

GEOLOGICAL OBSERVATIONS IN NORTHERN MANCHURIA
AND BARGA (HAILAR).

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(*Musee Hoangho-Paiho*)

During a spring trip made the last year (1929) in the Chang Chun, Harbin and Hailar districts, opportunity was given to us to collect some facts which may help to link the Chinese to the Manchurian or East Mongolian geology. These observations refer to the two following points;

- a) Pleistocene formations of the Manchurian and Hailar basins.
- b) Correlations in the Great Khingan structure as seen along the Siberian railway and in the Linn Si area respectively.

I. PLEISTOCENE FORMATIONS.

1. MANCHURIAN BASIN

By "Manchurian basin" we understand the broad, depressed area which, between the Great Khingan, the Small Khingan and the Kirin ranges, is actually drained by the Lao Ho, the Sungari and the Noni rivers.

a) *The Chang Chun district:* A very characteristic example of the geological and physiographical features of the country is met, some 150 li S. W. from Chang Chun, in the small hills which, near the Ou Tao Tch'uan village (*), form the water divide between the Lao Ho and the Sungari basins.

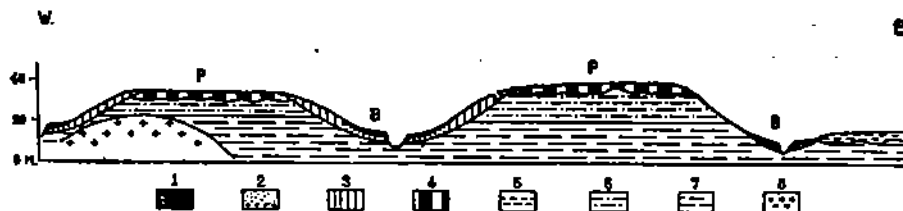


Fig. 1. Section of the hills near Ou Tao Tch'uan (partly schematic). 1, black earth; 2, sand and gravels; 3, loess; 4, drift (red sands and gravels, Sanmenian); 5, pre-Loessic sands; 6, green beds (Mesozoic); 7, red beds (Mesozoic); 8, granite. P, old peneplain; B, Loessic basins. The heights are given above the average level of the Chang Chun plain.

* To this interesting place, already studied by F. Licent in 1928, we have been led by our friend, R. P. Dubos. At the annual meeting of the Geological Society of China (1929), F. Licent has given a preliminary description and study of the locality.

In this place (fig. 1), distinct remains are found of an old (30-40 meters high) plateau (P), dissected by Middle and Upper Pleistocene ("Loessic") basins (B).

The floor of the plateau consists in the same Mesozoic sub-horizontal (or locally disturbed), scarcely consolidated, sandy clays, which occur everywhere, under the Pleistocene cover, in the Manchurian basin (*); and, on its top, strongly dissecting the clay, a 5-meter thick torrential deposit is spread: red loose coarse sands and well rounded gravels (Wu T'ai quartzite, probably rewashed from a Mesozoic formation,—Mesozoic rhyolites, andesites, chalcedony and silicified wood) (**). Over the same plateau (but most probably older than the red torrential deposits) occur in some places f.i. at Ta Tun (The second railway station S. of Chang Chun), and near Chang Tu (S. of Ssu Ping Kai), but not at Ou Tao Tch'uan, basaltic flows.

The structure of small basins or valley (B) carved in the plateau (P) is perfectly constant (fig. 2). In each case, the bottom of the depression is found lined with gravels and white sands, gradually passing into black sandy

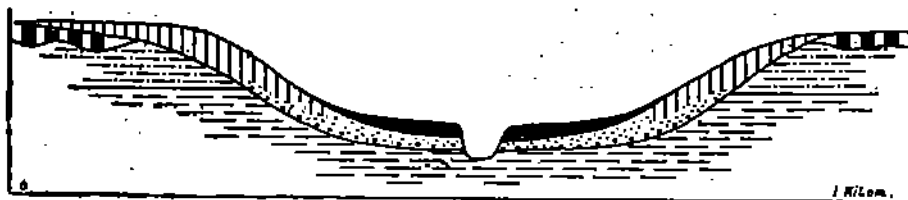


Fig. 2. Typical section of a Loessic basin in the Ou Tao Tch'uan area. Same explanations as in the figure 1. The basin is cut by recent dissection. Heights enlarged (for the thickness of the deposits see the text).

- * Near Ou Tao Tch'uan, the likeness of those green and red beds with the Upper Triassic beds of N. E. Shensi (Chungar) is simply striking. No fossils are found there but small and badly preserved *Estheria* and *Equisetum*. More northward, in harder and darker green beds (f.i. near the railway bridge over the Sungari, between Chang Chun and Harbin) small scales of Ganoid Fishes are commonly found (Ahnert). According to a personal communication kindly made to me by Dr. A. Smith Woodward, those scales belong probably to some *Pholidophorid*, a form which could prove to be contemporaneous with the *Lycoptera*.
- ** Just on the foot of the 40-meter high hills, along the road leading from Ou Tao Tch'uan to Huai Ten Hsien, another sandy formation, older than the Loess, dissects the Mesozoic red clays (see fig. 2). The geological age of those sands is very uncertain. If, as it seems, they do not belong to the Mesozoic sedimentary system, they might correspond to some Lower Pleistocene dissection of the Pliocene (?) plateau (P).

mud. Laterally, along the slopes, this water-laid complex turns in a subaerial yellow Loess (or rather "loehm"), more clayish and compact than the Chinese typical Loess. Average thickness of the sandy deposits in the center of the basins, 8 meters; of the Loess on the slopes, 12 meters.

Fossils are abundant in the central white sands and black earth (*): *Elephas* sp., *Rhinoceros tichorhinus*, *Equus* sp., *Cervus* (*Elaphus*) *canadensis*, *Cervus* (*Euryceros*) *megaceros* var. *mongolicae* Boule and Teilh. *Gazella* sp., *Bos primigenius*, *Bison* sp.

Elephas remains (curved tusks and thin-lamelled molars) are remarkably common, and belong chiefly to the Mammoth (*E. primigenius*). But *Elephas namadicus* is possibly also present. To this last mentioned species we can refer provisionally a very large and more straight tusk, 134 mm. broad (in diameter) near the base.

Equidae are of a small size, as generally in the Loess: *Equus hemionus*, and possibly *E. cf. przewalskyi*.

Euryceros (identified by two bases of antlers only) shows the same peculiar flattened basal tine as the Pleistocene specimens from the Sjarasogol (S.E. Ordos) (**).

Gazella, characterised by small and short horn-cores, is still scarcely known, and consequently difficult to compare with living forms.

Bison (limbs and skulls) is much more abundant than the *Bos* (in the true Chinese Loessic formations, on the contrary, *Bos* is very common, and *Bison* so far not reported).

Most of these fossils (those, at least, which seem to have been found in the black earth) look astonishingly fresh. F. i. the Deer antlers and *Elephas* tusks are carved and worked with knives by the country people. Some other bones, however, buried in less conservative beds, have the usual appearance of the fossils found in the Chinese Loess.

(*) The fossils are generally collected after heavy rains, washed in the rivers, so that their true level is not easy to determine. Nevertheless, by their colour and state of preservation, they are undoubtedly derived, for the most part, from the black earth, but not exclusively: in the sands and gravels underlying the black beds we picked up personally, a piece of *Elephas* tusk.

(**) M. Boule, H. Breuil, E. Licent and P. Teilhard de Chardin. Le Paleolithique de la Chine. Annales de l'Institut de Paleontologie Humaine, Mem. 4, 1928, p. 59 et pl. XIII.

b) *Geological interpretation of the Ou Tao Tch'uan section* :- In the above exposed facts, the most obscure point remains the geological age of the peneplain (P) and of its cap of red gravels. Age of the peneplain will be perhaps ascertained some day by the age of the overlying basalts (Pontian? . .). The gravels are probably much younger (Sanmenian?).

On the other hand, a Middle Pleistocene (that is, ante-Loessic) erosion is clearly responsible for the formation (or achievement) of the basins (B); and the filling of those depressions corresponds clearly to a regular sedimentary cycle. We give below (s. p. 31) a tentative comparison between the special facies of the Manchurian "Loessic" deposits and the facies met, for deposits of the same age, in China Proper and in Mongolia. Here will be noticed only:—1) that the formation of the black earth seems to have lasted a very long time (so late, perhaps, as the beginning of the Holocene); and 2) that, in such flat and marshy areas as the Chang Chun district, the topography of the land almost untouched by modern erosion, is probably still the same as it was left at the end of the Pleistocene.

c) *Extension of the Ou Tao Tch'uan formations*: As we told above, the Ou Tao Tch'uan section is very characteristic of the whole Manchurian basin. For instance, the 40-meter high plateau (P) is seen well preserved, and in connection with basalts, so far as Chang Tu (between Mukden and Ssu Ping Kai). Another erosional, 40-meter high, platform of red banded clay is found, 25 li N. E. from Chang Chun, near the Siao Ho T'ai village,—capped locally, along its border, by a thick pre-Loessic gravel.

But, over still larger areas, traces of this ancient peneplain (the former extension of which is indicated almost everywhere, around Chang Chun and Huai Teu Hsien, by isolated pebbles) have entirely disappeared. And, in such cases, the small fossiliferous basins of Ou Tao Tch'uan grow to extensive shallow valleys (the Chang Chun rivers valley, the Sungari valley, etc.) bordered by compact Loess, and filled with sands and black earth.

In the Harbin and Tsitsikar districts, the sandy facies becomes decidedly prominent; and the sediments, sometimes distinctly bedded and quite similar to the Sjara-osso-gol formation of S. E. Ordos, are richly fossiliferous. Fossil bones are specially reported from Fuliardi, near Tsitsikar (Ahnert), and from Harbin itself, where a young and enthusiastic searcher, Mrs. Delevsky, succeeded in collecting, in a short time, from the Sungari sands, a large number of specimens including the following forms: *Elephas*

sp. (tusk), *Rhinoceros tichorhinus*, *Equus* sp., *Equus hemionus*, *Cervus megaceros* (?), *Gazella* sp., *Bison* (skull and limb-bones), and the pelvis of a large Carnivore*.

Across the Sungari and the Noni basins, Neolithic remains are generally common in the sand dunes. But, and this fact is rather puzzling, from such an extensive, fossiliferous and well exposed formation as the Manchurian Pleistocene, no traces of Palaeolithic Man have been so far reported.

d) *Observation on the Pleistocene of the Southern Manchurian basin:* Although this paper is practically restricted to the Central and Northern Manchurian basin, we can observe that, so far in the South as the upper Lao Ho valley (near Tchi Fang, f.i.), the Pleistocene formations belong to a type distinctly similar to the Ou Tao Tch'uan deposits (compare the fig. 2 above with the fig. 4 of our "Etude géologique sur la région du Dalai-noor" (**)). We have been therefore probably wrong in this last indicated memoir when we assumed, for this region, the occurrence of a special post-Loessic torrential phase (the "Lao Ho phase"). The sands referred by us to this phase would only represent a sandy river facies, limited, along the slopes, by a Loessic facies, both of them belonging to the same Pleistocene age. Part of the "black earth" in the same locality (Fang Chenn) is probably also to be attributed to the Pleistocene, another part only (containing pottery and recent fauna) being surely of a Neolithic age.

* In this series, a radius of *Rhinoceros* is surprisingly large (145 mm. of proximal breadth, 114 mm. being the maximum observed in the Sjara-osso-gol); but it does not show, in the front of its proximal part, the characteristic fossa present in *Elasmotherium*. A *Gazella* horn-core seems shorter than in any living form.

On another hand, in the so well kept Museum of Harbin, a fine collection of Pleistocene fossils is preserved, some coming from the Djalai-nor (s. below), but the bulk of them collected in the Sungari basin: *Elephas primigenius* and probably *E. namadicus* (tusks more straight, molar lamella thicker), *Rhinoceros tichorhinus*, *Cervus megaceros* (?) (a female skull) *Bison* (a full series of skulls), *Bos primigenius* (two skulls), etc.

A description of Pleistocene fossils (including such rare forms as the spiralhorned Antelope *Spirocerus kiakhtensis* Pavl. and *Bubalus wansjochi* Boule and Teilh), part of which were collected in the Sungari sands, has been given, in 1910, by Mrs. M. Pavlow (Mammifères fossiles du Musée de Troïzkossavsk-Kiakhta, Travaux de la sous-section de Troïzkossavsk-Kiakhta, section du pays de l'Amour, de la Soc. imper. russe de Geogr., t. XIII, livr. 1.—Cf. Boule, Breuil, Licent et Teilhard, Le Paléolithique de la Chine, pp. 66 and 71).

(**) Mémoires de la Société géologique de France, Nouvelle série, tasc. 3, 1920, p. 12

2. THE HAILAR BASIN AND THE DJALAI-NOR (*)

Our visit, in 1929, to the Djalai-nor, was made entirely under the scientific help of our friend Dr. Ahnert, and with the most kind support of the Administration of the Djalai-nor coal mines (Mr. N. A. Heyking technical Inspector, Mr. Zeziukewitch director, and Mr. V. P. Vodenikoff engineer).

In this paragraph, we shall only deal with the Pleistocene formations, which, some 20 kilometers N. from the actual lake, extend over the slightly tilted, lignite-bearing Tertiary (Oligocene?) marls.

The Pleistocene deposits of the Djalai-nor, well exposed by the coal mines cuttings, cover an about 20 meters high terrace along the Argun river (water escape of the lake). They represent obviously ancient sediments left by the Djalai-nor during a former, and very large, extension of the lake. Their thickness is irregular, ranging from about 20 to less than 10 meters, and their facies is subject to rapid local changes. In figure 3 are given two characteristic sections taken north and south of the mines respectively (that is some 5 kilometers distant one from the other).

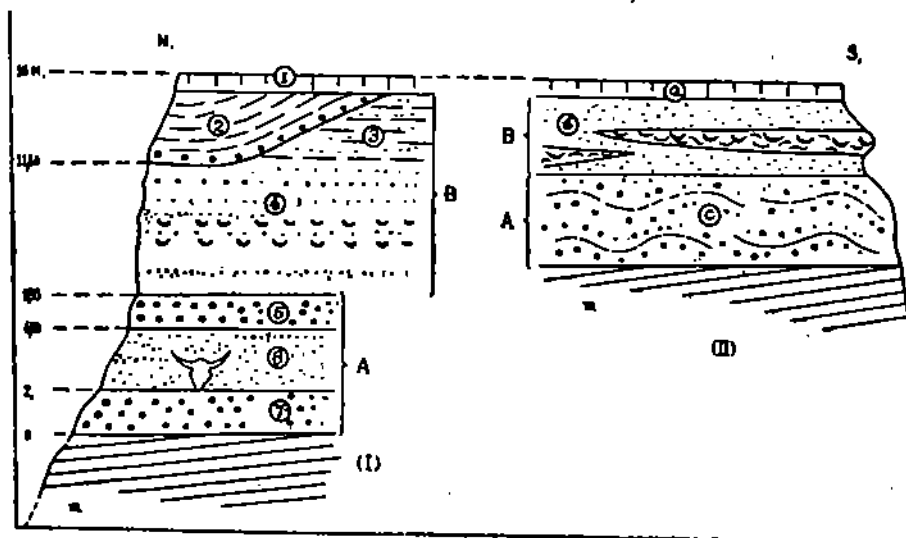


Fig. 3. Section through the Pleistocene deposits of the Djalai-nor: (I), northern part; (II), southern part of the coal mines. 1-7 and a-c, chief levels; m, Tertiary (Oligocene?) marls. A, torrential phase; B, mature phase.

(*) In this paper we shall conventionally take the name of Djalai-nor for the great lake in the Hailar district, the designation of Dalai-nor being restricted to the smaller lake, N. of Dolonnor.

Figure 3 (I).

1. Sandy black earth, showing columnar breaking.... 1 meter
2. Local sandy procket, with plants layers and basal gravels 3 m.
3. Cross-bedded sands and plants layers.
4. Thick layer of loose and massive, or clayish and foliated sands, full of large Anodonts (contains occasionally lenticular patches of gravels and pieces of wood) 6 m.
5. Strongly stained gravels 1 m.
6. Sands, with some local gravels layers. Wood and fossil bones (*Elephas* tusk; skulls and limbs of *Rhinoceros tichorhinus* and *Bison*) (*) 2.50 m.
7. Basal gravels, lying over the Tertiary marl 2 m.

Figure 3 (II).

- a. Sandy black earth..... 1 m.
- b. Loose sands containing thick bundles or mattresses of wood and weeds, and shoals of large Anodonts.. 2.50 m.
- c. Contorted gravels 2 m.

Levels 5-7 (and c) seem to correspond to the torrential phase (Phase A), and levels 3-5 (and b) to the mature phase (Phase B), of a single sedimentary cycle. The pocket (level 2) is probably a local feature. As regards the black earth (level 1 and a), whether it represents the black Pleistocene mud of Ou Tao Tch'uan, or rather the black Neolithic soil of Mongolia, we can not decide.

A curious fact is that, whereas in the northern part of the mines (fig. 3, I) the mammalian remains are normally fossilized, and the Anodonts strongly weathered, or even reduced to their horny sheet, southward (fig. 3, II), on the contrary (where no fossil bones have been reported from), the shells look extraordinarily fresh (**). Yet, both in the north and in the south, the

* Chiefly according to the report of Dr. Ahnert and Ing. Vodenikoff

** We did not notice any positive reason, however, for considering this southern part of the deposits as more recent than the northern one (that is as representing a different and younger line of retreat of the lake.)

plant remains are equally well preserved, almost modern looking, still flexible and scarcely carbonised (*)

Prehistorical finds in the Djalai-nor. Rather puzzling are the following archaeological finds recently reported from the Djalainor deposits :

a) The sectioned beam (abnormally large) of a Deer's (*Elaphus*) antler, bearing a deep annular incision in the middle; and the base of another antler transformed in a hammer (with a hole for the handle) (**). In spite of their Neolithic appearance, the two pieces, strongly fossilized, were found (according to the workmen) several meters deep (in the southern part of the mines).

b) A net or screen, made with interlaced wood or weeds, horizontally lying at the base of layer 7 (in the northern part of the mines) (**).

Personally, we extracted *in situ*, from the level 6, a *Bison's* rib showing some artificial (?) incisions, and, in the same (northern) place of the mines, but in the rubbish, we picked up a square rhyolitic pebble, distinctly trimmed and used as a hammer. Judging by the colour, this last piece (strangely akin to the bony hammer above mentioned) might be derived from the Pleistocene gravels.

Those facts are not sufficiently clear, nor sure, for allowing any scientific conclusion. If confirmed by further finds, they would oblige us to admit :

—Either that, in N. E. Mongolia, the Palaeolithic industry was very progressive ;

—or that, in this region (and in Manchuria?) *Elephas*, *Rhinoceros* and *Bison* bearing beds belong to a later age than in China, in consequence of some shifting of the sedimentation and the fauna towards the north, through the Pleistocene age.

* The same fact occurs in the Sjara-osso-gol sands.

** Those pieces, kept in the Harbin Museum, were shown to us by the Conservator Mr. Jacowan.

*** According to Mr. Vodenikoff, who saw the specimen *in situ*, the net (1-2 meters broad) was made of parallel rods, not thicker than a pencil, connected by transversal thinner bits of woody substance. The specimen was too much breaky for being preserved.

But still, against this last assumption, is the extreme likeness (lithological as well as faunal) existing between the Djalai-nor sands and such meridional deposits as the Sjara-osso-gol formations.

Extension of the Djalai-nor Pleistocene deposits. Pleistocene formations similar to the above described deposits are probably existing everywhere along the huge N.-S. depression, the bottom of which is occupied by the present Djalai-nor.

As regards the general history of this depression (Dalai Tala), it seems that such a basin has necessarily acted, without any interruption, as a "catch-water" for long geological times (perhaps from those very times in which the Khingan barrier rose along the sinking Manchurian basin : are not the lignite-bearing Oligocene (?) marls an evident lake deposit ?). No other area, consequently, is more likely to preserve a continuous series of late Tertiary and lower Quaternary sediments. But, except by borings, this series, buried under recent sands and mud, is probably still lying out of the reach of the geologists.

3. GENERAL GLANCE OVER THE LATE PLEISTOCENE OF N. CHINA, MANCHURIA AND MONGOLIA.

As a general conclusion to the precedent observations and to many others made in the course of previous journeys, the following points might be stated, concerning the late Pleistocene formations of N. China, Manchuria and Mongolia.

a) All the Middle and Upper Pleistocene deposits met in Eastern Asia, inside an area comprised between the Tsingling range and the Siberian border, can be divided, schematically into three types or facies : (*)

a *Chinese facies*, chiefly Loessic ;

a *Mongolian facies*, chiefly sandy ;

and a *Manchurian facies*, partly sandy (in the center of the basins), partly Loessic, or rather, loehmic" (around the basins).

b) In each of those three facies, a complete sedimentary cycle is always recognisable, starting with gravels, and ending in the deposition of

* We do not mention here the hundred feet of silt and mud filling the Hopei depression (Chihli plain), because the maritime plain of China has better to be considered as a special and distinct sedimentary area.

lighter material. Moreover, in the Manchurian and Mongolian facies, some transition between the Pleistocene and Holocene periods seems to be represented by the "black earths" (muddy or sandy vegetal soils). Perhaps owing to some drier climatic conditions, the black earth is missing in the Chinese Pleistocene facies.

c) More distinctly (fig. 4), the Chinese facies extends over the following area: Kansu, N. Honan, Shansi, W. and N. Hopei. The Mongolian facies, spread along a concentric and inner area, is met in S. and E. Ordos, in S. and E. Gobi (Dalai-nor, Djalai-hor and Tsagan-nor basins), and also in the upper Sira-mouren and Noni valleys. The Manchurian mixed facies is restricted to the Chang Chun, Harbin and Lao Ho areas.

d) This distribution of the facies is well explained by the prevalent action of the wind. For, if we suppose that, during the late Pleistocene

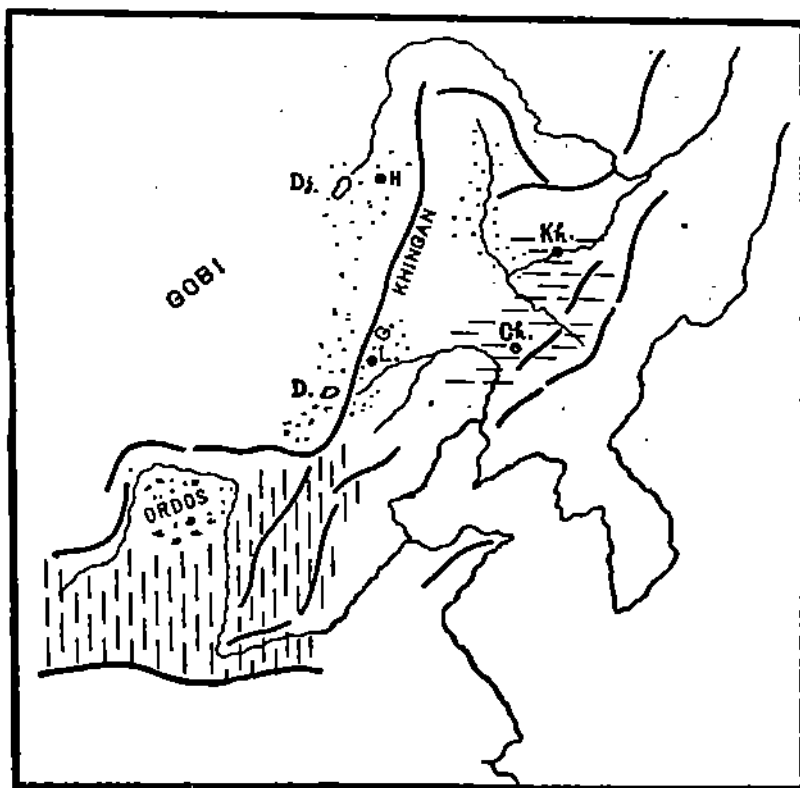


Fig. 4. Map indicating the distribution of the late Pleistocene facies in N. China. Vertical lines, Chinese facies; horizontal lines, Manchurian facies; dotted area, Mongolian facies. Dj, Djalai-nor; D, Dalai-nor; H, Hailar; Kh, Harbin; Ch, Chang Chun.

times, the weathered soil of Central Gobi was swept by strong and constant N. W. winds, we see that the more external (eastern) sedimentary zone actually formed by the Chinese Loess would correspond precisely to the area of deposition for the lighter parts, and the Mongolian (more western) sands to the area of deposition for the heavier part, of the blown material.

e) Crossing transversally (roughly along the N. Lat. 42°) the Loessic and sandy concentric belts, a *faunal divide* seems to exist, north of which only (that it is in the Manchurian and Djalat-nor basins) such rather septentrional forms as the Mammoth and the Bison (but not the Reindeer) have been so far reported.

II. GEOLOGICAL CORRELATIONS ALONG THE GREAT KHINGAN RANGE.

THE "KHINGAN COMPLEX."

Thanks to Dr. Ahnert (*), the geological section of the Great Khingan, along the Siberian railway, is well known, both in itself and in its relations with the Amur region. With the southern part of the range, on the contrary, connections were, up to the recent time, perfectly obscure, so that a large part of the formations recognised, almost thirty years ago, by Dr. Ahnert, in the northern area, was left practically isolated from the now classified sedimentary series of N. China.

Putting together, on the one hand, our personal knowledge of the southern Khingan (Linn Si, K'ing Pan and Dalai-nor region) (**), and on the other hand the fundamental work (and the personal communications) of Dr. Ahnert for the northern part of the same range, we have tried, in a short trip from Harbin to the Djalai-nor, to break the partition wall. And the task (if we are correct) proved to be an exceptionally easy one: for, as a result of our investigations, it seems that the geological composition and structure of the Great Khingan along the Djalai-nor latitude (40°) are exactly the same as in the Linn Si region (44° lat.).

(*) E. Ahnert. Explorations géologiques et minières le long du Chemin de fer de Sibirie. Livraison XXVI. St. Petersburg, 1903.

(**) P. Teilhard de Chardin. Etude géologique sur la région du Dalai-noor. Mem. de la Soc. géol. de France, n. s. III, fasc. 3, 1926.

Another memoir on the Wei Tch'ang region is in preparation;—cf. Teilhard, Les Roches éruptives post-Paléozoïques du Nord de la Chine. Bull. Geol. Soc. of China, vol. VII, n. 1, 1928.

Near Linn Si, the Khingan consists essentially in a NE-SW. folded complex of two terms: one intruded and one intrusive series.

a) *The intruded series* (the "Linn Si series", cf. Teilhard, *Géologie du Dalai-nor*, p. 19) begins sometimes with a thin fossiliferous (Permian) limestone, but includes chiefly green slates, thick conglomerates, and occasionally andesitic flows. It corresponds closely to the Men Tou Kou series (Lower Jurassic) of the Peking Western Hills.

b) *The intruding series* forms a continuous sequence of acid rocks: innumerable dykes ranging from true rhyolites to true granites, or intrusive monzonitic and dioritic bodies. It has to be correlated obviously with the Kalgan rhyolites, and the Western Hills recent granites.

Besides those two clearly recognisable series, an older granitic and gneissic floor is possibly present; and possibly, also, traces of a strongly metamorphosed Paleozoic series are indicated by large amphibolitic masses (noted as Δ in the Dalai-nor cit. memoir, *Geological map*), and small preserved quartzitic outcrops (*Ibid.*, p. 25).

Now, between Tsitsihar and Manchouli, the same geological elements are immediately noticeable. In an endless series of parallel NE.-SW. bands, the same green, glazed, slates and hardened conglomerates, the same powerful rhyolitic and granitic dykes (*) as in Linn Si, are cut by the rail when it forces its way through the Khingan barrier. Even the characteristic small patches of Permian limestone, associated with the slates, have been found and carefully reported by Dr. E. Ahnert (**).

Yet, no more than in the Linn Si area is, along the Siberian railway, the "Khangai complex" limited to the border of the Mongolian plateau, so far as the Djalai-nor at least (and probably much further), worn outcrops of Linn Si slates, and worn rhyolitic "caterpillar-dykes", are met everywhere, rising over the Mongolian plateau (***). If, as we suspect, the *Khangai series* of the

* As specially striking we have noticed the localities of Barim (dyke of "Linn Si granite") and of Niangtzeshan (another dyke associated with our metamorphic rock).

** In one of those patches (in Kharko, West of Erekte), excavated by the Djalai-nor mines for lime, we found recognisable Crinoids in the metamorphosed limestone.

*** At its NW. corner, the Djalai-nor is bordered by a fine dyke of prismatic rhyolite, containing large jaspered pyromerids (or pseudo-pyromerids). This rock is associated with (and probably intrusive in) andesite, exactly as in Joho (cf. Teilhard, *Bull. Geol. Soc. of China*, loc. cit., 1928). Pebbles of both rhyolite and andesite occur in the lignite-bearing marls.

American Expedition (*) is identical with our *Linn Si series*, the "Khingian complex" will perhaps prove some day to be the most general floor of the Gobi (intimately associated with the "Great Mongolian Bathylit" of the American geologists).

EASTERN REAPPEARANCE OF THE KHINGAN COMPLEX.

Up to now, the geology of E. Manchuria (and Korea) seems to have been built without any real effort for harmonizing it with the geology of N. China. This lack of correlation is so much the more to be regretted that, between both countries, many geological trends are evidently continuous.

Here we will only emphasize the fact that, near Kirin, green metamorphosed sandstones intruded by post-Paleozoic (?) granites, and, near Chang Chun (**) rhyolitic dykes (with pyromerids), seem to prove the reappearance of the Khingan complex *East of the Manchurian basin*, along a broad NE.-SW. band extending northward further than Vladivostock, (***) and possibly represented, southward, by the so curious metamorphosed (Mesozoic ?) slates of the Hou Li Tao promontoire (near Lien Shan, N. of Shan Hai Kwan).

Between this eastern folded and Metamorphosed band, and the Great Khingan, a distinctly less disturbed (or indisturbed area) is formed by the Manchurian basin, in which acid intrusive rocks seem entirely absent from the Mesozoic floor, although this floor belongs almost surely to a pre-rhyolitic age (****)

* Charles P. Berkey and Frederick K. Morris. Geology of Mongolia, 1927, p. 295 and sq.

** Near Siao Ho T'ai, s. above p 26.

*** In many places along this band (i.e. near Mulin) metamorphosed Mesozoic sediments have been reported by Dr. E. Ahnert, and other geologists.

**** In the Tchi Fang area, rhyolitic intrusions occur in the *Lycoptera* beds (Cretaceous), which are probably younger than (or at the most contemporaneous with) the Ganoid (*Pholidophorids*) beds of the Manchurian basin.