PROCEEDINGS OF THE SOCIETY.

PROCEEDINGS OF THE SIXTH GENERAL MEETING§

JUNE 15th, 1923.

DR. W. H. WONG, VICE-PRESIDENT IN THE CHAIR.

After the meeting was called to order, at 8 p. m. June 15 in the Library building of the Geological Survey, Dr. Wong introduced to the Society Père Teilhard de Chardin, Professor of geology of the "Institut Catholique de Paris", and vice-President of the Société Geologique de France, who is studying some vertebrate fossils from China with Prof. M. Boule of the "Museum National d'Histoire Naturelle de Paris" and who is recently come to China for further field research. Dr. Wong expressed welcome to the French palaeontologist and annonced that his study will be published in "Palæontologia Sinica" edited by the Geological Survey.

The following communications were read:

1. CENOZOIC VERTEBRATE FOSSILS OF E. KANSU AND INNER MONGOLIA BY P. TEILHARD DE CHARDIN.

(Abstract)

It is a great and very unexpected pleasure and honour for me to be presented this evening to the Meeting of your Society.

Let me first offer to you, in the name of the Geological Society of France, the best wishes of ever-growing prosperity. In France, we are well aware of the steady labour of the geologists of Peking, and we hope heartily that you will successfully perform the great work you have so well started.

Now, in this splendid work of building a Geologia of China, a most interesting part indeed (I am not quite competent to speak of the fundamental studies of Dr. Grabau on Invertebrates) is the recent discovery of well preserved vertebrate fossils. Thanks to Dr. Andersson, to Father Dr. Licent, and to the American Third Asiatic Expedition, we are able today to understand in a very much improved way the evolution of the continental life in Asia.

Because it happens to me to have at hands the whole collection of F. Licent, I would be pleased to emphasize before you the very important share which does fall in your colleague and my friend F. Licent in our better knowledge of the Cenozoic deposits of China.

§ By the secretary, recomposed by the editorial staff.

During his first systematic palæontological researches (1920), F. Licent dug out chiefly bones in the "Red Clay" (Upper Miocene) of the Eastern Kansu. As to the mammalian remains he collected there, I have recently published, in the "Comptes-Rendus de l'Académie des Sciences de Paris" (Novembre 1922) a preliminary study to a more extensive Memoir to be printed in the "Palæontologia Sinica". Amongst the numerous fossils sent to me by F. Licent, I was able, under the direction of Prof. Boule, to describe the following forms, all o them being represented by complete skulls:

Hipparion and *Gazella;*

Giraffidae (two forms: a larger one, perhaps hornless, *Helladotherium*-like, and a smaller one, with horned male, *Alcicephalus*-like);

Ictitherium, *Palhyaena*, and *Hyaena;*

a large *Gulo*-like Mustelide.

Some scattered mandibles and teeth proved to belong to *Antilopidae*, *Teleoceras*, *Promeles*, *Mustela*.

By the fact, this provisional study was by no means a complete one. F. Licent had not sent to me but the slightest part of his big collection. Lately, in a summary review of the specimens kept in the Hoang ho Pei ho Museum, in Tientsin, I noticed many interesting pieces, for instance:

the skull of a large pair-horned Giraffide (perhaps different from the *Helladotherium*-like animal above mentioned, but of the same size);

a complete skull of *Teleoceras*, and complete lower jaw presumably belonging to the same species (the canines of which are astonishingly long):

a complete skull of *Promeles;*

a complete skull of a small Félidé;

some lower jaws of the *Gulo*-like Mustélidé and of another smaller Mustélidé;

many teeth of *Sus;*

many limb bones of *Giraffidæ*.....

In the Cenozoic beds of Kansu, the strata immediately overlying the eroded "Red Clay" contain no fossiles but limbs and skulls of Rodents (a larger species, and a smaller one). But, during the past years, F. Licent was so happy as to find, in western Mongolia, a highly fossiliferous sandy section, about 65 meters thick, probably corresponding to the older loess. In that place only, he picked up, in a few weeks work, abundant remains (not yet thoroughly studied) of:

Elephas cf. primigenius;

Rhinoceros tichorhinus (eight complete skulls and three complete skeletons);

Bos (a large species, with very big horns of crescentic shape and triangular section);
? Hemione (small long-tailed, slender-toed, large-headed Equidé);
Rodents (*Myospalax Lagomys*);
Cervus, *Gazella* (2 species).
In the same spot were collected some isolated bones of
Lupus (skull); *Meles* (carnassial tooth); *Equus*;
Camelus (a very fossilized canon-bone);

It is wonderful how slightly some of those fossiles (viz. some Rhinoceros) look mineralized. Nevertheless all of them are unquestionably of Quarternary age.

I do not speak here, on purpose, of other vertebrates (Snake, Tortoises and Birds) found in the same beds, nor of other fossil material collected by F. Licent in Eastern Mongolia and other countries.

From those several discoveries we may gather new evidence that China is a very promising field for the stratigraphical and biological history of the late Cenozoic.—What a magnificent result it would be if, as pointed out by the data we owe to the discoveries of various sientific parties, the series of fossiliferous continental strata could be traced down to early Cenozoic and Mesozoic times!

2. NEW FOSSILS FROM THE MESOZOIC AND CENOZOIC FORMATIONS IN EASTERN SHANTUNG BY H. C. TAN.

Read by title, the full paper will be published by the Geological Survey, in the Bulletion of the Survey No. 5.

3. PRELIMINARY NOTES ON THE FUSULINIDÆ FROM THREE LOCALITIES OF N. CHINA BY J. S. LEE.

Discussion followed on the geological age of some Carboniferous species. Some remarks were made on the Chinese translation of the term Fusulinidae.

The full paper will be published in the bulletin.

4. A CONTRIBUTION TO THE CAMBRIAN STRATIGRAPHY OF SHANTUNG BY Y. C. SUN.

Illustrated by photos and specimens. Dr. Grabau made the remark that even though in a formation as well known as the Cambrian of Shantung, Mr. Sun has been able to find several new species. The material will be fully described in Palæontologia Sinica.

5. ON THE COMPOSITION AND STRUCTURE OF THE FIRST SPECIMEN OF METEORIC STONE RECEIVED BY THE GEOLOGICAL SURVEY OF CHINA BY C. Y. HSIEH.

The full paper will be published in the bulletin.

6. PALÆOGEOGRAPHIC STUDIES IN CHINA BY A. W. GRABAU.

A comprehensive study is being published by the Geological Survey of China under the title of "Straitigraphy of China".

The meeting was adjourned at 11 p. m.

PROCEEDINGS OF THE SOCIETY

PROCEEDINGS OF THE SEVENTH GENERAL MEETING OF THE GEOLOGICAL SOCIETY OF CHINA, SEPTEMBER 27, 1923.

BY Y. C. SUN, SECRETARY *pro. tem.**

This meeting was held as a welcome to Prof. Henry Fairfield Osborn and the members of the Third Asiatic Expedition of the American Museum of Natural History, New York. The meeting was opened at 3 o'clock p. m., President V. K. Ting in the chair. The chief speaker was Prof. Osborn, then followed by Messrs. Andrews, Granger and Morris

The abstracts of the addresses are printed in this bulletin.

The meeting was largely attended by members and their guests including many ladies. In the evening, the Society gave a dinner in honor of Prof. Osborn and the members of the Third Asiatic Expedition at the dining Hall of Lai Chin Yü Hsuan (來今雨軒), Central Park, Peking. Dr. V.K. Ting acted as toast master and first called upon Dr. Andrews who responded in a happy reminiscent vein dealing with the early problems of the expedition and paying graceful tribute to the scientific men of this country. Dr. W. H. Wong, Director of the Geological Survey of China, was next called upon and responded in French, graciously welcoming the guest of honor on behalf of the Survey, and outlining the history of the development of that organization. "Our Survey," Dr. Wong said, "represents the Quarternary period in the history of the Geological Surveys, for it is the youngest of National Surveys". Prof. J. S. Lee of the Geological Institute of the National University welcomed Prof. Osborn on behalf of the university and extended a cordial invitation to visit that Institution and address its students and faculty.

Finally Dr. V. K. Ting introduced the last speaker Prof. Osborn saying: "If I were to mention the greatest Englishman of the last generation, the one who has wielded the highest influence in intellectual thought, I should name Thomas Henery Huxley. And if I were to mention the man most prominent in carrying on the Huxleyan tradition I should unhesitatingly say Henry Fairfield Osborn".

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* Recomposed by the Editorial Staff.

http://www.geojournals.cn/dzxb/ch/index.aspx

In his response Prof. Osborn feelingly expressed his profound gratification at having at last achieved one of the great ambitions of his career, to come to Asia, the ancestral home of the mammals, and to speak to the scientific men of this country on the problems so dear to his heart.

THE BROADER ASPECTS OF THE WORK OF THE THIRD ASIATIC EXPEDITION.

BY H. F. OSBORN

(Abstract)

"I assure you that it is one of the most delightful experiences of my life to be able at last to visit this great country, and to make my first scientific address before the Geological Society of China and in the presence of such a distinguished audience including so many men whom I know to be particularly interested in science, and especially in the sciences of geology and palæontolgy. I shall approach my subject by using an expression which might under certain conditions be embarassing but one which the man of science may sometimes experience even as does the poet when he feels 'too full for utterance'. And when I consider the task of compressing my thoughts into adequate language to encompass this great subject in the space of time available, I realize the extreme difficulty of my position. I will therefore ask you to allow me to talk in very untechnical language and beg the geologists present to pardon me if in this rapid survey I do not go into all the details which they would like to hear and which I should like to present if I had more time.

"On my own behalf as well as that of the Third Asiatic Expedition let me begin by expressing the deep indebtedness which we all feel toward the Geological Survey of China and to this Society, and towards the geologists and palæontologists working here, for the hospitality which they have extended to us. I voice not only my own, but the sentiments of my colleagues as well, when I say that the memory of this hospitality will be treasured by us as one of the pleasantest experiences of our sojourn in this land, where scholarship and learning have always been held in high esteem. We hope to do our part in the exchange of ideas and material and in this way we may be able to show our appreciation.

"The theme of my address is: The Broader Aspects of the Work of the Third Asiatic Expedition. I shall confine myself entirely to the geological and palæontological work, and shall begin by giving a brief summary of the results of the first season's exploration during the summer of 1922, when the expedition was in the hands of Messrs. Andrews, Granger, Berkey and Morris.

"From the standpoint of comparative geological history I may liken the work which was done to that undertaken in the United States of America between the years of 1850 and 1870, when various surveys were organized by the United States government. These were in charge of Hayden, as explorer and chief geologist, Joseph Leidy as chief palæontologist and Holmes as chief topographer. They entered a wholly unknown Region. The wonderful success of our Expedition during the season of 1922 was also due to the fact that we had three men working harmoniously under the leadership of Mr. Andrews, three men trained in different schools of thought, in different lines of science but ready to cooperate, just as Hayden, Leidy and Holmes cooperated.

"I can assure you that when I reported the results of the 1922 season to the scientists of the National Academy in America and to the American Philosophical Society, it was agreed that ever in the history of science has a survey of such magnitude been undertaken, with results that are absolutely surprising, considering the fact that the members were in the field for only a few instead of extending their work over a period of from 10 to 12 years as was the case of the survey of months lines of the territories which included the Dakotas and Nebraska and Wyoming under Hayden.

"This splendid showing was in no small measure due to the fact that our Expedition was equipped with the most modern means of conveyance. To the older methods of transportation in the desert by camel, we added the newer methods of transportation by automobiles. And this effective transport service was engineered by the leader of the Expedition in such a way that each point on the route of the 3000 mile tour, was reached at the time appointed beforehand, and connection was made with the camel train which carried the necessary supplies. Thus the party was able to carry on its work unhampered and come back at the end of five months' continuous field work with a wealth of geological and paleontogical obsevations."

Dr. Osborn then summarized the chief results of the first year's reconnaissance work as ollows:

The present territory of Mongolia has been a continent ever since Jurassic time, watered by great slow-flowing rivers and covered by vegetation sufficient to support an extensive terrestrial fauna. He contrasted this with the conditions existing throughout Lower Cretaceous time in western North America which at that time was largely submerged beneath the sea, with extensive shore lines and partly submerged lands. Western Europe was in the same unstable condition with extensively submerged inland basins whose bottoms were raised for short periods during which the land-living fauna could appear. "Thus" Professor Osborn continued "you get the key to the most important paleontological results of the expedition for this land of stable conditions made the continuous evolution of terrestrial faunas possible.

"The land-living forms of this period in Mongolia, were successively reptilian and mammalian types. Never before have we found such an extensive series of animals representing the terrestrial life of the middle periods of the Mesozoic. These were periods of tremendous importance in the history of the life of the world, for the reptilian types were then dominating the lands while the mammals began their early struggles for existence upon the continents. All the basins explored in the first survey of 1922 gave promise of unique harvests of facts bearing upon these great problems.

"A second fact demonstrated by the first season's work was the unparalelled extent of the sedimentation. Some of the deposits are of considerable thickness while others of less thickness have a truly surprising areal extent. Nothing like it is found in the sedimentary series of the same age in the Rocky Mountain region of North America in which the deposits have greater thickness and less areal extent.

"The third great result of last season's work is of especial interest to the paleontologist. During the sucessive periods of sedimentation, the climate of Mongolia was singularly fitted to favor terrestrial life. It was fertile, kindly, and permitted a sufficient growth of vegetation to support an

abundant terrestrial fauna. From the lowest beds of the series to the highest, we have found evidence of the existence of a fauna of lowland living animals, of animals living in rivers and streams, and also of upland-living animals which occupied the higher, drier places and there developed into a large number of distinct species. We find the swift-moving animals of the uplands and we find the slow-moving grazing types and, indeed, types adapted to all the varieties of environment then existing.

"The aim of the first season's work was reconnaissance and the Expedition stayed only long enough at the various places to make preliminary observations. They made a great circular tour and that in the end proved to be the very wisest policy.

"During the season of 1923 the problem was a different one, it required a return to those places where specimens had been found to make extensive collections, to execute careful surveys of these sections and to study them in greater detail. This is a good model for all scientific work. A general survey of the field should precede the more intensive work at selected localities. Thus alone can we avoid becoming lost in a forest of facts and find ourselves unable to see the trees because of the woods.

"It is very gratifying that the results of the second year's survey far exceeded our fondes hopes. The richness of the ancient life of Mongolia as shown by the abundance of the deposits both of reptilian and of mammalian bones, far surpassed our expectations. I am sometimes asked what I would like to have brought back from divers expeditions. If I had been asked what I would like to have brought back from this Expedition, I should have considered it an act of tyranny to request Mr. Andrews to obtain just what he has brought back. Mongolia proved to be far richer both in reptilian and mammalian life than could have been anticipated. There are still very extensive exposures, only a portion of which we have found time to explore. But never in all my journeys, begun 46 years ago, have I seen beds so rich in organic remains as those which have been found by our party in Mongolia in the season of 1923.

"Speaking from the point of view of the original plans of the Third Asiatic Expedition we feel that one third of the original objects of the Expedition has been accomplished. There remain two thirds of our work still to be done. One of the great problems which awaits solution is whether Mongolia was the home of the primates, the order to which man belongs. I may venture an opinion on this point. I am inclined to think that if we find deposits in Mongolia showing primates, that is apes, etc., that they will be of the higher type.

"It seems to me from analysis of the fauna already discovered that Mongolia was formerly not a densely forested country but rather a plains or savannah country, with intervening meadow lands and grassland, leading up to the other more densely forested parts. It was primarily an open country. The higher type of primates, especially those which are likely to belong to the division which considers itself the highest of the primates, namely man, will be found to have existed in an open country. If Mongolia was an open country, the chances of our finding the remains of these primates are good, and we trust that it may be our good fortune to find such remains, though experience proves that they are extremely rare in all deposits. Remains found in India are the rarest of fossils, and it is probable that India was densely forested during the Tertiary period. According

to the latest theories we must look into a plains country for the ancestors of man. Consequently the chances of the Third Expedition are as bright in Mongolia as they would be in any other portion of the world.

"Another one of our tasks for the future is the discovery of a terrestrial fauna in the Basal Eocene of Mongolia. Let me explain why this is so very important. It is a recognized fact that modern types of mammals first appear in North America, at the bottom of the Lower Eocene and at the top of the Basal Eocene. Here we find 4-toed horses, 4-toed tapirs, 4-toed titanotheres. 5-tord horses have never been found in North America.

"Still we are convinced that the ancestors of these 4-toed ungulates possessed 5 toes. We want to find the 5-toed horses, the five-toed tapirs, rhinoceroses, etc., which were the ancestors of the 4-toed types. Where did they live? We hope that they lived in Mongolia and our chances for discovery depend upon the finding of the Basal Eocene. If we succeed, we shall have found the center from which the higher type of mammals spread to the American region in the East, and to the European region in the West.

"In conclusion I would like to say that the work thus far accomplished has been due primarily to the character of the men who went into the field, their highly trained ability in these special lines, and to the splendid generalship of the leader, Roy Chapman Andrews to whom I shall now yield the floor."

THE SECOND YEAR WORK OF THE THIRD ASIATIC EXPEDITION

BY ROY C. ANDREWS

(Abstract)

"In asmuch as my work on the Expedition this year was not at all scientific, but merely that of bringing about the ways and means for the staff to go where they wanted to go and to do the work that they had to do with the least trouble. I am not going to tell you about the scientific work but will leave that to my colleagues, Mr. Granger, chief paleontologist, and Mr. Morris, chief geologist. I want only to speak of the ways and means of carrying on work such as we have done for the last two years in Mongolia. As Professor Osborn has said, last year we made only a reconnaissance. We went into an entirely new country; one which might contain fossils or might prove entirely barren. The aim was to cover a great deal of ground and to find out exactly what we had in front of us. This year, our intention was to go back with a working party, and to exploit the places which we had discovered last year.

"I believe, after talking it over with the members of our party, and thinking over the whole subject, that this is the only way that a great expedition of scientific exploration can be carried on without loss of time. First one must explore, locate each region to be worked, then go in with a working party and begin for extensive study and collecting. And as we have gone over the results, it has become clear that in all our future work it will be necessary to follow exactly the same method.

PLENTY TO DO.

"After returning from our reconnaisance of 1922 and discussing with Mr. Granger and Mr. Morris, we decided to ask the Museum to send us three first class paleontological collectors. We wrote them very strong letters. I remember that I told Professor Osborn that if he wished a collection such as one man could obtain we could do that; if he wanted a collection such as two men could get together, or three, or ten, we could produce it. Then I began to worry for fear I had given myself too large an order, and that we would not be able to keep a staff of five or six paleontological collectors busy; but, after we got to Mongolia and had our first peep into the fossil fields, that worry began to disappear with lighting rapidity. Not only did we have the three new men, who are trained experts in the finding and removing of fossils, but we also had a Chinese named Buckshot. That, I need hardly say, is not his Chinese name. He is a young man who has developed into a splendid fossil collector and if we wanted to find specimens in the quickest way, we sent him, for he had an eye that could penetrate the soil and get down to the very things we wanted.

"These men worked under the direction of Dr. Granger, and I need not say that the credit for the splendid paleontological discoveries that have been made is due largely to him and also that to the way in which the fossils have been removed is due the splendid condition in which they have arrived, many of them being already in the Museum. Inasmuch as we would not have such long reconnaissance, Mr. Morris felt that this year he could take care of the geological and topographical work unassisted, although he and Dr. Berkey worked together last year.

HOW THE WORK IS DONE

"You may be interested in knowing the methods by which we carried on the actual physical part of getting to the remote interior Mongolia with our large party. Our caravan of seventy camels either preceeded or followed after the motor cars, carrying supplies of gasoline and food. We had 2,000 gallons of gasoline and more than a ton of flour, a half ton of sugar and other supplies in proportion, because there were twenty six men; nine Mongols, nine Chinese and eight foreigners. It takes a great deal of food to keep twenty men in good health and working at their full speed, and it takes a great deal of gasoline to keep five cars going all the time, either on reconnaissance, or on the trail. These supplies were carried on camels.

"Our great problem was boxing the fossil which we obtained, for no wood can be found in the region we visited. We adopted the system of carrying the gasoline in cases, and had large boxes to carry the food. As the gasoline and food were used, the fossils were packed in the boxes. The packing material was a highly important item. We found that we carried it with us, for the camels of our caravan shed their coats at the right season of the year, and when a fossil needed to be packed we pulled out the camel's wool. A splendid arrangement for both camels and fossils. Thus we solved or rather the camels solved, for us one of the most difficult problems.

"This year we did only geological and paleontological work though last season we were all collectors. I myself directed the investigations in zoology but we had covered the subject so thoroughly that only a hull work was needed to fill in the gaps. We went from

Peking to Kalgan and then to Dabasu where our party divided. Two men were left at Dabasu while the rest of the staff returned to Ireden-Manha and worked in the Eocene quarries. Then we reassembled and proceeded west 180 miles to Ula-Ussa where we collected Titanotheres, and other mammals of the Eocene. This field proved to be much richer than we had anticipated.

HUGO COLLECTIONS.

"During this season we have taken nine tons of fossils and this collection includes over one thousand individual specimens so you can see that conditions were ideal. We obtained beautiful skulls of Titanotheres and seventy skulls of protoceratopsian Dinosaurs. Our greatest popular discovery of the most scienfic importance was near the Altai mountains where we found a nest of Dinosaur eggs. It was not known whether or not Dinosaurs laid eggs but we found eggs in perfect condition as well as fragmentary specimens. We even have several eggs containing embryos so that it will be possible to study the embryonic stage of these extinct reptiles.

"Returning to Ulu-Ussu I returned to Peking to bring Professor Osborn to Mongolia where the Expedition was waiting. It was a delight to have Professor Osborn with us. I have been in Mongolia five years but on this trip I saw a new Mongolia through his eyes. It was the culmination of two successfil seasons to have him with us."

PALÆONTOLOGICAL DISCOVERIES OF THE THIRD ASIATIC EXPEDITION

BY WALTER GRANGER.

(Abstract)

As Mr. Andrews has said our first season in Mongolia was one of reconnaissance - the past season has been one of work. We realized upon returning to Peking last fall that we had opened up a great new field for paleontological exploration and this spring we started out and equipped to take the fullest advantage of our discoveries of the previous year.

The proper collecting of vertebrate fossils is a work which requires great care, a certain amount of skill, and, above all, experience. In our first year in Mongolia I was the only member of the party who had this requisite experience and, therefore, the size of our collection was limited to just what I could excavate myself. Of prospectors there were plenty; all members showed a keen interest in hunting for fossils and some of them showed exceptional skill and several of the most important finds were made by them. Even my Chinese chauffeur developed into a very successful fossil hunter. But the specimens once found it departed upon me to excavate them and prepare them for shipment.

This season, in response to appeals made to the museum authorities, three highly trained men, Messrs, Olsen, Kaisen and Johnson, were sent out from America in order that we might reap the harvest which we knew to be awaiting us. A fourth man, the Chinese boy "Buckshot", whom I

had trained at fossil work in Szechuan last winter, proved of the greatest assistance. With this splendid working force we were able to accomplish much and I wish to acknowledge indebtedness to these assistants for our really large and important collection.

In our first year's exploration work we covered a great deal of territory necessarily, our route leading first to Urga, thence westward along the southern edge of the mountains of northern Mongolia and then south into the Gobi and finally eastward along the great trough of Central Mongolia and back to Kalgan. We learned in this reconnaissance that the sedimentary basins in which our fossils are found lie entirely in this great central region, stretching eastward and westward as far as our explorations took us. And so this year, with the collecting of fossils as our principal object, we spent our entire time in this central Gobi region. We began work at Iren Dabasu, on the automobile route to Urga, and gradually, during the summer, worked our way westward through the long line of basins and finally finished up at the base of the Altai mountains. Every permanent camp was in the immediate neighborhood of fossil-bearing strata and, except for the time spent in travelling, hardly a day was lost during the entire season.

I might liken this series of sedimentary basins to a line of saucers laid out on a table; each saucer filled with alternating layers of sand and mud and then with dissections through this mass so as to expose in cross sections the entire series of sands and clays, such dissections being caused in nature by the subsequent erosion of the mass by streams. The floors and rims of these basins are of hard rock—rock which with few exceptions, does not contain fossils, granite being one of the common types. These basins were formed at various times by folding, or warping of the hard rocks of the earth's crust, and in the basins so formed there have accumulated the sediments made by the wearing away or eroding of the old hard rocks which form the rim of the basin. The layers of sand and mud so deposited have now become, after a great lapse of time, sandstones, hard clays and shales and it is in these sandstones, clays and shales that we find entombed the bones of the animals which inhabited that particular region at the time when the sediments were being accumulated, and whose bodies became buried under the accumulation.

As these basins were formed at different times of the earth's history so the sediments which fill them, and the fossils which are contained in these sediments, represent different geological periods. In range they extend from well back into the Age of Reptiles down almost to the Age of Man—a period of time of probably ten millions of years. At least six, possibly eight, distinct periods, or life zones as they are called, are represented in our collections.

Of popular as well as scientific interest the Dinosaurs of the great Age of Reptiles, and which we found in three different zones, probably are the most important of our finds. In the oldest rocks of this age, in the Oshik basin at the foot of the Altais, we found skeletons of small bipedal dinosaurs and in the same beds remains of the great dinosaurs of the *Brontosaurus* and *Diplodocus* type—animals which reached a length of eighty feet or more and were the greatest quadrupeds of all time. At Iren Dabasu, at the extreme eastern end of our series of basins, we found abundant remains of more recent types of dinosaurs, carnivorous dinosaurs of various sizes and species and a large herbivorous bipedal type, apparently similar to the Iguanodons of Belgium.

But the discovery which has pleased us most is the one Mr. Andrews has mentioned—the finding for the first time of the eggs of the dinosaurs. These come from the third series of

dinosaur-bearing beds and in age are in between the two points mentioned. Geographically the basin containing them lies just east of the eastern end of the Altais. We have called them the Red Beds because the sediments here are almost entirely a brick red sandstone, some of it water carried and some of it obviously deposited by the wind, similar to the loess deposit of Northern China.

Last fall when we were on our way back to Kalgan we discovered these beds, almost by accident, late one afternoon and in the short time at our disposal before dark we secured one fine skull and other parts of what we now know was the commonest type of dinosaur of that time and place. This skull has since been described by Dr. Gregory of our Museum as *Protoceratops* and it is, as its name indicates, an ancestral form of the Ceratopsians or horned dinosaurs which in late Cretaceous times in North America became one of the most striking group of an extraordinary dinosaur fauna; animals with skulls five and six feet in length, a great frill extending out over the neck as a protection and with a pair of long and sharp pointed horns over the eyes. The *Protoceratops* while it undoubtedly belongs to this group of dinosaurs, is so primitive that it has not yet developed horns, or at most has only rudimentary ones.

This year we spent six weeks in these Red Beds and we found the little Ceratopsians to be very abundant there. Some seventy skulls and a dozen skeletons were collected. There were various species of them, some with skulls only a few inches long, others with skulls up to thirty inches and a probable total length of eight or nine feet. Closely associated with the skulls and skeletons of the Ceratopsians were the eggs and we have great reason to believe that they were laid by this particular kind of dinosaur because while other sorts of dinosaurs were found here they were rare. The Ceratopsians were common and the eggs were common and the natural inference is that they belong together.

The eggs were found in clusters or groups of from three to a dozen or more each. Apparently they lay just as the parent had deposited them and covered them up in the sand to hatch in the heat of the sun after the fashion of many living reptiles. It is probable that before incubation was completed the eggs became buried, possibly by severe sandstorms, to such a depth that the eggs were deprived of the heat of the sun and development stopped. And so there they have lain ever since, deeply buried in the sandstone until the erosion of recent times has again brought them to surface by the removal of the covering rock. The eggs vary in size from five to eight inches long; they resemble snake eggs in shape about the same at both ends and the shell, which is hard and brittle, shows a fine wrinkled surface. Most of the eggs are slightly crushed and the inside of the shell is filled with the same fine red sandstone in which the eggs are imbedded. Two of them which happened to be broken through in weathering showed what we took to be traces of the embryo inside. It is hoped that some of the eggs may contain embryos sufficiently developed to enable us to determine if they really do belong to the *Protoceratops*. There is also a chance that we may find an unlaid egg in the body cavity of one of the dozen skeletons which we have.

The three formations of the age of Reptiles in which we have worked in Mongolia represent three distinct periods in the history of that region. In the oldest of these, the Oshih basin beds, a warm humid climate is indicated with an abundance of water and with the country probably not much above sea level. In the Red Beds we find a distinctly upland fauna

with more arid conditions prevailing and in the Iren Dabasu beds we again find a lowland fauna with a warm humid climate and the presence of fairly large bodies of water indicated.

There is not time, and this is hardly the occasion, to enter into any detail about the several life zones of the great Age of Mammals which we have discovered in Mongolia, but I may say briefly that we have determined five such zones ranging in time from Eocene to Pliocene, and that from three of these we have secured sufficient collections to enable us to picture the life of these periods in a fairly satisfactory manner. In the Upper Eocene or Irdin Manha beds we found an abundance of those rhinoceros like beasts known as Titanotheres similar, almost to the point of specific identity, to the Titanotheres of North America of that same period. Also from the Irdin Manha we have the skull of a giant carnivorous animal related to our American Mesonyx and the largest flesh-eating land mammal of which we have knowledge. From the Artyn Obo beds, slightly later than the Irdin Manha we have another Titanothere, more advanced in structure, than that from the Irdin Manha. There is also from this formation a rhinoceros called *Caduroatherium* which is more closely related to European forms than to the American types. In still younger beds, belonging to Oligocene or perhaps early Miocene time, and which we have name the Houldjin and Heanda Gol formations, we have a large fauna which is entirely old world in its relationships. It is in these beds that we found the first season the scattered remains, including one good skull, of the giant rhinoceros *Baluchitherium*, an animal which probably exceeded the elephant in size and may thus be considered as the largest land mammal.

As result of our two years paleontological work in Mongolia we have amassed a very considerable collection of vertebrate fossils covering a wide range of geological time. Most of the forms discovered are new species, many belong to new genera and a few represent new families. A careful study of these different faunas and a comparison with the faunas of Europe and America covering this same period is going to yield important information as to former land connections between Asia and the other two continents, and of the migrations to and fro across these connections.

The six or eight faunal zones represented in our collections are by no means in a continuous series; there are many gaps to be filled in before we shall have anything like the remarkable sequenae of horizons which are to be found in America and Europe. The most important of these gaps is the one between the last of the dinosaurs-bearing beds and the earliest of the mammal beds. But our Expedition is yet young. As originally planned the work was to be carried on for five years. Two years have now elapsed and the party is going home in order to get a better perspective on what has been accomplished and on the work of the future. When the Expedition returns and resumes its explorations in Mongolia we shall be free of the doubts and apprehensions which attended our entry into this region. We now know Mongolia to be one of the great fossils fields of the world and in our work of the next few years we have at least a good promise of success.

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PHYSIOGRAPHY OF MONGOLIA

BY F. K. MORRIS

(Abstract)

Mongolia during the earlier ages was the site of a great geosyncline, filled by marine waters, which extended across it from east to west. In these waters were deposited the sediments which enclosed the life of the later Paleozoic, extensive collections of the remains of which have been made. At the end of this period the region was folded into a system of mountains, rivalling the Alps if not the Himalayes, in height, and during the succeeding periods of time these mongolian Alps were slowly worn down by wind and weather, rain and frost, until they had disappeared as a, topographical feature, leaving in their stead a broad level plain, or peneplane, so level that it made motor traffic across it almost a pleasure. It was upon this "Mongolian peneplane" as it is called, that the younger sediments which enclosed the remains of the land vertebrates were deposited. A remarkable fact discovered by this expedition was the peculiar migration of the basins in which these sediments were laid down. Thus in one place a basin contained the earliest of these younger sediments and directly before these lay almost the latest members of the series. The intervening members were deposited in other basins which were formed while the previous area of deposition rose to become a region of denudation.

PROCEEDINGS OF THE SPECIAL MEETING, NOVEMBER 8, 1923.

A special meeting was held in the Library of the National Geological Survey of China in honor of Dr. Sven Hedin. It was attended by more than hundred persons including members and guests who specially come to see the world-wide known geographer.

In the Lecture Hall of the Library was exhibited a complete collection of publications of Dr. Hedin and his collaborators, which were previously presented to the Survey by this great author. Among the publications the magnificent volumes of "South Tibet" and of "Transhymalaya" were specially remarked.

The meeting was presided by Dr. W. H. Wong, vice-president, who after a few words of introduction thanked Dr. Hedin for his valuable contribution of the publications to the Geological Survey and also for his kindness of delivering this first speech since his arrival in Peking. An abstract of his address was made by Mr. G. B. Barbour in absence of the Secretary and it is as follows.

In rising to reply to Dr. Wong's introduction and expression of thanks on behalf of the Geological Survey and the Geological Society Dr. Sven Hedin said he was specially glad to be able to present the published records of his journeys to the Survey Library, since his expeditions in Asia were very largely along the border lands of China.

Of the several journeys referred to, the first was in 1885, when the explorer left Sweden, travelled through Russia to Baku where he worked for 7 months in the Nobel oil-field, passing on by Teheran across Persia to the ancient capital Ispahan, and so by Shiras, Basra and Baghdad, the city of Haroun-al-Raschid and the scene of the "Arabian Nights" into Kurdistan. The return was made across the Caspian Sea to Baku and throughout the whole journey Dr. Hedin travelled alone, being at this time 20 years of age.

Four years later he again set out, this time in company with the three other members of a royal embassy to the late Shah of Persia After being entertained by the Sultan in Constantinople he received special permission to separate from the other members of the mission and extended the trip into 1891, travelling alone from Teheran by the famous turquois mines at Nishapur, via Samarkand, and Bohkara across to Kashgar, the most westerly city under Chinese dominsion. Here he met the Bristish explorer Younghusband. The return journey to Samarkand was taken across the Tien-Shan range.

In 1893 he set out again going by Samara across Russia and then striking south 2000 kilometers to the capital of Turkestan. The crossing of the Pamir mountains in midwinter over snow-drifts 3 metres deep was a feat in itself, the surface having at places to be covered with mats and carpets to prevent the ponies sinking; when attempting to make the first ascent of Atar Mustag, the highest peak of range the party was forced by storm to turn back at an altitude of 20,000 feet. On returning to Kashgar a new caravan was collected, 8 bactrian camels being used.

The Taklamakan depression in Chinese Turkestan is drained by the Tarim which flows East through Sinkiang, fed from the south by the Yarkand Daria and the Khotan Daria which drain the back slopes of the mountains forming the northern borders of Tibet. This basin between the Kuenlun mountains and the Tienshan range on the north is a true sand desert unlike the bed-rock desert which occupies the major area of the Gobi. The desert sand-dunes offer almost unimaginable barriers to travel; whereas the maximum altitude of storm waves on the Pacific or Atlantic seldom exceeds 35 feet, the dunes here may reach 200 feet high, and in the eastern desert some were measured over 270 ft.; but it is interesting to note that v. Helmholtz' calculations hold good for waves in both media, and sand-dune data are as deducible from the formulæ as are waves on water.

The vital problem of water-supply was thought to be solved by the use of iron-tanks carried on camel-bank but on the long stretch across the desert after leaving the banks of the Yarkand Daria the failure of the servants to obey orders and keep the tanks filled doomed the party; the supply ran out and for seven days they were without a drop of water; the terrible sufferings of the explorer were described, and the death of the majority of the party after loss of all the camels, sheep and dogs and the abandonment of equipment including all instruments, maps and notes. Finally only one servant and the leader managed to win through in the last stages of exhaustion from drought.

After re-equipping himself with a new outfit from Europe, Dr. Hedin returned again from the borders of Afghanistan to trace the third of the rivers that flow into the Tarim basin from the South. The Keria Daria however is one of those rivers which after flowing across the

desert for a considerable distance dies out and vanishes the water evaporating or sinking into the sand before reaching the Tarim. The explorer described his method of taking observations and preparing reconnaisance maps. It is a tribute to the accuracy of his work that Dr. Stein could rely on them as his sole guide in striking the only well-watered spot in the region; had he missed it he would have certainly never come out alive, as he tells vividly in the "Ruins of Desert Cathay."

The next stage of the expedition took Dr. Hedin south and then east through Tibet, along the Chinese frontier and across the Ordos region where the Huanglio swings into China again, and so by Kalgan to Peking where Li Hung chang welcomed him in 1897.

The next expedition following his return to Stockholm made its base at Kashgar in an attempt to explore further the course of the Tarim across the Tuklamakan desert. This time flat-bottomed boats were used; these being specially equipped for photographic work and having special provision made for transporting animals and food. But the river froze over before the eastern stretch was fully explored and while the boats were locked up the explorer was enabled to made an ever-land trip to the South as far as the edge of the Kuenlun range, returning by Lop Nor, the lake which was known to Chinese geographers thousand of years by.

The Russian traveller Prshevalski had reported finding a lake corresponding closely to the Chinese description but lying a degree further south than the ancient chronicles stated. But the German geographer v. Richthoven to whose records we owe so much in Eastern Asia today, and under whom Dr Hedin studied this very problem, was convinced that the old cartographers could not possibly be wrong in their calculation and that there must have been a lake on latitude 41 as well as the one recognized by Prshevalski 70 miles to the south. Could the lake have migrated? or could the former lake have been drained or filled with sand and a new lake developed at a much later date at the point indicated by Prshevalki? Ven Hedinset out to solve the question. Aiming first for the historic spot of the Chinese records he found only the "60 springs" which proved to be of water so salt that only the wild camels found in that particular locality would touch it. However by collecting the ice that formed over it in goat skin bags a potable supply was secured for his own camels and the rest of their caravan. Turning south to Prshevalski's spot he found a depression, free of water but with abundant shells of Limneo and Planorbis, fish bones and weeds, all of freshwater origin. This proved conclusively the correctness of v. Richthoven's prediction. However the most unique and valuable find was the discovery nearby of a ruined town of old clay dwellings; here were found implements and Chinese coins, and ruins of a temple with wooden images of Buddha. After making a detour to the east the caravan struck the Tsinshan range from the north-east and again entered the desert area where the dust-storms were so severe as entirely to hide the sun. Coming again to the ruined city of Lou-lan he had the good fortune to discover 157 manuscripts on bamboo strips and paper written in Chinese characters and dating from 260-270 A.D. There can be no question as to the accuracy of these dates as the writings are mostly correspondence between merchants and officials of neighbouring towns and bear both the year and the month of the reigning prince's rule. The most interesting relic is a page from a book, written by hand in the year 180 A.D. (the days of Marcus Aurelius). This is the oldest scrap of paper known to exist and must have been made within 75 years after the first recorded invention of paper by the Chinese. It

also is the oldest extant example of handwriting on paper, and predates by 700 years the next earliest known sample of paper found in Europe. One reason for the abandonment of Loulan was doubtless the invasion of barbarians from the north, before whom the Chinese were driven back within their own borders. Is it not however also likely that the change in the course of the river and the resulting drying up of the lake left the city without water and killed its prosperity? Once again the accuracy of the early Chinese observers was vindicated.

The next adventure was an attempt to enter Lhasa disguised as a Mongol; but the suspicious Tibetans made him prisoner. A second attempt met with the same result. He had therefore to give up the idea and returned to Calcutta, spending the following months in shorter journeys across India.

1905 found Dr. Hedin again on the road to Teheran by the Crimea Sebastopol and Trebizond, finally crossing Baluchistan and coming down on Simla. When the British Foreign Office refused to give permission to enter Tibet directly from the south, the explorer made a detour with a large caravan of 130 mules and ponies and 26 men intending to come in from the NE and reconnoitre the strip of Southern Tibet marked "Unexplored" on the map of the R. G. S. the biggest "white patch" on the map of Asia with perhaps the exception of the Arabian desert; by traversing it 8 times Dr. Hedin could map in the main features of the region. On this trip the true sources of the Indus and the Sutledge were discovered for the first time. Then he crossed India and went on to Japan before coming home across Siberia.

The explorer's last expendition, made during the war, was through the heart of Mesopotamia.

Among the printed records of his travels the one of greatest use to Chinese workers is probably volume VIII of "Southern Thibet" since it deals with Tsungling range along the Western border of Eastern Turkestan, for centuries a classical region, but not always placed at the same spot by different writers. Properly the term refers to the girdle of mountains surrounding Eastern Turkestan. Owing to a curious misinterpretation of field records, the Huang-ho was mistakenly supposed by the Chinese to have its source in the desert east of Lop Nor, and thence thought to sink in the ground and rise again further to the East. The real source of the Yellow River was found by Pshrevalski at Orin Nor and Zorin Nor. Dr. Hermann's conclusions from the study of the writings found at Loulan show that the Middle Kingdom was thought to be a square with Kansu and Szechuan forming its boundary at the west limits of the earth. The age-long problem of the geographical Yü-Kung gains light from these discoveries.

The reproductions thrown on the screen dealt both with the caravans taken on various journeys, the country they crossed and the finds they made. Stein and Sachibana and Huntington have visited Lou-lan, famous since its discovery by Hedin. Among the trophies rescued were coins dating from the first decade of the Christian era, glass and metal ornaments, one being definitely Roman in design and showing the connection that is known to have existed btween the Mediterranean world and the east in those days. Besides metal tools, trinkets and brushes there were found bits of woven material including an exquisitely coloured piece of carpet with pattern in five tints all as bright as if made last month, bordered with a pattern of swastikas.

The whole series of discoveries at Loulan throw a clear and unique light on an otherwise obscure period in Chinese history giving sidelights on family, social and official life in a distant community long since buried under the sands of the desert.