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PLIOCENE BEDS OF THE IREN GOBI[1]

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INTRODUCTION[2]

The purpose of this paper is to place on record the finding of Pliocene strata containing a rich and varied vertebrate fauna in the eastern part of the Iren Tala of Mongolia by the Central Asiatic Expedition of the American Museum of Natural History in 1928. Pliocene beds had already been described by P. Teilhard de Chardin[3] in the region of Dalai Nor, and in Southern Inner Mongolia by Andersson,[4] but their existence in Central Mongolia had not been known previously. In 1922 the name Hung Kureh[5] was applied by the members of the expedition to fossiliferous beds of Pliocene age discovered at the base of the Baga Bogdo, in the Altai region of Western Mongolia.

During the 1928 field season, the Central Asiatic Expedition spent in all several weeks exploring the country which lies east of the main Kalgan-Urga trail. The region had never been visited before by the Expedition and was first crossed in June by a reconnaissance party in search of new fossil fields. On the second day of this exploration (June 19), vertebrate remains were found near Gur Tung Khara Usu (Fig. 1) in more than sufficient abundance to justify detailed investigation by the entire Expedition. Later in the season, during July and August, the country was explored more carefully and many fossils were collected.

THE IREN GOBI

In the central part of the Iren Tala,[6] the lowest region of the Gobi desert, there extends a wide area of the "later sediments," covering several thousand square miles. For this great basin the name Iren Gobi

[1]Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 96

[2]The general geologic setting of Mongolia and the methods of study which served as a basis for the present work have already been described. Berkey, C. P., and Morris, F. K. 1927. "Geology of Mongolia," Natural History of Central Asia, Vol. II.

[3]Teilhard de Chardin, P. 1926. 'Etude Géologique sur la region du Dalai-Noor.' Mém. de la Soc. Géol. de France, No. 7.

[4]Andersson, J. G. 1923. 'Essays on the Cenozoic of Northern China.' Mem. Geol. Survey of China, Series A, No. 3, pp. 36–52.

[5]Berkey, C. P., and Morris, F. K. 1927. 'Geology of Mongolia.' Natural History of Central Asia, Vol. II, pp. 233–236, 365–366.

[6]Berkey, C. P., and Morris, F. K. 1927. 'Geology of Mongolia.' Natural History of Central Asia, Vol. II, pp. 206, 207.

is here suggested, the name being taken from Iren Dabasu, the first discovered of many fossil fields which have been examined by the Central Asiatic Expeditions within the borders of the basin. The sediments, nowhere believed to be more than 1,000 ft. thick, occupy a broad shallow depression formed by the downwarping of the ancient deformed and peneplaned rocks which comprise the desert floor.[1] The peneplane surface on which the sediments rest was formed in pre-Cretaceous

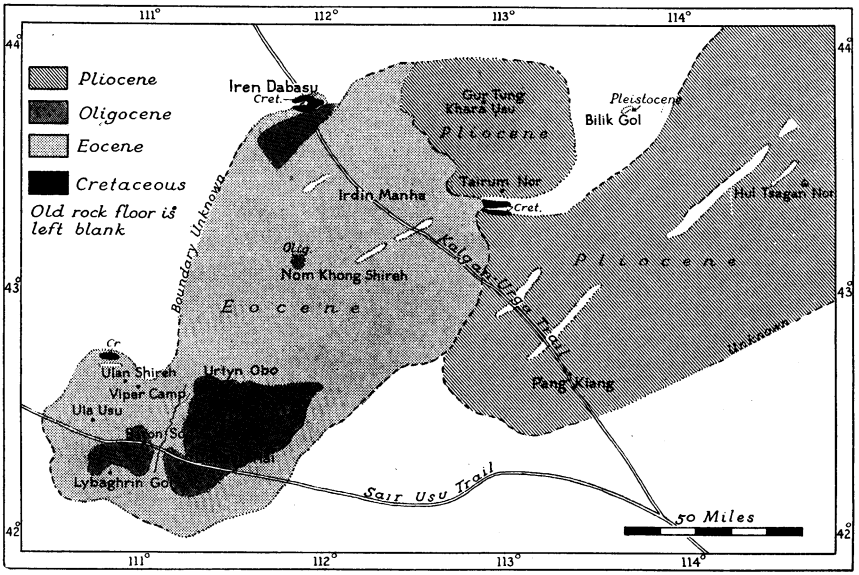

Fig. 1. Sketch map of the Iren Gobi showing principal fossil localities. Contacts shown by broken lines are inferred and subject to correction.

time; the basin-warping began in the Cretaceous period and presumably has been active in an intermittent fashion through most of the time which has elapsed since the initial warping. Iren Gobi sediments do not present a complete succession of strata, but have been deposited and eroded in response to changes produced by differential warping and fluctuations in climatic environment. The Eocene and Pliocene are well represented by both sediments and fossils. The Cretaceous and Oligocene beds contain a rich fauna but are restricted in thickness. Miocene beds have not yet been discovered and the Pleistocene record is but poorly preserved.

[1]Berkey, C. P., and Morris, F. K. 1924. 'Basin Structures in Mongolia.' Bull. Amer. Mus. Natural History, Vol. LI, Art. V, pp. 103–127.

The outline of the Iren Gobi is roughly elliptical, with its longer axis trending NE–SW in parallel alignment with the main structure lines of this part of Asia. In crossing the desert by the Kalgan-Urga trail, Iren Gobi sediments are first encountered at P'ang Kiang,[1] from which place they continue northward to Iren Dabasu with only minor local interruptions.

The western and central parts of the area in question are fairly well known, and have been studied by members of the Expedition during all four field seasons (1922–3–5–8). Strata of Cretaceous, Eocene and Oligocene age were recognized in 1922[2] and have yielded large collections of fossils. Recent exploratory traverses indicate that these fossil localities and their surrounding sediment are to be considered part of the same basin and continuous in a geographic sense with the Pliocene strata of the eastern part of the Iren Gobi.

PLIOCENE SEDIMENTS

Pliocene sediments are spread over the eastern and northeastern area of the Iren Gobi. Since the eastern margin of the Iren Gobi has not been seen by the Expedition, the boundaries of the Pliocene cannot yet be determined; nevertheless sediments of this age are known to occupy several thousand square miles. They differ materially from the Cretaceous and earlier Tertiary sediments in being largely of lacustrine origin. This is essentially the condition in the eastern part of the area, centering about the lake district of Ungur Tsagan Nor. To the west and south, notably at P'ang Kiang, most of the Pliocene deposits are stream-laid and closely resemble the earlier, better-known Tertiary strata. The lacustrine and fluvial beds grade into each other laterally with an imbricating and mutually overlapping contact which may well be attributed to the fluctuating size of the lakes in which the sediments of the eastern area were laid down. Apparently the Pliocene climate was characterized by marked changes in rainfall. It is worthy of note that fossils have been discovered only where there is an alternation of stream and lake deposits, and no organic remains have yet been found where there is an uninterrupted sequence of beds of the same origin. From this mode of distribution and from other supporting evidence, the fauna is believed

[1]Berkey, C. P., and Morris, F. K. 1927. 'Geology of Mongolia.' Natural History of Central Asia, Vol. II, pp. 52–55.

[2]Granger, Walter, and Berkey, C. P. 1922. 'Discovery of Cretaceous and Older Tertiary Strata in Mongolia.' American Museum Novitates, No. 42.

Berkey, C. P., and Granger, Walter. 1923. 'Later Sediments of the Desert Basins of Central Mongolia.' American Museum Novitates, No. 17.

Berkey, C. P., and Morris, F. K. 1927. 'Geology of Mongolia.' Natural History of Central Asia, Vol. II, pp. 182–183, 196–212, 355, 359–362, 364.

to have had a lake-shore habitat. The lacustrine deposits consist of light-colored (white, gray and buff) sands and clays with considerable marly limestone. The fluvial material is commonly coarse gravel and brick-colored silts and clays. In the northwest, the Pliocene is underlain by Eocene beds; elsewhere it rests directly on the pre-Cretaceous peneplane developed on the ancient rocks.

Over large areas the Pliocene beds lie undisturbed and horizontal. They are nowhere covered by later deposits. During the formation of the Gobi erosion plane, no appreciable residual material was left as a

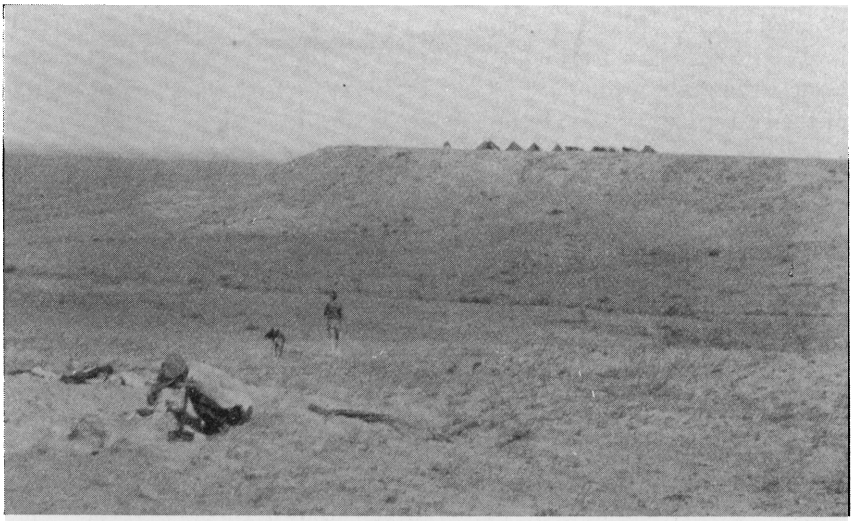

Fig. 2. Type locality of the Pliocene Tung Gur formation. The scarp in the background is formed by a layer of resistant limestone. The fossil in the foreground is a rhinoceros.

capping, a condition in which these beds differ considerably from the earlier Tertiary and Cretaceous deposits of the Iren Gobi. Their maximum thickness is on the order of 500 ft.

The Tung Gur Formation

The Tung Gur formation is the only Pliocene formation named during the 1928 season. Its type locality and the surrounding country form the only region yet discovered in the Iren Gobi where Pliocene fossils are both well preserved and abundant. On the scarp some three and a half miles north of the well, known as Gur Tung Khara Usu,

fossils occur at several horizons, in each case embedded in a rather coarse matrix of sand. This material is in part firmly cemented and in many places highly cross-bedded. Associated beds of clay and limestone are barren. Lack of continuity and a pronounced lens-like form are the outstanding characteristics of the beds. The bivalves noted in the faunal list occur in the coarse sandstone together with the mammalian remains. The general relations of the beds and the position of the fossils are indicated in Fig. 4.

Fig. 3. Pelecypod shells in the Tung Gur formation west of Gur Tung Khara Usu.

The following is an abridged preliminary list of the fossils collected in the locality as supplied in the field by Mr. Granger:

Mastodonts[1], 2 genera, including *Amebelodon grangeri* Osborn
Canid
Rhinocerid
Cervid
Antelope cf. *Gazella*
Turtles
Pelecypods, at least three species.

[1]Osborn, H. F. 1929. 'The Revival of Central Asiatic Life.' Natural History, Vol. XXIX, No. 1, pp. 12, 15, 16.

Thirty miles to the southeast, on the lip of the great depression of Tairum Nor, the same formation is exposed on the face of a precipitous scarp (Fig. 5). Although the fossils are the same types as those discovered at Gur Tung Khara Usu, the sequence of beds in quite different. The scarp is composed largely of red clays, divided horizontally by a lens of coarse river deposits and capped by a heavy gravel member. The fossils are contained in the upper gravel and less abundantly in the clay and lower gravel, but the pelecypods so common at Gur Tung Khara Usu are absent. The same sequence of beds has been observed on the south side of the Tairum Nor depression and also farther to the east

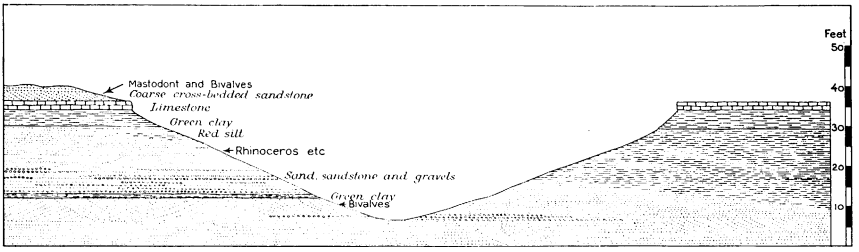

Fig. 4. Section of the Tung Gur formation at the type locality.

near Gosho-in-Sumu. No fossils have been obtained from the two places last mentioned, but it is not improbable that they may be found in the future, since the scarps in the general region of Tairum Nor have a total length of more than 25 miles and have not been fully prospected. Farther to the east, a few fragments of bone of sufficient diagnostic value to determine the Pliocene age were found by Mr. Granger on the Barro Unduh upland, but there was no evidence of extensive deposits of fossils. To the east and south of this point, the Pliocene consists entirely of lake-deposited sands, clays and limestones which are completely barren at the places examined by the Expedition.

In view of the thickness and extent of the known Pliocene deposits east of the Kalgan-Urga trail, it seems quite probable that the beds of the P'ang Kiang[1] formation may be a lateral southward continuation of the Tung Gur and associated Pliocene formations. This tentative correlation is made on structural grounds only, for as yet no diagnostic fossils have been found in the P'ang Kiang beds. This question will be taken up in a later publication.

[1]Berkey, C. P., and Morris, F. K. 1927, 'Geology of Mongolia.' Natural History of Central Asia, Vol. II, pp. 52–55 and 276.

LATER HISTORY

Over most of the region underlain by Pliocene deposits, the Gobi erosion plane is developed in a high stage of perfection and one may travel for many scores of miles in a straight line over monotonously level plains with seldom a break even on the horizon. The preservation of the erosion surface is remarkable in that the Pliocene uplands are not normally protected by resistant layers of cap-rock nor by the equally

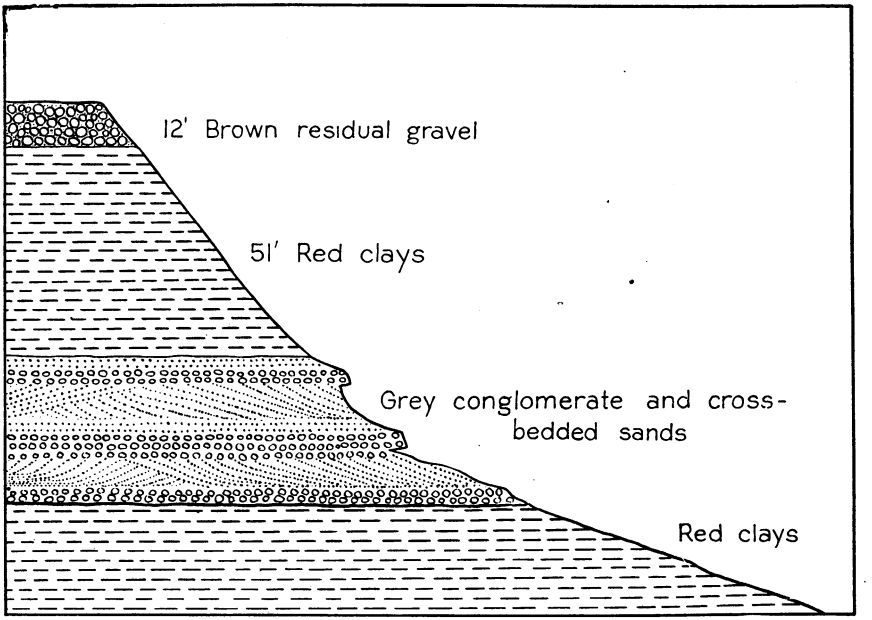

Fig. 5. Section of the Tung Gur formation on the north side of the Tairum Nor depression.

durable accumulations of residuary gravels which are the rule in the central and western portions of the Iren Gobi. To the west and north the beds are undergoing destruction; they are encroached upon by the constant enlargement of the inner lowland which separates them from the oldrock basin rim of the Iren Gobi, and by the equally rapid expansion of the lowland hollows of Tairum Nor and P'ang Kiang. In the easternmost part of the region seen by the expedition, the surface is pitted by a great group of depressions forming the lake district of Ungur Tsagan Nor.

The lake bottoms commonly occur at elevations from three to four hundred feet below the surface of the Gobi erosion plane; the slopes which separate the lake bottoms from the upland are cut into steps by a complicated series of lake terraces (Fig. 6). Here is a record of Pleistocene history which clearly demonstrates the changing climate; each

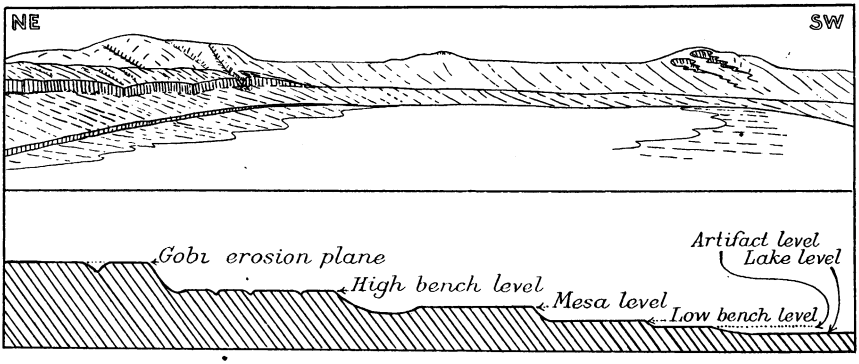

Fig. 6. Sketch of Ungur Tsagan Nor and profile of lake terraces. The upper level is the Gobi erosion plane, a feature probably developed in early Pleistocene time.

lower terrace indicates not only a break in the amount of moisture, but a break which, if the record is interpreted correctly, points to increasing aridity. The lake basins are cut in lacustrine deposits; the lakes of the Pliocene time extended westward to Gur Tung Khara Usu and covered many hundreds of square miles; now they are diminished to playas and are in danger of being buried by the sands.