

# OROGENIC MOVEMENTS IN HUNAN\*

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With 8 text figures

Through researches during recent years in central and southern Hunan, it is desirable not only to extend the two well known movements, Caledonian and Yenshanian, but also to apply the new term Hunanian for indicating an orogenic movement which occurred somewhat later than the Hercynian but actually earlier than the Yenshanian. Besides, at the end of the Cretaceous or the beginning of the Tertiary also occurred an orogenic movement in Hunan, although it is rather small in magnitude as compared with the older ones.

The important evidences of these different movements so far observed in this province may be summarised as follows:

## I. THE CALEDONIAN MOVEMENT

The orogenic movement of undoubtedly pre-Devonian or Caledonian age has long been known in eastern Asia. In the western part of Fergana it was named Turkestanian by Mushketov.<sup>1</sup> The late Dr. V. K. Ting<sup>2</sup> remarked in 1929 that this term is to be applied to the NW of China while for the SW he proposed the term Kwangsian.

In central Hunan the distinct unconformity between the Devonian and its underlying sediments has been observed in a number of sections. For the present it seems to me only necessary to give such as are most important.

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\* Received for publication in July 1936.

1 D. J. Mushketov: Geological Map of Central Asia. Mem. Com. Geol. Nouv. Livr. 169, 1928.

2 V. K. Ting: The Orogenic Movements in China. Bull. Geol. Soc. China, Vol. VIII, No. 2, p. 152 & 157, 1929.

1. The section near Tanchiapa as well as in the Shangwutu manganese field of Hsiangtan shows the strongly folded Tanchiapa series of most probably Silurian age unconformably overlain by the Middle Devonian Chaomakien series with a basal conglomerate (see fig. 1).

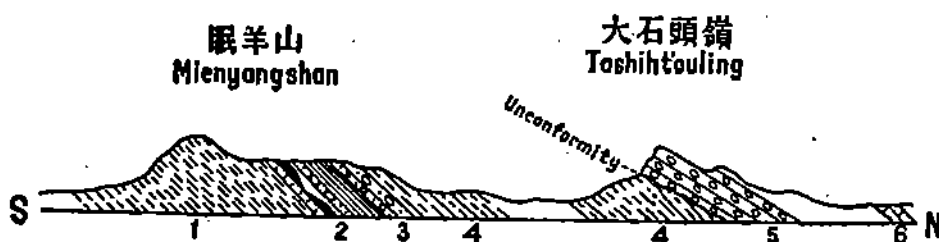


Fig. 1 Section from Mienyangshan to Tashiht'ouling

1-4. Silurian

1. Whitish gray shale
2. Sandstone and black shale intercalated with Mn. ore beds
3. Sandy shale with pebbles
4. Shale and Siliceous shale
5. M. Devonian basal conglomerate
6. M. Devonian limestone

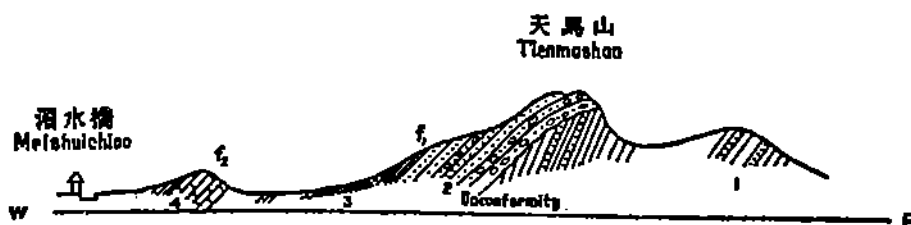


Fig. 2 Section at Tienmashan showing the M. Devonian conglomerate unconformably lying upon the Siluro-Ordovician phyllite

1. Tienmashan phyllite (Siluro-Ordovician)
- 2-4. Chaomakien Series (M. Devonian) 2. Conglomerate
3. Shales and shaly limestone 4. Argillaceous limestone

2. In the Tienmashan section near Meishuichiao, Hsianghsiang, we actually observed the basal conglomerate of the Chaomakien series which dips to N 50° W at an angle of 45° while its underlying phyllite, belonging to the Tienmashan series of Siluro-Ordovician age, is nearly vertical as shown in fig. 2.

3. In the boundary region of Ninghsiang and Anhua districts we found the Chaomakien series in many sections lying unconformably with a basal conglomerate upon a series of yellowish or greenish yellow phyllitic shale containing Lower Ordovician *Didymograptus* and *Tetragraptus*. The sections observed at Kaomingpu is given here for example (see fig. 3).

Besides, in Henshan and Henyang districts there are also many sections which show the unconformity between the Chaomakien series and its underlying sediments. These sections, owing to their close similarity to either one or the other of the above mentioned examples, are unnecessary to be repeated here. It has to be noted that in central Hunan wherever the Devonian rocks expose, they are always found much less disturbed and folded and also never traversed by quartz veins although

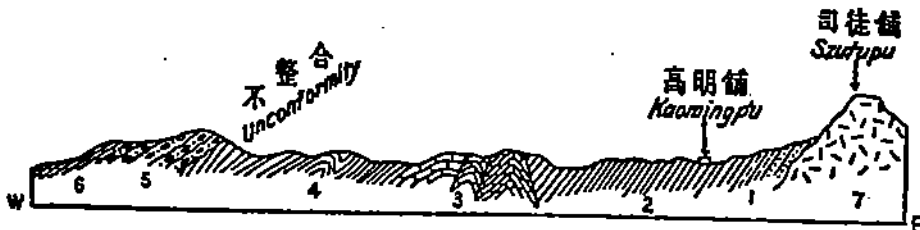


Fig. 3 Section at Kaomingpu showing the M. Devonian basal conglomerate unconformably lying upon the Ch'iaot'ingtzü series

- 1-4. Ordovician
- 2. Black shale
- 4. Ch'iaot'ingtzü series
- 6. Sandstone, shale and shaly limestone

the latter are very common in their underlying sediments. Again, no matter what sediments they overlie, they always begin with a basal conglomerate of which the chief constituent is of small rounded quartz pebbles, undoubtedly derived from quartz veins in their underlying sediments. So, in any case, the existence of the pre-Devonian unconformity in central Hunan is quite certain.

Whether such unconformity also occurs in southern Hunan is still a question, since up to the present no Siluro-Ordovician rocks have so far

been observed below the Devonian in regions surveyed during recent years. In western Hunan, however, it was replaced by a disconformity because there the Yanghsing limestone of Permian age lies concordantly though disconformably upon the Wutung quartzite of probably Lower Carboniferous age and the latter is in the same relation upon the Hsintan shale of Silurian age, thus clearly indicating the absence of intense folding after the Silurian times as it prevails in central and eastern China.

In other parts of SW China, so far as we know, the pre-Devonian or Calidonian movement was noticed only in north-western Szechuan and Kwangsi. According to Dr. T. K. Huang, this movement actually occurs, in Szechuan, near Chaotienchen where fossiliferous Silurian green shale dipping steeply to the north is capped by a formation of quartzite and limestone of undoubtedly Devonian age, dipping in the reverse direction. But its extent as noticed by Dr. Huang is rather limited since it never affected the main Tsinlingshan and Tapashan in that province.

In the province of Kwangsi the unconformity between the Devonian and its underlying sediments was first noticed by Mr. T. O. Chu in two sections: one to the north of Kueih sien and the other in the E-W range north of Nanning. Later on, Dr. V. K. Ting crossed the last named range and observed some more sections; he came to such conclusion that "in any case the existence of a pre-Devonian movement in Kwangsi is quite certain, whether it occurred between Middle Devonian and Silurian or the former and Lower Devonian," and for this he proposed the term Kwangsiian. But to me, as can be judged from the above mentioned facts in NW Szechuan and central Hunan, we are inclined to admit that this movement in Kwangsi would occur in pre-Devonian rather than in Devonian itself.

In North China, it has long been known that the Penhsi series of Moscovian age lies directly on the Ordovician limestone without any angular discordance so as to lead Richthofen to regard the latter as Kohlenkalk. Evidently no orogenic movements have affected that part after Ordovician times except for epeirogenic ones.

So far as we are aware, the Caledonian or Kwangsi movement actually occurred only in NW Szechuan, Central Hunan, Nanling and Kueih sien of Kwangsi while in other parts of S. China as well as in N. China, it was generally transferred into an epeirogenic movement. In Southern Hunan further studies are needed for proving or disproving the existence of this movement.

## II. THE HUNANIAN MOVEMENT

In Hunan, after the Caledonian is the Hunanian movement which also played an important rôle and occurred between Jurassic and Permian instead of between Permian and Carboniferous. So it is apparently younger in age than the Hercynian but older than the Yenshanian, the latter being post-Jurassic. This movement has recently also been noticed by Y. Y. Lee and S. Chu at Kenkou, Ichang, of Hunan and named by them the Kenkou movement.<sup>1</sup> It seems to me that the term Kenkou is not suitable because it was named only after a small village situated on the Hunan-Kwangtung border; as a matter of fact this same movement extends also to the interior of the former province. I therefore propose the term Hunanian instead.

Before summarising all the data of this movement let us discuss in a general way its existence in Hunan.

First of all, since the end of Triassic time this province has been land as is the case in other parts of China, for no representatives of any later marine deposits have so far been found. Secondly, the so-called thin-bedded limestone of Triassic age as well as the Permian coal series are always folded together with their underlying sediments. Thirdly, wherever the Jurassic coal series exposes, there is a profound unconformity below it.

From the first point of view, it becomes evident that after the Triassic there would be a movement so as to prevent this part of Asia from transgression. From the second and the third points of views, it is also obvious that in Hunan an orogenic movement

1 Y. Y. Lee & S. Chu: Geology of Kenkou on the Hunan-Kwangtung border and its bearing to the orogeny of the Nanling ranges. Bull. Geol. Soc. China, Vol. XIII, No. 2, p. 194.

would occur between Triassic and Jurassic in correspondence with the epirogenic one generally occurring in other parts of China although up to the present the actual contact of an unconformity has been observed only between Jurassic and Permian or even older.

The following are the data of this movement so far observed in Hunan:—

1. Section at Shihmenkou, Liling. Here the Jurassic coal series lies unconformably on a formation of conglomeratic quartzitic sandstones and shales of undoubtedly Devonian age, the former dipping to S at  $40^\circ$  while the latter to SEE at  $50^\circ$ . To the south of Shihmenkou the coal series was actually observed to be unconformably overlain by the Henyang red sandstone of most probably Cretaceous age (See fig. 4).

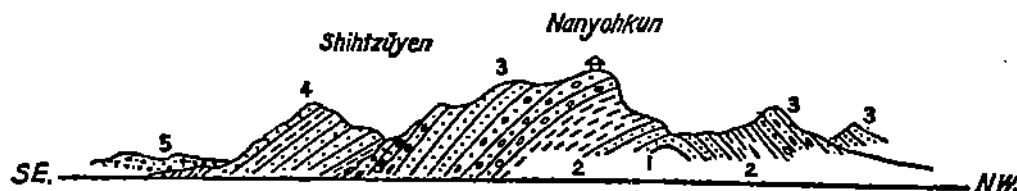


Fig. 4. Section at Shihmenkou W. of Shihmenkou, Liling, showing the unconformity between the Jurassic coal series (4) and the Upper Devonian formation (1-3) and that between the former and the Cretaceous Red Beds (5).

2. Section at Yangmeishan, Ichang. The nearly vertical strata of the Jurassic coal series rest on the various members of Carboniferous formations. Formerly the contact between them was thought to be an overthrust, but now it seems to me, most probably, that there is a distinct unconformity.

3. Along the Hunan-Kwangtung border. The first section noticed by Y. Y. Lee and S. Chu is at Kenkou where the Jurassic coal series dips to NW and lies unconformably with a basal conglomerate on the strongly folded Carboniferous-Permian limestones (fig. 5).

Tracing south-westward from the Kenkou section, we found that the basal conglomerate of the coal series thins out and a sandstone takes

its place, the latter lying also unconformably on the folded Carboniferous-Permian limestones. Still further on to the vicinity of Kouyatung we

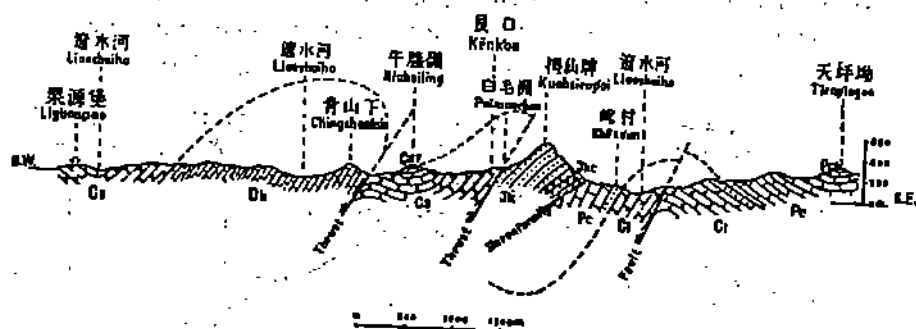


Fig. 5 Section of the Kenkou district, S. of Ichang.  
(After Y. Y. Lee and S. Chu)

- Dk. Upper Devonian limestone
- Cs, Cl. Lower Carboniferous limestones
- Pc. Middle Carboniferous to Lower Permian massive limestone
- Pch. Middle Permian flint limestone
- Jkc-Jk. Jurassic basal conglomerate and coal series

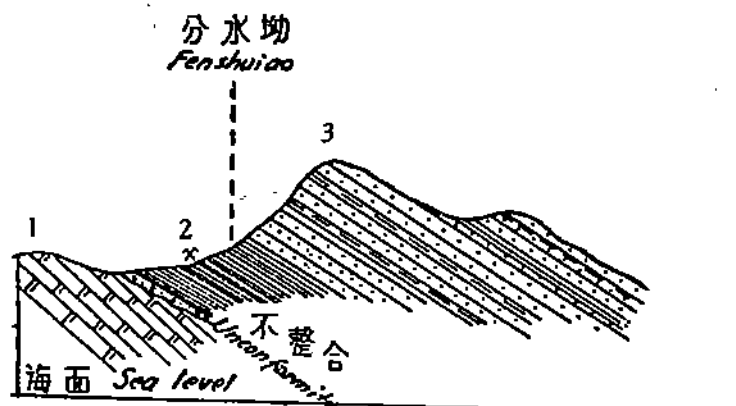


Fig. 6. Section EW of Fenshuiao, S. of Kouyatung

- 1. Permian Hutien Limestone
- 2-3. Jurassic Coal Series
- 2. Black Shales with Coal Seams
- 3. Coarse Sandstone with Shale Intercalations



found the sandstone again replaced by a series of black shale which comes directly upon the Permian limestones (fig. 6). To the north-east of the Kenkou section the replacement of the basal conglomerate by the sandstone as observed to the south-west also occurs (figs. 7-8).

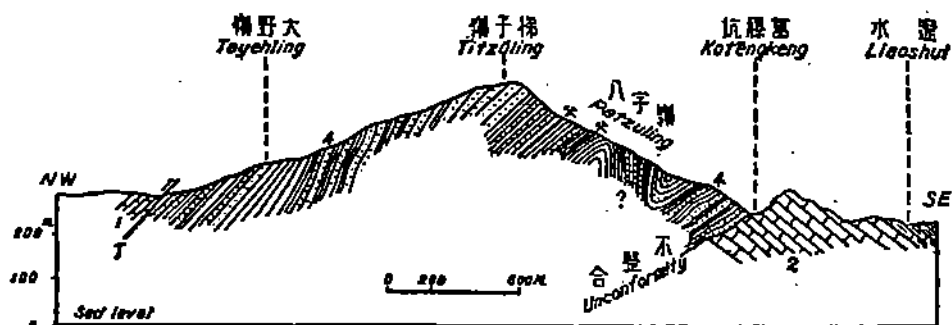


Fig. 7. Section from Kuchutsun to Patzuling

- 1-2. Lower Carboniferous 1. Mengkungao Limestone 2. Tzemenchiao Limestone 3. Permian Shuitungli Limestone 4. Jurassic Coal Series 7. Thrust.

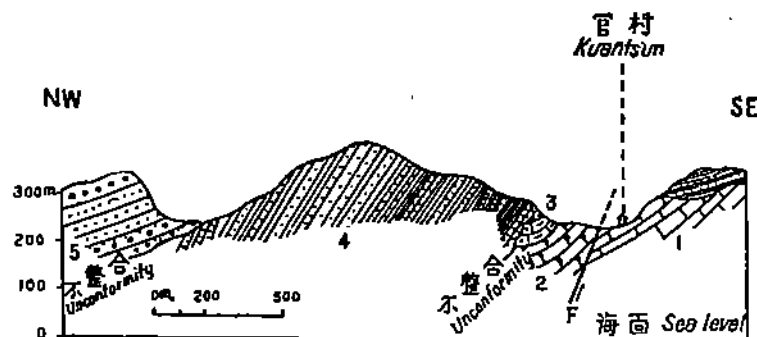


Fig. 8. Section from Kuantsun to Changchia

1. Tzemenchiao Limestone 2. Hutien Limestone 3. Shuitungli Limestone 4. Jurassic coal series 5. Red beds F. Fault.

From the above-shown sections it is very clear that in Hunan a disturbance took place not only before Jurassic time but also after it, since in many sections the Jurassic rocks were also strongly affected by



faultings or sometimes even by local foldings and are again capped unconformably by the Red Beds of most probably Cretaceous age. For the first disturbance I have proposed the term Hunanian instead of the term Kenkou movement and for the second, as it undoubtedly corresponds to Dr. Wong's Yenshan movement<sup>1</sup> and in order to bring the terminology into harmony with the two previous movements, I would prefer to follow Dr. Ting<sup>2</sup> to call it Yenshanian.

### III. THE YENSHANIAN MOVEMENT

In eastern and southern Hunan the Jurassic coal series is unconformably overlain by a series of red beds which range in age most probably from Cretaceous up to Tertiary (see figs. 4 and 8). In other parts of this province where the Jurassic rocks are wanting, these red beds then come to rest unconformably on an erosion surface of different Palaeozoic rocks. It is thus evident that in Hunan the Yenshanian movement not only actually exists but also extends more widely as compared with the two previous movements, although in magnitude it is rather less considerable.

The name Hsiangyuh movement was applied by Lee and Chu<sup>3</sup> to a post Jurassic movement in the boundary region of Hunan-Kwangtung provinces. It is apparently the same as the Yenshanian because to the north-east of Kenkou we found the Jurassic strata unconformably overlain by the Cretaceous-Tertiary red beds as already shown in fig. 8. This section was obviously not observed by these two geologists during their surveying in that region. According to their observations the Jurassic hill along the Hunan-Kwangtung border strikes in the same direction as the Nanling range, namely ENE-WSW. So in the conclusion they suggested that the mountain-building of the latter range was

- 1 W. H. Wong: Crustal movements and igneous activities in E. China since Mesozoic time. Bull. Geol. Soc. China, Vol. VI, 1929, pp. 9-36. and Vol. VIII, 1929, p. 39.
- 2 V. K. Ting: Orogenic movements in China. Bull. Geol. Soc. China, Vol. VIII, 1929, p. 164.
- 3 Y. Y. Lee & S. Chu: Geology of Kenkou on the Hunan-Kwangtung border and its bearing to the orogeny of the Nanling ranges. Bull. Geol. Soc. China, Vol. XIII, No. 2, p. 198.

also due to this movement. But in fact, the Jurassic hill, as a result of intense faults and thrusts, shows different strikes in different parts. So far as we observed, the ENE strike is only true for the middle part between Patzuling and Kuantsung, while in the northeastern part it turns to NE-SW and in the southern part even to N-S with strata dipping NEE. Again in Ichang district between the Nanling range and the Jurassic hill there lies a red basin in which the Red Beds accumulate to a thickness of no less than 700 meters, extending quite up to the Nanling range with a general southern dip at 10 to 15°. In the pass (about 10 miles long and 7 miles wide) across the Nanling range between Ch'enhsien and Ichang, however, no trace of any red beds have so far been found. Were this range built up by the Yenshanian, the absence of any red beds in the pass would admit of no other explanations except that it is due to the result of later erosions or due to the formation of this pass after the deposition of these red beds. Anyhow, there are no evidences toward either the former or the latter case. Furthermore, the Wushui and its tributaries, after deriving their courses from the Nanling range, all flow into deep canyons of the red beds and likewise of the Palæozoic rocks to the south of the red basin. It then clearly indicates that since the deposition of the red beds the Nanling ranges have been uplifted although we can not say with certainty at what time they began to rise.

From the above mentioned facts it is clear that the formation of the Nanling range remains still a problem and needs further researches.

#### IV. THE HENYANGIAN MOVEMENT

In Hunan the so called Red Beds have been divided into two series; the lower is named Henyang red beds and the upper the Tanshih series. Recently in the upper shale part of the latter series we have found plants in association with fishes. According to the determination of plants by Dr. H. C. Sze this series is most probably of Eocene age. If so, the Henyang red beds would be Cretaceous. Along the margin of the red basins the Henyang red beds usually begin with a thick basal conglomerate lying unconformably on the Jurassic or older formations. In many cases

these red beds appear to have been affected to some degree by both folds and faults and sometimes assume a dip of 30-40° as shown in the Henyang red basin along the earth-cuttings of the Yuh-Han railway or of the motor road between Henyang and Leiyang, but in no case do we find the Tanshih series disturbed, this being everywhere only slightly tilted or even horizontal. Besides, there is another evidence to prove the existence of an unconformity between these two series that the basal conglomerate of the Tanshih series contains pebbles of not only Nanyoh granite but also the Henyang red sandstone. So in any case, the occurrence of a movement at the beginning of Eocene or at the end of Cretaceous in Hunan is certain.

Now the question of the age of granite intrusions in Hunan arises. In the central and southern parts of this province the granite is very widespread and usually builds up lofty mountains. According to their different constituents we have distinguished the Nanyoh granite and the Nanling granite. So far as we observed, the former granite intruded only into the Permian limestone and the latter even only into the Carboniferous rocks, the Red Beds being never affected by these intrusions. It then seems that in Hunan the intrusions took place before the Red Beds. On the other hand, we have a conflicting fact: observations made in the basal conglomerate of the Henyang red sandstone near the Nanyoh range and on both sides of the Nanling range, reveal no pebbles of any granite although such pebbles are present in the conglomerate of the Tanshih series. For this, we have only one explanation namely, that during the deposition of the Henyang red sandstone the granites were still hidden underneath the sedimentary rocks and they have not been exposed until the deposition of the Tanshih series. From this point of view the granite intrusions in Hunan would most probably be only a little earlier than the deposition of the Henyang sediments, being immediately after the Yenshanian movement. The accumulation of the Red Beds as not less than 700 meters, which dip southward at 10-15° on the southern slopes of the Nanling range, and the young features of the Wushui and its tributaries as now shown in the Red Beds of Ichang are not only further in favor of this view but also indicate that the uplift of the Nanling range continues up to the present.

Whether the granite intrusions in Hunan occurred simultaneously or they might be divided into different phases is another question. So far as we are aware, the Nanyoh and the Nanling granites are different not only in constituents but also in geographical distribution; the former is a biotite granite, occurring only in central and northern Hunan, while the latter, a common granite, limits its distribution only to the southern and eastern parts of this province. Here we have also a fact to be noted that the metallic ore deposits such as wolframite, cassiterite, arsenopyrite etc., so far known in Hunan, all occur in the field of the Nanling granite in some definite successive belts. In the field of the Nanyoh granite, except for some galena and sphalerite-bearing quartz or barite veins, such ores as wolframite etc. are entirely absent. At Nanyohshan proper we further found a younger granite dyke and many albite veins cutting through the Nanyoh granite. We then regard the granite intrusions in Hunan to be at least of two different phases: the first, the Nanyoh granite, intruded most probably at the beginning of Cretaceous and the second, the Nanling granite accompanied with greater development of pneumatolytic minerals, took place most probably at the end of that period. The younger granite dyke as seen in the Nanyoh granite obviously corresponds to the second phase.

In Hunan volcanic rocks are extremely rare or absent. A small exposure of andesite occurring as intrusives in the Henyang red sandstone is seen at Chungkiangpu in Laiyang. This igneous activity is considered to be in connection with the Henyangian movement.

#### SUMMARY OF THE PRINCIPAL OROGENIC MOVEMENTS

From the above description it is clear that in Hunan since Silurian time there were four main orogenic movements, namely the Caledonian, the Hunanian, the Yenshanian and the Henyangian. Of them, the most important is the Caledonian which occurred before Devonian, next are the Hunanian and the Yenshanian of which the former occurred probably at the end of Triassic and the latter probably at the end of Jurassic, and

1. C. Li & S. Chu: Stratigraphy of Environs of Maping City. Bull. Geol. Soc. China, Vol. XIII, No. 2, p. 231.

the last is the Henyangian which took place either at the end of Cretaceous or beginning of Tertiary. After the Henyangian no movements have, however, affected this province in the sense of orogenesis, their effects being limited to tilting and faulting.

As regards the Liukiangian movement noticed by Messrs. C. Li and S. Chu between the Upper Devonian limestone and the Lower Carboniferous Yentze series in the east of Maanshan, north of Lapaoyu, Kwangsi and the Hercynian movement noticed by Loczy in the Nanshan and by Richthofen and others in the Tsingling range, we still have no strong evidences to prove their existence in Hunan.