THE STRUCTURE OF THE NANKOU DISTRICT

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The structure of Nankou is characterized by large and small folds, might faults and abundant igneous intrusions in the form of dikes and sills. Anticline of considerable magnitude extends east and west with a squence of siliceous limestones and alternating beds of slates and quartzites forming its southern limb. The northeastern part of the district appears to be folded into a great syncline as is shown by the gradual change of dip, being steep at the foot of the mountain and very gentle on the top, and by the curving of the strike so that on the flank of the mountain the strata dip towards a common center. The highest mountain in that district locally known as "The Home of Crows" (老鴰頂) is probably the center of that syncline. Apart from these great folds, there are to be noted many local folds of smaller magnitude.

Besides these folds, the structure of Nankou is further complicated by many faults. In a brief research, I found out three faults which constitute probably two series. The tracing of fault A. (see the accompanying map and sections) but was very troublesome, but extremely interesting, while fault B. was clearly shown in the field. Fault C. was infered by the occurrence of a great thickness of breccia and its approximate parallelism to the fault B.

Those who have ever walked along the railroad north of the Nankou Station, must have gained an impression that the mountains on the south are all made up of siliceous limestone and alternating beds of slates and quarzites with a strike of due east and west, and dip 38° to the south. As the shaly beds are softer, so weathering agencies reduce them to gaps, while quarzites, being harder, project as ridges. In this way, the road leading to the Nankou Pass has been rendered so attractive to tourists and scenery-hunters, otherwise it would have been bleached and become dreary. Going northward the topography changes suddenly: cliff-forming limestone crowns the mountain top while turf-clad metamorphic gneiss and schists form the lower part. As topography is admittedly indicative of internal structure, so a change of the former would mean a corresponding change in the latter. Nearly the whole of my time in the field was spent in this part of the country with the object of seeking out relations between the cliff-forming limestone and the soil-covered metamorphic rocks.

At the southern end of the cliff, the limestone dips 20° to the south, but after passing a short distance of apparently stratified limestone, the dip becomes 15° to the north. The contact between the limestone and metamorphic rocks is not shown. I then walked along this line and came to a place where the metamorphic rocks were found to be covered by quartzite. This is due to the fact that the very thick limestones are underlain by a bed of quartzite as shown in section DE. From this point northwestward, the green metamorphic rocks can be seen being covered by white quartzite until they are buried by the embankment of the railroad.

All the above-mentioned contacts are soil-covered and inobservalbe, but what cannot be seen is within 2 or 3 feet, so that it is quite sure that no other strata intervene between them. In a small valley a little north of the railway bridge, the actual contact, however, is more or less indicated. There is a shear-zone between the quartzite and the metamorphic rocks with a kind of cleavage parallel to the contact-line. This bed of quartzite can be traced to the south of Tung Yuan Station (東原車站), passing across the river and reaching the hills on the westside. The contact-zone there is intruded by many igneous bodies. From these facts, it seems to be apparent that the several members of the Sinian System in the sense of von Richthofen, rest in someway upon the metamorphic rocks.

Then what is the actual relation? It is certainly not an unconformity, for if so, the above-mentioned quartzite would cover the metamorphic rocks everywhere. No sign whatever was found that it may be regarded as indication of a progressive transgression. It is also not a perfect anticline, for if so, the cross-bedded quartzite found in the south would overlie the metamorphic rocks everywhere. Since there are only three possible interpretations, i.e., unconformity, anticline and fault, and since the first two are denied by the observed facts, we are then forced to accept the last interpretation. This is also corroborated by the occurrence of a shear-zone already mentioned.

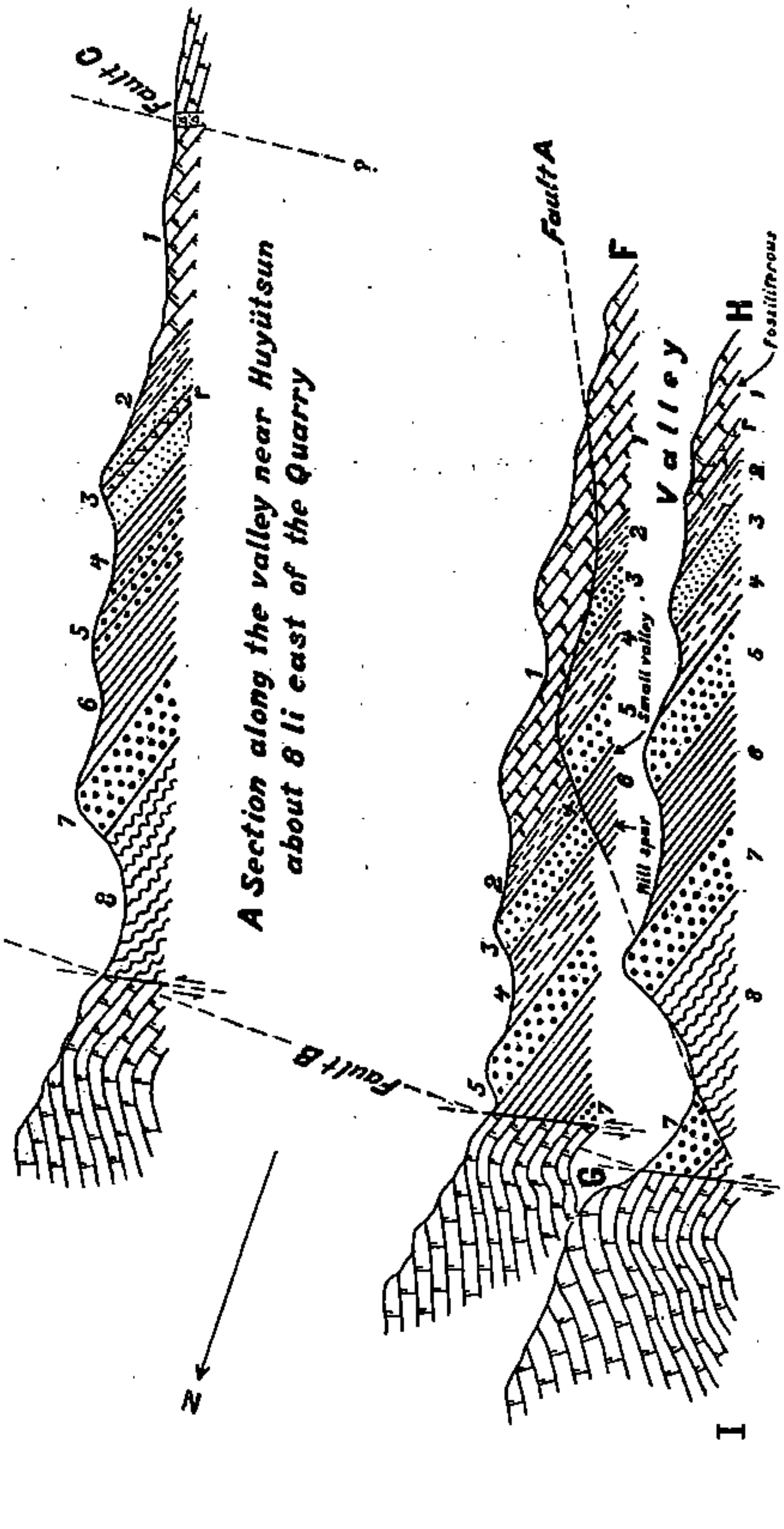
Now we realize that it is a fault or thrust. How then does it run, or what is its hade? If we assume the inclined contact-line indicates the direction of dislocation as it seems likely to be the case, then the same contact line ought to be seen in the rear of the mountain. But the facts are otherwise. What was seen in the valley behind the mountain is a vast series of limestones. So the direction of dislocation as is assumed cannot be in the way.

As there is only limestone present in the rear valley, it leads me to think that this contact-line is the fault-line with the downthrow to the northeast. If so, similar facts ought to be discovered if this line will be followed further southeast. I then went to the valley behind the mountain, further evidence fortunately helped me to settle the problem.

It was extremely interesting to work in this valley, but the work was not unattented by difficulty. The strata exposed on the one side sometimes correspond to and sometimes differ from those on the other, although all of them seem to coincide in strike. On the west side of the vally, the sequence of rocks is the same as that along the railway, but a bed of quartzite is seen below the gneiss, the contact being covered by soil. On the east side, the upper part of the mountain is largely composed of limestones while the lower part consists of alternating beds of quartzites, slates etc. exactly similar to those on the west. Its relation is shown on the sections along the two sides of a valley about 1 li east of the quarry. A zone of crushed rocks is exposed in a small valley on the east side. On the northwest side of this small valley shale forms a small hill spur, and on the southeast, a grey shale crops out; the latter was found everywhere to underlie the massive limestone and far above the purple shale. This sheared zone is marked out by a cross on the section.

Thus, we can readily see that the large valley behind the quarry is really obliquely cut through by the same fault. That is why a bed of quartzite is thrown in contact with the gneiss and schists. This would also account for the fact that in the southern half of the valley, the sequence of rocks of the lower parts on the east side is exactly the same as that on the west while on the top of the mountain only limestons are present.

In the same valley fault B. was seen. Its strike nearly coincides with that of the strata. This is what is commonly known as a dip slip strike fault. In a valley about 2 miles east of the quarry near Hu Yü Tsun (虎峪村), the



HI Section along the west side of a large valley about 1 li east of the quarry
FG View along the east side of the same valley
1. Siliceous limestone 2. Shaly beds 3. White quartzite 4. Grey slate 5. White quartzite 6. Purple shale 7. Cross-bedded quartzite
7. Gneiss & schists 9. Fault breccia

(Scale 1: 7500)

same thing was seen as what has been illustrated in the section. This fault is very clearly indicated in the field and needs no further discription. So far as it is known, no fossiliferous bed has been found on the north, and therefore it is not possible at present to calculate the amount of vertical displacement. But according to the sequence of rocks exposed at the quarry, quartzite is overlain by a thick series of limestone while on the north, just below the thick limestones, a bed of quartzite has been also found. Thus, it appears probably that the limestones exposed at quarry may correspond to the lower part of the limestone on the north. This, however, needs a further investigation. Now the highest mountain in that district is of 1,000 meters above sea-level or about 900 meters above the bed of the Nankou river. Since the dip of the successive series of rocks varies in amount, from a gentle inclination of the top of the mountain to fairly high angles at the bottom, exact measurement of the total thickness of the massive limestone is not altogether an easy matter. But it must be well under 1,000 meters.

These two faults constitute the important factors of the structure and topography of the Nankou district. It is because of these two faults that lofty mountains rise in the northeastern part of the area, followed by somewhat gentle but undulated slopes to the south.

As regards fault C. few observations were made. Nevertheless I was compelled to assume that it indicates a mighty fracture, because that belt of autogenetic breccia which I have already mentioned, could not have been there. This brecciated zone can be traced from the hill top of Chao Erh Chien (雀兒澗) eastward to the mountain near Hu Yü Tsun. In a valley near Hu Yü Tsun as indicated on the section, it measures 20 meters. If it actually indicates a fault, it must be of a gigantic scale. As no breccia was found on the section along the railroad, this inferred fault may run beyond the southern end of the mountain. This, however, needs more careful investigation.