of the brood and their laggard brothers

!By June 30 the nestlings had taken a long stride toward maturity and were very nearly as large as their mother

white down having almost disappeared), the wing coverts were well feathered, and the flight feathers were just beginning to grow.

On June 30 we were greatly surprised at the marked change in their appearance. The white down had entirely disappeared; the wings and tail, while short, were fully feathered out; the prominent, light-colored "V" between the eyes was very conspicuous; the entire plumage was of pure chocolate color (altogether different from the color and markings of the parent); and the birds were almost as large as their mother. This was the stage of their growth we had been waiting for, so we placed them in a roomy box and carried them triumphantly home where they could be more closely studied.

On each of our trips we were greeted by the parent bird at the entrance of her nest and, while she did not exhibit any evidence of fear or excitement, it was plain that she did not relish our company and she left the nest a little sooner at each succeeding visit.

While we had the young ones out of the nest, she made no demonstration, although a careful search would usually reveal her in a shady spot near by intently watching us. So far as we could tell, we did not see the male bird at all. In any event we did not see both parents at the same time. After our first visit we were unable to approach the old bird closer than fifteen or twenty feet.

The only evidence of food about the nest were a few remains of mice, and we were unable to find any disgorged "owl pellets," which are the best index of an owl's food. There were no bird feathers about the nest and in fact no feathers at all in the nest cavity, although the entire abdomen and part of the breast of the female were entirely devoid of feathers.

The young birds, from beginning to end, showed no fear of us whatever and did not make any attempt to escape, even when fully fledged. They were very awkward, often falling off the branches where we placed them and (until well grown) frequently tipping forward on to their beaks in a most ludicrous fashion. We handled them freely with bare hands and they made no attempt to use their strong, sharp claws which, even in the very early stages would have made formidable weapons, had the birds been inclined to use them upon us. The attitude of both young and adult, except in rare instances, was decidedly lacking in animation, spirit, and aggressiveness, in sharp contrast to that of other species of owls. They seemed rather to enjoy gentle stroking and would cuddle down in the palm of one's hand in a very confiding manner. As the young grew older, they were much less affected by heat and bright light; and the parent to our amazement would gaze with unblinking eyes directly into the sun's rays reflected from a mirror (used to throw light upon the object) for minutes at a time. During all of our visits we did not hear the parent utter a sound, and unfortunately we were unable to spend a night near the nest to enjoy their peculiar night "song" from which their name is derived.

The young birds from the first took kindly to their captivity, showing comparatively little fear, and maintaining their characteristic lack of animation. They readily accepted a change of diet from the mice they had undoubtedly subsisted upon while in the nest to one of small bits of beef and an occasional meal of liver. Curiously enough they persistently refused to touch mutton.

During their entire captivity, which extended through the summer and well into the fall, they were almost entirely silent. During the day they retired to the shady spots in their large flying-cage and slept cuddled close together, but at night they showed more activity, hopping or flying about the cage, very much awake and alert. The difference in size noted before continued and the larger birds were apparently stronger and more healthy than the smaller ones.

This captive bird illustrates the changes in plumage corresponding with increase in age. The least advanced stage is represented by the topmost photograph

Two of the captive birds. The one bird has developed more rapidly in size, the other in plumage

Their development from the juvenile to the adult plumage was also more rapid and they exhibited more animation. The smallest (youngest) bird of the brood was a weakling and after a few weeks of captivity began to fail in strength and finally died.

While the birds were never very wild, they did not become very tame and, as they grew older, showed an inclination to use their sharp claws when handled although not with the ferocity exhibited by captive owls of other species. They did, however, apparently enjoy having the backs of their heads gently stroked, and would sit quietly in the hand while being petted. On the whole they proved to be unusually attractive, interesting, and cleanly pets, and we regretted the day when we finally decided that no more information was to be secured by their continued captivity and that the time for their liberation had come.

Their presence in our family circle prompted us to read all the available literature regarding the species and we found delightful descriptions of their habits in Bendire's *Life Histories of North American Birds* and Fisher's *Hawks and Owls of the United States*.

Fisher, quoting Brewster, gives an interesting account of the operation of disgorging the pellets, which he observed in a young specimen in his possession:

"The owl would gape several times, then the head would be violently shaken sideways, and finally the pellet, coated with mucus, would shoot forth, frequently falling several inches in front of the spot where the bird was sitting. After it was all over the little fellow assumed an expression of relief and contentment which was very comical."

Both writers agree that the birds are easily captured during the day. Fisher, quoting Ridgway, says: "But a single individual of this pretty little owl was met with; this one was captured alive by Mr. O. L. Palmer, of our party, who found it asleep and *placed his hat over it.*" Bendire says: "Each winter one or more specimens were brought to me alive by some of my men, who found them sitting in the shrubbery bordering a little creek directly in rear of their quarters, where they usually allowed themselves to be taken without making any effort to escape. I thought at first that they were possibly starved, and on that account too weak to fly, but on examination found them mostly in good condition and fairly fat. Just before and during the mating season these little owls are quite lively; their peculiar whistle can be heard in almost any suitable wood and one may by imitating it often decoy them within reach of the hand. Upon one occasion, when my assistant was imitating one, it alighted on the fur cap of a friend who stood near him. They are not at all suspicious and I have more than once stroked one with my hand as it was roosting sleepily in some bush or tree."

Fisher says: "The mortality which sometimes occurs among this species in winter is difficult to account for. Specimens which show no signs of violence, though somewhat emaciated, are found on barn floors, under trees, or along fences. That cold has anything to do with killing this hardy little owl is not to be supposed, for such accidents occur more often towards the southern limit of its range; and why should it starve in localities where food abounds, as about Washington, where most of the specimens secured have been picked up dead?"

That the diet of these owls is not entirely restricted to mice is borne out by the amazing statement of Mr. George Lawrence Nicholas, who says: "While hunting in a pine wood near this town (Summit, New Jersey), I obtained an Acadian (saw-whet) owl. Upon dissecting it I found that its stomach contained a flying squirrel, which had been *swallowed whole* and but slightly digested." Dr. Merriam mentions the following, which occurred at Point de Monts, Canada: "In winter Mr. Comeau once saw one of these little owls fly from within the carcass of a great northern hare which had been caught in a snare. The owl had eaten away the abdomen and was at work within the thoracic cavity when frightened away."

Fisher states that while the species is not migratory, it is more or less an irregular wanderer in its search for food during the fall and winter, and that it may be quite common in a locality and then not be seen there again for several years.

Two interesting variations from the usual nesting site in a cavity are recorded by Captain Bendire, who cites one found in a deserted nest of the black-crowned night heron and another in an old squirrel's nest. Fisher states that: "Mr. W. Perham, of Tyngsboro, Mass., was very successful in inducing this owl to build in nests which he put up in different parts of the forest. These 'nests' were sections of hollow limbs closed at the ends, with an entrance hole made in the side."

A word about our photographic equipment may be of interest. As is invariably the case in bird photography, the most satisfactory results were secured with a four by five graflex camera fitted with a ten-inch lens for close work and a twenty-inch lens for distance pictures. However, several "posed" pictures of the young birds were taken with an ordinary type of postcard-size folding camera, with a six and one half inch anastigmat lens and rapid shutter.

One of our most indispensable adjuncts, aside from the cameras, was a large mirror fitted upon a tripod with an adjustable head, which permitted us to throw a beam of brilliant light upon the object to be photographed when it was in shadow, and thus made possible fast exposures where a time exposure would have shown movement. It kept one of us busy adjusting the tripod head to compensate for the movement of the sun, but the results were worth the effort, for through the use of the reflecting mirror we secured several pictures that would have been photographic impossibilities without it.

Another very useful appliance was a huge, specially designed tripod with legs nearly twelve feet long, which enabled us to elevate the camera to otherwise inaccessible positions.

Our twenty-inch lens made possible good-sized images of the owl at a distance of ten or twelve feet, but the lenses of shorter focus required exposures at a distance of from two to four feet. Additions to the above equipment were a small keyhole saw for cutting into the cavity, nails to reattach the part removed, a very generous supply of plates, and an inexhaustible (?) amount of patience and good humor.

Our experiences with these little owls in addition to the information we gained concerning them, taught us many things: just how long we could hold our tempers; how many tons our paraphernalia weighed after we had packed it up the steep hillside; how much stifling heat a human being could endure under a hot focusing cloth, and how good a lunch could taste after our work was over. Yet in spite of it all we look eagerly forward to another intimate glimpse into the home life of our new-found friends—the saw-whets.

A captive saw-whet (on the right) photographed with an adult Rocky Mountain screech owl (on the left) to illustrate differences in size and markings and the absence in the one owl, the presence in the other, of the ear tufts

WHY PALÆONTOLOGY?

BY

W. D. MATTHEW

In an institution as large as the American Museum, where each department is giving devoted attention to its own tasks and aims, there is need, in the interest of coördination, of bringing to the attention of each department the purposes and accomplishments of its fellow departments. With this end in view there were arranged during the past year a series of informal addresses delivered in turn by the several department heads before the assembled Museum staff. These addresses accomplished their purpose admirably, making clear as they did, the varied scope and meaning of the Museum's different fields of endeavor. Feeling that a larger audience than that originally addressed may be interested in having an opportunity to judge of the character of these informal talks, Natural History prints below that of the curator of vertebrate palæontology.

When Director Lucas invited me to take part in this series of more or less informal talks, he told me my subject would be "Why Palæontology?" What are we trying to do in the department of vertebrate palæontology, and why is it worth doing? That reminded me of a rhyme that I learned when I was a small boy:

There once was an Eminent Elephant
  Who invented a thing called a Tele-
    phant.
When asked "What's it for?"
  He replied: "Such a bore
To be pestered with questions irrele-
    vant."

Now I think there are a good many people who are inclined to ask that question and, in spite of the eminent authority I have cited, they have a good right to ask it. It is a question that ought to be asked and answered. And if the answer isn't satisfactory, we have no business to be wasting our time on it. What's the use of collecting and studying fossils, and why should this public institution be devoting so much money and space to them?

I may as well say in the first place that, from a purely materialistic point of view, palæontology isn't of much direct use, if any. Chemistry, physics, economic geology, the agricultural sciences, and many others are decidedly practical subjects. They lead directly to inventions and discoveries that improve our methods or increase our output or save labor, in manufactures, in mining, or in agriculture. They are applied sciences from this point of view, and their use to civilization is obvious, as they are directly responsible for its great advances in material comfort and prosperity.

But there is something more than this to civilization, something more to be desired in the world than luxury and short hours of labor. Knowledge and understanding, the appreciation of the beautiful both in nature and art, are things worth while for themselves alone, even though they do not increase our income or decrease our hours of labor. Everybody reads the newspapers. Why? Certainly not one in ten thousand reads them solely for business reasons. We read them because we want to know and understand what is going on about us. We read books mostly for the same reason, because we want to know. The newspapers maintain a vast organization for the purpose of gathering news, of getting together evidence of what is going on in the world, and presenting it to their readers. We, in our smaller way, are gathering together evidence as to what went on in the world in past ages and presenting it before our visitors, because they want to know about it. If anybody demands "Why palæontology?" I may answer "Why the newspapers?" They do not need to apologize for their existence, and neither does palæontology. What we are trying to do is to get together all the evidence we can bearing on the past history of life on the earth, and of vertebrate life in particular. It is a most interesting history, varied and changeful, with many sensational aspects and episodes, and through it all runs the silver thread of evolution and adaptation, uniting all the scattered data into a continuous historic record. The fossils are our documents, and are to be treasured and preserved and studied as such, and the first and fundamental object of a museum is to take proper care of its records, the second and larger task is to interpret them and show people what they mean and what they prove. We are not collecting curios, we are teaching geologic history.

This history, of course, is on a very different scale from human history. It deals in æons, not in centuries, in geologic ages that cover millions rather than hundreds of years. But in either case the history has to trace the evolution of races, their development and adaptation to their environment, their rise and growth and extinction and replacement by others, the sequence of cause and effect in the events that are recorded; and in the end to interpret and understand what exists today through our knowledge of what has happened in the past.

In the history of the vertebrates we deal chiefly with five great geologic eras, the Age of Fishes, the Age of Amphibians, the Age of Reptiles, the Age of Mammals, and the Age of Man. The last three are represented by the three exhibition halls in which our collections are placed; the first two will be adequately installed later on, but at present we have to crowd them into the little tower room and a corner of the reptile hall. These represent the five principal stages in the history of vertebrate life, beginning with the fishes of early geologic ages, then the amphibians of the coal era, then the dinosaurs and other giant reptiles of the Mesozoic period, next the evolution of the mammals during the Tertiary period, and finally the dominance of man during the latest geologic period, or Quaternary.

The Age of Fishes is marked by the dominance of the fishes as the principal known type of vertebrate life. These, of course, lived in the water, and we know very little about the terrestrial life of that period. I think it is rather rash to assume that there was not any, as Mr. H. G. Wells does in the sketch of geologic history that opens his *Outline of History*. We do not know.

The Age of Amphibians is characterized by numerous kinds of amphibians and primitive reptiles. The amphibians began life as tadpoles, breathing by gills and living in the water, and when full grown, came out on the land and breathed by lungs. The reptiles breathed air by lungs and lived upon the land. These amphibians and reptiles were the dominant animals, the highest types of vertebrate life of their time. Many of them were strange in form, and of fairly large size, and nearly all preserved a good many features from their fish ancestry that have been lost by the later reptiles and mammals. We have two important collections of the animals of this period: the skeletons of *Eryops* and *Naosaurus* and *Dimetrodon* and *Diadectes* from Texas and the *Moschops* and *Endothiodon* from South Africa.

The Age of Reptiles is especially distinguished by the dinosaurs, which were the great land animals of their time, and by the ichthyosaurs and plesiosaurs and mosasaurs, great sea-reptiles, and the pterodactyls, or flying reptiles. There was a great variety of dinosaurs, biped and quadruped, armored and unarmored, herbivorous and carnivorous, and they are splendidly represented in our exhibits, so much so that they have crowded almost everything else out of the reptile hall and encroached a good deal on the mammal hall beyond. The *Brontosaurus* and *Allosaurus* and two smaller kinds represent the middle period of the Age of Reptiles; the *Tyrannosaurus*, the *Trachodon* group and about a dozen other skeletons represent its later development.

The marine reptiles are very scantily represented, as compared with what could be done, chiefly because of lack of space, but there are skeletons of three kinds, ichthyosaurs, plesiosaurs, and mosasaurs on exhibition, and the fine *Pteranodon* skeleton and a tiny little pterodactyl represent the flying reptiles.

The animals of the Age of Reptiles are so remarkable and different from anything familiar to us that they strike the imagination as creatures of another world. In the Age of Mammals, on the other hand, the prominent feature is the evolution of the various types of modern animals from primitive ancestors. This is the keynote of the hall, and the evolution of the horse is the most striking and best arranged illustration of it. The record is also well shown, however, in various other races,—the camels, rhinoceroses, the extinct titanotheres, and others.

The last and finest of our exhibition halls represents the Age of Man. The most impressive feature in it is the series of mural paintings by Charles R. Knight representing faunal life scenes of this period, and showing both primitive types of man and the animals that were contemporary with him in various quarters of the globe,—the immediate predecessors, and near relatives for the most part, of modern animals. The central exhibit in the hall shows what is actually known of fossil remains of primitive man with reconstructions and charts to interpret and explain it. The fossil remains as yet are few and fragmentary, but we hope that in the future our records may be more complete. On the north side are arranged the mammoths and mastodons of the northern continents, and on the south side the ground sloths and glyptodons and other South American giant animals. These will be supplemented later with other characteristic types of the magnificent fauna that lived in all regions of the world during the Age of Man—the cave-bear and the Irish deer, the *Diprotodon* of Australia, and the great variety of animals which have been found at Rancho-la-Brea near Los Angeles.

A section of the hall of dinosaurs, showing an interested group of crippled children gazing upon creatures that are impressive not only from the standpoint of size but also because of the vast period of time that separates them from the present

A PRIZE–WINNING EXHIBIT

Jamaica High School was awarded first place in an eagerly contested floral competition. Initiative, ingenuity, and an ardent school spirit were required to bring together flowers and products of such variety and attractiveness. Underlying the gayety of the setting were real lessons in science. Boxes of seeds were arranged in a manner to convey instruction, and the flowers and vegetables were carefully identified and labeled with the scientific and family names as well as with their common designations

JUNIOR HORTICULTURISTS OF GREATER NEW YORK

A FLOWER SHOW AT THE AMERICAN MUSEUM IN WHICH PUPILS OF THE CITY WERE INTERESTED COMPETITORS

BY

RUTH CROSBY NOBLE *

TO THOSE who believed that the high-school students of New York City could not derive pleasure and benefit from nature study, the Flower Show held at the American Museum on September 30 and October 1 and 2 was a convincing refutation. The eagerness and pride illuminating the faces of the boys and girls as they brought in their contributions, the enthusiasm with which they arranged their exhibits, and their genuine interest to know of the things before them proved conclusively that nature study does have a place even in a city as built up and well-nigh gardenless as is New York.

The Show was planned by the New York Association of High School Biology Teachers for two purposes: to increase the interest in nature among the children themselves, and to give the public an opportunity of seeing what the schools had accomplished in the way of practical nature study. Aside from this was the desire, through displays of artistic posters announcing the Flower Show and musical recitals by school orchestras, to establish among the departments of art, music, and biology, a common object of endeavor. The plan was confined at first to the high schools of Greater New York. The committee in charge later decided to invite the coöperation of other organizations and were more than gratified by the splendid response which they received. The exhibits of the National Plant, Flower, and Fruit Guild, the State Institute of Applied Agriculture at Farmingdale, the School Garden Association, and the Brooklyn Botanic Garden proved to be valuable and striking additions to those of the high schools.

The afternoon before the formal opening, Memorial Hall and the Hall of the Eastern Indians were flanked with dull-looking tables over which were scattered long rolls of paper and hundreds of empty receptacles. Cut flowers, vegetables, potted plants, flowerless plants, water flowers, and seed collections were gradually brought in by eager school children, beaming with pride over their own garden produce or over the gifts of their friends. Teachers and pupils energetically labelled the material, arranged it in the proper booths, and soon had the halls transformed.

Those who came to the opening of the Flower Show Friday afternoon faced, as they stepped into Memorial Hall, the gay display of the outside organizations. There was the central exhibit planned by the National Plant, Flower, and Fruit Guild,—an association organized to distribute among the city hospitals and tenement districts the flowers, fruits, and jellies which are sent in from rural branches. Community gardens are also an important feature of the work of this association. To the right of the entrance were photographs and pamphlets, as well as garden produce, shown by the State Institute of Applied Agriculture at Farmingdale. Roosevelt said of this school, "Among all valuable agricultural colleges of the nation, the institution at Farmingdale stands out, because it doesn't only teach farming but, to an extent equalled nowhere else, it *creates farmers*." At the left stood one of the most appealing of all the exhibits,—the flowers and vegetables harvested by grammar school "farm hands" in the tiny plots of the School Garden Association. Last year more than thirty acres in Greater New

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York were cultivated under the supervision of this Association and the produce harvested by the 3700 children enrolled was valued at $100 a day.

A picturesque background to these groups was formed by screens of posters which had been submitted by the high school art students for the competition. On Saturday the posters were judged by Mrs. Charles R. Lamb of Mosaic Cornell Chapel and Miss Katherine Lamb of the Institute of Design at Cooper Union, and first place was given to one of the girls of the art department of Washington Irving High School. From behind the screens strains of music rang through the formal halls of the Museum,—the high school orchestras were also contributing to the success of the Show.

An especially interesting exhibit of ferns and flowerless plants was arranged just west of Memorial Hall under the auspices of the Brooklyn Botanic Garden. Near by was a case of colored prints portraying the wild flowers of New York, loaned by the State Botanist, Mr. Homer D. House.

The Hall of the Eastern Indians was given over to the exhibits of the competing high schools. Each alcove was backed by a flaring high school banner and transformed into a thing of beauty and color with flowers, plants, fruits, and seeds, procured from all possible sources. Some of the specimens were brought by the boys and girls from their own gardens or from the gardens of their parents. Others were contributed by friends. The children who lived in the more crowded districts hiked into the country and returned with armfuls of fruits and nuts, flowers and shrubs. Still other material came from florists and seed dealers. Each plant was labeled with a card, upon which was indicated with great care and accuracy the scientific name, the family name of the plant, and the name of the school exhibiting it. Miss Ellen Eddy Shaw and Mr. Montague Free—both of the

A harvest of carrots of which any farmer might be proud

The school gardens of Greater New York offer a means of escape from the high cost of living. Market prices of vegetables as wholesome and fresh as these are prohibitive for many people

Brooklyn Botanic Garden—judged the exhibits from the point of view of variety, quality, and arrangement. First place was given Jamaica High, with Bay Ridge coming second, and Newtown third. In addition to the contest between the high schools, there was the contest within the schools for the best individual contributions. Seventeen prominent publishers lent their encouragement by donating books as prizes. Seeds were also presented by H. Burpee and Company for the same purpose.

On Friday evening the Visual Instruction Committee arranged an exhibition of motion pictures of scientific interest, photographed by Mr. Charles F. Herm, formerly of the American Museum. Addresses were made by Dr. Ernest L. Crandall, director of visual instruction, and by Dr. Maximilian Grossman, head of biology in the high schools. Additional motion pictures were shown Saturday afternoon and a lecture on dahlias was given Saturday evening by Dr. Howe of the New York Botanical Garden, Bronx Park.

The Flower Show was the first of its kind ever held. Great credit is due not only to Superintendent Meleny, in charge of the high schools, who gave his sanction to the project, but also to the efficient committee, headed by Miss Rosemary Mullen, which was in immediate charge of the arrangements. Not only was interest in botany stimulated, but also that love for growing things which is inherent in all boys and girls. Their store of facts was enriched, they were given an object lesson in scientific accuracy, and their appreciation was perceptibly broadened. Incidentally they had placed before them a worth-while diversion for their energies. It was healthful and attractive work, offering opportunity for that refreshing out-of-doors exercise of which city children are always in need.

Community gardens are a feature of the work of the National Plant, Flower, and Fruit Guild. The children's garden maintained by the Guild at Avenue A and 65th Street is sufficiently spacious to permit 600 children to have plots for cultivation

Various methods of attack were employed in the campaign waged in New Jersey against the gypsy moth. Before the potential destroyers of foliage had an opportunity to emerge from the egg, vast numbers of them were rendered harmless through creosoting of the egg clusters. During the caterpillar season twelve machines of the type shown in the illustration above were operated in the infested territory. The foliage of parts of the Watchung Mountains was sprayed, the insecticide being forced through a half mile of hose laid on the mountain-side. In treating small trees and low growth, a spreader was attached to the nozzle, causing a fan-shaped spray to be delivered

THE GYPSY MOTH IN NEW JERSEY

HOW AN INSECT MENACE HAS BEEN CHECKED

ONE of the most pernicious of insect immigrants from the Old World and one so tenacious that the efforts of the federal government as well as those of several of our states have as yet failed to accomplish its extermination, is the gypsy moth (*Porthetria dispar*). Accidentally liberated in Massachusetts in the late sixties, it has to its discredit more than half a century of destructive activity in this country. Its ravages would have been even more destructive except for the unremitting labors, backed by lavish sums, that have been devoted to its control. Until recently the campaign waged against this insect had succeeded in keeping it confined to New England, and the hope was cherished that it would not extend beyond this area. Very disquieting, therefore, was the discovery, made now well over a year and a half ago, that it had gained a firm foothold in New Jersey. It has been surmised that it reached that state in a shipment of blue spruces imported from Holland and planted on the Duke estate in Sommerville during 1911. To the prompt action of the United States Bureau of Entomology in placing a force of scouts in the field, and to the foresight of the state legislature in voting funds, supplemented later by an appropriation made by Congress, is due in no small measure the fact that the havoc wrought in New Jersey has not been greater. Indeed, so effective have been the preventive measures that it is reported that less than a year after the inauguration of the campaign, gypsy moth caterpillars are difficult to find, even in the areas most heavily infested. Reference to the progress of the work in New Jersey has been made from time to time in NATURAL HISTORY; these earlier reports can now be supplemented by a further statement of accomplishment.

The magnitude of the task is indicated by the fact that no less than 403 square miles were found to be infested, of which 175 were generally infested, the rest lightly. About most of this territory a wide border area was examined and found free of traces of the gypsy moth. The infestation was heavy in Hillsboro, where more than 3,000,000 egg clusters were creosoted. At Mendham, where, as a result of the scouting work, 1400 egg clusters were found in old orchards and grounds near by, many of the infested trees were cut down and burned, the owners coöperating. In the case of trees not so destroyed, the egg masses were creosoted and, furthermore, a large safety area was sprayed.

In addition to scouting and the destruction of egg clusters, extensive spraying operations were engaged in over the entire territory. More than 2400 acres were so treated, exclusive of miscellaneous growth along fences, river banks, etc. Seventy-five tons of arsenate of lead were used, and approximately 2,700,000 gallons of spray applied. Also, approximately 20,000 trees were banded with sticky material and 15,000 with burlap.

A state quarantine, administered in coöperation with the Federal Horticultural Board, has been placed on the infested territory, as well as upon the small outlying areas where only a few egg clusters were found. This quarantine furnishes adequate authority to prevent the shipment of infested stock to other parts. Nurseries and other centers of distribution have been inspected, some several times, and every precaution has been taken to prevent the shipment of material carrying egg clusters or larvæ.

So satisfactory have been the results that a spirit of over-confidence may easily be engendered in the public, with resulting failure adequately to support the continuation of the work. Not to recognize the fact that only by persistent, unrelaxed vigilance can this pest be permanently checked is to invite a repetition of the situation, or worse, that has happily been remedied. A comparatively small number of liberated insects sufficed for the colonization of large areas in New England; the comparatively insignificant remnant of the New Jersey infestation, if allowed to breed unchecked, may in a short time become a menace difficult to control.

NOTES

AFRICA

The accomplishment of one of the major purposes of Mr. Carl Akeley's expedition into the African jungle, namely, the securing of a group of gorillas for an American Museum exhibit, is tersely announced by the explorer in a cablegram, dated December 10: "Five beauties. Male 360 pounds. Span 7 feet 8."

To appreciate the significance of this announcement, one must bear in mind that although so many of the larger animals of Africa have long been familiar to the world, it was not until 1846 that definite proof of the existence of the gorilla was furnished through the accidental discovery of a skull of this ape by the Rev. Dr. J. Leighton Wilson, a missionary.

Tales of the existence of such an animal had, however, drifted to civilized lands from time to time prior to this event. The earliest of these descriptions which may with some degree of probability be applied to the gorilla is that given by one Andrew Battell, who sojourned for a time among the Portuguese in Angola. It was printed in *Purchase His Pilgrimage* by Samuel Purchase, several successive editions of which appeared in the first quarter of the seventeenth century. In spite of the statements therein contained to the effect that the huge apes, or, as Battel calls them, pongoes, "will come and sit about the fire [made by natives]," and that "many times they fall upon the Elephants, which come to feed where they be, and so beate them with their clubbed fists, and pieces of wood, that they will runne roaring away from them," Battel's account is not lacking in touches which have inclined some to the belief that the creatures he writes about are actually what we today know as gorillas.

Relatively few specimens of the gorilla have been secured in the period that has elapsed since 1846 and contradictory statements regarding its alleged habits in the wild still await clarification. It was to study the living animal, in addition to securing a Museum group, that Mr. Akeley undertook his trip, and an evidence that this side of his work is meeting with success is the fact that he has actually come close enough to gorillas to photograph them.

ASIA

The latest report of the Third Asiatic Expedition of the American Museum in coöperation with the American Asiatic Association and *Asia Magazine*, contains the reassuring news that Mr. Andrews returned successfully from an expedition for takin, a very rare mountain type related to the chamois, the serow, and our own Rocky Mountain goat. Mr. Andrews writes, October 31, 1921:

"I am on the train *en route* to Pekin after the trip into Shensi for takin. It was the hardest trip I've ever had—fearful work in the roughest mountains of China—and we came as close to having 'adventures' as I have ever come. There was a good bit of fighting going on about us and we ran squarely into a crowd of 200 brigands, but my medical kit came in very nicely; I patched up wounded men for an entire day, and they were very grateful. They treated us with the greatest courtesy and even gave us a guard of honor until we were out of the danger zone. It was an interesting little experience and proves my doctrine that understanding of the people avoids 'adventures.' We got the takin and a splendid lot of small mammals, many of which are certainly new to science."

A letter sent by Mr. Andrews from Pekin on November 11 throws further light on the exceptional difficulties attending the hunt for the takin:

"The takin were down in the thick bamboos on the summit of very rough peaks at an altitude of 12,000 feet, and it was heartbreaking work getting them. I shot a splendid cow and her calf. I have left two of my native hunters in the mountains to try to get a bull, for we were driven out by a heavy fall of snow. Moreover, we were almost exhausted, our food was entirely gone, and we were so badly battered up from falling among the rocks and the terrible work in the bamboos, that we had to have a respite. I have no doubt that my native hunters will get a bull and we will then have a very spectacular group.

"I have never beheld any animal so remarkable as the live takin. It is the reincarnation of the Golden Fleece. These Shensi takin are quite different from those of Szechwan, of which we have a mounted specimen in the Museum. They are bright golden yellow, and when seen among the green bamboos give a really startling effect."

A letter from Mr. Walter Granger to President Henry Fairfield Osborn of the American Museum reports on the progress of Mr. Granger's work in China, and like the letter from Mr. Andrews just quoted gives some idea of the difficulties of exploration in that much disturbed country. He says:

"I reached Wauhsien on September 8 after some delays and some interesting experiences due to the inter-Provincial warfare going on along the Yangtze. At Ichang we ran directly into fighting and found a good deal of entertainment in watching it, through field glasses, from the deck of our boat. After five days we got away from Ichang on an up-river boat, the 'Loong Mow,' and had a day and a half of some of the most remarkable scenery to be observed anywhere.

"The steamers do the gorge trip almost too quickly and the wonderful limestone cliffs are behind one before one has time fully to take them in. The proper way to see the gorges is by house boat in winter when the water is low.

"On our arrival at Wauhsien we were most cordially received by the Commissioner of Customs, Mr. C. G. C. Asker, who invited us to make our headquarters at his place. Mr. Andersson had been in correspondence with him and he was expecting us. This is only a very small foreign community and visitors are always welcome. The Standard Oil (2 men), the customs (3 men), the post office (1 man and wife), and one Protestant and one Catholic mission constitute the white population of the town. . . .

"The country is reported fairly free of bandits just now. Most of them, in fact, have joined the Szechwan army and are either around Ichang or on their way there. This leaves things relatively peaceful here, but the population dreads the time, later in the fall or early winter, when these soldiers begin to drift back, looting as they make their way up-river. They seldom get any pay and have to live off the country, as it were.

"We are all well. The cool weather of fall is just setting in. There were no frosts here last winter, and work throughout the season is possible."

In his next letter Mr. Granger expects to report upon the results of the collecting trip to which this journey was preliminary.

AUSTRALIA

Under date of October 26, Mr. Harry C. Raven, the field representative of the American Museum in Australia, writes:

"I left Moseley's Ranch, in the mountains of northern New South Wales, on the fifth of September and went to Ebor for a few days. It was raining when we broke camp and rained for most of the following week or so. While at Ebor we were able to make use of the time by drying the specimens already prepared and in getting a few others from the gorges near the Ebor Falls. They included the wallaroo, *Macropus robustus*, and a wallaby, *Macropus ualabatus*. One of the females of the last-named species had a young one in her pouch. The young one was well developed and was certainly about ready to leave the pouch for good. We kept this young wallaby as a pet for two or three weeks and I was able to get some photographs of it.

"Next we made a camp at a place called Glen Ferneigh, or Cedar Log. At this camp two species of phalangers, *Pseudochirus peregrinus* and *Trichosurus caninus*, were found to be quite common. The former was the more numerous and I collected a good series of it. The skins would probably have been in better condition had we obtained the animals a few weeks earlier; the spring weather had caused them to begin shedding their coats. Each of the greater number of females (and nearly all were females) had two naked young in the pouch. There were also two or three young of the *Trichosurus* procured from the pouches of the females of that species; in no case did a female have more than a single young one in the pouch. Besides the phalangers, we found *Phascologale flavipes* with young in the pouch. At Moseley's Ranch, in New South Wales, only the *Phascologale swainsoni* had young. At Glen Ferneigh we also secured two additional species of *Macropus*, namely, *thetidis* and what is probably *parryi*. Besides the specimens already mentioned, the only other new one added to the collection from this locality was a bat, which I believe to be a species of *Chalinolobus*. These bats were very numerous in some caves that we found beneath a waterfall, so we collected a large series of them."

SOUTH AMERICA

In the last issue brief allusion was made to the accident which cut short Mr. Cherrie's recent expedition to Ecuador. Fuller details are now available and deserve to be recorded if only for the light they shed on the personality of one who has worked indefatigably in the interests of the American Museum. The accident occurred on the morning of September 21, 1921, while Mr. Cherrie was out hunting in southwestern Ecuador, close to the Peruvian border. Both barrels of his gun, which was loaded with number eight shot, were discharged simultaneously into his forearm, severing the ulna.

A return to the coast was, under the circumstances, imperative. Accordingly, as soon as first-aid treatment, necessarily very rudimentary, had been administered and animals for the trip had been secured, a start was made for Santa Rosa, distant eighty-five miles, where Mr. Cherrie hoped to catch the weekly steamer for Guayaquil. So great was his pain that he was unable to ride on the level or downhill and consequently, the upgrades excepted, he walked all the way. The journey to Santa Rosa necessitated the ascent and descent of a mountain 8000 feet in height. Food that the invalid could retain was difficult to find and the natives he met naïvely asked, "Why eat anyway?" The last day of the three-day journey the party took the trail at midnight, in the hope of getting the boat that reached Santa Rosa at 11 A.M., but arrived three hours after the boat had left. Since Mr. Cherrie's life depended upon their catching this boat, they started after it in a canoe and by great good fortune overtook it at a port farther down the river at midnight, just fifteen minutes before it sailed. The last day, therefore, Mr. Cherrie was on the way for twenty-four hours. He did not sleep from the time of his accident until he boarded the steamer.

Guayaquil was reached at 1 P.M. on September 25. By that time his arm was the size of his leg and was so gangrenous that his life was despaired of. An operation was performed as soon as possible and the shattered sections of the ulna were removed. Under the care of an American physician, Dr. H. Parker, Mr. Cherrie's condition then began to improve and five weeks later, taking advantage of the return to this country of the American Health Officer resident in the port of Guayaquil, Mr. Cherrie accompanied him to New York. He reached the American Museum in remarkably good condition when one considers all he had undergone. His wound was healing as rapidly as could be expected. An X-ray showed a probable regeneration of bone in the ulna which may eventually unite the severed ends. In short, every hope is entertained that in due time he will recover the use of his arm. Courage of rare quality was shown in proceeding in the face of obstacles so formidable. It would have been far easier to lie down on the trail and die than to keep under way. By fighting through, Mr. Cherrie again gave evidence of those sterling traits of character that have made him beloved not only by Colonel Roosevelt, with whom he was associated in the exploration of the River of Doubt, but also by all who have come in contact with him.

Since its foundation in 1916 the New York Zoölogical Society's Tropical Research Station at Kartabo, British Guiana, of which Mr. William Beebe is the director, has had as its main object, the observation of living organisms in their natural environment. No less than ninety-three contributions have already been published from the Station, eighty-nine of which are scientific papers and magazine articles, the remaining four being books, three from the pen of Mr. Beebe and one from that of Mr. Paul G. Howes. The New York Zoölogical Park, in which Mr. Beebe is honorary curator of birds, the New York Aquarium, and the American Museum have benefited from the activities of the Station. To the Zoölogical Park have been shipped live specimens, ranging from the silky anteater (*Cyclopes didactylus didactylus*) to an eight-foot bushmaster (*Lachesis mutus*); the Aquarium has acquired, among other fishes, electric eels (*Electrophorus electricus*) and Perai (*Pygocentrus niger*). The American Museum is indebted to the Tropical Research Station for a total of 521 mammals, belonging to fifty-six species and subspecies. These specimens are of particular value because, in addition to the skins, there are many skeletons. Many of these mammals are of especial importance because of the fact that a number of the South American types of the great eighteenth-century naturalist, Linnæus, were obtained from this general region. A report of the "Mammals Collected by William Beebe at the British Guiana Tropical Research Station," covering this acquisition and written by Mr. H. E. Anthony, curator of the mammals of the Western Hemisphere, American Museum, has just been published in *Zoologica*. Several hundred reptiles, amphibians, and fish have been collected at the Station, placed in alcohol, labeled, and shipped to the American Museum.

An exhibition of water colors of tropical animal life by Miss Isabelle Cooper, of the Tropical Research Station, was on view in the west assembly hall of the American Museum from January 5 to January 20. The exhibition was held under the auspices of the Ladies' Auxiliary of the New York Zoölogical Society, of which Mrs. Henry Fairfield Osborn is the chairman.

ANTHROPOLOGY

During the last week in October Mr. N. C. Nelson, associate curator of North American archæology in the American Museum, made his first and only field trip this year, to examine an alleged "Indian workshop" in the headwater region of the Lehigh Valley, northeastern Pennsylvania. His informant, Mr. Max Schrabisch of Paterson, New Jersey, accompanied him and they made their headquarters eight miles from White Haven on the farm of Mr. Calvin D. Dotter. It is on this property that the Indian site is located. The workshop in question turned out to be only a small one and might be designated more exactly as a temporary camping place. It is situated in a slight hollow of a broad, elevated mountain plateau, which until recently was virgin forest and is still largely covered with second growth. The particular attraction of the spot was a group of springs, furnishing a permanent water supply, and it is reasonable to suppose that Indian hunters and berry pickers occasionally made camp here and that the hunters during their stay spent some time at chipping spear and arrow points. At any rate, some three hundred points and numerous small chips have been unearthed during the past year from the surface soil, mostly in the immediate vicinity of the springs but scattering out thinly over an area covering several acres. Protracted search and excavation, however, revealed, on the one hand, neither blocks nor blanks of raw chipping materials that would indicate that the place was a true workshop; and, on the other hand, no other forms of implements or of pottery such as would be expected at a regular village site. The elevation, moreover, is too high to permit maize properly to mature and it is, therefore, improbable that a permanent settlement was established.

During the stay, Mr. Schrabisch personally investigated a rock-shelter in the cañon of the Lehigh River, about two miles to the north, where he found evidence of occupation in the shape of net sinkers, chipped points, broken pottery, and fragmentary animal bones. Representative samples of everything found were brought to the Museum.

Clarence Leonard Hay, research associate in Mexican and Central American archæology, has been appointed an American Museum Fellow, to represent the Museum in the International School of American Archæology and Ethnology in Mexico. This school is designed primarily as a research center for mature students; fellowships are maintained in it by several American institutions of learning. Mr. Hay, who is on the point of leaving for the southern republic, will take an active part in the investigations and instruction carried on by the school. In company with Dr. Alfred V. Kidder of Phillips Academy, Andover, he will make an archæological reconnaissance of the region lying between Mexico City and the Rio Grande, with a view to studying the pre-Pueblo culture of that area.

ENTOMOLOGY

A unique exhibit is being installed in the railing cases of the third floor, east wing, of the American Museum. It will show different kinds of insects that were actually found in the small yard (75 x 200 ft.) of a residence in the center of a suburban village. Dr. Frank E. Lutz, curator of entomology, is unwilling to commit himself at present as to the number of species beyond saying that there are "more than five hundred." One of the fascinations of entomology is, that, in spite of the vast number of species already known, discoveries can still be made at our very doors, as this collection well illustrates. A number of the species in it have not hitherto been recorded from the state in which the suburban yard is situated, namely, New Jersey, although that state is the best known, entomologically, of any of our states. Furthermore, so much still remains to be discovered concerning insects that the life histories of more than half of the species found in this suburban yard are unknown. On what do the young feed; where do they pupate; how is the winter passed? These are a few of the puzzling questions that still await the investigator.

Mr. F. E. Watson, assistant in Lepidoptera, American Museum, is now in Hayti, continuing the American Museum's entomological survey of the West Indies. The expenses of this expedition are being defrayed by Mr. B. Preston Clark, himself an authority on the moths of the family Sphingidæ and possessor of an unrivalled collection of these insects. Mr. Clark also met the expenses of Mr. Watson's expeditions to Santo Domingo and Jamaica. Hispaniola, the island composed of Santo Domingo and Hayti, is particularly interesting because the relatively large extent of wild land there still harbors ancient and unique forms of life. The island is interesting also because it is the type locality of a large number of species of insects that were described in the early days, some of which have not been taken since.

HERPETOLOGY

An African land turtle, *Testudo loveridgii*, is the only known example of a reptile which in the adult stage lacks ribs. As the carapace, or shell, of turtles consists to a large extent of the ribs, it is not surprising to learn that in the adult stage this turtle lacks a shell, which is perhaps the principal element in any mental image we form of a turtle. Not in all of its stages is this turtle, which is confined to a rather limited area of Tanganyika Territory (German East Africa), devoid of a bony protection. In fact, at a certain stage the young have ribs with platelike ossifications lying on top of them, and resemble in this respect, as in several others, the corresponding stage of the turtle *Testudo pardalis* or *græca*. There is a progressive degeneration of the bony structure as *loveridgii* approaches the adult stage.

There is a turtle, *Testudo tornieri*, that represents with respect to the carapace an intermediate stage between the turtle herein described and the other members of the genus *Testudo*.

The flat shape of the turtle, *Testudo loveridgii*, is another peculiarity deserving emphasis. Almost all land turtles incline to the dome shape, many conspicuously so. The flat shape is more characteristic of the aquatic species. Yet here we have a land turtle that is excessively flat, more so than any of the aquatic members of the family Testudinidæ.

Three specimens of this remarkable turtle have recently reached the department of herpetology, American Museum, having been supplied through the courtesy of Mr. Arthur Loveridge, after whom the species has been named. One of these specimens represents the early stage, in which there are evidences of ossification; the second, an intermediate stage; the third, the soft-backed adult reptile, which is six inches in length.

What explanation can be given of the peculiarity mentioned? What function, if any, does this apparent degeneration serve? Why should the adult be deprived of a shell—which one would consider a character of no little value in the struggle for existence—in which the soft parts of the creature can take refuge when enemies approach? The sole advantage seems to be that, unencumbered by a bony burden, the turtle is able quickly to seek shelter amid stones or under them, as do lizards and serpents. The region inhabited by this turtle is arid, sandy, and stony. The vegetation is of the spiny kind. Mr. Loveridge, who has observed the turtle in life, has been cited to the effect that it has the ability of elevating, and in turn, of lowering the back, regulating these actions through its lungs and that thereby it is enabled to penetrate into the crevices of rocks and amid stones from which it is dislodged only with great difficulty. There are lizards, especially of the genus *Sauromalus*,

Picturesque rock formation in the tidal zone just below the Harpswell Laboratory. Formations of this kind are characteristic of Mount Desert Island

that wedge themselves into the crevices of rocks they inhabit by inflating the body in much the same way.

LOWER INVERTEBRATES

Mr. Roy W. Miner, associate curator of lower invertebrates, spent part of the month of September on Mt. Desert Island, where he visited the newly established Weir Mitchell Station of the Harpswell Laboratory. Through the courtesy of the director, Prof. Ulric Dahlgren, and other members of the laboratory staff, Mr. Miner was enabled to examine the possibilities of the island as a site for future studies of the marine invertebrates characteristic of the rocky coast, from the viewpoints of exhibition work and scientific, ecological investigations. Mt. Desert Island is unusually diversified for an island of its size. Though only about fifteen miles long and twelve miles wide, it possesses eight mountain peaks from 1000 to 1500 feet in height, and many others of smaller elevation. There are several beautiful mountain lakes and the only typical "Norwegian" fiord on the American coast. The latter extends ten miles into the body of the island. The mountainous parts of the island are largely comprised within the limits of the new Mt. Desert National Park, obtained for the government through the activity of the Wild Gardens of Arcadia Association, of which Mr. George B. Dorr is president. The coasts of the island are bold and rocky, with here and there typical examples of sandy beach or mud flat. Huge caverns, carved by wave action, overarch sea pools where at low tide may be seen displayed beautifully tinted sea anemones, sponges, corallines, and other marine invertebrates in great abundance. The new laboratory, situated at Salisbury Cove village on the northern shore of the island, about six miles from Bar Harbor, stands on a picturesque promontory between two sheltered coves. The tide rises here a distance of twelve feet. The animal and plant life is profuse, not only in the shallow waters but in the deeper channels which run close to the shore in many places, affording unusual opportunities for dredging. The flora of the island is as distinctive as the fauna, boreal forms growing side by side with plants characteristic of more southern climes. The alpine *Empetrum*, generally found at high altitudes, here grows just above the tide limit.

During his stay Mr. Miner made collections at ten different points in ten days, and took many photographs. He then visited the Marine Biological Laboratory at Woods Hole, where he was joined by Mr. W. H. Southwick, the artist of his modeling staff, and with the coöperation of the laboratory officials, obtained additional data for the Gay Head Sound bottom group now in an advanced stage of construction.

In the July-August issue of Natural History the capture of the large squid (*Sthenoteuthis pteropus*), which was washed aboard the steamship "Caronia," was reported as the third record of the capture of this species. A letter has recently been received from Dr. James Ritchie, keeper of the natural history department of the Royal Scottish Museum of Edinburgh, stating that the species is by no means so rare in the neighborhood of the British Isles as this would indicate. He says that at least three individuals have been found at various times on the shores of the British Isles (in Ireland, and in England at Plymouth and in Northumberland), and he further states that during the past year he has examined two specimens from the shores of Scotland, one of which was alive when cast up on the Firth of Forth, not many miles from Edinburgh. The latter specimen exceeds in size that which was stranded on the "Caronia," and Dr. Ritchie has had it placed on exhibition in the Royal Scottish Museum, a plaster cast having been made of the fresh specimen. This remarkable specimen was described by him at the British Association meeting in Edinburgh in September of 1921, and the description will be published in an early number of the *Scottish Naturalist*.

It is quite evident, however, that the records of this species are few and noteworthy, and that the specimen in the American Museum of Natural History ranks well among the captures in point of size.

ICHTHYOLOGY

On December 15, Dr. E. W. Gudger, associate in ichthyology, American Museum, gave an address on "Sharks and Shark Hunting" before the Biology Club of the College of the City of New York. Readers of Natural History will recall the pictures of sharks which Dr. Gudger supplied for the article "What Sharks Really Eat" in the May-June issue. Although in his address, which was well attended, Dr. Gudger spoke of several sharks, he laid special stress on the nurse shark, *Ginglymostoma cirratum*.

MAMMALOGY

Through the generosity of Ringling Brothers, the circus proprietors, the American Museum of Natural History was fortunate in coming into possession, in April, 1921, of the body of little John Gorilla, or John Daniel as he was at first called. John is now on view in a case containing other anthropoid apes, on the third floor of the Museum.

John was extremely affectionate and intelligent, and to Miss Alyse Cunningham, of London, his former owner, who has given a very interesting account of his life in the issue of the *Zoölogical Society Bulletin* for September, 1921, credit is due for having developed these traits to an unusual degree.

Originally John Gorilla came from the French Congo and was taken to England in July, 1918, when not quite three years old. He entered England in company with a lot of monkeys consigned to that government for experimental purposes. He was sold to a departmental store as a Christmas attraction. A nephew of Miss Cunningham bought him in December, 1918, and under the tuition of the latter his real education began. He was taught just as a child would be taught to be cleanly. His feet and hands were washed twice daily and his hair combed and brushed. He sat at the table with the family and gradually acquired really good table manners. He loved children and heartily enjoyed playing with them. Many were the evidences of his intelligence and appreciation of kindness shown him.

He died in Madison Square Garden Tower, during the last week of April, 1921. His death created much interest among scientists, who saw in it the opportunity to acquire more definite knowledge of gorillas through a study of the anatomy of little John. Aside from this aspect of the case, John Gorilla left behind him a group of friends who sincerely mourned the loss of an intelligent and affectionate pet.

The department of mammalogy, American Museum, has recently installed fifty-four new steel storage cases of the "slidelite" type. In view of the congested condition in the storage space of the department, it has been necessary to place these cases along the walls of the main corridor on the fifth floor.

Tributes to the personality and scientific attainments of Dr. Joel Asaph Allen, late honorary curator of the department of mammalogy, American Museum, have appeared from the pen of H. E. Anthony, his colleague in the department, in the issue of *Science* for October 28 and of *Nature* for December 8. The "In Memoriam" address, delivered by Dr. Frank E. Chapman, curator of the department of birds, before the thirty-ninth congress of the American Ornithologists' Union, will appear in the January issue of *The Auk*.

In front of the ground sloth and glyptodont group (see Natural History, September-October, 1921, pp. 557-9) are shown a great armadillo, *Priodontes gigas*, and a two-toed tree sloth, *Cholœpus hoffmanni*, placed there for comparison with their extinct brethren—the glyptodonts and ground sloths. In looking at these degenerate representatives of a race of giants, one sympathizes with the Spanish naturalist who

JOHN GORILLA OR JOHN DANIEL

Few apes have excited more interest than this young gorilla, which was reared by Miss Alyse Cunningham of London and given almost human privileges. It was later acquired by Ringling Brothers, the circus proprietors, but lived only a short time in its changed environment. The ape, mounted in a realistic attitude, has been placed on exhibition at the American Museum objected to placing the *Megatherium* (the greatest of the ground sloths) in the order Edentata, since all the living species of edentates could dance in the hollow of its carcass.

None the less, the tree sloth is an interesting animal and much has been written about him. Charles Waterton, in the Third Journey of his *Wanderings in South America*, speaking of the sloth, says:

"Those who have written on this singular animal, have remarked that he is in a perpetual state of pain, that he is proverbially slow in his movements, that he is a prisoner in space, and that as soon as he has consumed all the leaves of the tree upon which he had mounted, he rolls himself up in the form of a ball, and then falls to the ground. This is not the case."

It seems probable that in writing this, Waterton had in mind the following account of the sloth given in *A New Geographical Grammar* by William Guthrie, Esq., London, 1776:

"Among those peculiar to this country, the most remarkable is the sloth, or as it is called by way of derision, the Swift Peter. It bears a resemblance to an ordinary monkey in shape and size, but is of a most wretched appearance, with its bare hands and feet, and its skin all over corrugated. He stands in no need of either chain or hutch, never stirring unless compelled by hunger; and he is said to be several minutes in moving one of his legs, nor will blows make him mend his pace. When he moves, every effort is attended with such a plaintive, and at the same time, so disagreeable a cry, as at once produces pity and disgust. In this cry consists the whole defense of this wretched animal. For on the first hostile approach it is natural for him to be in motion, which is always accompanied by disgustful howlings, so that his pursuer flies much more speedily in his turn, to be beyond the reach of this horrid noise. When this animal finds no wild fruits on the ground, he looks out with a great deal of pains for a tree well loaded, which he ascends with a world of uneasiness, moving, and crying, and stopping by turns. At length, having mounted, he plucks off all the fruit, and throws it on the ground, to save himself such another troublesome journey; and rather than be fatigued with coming down the tree, he gathers himself in a bunch, and with a shriek drops to the ground."

Sydney Smith wrote, in reviewing Waterton's book:

"The eagle to the sky, the mole to the ground, the sloth to the tree; but what is most extraordinary, he lives not upon the branches but underneath them. He moves suspended, rests suspended, sleeps suspended and passes his whole life in suspense like a young clergyman distantly related to a bishop."

Mr. Councilman says:

"Your sloth is a beautiful specimen and brought to my mind one that I had seen eating the leaves of a Cecropia. I saw him ascend a branch and completely disappear in a small bunch of leaves. When he moved I saw him again but when he stopped it was impossible to distinguish him from the leaves. It was like a conjuror's trick and I watched the appearance and disappearance for several minutes."

Evidently Mr. Councilman had seen the sloth in its native haunts where its hair is covered with a microscopic green alga, which, as noted, renders the sloth almost invisible, a most extraordinary case of concealing coloration.

MINERALOGY

RECENTLY the gem collection of the American Museum has received, through the gift of Mr. M. L. Morgenthau, a fine addition to its series of objects illustrating the antique use of gems. This takes the form of a necklace-shaped assemblage of aquamarines and other stones which constituted the trappings of a vizier of Morocco of the period of about 1750. It is made up of nine triple pendants in the form of medallions, the center of each of the twenty-seven medallions consisting of a rough-shaped aquamarine. In the case of the largest, middle medallion, the aquamarine is encircled by irregularly cut diamonds and sapphires arranged alternately; in the large medallions of the end pendants and the smaller medallions the surrounding gems are garnets. Below each triple pendant is suspended a crescent set with garnets. The pendants are richly set in gold and the spacing between them is filled in with elongated gold beads and six-sided, flat plates of carnelian, the latter engraved with the significant star and crescent of Islam. The reverse of the pendent medallions is richly enameled in intricate patterns and the pendants, beads, and carmelian plates, are strung on green silk spaced with groups of sequins.

This detailed description, however, gives no adequate idea of the rich and striking effect of barbarity produced by this ensemble. The stones are rough-shaped and polished after the manner of mediæval jewelry, the settings following the somewhat irregular outlines of the central stones. Moreover, all of the larger aquamarines used as central stones give evidence of having been pierced, evidently to be strung together as beads—an indication that they must have belonged to a much older and more primitive piece of jewelry.

It would be interesting to trace the former history of these old aquamarine beads, for rarely, if ever, is a gem once cut destroyed. It never wears out. If not buried with its owner, it must pass on to grace the person of his heir, or that of some less legitimate appropriator, and even when buried it may be dug up to dazzle the finder, kindle new envies, mayhap even to prompt crimes. Gold and silver objects are ultimately melted up and shaped into something else. A gem never loses its identity. The emeralds which graced Cleopatra are probably in existence somewhere in the world today.

Readers of the *Arabian Nights* will recall the reference in "The Second Voyage of Sinbad the Sailor" to an inaccessible valley, over the floor of which were strewn diamonds of incalculable value, and to the ingenious device employed by inventive merchants of the East to obtain the gems. The story relates that they flung meat into the depth as a lure to hungry eagles, which, in snatching up the meat, bore to their eyries also the adhering diamonds, that were then collected without difficulty.

There are numerous variants of this story, in some of which Alexander the Great figures as the contriver of the ruse. The oldest extant version of the story is contained in the writings of Epiphanius, Bishop of Constantia, in Cyprus, about 315–403. The story made its way to China and Arabia, to Persia and India, where Marco Polo picked it up during his travels.

A later day and more prosaic example of the employment of fowls for the recovery of precious stones is told by Mr. J. R. Sutton in a recent issue of the *Transactions of the Royal Society of South Africa*. In the early days of Kimberley, he relates, the breeding of poultry was a profitable business, because the fowls, picking for a dinner among the débris scattered about the mine, were wont to swallow not a few small diamonds. Hence it was customary after slaughtering a fowl, carefully to examine its crop for the possible yield of gem material. On one occasion no less than twenty-three diamonds, which in the aggregate weighed five and a half carats, were recovered from the crop of a pigeon shot on the DeBeers depositing floors.

The existence of emerald mines in the Muzo region of the Republic of Colombia was first disclosed to the world through the accidental discovery of small and indifferent stones in the crops of some chickens that had been introduced into the country. The location of the mines from which these gems were derived was, however, not ascertained until several years later, owing to the fact that the expedition under Captain Diego Martinez, which had come upon the stones in the curious manner mentioned, met defeat at the hands of the Muzo Indians, as had the previous expedition under Captain Luis Lanchero, to whom the introduction of the fowls in question is attributed. When finally the white men gained ascendency over the region, the location of the mine was discovered through a happy accident. It was on August 9, 1564, that one of the Spanish settlers, riding into the little town of Muzo, found that his horse was limping, and dismounted to examine its hoof. What was his surprise when, in place of a common stone as the offending cause, he took out of the animal's hoof an encrusted emerald! The excitement that this find occasioned in the village may easily be imagined. At once a party was formed that, with the owner of the animal, retraced carefully every foot of the trail over which he had ridden and the painstaking search resulted in the discovery of the since famous mines.

In our Southwest the industrious ants bring to the surface the garnets that obstruct their excavating and thus it happens that these stones are relatively abundant about ant hills. In serving their own ends these insects are thus unconsciously assisting man.

Popular fancy, in other periods of history, has associated gems of value with certain animals. Elizabethan and Jacobean literature, for instance, contains not a few allusions to the presence of a precious stone in the head of the toad. Thus Lyly in his *Euphues* states that "The foule Toade hath a faire stone in his head" and then euphuistically continues: "the fine golde is found in filthy earth; the sweet kernell lyeth in the hard shell; vertue is harboured in the heart of him that most men esteeme misshapen." The lines from *As You Like It* are even more familiar:

"Sweet are the uses of adversitie
Which like the toad, ougly and venemous,
Wears yet a precious Jewell in his head."

Curious potencies are attributed to this fictitious gem. One writer states that "it is available against envenoming"; another adds that it is "of power to repulse poysons, and that it is a most sovereign medicine for a stone."

ORNITHOLOGY

The thirty-ninth Congress of the American Ornithologists' Union was held at the Academy of Natural Sciences in Philadelphia, November 8-10, 1921. There was an exceptionally large attendance of fellows, members, and associates. The three days devoted to the presentation of scientific papers were fully occupied with interesting and valuable communications.

The following papers were presented by members of the American Museum's department of birds: "The Distribution of Bird-Life in Ecuador," "In Memoriam—Joel Asaph Allen," "Discontinuous Distribution as Illustrated by the Species of the Genus *Diglossa*," by Dr. Frank M. Chapman; "The Distribution of the House Wrens of the Genus *Troglodytes*," by Doctor Chapman and Mr. Ludlow Griscom; "The Andean Condor as a Coastal Bird," "The Status of Cory's Shearwater," "Distributional Notes on American Water Birds," by Dr. Robert Cushman Murphy; "The Classification of the Woodpeckers and Their Allies," "A New Family of Neostropical Birds, the Ramphocænidæ," "A Suggestion as to the Origin of Diastataxy," by W. DeWitt Miller; "The Problem of Field Identification" and "Identifying the Ducks of the Eastern United States at Long Range," by

Ludlow Griscom; "Some Remarks on the Avifauna of Matto Grosso, Brazil," by Mrs. Elsie M. B. Reichenberger. Mr. John T. Nichols of the department of ichthyology, who also attended the Congress, contributed a paper on "Yellowleg Skeletons."

The Brewster Medal, which was awarded for the first time at this meeting, was given to Mr. Robert Ridgway, as the author of *The Birds of North and Middle America*, vol. 8. Mr. James P. Chapin, assistant curator of African birds in the American Museum, was elected a fellow of the American Ornithologists' Union, an honor restricted to a total of fifty individuals.

PALÆONTOLOGY

The mountains of Cuba and the forests of Württemberg seem very far apart today, but the American Museum has recently received proof that the Jurassic seas of probably 130,000,000 years ago, in these two distant localities, were united by surprisingly similar forms of life. The collection made by Barnum Brown in 1918 and 1919 from the Jurassic beds of Cuba in the Province of Pinar del Rio has revealed a succession of the ancient cephalopods known as ammonites remarkably similar to those of Swabia and Switzerland and the Rhone Valley. As worked out by Miss Marjorie O'Connell for a forthcoming Museum *Bulletin*, we find in the mountains of Cuba an ammonite shell which in all of its proportions and dimensions varies by less than a millimeter from a shell of the same species described by the German palæontologist Oppel in Württemberg in the year 1863. This is a sure demonstration of the continuity of the seas which swept the coast of Cuba and of Württemberg in Jurassic times and furnishes convincing evidence of the exceptional value of species of marine shells for the history of the two hemispheres. It is especially gratifying to have in the American Museum, from formations of our sister republic of Cuba, palæontological specimens of such value that they shed light on related European fossils. The collections in the American Museum from the Jurassic of Cuba take the lead, and Barnum Brown, who is now in Asia, may feel repaid for the care which he took in assembling them.

Prof. E. C. Case, of the department of historical geology and palæontology of the University of Michigan and one of the research associates of the Carnegie Institution, has secured from the Triassic beds of Texas a very valuable collection, which he reports under date of December 12, 1921, as including "the finest stegocephalian skull ever found perfect; three phytosaur skulls; my new *Desmatosuchus;* some very puzzling dinosaur material." Triassic deposits are as rare in North America as they are abundant in Germany; the beds of Texas are one of the few localities in North America where the Triassic fauna, the most ancient of the Mesozoic, has been revealed. Scattered localities are represented in the American Museum collections: the Egypt Coal Field of North Carolina, which has yielded a fine collection of the crocodile-like phytosaurs, described many years ago by Dr. J. Howard McGregor, research associate in human anatomy in the American Museum; the Triassic beneath the Palisades, directly opposite the city of New York, where was found a single phytosaur; the Triassic in Pennsylvania, lying immediately above the coal measures; and one promising locality near Lander, Wyoming, which was explored by the late Samuel W. Williston of the University of Chicago.

The ostrich dinosaur (*Struthiomimus altus*) was a slender, long-legged animal with a very long neck and small, birdlike head. It had no teeth at all, but probably a horny beak like an ostrich. A very fine skeleton, found by Mr. Barnum Brown in Alberta, has been on exhibition in the dinosaur hall of the American Museum since 1915, but it was left in the queer, distorted position that it had when found in the rock and it was not easy for anyone to get from it a clear idea of what the animal really looked like. Recently there has been placed on exhibit a new skeleton that is not so complete, as the neck and head are missing as well as a good part of the tail; but it has been mounted in a standing pose, with the missing parts, copied from the more perfect skeleton, sketched in on the panel. It is temporarily placed in the Age of Mammals hall, opposite the huge *Gorgosaurus* skeleton. The sketch restoration by Erwin Christman shows how the animal may have looked when alive. Exactly what the ostrich dinosaur did for a living is still something of a problem. In the picture a couple of these creatures in the background are feeding on a bunch of plantains; for the climate of Alberta in the Cretaceous period was semitropical and such fruits grew wild in profusion. What prosperous banana plantations and sugar cane fields could have been laid out on the Canadian plains in those days, cultivated with the help of the horned or duckbilled dinosaurs as draught animals! What a fence one would have had to build to keep out the fierce carnivorous dinosaurs, threatening to play havoc with one's stock! As for the ostrich dinosaur, he might have been trained as a messenger. Speed he would have had, certainly, and a fine equipment for carrying small bundles in his hands; but too much dependence could not have been placed upon his intelligence.

However, we must check ourselves in the all too common tendency to think of animals only in relation to man, forgetting that these creatures walked the earth millions of years before man's dominion was dreamed of.

Another theory as to the habits of the ostrich

A SKETCH BY ERWIN CHRISTMAN OF THE OSTRICH DINOSAUR IN ITS ENVIRONMENT OF CRETACEOUS TIME

Although ostrich-like in respect to its long limbs, elongated neck, small head, and toothless beak, this Cretaceous dinosaur must in reality have been unbird-like in appearance, for it was, of course, devoid of feathers, had a long lizard tail, and was provided with grasping fore limbs

dinosaur is that the long fingers of the fore-limbs were used to rake up from the river bottoms the shells and crustaceans on which he may have fed. It is at all events clear that he was not a predacious beast although related to the huge carnivorous dinosaurs, nor was he well adapted to feed upon vegetation as were the duck-billed, armored, or horned dinosaurs that were his contemporaries.

Beside the restored skeleton have been placed the fore and hind limbs of another specimen of the same kind of animal. These limbs come from a somewhat later formation, the Edmonton beds, in the same region, and like the other specimens were found by the Museum expedition to Alberta in charge of Associate Curator Barnum Brown. Mr. Brown is at present in northern India, looking into the possibilities for securing collections there that may throw light on the ancestry of man.

A fine mammoth skull with part of the skeleton has recently been purchased by the American Museum from Mr. E. C. Swabey. It was found near Rochester, Indiana, about six years ago and is a female, as indicated by the small, slender tusks. The mammoth skeleton mounted in the hall of the Age of Man is also from Indiana, and is a male, the tusks being at least twice as large in diameter. The two specimens very well represent the variety or subspecies of the true mammoth that inhabited the central and northern parts of the United States during the late Pleistocene. It was called *Elephas jacksoni* by Mather ninety years ago, but in recent years has been usually referred to the true mammoth or *Elephas primigenius*. It is, however, a larger and more robust animal than the Siberian or Alaskan specimens and it is not at all certain that they are really the same species. Critical study of these fine skulls will perhaps enable us to settle the question. W. D. M.

A VALUABLE collection of fossil mammals was secured last summer by the American Museum expedition under Albert Thomson in the Snake Creek quarries in western Nebraska. This collection has arrived at the Museum and the specimens are now being prepared for study and exhibition. It includes a dozen or more fairly complete skulls, besides many parts of skulls and a multitude of fragmentary specimens. The Snake Creek quarries are our richest source of fossil mammals of Upper Miocene and Lower Pliocene age. The quarries are about twenty miles south of the famous Agate fossil quarry, and represent the animals of a later geological age. The fossils are much more fragmentary than those at Agate, complete skulls are scarce, and only one entire skeleton has been found (the *Pliohippus* skeleton on exhibition in the alcove portraying the evolution of the horse). But while the Agate quarries contain the remains of only three kinds of animals (aside from unimportant fragments) the Snake Creek quarries contain the remains of a very large variety. More than fifty different genera have been recorded from it, and every new collection adds to the number. The majority of these animals are still known only from jaws or parts of skulls; but Mr. Thomson's collection includes at least a dozen fairly complete skulls, and these will add largely to scientific knowledge. One of the skulls in the collection which has been prepared and studied may serve as an instance. In 1856 Doctor Leidy described a small fossil tooth by the name of *Leptarctus*, found at Bijou Hills, near the Missouri River. It was supposed that the animal to which the tooth had belonged was a relative of the raccoons and coatis. In 1892 Doctor Wortman found a lower jaw which he believed confirmed this relationship. Two lower jaws were also found in the Snake Creek quarries, and finally last summer Mr. Thomson secured a complete skull. This skull shows that the creature belonged to a peculiar group, about halfway between the raccoons and the badgers in its affinities. It was not an ancestor of the raccoons, as had been supposed, but an extinct group, and must be placed rather with the badgers in the family Mustelidæ than with the raccoons in the family Procyonidæ. No one could have known this from the study of the single upper tooth and the incomplete lower jaws that were previously known; but the skull settles the matter.

THE unexpected always happens in the prehistory of man. In "Bone Cave," at the Broken Hill Mine in northern Rhodesia has been discovered a skull of pre-human type which seems to be transitional between the most primitive member of the human family at present known to us, the erect ape-man (*Pithecanthropus erectus*) discovered in Java by Doctor Dubois in 1892, and the true Neanderthal man. Fortunately, the skull is quite complete and, while the jaw is missing, the collar bone, leg bone, and part of the hip bone were found and will enable us to arrive at some idea of the bodily form of this new Rhodesian man. Fortunately, also, the specimen was taken to the British Museum of Natural History in London, where it arrived November 7, 1921, and has fallen into the very able hands of Dr. Arthur Smith Woodward and of Prof. G. Elliot Smith, the most competent authorities among living students of human anatomy to pronounce upon its relationships. Dr. Elliot Smith writes, November 8, 1921, that it is an entirely new species, if not genus, of the human family, being far more primitive than the Neanderthal, and in many respects curiously suggestive of *Pithecanthropus*. The same authority states that there is also a fragment of the upper jaw of a second skull and that the whole find is extraordinarily interesting as it raises a host of fascinating problems. Dr. Robert Broom, of Douglas, South Africa, writes: "It is much like *Pithecanthropus* but fortunately nearly perfect. . . . The lower border of the nostril is still filled with matrix and the limits are not clearly shown. Won't it be grand when Doctor McGregor makes a restoration of this man!"

A finely illustrated account by Dr. Smith Woodward appears in the *London Illustrated News* of November 19, 1921.

THE fossil-bearing beds of the famous Tarija region of Bolivia, recently described by Marcellin Boule, professor at the Muséum National d'Histoire Naturelle, Paris, in his monograph, *Mammifères Fossiles de Tarija*, resemble those of our western Bad Lands so closely that it is hard to believe they are not of the same geologic origin. The city of Tarija lies in southern Bolivia near the Argentine frontier, at an altitude of 1770 meters. In his introduction Boule observes:

"The great distance from any port of embarkation, the material and financial obstacles attending transportation on mule back over uneven ground, of pieces that are both very heavy and very fragile, make the scientific riches of Tarija difficult of access to the museums of Europe. Therefore, we ought to be duly grateful to the Expedition of G. de Créqui-Montfort and E. Sénéchal de la Grange for having worked these fossil beds and for having succeeded first in acquiring and then in transporting to France, there to be presented to the Museum, the superb collection which is the subject of this Memoir and which includes remains of several hundreds of mastodons, of a hundred horses or related animals, and of at least an equal number of llamas, without counting the edentates, rodents, and Carnivora."

In Pleistocene times Tarija was on one of the great animal migration routes traversing North and South America. It received from the former continent its mastodons, horses, peccaries, deer, bear, and Carnivora, which met from the southern continent the macrauchenias, toxodonts, and giant and lesser sloths, remains of which are preserved in the rich collections of the Muséum d'Histoire Naturelle in the Jardin des Plantes.

BELGIAN CONGO

The Zoölogy of the Belgian Congo is appearing in sections in the American Museum *Bulletin* and *Novitates*. It will probably be issued uniformly in twelve volumes on the completion of the series. The work on the different papers is making excellent progress, although on no group of animals are the reports as yet complete. If they were to be assembled at present, the first volume would contain miscellaneous papers; the second, monographic studies on vespids by Joseph Bequaert and on reptiles by Karl P. Schmidt; the third, a report on land mollusks by Pilsbry; the fourth, papers on invertebrates by various authors. A volume on ants, in two parts, by William Morton Wheeler and collaborators, will comprise possibly about 1100 pages and 40 plates and, like that on the wasps, will be a great contribution to our knowledge of Hymenoptera.

Twenty-eight papers have already appeared, as follows: introduction, four on mammalogy, six on ornithology, three on ichthyology, one on herpetology, six on entomology, and seven on general invertebrate zoölogy.

JOHN BURROUGHS

Under the auspices of the American Academy of Arts and Letters and of the National Institute of Arts and Letters a memorial meeting in honor of John Burroughs was held on November 19, in the auditorium of the Academy building, 15 West 81st Street, New York City.

Among those who through their presence paid affectionate tribute to the personality and greatness of the seer of Slabsides were artists, men of letters, and scientists. The attendance at this gathering of the diplomatic representatives of Brazil, Chile, France, Mexico, and Spain was a convincing reminder that Burroughs' reputation as a naturalist and a man of letters is international.

Those who spoke—some of them from an intimate knowledge gained by long association with Burroughs—were President Henry Fairfield Osborn, of the American Museum, John H. Finley, Hamlin Garland, and Bliss Perry.

Portraits of Burroughs, to the number of fifteen or twenty, painted by Orlando Rowland, Joseph Mannheim, and others had been hung on the walls of the auditorium, and on the floor itself had been placed sculptures of Burroughs by Pietro, Paolo, and others.

WOODS AND FORESTRY

In a recent number of *American Forestry* Mr. Henry S. Graves pays a fine tribute to Dr. Charles Sprague Sargent, whose study of the forests of this country, undertaken in connection with the tenth census (1880), Mr. Graves characterizes as "the first action of importance" initiated by the Federal Government in the interest of forestry. The results of Doctor Sargent's study were of so monumental a character that an entire volume of the census was devoted to their presentation. This volume includes a catalogue of the forest trees of North America, exclusive of Mexico, with remarks upon their synonymy, biographical history, distribution, economic values, and uses; a section on the fuel value and the value as construction material of the wood of the principal timber trees of the country; and finally, a section, fully illustrated by maps, tracing state by state the forest resources of the United States in their economic aspects. Mr. Graves points out that in connection with this work for the tenth census Doctor Sargent was able, through funds generously supplied by Mr. Morris K. Jessup, to gather a noteworthy collection of specimens of the woods of the United States. These specimens were in the form of cylindrical sections of tree trunks with the bark attached and with a portion of each section cut in such a manner as to indicate the grain of the wood. Of this collection, which has long been an object of attraction in the American Museum, Mr. Graves says: "So far as I know there is no other collection of wood specimens equal to it anywhere in the world."

The observant visitor at the American Museum who pauses before the New England spring group or the Florida group in the reptile hall on the second floor and marvels at the lifelike appearance of the mounted animals is but paying tribute to the ingenuity no less than to the artistic sense of the Museum's preparation staff and the value of museum exhibits as a means of education. The seventy-five or more specimens of animal life in the New England group and the 150 in the Florida group (the largest yet attempted in the American Museum) have been endowed with a naturalness attainable only by the most delicate skill in fine modeling and color work applied to the original wax casts—for that is what they really are. The following statement answers briefly the many inquiries that have come to the Museum regarding the technical processes used in preparing specimens for exhibit.

The usual method of casting from the plaster negative to the wax positive is used. When specimens are too soft, however, to have a mold made from them, they must be treated differently. Kerosene oil is put into a pan, and plaster mixed with water is poured into the oil; when this plaster is partly set, the soft specimen is put into it, and the lower half of the mold is allowed to set hard; the upper half is then cast; the oil gives buoyancy to the specimen and prevents the heavy plaster from sagging it. Very small and soft specimens are frequently modeled in wax by hand.

After the wax casts are made from the plaster mold, much skillful tooling and modeling are necessary. The wax must be of a certain flexibility when worked, and the tools kept heated at a proper temperature to insure success in portraying the delicate body lines, scales, etc.

The cast is then colored, a living specimen being used as a model. The eyes, made of glass, must be accurately painted on the inner surface and set in the wax at just the right angle; the eyelids also must be carefully modeled to give individual expression. This colored wax model has an appearance of life which is frequently unattainable in a mounted skin, for it possesses the advantage, not to be underestimated, of exhibiting the subdued translucency characteristic of many of the specimens when alive. When warmed, the finished cast can be easily posed on trees or elsewhere in any position.

Among those on the preparation staff of the Museum is an artist, Frederick H. Stoll, who possesses unusual accuracy in reproducing reptile and amphibian forms from life; to this, as well as to his careful observation and study of the living animal, is due his success in bringing to perfection the wax cast so that it appears lifelike enough to be mistaken for the real creature. In addition to the specimens in the New England spring group and the Florida group, another fine example of Mr. Stoll's workmanship is the alligator snapper (*Macrochelys temminckii*), recently placed on exhibition on the second floor of the American Museum—the first alligator snapper to be mounted here. Because of the huge size of the specimen and the costliness of wax, the cast was made in plaster. Plaster, however, is extremely opaque. To overcome this a thin coating of wax and turpentine was applied to the surface of the cast, very delicately so as not to destroy the reproduction of the texture as shown in the plaster. When paint is applied to a model treated in this way, a soft, fleshy appearance is imparted to the body and the translucent effect of horn to the carapace.

As the fleshy parts inside the mouth of the turtle were soft, a plaster cast would not have been very accurate. Accordingly these had to be modeled in wax by hand. A mixture of wax and color of the consistency of thin cream was then sprayed on with an atomizer, giving a lifelike appearance. The peculiar fleshy protuberances above the eyes were also modeled in wax, as were the claws. Wires were placed inside the claws to strengthen them and to fasten the claws in place.

Mr. Frederick H. Stoll, an artist of unusual ability and seriousness of purpose, connected with the American Museum, comes from Swiss ancestry—miniature painters, ivory carvers, and sculptors. He is known in the museum as an expert wax modeler and colorist with considerable breadth of artistic appreciation

The methods described require modification according to the effect desired and the nature of the texture to be reproduced, and it is the skill and care with which each specimen is studied that insure the final successful result.

OTHER MUSEUMS

An interesting account of the second expedition made by Martin Gusinde to Tierra del Fuego appears in Volume II, No. 2, of the publications of the Museo de Ethnología y Anthropología of Chile. The first expedition, made in 1919, was devoted primarily to a study of the Ona, one of the nomadic tribes of the region; the second trip to a companion study of the Yámana. In the four centuries that have elapsed since Magellan conducted his armada through the tortuous strait, walled with snow-clad mountains, that bears his name, this people, popularly thought of as cannibals but, according to Señor Gusinde, showing no proclivities to justify their reputation as such, have so dwindled in number that they are approaching the verge of extinction.

In addition to securing valuable ethnological material for exhibition purposes, Señor Gusinde was able, through the rare confidence which the Indians reposed in him, to gather from their lips a treasured collection of myths. Most interesting of all, however, he was one of three initiates—the other two being Indians—to participate in the ceremonies connected with pubescence, which prior to that had not been celebrated for about nine years. He relates how he was seized, borne off to the place where the rites were to take place, and blindfolded, being freed of his encumbrance only when the feigned evil spirits entered to strike terror into the hearts of the neophytes. Two sponsors were then assigned to each neophyte to watch over their charge and instruct him in all the things that he should know. Severe physical ordeals followed, including fasting and the assumption of a squatting pose, to be maintained without moving or looking about. Deliberately the older people said laughter-provoking things, but the neophyte was debarred from joining in the merriment. They would at times put an insect upon him, taking good care that he did not brush it off. At night they would permit him about three hours of sleep, requiring, however, that he should preserve the position maintained during the day. Monotonous chants were sung day and night for the purpose of keeping malignant spirits at a distance. In the course of this ordeal Señor Gusinde was told many of the myths of this people: that of the creation of the world, the coming of the first men, and the instructions they gave to the Yámanas, their direct descendants—all of importance for ethnology.

The Museums Association, the object of which is the promotion of better and more systematic working of museums, held its thirty-second annual meeting in Paris, July 12–18, under the presidency of Sir Frederic G. Kenyon, director of the British Museum. One of the amphitheaters in the Musée National d' Histoire Naturelle was set apart for the gathering. Mr. L. Earle Rowe, a delegate of the American Association of Museums, spoke on the growth and development of art museums in America.

Mr. L. B. Coleman, until recently chief preparator of the American Museum, became director, on October 1, 1921, of the American Museum of Safety. This museum is maintained by the Safety Institute of America, 141 East 29th Street, New York City, which was incorporated in 1911. Through exhibits this museum purposes to acquaint the public with devices for conserving human life, which in this age of machinery is exposed to so many hazards. The position in the American Museum left vacant by Mr. Coleman's departure has been filled by Mr. Rubin R. Rector.

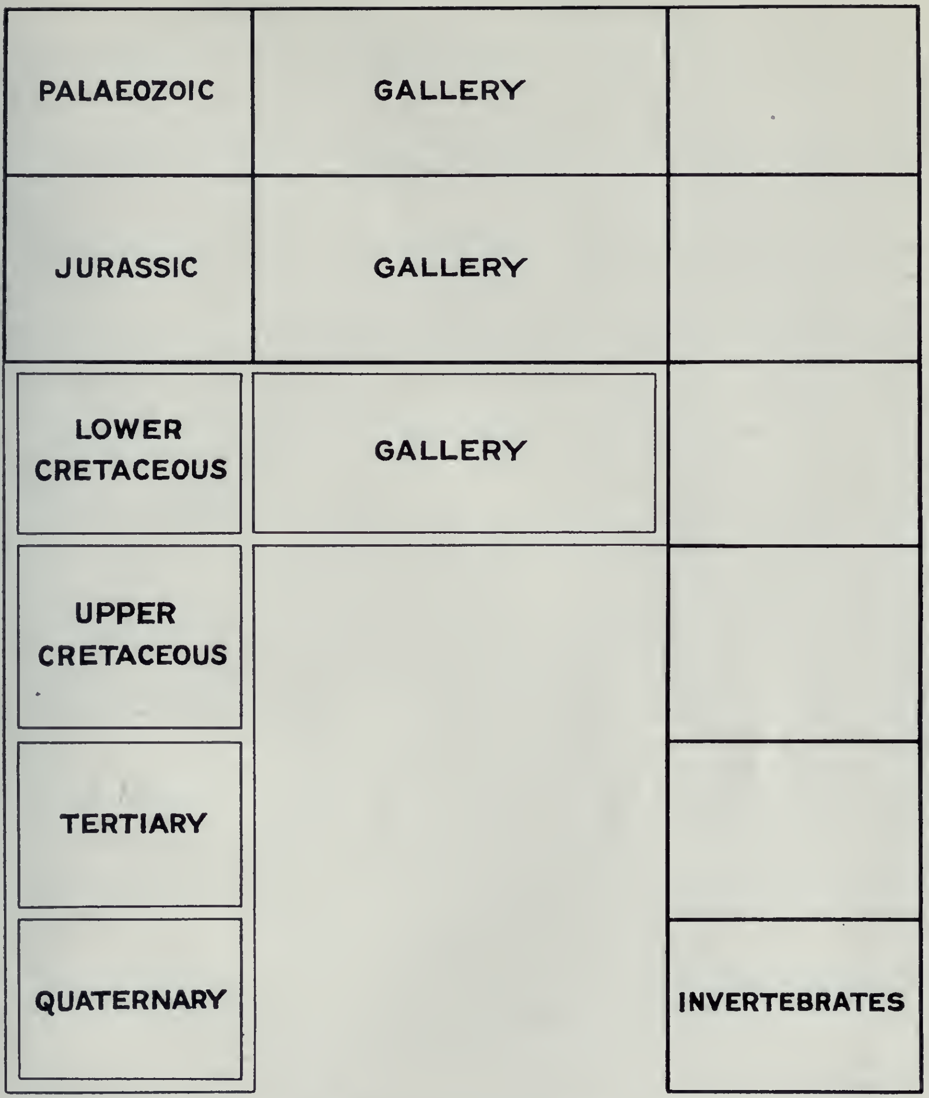
BIOGRAPHIC

Dr. Louis Dollo, of the Natural History Museum of Brussels, present leader of vertebrate palæontology in Europe, will soon celebrate his sixty-fourth birthday. He has issued in good health from the trying period of German occupation of Brussels and is continuing his lectures in the University there and his researches in the Museum, especially on new fossils from Orsmael, Belgium, which he is inclined to compare with the very ancient Torrejon mammals of New Mexico. Among his European fellow-workers, Doctor Dollo greatly admires the work of Othenio Abel, of Vienna and of Dr. Hans G. Stehlin, of Basle, Switzerland. He considers that vertebrate palæontology in Europe as a whole is in a very chaotic condition at present and that a new conspectus of our knowledge is very desirable—a *résumé* of recent discoveries, both in America and Europe. It appears that Pompečki, of Berlin, will describe the splendid Tendagaru Collections of sauropods of East Africa. Doctor Dollo is hopeful of constructing new galleries of palæontology in Brussels in his unique arrangement of geologic order. The Museum is enormously rich with sixty thousand specimens representing the cave fauna of Belgium alone. On another page we show a little diagram of Dollo's proposed arrangement when the Belgian Government provides the funds. The only obstacle is the cost of construction in Brussels, which, it is said, is ten times as great as it was.

NEW YORK AQUARIUM

The attendance at the New York Aquarium during 1921 exceeded that of any year since the commencement of the war. The impressive total of 2,281,611 visitors during the first eleven months of the year—a total equivalent to more than a third of the population of Greater New York—measures the educational influence which this institution exercises in the metropolis. The new tanks to be installed in the space vacated by the old pumping plant will increase the exhibition space of the Aquarium by fully one fifth and will offer a new incentive to those who would view the life of the deep.

The Aquarium boat "Sea Horse," built by the Zoological Society for the use of the Aquarium, has rendered splendid service for two seasons, having brought to the Aquarium in brief, weekly trips, more than 5000 marine fishes of more than sixty different species without going more than twenty miles from the Aquarium. The possession of this first-class boat has made com-



PRESENT AND PROPOSED FLOOR PLAN OF MUSÉUM D'HISTOIRE NATURELLE, BRUSSELS, BELGIUM

The wing on the left is reserved for the palæontological collections made in Belgium and other countries; the wing on the right will be devoted to the zoölogical collections paratively easy the work of maintaining the exhibits of the Aquarium, which had previously been a heavy burden on the staff and employees.

In the collecting work of this well-boat, Mr. C. M. Breder, who was appointed aquarist on April 1, 1921, in place of the late W. I. De Nyse, and Mr. S. A. Callisen, who since June 15, 1920, has been serving as clerk, participated actively. Papers by Mr. Breder on the life history of the puffer, *Spheroides maculatus*, and on the hermaphroditism in the croaker, *Micropogon undulatus*, have been accepted for publication in *Zoologica*. In the *Bulletin* of the Zoological Society for November, 1920, Mr. Collisen published a popular account of the extensive pound net fishery of Lower New York Bay. He is now preparing an account of the rather extensive lobster fishery in the same neighborhood.

Miss Ida M. Mellen, secretary of the Aquarium, prepared two numbers of the *Zoological Society Bulletin* devoted exclusively to the care of small aquaria fishes. These two *Bulletins* excited popular interest to such an extent that they have been reissued as one of the Aquarium Nature Series under the title of *Fishes in the Home*. Miss Mellen has prepared for *Zoologica* an illustrated paper on pond life and for *Zoopathologica* a catalogue of the parasites of fishes exhibited in the Aquarium.

CONSERVATION

A SIGNAL victory for bird protection,—a movement in which, it is to be hoped, all the countries of the world may ultimately be leagued,—has been achieved in England through the placing on the statute books last July, of the Importation of Plumage (Prohibition) Act, which will come into operation in April, 1922. It forbids the importation of wild birds' feathers for millinery purposes, with two exceptions specified in the schedule—African ostrich and eider duck. Facilities are, of course, allowed to approved persons for obtaining specimens for scientific research.

Under the Act an Advisory Committee has been appointed by the president of the Board of Trade, with power to recommend the addition to, or removal from, the existing schedule, of the name of any bird. Supporters of the Act have no cause to be anxious as to the future decisions of this Committee, for it is difficult to see how the special conditions that may have justified the exemption of the ostrich and the eider duck can be shown to apply to any other wild bird.

Thus has ended the long and bitter conflict against the feather trade centered in London—the largest market in the world. It is more than twenty years since the fight began. The power of the vested interests attacked, the congestion of Parliamentary work, and the indifference of an unstirred public opinion made the task appear at first hopeless. But once the case for the birds was stated and understood, splendid support was given both in and outside Parliament. Throughout the campaign, money was most generously subscribed by men, women, and children living not only in the British Isles but all over the world. Workingmen would send contributions from their wages, and children, their Christmas money.

There are two names which will always be associated with the work—that of James Buckland, who started the movement and whose inspiration long outlived the short lease of life which left his task unfinished, and that of Harold Massingham, Founder of the Plumage Bill Group, whose untiring advocacy led to this year's victory. Those who have worked in England for this long overdue reform feel, however, that even now the battle is only half won and that although an important advance in the protection of bird life is foreshadowed by the imminent closing of the world's central market, yet no security can be reached until all the other markets are closed too, so that the dead body of a bird will have no market value. It is hoped, now that England and America are united in their resolve to suppress the slaughter of birds for millinery purposes, other countries may be induced to join in the movement, so that by concerted effort an end can be put to this misuse of one of the crowning glories of creation and save for future generations a vanishing heritage of usefulness, beauty, and joy.

ONE HUNDRED TWENTY THOUSAND women, members of the New York City Federation of Women's Clubs, are organizing in Greater New York, under the leadership of Mrs. Charles Cyrus Marshall for the purpose of arousing interest in the conservation of natural resources. That their influence in this direction may be more definitely felt, the Conservation Committee of the Federation, of which Mrs. Marshall is chairman, met with representatives of the various women's clubs at the American Museum on November 29, to outline plans, the chief feature of which is the celebration of the first week in April as Conservation Week.

The coöperation of the State Federation, with a membership of 300,000, has been secured for this celebration, so that the movement will be at least state-wide. As arrangements for Conservation Week are developed, it is probable that the Federations of other states will also join in its observation. Each day of the week will be dedicated to the study of a designated aspect of the conservation problem. To quote Mrs. Marshall, "Women will do much better work for conservation when they know more about it. Fortunately they realize this and are eager and willing to learn." That they may be accurately informed, lectures will be given during the week on such subjects as reforestation, the national parks, the protection of animal and plant life, stream pollution, and the conservation of the water supply. One day of the week will be set aside that honor may be paid to great naturalists and conservationists such as Roosevelt. The Federation of Women's Clubs has demonstrated its power for good in numerous instances where a question of public welfare has arisen. Similarly on this occasion, the enlightenment of public opinion which will result from the observation of Conservation Week by thousands of American women should add great impetus to the conservation movement.

The American Bison Society, founded in 1905 for the permanent preservation and increase of the American bison and the protection of North American big game, under the successive presidencies of William T. Hornaday, Franklin W. Hooper, Henry Fairfield Osborn, and Edmund Seymour, has been instrumental in restoring the bison to North America and in indirectly increasing their number from 1116 in 1908 to 9311 in 1920. Since 1919 the Society, under the vigorous presidency of Edmund Seymour, has taken up the preservation of the American antelope or pronghorn, which is still nearer the verge of extinction than was the bison at the time of its greatest depletion. One of the first steps was to seek protection for the few remaining bands of wild antelope that still existed in remote sections of the country, by coöperating with the government in creating an antelope preserve under federal protection. Early in the spring of 1921 the society purchased, under contract, ten young antelope, to be captured in Alberta, Canada, with the consent of the Dominion Government, for the purpose of stocking the Wichita Preserve in Oklahoma. The capture of these antelope (3 bucks and 7 does) was successfully carried out and shipment was made. They arrived in the preserve without a blemish, and are said to be an unusually perfect lot of specimens. This splendid work has been supported by contributions from outsiders like the Wild Life Protection Fund, the New York Zoological Society, the Audubon Society, and the Boone and Crockett Club and by liberal contributions from individuals interested in the preservation of North American big game, like George D. Pratt, John C. Phillips, A. Barton Hepburn, John D. Rockefeller, Jr., H. A. Edwards, John M. Phillips, William P. Wharton, Robert M. Thompson, Louis Weber, and many others.

One of the most flagrant and vicious cases of the needless destruction of wild animals is the reported recent shooting of a number of pronghorn antelopes in one of the few places where these once abundant and widely ranging animals are still to be found.

Along the boundary of eastern Oregon and northern Nevada there is a strip of territory, valueless for agricultural purposes, which has long been occupied by a band of antelopes. Efforts were being made to have this area set apart as a sanctuary and thus assure protection to these graceful animals. The proposed creation of such a refuge aroused, however, the antagonism of certain sheepmen who in late years have been making use of this region as a pasturage for their herds. It is said that in order to defeat the project, the sheepmen threatened to exterminate all the antelopes of the region. The recent discovery of fourteen antelope carcasses on the Oregon side of the boundary line and the reported slaughter of twenty-seven antelopes a little farther north will, it is to be hoped, prompt the authorities to take stern measures to protect this jeopardized band.

In the November issue of the *Oölogist* is printed an extract from a letter by Harold H. Bailey, director of the Miami Zoölogical Park and Museum of Natural History. The letter is addressed to the American Consul at Nassau and contains an appeal for the more adequate protection of the flamingo colonies of the Bahamas. The government of the Islands imposes a heavy fine on any one molesting the birds but because of the dearth of wardens, offenders easily escape punishment. Neither the eggs nor the birds are spared and Mr. Bailey believes that if these conditions persist, the flamingos of the Bahamas will more than probably become extinct. An indispensable step in according protection is the appointment of a warden for each one of the four breeding colonies. It would be a neighborly act, and one in harmony with the spirit of international coöperation that is making itself manifest, if one or another of the societies in America that are interested in conservation offered its aid in establishing such a wardenship.

In 1904 Dr. Frank M. Chapman, of the American Museum, made a close study of the nesting habits of these birds. From a blind placed in a bush in the heart of the colony, he was able to secure a series of photographs that made possible a veracious reproduction, in the impressive habitat group on the third floor of the Museum, of the attitudes and the activities of these birds. With the threatened extinction of the Bahama colonies, this lifelike representation of a flamingo city is assuming importance as an historic record, a distinction already acquired by the habitat group illustrating the now extinct Klamath Lake bird colony. Klamath Lake, on the Oregon-California boundary line, dominated by the lofty peaks of Mount Shasta, was until recently one of the favorite haunts of water birds. On its tule or rush islets, nested in fancied security white pelicans, California and ring-billed gulls, Caspian terns, and Farallon cormorants. The drainage of this lake has resulted in the dispersal of these birds and today the habitat group in the Museum is an evidence of the interest and beauty of the Klamath Lake region before man attempted to pervert it to his uses. We say "attempted" for the soil has proved to be too alkaline to be suitable for agricultural purposes.

AWARDS

Colonel Roosevelt, casting a retrospective glance over the adventurous trip recorded in *Through the Brazilian Wilderness*, said: "Such a trip as that we had taken tries men as if by fire. Cherrie had more than stood every test; and in him Kermit and I had come to recognize a friend with whom our friendship would never falter or grow less." Mr. George K. Cherrie, to whom this fine tribute was paid by his great fellow explorer, is the veteran of many an expedition to Latin America undertaken in the interests of the American Museum and has richly deserved election as Honorary Fellow in that institution—a distinction awarded him by the unanimous vote of the Executive Committee, at a meeting held on November 23, 1921. The Resolution conveying this award was worded as follows:

"*RESOLVED*, That the Trustees desire to record their warm appreciation of the exceptional services which George K. Cherrie has rendered to The American Museum of Natural History in particular and to the science of ornithology in general through extensive collecting expeditions in Latin America, which cover a period of more than thirty-four years. His rare skill and indefatigable energy as a field collector have greatly enriched the Museum's collections of birds and have revealed many species new to science, while his keen sense of justice, his splendid courage, his appreciation of the temperament and viewpoint of foreign people, and his high principles of living have made him a representative of American ideals of which the Museum and the whole country may be justly proud. In recognition of this enviable record and of Mr. Cherrie's years of devotion to the Museum, the Trustees take pleasure in hereby electing him an *Honorary Fellow*—the highest gift in their power to bestow."

The Société Nationale d'Acclimatation de France, the leading zoölogical society of France, has awarded its Grande Médaille to the American Bison Society, and to the Rev. Sheldon Jackson, in memoriam.

The Société Nationale d'Acclimatation de France stands as high as the Zoölogical Society of New York and the Zoological Society of London, and devotes special attention to the acclimatization of species in places never before occupied by them.

The medal given the American Bison Society is of silver and was designed by Barre. On the front is the intaglio of Isidore Geoffroy Saint-Hilaire, a celebrated French naturalist, the founder of the society, and upon the obverse is:

Société Nationale d'Acclimatation de France
The American Bison Society
1920

The medal awarded to the Rev. Sheldon Jackson, in memoriam, will be given to his two daughters, who live in Washington, and are his sole survivors. This medal is bestowed in recognition of Dr. Jackson's great service to Alaska in the introduction of the reindeer.

The medal awarded to the American Bison Society is bestowed in recognition of its preservation of the American bison on a continuing basis, and, accompanied by a handsomely engraved diploma, was transmitted to the society through the American ambassador, Hugh Campbell Wallace.

The society has been very successful in its work. Associated with the Biological Survey of the National Government and with the Zoölogical Society of New York, it has materially assisted in establishing some nine nucleus herds of American bison in various national parks in the United States. When the society started its operation, there were less than 1000 bison known to be in existence, a puny remnant of the millions that formerly roamed the western plains. Now there are in the United States, according to the last census, 3993 head of pure bred bison, and in Canada, 4080. In the Government herds there are 1032; 184 calves were born in 1920. The society, therefore, has accomplished the principal objects of its formation.

The society at the present time is taking up the preservation of the antelope, which is in danger of extinction. This animal is one of the most interesting. It is a purely big game animal and can subsist in the most arid portions of the United States.

The objects of the American Bison Society are the preservation and increase of the American bison and the protection of North American big game.

The officers are:

Honorary President, Theodore Roosevelt, in memoriam.
Honorary Vice President, Prof. Henry Fairfield Osborn.
President, Edmund Seymour.
Vice President, Dr. William T. Hornaday.
" " Carl K. MacFadden.
Counsel, Leonard D. Baldwin.
Treasurer, Clark Williams.
Secretary, M. S. Garretson.

Prof. Henry Fairfield Osborn has recently been elected a Corresponding Member of the Société Géologique de Belgique, which was founded in 1874.

THE following extract from the Record of the Royal Society is sent by its secretary:

"In accordance with a resolution of the Council, a silver medal is awarded biennially in recognition of work of acknowledged distinction (especially in Biology) in the field in which Charles Darwin himself laboured. The medal is accompanied by a grant of £100. The first medal was awarded to Alfred Russel Wallace in 1890. The award may be made either to a British subject or a foreigner, without distinction of sex."

Awards of the Darwin Medal by the Royal Society have been made every second year since the foundation as follows:

1890 Alfred Russel Wallace
1892 Sir Joseph Dalton Hooker
1894 Thomas Henry Huxley
1896 Giovanni Battista Grassi
1898 Karl Pearson
1900 Ernst Haeckel
1902 Francis Galton
1904 William Bateson
1906 Hugo de Vries
1908 August Weismann
1910 Roland Trimen
1912 Francis Darwin
1914 Edward Bagnall Poulton
1916 Yves Delage
1918 Henry Fairfield Osborn
1920 Rowland Harry Biffen

The award of this medal to Rowland Harry Biffen, the last recipient, was made in recognition of his researches in the application of scientific principles to the breeding of plants.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patron: MR. OSWALD UHL.

Honorary Fellow: MR. GEORGE K. CHERRIE.

Life Members: MESDAMES ROBERT WOODS BLISS, COLUMBUS O'D. ISELIN, HENRY R. REA, ROBERT S. RUSSELL; the MISSES ADELIA A. DWIGHT, EVELYN PRESTON; MESSRS. PIERRE C. CARTIER, CHARLES M. CHAPIN, CHARLES CHENEY, S. WILBUR CORMAN, GEORGE L. EATON, EMANUEL GERLI, OTTO R. KOECHL, JOSEPH PARSONS, CURT G. PFEIFFER, R. STUYVESANT PIERREPONT, JOHN T. PRATT, STEVENSON SCOTT, and ARTHUR S. VERNAY.

Sustaining Members: MESDAMES OTTO H. KAHN and WM. R. PETERS; MISS M. I. HENDERSON; and MR. M. TAYLOR PYNE.

Annual Members: MESDAMES JOHN W. ALEXANDER, ROSECRANS BALDWIN, J. A. BARNARD, GEORGE B. BERNHEIM, FRANCES BINGER, MCCOSKRY BUTT, CHARLES L. CASE, F. Y. CHUBB, HOWARD CONSTABLE, HENRY W. DE FOREST, CLIVE L. DUVAL, STERLING FOOTE, ALBERT FRANKE, E. GARFIELD GIFFORD, MARGUERITE GOVE, EUGENE A. GROFF, MARY S. HASBROUCK, FORBES HAWKES, JOSEPHINE POMEROY HENDRICK, JOHN SHERMAN HOYT, MARJORIE V. L. HUDSON, F. ABBOTT INGALLS, C. OLIVER ISELIN, WALTER T. KOHN, PETER LARSON, R. HALL MCCORMICK, ALLAN MCLANE, JR., ROSWELL MILLER, JR., G. W. MINOT, CHARLES KING MORRISON, CHARLES WALTER NICHOLS, ALICE R. NORTHROP, WILLIAM H. OSBORN, WILLIAM LINCOLN PARKER, WALTER WINSTON PRICE, THOMAS R. PROCTOR, MAX SCHWARZ, RAYMOND HART SMITH, LANDON K. THORNE, H. D. WHITFIELD, GEORGE WHITNEY, FRED WILLENBROCK, WULSIN, PETER B. WYCKOFF; the MISSES FLORENCE SUTRO ESBERG, ESTHER KEAGEY, ALIDA LIVINGSTON, MILDRED SAWYER, CHARLOTTE R. STILLMAN; DOCTORS GEORGE E. BREWER, ROYAL S. COPELAND, ROBERT H. FOWLER, ALEXANDER LAMBERT, J. DOUGLAS NISBET, ROBERT G. REESE, ALBERT M. STEVENS, and FREDERICK S. WEINGARTEN; the REVEREND SAMUEL M. DORRANCE; the HONORABLE GEORGE C. HOLT; MESSRS. BENTON E. ADAMS, EDWARD H. ASCHERMANN, J. W. AUCHINCLOSS, ROBERT W. BERNARD, JAMES A. BLAIR, JR., F. BODENHOFER, W. P. BOWMAN, THOMAS BURKHARD, G. M. CARNOCHAN, FREDRIC CONDÉ, J. H. COWPERTHWAIT, W. A. DAY, DONALD DE LEON, ADOLPH M. DICK, CHARLES D. DICKEY, JR., RAYMOND B. FOSDICK, ALBERT FRANKE, SYDNEY A. FRIEDE, WILLIAM I. FROTHINGHAM, JOHN W. GRIGGS, WILLIAM B. GUTHRIE, CHARLES D. HALSEY, THOMAS HEMENWAY, SETH B. HUNT, R. L. JULIAN, ROBERT B. KELSEY, B. E. LEVY, BASCOM LITTLE, CHAS. W. LITTLEFIELD, DAVID MANNES, A. H. MARCKWALD, EDGAR J. MARSTON, HOWARD W. MAXWELL, STANLEY D. MCGRAW, CLARENCE S. MCKUNE, THOMAS S. MCNEIR, ROSWELL MILLER, DWIGHT MOORE, FRANKLIN MURPHY, WINTER W. MYERS, GEO. B. OGDEN, CHARLES C. PAULDING, SAMUEL PEARSALL, E. STUART PECK, FRANK L. POLK, FRANK H. POTTER, ROLAND L. REDMOND, THOMAS K. SCHMUCK, FRED R. SEEMAN, WILLIAM SHIELDS, CASWELL M. SMITH, HANS C. SONNE, CHAS. W. STAPLETON, L. M. SYMMES, F. CARROLL TAYLOR, D. B. TURNER, HENRY WHITE, HARRISON WILLIAMS, WALTER CHANNING WYMAN; MASTER EDWARD P. LEVEEN; and THE BREARLEY SCHOOL.

Associate Members: MESDAMES WALTER P. ANDREWS, A. S. BROOKS, H. L. BRUNER, C. DE F. BRUNSMAN, WM. L. BULL, J. J. CARROLL, Z. CHAFEE, GEORGE E. CROSBY, GEO.

E. Crowell, Ernest B. Dane, Mary Moore Fowler, Mary Stewart Huber, Anna Leach, N. H. Mapes, Granville Phillips, Emily M. Rand, E. A. Taylor, and William T. Ward; the Misses Alice A. Atkinson, J. H. Bowen, Elizabeth F. Burnell, Ella F. Burnham, Marian Roby Case, Sallie E. Cavaness, C. L. Coyle, Sarah Crater, Elizabeth I. Cummins, Grace Dana, Mary O'Hara Darlington, Anna H. Denny, Katharine T. Doherty, Mathilde M. Lange, Hattie E. Melvin, Helen G. Turner, Mary S. Vermillion, and Ruth Wickstrom; Doctors J. M. Blair, John C. Bowman, E. H. Bruening, Samuel L. Caldwell, Bruce L. Clark, C. C. Cone, Charles Williams Crane, D. L. Gaillard, I. M. Hawley, Arthur Monrad Johnson, D. M. Molloy, Cyril Arthur Nelson, A. O. Singleton, and George B. Wislocki; the Reverend George Roberts; Professor Albert R. Sweetser; General James A. Buchanan; Messrs. Alfred H. Aldridge, T. W. Alexander, W. S. Andrews, A. J. Aresten, Jr., H. T. Asbell, J. S. Atterbury, Mark R. Averill, Edwin L. Ballard, A. F. Bartlett, W. H. Bergstresser, C. S. Bissell, Henry H. Blagden, B. F. Bonner, Charles L. Bouk, Charles C. Bowen, M. M. Bramlette, Ralph M. Broadhurst, Allan Brooks, Gorham Brooks, E. R. Brown, Henry C. Brown, W. C. Brown, D. L. Browne, Joe Bruening, Edward W. Brush, C. W. Bunn, Frank S. Butterworth, Jr., Norman G. Buxton, John Cadwalader, 3d, Ralph R. Caldwell, Wm. T. Callaway, Karl Campbell, Gabriel Cannon, E. F. Carry, Charles Carver, Gardner Chamberlin, W. F. Chandler, G. H. Chisholm, Hugh P. Chrisp, Rudolph Clauder, Wayne G. Clements, Hubert J. Clifford, Philip H. Cobb, Hal H. Coffel, Max M. Cohn, Merritt J. Corbett, William Cordes, Edward D. Crabb, Kendall F. Crocker, John C. Crosby, Nelson B. Crowell, Grafton D. Cushing, J. T. Daniell, Harry S. Dickey, Henry B. Dike, W. T. Drury, Axel A. Eberhart, H. Ashley Ely, Richard P. Erwin, Jed F. Fanning, Horace J. Fenton, Herbert C. Fowler, Anson C. Fry, H. M. Fry, Loring Fullerton, A. Graff, C. H. Guilbert, F. Gregory Hall, Claude Hamilton, R. L. Hamilton, E. W. Hamlin, Thomas E. Hapgood, J. A. Harvey, Henry H. Hite, Wm. P. Holt, Wm. B. Hunt, W. J. Hutchinson, Clarendon Ions, Howard I. Isbell, F. E. Jilek, J. A. Johnson, S. Paul Jones, Geo. Kalbach, George W. Kellogg, George Kennan, Earl B. Kent, J. Fred Kistler, L. L. Lane, George Langford, Henry Ranney Large, Frederick W. Leonard, O. E. Lofthus, Jos. B. Lyding, Storrs H. Lyman, Edgar A. Meckes, J. Hain Mengel, Fillmore Millard, F. L. Moffett, Edward Studley Myers, Gardner H. Narbonne, W. D. Paine, Alfred G. Papworth, Fred H. Porter, A. F. Powell, F. F. Prentiss, Fredric L. Putnam, Robert Ridgway, I. E. Rockwell, A. F. Roehlke, Ernest Russell, Louis A. Sanchez, Paul Sansom, B. T. Schmauk, Theo. Sengstak, John L. Severance, R. L. Sleeth, Jr., K. Harold Smith, Francis Arnold Snell, Geo. F. Southard, J. M. Sterling, J. Terry, Elmslie Timbs Thomas, Robt. S. Thomas, Carlos Toro, Allen B. Tucker, Louis C. Welch, Richard Wetherill, and Edwin J. Wilcox.

"NATURAL HISTORY" 1922

Natural History, having attained its majority, stands at the threshold of its twenty-second year, grateful to the Museum members who have supported it and to the nature lovers who, without financial recompense, have filled its 7375 pages with records of their travels and observations in all parts of the world. Natural History will continue to invite nature lovers to tell their stories through its pages; it will describe what the American Museum and sister institutions are doing in every continent and among the celestial as well as the terrestrial spheres.

President Henry Fairfield Osborn opens the present number of *Natural History* with a description of the important discovery of Pliocene Man in England, and for the issues of the new year will write several distinctive articles devoted to the ever-absorbing subject, the prehistory of man. These articles will be entitled: "The Birth of Sculpture in Southern France"; "Our Ancestors Arrive in Scandinavia"; "Brittany Four Thousand Years Ago."

Another feature of the new year will be a series of articles upon the history of the several departments of the American Museum. The accomplishments of the present can best be visualized through the contrasting conditions of fifty years ago. The keen vision of those who planned the institution, the attentive study of the Museum's growing needs by those who in succeeding years assumed the responsibility of its direction, the steady advance from modest beginnings to the present magnitude, and the assurance of even greater expansion and increased usefulness in the future, constitute a story of achievement and bright prospects that is as inspiring as it is interesting.

In several remote corners of the earth expeditions of the American Museum are at work, solving zoölogical and anthropological problems. Other expeditions of this institution have successfully completed their work and are in a position to report upon their accomplishments. NATURAL HISTORY, as the organ of the American Museum, will tell of the progress of such field work. It will, through the contributions of Mr. Roy Chapman Andrews, keep its readers informed of the search for the earliest records of man in Asia. Through Mr. Carl Akeley, one of the keenest observers of jungle life, who is at present studying the gorilla in its native haunts, readers of the magazine will receive first-hand information regarding the home life of these little-known anthropoid apes. Dr. William K. Gregory, curator of the department of comparative anatomy, has but recently returned from a trip, rich in results, undertaken to remote Australia, where Mr. Raven, representing the Museum, is still engaged in field work. Doctor Gregory's experiences were full of varied interest and give promise of an article as entertaining as it is certain to be informing. The scientific accomplishments of Mr. Sullivan have been commented upon from time to time in the Notes of NATURAL HISTORY. Some weeks ago Mr. Sullivan returned from the Hawaiian Islands and is therefore able to report in person regarding the racial survey of the native population in which he has been engaged. Mr. Rollo H. Beck, whose collecting among the sun-bathed islands of the South Pacific has yielded the Museum many specimens of scientific interest, will continue to write spirited narratives of his adventures.

Conservation of the wild life of the world—that trust imposed by past ages upon the present and which the present has so flagrantly neglected—will receive in the pages of NATURAL HISTORY the emphasis that is demanded in view of the tragic inroads that continue to be made into the dwindling remnants of the world's once abundant fauna and flora.

Many are the contributions planned for publication in NATURAL HISTORY in addition to those outlined above dealing with the special undertakings of the Museum. Dr. David Starr Jordan, who has made so close a study of Japan and the Japanese, will write about his visit to a village of the Ainu, the indigenous race, now greatly depleted in numbers, that formerly occupied a large part of the archipelago. An article on the "Stone Age Pottery of Japan" by H. Matsumoto, the distinguished Japanese palæontologist, will throw additional light on the history of early man. Dr. Ulric Dahlgren, director of the Harpswell Laboratory, will give an account of the luminiferous animals that inhabit the seas. The distinctive fauna of more than one of the tiny islands of the Madeira group will be discussed by Prof. T. D. A. Cockerell, of the University of Colorado. Dr. Edward W. Berry, professor of palæontology at Johns Hopkins University, whose article on "The Journey from La Paz to the Yungas" will be recalled with pleasure by readers of the September-October issue, has in train for publication an article on "Bolivia's Least-Known Mountain Range," which is written in the same delightful vein as his earlier paper. Mr. William J. La Varre will give a vivid account of his sojourn among the copper-skinned Caboklas of the Rio Negro, one of the confluents of the Amazon.

The National Geographic Association is engaged in the further excavation of Pueblo Bonito, the aboriginal ruin in northwestern New Mexico. Dr. Clark Wissler, curator of anthropology in the American Museum, in an article entitled "The Hyde Expedition and Pueblo Bonito" presents an account of the earlier archæological results attained through the work initiated by Messrs. B. Talbot Hyde and Frederic E. Hyde, Jr. Associate Curator P. E. Goddard, of the department of anthropology, during his recent visit to North Dakota, witnessed the ceremonies connected with the completion by the Arikara Indians of one of their characteristic earth lodges. An account of these ceremonies will appear in an early issue. Mr. Charles W. Mead, assistant curator of Peruvian archæology, will present some facts regarding tapioca, a familiar food of unfamiliar origin. An account of a four-hundred-mile trip by horseback along the boundary line between Utah and Arizona, taken in the company of Mr. Charles L. Bernheimer, will be contributed by Mr. Earl H. Morris, in charge of the Museum's excavation of the Aztec Ruin in New Mexico. Dr. Robert H. Lowie, until recently of the anthropological department of the American Museum and now associate professor of anthropology in the University of California, will contribute two papers, the one entitled "A Cultural Parallel Between the Lapps and the North American Indians" and the other "A Women's Ceremony Among the Hopi Indians."

"Nature Study with a Microscope" will be considered by Mr. Phillip O. Gravelle. "Some Little Known Songs of Common Birds," by Mr. F. H. Allen, will attract attention to a subject deserving closer study. "Labrador, Its Present and Its Future" will be discussed by Mr. Wynant D. Hubbard. Some of the rabbits of our western states will receive consideration in an article to be contributed by Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere. The history of "The Public Museum of Staten Island" will be recounted by its director, Mr. Charles W. Leng, research associate of Coleoptera in the American Museum. Agricultural museums will be discussed by Director F. A. Lucas in an article accompanying illustrations, supplied by Mr. F. Lamson-Scribner, of certain museums of this character. Additional articles are promised by Messrs. Rockwell and Blickensderfer, whose joint contribution on the saw-whet owl forms so striking a feature of the current issue. Mr. W. De W. Miller, associate curator of birds, will communicate his observations on the food of the winter sparrow. In "A Pilgrimage to the Home of Fabre," Dr. L. O. Howard, chief of the United States Bureau of Entomology, will record his impressions of a visit to the site made famous by the studies of the great French entomologist. Mr. William Savin, who wrote a defense of the spider for the July-August issue of NATURAL HISTORY, has in train an article on the leaf-cutting bee, an insect that well repays study, and a further article on certain wasps that prey on spiders. Mr. W. H. Sheak, well known for his studies of the higher apes, will contribute a paper on this subject.

Dr. Edmund O. Hovey, curator of geology and invertebrate palæontology, has in course of preparation an article on the Hawaiian Volcano, Haleakala, based on a personal visit to this natural wonder. Dr. Hovey will also present a review of Mr. Herbert P. Whitlock's "List of New Crystal Forms." Dr. Chester A. Reeds, associate curator of invertebrate palæontology, will contribute an article that cannot fail to interest those who live in New York or its vicinity. This article will be devoted to an account of the geology of Manhattan Island and its environment and will inform the reader of things that he has seen over and over again but whose real significance he may have failed to appreciate. Bizarre happenings in the world of fishes, as interesting in their way as the "Rains of Fishes" described in the present issue, will be chronicled by Dr. E. W. Gudger. To the courtesy of Monsieur V. Forbin, NATURAL HISTORY is indebted for several interesting series of photographs, with accompanying captions, that will make their appearance in the course of 1922. Articles having to do with the general subject of nature study and the child are promised by Mrs. John I. Northrop, Miss Ellen Eddy Shaw, and Thornton W. Burgess.

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Names of contributors and articles are set in small capitals