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REPORT OF THE NORTHWESTERN CHINA SCIENTIFIC EXPEDITION

By Shu-Tang Lee, M.Sc. (Cantab)

(National Central University)

This paper is a general report of the Northwestern China Scientific Expedition organized by the Natural Science Society of China during the summer 1941. It was a small party with only four members. Two of us are geographers, Prof. M. N. Jen and I. The other two are Dr. Hao, Professor of forestry and Mr. Chang, Professor of animal breeding. All the members met at Chengtu on July 16. Ten days later, we started from Chengtu northward, crossed the Motienling, the bordering range between Szechwan and Kansu, and reached the Peilungkiang or the White Dragon river at Pikow. From Pikow, we followed up the river and its main tributary Minkiang. After passing a low divide, we came to Minhsien, an important city situated on the south bank of the Taoho bend. Ascending westward, we travelled on the Taosi plateau or the alp, the region of pure nomadism, until finally we arrived at Labran, the resident place of Ala Jayan and one of the greatest religious centers for the buddists in China. We did not have time to go further west, but following down the Tashiaho we turned eastward through Hochow to Lanchow. On the 20th of September, we arrived at the capital of Kansu just in time to see the wonderful scene of sun eclipse on the next day. Our return journey took us a fort-night on buses in a round about way through eastern Kansu and western Shensi. On October 14, we returned safely to Chungking. During our three months' absence, the war capital has suffered repeated air raids and our university buildings were also bombed and severely damaged. The expedition traverses a distance of 3000km and covers a large part of South Kansu. The whole journey may be divided into four sections. A full discription of the journey is seen in the Chinese text. In this abstract, I am only giving a brief account.

From Chengtu to Pikow

Through the whole length of nearly 150 km. from Chengtu to Kiangyou, we travelled on the plain. Kiangyou is a piedmont city situated at the bottle neck of the Fukiang on the border of the Szechwan basin. It is a small city of only strategical importance, while Chungpa, some 15 km. south, is a large commercial town, a trading center of grains and Chinese medicinal herbs. North of Kiangyou, high mountains rise abruptly from the plain and the torrential rivers rush through the narrow gorges. From the Chengtu plain to the border mountain the landscape quickly changes. After four days' ascending, we reached Tsinchwan (1089m), a walled town in an intermont basin of about ten square kilometers in size. Thence we passed the Motiengling and came to Pikow on the Peilungkiang. Pikow is a commercial post on the border of Kansu and Szechwan and keeps direct junk traffic with, Chungking in most time of a year.

On the whole, the border mountains are maturely dissected with bold topography and maximum relative relief. Cultivable land is too much limited to support a large agricultural population. Deforestation is a prevail phenomenon especially on the tracts along the river and near the villages. On those balded mountain farmers collect wild herbs to be used as medicenes transported to the neighbouring markets of Chungpa and Pikow by pedallers with big baskets on their shoulders. Human settlements are concentrated on a few river terraces, alluvial cones and fans, and intermont basins where some patches of rice are cultivated. Most villages are small in proportion to the cultivable land that belongs to them. On gentle mountain slopes corn is widely cultivated constituting the staple food of the inhabitants.

Pikow to Minhsien

Following up the Peilungkiang, we travelled on sedan chair and on foot. Peilungkiang takes up its source from the Tibetan plateau and flows along the south-

western part of Kansu acting as the upper course of the Kialing river. It is for the most part an incised meander river forming deep gorges in areas of hard metamorphosed rocks. High steep mountains and deep cutting torrential rivers show features of a late young topography. To travel on this rugged region is a taxing job. In order to establish direct connection between Chengtu and Lanchow, a motor road is now in building, but owing to the topographical obstructions progress is slow. In many places mountain paths are so narrow and deteriorated that even mule traffic is impassable. Where highways are in building, foot paths are also destroyed. One has to climb mountain after mountain with both the hand and foot and to cross a river on bridges made of two rounded wood trunks parallely put on cliff rocks above the boiling stream of some twenty meters wide.

This difficult journey ends at the town of Tanchang on the upper course of Minkiang. North of Tanchang, the topography remains in an early youth stage. The gentle surface of the plateau is unbroken by dissection of the cutting rivers and is further smoothed by the depositing loess. River valleys are wide and flat. Roads are broad passable for wheeled wagons.

From Pikow to Minhsien we notice a clear and interesting transition of geographical landscape from south to north. In China, we usually take the Tsingling and Hwaiho as the geographical demarcation between North and South. West of the Tsingling or in the southern Kansu, this line, however, losses its topographical distinction and is often freely drawn by various regional geographers ranging between the Szechwan border mountain to the south and the Waiho and Taoho to the north without any factual basis. But as can be verified by our observation, this transition of landscape distinctly exists in spite of lacking topographical discrimination.

The transition begins at Koutoupa some 50 km. north of Pikow. Loess deposition, a characteristic feature of North China, is first seen near at Koutoupa.

Thence northward loess deposits increase their depth and magnitude; while rainfall decrease in spite of the increase of altitude. Wutu plain, the largest alluvial plain on the Peilungkiang is a rich local agricultural center with rice and cotton as the chief crops. North of Wutu, rice is no more cultivated owing to the cold summer and insufficient rainfall. Kaoliang and wheat become the dominant crops. Travelling northward we see the green wooded mountains change gradually into grav and yellowish barren slopes. The transition of natural vegetation is even clearer.

North of Tanchang, the precipitous mountains change, owing to less dissection, into gentle undulating plateau. Valleys are wide and roads broad. Yaks and horses are employed as burden and field animals. Pastoral activities increase using the natural alp as grazing ground. As the altitude increases, agricultural crops are limited to those cold resisting plants of barley and potato.

East of Peilungkiang from Tienshui to Hanchung the same transition can be traced. Hweihsien, as Wutu, is the northernmost frontier of rice cultivation. The geographical demarcation can be, therefore, properly drawn along a line just north of Wutu and Hweihsien to be the western extention of the Tsingling boundary.

On the Taosi Plateau

After a few days' stay in Minhsien, we went westward to the Taosi Plateau travelling on horsebacks. The plateau, being only faintly dissected, becomes still more gentle and flat. It gives a monotonous landscape tinged with the boundless green of natural grasses.

Taosi plateau or the plateau west of Taoho is a land of racial mixture. The Chinese, being exclusively agricultural, live in its easternmost part cultivating barley and potato in the broad valley lands. The Tibetans, mostly nomads, occupy the true alp or the mountain steppe with their herds of cattle and sheep. The Mohammedans

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are most of them traders and are, therefore, city dwellers and caravan merchants. From Minhsien to Old Taochow, Chinese form the majority mixed with minor sedentary Tibetans. Joni on the north bank of the Taoho is a city inhabited by both the people and is governed by both the Kansu government and Tibetan prince. West of Old Taochow is a region of pure nomadism. There, except in the town and large village, no Chinese and Mohammedans are seen living on the land; for the land belongs to the lama temple and only the Tibetan followers are allowed to tent.

One day's journey west of Old Taochow is Erkoro, the first Tibetan village on our way. We arrived at Hetzo the another day passing an endless and desolate high steppe dotted with distant tents and wondering cattle. Hetzo (2996m) is an important marketing town with a big lama temple situated in the center of plateau about the same distance from Joni, Labran, Hochow and Old Taochow. Thence we passed Karka and Lungwa, both of them are famous lama temples. After Lungwa, we climbed up the Tameishan Pass, 3695 meters above the sea level. Descending from the mountain and following some 15 km. up the Tahsiaho, we reached Labran in the dusk of the day September 6th.

Along the Tahsiaho

Labran is widely famous city both as a religious center of the Tibetans and a frontier post of the Chinese cultural and political influences. Standing on the river bend, the Labran temple, a group of grand and picturesque buildings of western outlook, is visited yearly by hundred thousands pilgrims from all part of the Tibetan land. The grotesque wall painting and sparkling golden roofs magnify its mystery and grandeur. Some few hundred meters down the stream stands the district city Hsiahohsien. The crowding houses and crooked streets give the city a humble and contrasting outlook. The district city is peopled by 3000 inhabitants, a mixture of Chinese officials cultural missionaries and shop keepers, Mohammedans merchants

and Tibetan farmers. Adding another 3000 lama priests who live in the temple, Labran is proud to be one of the largest city on the Tibetan border. During our five days' stay in Labran, we enjoy in visiting the near by mountains and scenic spots and are honoured by a reception of the Ala Jayan.

On the 13th September we left Labran (2950m) and followed the Tahsiaho down to Hochow (1900m). In two days we descended one thouasnd meters. Hochow is located on the broad alluvial plain of the Tahsiaho banked on both sides by vertical loess cliffs leading up to the maturely dissected loess plateau. Rice is grown on the alluvial plain; while on the plateau, wheat and kaoliang are chief crops. The district is one of the richest in Kansu and is inhabited mostly by rural Mohammedans especially in its southeastern part. The Chinese and Mohammedan farmers live in separate villages; and, owing to their religious and cultural differences, contact between these two people is still obstructed by their mutual suspicion and prejudice.

Another two days' journey brought us to Lanchow. On the first day, we crossed the Taoho, acting as an ethnographical boundary between the Mohammedans and Chinese. East of Taoho we travelled in all Chinese land. After passing a high pass of some 3000 meters, we reached the Hwangho valley.

In Lanchow, we were heartily received by the Governor and many of our old friends. We made several sight seeing trips in the neighbourhood of this strategical city of both ancient and modern.

We made no detailed observations on our return journey.

Separating papers on physiography, forestry and animal breeding of this area are written by Professors Jen, Hao and Chang respectively as can be seen in the following pages of this issue.

NOTE ON PHYSIOGRAPHY OF NORTHERN SZECHUAN AND SOUTHERN KANSU

By Prof. M. N. Jen, Ph. D.

(National Chekiang University)

The Present paper is an outcome of a trip to Northern Szechuan and Southern Kansu in July-October, 1941. Briefly speaking, the region under consideration is limited by Lanchow on the north, Nuikiang on the south and Lintan and Hanchung on the west and east, comprising about six degrees of latitude and four degrees of longitude.

The region is of particular significance in geography of China from several respects. Historically, it marks the field of contest between Han and Wei dynasties during the period of Three Kingdoms in the 2nd and 3rd centuries, the story of which forms one of the most popular legends in China. Geographically, the region constitutes a distinct zone of transition between North and South China which differ fundamentally from each other in climate, physiography, vegetation and numerous human activities. Racially, the western part of the region forms the place of contact between three principal races of China, namely Hans, Mohammedans and Tibetans.

The region is also interesting in its physiographic features. As we travel northward from Nuikiang to Lanchow, we pass through successively three important physiographic provinces of China, viz. Szechuan Basin, Border Mountains and Loess Plateau.

Szechuan Basin

Physiographically, Szechuan Basin is a dissected basin carved out of Cretaceous Red Beds. The Red Beds of Szechuan is a continental sediment brought down by streams from Border Mountains and deposited in the inland lake then existing in the basin. Consequently, the size of sediment varies according to its places of deposition,

from conglomerate on the flanks of mountains to shale in the centre of the basin and dip of strata also changes from highly inclined near mountain flanks to nearly flat-lying in basin centre. As the form of hills is largely determined by the amount of dip of strata, we find flat-topped mesas near Nuikiang and Tzuchung in the centre of the basin changes systematically to cuestas near Tzutung and hogbacks near Kuangyuan on the north border of the basin. The change of hill-forms may be conveniently observed at a point about 10 km. west of Kuangyuan, on the Chengtu-Kuangyuan highway, where, looking towards west, Red Beds can be seen sloping away from high mountains forming in succession hogbacks, cuestas and mesas.

Contrast to current notion of plain-like landscape of a basin of deposition, the prevailing landscape of Szechuan basin is one of rolling topography, with innumerable valleys interwoven amid scattered hills. As dissection is more advanced towards the centre of the basin, the physiographic landscape in the centre is slightly different from that on the mountain flanks. In the centre, broad valleys and smooth hills present a gentle and tame topography and intricate valley flats have cut up hills into scattered mounds, their relative relief generally not exceeding 20-30 metres. On the flanks, however, narrow and steep valleys are the rule, between which large tracts of interstream area still remain intact, rising 100 metres or more above the neighbouring valleys. Here, the presence of thick beds of conglomerate tends to produce precipitous cliffs and adds boldness and picturesqueness to the landscape. The renowned Chienmen-kuan, north east of Chienkuohsien, is a deep gorge bordered by vertical cliffs of conglomerate.

In Szechuan Basin, alluvial plains are generally of limited extent forming discontinued local flats. Along the Foukiang or Fou River, Chungpa Plain and Kiangyiu plain are among the most notable alluvial plains, the former being 15 km. long and 8 km. wide. Chengtu Plain is of much larger extent and constitutes

essentially a huge alluvial fan deposited by the Min Kiang, sloping imperceptibly to the south. Looking from hills near Lung Tsuan Yi, on the Chengtu-Chungking Highway, vast Chengtu Plain on the west stretching flat as far as eyes can see differs remarkably from rolling topography of the Basin on the east. Owing to its unusually large extent, Chengtu Plain constitutes a distinct physiographic unit and it is here considered as a subprovince in the physiographic province of Szechuan Basin.

Border Mountains

The borderland between Loess Plateau on the north and Szechuan Basin on the south is essentially a mountainous country characterised by high mountains and deep valleys. In South Shensi, Tsinling Range and Tapashan are well marked, between which extends the rich and broad basin of Hanchung. Further west, in south-western Kansu, Tiehshan and Minshan form distant continuation of Tsinling and Tapashan. But between the two well marked mountain systems on the east and west, the intervening territory consists of a matrix of mountain and valleys so broken and scattered that no well defined system may be discerned.

With the exception of Hanchung Basin, alluvial plains in the region are extremely limited, most of rivers being closely restricted by mountains and forming narrow gorges. The region is maturely dissected with the result that mountains are steep and sharp-crested and their relative relief has reached maximum ranging up to 600-700 metres in the Minkiang Gorge District, Sikuhsien, Kansu. (1) The rough and difficult terrain of maturely dissected mountains may be conveniently seen from the top of Te-O-Liang, Pinghuhsien, Szechuan.

The southern boundary of the region is sharply demarcated, high mountains usually rising abruptly from Szechuan Basin. On the north, however, the limit is not so well defined. Roughly speaking, the southern limit of loess may be taken as the boundary separating Border Mountains from Loess Plateau. As will be fully explained

in a later paragraph, the characteristic topography of Loess Plateau is largely due to loess covering which mantles a greater part of the surface. In Shensi, the distribution of loess is sharply limited to the north of Tsingling and Fungling. But further west as mountain ranges are more broken, the southern limit of loess becomes more irregular. Loess is often blown over low water divides and descends down river valleys. In the Pelungkiang valley, loess transcends over the low divide between the Tao River and Pelungkiang and comes down as south as Kou-Tou-Pa, some 60 km. north of Pikou. On the south of the Tao River, Tiehshan Range is comparatively unbroken and forms an effective barrier against the distribution of loess. The landscape on the south side of the Tao River is fundamentally different from that on the north side, the former being forest-covered rocky mountains while the latter constituting generally terraced loess hills.

On the whole, it may be said that with exception of limited tracts, Border Mountains is generally free from loess covering and its bold rocky mountains form a striking contrast to loess covered smooth hills of Loess Palteau.

Loess Plateau

The loess plateau of Northern Shensi and Central Kansu is one of the most distinctive physiographic units in China. It is essentially a dissected plateau where gentle surface of the plateau is broken by recent dissection of deep gullies. The characteristic landscape of the plateau may be attributed to the influence of loess. Firstly, the accumulation of loess, by burying up original irregularities, has a smoothening effect on topography. The present gentle surface of the plateau may represent the depositional surface of loess which has suffered little denudation since the time of accumulation. The smoothening effect of loess can be best observed at the margin of the loess region. For example, on the north of Kou-Tou-Pa, mountains are steep and sharp-crested wherever not mantled by loess, but assume round and plateau-like

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forms where they are covered by loess. (Fig. 1) In the Plateau, rocks are usually buried beneath loess so that smooth loess hills instead of craggy rock mountains form the most common features in the landscape. But higher grounds at about 3000 metres are usually loess free and craggy, standing out like rocky islands above vast sea of surrounding loess hills, as Lienhuashan in south-western Kansu and Lungshan in eastern Kansu.

The steepness of gullies in the plateau is due to vertical cleavage of loess. Where gullies have cut down through loess into underlying red clay, their forms change from vertical gullies to V-shaped valleys. The porous nature and fine texture of loess coupled with excessive terracing has caused rapid erosion and it is a common sight to see loess slopes cut by innumberable ravines into typical badland.

In greater part of the region, the dissection of the terrain has only reached youthful stage so that large tracts of flat plateau surface are still preserved forming a continuous sea of smooth rolling hills. For example, between Tsingning and Tingsi in Central Kansu, the plateau extends unbroken for nearly 100 km. as can be best seen near Hua-Chia-Ling on the Sian-Lanchow Highway. (Fig. 2).

Towards south-west, the plateau rises to 3000 metres or more. Owing to cold and wet climate, the surface is covered with a thick layer of humus forming typical black earth. This is the eastern corner of the extensive grassland of Tsinghai and Tibet where, unaffected by recent gullying, smooth topography of old age is still survived.

Geology as a Factor in Sculpture of Landforms

The influence of geology on sculpture of landforms has been discussed elsewhere. (*) It is admittedly true that other things being equal, the difference of landforms is determined to a large degree by geological structures.

The shape and slope of mountains are influenced by resistance of rocks. This is well illustrated in Border Mountains where strata of unequal resistance are exposed,

In Border Mountains, limestone has often undergone slight metamorphism, forming a marble like rock. The slight metamorphism of limestone coupled with its massive and compact nature has rendered it highly resistant to erosion. Consequently, limestone mountains are usually steep and craggy and where they are cut by streams, wild gorges are often resulted. The impassable Minkiang gorge near Tun-Tun Bridge, in Sikuhsien, Kansu is one of the most notable examples. (Fig. 3) In fact, it may be said that limestone constitutes the principal cliff-making stratum of the region. In Lienhuashan, Lintan, limestone crags stand out above smoother hills of slate and schist and offer a contrast of the most vivid kind.

In contrast to high and steep limestone mountains, the prevailing landscape in shale districts is soft and tame. The limited outcrops of shale in the region invarably associate themselves with low and gentle hills, as in the neighbourhood of Sien-Tieh-Kou, Pinghuhsien. In passing from limestone to shale districts, we find a corresponding change in valley forms from precipitous gorges to open valleys. Where limestone cliffs are intercalated with shale, the gentler slope of shale layers adds some variety to otherwise vertical forms. For example, in Tsing-Shui-Kou, Hutuhsien, Kansu, vertical cliffs of limestone are interrupted by smoother slopes of interbedded shale, the contrast being most distinctive. (Fig. 4).

Metamorphic rocks are also of wide occurrence in Border Mountains. Consisting chiefly of slate and schists, they are intermediate in resistance between limestone and igneous rocks on the one hand and shale on the other. They also give rise to high mountains, but vertical cliffs characteristic of limestone and igneous rocks are seldom met with. For example, along the Pi-Shan-Kou, a small tributary of the Pelungkiang, diorite intrusion forms precipitous gorge between Yuan-Tan-Tsu and Tsing-Yeh-Shu; below Tsing-Yeh-Shu, slate and schists crop out and the valley immediately becomes more open and mountain slope more gentle. In fact, the change of topography

coincides exactly with the transition between two formations of unequal resistance.

In Border Mountains, owing to steepness of mountain slopes, debris are often quickly transported down slope by gravity so that instead of soil creeping, rock debris literally fall down in blocks without time for further disintegration to soils. Everywhere, rock falls are common sights.

Landslides of considerable scale occur notably in the Minkiang Gorge district, Kansu. Between Hua-Ma and Hua-Shih-Kuan, landslide debris form a conspicuous deposit, consisting of a loose matrix of large limestone blocks and fine black silts. It is reported by a highway engineer in the district that in a single landslide early in spring, 1941, debris were come down in such a huge quantity that the river was temporary blocked and its bed raised as much as 9 metres. In fact, the frequent occurrence of landslides contributes considerably to steepness of mountain slopes in the district. The reasons for such frequent occurrence of landslides may be summarised as follows:

(1) Geologic structures. The prevailing strata in the district consist mainly of thin or medium thick bedded limestone with intercalated layers of shale. It is conceivable that the shale layers, being easily weathered into clayey soils, may act as a lubricant which readily slides down along steep slopes carrying with it the overlying mass of limestone. The fine black silt in landslide debris is essentially a weathered product of shale.

(2) Climatic conditions. The frequent occurrence of thunderstorm and hail in summer is an important factor in causing landslides. Though of a short duration, these storms attain an intensity comparable to terrific swept of typhoon. The violent wash of rain sets unstable limestone and shale layers in motion and consequently, landslides are especially common immediately after the storm.

(3) Topography. Owing to steep dip of limestone, mountains in the Minkiang

Gorge District are unusually steep often forming vertical cliffs. The steepness of slopes creates unstable condition in strata and paves the way for landslides.

Some Observations on the Relation Between Physiography and Human Activities

Lastly, it may be interesting to note some outstanding features of human response to physiographic conditions in North Szechuan and South Kansu.

(1) Land Utilization In Border Mountains, cultivation is limited not only by altitude but also by declivity of mountain slopes. In northern Szechuan, wherever slope exceeds 40 degrees, deciduous forest usually takes the place of terraced fields. The character of rocks has also considerable influence on the utilization of mountain lands. In general, slate and schist mountains are intensively terraced and their steeper slopes are often covered with forest. This is largely due to the fact that the metamorphic series, being easily weathered, has often left a soil cover of considerable thickness on mountain slopes which are therefore rendered capable of cultivation. The prosperous landscape of these mountains forms a striking contrast to barren slopes of limestones and diorite mountains which owing to greater resistance of rocks, usually lack cultivable soil cover and are consequently left without any visible sign of human occupation.

(2) Settlements Important settlements of Border Mountains are all concentrated in limited plains, the size of settlements being roughly proportional to the extent of plains. Briefly speaking, focal plains in the region may be grouped under three categories. Firstly, alluvial plains. Owing to their larger extent, alluvial plains furnish sites for practically all important towns in the region, as Hutu, Tsingchuan etc. Secondly, alluvial fans Sien-Tieh-Kou, Ping-Yi-Pu and other larger villages in the gorges are generally situated on alluvial fans which often constitute the only flat land available in the locality. Thirdly, terraces, Scattered terraces occur in the Upper

Foukiang and Pelungkiang and form sites for few settlements in wild gorges.

(3) Communication In accordance with conditions in other parts of the world, (2) principal roads in maturely dissected Border Mountains follow river valleys. Cutting cliffs and filling up hollows, they were built with greatest difficulty and are famous in China for their bleak danger and scenic grandeur. In youthfully dissected loess plateau, on the contrary, roads are often built on hilltops, as in Hua-Chia-Ling district, Kansu.

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(1) The Minkiang in South Kansu is a tributary of the Pelungkiang and should not be confused with the Minkiang of Szechuan which is a much larger river and flows directly to the Yangtse.

(2) See M. N. Jen, The Influence of Joints on the Detailed Sculpture of Landforms: A Study in Microgeomorphology, Jour. Geog. Soc. China, Vol. VII, 1940, pp.1-9.

(3) See J. L. Rich, Cultural Features and the Physiographic Cycle, Geog. Rev., Vol. IV, 1917, pp.297-308.

UEBER DEN ZUWACHS DER KIEFER UND DER FICHTE.

Von Prof. Dr. K. S. Hao

(National Central University)

Die hier von mir untergesuchten Bestände von Kiefer, Pinus tabulaeformis Carr. und von Fichte, Picea Wilsonii Mast. sind in der Provinz Kansu, länges des Flusses, Tao-ho circa 70 Kilometer westlich von der Stadt, Minhsien, sich befunden worden. Nach meiner Meinung werden die Standörter der beiden Bestände als gute Bonität eingestellt.

Die Kieferwälder bestehen hauptsächlich aus Pinus tabulaeformis. Nach dem Durchmesser der Stämme sind die Bäume in 3 Klassen eingeteilt worden:

	Stammzahl je Hektar	Alter	Durchmesser ohne Rinde in cm	%
Klasse I	90	130	54	50
Klasse II	54	70	24	30
Klasse III	36	50	18	20

Zu den im Unterwuchs dieser Wälder vorkommenden Sträuchern sind als wichtigste Cotoneaster-Arten mit roten Blüten, Lonicera tangutica und Lonicera syringantha mit rosigen Blüten, die schon im August Früchte tragende Berberis, Picea, Betula, Thalitrum, Polygonatum verticillatum, Asparagus, Cacalia und das weiss blühende Gnaphalium. Von den Pteridophyten, die in den Wäldern der Kiefer sich finden, habe ich nur eine Art, Osmanda japonica gesehen, deren Rhizom von den Bewohner als medizinisches Mittel benutzt wird. Durch den Pflanzenindikator, Epimedium-Arten wissen wir dass, der Boden hier in den Wäldern von Kiefer säurehaltig ist.

Nach dem Sektionverfahren habe ich die Stammanalyse der altesten Bäumen genau gearbeitet. In den folgenden Tabellen und der Abbildung zeigt sich das Zuwachsresultat:

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