GEOLOGICAL MEMOIRS

(Being the continuation of the Memoirs of the Geological Survey,
to be quoted as Mem. Geol. Surv. China)

Series A, Number 8,

PRELIMINARY OBSERVATIONS ON THE PRE-LOESSIC AND POST-PONTIAN FORMATIONS IN WESTERN SHANSI AND NORTHERN SHENSI.

BY

P. TEILHARD DE CHARDIN AND C. C. YOUNG

Published by

THE GEOLOGICAL SURVEY OF CHINA

(Under the Ministry of Agriculture and Mines and
affiliated with the Academia Sinica)

AND

THE SECTION OF GEOLOGY OF THE NATIONAL ACADEMY
OF PEIPING

PEIPING MAY 1930.

地質專報甲種第八號

山西西部陝西北部蓬萊紀後黃土期前之地層觀察

德日進
楊鍾健 著

中華民國十九年五月

（學術研究與國立中央研究院合作）
農礦部直轄地質調查所
國立北平研究院地質學研究所 印行

GEOLOGICAL MEMOIRS

(Being the continuation of the **Memoirs of the Geological Survey,**
to be quoted as **Mem. Geol. Surv. China**)
Series A, Number 8,

PRELIMINARY OBSERVATIONS ON THE PRE-LOESSIC AND POST-PONTIAN FORMATIONS IN WESTERN SHANSI AND NORTHERN SHENSI.

BY

P. TEILHARD DE CHARDIN AND C. C. YOUNG

Published by
THE GEOLOGICAL SURVEY OF CHINA
(Under the Ministry of Agriculture and Mines and
affiliated with the Academia Sinica)
AND
THE SECTION OF GEOLOGY OF THE NATIONAL ACADEMY
OF PEIPING

PEIPING MAY 1930.

CONTENTS

目次

PRELIMINAR OBSERVATIONS ON THE PRE-LOESSIC AND POST-PONTIAN FORMATIONS IN WESTERN SHANSI AND NORTHERN SHENSI

(With three Appendices: on the basal Pontian formations, on the history of the Yellow River valley, and on the Palæolithic, in the same area)

BY P. TEILHARD DE CHARDIN AND C. C. YOUNG.

INTRODUCTION.

The stratigraphical analysis of the massive earthy formation which, in Northern China, shelters the hard crust of the Mesozoic and older rocks, is not easy; and it was, in fact, slowly carried on by the geologists. After the Richthofenian period (who used to put all these loose deposits in his evidently too comprehensive "Loess"), a first, and rather obvious, distinction was made between the true Loess (or Yellow earth), and the underlying Red earth,—this last one being wholly incorporated in the Pontian (*Hipparion richthofeni* beds). As the geological work went further, however, it became more and more evident (especially after the discovery of the Sanmen formation by Dr. V. K. Ting) that the so called Red earths were still an un-analyzed complex. And, in his fundamental "Essays on the Cenozoic of N. China" (p. 117) Dr. J. G. Andersson pointed out already in 1923, that "there exist in fact widely distributed deposits which form a kind of petrological transition between the genuine deep red *Hipparion* clays and the typical greyish-yellow Loess."

An important step in the recognition of these intermediate beds was made in 1927, when Teilhard and Licent noticed, along the Lower Fenho basin, some special "reddish loess," in the limy concretions of which *Siphneus tingi* was found, a characteristical Rodent of the Sanmenian lake deposits of Nihowan (Sangkanho). In the short paper relating this discovery,[1] and in a subsequent study, with G. Barbour, on the Nihowan beds,[2] the distinction between the true Pontian Red clay, and a probably Sanmenian Reddish Loess was distinctly indicated.

---

1. P. Teilhard et E. Licent. Observations sur les formations quaternaires, et tertiaires supérieures du... Shansi méridional. Bull. Geol. Soc. Chin., vol. VI. n. 2, 1927, p. 145.

2. G. B. Barbour, E. Licent and P. Teilhard de Chardin. Geological Study of the deposits of the Sangkanho Basin. Ibid., vol. V, n. 3-4, 1926, p. 276.

Nevertheless, the real characters, fauna and extension of this new reddish formation remained still almost unknown.

It was therefore taken as the chief object of the summer expedition sent in 1929 by the Cenozoic Laboratory of the Geological Survey, to make a careful survey of the red under-Loessic formations so widely spread in W. Shansi and N. Shensi, in order to distinguish, if possible, which part of the deposits should be retained in the Pontian, and which parts ascribed to some later geological age.

During three months, the authors of the present note carefully investigated a long circular zone, running from the North to the West, and then to the South, of the Taiyuan-Yulin sheet of the General Geological Map of China. And, as a result of this extensive trip, they were able to establish that, on the whole surveyed area, between the yellow Loessic, and the deep red Pontian deposits, a very important formation occurs, to which the name of "Reddish clays" may be provisionally attached.[1]

A preliminary description of the geological and palæontological characters of those Reddish clays is given in the following paper.

1. In this Memoir, the term "Red clays" will be *exclusively used* for designating the Pontian ***Hipparion*** clays.

PART I. GENERAL CHARACTERS OF THE REDDISH CLAYS IN W. SHANSI AND N. SHENSI.

1. Lithological characters.

On the whole, the Reddish clays are perfectly intermediate, in their lithological characters, between the typical Yellow and Red earths of N. China.

In contradistinction from the Loess, they can be described as generally more clayish and distinctly redder, red banded, very rich in limy concretions,[1] sometimes (f. i. near Ta Ning Hsien (大寧縣), see below p. 21) gypsiferous.

Now, compared with the Red Pontian clays, they look lighter in colour, are not so sticky, and are never cemented into hard beds by a continuous network of concretions. *Helix* is very common (surely *in situ*), with well preserved white shell.[2]

But, of course, these characters are rather variable. For instance, the Reddish clays, in the Ching Lo (靜樂) and Pao Te (保德) districts, are sometimes as red as the lighter parts of the *Hipparion* clay. And, on the contrary, the remarkable "Yülin formation"(see below, p. 15), but for its fossiliferous concretions and some coloured bands, looks almost exactly like a true Loess.

Facies, in geology, are often deceptive. The real characters of the Reddish clay have evidently to be taken from Palæontology, Stratigraphy and Physiography.

2. Palaeontological characters.

As just noted, the Reddish clays are rich in well preserved *Helix*, sometimes found in concretions,—but, more often, identical with those found in the Loess. When carefully studied, these land snails will surely prove to be very different from those found in the Red clay, and belonging to more recent types.

Speaking here only of the Mammals, we can give, as definite palæontological notes of the Reddish clays, the following characters:

a) Presence of large *Equus*, small *Bison* (or *Bos*), large Deer.

b) Amongst the Rodents, absence of the true Pontian genus *Prosiphneus*, and presence of some characteristical forms: special *Ochotona* and

---

1. In the Chinese Loess, concretions are exceptional,—and generally not so well individualized, nor so hard, as in the underlying Reddish clays.

2. In the Red clay, *Helix*, when found (they are rather rare), seem to have generally lost their shell, this being replaced by a crystalline calcite shelf.

Siphneus (*O. complicidens* Teilhard, *S. arvicolinus* Nehring, *S. tingi* Young, etc.).[1]

As indicated in the following table, and made clearer in the second part of this paper, remains of fossorial Rodents are found almost everywhere, in the Red as well as in the Reddish clays, in Shansi and Shensi. It is therefore our hope that by a careful examination of the characters and associations of the fossorial Rodents, definite zones will be established in these apparently so homogeneous formations. The same being true for the Oligocene (and even Eocene) basins of Ordos and Mongolia, the zoological interest and stratigraphical value of the Rodents in the Cenozoic deposits of Northern China will surely prove more and more to be exceptionally great.

Provisional list of the fossils found in the chief Reddish clay localities

	LOCALITIES.													
	1	2	5	6	9	10	11	13	14	15	16	17	18	19
Equus (large)(1)	..	..	..	..	..	..	..	..	+	+	..	+	..	+
Cervus sp. (flat antlers)(2)	..	..	..	..	..	..	..	..	..	..	..	..	..	+
Cervus sp. (thick jaw)(3)	..	..	..	..	..	..	..	..	+	..	..	..	..	..
Bison (small)(4)	..	..	..	..	..	..	..	..	..	+	..	..	..	+
Ochotona complicidens(5)	+	..	..	..	..	..	..	..	+	..	..	..	..	..
Siphneus arvicolinus	..	+	..	..	..	..	..	..	..	..	+	..	..	..
Siphneus tingi(6)	+	..	..	+	..	..	..	..	..	..	+	+	..	+
Siphneus chaoyatseni sp. n.(7)	..	..	..	..	..	..	..	..	..	..	..	+	..	..
Siphneus omegodon sp. n.	..	..	+	..	+	..	..	..	..	..	..	..	..	..
Siphneus hsuchiapinensis sp.n.	..	+	+	..	+	+	..	..	..	..	..	+	+	+
Siphneus minor sp. n.	..	..	..	..	..	..	..	+	+	..	..	+	+	+
Siphneus (Fontanieri group)..	+	..	..	+	..	..	..	+	+	..	+	+	+	+

1. The same species apparently as in Nihowan, Chou Kou Tien, etc.
2. The same species perhaps as *Cervus* cf. *tetraceros* from Nihowan.
3. Chiefly known from Chou Kou Tien, but found also in Huai Lai, Shantung and E. Kansu.
4. Perhaps *Bison palæosinensis*, from Nihowan.
5. Rather common in Nihowan.
6. Common in Nihowan.
7. This, and the other new species will be described in Palæontologia Sinica.

3. Stratigraphical boundaries.

Whenever two unconsolidated sandy or clayish deposits come into constact without any interposed basal gravel, it happens generally that the bounding

1. The so interesting and characteristical *Canis (Nyctereutes) sinensis* Schlosser, so abundant in the Nihowan beds, was sometimes held by us as a typical form of the Sanmenian beds. But, this year, we met a skull of this animal in a probably Pontian level (Ho Shan).

Up to now, the presence of true *Siphneus* in Pontian beds is not proved, although a small and archæic form, *Siphneus omegodon* sp. nov. is found very low in the Reddish clays.

line between the two formations cannot be detected otherwise than by the different colours of the adjacent perfectly fused beds.

For this reason, if the separation of the Reddish clays from a pure gray overlying Loess is generally sufficiently clear,[1] their distinction from the underlying Red clay, in the same section, is, in many cases, extremely difficult. Red coloured bands or concretionary layers are practically parallel in both formations, and do not help. On the other hand, when gravels seem to divide the Reddish clay from the Red one beneath, it can be doubted, often, whether those gravels, far from being a basal gravel of the Reddish clay, do not belong to the sometimes very complex system of gravels found in the base of the Pontian (s. below, p. 24).

Sometimes, of course, we were able to see directly, between the Red and the Reddish clays, a positive disconformity. For instance, in S. W. Shansi, north of Locality 17 (s. the map, plate I) the Reddish clays lie sharply over a worn concretionary bed belonging to the Red clay (fig. 8 B, p. 20),—or are separated from this Red clay by distinct basal gravels (fig. 8 A, and also figs. 6 and 9). But such cases are very rare.

Practically, the best ways we found (outside of the so often fallacious colour of the sediments) for establishing a stratigraphical break between the Red and the eddish clays are the two following ones:

a) *Inspection of the basal conglomerates.* As regards their composition, the basal gravels of the Red clay are free from any rolled limy concretions;[2] such concretions, rewashed from the Red clay, are on the contrary abundant in the basal gravels of the Reddish clay (s. fig. 5 and 6, pp. 17 and 18).—Now, as regards their topographical distribution, basal gravels of the Red clay are ***distantly***, and basal gravels of the Reddish clay very ***closely***, connected with the present system of valleys and gullies.

b) *Observation of the overlap of the Red clay by the Reddish clay.* Such an overlap is everywhere conspicuous, either in restricted places (whenever a strong dissection took place between the deposition of the two formations: f. i. along the

1. Except in some cases such as the Yülin formation in which the Reddish clays are sometimes neither reddish, nor clayish...

2. Such concretions could only be derived from some Oligocene or earlier Tertiary horizons. Practically, they were never found in the surveyed area.

It might be observed here that the occurrence of rolled concretions in the basal gravels of the Reddish clays and the Loess proves that the formation of the concretions in each sedimentary series was achieved *before* the beginning of the deposition of the next following series.

Yellow River, s. fig. 3, p. 14),—or over extensive areas (when the Reddish clay extends very far beyond the Red clay limits; f. i. in the Yülin districts, s. the map).

This overlap of the Red by the Reddish formation is, by far, the strongest stratigraphical proof of the true geological individuality of the latter.

4. Extension and thickness.

Understood, and recognised, as noted above, the Reddish clays (s. the map) are widely spread over the W. Shansi and N. Shensi, and they surely extend over the greater part of N. Kansu.[1]

In the Paote-Hochü district, they seem to be poorly represented (perhaps because they are distinguished with difficulty from the underlying Red clay). But everywhere around the S.E. Ordos, their belt (the Yülin formation) is regularly extended, as if representing the marginal facies of sediments filling some huge basin. In S.W. Shansi, most of the formerly supposed to be "*Hipparion* clays" have probably to be attributed to the Reddish clay.

Over Yülin, Wu Pao (吳堡), Hsi Hsien (隰縣), and Hsiang Ning (鄉寧) districts, the average thickness of the Reddish clays is very great : about 150 meters. Whenever dissected, the highest Loessic domes, in those parts, prove invariably to contain a solid core (extending up to the top of the dome) of Red and Reddish clays.

Much thicker than the Loess,[2] and less eroded than the Red clay, the Reddish clays are probably the most important with formation actually met Post-Mesozoic in W. Shansi and N. Shensi—and even, perhaps, in the whole of N. E. China.

5. - Physiography.

The Physiographical characters of the formation here studied will be sufficiently summarized in a few words if we say that the Reddish clays represent actually :—the remains of a conspicuous ancient platform,—built over an older, highly dissected, plateau of Red clay,—and strongly dissected, itself, in turn, by a pre-Loessic erosion.

---

1. Typical fossils of the Reddish clays (*Equus* sp., *Ochotona complicidens*, *Siphneus arvicolinus*, etc.) were found abundantly by F. Licent, rewashed in the basal gravels of the Loess, near Ching Yang Fu (E. Kansu). And the first specimen of *Siphneus arvicolinus* was collected by Loczy in the Lan Chou basin (W. Kansu).

2. Over the surveyed area, the Loess does not exceed 50-60 meters in vertical thickness.

a) Large remains of the ***ancient Reddish clay platform*** are found in S. W. Shansi: for instance in the Hsi Hsien district,[1] and along the Lower Fenho valley (District of Chi Shan (稷山)). In both places, the upper level of the Reddish clay still forms a wonderfully plane surface, gently dipping towards the center of the basins, and sometimes (near Hsi Hsien and Hsian Ning) distinctly channelled by a system of shallow depressions.[2] the traces of pre-Loessic, Loess-filled, valleys.

In N. Shensi, the Yulin formation, though so much wind and sand worn actually, represents also an ancient massive and flat built deposit.—But, in other places (f.i. between the Yulinho (榆林河) and the Huangho, s. fig. 5, p. 17), the Reddish clays are seen capping isolated domes of Red clay and Mesozoic sandstone, over which we have no proof that they did ever extend as a ***continuous*** platform. Those domes are the dissected surface not of a Reddish, but of a Red clay plateau (under which a still older sculptured peneplain of sandstone is perfectly distinct): as proved by the surrounding basal gravels (s. fig. 6, p. 18), they were dissected in the course of an erosional stage immediately preceding the deposition of the Reddish clay.

b. ***Remains of the same Red clay plateau***, spread over the so-called Tanghsien post-Miocene erosional surface, are met practically everywhere (at least as isolated patches) under the covering and overlapping shelf of the Reddish clays.

c. In turn, ***over the Reddish clays, Loess*** is largely spread, filling every valley or channel opened (or rejuvenated) by the pre-Loessic erosional stage,—An interesting fact is that, during the pre-Reddish clay (Fenho stage) and the pre-Loessic (Chingshui stage) erosion, the drainage system of the region was the same (even in the most amazing details) as the actual one: in the smallest gullies of N. Shensi (s. fig. 6) basal gravels belonging respectively to the Reddish clay, to the Loess, and to modern deposits, are met with, along the same lines of dissection, sometimes at distinct levels, sometimes in actual contact.[3] As already told above, and better explained below, the case is not the same with the under-Red clay gravels, which, although distinctly foreshadowing the chief actual river system, do not, in most cases, coincide with it, except in a rough and distant way.

---

1. As already pointed by C. C. Wang, who, however, did not distinguish the Reddish from the Red clays.

2. Presently re-dissected, sharply, by the general sub-recent erosion of the land.

3. This contact is easily explained by the fact that each basal gravel forms a hard level along which the subsequent erosion is stopped. Very often, the hard basal pudding-stone of the Red clays supports directly a younger formation, f. i. the Loess.

6. Origin of the deposits.

The Reddish clays belong to, and are the last representative of the vast family of red-stained, concretion-bearing, subarid deposits, which, in striking contrast with the chiefly freshwater Mesozoic sandstones or slates, are the most generalized facies of the Ceno-Psychozoic sediments of N. China.

Concerning their origin, we may suppose that their material was supplied, in large part, by the redeposition of the Pontian sediments (the rolled concretions of which are so abundantly found in their basal gravels).[1] In addition to this fundamental stuff, and for explaining the lighter colour of the sediments, some addition of a fresh "Loess-like" element has to be admitted. Eolian origin is specially probable in the Yulinho district, where the Reddish clay seems to lie over the Red clay and the sandstone domes as a super-imposed cap (s. above), —and also along the Ordos, in the Yülin formation, where they are sometimes almost indistinguishable, lithologically, from the true Loess.

Such a hypothesis, of a partially similar origin of the Loess and the Reddish clays, is strongly reinforced by the fact that the most common fossils found in both formations (***Helix*** and fossorial Rodents: *Ochotona*, *Spermophilus*, ***Siphneus***...) belong exactly to the same zoological groups: For such similar faunas, we must suppose very similar ecological conditions.

7. Geological age, and possible complexity.

The Reddish clays are younger than the Red Pontian clays, and older than the Middle or Upper Pleistocene Loess. They have therefore to be carefully compared with the two only formations so far recognised, for the same geological interval, in N. China: the Basal Polycene (or Uppermost Pliocene) Sanmenian (Sanmen sands and Nihowan beds), and the probably Polycene deposits of Chou Kou Tien.

With those formations, a close paleontological comparison is difficult, on account of the wide difference of the facies: the Reddish clays represent slope or steppe deposits, whereas the Sanmenian is chiefly known from river or lake sediments, and the Chou Kou Tien formation by cave deposits.

On the other hand, the Reddish clay itself is probably a complex formation. Some redder and lower levels (***Zone A***), containing a primitive ***Siphneus*** (*S.* ***omegodon***) and a small ***Lepus***, seem to be older than the less coloured beds

(1) In the same way as fossiliferous concretions of the Reddish clay itself occur, rewashed, in the basal gravels of the Loess.

(*Zone B*) in which the typical *Siphneus* (*S. arvicolinus, S. tingi, S.* cf. *fontanieri*) are decidedly abundant. In turn, over those middle beds, some very Loess-like deposits are met with, f.i. near Yülin and along the Lower Fenho (s. below, p. 18) which possibly correspond to a specially distributed and later phase (*Zone C*).[1]

All that we can say, actually, is that, by some of its faunistical elements (*Equus*, small *Bison*, Deer with flattened antlers, *Siphneus tingi*, of the Loc. 17 and 18),—and also by the important stratigraphical fact that its deposits are found just over (and possibly in direct connection with) the *Quadrula* bearing gravels of the Yellow River near Ho Chu and Wu Pao (s. fig. 3 and 7, pp. 14 and 19), the Zone B seems to be the most probable equivalent (the "Loessic" facies) of the Sanmen river sands and Nihowan lake deposits. If so, the Zone A would belong to the Middle or Upper Pliocene (that is, roughly, to the Ertemte formation and Dalainoor "white beds"[2] of Eastern Gobi); and the Zone C ranks very close to Chou Kou T'ien.

But, evidently, for such comparisons, a large amount of new palaeontological, stratigraphical and physiographical data is still necessary.

---

(1) In possible relation with those hypothetical zones is the fact that along the Yellow River (s. fig. 3 and 7) the basal gravels of the Reddish Clay seem to build two or three accessory terraces.

(2) P. Teilhard de Chardin. Mammifères fossiles de Chine et de Mongolie. Annales de Paléontologie, t. XV, 1926, p. 35.

PART II. DETAILED STUDY OF SOME TYPICAL SECTIONS IN THE REDDISH CLAYS OF W. SHANSI AND N. SHENSI.

As a proof and a further explanation of the general views given in the preceding part of this paper, we will now, following the sketch map (plate I), make a short review of the most typical sections met by us, in the Reddish clays, in the various basins crossed in our last expedition.

1. Upper Sangkanho basin. (Plate II, fig. 1 and 2).

On account of its important, and almost unique, features, the Sangkanho basin deserves a special study, for which a new and general survey is necessary. Here, we shall only point out the fact that, South-East of Ta Tung, the same lake deposits (green and pink sands and marls) are widely spread, in the bottom of the valley, as they are a hundred kilometers distant near Nihowan. Mammalian fossils are reported existing in those beds, by country people.

Bordering immediately the basin, northwards, a series of perfectly preserved, Loess covered, small *volcanoes* (nine, at least) are seen,—the lava of which overlies (and is probably interbedded with) the Sanmenian beds.[1]

Connected with the lake deposits, red sub-aerial clays occur almost surely, and ought to be searched for along the gentle, northern, slopes of the valley. Along the southern, steep barrier of the basin, such deposits have been entirely swept away by the pre-Loessic erosion.

Nor in the Hun Yuan (渾源) basin either did we notice any red deposit preserved, under the very thick accumulated Loess.

2. Upper Hutuoho basin.

In the Upper Hutuoho basin, East from Tai Hsien (代縣), the Reddish clays occur, near the bottom of the valley, lying over the strongly dissected surface of the powerful basaltic flow which in this place, covers the entire northern side of the basin. They are separated from the basalt by a basal sub-angular gravel

1. These volcanoes were indicated to us by R. F. de Vleschower (Ta Tung). According to F. Licent (1925) some other are probably found more eastward, along the same valley.

2. Cf. the Geological Map (Taiyuan-Yülin Sheet), on which the basalts are reported as Oligocene. The Tai Hsien basalts have been first studied by Dr. J.G. Andersson (Essays on the Cenozoic of N. China, p. 103).

and overlain by a well developed (about 30 meters thick) Loessic shelf, the basal gravels of which are, sometimes, 10 meters thick.—Basal layers distinctly red. Middle and top layers very Loess-like, red banded,[1] with many hard (although often incompletely individualized) limy concretions. (fig. 1, A and B)

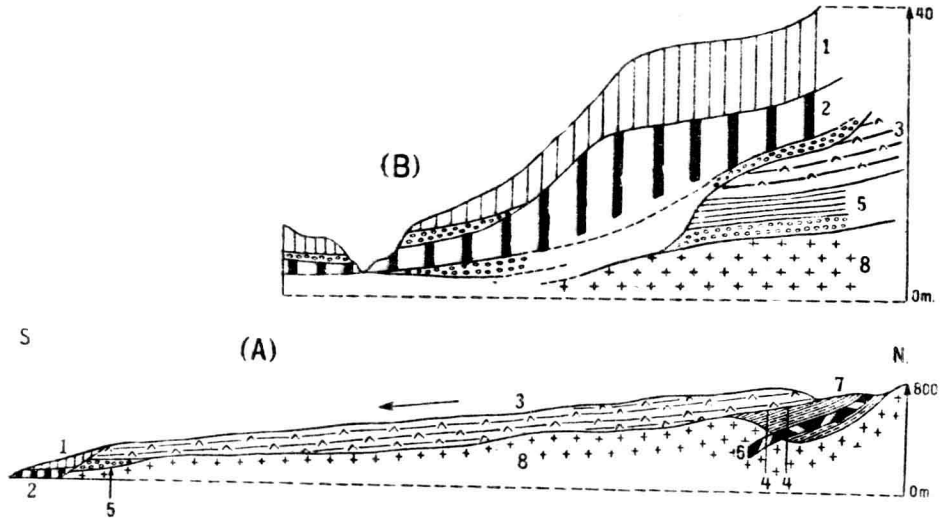

Fig. 1 A.—Section through the N. side of the Hutuoho valley, near Tai Hsien. 1, Loess; 2, Reddish clay; 3, basalt; 4, basalt dykes (vents); 5, coal-bearing beds and conglomerate; 6, Mesozoic rhyolite dyke (25 m. thick); 7, Cambrian red slates and oolithic fossiliferous limestone (90 m. thick); 8, Archæan. The Cambrian red slates (not reported on the Geological map) contain abundant pseudomorphised salt crystals.

Fig. 1 B.—More detailed (synthetic) section taken in the southern part of the fig. 1A. Same numbers as above. The formation 5 is underlain by a quartzic basal conglomerate.

The post-Pontian age of those deposits is based on fossils: numerous ***Helix*** of Pleistocene type, with shell well preserved, and bones of ***Siphneus***. A large collected humerus belongs surely to *S. **arvicolinus***.

It is worth observing, here, that, in this case as in so many others, it is impossible to prove, by stratigraphical superposition, that the basalts are older than the Pontian. Their pre-Sanmenian age only is absolutely clear.[2]

---

1. In the best exposure, we have seen twelve of those red bands, parallel, each at 1 meter of the next one.

2. According to the rather poorly preserved fossil flora found in the underlying coal-bearing beds, the basalts are still held as Oligocene. In any case, they do not seem to us (nor to Dr. C.C. Wang?, in his explanation of the Geological Map) to be tectonically warped. The dipping of the lava beds seems to be due to its flowing down *in a preexisting valley* (still indicated by the underlying gravels or Plant bearing beds), as it is the case everywhere for the basalts in the Jehol region (cf. P. Teilhard de Chardin. Etude geologique sur la region du Dalai-noor, Mem. Soc. Géol. Fr., nouv. Série. t, III, fasc. 3, 1926, p. 52).