

CONFIRMATORY EVIDENCE OF PLEISTOCENE GLACIATION
FROM THE HUANGSHAN, SOUTHERN ANHUI*

BY

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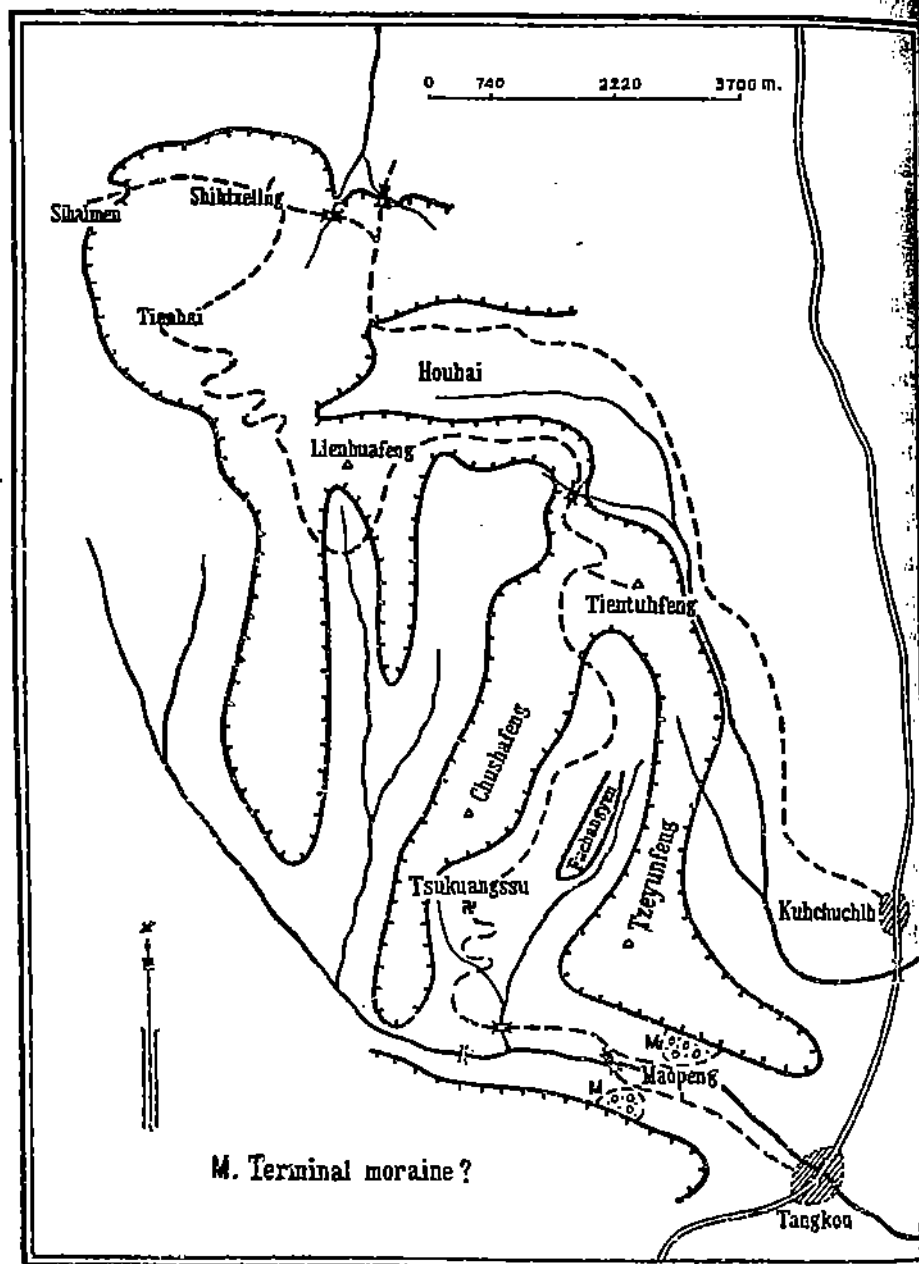
(*Academia Sinica*)

A body of facts gathered a few years ago from the Lower Yangtze Valley compelled the writer to draw the conclusion that glaciation occurred in parts of this region some time during the Pleistocene period. So radically this explanation differs from the "orthodox" view that "scientific scepticism" has tended to do all what it can to keep such a disturbing interpretation in the background. A few geologists however may have been anxiously waiting for further evidence. For their consideration I venture to offer the present case. In this short note I shall endeavour to call attention to a number of crucial points which have a fundamental bearing on the problem, leaving the detailed consideration to a later occasion.

According to the 'New Atlas of China' (Ting, Wong and Tseng) the position of the Huangshan is located at about long. $118^{\circ} 8' E.$ and lat. $30^{\circ} 10' N.$ Barometric readings by different observers vary considerably as regards its altitude. The figures recorded by Dr. Lishouhua appear to represent the happy mean. According to this observer the Lienhuafeng which is the highest peak, reaches a height of 1,820 m. above sea level. If we take Tienmenkan and Sihaimen as representing the minimum height of the top of the mountain, then we may say that the altitude of the Huangshan minus the few peaks varies between 1,500 and 1,660 m. These figures are of course only provisional.

The whole mountain is almost entirely composed of a coarse-grained granite with large phenocrysts of feldspar, irregularly shaped quartz, some hornblende and a little black mica. Fine-grained granite of similar

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A sketch showing the general plan of sculpturing of the Huangshan.

composition occasionally occurs. Whether it represents a marginal facies or a later intrusion into the main body of the porphyritic granite is yet unknown. Usually the Huangshan granite is traversed by vertical or nearly vertical master joints. As a consequence, huge prisms of rock are liable to be detached at a time from the mountain by natural agencies of destruction leaving fantastic peaks looming high and cavernous precipices forming the walls of the cañons which rapidly head their way into the mountain from all sides. In these circumstances it may be easily understood that the processes of destruction of former geomorphological features have been rigorously at work. Few would therefore suspect the existence of any trace of ice-action in such an area, if it had ever taken place.

It is by mere chance that certain glacial features have been preserved. The most striking of these were found in the U-shaped valley above Tsukuangssu. This U-valley is walled on both sides by massive granite with the Chushafeng standing on the west and Fuhchangyen on the east, and carries a meagre stream which has not yet eroded the valley to the extent as to destroy its U shape. It hangs to the depression of Tsukuangssu lying in front of it. Close examination of the rocky walls on both sides of the valley shows that the even and smooth surface of the walls is not entirely due to the peeling off of huge slabs of granite along its master joints, but is at least partly due to a process of abrasion traceable to a disappeared glacier or glaciers.

The evidence of glacial erosion is particularly clear at a point less than a mile above Tsukuangssu where the ice-abraded and striated surface is well preserved in the lower part of the eastern wall of the U-valley already referred to (about 960 m. in altitude), and is readily visible from the foot-path along which visitors usually climb the mountain. Fairly deep and broad markings of variable length are arranged parallel to each other on an abraded surface of the granite. They are not strictly horizontal, but are slightly inclined towards the lower part of the valley. The latter fact indicates the direction of flow of the ice. In this particular part of the granite the rock is fortunately free from joints, cleavages or any other kind of structural habit that might

possibly give rise to pseudo-glacial striation. At any rate, the nature of the striæ and the form of the abraded surface on which they are developed are so characteristic of glacial origin that such possibilities hardly need to be considered.

The effect of ice-abrasion becomes even more manifest when we come to consider the projected part of the rock-surface which forms the upper rim of the abraded area, and stands out in strong relief. The lower edge of this overhanging feature has been obviously ground up by some forcible mechanical agency that operated against the rock-surface below it. That this salient feature runs parallel to the striæ is also a fact of some significance. If we compare the nature of the rock-surface below this line of demarcation and that above it, it will be at once realized that the glacier which effected this abrasion and wrought out the markings maintained its upper limit for some time at the level of the lower edge of projection. Above this level the wall of the valley is generally less smooth, though still fairly even as a whole. In the higher part of the rocky wall obliterated horizontal striæ are in places recognizable with difficulty. They are however so faint that it would be rash to regard them as of glacial origin.

A few markings of a similar kind, but less distinct, were found on a rock-surface at Tienhai, one of the areas of mild relief developed on the top of the northern part of the mountain. This together with the cirque-like depressions in the neighbourhood of Shintzeling apparently formed vast snow-fields in glacial time. The local topographical features together with the direction of the few striæ suggest that fairly large glaciers were sent from these places down to the northern side of the mountain. Overflow of ice-tongues found their way however to the south-east as indicated by the gaps on the south-eastern side of the cirque-like areas.

No less important is the evidence offered by a striated boulder found in one of the side-valleys leading to Houhai behind Tientuhfeng. The rock of which the boulder is composed is a relatively fine-grained granite. It was found among a number of subangular boulders of the ordinary coarse variety of the Huangshan granite, and was half buried

in a reddish sandy clay. None of the other boulders however shows any scratches, though they generally have one or two faces polished.

The boulder under consideration has not yet lost its angularity. Two opposite faces are polished and scratched. One of these faces is more strongly worn off than the other as shown by its slightly convex shape. Three sets of striae are noticeable on each of the polished faces. In each case one set runs nearly parallel to the long axis of the boulder, another almost perpendicular to it, and the third oblique to it. The oblique sets on the two faces do not agree in direction. On the slightly convex face the first set of striae agrees in direction with the long axis of the boulder. They are barely visible in the apical and basal parts of the triangular surface under suitable incident light. The other two are distinct enough as to show that they are true scratches. The other face is not only striated, but indented, a phenomenon often noted among glacial boulders. These facts point to the conclusion that the boulder in question achieved a steady movement against some gritty but fairly even surface being all the time firmly held by some agency which at the same time applied a considerable pressure. Nothing but a glacier, perhaps of a fairly large size, would answer these requirements.

Moraine-like material is often met with in the foot-hills and valleys on the southern side of the Huangshan, though by no means as extensive as on the northern side. Sometimes it is covered by the red clay, but more often by rock debris and gravels. From the village of Kuhchuchih to that of Tangkou beds of whitish or reddish tough clay, exceedingly fine in quality, are now and then intercalated with the boulder clay being overlain by a rudely stratified, detritus material. In places the tough clay is apparently free of pebbles, and is finely laminated with the laminae alternately whitish and reddish in colour and finer and coarser in texture. Most of the coarse grains consist of angular particles of quartz, but a few are of fragments of feldspar. The thickness of each individual lamina varies from a fraction of a millimetre to a little over two millimetres. These varved clays were apparently deposited in a local lake which received its water from the glaciers under varying seasonal conditions. In some cases a number of successive

laminæ are distinctly deeper in colour than those succeeding. Such deep coloured bands appear in regular intervals suggesting the effect of minor climatic cycles during the time of their deposition.

The puzzling problem that calls for attention arises from the fact that these varves and their associated boulder clay obviously cannot be produced by the small and probably decaying glaciers such as the one which marked the rock-surface above Tsukuangssu. If they had originated from glaciation, the glaciers must be of large size, and came down to an altitude of no more than 300 m. above sea level. The provisional explanation is that glaciation occurred in several stages, the oldest of which has left no geomorphological record because of the erosion which had subsequently taken place. Some light may be shed upon this problem through comparative studies in other areas.

Explanation of
Plate I

PLATE I.

Upper figure: A U-shaped valley developed above Tsukuangssu on the southern side of the Huangshan being slightly eroded at the bottom by a small stream. Left side: Chushafeng; right side: Fuchangyen.

Lower figure: Lower end of the same valley showing its overhanging position as viewed from Tsukuangssu.

(趙太侔先生攝影)





Explanation of
Plate II

PLATE II.

Figure 1. A portion of the ice-abraded surface preserved in the lower part of the left wall of the U-valley shown in Plate I with parallel, coarse striæ slightly inclined down-stream.

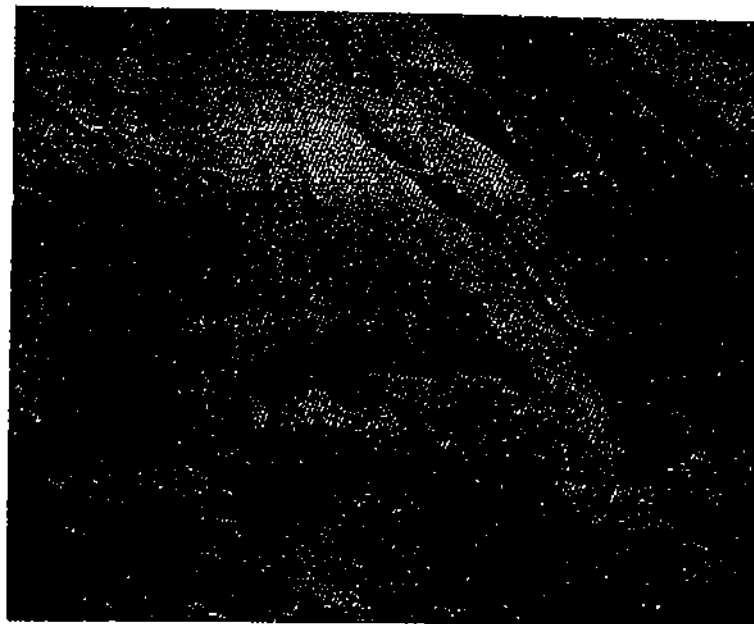
(趙太侔先生攝影)

Figure 2. A polished and scratched boulder found in a valley to the north-east of Tientuhfeng. Note the three sets of striæ, the earliest of which is almost unrecognizable in this photograph, and also the strong weathering suffered by a part of the granite boulder since the process of polishing and scratching took place.

Figure 3. The back-face of the same boulder as shown in fig. 2 with several sets of striæ and indentation.

Figure 4. A specimen of the varves intercalated with the boulder clay exposed at Tangkou (See also Pl. III. lower figure).

(以上三圖孟憲民先生攝影)





Explanation of
Plate III

PLATE III.

Upper figure: Partial view of Tienhai looking towards Lienhuafeng from the east. The gap below Lienhuafeng on the left side of the picture has been largely produced by a stream which has attacked this cirque-like depression from the south-eastern side. Glacial striæ are preserved in one place on the hummocky surface of the granite. They show the movement of the ice directed to the west or west by north.

Lower figure: A section at Tangkou showing varves (white) intercalated with moraine-like material being overlain by a thick deposit of stratified rock-debris and gravels. The latter are probably of fluvio-glacial origin.

(趙太侔先生攝影)

