

## DISCOVERIES DURING THE SEASON OF 1923 BY THE THIRD ASIATIC EXPEDITION IN MONGOLIA

BY HENRY FAIRFIELD OSBORN

AMERICAN MUSEUM OF NATURAL HISTORY

Read before the Academy, November 14, 1923

To eastern Mongolia under the guidance of Roy Chapman Andrews, leader of the Third Asiatic Expedition, which has now been in this field for three seasons, the writer made a rapid journey examining personally the fossil beds surrounding Iren Dabasu, at the lowest point of the eastern end of the Gobi Desert on the Urga trail. The three formations exposed here are:

Houldjin beds, Baluchitherium Zone, Upper Oligocene

Irdin Manha beds, Protitanotherium Zone, Upper Eocene

Iren Dabasu beds, Middle Cretaceous.

The Houldjin Formation is of historic interest as including the spot where the Russian explorer, Obruchev, found a single rhinoceros tooth, probably belonging to *Baluchitherium*; also because the first fossil by the Third Asiatic Expedition was found here. This eastern exposure of the Baluchitherium zone has very rich and fragmentary remains. The finest specimens of Baluchitherium came from the far western exposure of Hsanda Gol.

The Irdin Manha is extraordinarily rich in Titanotheres and other mammals of exactly the same geologic age as the Uinta C beds of Utah, at the very close of Eocene time. Superb collections were obtained from these beds in the type locality, also ninety-eight miles west at Ula Usa.

The Iren Dabasu ("valley of the salt lake") beds yielded rich littoral fauna, of iguanodonts, of dinosaurs, of carnivorous dinosaurs and of toothless herbivorous dinosaurs known as *Ornithomimus* or *Struthiomimus*, which will enable us to determine precisely the geologic age of these beds, probably lower levels of Upper Cretaceous.

The Third Asiatic party this season consisted of Leader Roy Chapman Andrews, Frederick E. Morris, geologist and topographer, and Walter Granger, vertebrate palaeontologist, with three field assistants, Messrs. Kaisen, Olsen and Johnson, all highly experienced in Montana and Wyoming exploration. This strong party returned to the locality in eastern Mongolia where a single small type specimen of *Protoceratops andrewsi* was discovered during the season of 1922 and assigned to the Lower Cretaceous. Here the most remarkable discoveries of the year were made, namely, dinosaur beds of unparalleled richness, probably of Lower Cretaceous age and of Aeolian origin. The dominant element in the fauna is Protoceratops, which is found in all stages of development from the

young still contained within the egg before hatching to the fully adult. This proves to be a veritable ancestor of the Ceratopsia, with a well-developed neck frill, with rudiments of horns above the eye and also beneath the nasals. Seventy-two skulls and twelve more or less complete skeletons of this remarkable animal were unearthed and transported by camel caravan 800 miles across the desert to Kalgan, where they have recently arrived, as announced by cable. With Protoceratops were found many other kinds of reptiles, affinities of which have thus far not been determined.

To sum up the season 1923, out of the thirteen fossil-bearing horizons discovered in 1922, seven were extensively explored; five of these yielded very rich fossil results, which in time will enable us to determine precisely their geologic age. Mongolia is proved to have been highly fertile, a richly inhabited country from the close of Tertiary time, an evolution center—possibly the chief evolution center of land reptiles during the Age of Reptiles and a very important evolution center of the land mammals during the Age of Mammals.

---

## SPECTRA OF METEOR TRAINS

BY C. C. TROWBRIDGE (*Deceased*)

DEPARTMENT OF PHYSICS, COLUMBIA UNIVERSITY

Communicated, October 20, 1923

NOTE: The material for this paper was completed by Professor Trowbridge shortly before his death in June 1918. The paper was actually written by Miss Mabel Weil, who worked with Professor Trowbridge and who had learned from him the form in which he had intended to publish this research. This work was carried out and is published with the aid of grants from the J. LAWRENCE SMITH FUND of the NATIONAL ACADEMY OF SCIENCES.

1. *Historical Summary.*—The origin of meteor trains, or the persistent phosphorescent streaks left by large meteors, has been one of the enigmas of astronomy. Many of the streaks observed persist for several minutes, sometimes for an hour or more, before gradually fading from view. The meteor trains observed at night are self-luminous, for they appear in a part of the sky where there is no possibility of reflected sunlight and they often have discontinuous bright line spectra. The present investigator has, in previous papers, expressed the view that meteor trains are probably due to the phosphorescent afterglow in a gas at extremely low pressure. An investigation regarding the spectra of these bodies would prove of