

## THE YÜHUATAI GRAVEL AND ITS PHYSIOGRAPHIC SIGNIFICANCE.

By C. Y. HSIEH (謝家榮)

(*The Geological Survey of China, Peiping*)

A few li outside of the southern gate of Nanking is located a famous scenic point, the Yühuatai, a flat hill well-known for the occurrence of a great number of beautifully banded agate pebbles, much used for ornamental purpose. The agate together with other rocks, form pebbles in a gravel formation, called Yühuatai gravel by Messrs. Liu and Chao.<sup>1</sup> It is said that good agate has become very rare now, and those pebbles that are sold at Yühuatai have been mostly imported from different places north of the Yangtze River, but still under the name of Yühuatai. Travellers who pay occasional visit to this place may pick up some fairly good pieces of agate, but this is certainly a very rare chance.

The Yühuatai gravel forms a distinct terrace about 20-30 meters higher than the bank of the Yangtze river. This terrace, being more or less dissected or destroyed, can be traced quite extensively south of Nanking. Thus, any one who comes from Fangshan or Niushushan to Nanking will cross a gravel platform which has evidently a wide extension; and before the southern gate of Nanking is reached, one must descend a slope of about 20 meters high. This is the Yühuatai terrace.

Gravel formation of similar nature but in more complete sequence is found at Fangshan, a characteristic table mountain or mesa, situated about 45 li south of Nanking. The gravel formation about 40 meters thick, is composed of many layers of loose sandstone or sand and at a few horizons, argillaceous rocks are also found. It lies unconformably on a red and massive sandstone, the Chihshan formation of Liu and Chao,<sup>1</sup> and is itself overlaid by basalt. Evidently the capping position of the latter has a great influence on the preservation of this loose and soft formation which would otherwise have already been eroded away.

---

1. Liu, C.C. Chao, J.C.: A preliminary report on the Geology and the Mineral Resources of Kiangsu. *Memoir Geol. Surv. China, Ser. A. No. 4.* 1924, p. 14.

The stratigraphic sequence at Yūhuatai is a little different from that seen at Fangshan. The gravel lies here on a purplish red sandstone and shale evidently equivalent to the red formation of Liu and Chao, while the basalt is entirely missing. So here the gravel has been exposed bare and is subjected to direct atmospheric denudation.

According to Messrs. Liu and Chao and Andersson<sup>1</sup>, gravel of similar nature as that of Yūhuatai is widely distributed north of Yangtze River in the district of Luhhsien, there forming the same type of mesa topography, and almost the same kind of sequence as Fangshan. In some of the hills studied, loess is found to lie above the basalt (Figure. 1.).

More recently, while he was engaged in a survey of the artesian wells condition in Nanking<sup>2</sup>, the writer was impressed by the constant occurrence of a thick gravel or sand formation in many of the well logs studied. This formation about 20-70 meters thick lies under a cover of loess and later debris of about 5-20 metres in depth. It is succeeded at a depth of 70-100 meters by a



Fig. 1. Section of Linyenshan, Luhhsien, Kiangsu (according to T. Tung). 1, Loess; 2, Basalt; 3, Volcanic tuff; 4, Yūhuatai gravel; 5, Red sandstone.

purple shale and sandstone formation of considerable thickness, as a boring of 170 meters depth has not yet reached its lower limit.

In comparing the stratigraphical sequence of the well logs and the sections mentioned above, it seems evident that the gravel and sand encountered in different wells can be correlated with the Yūhuatai gravel, while the purple shale and sandstone is most probably the same one as found at Yūhuatai, i.e. the red formation of Liu and Chao. The most significant fact is that here

1. Andersson, J. G.: Essays on the Cenozoic of North China. Mem. Geol. Surv. China, Ser. A, No. 3, 1923.
2. Hu, P. Y., Liang, T. and Hsieh, C. Y.: Notes on the artesian wells in Nanking, Bull. Geol. Surv. China, No. 16, Mar. 1931.

the gravel formation lies at a level at least 30 meters lower than that found on terrace. As such a difference of elevation is certainly not due to fault; the only plausible explanation is that the gravel has been subjected to a far reaching erosion since its formation so that scouring of a basin-like depression at Nanking was resulted. These features are clearly shown in Figure 2.

As no fossils have ever been found from either the gravel formation or its underlying red sandstone (The Chihshan formation) or purple shale (the Red formation), no definite age, therefore, can yet be assigned to each of the formations mentioned. However, if we compare the above sequence with that of North China, where the Cenozoic stratigraphy — thanks to the laborious works of Andersson, Ting, Teilhard, Barbour and Young—is better known, a striking resemblance between the two can be found. Thus everywhere in

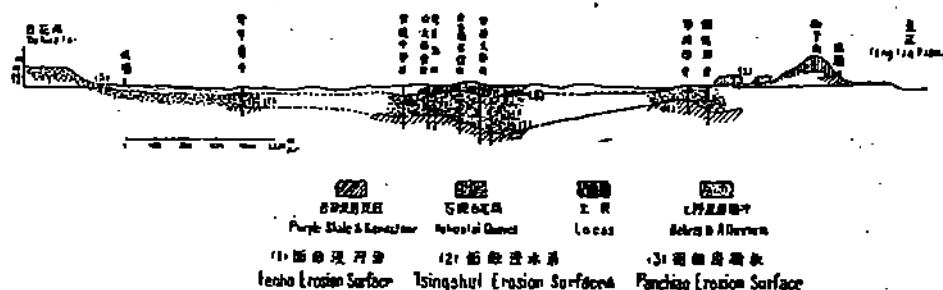


Fig. 2. Section across Nanking showing the Physiographic Stages.

North China, the Sanmen gravel of early Pleistocene age is found to lie above a red clay formation, the Hipparion clay, and below the loess. Furthermore at northeast of Tatung, a Quaternary basalt has been recently noticed by Teilhard and Young,<sup>1</sup> and Barbour.<sup>2</sup> There the basalt lies at exactly the same stratigraphic position as at Nanking, i. e. above the sand and gravel of Sanmenian age and below loess.

1. Teilhard de Chardin and C. C. Young: Preliminary observations on pre-Loessic and post-Pontian formations in W. Shansi and Northern Shensi. Mem. Geol. Surv. China, Ser. A, No. 8, 1930.
2. Barbour, G. B. and M. N. Pien: The Pleistocene volcanoes of the Sangkanho, Bull. Geol. Soc. China, Vol. 9, No. 4, pp. 361, 1930.

On the basis of the above mentioned evidences, the writer is compelled to think that the Yūhuatai gravel at Nanking can be correlated with the Sanmen gravel of North China, while the Chihshan red sandstone is probably the equivalent of the Hipparion clay. According to Barbour, an erosion interval of not less significant degree exists between the Sanmenian and the Loess, and to which the name Chingshui stage has been recently proposed. This erosion interval seems to be also present or even more developed in Nanking as is evidenced by the higher position of the Yūhuatai gravel in comparing with its northern extension found by well drilling below Nanking. An excavation of at least 40 meters has been therefore accomplished by the Chingshui erosion.

Furthermore the erosion interval is marked at both places by a basaltic extrusion of moderate thickness, which in view of its characteristic lithologic character and constant stratigraphic horizon can be used as another key bed for the correlation purpose. Thus in spite of the great distance interspacing between North and Central China, physiographic development especially the latter part of the history seems to have taken practically the same course. This is not to be wondered, however, as the skeleton of the Chinese continent as a whole has been already developed at the beginning of the Cenozoic Era, so that major physiographic evolution must have taken essentially the same course of development, though they may be quite different in details.

It is certainly to be admitted that what has been discussed above is nothing more than a suggestion. Conclusive evidence especially from the palentological side is greatly needed in order to confirm or to disprove the proposed correlation, which is summarized in the following table:

Physiographic stages	Geological age	North China	Central China
Malan	Pleistocene,	Loess	Loess
Chingshui		Basalt (N. E. Tatung)	Basalt
Sanmen		Reddish clay and gravel	Yūhuatai Gravel
Fenho	Pliocene.	Red clay and gravel	Chihshan Red sandstone
Paote			