Summary of Physiography of Manchuria

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1. Outline

At first sight of the general physiography of Manchuria, the mountain systems seem to trend in all directions. Careful observation reveals, however, that the mountain systems can be divided into two regular groups which trend, NE-SW and NW-SE.

The NE-SW trend was named the Sinian direction by R. PUMPELLY in 1866. The mountains along this direction include the Great Khingan Range in the west extending from Jehol Province to Khingan Province, and the Chang-pai Mountains in the east near the border between Manchuria and Korea. The northern extension of the Changpai Mountains constitutes the Wan-ta Mountains which form the axis of Mu-tan-chiang and Tung-an Provinces, and the southern extension forms the backbone range of the Liao-tung Peninsula. In addition to these two great mountain systems, there are the Sa-ha-liang and Lao-chang-kuang-sui-ling Mountains, running west of, and parallel to, the Chang-pai Mountains. They constitute the central mountain region found in Feng-tien and Kirin Provinces. On their west, and also parallel, runs the Ta-hei-shan Mountains along the Chang-chun～Ta-lien Railway. Other mountain systems of the Sinian direction are the Sung-ling, Ta-ching-shan and Ling-yuan Mountains stretching roughly parallel to, and west of, the Feng-shan Railway.

The other trend, NW-SE, was named the Korean direction by Bunjiro KOTO in 1930. This trend is represented by the Small Khingan Range that runs along the Hei-lung-chiang River in the northern part of East Khingan Province and along the border between Hei-ho and Pei-an Provinces. Other mountains of the Korean direction are the Chi-lao-tu and Yen-shan Mountains, running roughly parallel to the Great Wall of China in the southern part of Jehol Province, and the so-called Hei-laio Divide, which is undulating hilly land dividing the Laio-ho and Hei-lung-chiang Rivers.

In the structural geology of Manchuria, there is one notable fact. The Sinian direction roughly coincides with the strikes of formations that constitute the mountains, but the Korean direction is not followed by these mountain ridges. Although

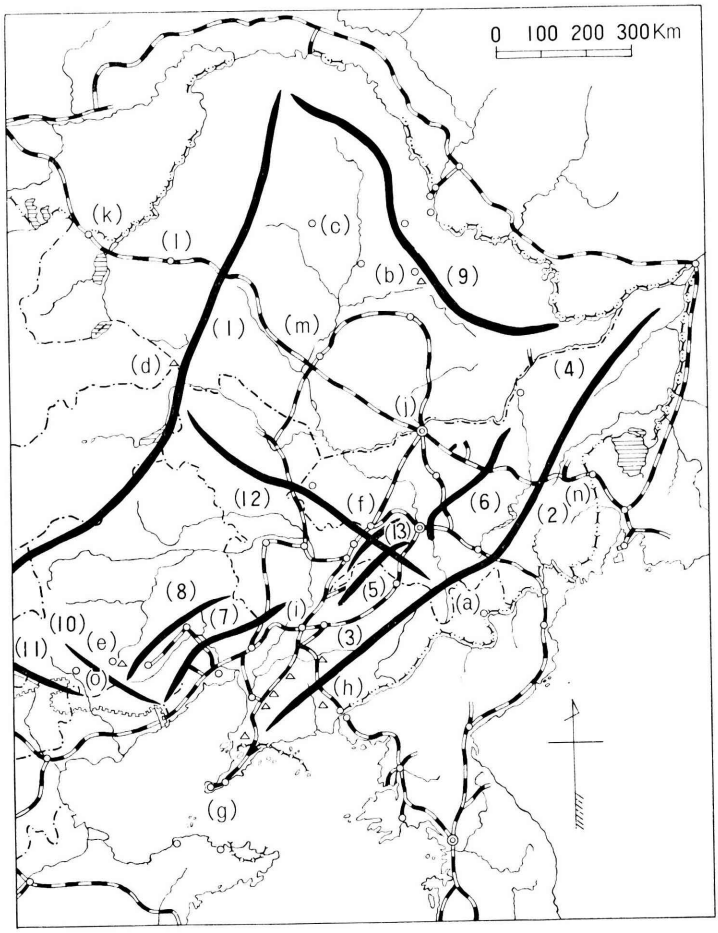

Fig. 1. Outline of Physiography of Manchuria.

1. Great Khingan Range
2. Chang-pai Mountains
3. Backbone mountain range of Liao-tung Peninsula
4. Wan-ta Mountains
5. Sa-ha-liang Mountains
6. Lao-chang-kuang-sui-ling Mountains
7. Sung-ling Range
8. Ling-yuan Range
9. Small Khingan Range
10. Chi-lao-tu-shan Range
11. Yen-shan Range
12. Hei-liao Divide
13. Ta-hei-shan Mountains

a. Pai-tou Volcano
b. Wu-ta-lien-chih Volcanic Group
c. Shatir Volcano
d. Harhin Volcano
e. Wan-pao-shan Volcano
f. Chang-chun
g. Ta-lien
h. An-tung
i. Mukden (Feng-tien)
j. Harbin
k. Man-chou-li
l. Hailar
m. Chi-chi-ha-erh
n. Sui-fen-ho
o. Jehol

the general trend of the mountain systems follows the Korean direction, the ridges have a different trend, NE-SW. This indicates that the formations constituting these ridges strike in the Sinian direction. This is a very important fact in considering the tectonic structure of Manchuria.

Of the above mountain ranges, the Great Khingan Range is remarkable in character. From the train travelling from Man-chou-li to Sui-fen-ho on the China-U.S.S.R. border via Ang-ang-chih and Harbin, one notices the following topography: Between Man-chou-li and Hailar a plateau-like, 500~600 m elevation is predominant, but advancing eastward the altitude increases gradually, finally attaining 900 m above sea level at Khingan, a station located in the Great Khingan Range. Farther east, the railroad runs down a steep slope and reaches Nien-tzu-shan where the altitude is 300 m, and then enters the great plain drained by the Nen-chiang and Sungari Rivers. Ang-ang-chih, An-ta and Harbin are the cities scattered in this vast plain. Eastward from the vicinity of I-mien-po the altitude begins to increase again, as in the passage over the Great Khingan Range. West of Heng-tao-ho-tzu, the railroad crosses the Lao-chang-kuang-sui-ling Mountains, and near Hai-lin enters a basin 200 m above sea level. Toward the end of this basin the altitude rises for the third time and reaches about 600 m in the vicinity of Mu-leng, then gradually drops eastward down to a basin 300 m above sea level. At Tai-ping-ling, an increase in altitude is noticed for the fourth time. The railroad crosses another basin east of Tai-ping-ling, and nears the station of Sui-fen-ho where the elevation is recorded at 400 m. East of the station lies a lowland.

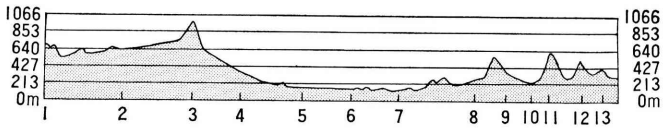

Fig. 2. Outline of the Physiographic Profile along the Pin-chou and Pin-sui Lines.

1. Man-chou-li 2. Hailar 3. Khingan 4. Nien-tzu-shan
5. Ang-ang-chih 6. An-ta 7. Harbin 8. I-mien-po
9. Heng-tao-ho-tzu 10. Hai-lin 11. Mu-leng 12. Tai-ping-ling
13. Sui-fen-ho

The topographic features seen along the North Manchurian Railway in the east-west section are found also in the southern part of Manchuria. Consequently, the Great Khingan Range is suitably named only when viewed from the east. When viewed from the west, the range appears to be no more than hilly land rising from a plateau.

According to F. von RICHTHOFEN, the above characteristic topography of Manchuria can be explained by assuming the presence of three great faults running NE-SW. When this assumption is applied to the physiographical facts presently known, a close similarity will be noticed between Manchuria and northern apan. TheJ Mongolian block and the Manchurian block are bounded on the east

by the Great Khingan Range and the Chang-pai Mountains, respectively, and the slopes of both ranges are gentle on the west and steep on the east. Thus, his view is quite reasonable from the standpoint of modern physiography, too.

Khingan Province and part of Jehol Province are in the plateau-like hilly land on the west slope of the Great Khingan Range. The region, dotted with sand dunes and grassland covered by aeolian sand, serves as grazing land. Salt lakes and vanishing rivers are found everywhere. There are two large lakes, Dalai (or Hu-lun) Lake and Bayer Lake. The water-storage area of the former lake is 300～400 km², half the area of the latter. The depth of water is 9 m in both lakes.

The area between the eastern foot of the Great Khingan Range and the Chang-chun～Ta-lien Railway is a plain of unlimited expanse, drained by three large rivers, the Nen-chiang, Sung-hua-chiang (Sungari) and Liao-ho. This great plain abounds in salt lakes and alkali earth. A chain of rolling hills stretches NW-SE in the center of the plain, and constitutes a divide separating the Hei-lung-chiang and Liao-ho River systems. This divide was named the Hei-liao Divide by Kunitaro NIINOMY. According to NIINOMY, the Hei-laio Divide was formed after the Pleistocene Epoch of the Quaternary Period, and by this divide the Nen-chiang and Liao-ho Rivers, which were previously one, were formed; the former became the Sung-hua-chiang River in the lower reaches and, joining the Mu-tan-chiang, flowed into the Hei-lung-chiang, the latter, after joining such tributaries as the Ching-ho, Hun-ho and Tai-tzu-ho, finally reached Po Hai (Gulf of Chihli). However, some geologists hold the opionion that the Liao-ho, not the Nen-chiang, was the upper stream of the Sung-hua-chiang.

Surrounded by the Sa-ha-liang Mountains, Lao-chang-kuang-sui-ling Mountains and Chang-pai Mountains there are two plains, one along the Feng-chi Railway that connects Feng-tien, Hai-lung and Chi-lin, and the other along the Mu-tan-chiang River, including the Ching-po Lake area. Both plains are fertile and good crops of rice and corn are cultivated there.

In eastern Manchuria and Tung-pien-tao, the slopes of the Wan-ta and Chang-pai Mountains form a plateau and are covered with dense virgin forests.

The physiography of the Small Khingan Range requires some comment. The axis of the range is composed of granite gneiss and basalt, and the northern and southern flanks consist of three to four terraces composed of Pleistocene gravel. This suggests that the flanks of the range were uplifted at least three or four times since the Pleistocene. A similar feature is noticed on the slopes of the Great Khingan Range also.

Volcanoes are scarce in Manchuria, and yet about 17 groups of volcanoes are known. Of them, the most noticeable is Mt. Pai-tou-shan (Chang-pai-shan), which is a dormant volcano rising on the Korea-Manchuria border. With an elevation of 2,751 m and an area of about 1,400 km², this volcano is indeed a *dominant* figure of the Chang-pai Mountains.

The Wu-ta-lien-chih volcanic group is also worth mentioning. It consists of fourteen truncated-conical homate-type volcanoes that are aligned NE-SW in three

rows, about 100 km east of Nen-chiang City in Lung-chiang Province. They are not high, the highest (Lae-hei-shan) being only 500 m or so, but standing side by side on a vast plain in northern Manchuria, they provide a spectacular sight. Similar homate-type volcanoes are found in the northern part of Lung-chiang Province, in the central part of Hei-lung-chiang Province, in the lower drainage area of the Sung-hua-chiang and other districts. Prominent ones are I-chia-shan on the southern bank of the Hei-lung-chiang River and Erh-ko-shan in the vicinity of Ko-tung-hsien-cheng, Lung-chiang Province.

Further remarkable topography related to volcanic activity is displayed by mesas composed of basalt lava flows. Tremendous flows of basalt lava form the Pai-tou volcanic group covered the ground, and the mesas came into existence when the ground was uplifted, or was subjected to intense weathering, leaving behind only the resistant portion of lava. Such basalt mesas are found in the neighborhood of the Pai-tou volcanic group and along the railroad between Tu-men and Chia-mu-ssu.

Rivers in Manchuria usually have a gentle gradient. Although rapids are found in such mountainous regions as Tung-pien-tao. The Great Khingan Range and the Jehol mountainland, the streams become very gentle as soon as they leave the mountains and enter the flat alluvial plains. The gradient is as small as 1/10,000 in some areas. As a consequence, these rivers meander greatly and are accompanied by numerous crescent-shaped or oxbow lakes and broad swamps. Meandering is especially remarkable in the Tao-li-ho, A-pu-hsin-ho, Chi-hu-lin-ho, Mu-leng-ho and Hei-lung-chiang Rivers in the lower reaches of Sung-hua-chiang, all along the China-U.S.S.R border, and in the Argun and San-ho Rivers.

2. Physiography of Northwestern Manchuria

What is called northwestern Manchuria here is the area occupied by the former North Khingan Province and was known in olden times as Barga or Hulunbayer. It is a plateau region west of the watershed of the Great Khingan Range.

The Great Khingan Range stretches NNE-SSW with an elevation of 1,100～1,400 m. Some peaks constituting the divide are 1,500 to 1,600 m or more above sea level. The elevation gradually diminishes westward. It is 1,100 m in the upper reaches of the Weatho, I-na-ho and I-min-ho Rivers, but it increases again southward and reaches 1,300 m in the upper reaches of the Ha-la-ha River where high peaks occur in groups. The western margin of the mountainous zone is composed of hilly land, 800～900 m in elevation, which ends in land of gentle relief covered with aeolian sand.

The area between the right bank of the I-min-ho and west of the Wu-erh-sun-ho across the Hui-ho River is part of the so-called Mongolian plateau, and is 600～800 m in elevation. The area, showing a gentle undulation, is a semi-desert waste land covered by aeolian sand with sporadic grassland, and is suitable only for nomads. Along the right bank of the Hailar River in the north, an undulating

plateau has developed. Similar to the above area, this plateau is a semi-desert dry land heavily covered with aeolian sand. Its elevation is 600～700 m. Going eastward from the left bank of the Tuenebe River the area becomes mountainous by degrees. To the north it is demarcated by a roughly east-west line passing through the lower reaches of the Mo-erh-ko-ho River and Tou-chan, and adjoins the northern mountainland. Except for the previously mentioned sand dune area, northwestern Manchuria is hilly land stretching away from the northern Great Khingan Range, and as the elevation increases northward the hilly land changes to somewhat rugged mountainland.

Almost all rivers belong to the Hei-lung-chiang water system. The Argun River and its upper stream the Hailar River, are the principal ones. The Hailar River begins in the Great Khingan Range and flows westward joining many small streams; then it meets the Dja-tun River at Ya-ko-shih and the Tuenebe River in the vicinity of Dja-la-mu-teh. Near Hailar, the river is joined by the I-min-ho, and by the Morkoho (Mo-erh-ko-lo-ho) River north of Wu-ko-no-erh. Downstream of Ho-lo-huang-te, the Hailar River meanders in an S shape and turns northeastward north of Dja-lai-no-erh. Downstream from Abagadz, the river is called the Argun and forms the border between Manchuria and the U.S.S.R. The Ken, Te-erh-pu-erh and Ha-wu-erh Rivers flowing through the San-ho district are tributaries of the Argun River.

A tributary of the Ha-la-ha River flows along the southern nationl border and drains the arid land before it pours into Bayer Lake. Another tributary flows directly into the Wu-erh-sun River. The Wu-erh-sun-ho coming out of Bayer Lake, is joined by the Kerlen (Ko-lu-lun) River which originates in the Kento (Keng-teh) Mountains in Outer Mongolia and flows eastward; after draining the southwestern part of the Barga plateau it flows into Dalai Lake.

The Moutonaya River, between Dalai Lake and the Argun River, seems to flow toward Dalai Lake. Consequently, the Dalai and Bayer Lakes may be called inland lakes under these circumstances. The water-storage area of Dalai Lake is 1,100 km² or more; the lake is 100 km long and 40 km wide, with a depth of 6～9 m, the lake is 545 m above sea level. Bayer Lake has an area of 600～700 km², is 50 km long and 30 km wide, and is situated 660 m above sea level.

Besides the above two large lakes, many smaller ones are found in the area east of Kan-chu-erh-miao. Some are salt and soda lakes, yielding natural salt and soda.

3. Physiography of Northern Manchuria

What is called northern Manchuria here consists of former East Khingan, South Khingan, Lung-chiang and Hei-ho Provinces and part of Pin-chiang Province. This region is bounded on the west by the Great Khingan Range stretching NE-SW, and on the north to northeast by the Small Khingan Range. Between the two ranges spreads a vast plain with Chi-chi-ha-erh in the center.

Important rivers are the Hei-lung-chiang and the Nen-chiang; the former flows along the Manchuria-U.S.S.R. border roughly parallel to the Small Khingan Range. Except the water system of Hei-lung-chiang, other rivers flow toward the great plain on the slopes of the Great and Small Khingan Ranges. The Nen-chiang River irrigates approximately the central part of great plain. Small volcanoes are scattered in the southwestern part of the Small Khingan Range. An arid topography is found in an area between Tao-nan and Tu-chuan, as well as in part of the plain.

The Great Khingan Range is 1,000 to 1,600 m above sea level, and the height gradually decreases toward the great plain in the east. Several terraces are observed on its slope. The part between Ying-chi-erh-ko-chi-ta-ling and Ta-hsing-an-ling is a ridge of almost uniform height at 1,200～1,300 m, and the slope between this ridge and the flat terrace surface, about 250 m in elevation facing the great plain, can be divided into four terraces at altitudes of 900～1,000 m, 600～700 m, 500～600 m and 350～450 m. This stepped topography may be partly attributed to upheaval of the piedmont area and partly to the development of step faults. These movements may have taken place in a period corresponding to the Nan-ling stage, i.e., Oligocene～Miocene in age.

In northern Manchuria, the northwestern end of the Small Khingan Range adjoins the northern tip of the Great Khingan Range. The Small Khingan range stretches NW-SE and forms the northern boundary of the great plain. It also extends along the Hei-lung-chiang River and serves as a divide, separating this river from the Nen-chiang and Sung-hua-chiang Rivers. Its elevation is generally around 1,000 m. The northwestern part, where older rocks are exposed, is somewhat higher but the altitude decreases toward the central part which is a plateau consisting of Pleistocene formations and basaltic lava flows. The elevation increases again in the southwestern part where formations of older rocks seem to follow an approximately NE-SW direction.

The tableland which consists of the Small Khingan Range stands from the great plain in North Manchuria and the altitude of its marginal part is estimated to be 300 $m^{\pm}$, then it increases gradually and attains 500～800 m in the vicinity of the divide. From these, the altitude changes more or less toward the bank of the Hei-lung-chiang River where it is estimated to be about 400 m. Thus, the Small Khingan Range is a continuation of the low undulating hilly topography; in the southern part where the valleys are shallow and slopes are gentle, its relative height from the great plain is estimated to be 40～60 m. On the contrary, in the northern part, the slopes are relatively steep and the relative height is estimated to be 100 m or more.

A "verebene" (level plane) 300 m in elevation has developed well along the Hei-lung-chiang River. This is probably a terrace formed by the river, but its boundary with a Pleistocene plateau that constitutes the main body of the range is not distinct. That is, the terrace grades into the plateau.

Many small volcanoes are found in the northwestern part of the Small Khingan

Range, especially into the west of Lung-chen in the vicinity of Mergen and to its north and west. Volcanic topography is found also on the eastern slope of the Great Khingan Range. Of these volcanoes, notable ones are as follows:

Wu-ta-lien-chih volcanoes (Wu-yun-ho-erh-tung-chi volcanic group), located at long. 125°0′ to 37′ E and lat. 48°40′ to 50′ N.

Chien-shan volcano, located at long. 124°4′ E and lat. 48°27′ N.

Erh-ko-shan, at long. 126°18′ E and lat. 48°3′ N.

Ko-lo-nan-shan volcanic group, scattered around long. 125°13.5′ E and lat. 49°13.5′ N.

Volcanic group along the Kung-pie-la-ho River.

Santir volcanic group, consisting of eight volcanoes aligned in a southwest direction 160 km northwest of Mergen, where the No-min-ho River turns abruptly south.

I-chia-shan, long. 127°40′ E and lat. 49°42′ N, about 40 km southeast of Ai-gun.

In addition to the above, there is Lake Onenor, which is a crater lake. It is located at long. 121°17′ E and lat. 47°34.5′ N, near the confluence of the Chai and Cho-erh-ho Rivers on the eastern slope of the Great Khingan Range.

All the above volcanoes are composed chiefly of basaltic lava flow. Since the lava flows cover the Pleistocene deposits, the volcanoes must have formed in a period extending from late Pleistocene to early Alluvium. Some volcanoes, such as the Huo-shao-shan and Chien-jen-shan of the Wu-ta-lien-chih volcanic group, have a record of eruption in 1720, but all the volcanoes are either dormant or extinct now.

A great plain stretches on the east and west sides of the Nen-chiang River south of Pu-hsi. It is a semi-desert steppe, with nothing whatever to obstruct the view. Careful observation reveals, however, that the plain undulates with low sand dunes and shallow depressions of aeolian origin. Many of the depressions are filled with water forming so-called playa lakes.

Major rivers in northern Manchuria are the Hei-lung-chiang flowing along the Manchuria-U.S.S.R. border, the Nen-chiang rising in the Great Khingan Range and draining the great plain, and the Hu-lan-ho that originates in the Small Khingan Range and flows southward to join the Sung-hua-chiang east of Harbin.

In the upper reaches the Hei-lung-chiang is known as the Argun River flowing west of the Great Khingan Range. After joining the Onon River it changes course at right angles and flows eastward. It continues round the north side of the Small Khingan Range and proceeds southeastward parallel to the range. From the vicinity of its confluence with the Sung-hua-chiang River, the Hei-lung-chiang turns northeast and flows through Maritime Province of Siberia until it empties into the Heilung Strait in the neighborhood of Nikolayevsk. The course of the river shows two principal trends, one northeastward and the other southeastward, corresponding respectively to the "Sinian direction" and the "Korean direction" that control the geologic structures of East Asia. Important tributaries of the Hei-lung-chiang are the Kung-pie-la-ho, the Puerhmandinhe and the Sung-pi-la-ho.

The Nen-chiang River rises in the east at the northern end of the Great Khingan Range, flows approximately southward, drains the great plain with Chi-chi-ha-erh at the center and joins the Sung-hua-chiang to flow northeastward. It was believed that the Nen-chiang in ancient days had been one with the Liao-ho River and flowed into the Po Hai (Gulf of Chihli), but a recent investigation indicates that it was one with the Zeya River until the Small Khingan Range came into existence. The water system of the Nen-chiang has a dendritic pattern, consisting of a large number of small streams coming from the Great and Small Khingan Ranges. Of these tributaries, notable ones are the Nomorho (No-mo-erh-ho) River rising in the Small Khingan Range, the Kan-ho, No-min-ho, A-lun-ho, Yin-ho, Cho-erh-ho and Tao-erh-ho, all from the Great Khingan Range.

The Hu-lan-ho comes from the southern slope of the Small Khingan Range, the area centering around Tien-shan-pao, and flows west or southwest to join the Tung-ken-ho; then it turns south and southeast, passes through Hu-lan and flows into the Sung-hua-chiang at Harbin. Besides the Tung-ken-ho, the Hei-ni-ho is also a tributary of this river.

In addition, there are vanishing rivers that rise from the slopes or feet of the Great and Small Khingan Ranges and disappear into the great plain or end in basins in the marginal areas of the mountains. Of them, the Hu-yu-erh-ho, Shuang-yang-ho, A-li-ko-tu-ho, Holen and Urgen Rivers are well known.

4. Physiography of Northeastern Manchuria

The region includes the former San-chiang Province, Mu-tan-chiang Province, Pin-chiang Province and part of Tung-hua Province.

Immature peneplains of early Neogene Tertiary age and roughly contemporaneous basalt plateaus constitute the original topographic features of northeastern Manchuria. The present physiographies represent the processes of eroision that began on the original topographic features.

The greater part of the region belongs to the northern Chang-pai-shan mountain system, comprising a number of mountain ranges aligned in the so-called Sinian direction. It is obvious that the principal plateaus also stretch in this direction.

Examining the relief, one notices the following: Elevation exceeding 1,000 m are restricted to the Lao-chang-kuang-sui-ling Mountains, the Chang-pai Mountains and to the southeastern mountainous region where the highest peak, 1,566 m, of the Pan-ling Range is found The zonal arrangement of mountains and lowlands in the Sinian direction is remarkable, and the following seven zones are found: From northwest to southeast, (1) a central great plain, (2) the Small Khingan Range, (3) a plain along the lower course of the Sung-hua-chiang River and a lowland between Tung-pin and the Wu-chi-mi-ho River, (4) from the A-erh-ha-wo Mountains to the Lao-chang-kuang-sui-ling Mountains, (5) a lowland along the Tao-li-ho River, another around Po-li and still another stretching

from Ning-an to Tun-hua via the Ching-po Lake, (6) Wang-ta and Chang-pai Mountains, (7) the southeastern mountainous region.

Such a relief pattern is, of course, due to crustal movements in the region, but differential erosion resulting from the geologic structure also accounts for the characteristics of the present-day topography. For example, the lowlands (3) are composed of soft Tertiary deposits, whereas the lowlands (5) are made of Mesozoic sandstone.

Most rivers in the region belong to the Hei-lung-chiang water system. Only two rivers in the southeastern part, Sui-fen-ho and Tu-men-chiang, gather water in relatively small areas and empty directly into the Sea of Japan. The Hei-lung-chiang bounds the northern limit of the region and has two large tributaries, Sung-hua-chiang and Wu-su-li-chiang. The Sung-hua-chiang drains the western part of the region, with the Mu-tan-chiang as a tributary. The Wu-su-li-chiang flows on the Manchuria-U.S.S.R. border and, after joining the Mu-leng-ho and Tao-li-ho, empties into the Hei-lung-chiang. Major lakes are Ching-po-hu and Hsing-kai-hu.

The southeastern mountainous region stretches from the vicinity of Hsing-kai-lu to Chien-tao, and belongs to the late young stage of erosion and basaltic plateaus are extensively distributed within these mountainous land. The land consists of mountain ranges elongated in the Sinian direction. Of these ranges, a most remarkable one extends from the northwest of Hsing-kai-hu to the drainage area of the Ka-ya-ho, passing through Tai-ping-ling and running along the Pin-sui railroad; its height is recorded at 1,100 m northeast of Tai-ping-ling and over 1,000 m north of Lo-tzu-kou.

The Chang-pai Mountains extend from the southwest and enter the region, and are called the Ha-erh-pa-ling Range, which gradually decreases in elevation northeastward and finally disappears under basalt. The elevation near Ha-erh-pa-ling is about 1,000 m.

The Wan-ta Mountains begin to rise in the northeast of Tai-ma-kou and extend northeastward. At Hsiao-chia-chi, they are cut by the Tao-li-ho, but extension across the river forms a small massif. The range is demarcated by the north-flowing Wu-su-li-chiang. On the whole, the Wan-ta Mountains are of a late young to early mature stage, seldom exceeding 800 m in elevation, but they present a unique topography contrasting with the surrounding lowlands.

The Lao-chang-kuang-sui-ling Mountains coming from the southwest extend south of San-hsing, via Chang-kuang-sui-ling and Kao-ling-tzu. In general, elevation exceeds 1,000 m, the highest peak southwest of Kao-ling-tzu being 1,438 m. It is most likely that the ancient monadnocks that survived the Tertiary peneplanation have been uplifted to form the rugged mountain range of today.

The A-erh-ha-wo mountain range starts from the east of San-hsing and stretches roughly east-northeast until disappearing in the plain. As separate remnants of the range are sporadically found in the plain, the total extension of the range can be estimated.

The volcanic topography of the region is represented by basalt plateaus and lava flows, but in spite of their extensive distribution the location of vents has not been determined yet.

Basalts of this region are divided into three groups according to the age of eruption; older basalt (late Cretaceous), middle basalt (Neogene Tertiary) and younger basalt (late Tertiary to early Pleistocene). Eruption of the older basalt took place before the peneplains were formed, so that the original features were completely destroyed. Therefore, the latter two groups constitute the volcanic topography of the region. The middle basalt is most important, forming extensive plateaus. The younger basalt occurs as lava flows, filling valleys here and there.

Notable basalt plateaus are the following: (1) A plateau south of Tung-ning, stretching 80 km east-west and 70 km north-south over the Manchuria-U.S.S.R. border. (2) A plateau west of Mu-leng-wo-chi-ling, which stretches from the vicinity of Pan-chieh-ho through Tai-ping-ling to as far as the vicinity of Li-shu-chen. (3) A broad plateau spreading from the vicinity of Hsia-cheng-tzu to the east bank of the Mu-tan-chiang via the upper reaches of the Mu-ling-ho. (4) A plateau south of Lao-sung-ling, stretching from the vicinity of Ching-po-hu to Tun-hua; another along the Ka-ya-ho River. (5) One around Hsiao-shih-tou-ho-tzu of Hua-chuan Prefecture, and another east of Yung-feng-chen of the same prefecture.

Of the lava flows, a most remarkable one is found to come down a valley west of Ching-po-hu to enter the valley of the Mu-tan-chiang and extend farther downstream. It has a total extension of about 80 km and a maximum width of 10 km. On its way, this lava flow created three lakes by damming, the Pei-hu, Yu-chuan-hu and Ching-po-hu.

Ching-po-hu Lake was formed when the main stream of the Mu-tan-chiang was dammed by the lava flow. It is located about 50 km southwest of Ning-an, and has an elongated S-shape. The lake is about 300 m above sea level. The lake has an outlet in the north, known as the Tiao-shui-lo waterfalls, with a height of 20 m. Another remarkable lava flow is found near Tun-hua, filling the main valley and branch valleys of the Mu-tan-chiang.

Hills are found in the following areas: (1) Between Harbin and Ping-hsien, (2) in the lower reaches of the Mu-tan-chiang between Hsiao-lo-la-mi and San-hsing and (3) along the Wo-ken-ho River.

The hills of area (1) are about 200 m high, their tops forming a very flat plane. There is another level plane 20 m below the top. The upper plane was formed by deposition, probably in the Upper Pleistocene period. The lower plane is an erosion plane of the river terrace that was formed perhaps by the main and branch streams of the Mu-tan-chiang.

The mountain ranges of northeastern Manchuria are elongated in the Sinian direction, with lowlands in between which also stretch in the Sinian direction.

Significant plains are found in the lower reaches of the Sung-hua-chiang and around Hsing-kai-hu Lake. The plain along the Sung-hua-chiang River has the

shape of a parallelogram, stretching east-west and northeast-southwest. Its northwestern side is bounded by the southeastern edge of the Small Khingan Range, the south side by the line connecting Chia-mu-ssu and Hsia-chia-chi, and the southeast and north sides fall within the territory of the U.S.S.R. This plain, 50 m above sea level, is penetrated by the Hei-lung-chiang which is joined by the Sung-hua-chiang and Wu-su-li-chiang. It is a vast plain and with great development of swamps and marshes. Near the southern end of the plain, small hilly blocks having an "Inselberg" appearance are scattered.

Between the lower reaches of the Mu-ling-ho and Hsing-kai-hu Lake there is an extensive alluvial plain. Hsing-kai-hu Lake, situated in the southern part of this plain, is the source of the Wu-su-li-chiang which consists of the waters of the Sung-ho, Cha-ho, Hsiao-mu-ling-ho, Mu-ling-ho, Chi-hu-lin-ho and A-pu-hsin-ho Rivers, and flows northward to serve as a boundary between Manchuria and U.S.S.R.

Besides the Wu-su-li, important rivers of the region are the Tu-men-chiang, Sui-fen-ho, Mu-tan-chiang, Wo-ken-ho and Sung-hua-chiang.

The Tu-men-chiang flows on the Manchuria-U.S.S.R. border and empties into the Sea of Japan. It originates in the vicinity of Pai-tou-shan and flows north-northeast. After passing Musan, the river curves until it reaches Hoeryŏng, then flows northward passing Tu-men. Subsequently it turns east again and at Hsun-chieh turns east-southeast and empties into the sea. The total length of the Tu-men-chiang is 520 km and the drainage area exceeds 41,000 km^2. The major tributaries are the Ka-ya-ho and the Hun-chun-ho.

The Sui-fen-ho in the upper reaches splits into the Ta-sui-fen-ho and the Hsiao-sui-fen-ho; the former rises southeast of Lo-tzu-kou and the latter from north of the town of Sui-fen-ho, and they come together west of Tung-ning and enter the territory of the U.S.S.R. to empty into Amur Bay. The drainage area exceeds 17,000 km^2.

The Mu-tan-chiang is one of the largest tributaries of the Sung-hua-chiang. It rises in the vicinity of Chuang-nien-shan south of Tun-hua, and flows roughly northward to enter Ching-po-hu Lake. It then passes through the town of Mu-tan-chiang and the vicinity of Ning-an and flows farther north to join the Sung-hua-chiang in the vicinity of San-hsing.

The Wo-ken-ho begins in A-erh-ha-wo-chi-ling. It flows first approximately south until reaching Tao-shan of Po-li Prefecture, then turns abruptly northwest. After collecting the waters of the Chi-hu-li and Pa-hu-li Rivers it flows west and joins the Su-mu-ho. Then it turns northwest again and flows into the Sung-hua-chiang at San-hsing.

The Sung-hua-chiang flows from Tien-chih Lake on Mt. Pai-tou-shan. In the upstream area of Hua-shu-lin-tzu it joins the Hui-fa-ho coming from the west and, after great winding, is joined by the La-fa-ho. Then it flows northwestward, passes through the Chi-lin provincial castle, traverses the Harbin~Chang-chun railroad at Sung-hua-chiang Station, is joined by the I-tung-ho on the left bank,

flows still northwestward along the west side of Po-tu-na and joins the Nen-chiang. After that, the river becomes much larger in both width and quantity of water before reaching Harbin. It begins to have broad alluvial plains after passing through Chi-lin. After joining the Nen-chiang, meandering also becomes conspicuous. In the vicinity of Harbin numerous distributaries and sand bars are found. Downstream from Harbin, the river is joined by the A-shih-ho on the right bank and later by the Hu-lan-ho on the left.

In the neighborhood of Lao-shan-tou the Sung-hua-chiang turns east and flows east of Tung-ho where it changes course to the northeast. At San-hsing, it is joined by the Mu-tan-chiang and the Wo-ken-ho, and flows toward Tang-ho. From Tang-ho downstream the river flows through a vast plain, and freely meandering on a large scale goes east-northeast reaching Tung-chiang where it flows into the main stream of the Hei-lung-chiang. All through the lower course the river is dotted with sand bars; swamps are frequent on both banks of the river.

5. Physiography of Southeastern Manchuria

The backbone range of the Liao-tung Peninsula has a NE-SW trend, in the so-called Sinian direction. In this area, granite, gneiss and quartzite are predominant. The Ta-ho-shang-shan series of the Sinian system is widely exposed in the basal and marginal parts of the peninsula. Older Paleozoic formations are developed relatively well in the western part. Mesozoic formations and terrace deposits are sporadically distributed throughout the area.

In the Liao-tung Peninsula, erosion surfaces are well developed. The level plane that was regarded as the final form of these erosion surfaces was once called the Liao-tung peneplain. Discontinuous peaks are found as monadnocks in this peneplain. The highest peak is Mien-yang-ting-tzu-shan, 1,061 m above sea level, in the central part of the peninsula. Few other peaks exceed 1,000 m.

Zenkyo IMAMURA and Sadajiro TSUCHIDA made a detailed analysis of this Liao-tung peneplain and divided it into three level planes, the Pi-tzu-wo, Kuang-ning-ssu and Ping-shan. In the Liao-tung Peninsula, the Ai-chuan level plane comes below the Pi-tzu-wo plane, and the Ta-ho-shang-shan monadnock remains on the Ping-shan plane.

The Pi-tzu-wo plane, 20~50 m above sea level, is developed in the eastern part of the peninsula with Pi-tzu-wo as its center. It is traceable east, west and north of the area, is very flat and where it faces the sea looks like a marine terrace. The boundary of this plane with the Kuang-ning-ssu plane is distinct, especially between Liang-chia-tien station and Tsan-chang-tien station on the railroad from Chin-chou to Pi-tzu-wo.

The Ai-chuan plane, less than 10 m above sea level, is found in various parts of the Pi-tzu-wo peneplain, mostly along the sea coast. This is a flood plain, dotted with salt fields, salt swamps, sandy plains and cultivated fields. Its typical development is seen in the village of Ai-chuan northwest of Chin-chou station.

The Kuang-ning-ssu plane occupies the greater part of the central area, and broadly extends in a NNE-SSW direction. It is 120 to 200 m above sea level, and is typically developed in the vicinity of Kuang-ning-ssu plane has a horizontal skyline.

The Ping-shan plane is found only as sporadic remnants 300～400 m above sea level. It is represented by the flat-topped Ping-shan hill north of Chin-chou station.

The Ta-ho-shang-shan monadnock, rising 340 m above the Ping-shan plane, was already a monadnock when the Ping-shan plane was completed.

The above three planes are easily seen along the railroad from Ta-lien to Chang-chun in the north, at least as far as the vicinity of Wa-fang-tien. Of them, the Kuang-ning-ssu plane is traceable farther north.

These level planes are also seen around the Wu-hu-tsui coal field in Fu-chou. The hills surrounding the coal field correspond to the Pi-tzu-wo plane. The top of the Pai-shan hill correlates with the Kuang-ning-ssu plane, and the top of the Tai-shan hill with the Ping-shan plane. The Ai-chuan plane occurs as broad salt swamps around Wu-hu-tsui.

Also in the An-tung area at the base of the Liao-tung Peninsula, level planes are well developed. Along the north bank of the Ya-lu-chiang River from An-tung to Feng-shan, monadnocks 760～800 m in elevation are found. In this area the Ping-shan plane occurs at an elevation of 360～440 m, which is 40 m higher than that in the central area of the peninsula. The Kuang-ning-ssu plane, 120～200 m in elevation, is extensively developed and well preserved. The Pi-tzu-wo plane is 10～14 m in elevation. The Ai-chuan plane of 10 m elevation is also seen, though on a much smaller scale.

Described thus far are the level planes in the border areas of southeastern Manchuria. Turning inland, one finds the Chang-pai Mountains most outstanding. This is a mountain range separating Manchuria from Korea and stands opposite the Great Khingan Range to the north across the Sung-hua-chiang. From this range the Wan-ta Mountains fork out to the northeast and the divide to the southwest forming the backbone range of the Liao-tung Peninsula and Tung-pien-tao.

The divide range, with Lao-tu-ting-tzu-shan (1,367 m) east of Hsien-chang as the main peak, stretches south-southwest, passes through the vicinity of Lien-shan-kuan on the An-feng Line, and through Ma-tien-ling (720 m) and the prefectural border of Liao-yang and Hsiu-yen, to connect with Tang-mao-tzu-shan (896 m). It then forms the Mien-yang-ting-tzu range that comprises such peaks as Mien-yang-ting-tzu-shan (1,672 m), Tien-chiao-shan (851 m) and I-mien-shan (774 m), and extends into the province of Kuan-tung.

Nearly parallel to, and on the south of the divide range, there is the Kuo-tou-ku range with Kuo-tou-ku-shan (1,041 m) as the main peak. San-chien-tzu-shan (468 m), I-mien-shan and Kao-ling are located in the southwestern extension of this range.

Also parallel to the divide range but to the north are the massif comprising Mu-la-tung-tzu-shan (780 m), Hung-miao-tzu-shan (922 m), Ta-lung-wan-shan (959 m), etc., and farther north stretches the Lao-yen-kang range constituting the backbone of the northern area of South Manchuria. The latter extends from the northeast of Shan-cheng-chen to the vicinity of Tieh-pei-shan east of Ying-pan, and contains Lung-kang-shan (1,065 m), Hsi-ta-ting-shan (948 m), Pei-ta-la-tzu-shan (642 m) and other peaks (600～1,000 m).

Volcanic topography of southeastern Manchuria is represented by Chang-pai-shan, known also as Pai-tou-shan, which is the highest peak in Manchuria. It stands on the Manchuria-Korea border at an elevation of 2,751 m. On the top it has an oval caldera lake, Tien-chih, 11.3 km in circumferance, 3 km east-west, 4 km north-south, with a water depth of 365 m. The lake water flowing out of Ta-men, a barranco, to the north is the source of the Erh-tao-pai-ho, an upper branch of the Sung-hua-chiang. In the middle of the Tertiary period an eruption of basalt occurred in this area, and in the latter part of the period alkali-trachyte erupted to form the main body of Pai-tou-shan. In the early Quaternary Period, a large scale outflow of basalt lava took place, but the lava flowed down northeastward without covering the top of Pai-tou-shan, and formed the so-called Hei-shan basalt plateau.

Other noteworthy volcanoes are Huang-i-shan of the Lung-wan volcanic group, volcanic cones in the neighborhood of I-tung and some hills near Fan-chia-tun.

Hung-i-shan, located at Kuan-tien southwest of the Hei-shan plateau, has a gently sloping cone, is 513 m above sea level and is composed of basalt.

The Lung-wan volcanic group is found in the Lung-kang mountain range that stretches over the two prefectures Chin-chou and Meng-chiang of Tung-hua Province. Seventy-two craters of various sizes are found on the lava plateau, and at least six are crater lakes filled with water. The lakes are 500～1,000 m in diameter. Of them, the Ta-lung-wan Lake and the San-chiao-lung-wan Lake are noteworthy.

In the area (5～15 km across) around I-tung of Chi-lin Province, there are five volcanic cones, Tung-chien-shan in the north, Hsi-chien-shan, Ma-an-shan and Mo-li-ching-shan in the northwest, and Ta-ku-shan in the south. These cones, 270～390 m in elevation, are aligned in a NE-SW direction and are easily recognized on account of their topographic features.

In the neighborhood of Fan-chia-tien are found four hills along the railroad between Kung-chu-ling and Chang-chun; Chien-shan, Ping-ting-shan and Ta-tun-tung-shan on the east side of the railroad, and Ta-tun-ping-ting-shan on the west. These hills are 225～280 m in elevation, have a shield-like shape, are composed of basalt and are aligned in two rows with a NE-SW trend.

Important rivers are the Ya-lu-chiang, Tai-tzu-ho and Hun-ho.

The Ya-lu-chiang is 540 km long. Rising from the western foot of Pai-tou-shan, it flows northeast to southwest along the Manchuria-Korea border, passing

through Chang-pai, Lin-chiang, Chi-an and An-tung. The stream is swift, accompanied by few alluvial plains on both banks and thus entirely different from the rivers of North Manchuria. But downstream from I-chou and Chiu-lien-cheng the stream becomes gentler, and where the river flows through plains it has a braided channel. Finally, the river empties into the northern corner of the Gulf of Korea.

The largest tributary of the Ya-lu-chiang is the Hun-chiang. It rises from the vicinity of the Lao-yeh-ling pass of the Chang-pai Mountains, and passes through Tung-hua Prefecture. From the vicinity of the Huan-jen-hsien Castle it turns south and markedly meanders before being joined by the Pan-la-chiang northeast of Tai-ping-hsiao. It travels a distance of 318 km before joining the Ya-lu-chiang at Hun-chiang-kou.

Other tributaries are the Pu-shih-ho and the Ai-ho; the former has few plains along its banks, but the latter has a large drainage area and flood plains are found in the Feng-huang-cheng area and to the east.

The Tai-tzu-ho is about 170 km long. Rising east of Ping-ting-shan of Pen-chi Prefecture, it flows westward collecting water north of the divide range, and passes through Pen-chi-hu and Liao-yang to enter the plain. Then, with much meandering and distributaries the river flows through the plain and joins the Hun-ho at Hsiao-pei-ho. During its course the river flows through an anticedent valley west of Laio-yang where 100~200 m high cliffs flank the gorge. Its tributaries are the Hsi-ho, Tang-ho and Hsiao-sha-ho.

The Hun-ho begins in Tsao-shih of Hai-lung Prefecture and flows west. East of Ying-pan it is joined by the Su-tzu-ho which rises in the vicinity of Hsing-ching, and flows northwest. Then, passing through Fu-shun and Feng-tien, the Hun-ho enters the great plain of the Liao-ho. From there it turns southwest, and above Hsiao-pei-ho-chen the Li-liao-ho branches off to the southwest. South of Hsiao-pei-ho-chen the Hun-ho combines with the Tai-tzu-ho coming from the east, and flows southwest penetrating the Liao-chung plain, and joins the Liao-ho at San-cha-ho.

In addition to the above rivers, there are the Ta-hun-ho, Pi-li-ho and Teng-sha-ho, all flowing south from the divide and empty into the Yellow Sea.

6. Physiography of the Central Great Plain

The present district contains the great plain which is covered by the water system of the Liao-ho River and is located at the south of the Hei-liao Divide. The great plain may be divided into three as follows: The area that is covered with alluvial deposits and encircles Tung-liao, Shuang-shan and Liao-chung; that at a higher level covered for the most part with sand and loess, comprising the area south of the Silamulun River and also where Kai-lu, Lu-pei and Kai-tung are located; hilly land composed of sand, gravel and loess-like clay in the vicinity of Li-shu west of Kung-chu-ling and Ssu-ping-chieh.

The latter hilly land is the southern end of the flat hilly land found around Harbin in North Manchuria.

In general, however, the great plain is flat land with a somewhat undulating surface, dotted with playa lakes. A semi-desert character is noticed everywherer. The monotony of the topography is broken only by hills rising in the area west of Kai-yuan between Fa-chung-men and Chiu-hsin-hou, and by the volcanic cones in the vicinity of Cheng-chia-tun.

The volcanic cones of the Cheng-chia-tun area are known as Chi-hsing-shan (Seven Stars); they are Po-po-tu-shan, Tung-ha-la-pa-shan and Pei-ha-la-pa-shan in the northeast, all about 300 m in elevation, Nao-pao-shan (170 m) in the southwest, Ta-tu-ko-chi-shan (267 m) and Hsiao-tu-ko-chi-shan (283 m) about 55 km west of Cheng-chia-tun, and Po-li-shan (278 m) 25 km north of Cheng-chia-tun. They are composed of basalt, but at their foot the rock exposure is poor because of a sand cover.

Almost all rivers flowing through this great plain belong to the Ta-liao-ho system, except for the Wurtchaonung River on the east slope of the Great Khingan Range in the west.

The stream below the confluence (San-chiang-kou) of the Tung-liao-ho and the Hsi-liao-ho is called the main stream of the Ta-liao-ho. The Tung-liao-ho begins east of Ta-ko-tsang. The Hsi-liao-ho rises in the Great Khingan Range in Ko-shih-ko-teng Chi of West Khingan Province, and flows eastward as the Wurhshunmur River, flowing through Kai-lu and Pai-yin-tai-lai it reaches Cheng-chia-tun, and turns southeast to join the Tung-liao-ho River at San-chiang-kou. From there the river is called the Ta-liao-ho and flows south, cutting the borders of Chang-tu, Kang-ping and Fa-ku prefectures, and reaches the vicinity of Tieh-ling where it turns southwest to flow through the prefectures of Hsin-min and Liao-chung. At San-cha-ho in the western part of Hai-cheng Prefecture it is joined by the Tai-tzu-ho and flows by Tien-chuang-tai reaching Ying-kou where it empties into the Po Hai (Gulf of Chihli). With a total length of about 1,700 km, the Ta-liao-ho is the largest river in Manchuria. Both meandering and distributaries become obvious south of Hsin-min as the river advances into the great plain, especially so in the area south of San-cha-ho. Large oxbow lakes are scattered east of Tien-chuang-tai.

The Wurhshunmur River rises from the slope of Mt. Pa-yen-wu-lan-feng on the northern border of Pa-lin-tso-i Chi, and flowing southeast is joined by the Puyanatoi and Kuluto Rivers. Then it flows eastward entering A-lu-ko-erh-chin Chi where it combines with the Hokotochiyonon coming from the southeast. Continuing on its eastward course, the river then enters Ta-erh-kan Chi and disappears into sand. Where the river flows through the loess area, some flood plains have developed on both sides.

7. Physiography of Southwestern Manchuria

The region comprises the so-called Jehol mountainland and adjacent areas. From the structural viewpoint, the region can be divided into four parts, the Khingan Range, the Yin-shan Mountains, the Mongolian Plateau and the Jehol Massif.

The Khingan Range corresponds to the southern end of the Great Khingan Range. The main ridge runs through the western part of West Khingan Province to the north of To-lun. The highest peaks are 1,500~1,700 m above sea level. West of Lin-hsi the watershed does not coincide with the highest ridge, but deviates far to the west where the valley-head erosion of the Silamulun River has advanced across the Khingan Range and is already beginning to invade the Mongolian Plateau. The range has generally lower elevation in the north, but stands on the whole between 1,400 m and 1,700 m, except for a peak 1,800 m high northwest of Ching-peng and a 1,910 m peak in the south.

In an east-west cross-section of the range between Ching-peng and Lin-hsi and farther east, it would be seen that the range has a stepped decrease in elevation, from 1,700 m to 1,500 m, to 1,400 m, and then to 1,000 m, until ending in a lowland in the vicinity of Kai-lu.

Topographic features of the Khingan Range suggest a stage of maturity. Creases on the slopes are dense, but the valleys are usually broad. When viewed eastward from the Mongolian Plateau, the top of the range is remarkably flat without any significant relief.

The Yin-shan Mountains at a range extending eastward from Sui-yuan Province of China, and rises in the southwestern corner of Jehol Province of Manchuria. Its height near To-lun is 1,500~1,700 m above sea level. In the Chahar area, the range shows typical old stage topography. The Yin-shan Mountains meet the Khingan Range in the vicinity of To-lun, both showing an abrupt decrease in elevation, by 200~300 m, to the Mongolian Plateau.

The Jehol massif, rectangular in shape, projects eastward from the eastern edge of the Mongolian Plateau, and separates the lowland of Central Manchuria from the North China plain. The massif is bounded on the north by the Silamulun River, on the south by the Great Wall of China and on the east by a narrow coastal plain that stretches NE-SW along the west coast of Liao-tung Bay. It is divided into two parts, the western half and the eastern half.

The western Jehol Massif has steep peaks south and northwest of Cheng-te, but in the western border area it shows a plateau-like topography with gentle valleys, in spite of the high elevation.

Wu-lung-shan, 2,500 m above sea level, is the highest peak of the western Jehol Massif. It rises directly from the North China plain. In the west, high peaks around 1,800 m are crowded along the national border, and constitute the "Roof of Jehol". Of them, Chung-sheng-tang-shan (1,890 m), La-ma-shan (1,910 m) and Yun-mu-shan (1,967 m) are most obvious.

Mountains in the area enclosed by Chih-feng, Lung-hua, Cheng-te and Ping-chuan are also high, noteworthy ones being Tiao-yu-shan (1,450 m), Ta-hsi-kou-shan (1,460 m) and Ping-ting-shan (1,944 m).

The Yen-shan range is part of the western Jehol Massif. It serves as the watershed of the Chao-ho and Luan-ho Rivers, and includes the previously mentioned Wu-lung-shan and adjacent Jen-tou-shan (1,649 m). Another range, Chi-lao-tu-shan, separates the water of the Lao-ha-ho system from that of the Luan-ho, and contains Ping-ting-shan and other high peaks.

The eastern Jehol Massif consists of three mountain ranges, Ling-yuan, Ta-ching-shan and Sung-ling, all of which trend in the Sinian direction. Their elevation gradually decreases to the east.

These ranges are steep in the south, showing a mature stage of topography, but in the north grades into foothills ending with a lowland along the Silamulun River.

The Ling-yuan range is bounded on the west by valleys of the Lao-ha-ho and Pao-ho, and on the east by valleys of the Ching-lung-ho and Lien-ho and by a lowland connecting the towns of Ling-yuan, Yeh-pai-shou and Ssu-chia-tzu. Major peaks are Chien-tzu-shan (1,095 m) and Pai-shih-la-tzu-shan (1,129 m), southeast of Ping-chuan.

The Ta-ching-shan range is located between the main stream of the Ta-liao-ho and the Ling-yuan range. Its main peak is Ta-ching-shan (1,115 m), northwest of Chao-yang. Ta-hei-shan (1,080 m) and other high peaks are also found in this range.

The Sung-ling range constitutes the easternmost part of the Jehol Massif. It runs parallel to the west coast of Liao-tung Bay and stretches from northwest of Shan-hai-kuan to the vicinity of Fu-hsin in the northeast. Hei-shan (1,258 m), east of Ling-yuan, and Wu-ting-shan (743 m) are included in this range.

As to the volcanic topography of the region, the lava plateaus and volcanic cones along the west coast of Lake Talinor of the Mongolian Plateau and the mesas in the vicinity of Wei-chang are most obvious.

Lava plateaus occur in two rows, one parallel to the national boundary and the other following an east-west direction. They are 70～150 m in relative height, standing on the Mongolian plateau which is 1,190 m above sea level. The lava plateaus are composed of 20～30 m high volcanic domes. Some of the domes have a typical crater at the top from which lingulate lava flows issued.

Three to four mesas are found in the area between Wei-chang and Chang-san-ying. They are 100 m above the present river-bed and have a flat top.

The Mongolian Plateau is the easternmost part of the so-called Mongolian Great Plateau. It is located west of the Khingan Range and northwest of the Yin-shan Mountains. Its height is between 800 m and 1,200 m above sea level. It slopes down to the north, with a level surface like a peneplain. The Talinor lacustrine basin west of Lin-hsi contains Lake Talinor and Lake Wang-niu-pao-tzu. Northwest of Lin-hsi, beyond the national boundary, broad marshy valleys

and plains, drained by vanishing streams, are found between the mountains of an old stage. The development of sand dunes is remarkable on the plateau in the vicinity of To-lun.

In the drainage basins of the Lao-ha-ho in the northeast and of the Ta-ling-ho in the eastern part of the Jehol Massif, low hills are found between the mountains or at their foot. These hills are composed of Mesozoic formations that yield many fish fossils. The hills undulate with a relative height of around 100 m. The most notable feature of the hills is the thick cover of loess, and gullies characteristic of a loess region are found everywhere.

Plains and lowlands of southwestern Manchuria are generally small in area, except for the northeastern part of the Jehol Massif, the coastal plain of Chin-chou and part of the North China Plain.

Major rivers are the Silamulun, the upper course of the Ta-liao-ho, the Lao-ha-ho and the Luan-ho. Lesser ones are the Ta-ling-ho, Hsiao-ling-ho and Liu-ku-ho.

The Silamulun River, bounding the northern side of the Jehol massif, takes a straight course west to east. Its upper stream, flowing west of Ching-peng, is found to cut through the Khingan Range and continues farther west to cut young V-shaped valleys, deeper than 100 m, on the Mongolian plateau. Eastward from Pa-lin-chiao the river becomes wider and is accompanied by a broad area of sand dunes along its south bank.

The Lao-ha-ho is one of the tributaries of the Silamulun, and its drainage area covers most of the northeast of the Jehol Massif. It rises about 18 km north of Ping-chuan in the south, and flows northward and irrigates the broad alluvial plain. Then it passes Hei-shui 40 km southeast of Chih-feng, and goes northeast, meandering occasionally before joining the Silamulun. The river is about 44 km long and has a large number of tributaries showing a pinnate pattern of branching and dissecting the northwestern Jehol District. The largest tributary is the Hsi-lu-ka-ho, whose tributaries, such as the Cho-su-ho, the Ying-chin-ho, the Hsi-po-ho and the She-li-ko-ho, present a radial drainage pattern with the Chih-feng basin at the center.

The main stream of the Luan-ho begins as the Shan-tien-ho far west of To-lun. It rises in the eastern end of the Yin-shan Mountains and joins the Ta-luan-ho north of To-lun. It is probable that the Shan-tien-ho was once an inland river, but was later captured by the Luan-ho through stream piracy.

The Luan-ho in the area south of Ta-ku-shan 35 km east of To-lun-no-erh flows roughly southeastward. Where it passes through the Jehol massif the river forms several gorges, and in the Chang-cheng mountainland it shows incised meanders. It has such tributaries as the I-ma-tu-ho, the Je-ho and the Ching-lung-ho.

The Pai-ho flows through the southwestern corner of the Jehol Massif, and after traversing the Chang-cheng mountainland enters the North China Plain to pour into Po Hai at Tien-chin.

The Ta-ling-ho has its drainage basin in the eastern part of the Jehol Massif. In the area west of the Sung-ling range, the river flows through a valley following the tectonic line, but in the middle reaches it becomes an obsequent stream cutting across the Sung-ling range, and then flows into Liao-tung Bay. The upper course of the river consists of two branch streams, one flowing southeast through Ling-yuan, and the other running northeast through Ling-nan. They join in the broad basin of Ta-cheng-tzu.

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