

SOME PALAEOONTOLOGICAL PROBLEMS OF CONTINENTAL DEPOSITS OF ASIA

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ABSTRACT — The paper records briefly the recent discoveries and problems connected with palaeontology, biostratigraphy and palaeoentomology of continental deposits of Asia, in particular those of China and the Asian portion of the USSR. Attention of the workers in other countries has been drawn to the recent discoveries in the field of fossil insects and their increasing utilization in the field of biostratigraphy of Soviet Palaeontology.

SEDIMENTARY rocks of continental origin have recently aroused great interest among palaeontologists and geologists. The fact that various valuable minerals have been found in the deposits of ancient continents has led to still greater attention being given to them. They are of special importance to the history of the earth in general and life in particular. This paper deals briefly with some recent discoveries and a few problems confronting palaeontology and biostratigraphy of continental deposits in Asia. These deposits, of different geological age, cover millions of square kilometres along the vast areas of the Asian continent. There naturally arise a lot of difficulties in the process of investigating continental sediments because of their relative insufficiency in the fossil fauna, as compared to the sediments of ancient seas; the sea fauna is much more varied and rich in types and groups of animals than that of fresh-waters. Furthermore, fresh-water ponds are of short life as compared to sea-waters and their fauna is often endemic due to their being isolated from each other; their fauna consequently had not as wide a palaeogeographical distribution as the fauna of the sea. But many land animals, some mammals included, were sometimes widely spread over vast areas of the earth and even now some of them can be found as far apart as Western Europe and Eastern Siberia. In fact, fossil vertebrates are rather often the only remnants of past life in continental beds.

The paper dwells on some results of research work and problems of palaeontology

of vertebrates in Asia. Leaving aside the history of study of the fossil vertebrates in Asia, it should be still pointed out that excavations made in classical localities in Siwalik Hills of India, and the subsequent investigation of the fauna discovered, have played a considerable role in the development of this special branch of palaeontology. Great interest of world science towards vertebrate palaeontology of India was aroused by palaeontological works, devoted to the fossil vertebrates of India, undertaken in the last century and during the first decades in the twentieth. Many scientists enriched the science by contributing new data in the field of palaeozoology, palaeozoogeography, palaeogeography and stratigraphy. The significance of their work extended beyond Asian borders.

SOVIET UNION

The Soviet Union, India's neighbour in the north, and its great friend today, started its systematic research work in the field of vertebrate palaeontology in Siberia and Middle Asia (Khazakhstan, Kirgizstan, Uzbekistan and other Republics) only after the October Revolution. Nevertheless, the drawing of the Siberian mammoth's teeth, made by a Russian traveller sent to Siberia by Peter the Great, when it first appeared in Western Europe, made G. Cuvier take up the study of palaeontology of vertebrates. Taking into consideration the vastness of Soviet Union's Asian territory, our research achievements as to the continental sediments, say, for instance, of the Upper Palaeozoic

and Mesozoic periods of Siberia, are relatively inadequate, though considerable work has been done already. A number of fossil vertebrate faunas have been found in southern parts of Western Siberia, Kazakstan, Kirgizstan, Uzbekistan and Turkmenistan. Some of these are the following:

- 1) Upper Cretaceous deposits: dinosaurs, crocodiles and tortoises.
- 2) Eocene: Brontotheres and others.
- 3) Middle Oligocene: gigantic rhinoceroses, Allacerops and other rhinoceroses, gigantic Suoidea-Enteladonts, some archaic carnivores, archaic small Artyodactyla, rodents, tortoises and others.
- 4) Lower Miocene: short-legged hippopotamus-like rhinoceroses, mastodons, large chalicoters, tapiroids, three-toed horses — Anchitheres, Suoidea, carnivora, rodents, insectivora, tortoises and others.
- 5) Lower Pliocene and probably partly the end of Miocene: hipparions, rhinoceroses, deers, giraffes, antelopes, gazellas, machairodonts and other cats, hyaenas, viveras, badgers, mertens, tortoises, ostriches and others.
- 6) Upper Pliocene: camels, rodents, carnivores and others.

In recent years in Khazakhstan there were found Lower Permian labyrinthodonts and Lower Permian reptiles — close relatives to some North American Lower Permian pelycosauria; besides, there were found footprints of Lower Permian tetrapods. These new palaeontological data and their study have not only been of palaeozoological and palaeozoogeographical interests but also of stratigraphic one. New localities of faunas of various geological ages are being gradually discovered and areas of their palaeogeographical distribution extended. There were recently discovered, for instance, Eocene mammals — aminodonts and others, in the Primorye Territory in the far Eastern Siberia, whereas Hipparion-fauna was found in the Baikal region. On the other hand, new localities of Hipparion-fauna have also been found in the south of Asian region of the Soviet Union — in Turkmenistan, Kirgizstan and Khazakhstan. In Alma-Ata, a new centre of vertebrate palaeontology was established at the Academy of Sciences of Khazakh Republic; good material has been collected that is of great interest for palaeo-

zoology and stratigraphy of continental beds of Mesozoic, Lower Tertiary (small archaic equids, gigantic rhinoceroses, entolodons) and Upper Tertiary (mastodons, rhinoceroses and many others).

Thus, systematic and planned search and excavations by special expeditions and the investigation of fossil vertebrates in the Asian part of the Soviet Union, for the last thirty-five years, have contributed a great deal to our knowledge of the history of life in a considerable part of the Ancient Asiatic land as well as the conceptions of the history of the Continent itself.

Detailed data concerning these faunas can be found in a series of special publications, mainly of the Academy of Sciences of the USSR, and in the survey works by A. A. Borissiak, E. J. Beljaeva and J. A. Orlov.

MONGOLIA

This article deals also with some notable works of the last decades in vertebrate palaeontology to south, east-south from the gigantic zone of mountain ridges of Tien-Shan, Altai and other young mountain ranges dividing Middle Asia and Siberia from the Mongolian People's Republic and China.

The Palaeontological Expedition of the Academy of Sciences of the USSR, under J. A. Efremov, invited by the Science Committee of Mongolian People's Republic in 1946-1949, was the second of its kind after the very interesting findings of the Central Asiatic Expedition of the American Museum of Natural History. This had worked on the Mongolian territory in the third decade of this century, and its valuable scientific material on Mesozoic reptiles and Tertiary mammals is preserved now in the USA. The Soviet expedition referred to made extensive excavations in newly discovered localities of Mesozoic and Tertiary vertebrates, thus adding many new data to those already known and establishing up to ten faunas of various geological ages in respect to the continental sediments of Mongolian People's Republic, ranging from various beds of Upper Cretaceous to later sediments of Upper Tertiary and Quaternary. The expedition discovered new dinosaurs formerly unknown in Asia, Ankylosaurs and huge carnivores (Carnosauria), hadrosaurs-Saurolophus, very close to those from the Upper Cretaceous

deposits of North America, numerous and various kinds of turtles, remnants of the gigantic Archelon-like form from the Upper Cretaceous of Northern America included; its existence in lake-sediments is of great interest, the fact signifying probably the closeness of the sea. Very numerous are the remains of new Dinocerata from Eocene of South Gobi, new rodents, carnivores and other orders. These discoveries supplemented the existing data and partly changed our conception as to the nature of the Mongolian landscape in the Upper Cretaceous time. It appeared that at that period, near vast lakes and great rivers flowing into them, there grew forests of huge coniferous trees, swamp cypress *Taxodium*-like (stumps up to more than two metres in diameter), magnolias and others. By the present time these data have been, for the most part, treated and published. Some materials are on display in the Museum of Palaeontological Institute of the Academy of Sciences in Moscow and in the new Central Museum at the Scientific Committee of the Mongolian People's Republic in Ulan-Bator.

CHINA

When speaking of vertebrate palaeontology in China we cannot help noticing that its vast territory had for many years attracted the attention of vertebrate palaeontologists, mainly foreign ones, due to the existence of continental sediments starting from the Jurassic and those even more ancient. The publication of a series of works by West European scientists and others appeared to be the result of their active interest at the end of the last century and at the beginning of the current one. Besides, in the biggest museums of Tian-Tsin, Nanking and Peking and a few others the most interesting collections of reptiles from Mesozoic beds as well as mammals from Tertiary are properly displayed. It is worth stressing the fact that all branches of sciences in the Chinese People's Republic have developed beyond recognition during the last ten years, the general scope and organization of palaeontological research work included. This is true of the vertebrate palaeontology as well. At the present time, on the basis of the former Laboratory of Cenozoic Research, a special Institute of Vertebrate Palaeontology is

established which deals with the investigation of fossil vertebrates that China is so rich in.

Nowadays the institute is engaged in problems of palaeanthropology, but the bulk of its efforts concern the palaeozoology of fishes, reptiles and mammals. The survey of total investigations for the last 10 years can be found in the publications by Prof. C. C. Young, the head of the Institute of Vertebrate Palaeontology, issued in 1959 in *Scientia Sinica* and *Acta Palaeontologica Sinica*. It should be noted that in such a short period the Chinese scientists managed to start some bases in the outlying regions for regular observations of some interesting localities and collection of fossil remains in them; the laboratories of the institute have been enlarged, a fundamental library on vertebrate palaeontology and adjacent branches of science is established and it is being constantly enlarged. A special journal, *Vertebrate Palasiatica*, dealing with vertebrate palaeontology, has been founded that is now issued in two editions—one in Chinese and the other in French, Russian, German and English. The rich collections include, in particular, a number of mounted skeletons of Permian, Triassic, Jurassic and Cretaceous reptiles, new amazing anomodonts, dinosaurs and other reptiles as well as skeletons of various fossil mammals. Chinese experts are very skillful in making casts of whole skeletons. All these collections are now on display at the Museums of Natural History of Nanking, Tian-Tsin and Peking. The Institute of Vertebrate Palaeontology has a small temporary museum attached, which is rich in most valuable material. Two other museums of Peking, the newly built Geological Museum and the big Natural History Museum, which attract thousands of visitors, possess collections of great interest. To accentuate the scientific value of fossil vertebrates, palaeontologists organize shows in many museums of Chinese big cities, devoted to vertebrate palaeontology, displaying local finds mainly. All these efforts of Chinese palaeontologists find every support on the part of the Academy of Sciences and the Government of the Chinese People's Republic. A big museum of vertebrate palaeontology is to be constructed in the nearest future. Taking into consideration the tempo, constructive

endeavour and skill of Chinese people, the museum is sure to become a reality soon.

SINO-SOVIET EXPEDITION TO INNER MONGOLIA

One of the most eminent palaeontologists of today, Prof. D. M. C. Watson, wrote in 1945 that vertebrate palaeontology is "essentially international science".

In fact, vertebrate palaeontology can be considered a truly international science for its specific objects being often unique as compared to the palaeontology of invertebrates or palaeobotany. Neither dinosaurs nor fossil horses and rhinoceroses were aware of any political borders that can hinder the work of palaeontologists; furthermore, gigantic mountain chains separating the Chinese People's Republic from other countries are known to be very young in the geological sense — they had not existed then. Many vertebrates of Siberia, Khazakhstan, Mongolia and the greatest part of China could travel and settle in new areas in the Upper and Lower Tertiary and still earlier in Cretaceous periods, though the speed was not at all like in modern jet-planes, but in any case no visas were necessary. . . .

An idea occurred to Chinese and Soviet palaeontologists as to joint research work in the field of vertebrate palaeontology. A joint Sino-Soviet Palaeontological Expedition conducted its investigations on the territory of Inner Mongolia in 1959. The materials obtained by the expedition are now under technical preparation, but the following information is already available.

The expedition visited some localities of Inner Mongolia that had been discovered in the thirties of this century by the Central Asiatic Expedition of the American Museum of Natural History. New excavations have been made. Quite recently new localities have been discovered and again excavations made. The results of the first year of research work, though taking only four months in all, are rather significant.

The following material has been collected:

- 1) An important duplicate material of those earlier findings which had not been reserved in China.
- 2) Additional skeleton material of fossil vertebrates that has been known up till now only from fragmentary remains.
- 3) New materials of great interest.

New localities have been discovered that are to be excavated in future. Some dinosaur skeletons have been excavated, but the most significant and extensive material originates mainly from the continental Lower Tertiary beds of Upper Eocene. We cannot but mention, for instance, some dozens of skeletons of an archaic artiodactyl buried together. The joint efforts of Russian and Chinese specialists in the field of vertebrate palaeontology seem to us full of perspective and there is every reason to expect the successful continuation of this kind of work.

FOSSIL INSECTS

Below we shall dwell on small fossil insects not 'popular' among palaeontologists and geologists who favour huge land inhabitants such as dinosaurs, rhinoceroses, proboscideans and others. While entomologists observe with due attention the imprint of an insect wing, most geologists consider insects not worth speaking about. They think that fossil insects can be found only in amber and they are of 'no use' whatsoever. Many have never seen a fossil insect. Nevertheless, fossil insects are not so rare an exception as it may seem and they can be found in continental sediments. The point is to devote due attention to their proper collection under the guidance of a specialist-palaeoentomologist in the deposits (facies) where frail and slight imprint of a whole insect, or of its wings, could be preserved. There is naturally almost no chance of finding any remains of fossil insects among pilings of skeleton or bones of dinosaurs, ungulates and others in places where the remains of fossil vertebrates were water-carried. But, on the other hand, there is some chance of discovering them in fine silt sediments of lakes, river-beds, back-waters and other sediments that can preserve, for instance, imprints of plant leaves. Extensive palaeoentomological collections of Palaeontological Institute of the Academy of Sciences of the USSR can be cited as an example of positive results of systematic work in this field. These collections amount to thirty thousand specimens of very different geological ages, for example, Carboniferous, Lower Permian, Upper Permian, Triassic, Jurassic, Cretaceous, Lower Tertiary and Upper Tertiary. The examination of these collections is not only of some palaeozoological interest

that throws light on the history and taxonomy of many insect groups, the problems of wing evolution, the convergent development of adaptations and so on, but it also enables us to make out some palaeozoogeographical relations. It contributes new data as to the climate and landscape of the past as many insect groups are specially adapted to certain conditions of life, landscape, zones of inhabitation and temperature. For a long time some almost unknown groups of fossils and those studied insufficiently were considered quite 'useless' for stratigraphy, but after having been studied properly these very groups appeared of certain use. Thus formerly 'useless' fossil insects became 'useful' and are utilized in the field of biostratigraphy of Soviet palaeontology. In the USSR the collection of fossil insects is going on so successfully that during the year 1959 only the Palaeontological Institute of the Academy of Sciences of the USSR got some seven thousand specimens from deposits of various geological ages from the Asian part of the Soviet Union as well. Palaeontological research is to be expected in the near future by Chinese palaeontologists.

ROLE OF PLANT FOSSILS

A few lines should be devoted to palaeobotanical research, as its importance to the history of the plants and the investigation of continental deposits is well known. As a matter of fact, palaeobotanical collecting is conducted quite independently of fossil vertebrates owing to the different facies and formations of fossil plant and insect localities on the one hand and land vertebrates on the other. The question is rather 'technical' and there is no reason why it should lead palaeozoologists and palaeophytologists to their acting apart in common tasks when studying former landscapes, climates and so on. Unfortunately, such practice exists as a result of being carried away by specific problems. But specialists in fossil vertebrates must know what plants served as forage for ancient giraffes, rhinoceroses and the like, as much as palaeontologists should know about these plants. But because of facies relationship of fossils and the conditions of their burial, palaeobotanists have to cooperate with palaeontologists more frequently than with palaeozoologists, experts in vertebrate palaeontology.

Different durations of existence of some fossil plants on the one hand and of land animals on the other sometimes cause a kind of discrepancy between palaeozoologists and palaeobotanists.

This rather incomplete survey on palaeontology of continental deposits of a part of Asia still conveys the idea that the knowledge of various faunas and groups of animals from continental sediments in different parts of Asia is quite different and incomplete. In our research work in vertebrate palaeontology we come across some organizational and technical difficulties, sometimes financial too, connected with extensive excavation work which is expensive. It impels us to think about joint efforts of scientists of different countries.

The part India has played in developing vertebrate palaeontology of Asia, or rather of the Eastern Hemisphere, and Indians' great contribution to palaeontology in general lead us to expect further successful investigations in vertebrate palaeontology of continental deposits and the development of palaeontology in this country as well.

There is every opportunity for that end: a large series of continental strata of various ages, stretching along vast areas horizontally, and sometimes displaced slightly due to later orogenesis; a rapid development and a high level and variety of biological and geological investigations conducted by Indian scientists. Furthermore, there is another big source in the form of a number of periodicals, specially palaeontological journals, besides many collections in the museums and colleges of the country that are to be thoroughly studied and revised. Needless to say, talented young people of India can contribute a great deal to the benefit of Indian science. Some branches of palaeontology of continental sediments in India such as palaeontology are to be developed in future and the world science is expecting their advances with an ever-increasing interest.

The recent resumption of excavations in Siwalik Hills, under Prof. M. R. Sahni, President of the Palaeontological Society of India, should be considered a beginning of a new stage in the work that is to throw light on many problems connected with the history of life and the earth; its significance will evidently be felt beyond the borders of the great and wonderful country of India.