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PHYTO-GEOGRAPHICAL SURVEY OF NORTHWEST  
SZECHWAN AND REGIONS OF CHANG-TU DISTRICT IN  
COMMUNIST CHINA

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PHYTO-GEOGRAPHICAL SURVEY OF NORTHWEST  
SZECHWAN AND REGIONS OF CHANG-TU DISTRICT IN  
COMMUNIST CHINA

Following is a translation of an article by  
Ts'ui Yu-wen in the Chinese-language peri-  
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I. INTRODUCTION

I joined the Cultural Commission's Tibet work Team on 7 June 1951 with the purpose of making a survey of the flora in Tibet. Due to difficulties of communications, I was only able to conduct my study along the northern part of Sikang. This undertaking covered almost 2,000 kilometers and took about six months [see Figure 1 appended at end]. About 500 kinds of specimens were collected, belonging to 81 families and almost 200 genera. Forest areas are vast and extensive and only the eastern part of Pa-su-hsien is a pure pastoral area. The rest are mixed agricultural-pastoral areas. Agriculture is confined to the lower alluvial terraces or a small part of the land in the alluvial fan.

## II. NATURAL CONDITIONS OF THE SURVEYED AREA.

### A. Geology and Topography

1. General Geological Description: A large proportion of rocks found in the area consists of arenaceous shales which formed themselves into red rock strata. Next are the limestone rocks. These rock formations are present in a few of the top ridges of the mountain ranges (from Chia-p'i-na, Yen-ta-kou, and Chiang-ta to T'ung-pu; from Kang-t'oh to Teh-ke; and in the vicinity of T'uo-pa). Igneous rocks were seen in a few mountainous areas (such as Ts'io-erh-sh'an; from Chu-ching, Jan-to to E-na; Cha-hsi-ta-ts'ang; Yu-hsi-kou, and Peng-peng-la). The soil formed from the weathering of the arenaceous shales is mostly of a dull red color. Incompletely weathered conglomerate rocks were often seen falling down the rather steep cliffs. (This was especially noticeable at Yen-to.) It is difficult for plants to grow in this soil. Only a few species of the Labiatee and some small shrubs of the Staliceae families were found to grow together. These are able to grow because of their deep main roots. Wherever arenaceous shale exists, vegetation is sparse and forests are especially lacking. Wherever the area is composed of limestone and granite, dense forestation grows and covers the area.

2. Topography and physical features: The mountain ranges and rivers generally run north and south. With the exception of the region along the eastern periphery of Pa-su, all the areas we traversed are mostly deep valley gorges. Peaks rise abruptly, and the lowest depth of some of the river valleys is about 3,000 meters. The water dividing the ridges of these mountains ranges from 4,000 to 5,000 meters.

The topography of these valley gorges can be divided into 3 types:

(1) Narrow valleys (V-shaped valleys) - The flowing river cuts through the steep, weathered and eroded banks on both sides for long distances. The slopes of the banks are 45° or greater with a cross-section shaped like a V. Most of these steep canyons were found in the four main rivers referred to above or in their main tributaries. On both sides of the very narrow bed, a few alluvial fans or alluvial terraces may be found. Sometimes there are no valley beds at all; or if there are, they appear only in traces. Sunshine on the valley is short, and their relative humidity is rather high. The main forest flora distributed over the area are *Ficea Balfouriana* and *Juniperus*. Forestation

is dense and luxuriant along the banks of the gullies which are shadowy even when the sun shines. The vegetation of young forestation is crowded and profuse while old forest trees shoot up into the air. Broad-leaf fall deciduous and acerose leafed forestation grow at the basis of the gullies. Some *Betula japonica* and *Populus Davidiana* are scattered through the pine forests while only shrubbery diffuses through the *J. pseudo-sabina* Fischer et Meyer juniper forest belts. The important forest areas are as follows:

(a.) Ts'io-erh-sh'an -- There are many large gullies in this area. Glaciers form U-shaped valleys at the top of the mountains. There is a large glacial lake on the eastern slope of the mountain surrounded by a forest of aged *Piceae*. The climate in the gullies is damp and humid, and the area is crowded with dense, luxuriant growth of majestic *Piceae* and *J. pseudo-sabina* Fischer et Meyer forests. Stretching from Ta-ma-tung over Ts'io-erh-sh'an to Tung-t'ai-chan is a gully over 100 kilometers long. The forest and timber areas here are the most enormous in this entire region.

(b.) Kuan-chai-tsu to K'o-lo-tung area -- There are many narrow valleys in this area reaching lengths of 15 kilometers and covered with young and mature forests of *Piceae* and the *J. pseudo-sabina* Fischer et Meyer variety of junipers.

(c.) Yen-ta-kou (from K'o-lo-tung to Ta-ma-tung) -- The length of this very narrow and steep gully is over 10 kilometers running east and west. At the bottom and on both sides of the gully grow dense and luxuriant forestation of broad-leaf trees. *Piceae* and *J. pseudo-sabina* Fischer et Meyer grow on the slopes but not so luxuriantly.

(d.) Kang-t'oh to E -- This is a long narrow valley about 10 kilometers running north and south. The gully is narrow and steep. Both slopes of the gully are covered from top to bottom with *Piceae* and *J. pseudo-sabina* Fischer et Meyer. At the lowest level of the slope, birches and poplars also grow. At the bottom of the gully small trees of yellow poplars grow.

(e.) From E-na to Jan-to in Chiang-ta -- This stretch of mountain valley is almost over 50 and some odd kilometers long. Its width varies much but is wider than the valleys described above. Small alluvial fans and terraces were frequently seen along the river bed. When we reached the uniform acerose-leaf forest region, it was found to have been destroyed by human efforts, and some of these trees remained only along the upper levels of the mountain. *Piceae* forests grow luxuriantly along the route from Je-ya to Teh-pa-ch'ia.

(f.) La-ma-la -- On the left bank of Lan-ts'ang River south of Ch'ang-tu, the mountain is about 5 kilometers long with varying width at different points. Piceae forest grows on the shady slopes while junipers and *J. pseudo-sabina* Fischer et Meyer grow on the sunny slopes. No birches or poplars were seen.

(g.) From Chung-yu to Cha-hsi-ta-ts'ang -- This area is along the left bank of Lan-ts'ang River. It is not very deep with varying widths. The Piceae forest covering it is extensive. Birches and poplars are mixed in the Piceae forest on the lower slopes of the valley. However, shrubby forest covers the southwest slope, and consists mostly of Berbericeas, Rosacea, Cotoneaster multiflora Bunge, etc.

(h.) From Ts'un-to to Pang-ta -- This is an area of many narrow valleys. Some large alluvial terraces exist in the river bed. Piceae and *J. pseudo-sabina* Fischer et Meyer forests grow in valleys with no river beds. This is both a forest and pastoral area.

(i.) Yu-hsi-kou -- This is a valley running east and west in the neighborhood of Lan-ts'ang River and lying between the Lan-ts'ang and Nu-chiang /Salween/ rivers. Extensive Piceae and *J. pseudo-sabina* forests cover this area with birch forests growing among them on the shady slopes. On the north and south branch gully both Piceae and *J. pseudo-sabina* forest grow.

(2) Wide Valley Areas - The base of the gullies is wider with a smaller difference in the incline and of flow of the river. Larger expanses of alluvial terraces are present in the river bed. At altitudes under 3,500 meters, small tracts of cultivated lands were found on the river bed. Mountain slopes are frequently under 45°. The vegetation on the valley slopes consists mainly of shrubby forests and tall grass steppes. The height of the grasses growing on this tall grass plain ranges generally from 15 centimeters to 1 meter. Forests when evident are scattered on the mountain showing signs of withered growth. The main rock formations are stratified red sandstones. Limestone and granite are rather meager. Because of the width of valleys, there is more sunshine with greater moisture evaporation. Therefore these valleys are more arid than the V-shaped valleys. These valleys are:

(a.) Kan-tzu and vicinity -- On both banks of the wide Ya-lung-chiang there are thick layers of yellow alluvial soil suitable for cultivation. The area upstream

to Jung-pa-ch'a consists of chestnut colored calcareous soil, a large part of which is for cultivation. Forests have been destroyed, and only on both the east and west entrances of the pine forest, small areas of natural *Picea* with withered *J. pseudo-sabina*, and new forests are evident.

(b.) From Ta-ma-tung to Teh-ke -- This is a valley gully of a little over 10 kilometers long. The river bed is not large and sparse shrubby forests cover the mountain slopes with tall grasses growing among the shrubs. There is a little farm land on both sides of the river, which serves both as a farming and grazing area.

(c.) Ch'ang-tu and vicinity -- Ch'ang-tu is situated at the confluence of Ch'ang-ho and Tu-ho. The river bed is not wide and the lower part not deep. There are small areas of alluvial fans and terraces. Growing vegetation exhibited conditions of drought and without water for the irrigation of the farm lands, the yields are very low. The mountain slopes are mostly covered with grass and sporadic growths of shrubbery. There were no forests to be seen.

(d.) Yen-to and vicinity -- The width and narrowness of the river valley is about average size with many bare mountains. The soil is mainly formed from weathering of arenaceous shale rocks. There are several flat and wide grassy banks in the river bed which can be utilized for cultivation. There is much good forage vegetation growing on the higher and steeper slopes (such as *Themeda Forskali*, *Spodiopogon sibiricus*, and *Pennisetum flaccidum* Grisebach). Sand and conglomerates derived from the weathered arenaceous rocks were not firmly settled on the mountain slopes. Only the few shrub families of *Labiatae*, *Staticaceae* and *Verbena officinalis* grow on the soil and effectively hold the water therein.

(e.) Hsiang-tui and vicinity -- The topography of this area is similar to Yen-to. There are several flat and wide grassy banks. Because of the use of irrigation, most of these have become farm lands. The natural flora found here is also similar to those found at Yen-to.

(f.) From Tso-kung to Ts'un-to -- This valley gully runs along the banks of the Yu-ch'iu-ho which is a tributary of the Salween River. Its length is over 20 kilometers. The river bed is wide at some places and narrow at others. The mountain slopes are sparsely covered with shrub forests and grassy land. A small part of the alluvial fans and alluvial terraces are utilized for cultivation.

(g.) From Chia-chiah to Ch'ang-tu -- This is a meandering gully about 40 kilometers long. The nature of the river bed is similar to that of the area from Tso-kung to Ts'un-to. Because its physical features are lower, the drought is especially serious. The mountain slopes are a mixture of tall grass lands and shrubby forests with scattered small areas of forestation at the top of the mountains. This area is chiefly pastoral.

(3) Area of rolling mounds (hilly plateaus) -- The physical features of these areas are rather high with very few rivers. The hilly ground along the river banks rise and drop, preserving their original high plateau feature. The inclination of the mountain slopes is under  $15^{\circ}$ . The climate is temperate; air pressure, low; radiation, strong, and rainfall, light. These conditions create drought. The flat grassy plains on both sides of the river are mainly covered with the variety of *Blysmus compressus* Panz grass. The grounds with shallow water are damper and on these grow mostly the variety of *Cobresia capillifolia* grass. This area is used mostly for animal grazing. The extent of land in this area covered with vegetation is about 40-50%.

The specie of *Cobresia bifida* Tang et Wang grass dominates the mound slopes if the sloping is under  $15^{\circ}$ . A small number of dwarf plants such as *Leondopodium japonica*, *Gentiana scabra*, *Polygonum sphaerostachyum* Kung, *Polygonum viviparum* L., and *Secale mongolica* Turczaninow are scattered among the dominant grass. Small patches of *Cobresia pygmaea* C. B. Clarke were also found scattered in the area. As the ground rises higher and the slope inclination becomes steeper, vegetation grows with less plant mixtures, and *Cobresia bifida* Tang et Wang and *Cobresia Royleana* Boeck dominates the area. In the summer these become good pasture lands for sheep and oxen.

(a.) From Yu-lung to Hai-tsu-sh'an -- The river bed is flat and wide. It is an extensive damp grassland with slight mountain slopes. The sunny slopes are entirely grasslands. In the shady slopes there are a few *Piceae* and some shrub forests. Shrubs grown in this area are chiefly *Prunus fructicosa* L., *Spiraea alpina* Pallas, *Rhododendron fastigiatum* Franchet, *Salix Brachystachys*, Benth., etc. Besides the *Cobresia* varieties of grass, the following variety of plants was also found: *Potentilla bifurca*, *Plantago major* L, *Leondopodium japonica*, *Potentilla anserina* L, *Taraxacum officinale* Wigg, *Veronica agrestis* L, *Astragalus sinicus* L, and a small variety of *Ranunculaceae* and some *Gramineae*. Vegetation coverage reaches 80-90% and there is a good grazing ground.

(b.) From Je-ch'u-ch'iah via Pai-li to A-ch'i-lung -- This meandering waterway has a wide river bed. With the exception of a few small shrub forests on the shady sides of both banks, *Cobresia* grasses cover almost the entire river bed and the sunny mountains. This area is especially important as grazing pastures in summer and fall. The dominant grasses grown on the river bed flatlands are the *Blysmus compressus* Panz and the *Cobresia bifida* Tang et Wang. Some *Potentilla anserina* L. were found among these. In the drier regions *Potentilla bifurca* was found. On the higher slopes are grown *Cobresia bifida* Tang et Wang and *Cobresia pygmaea* which are mixed with the genus *Polygonum* and *Secale mongolica* Turczaninow. Vegetation coverage is about 50-70%, making it a good summer grazing pasture.

(c.) From La-tsai to A-tsu -- The physical feature of this region is rather high with an elevation close to 3,800 meters. The river bed is wide but with little water running through it. The slopes on each side of the river are not steep and there is very little shrubbery. A few *Rhododendrons* and *Caragana bicolor* Komarov were seen among the sparse shrubberies. Several regions are formed into flat grass banks. The dominant vegetation is the *Cobresia*, with a few species of Gramineae scattered among the grasses. *Cobresia pygmaea* grows at higher levels with lime mixture of other plants. A very few *Caryophyllaceae* and *Primulaceae* are scattered among them.

(d.) From Pang-ta to L'ang-la -- This region of grassland represents the eastern edge of the Ia-su area. Its elevation is almost 4,000 meters. The river bed is very wide. The mountain tops on each side of the river are flat with very little shrubbery. Most of the land consists of *Cobresia pygmaea* and *Cobresia bifida* grasslands. *Stipa conferta* Poiret and *Aster trinervius* Roxb are distributed in the flat wild grassy banks. Vegetation coverage is about 80% overall.

## B. Soil and Climate

1. General Climate: The climate of this area is both arid and cold due to its high elevation and separation from the distant oceans by very high mountains. (Broad leaf evergreens are practically non-existent. Only one specie of yellow poplar was seen at Ta-ma-tung and on the banks of Chin-sha-chiang.) Summer is the rainfall season, and April-May of each year is drought season.

According to estimation, the annual rainfall for the agricultural areas is between 300 and 500 millimeters, and seasonally the greatest amount of precipitation occurs in the summer, next in amount is autumn, and both spring and winter receive the least amount of rain. The average annual temperature is above 5° C. but it can reach as high as 16-17° C. The lowest winter temperature is -20° C. In the shallow regions of the valleys, evening frost is still found in April-May. Morning frost is seen in August-September. Also, hailstorms occur between the months of July and September. As a result, *Hordeum vulgare* L. var. *nudun* Hk. f. of the Gramineae family is the main staple crop grown, due to its resistance to cold and its short growing period. This is grown in areas at the elevation of 3,000-3,800 meters. At higher altitudes, even *Hordeum vulgare* L. can not grow. The area of grasslands is greater than the cultivated area.

2. Types of soil and their distribution: The soil in this area can be classified into three types:

(1) Chestnut pedocals -- This soil is mainly distributed along the lowlands of the river valleys at the elevation of 3,000-3,700 meters. Generally this soil is found around the elevation of 3,500 meters. The alluvial fans and terraces of the river beds are mostly composed of this type of soil. The characteristics of this type of soil are its good drainage, richness in calcium, alkalinity, and top soil thickness of 20-30 centimeters. The color of this soil is light brown or gray-brown. Soil that developed from the red rock strata is purplish brown in color. The sub-soil is greyish white. The quality of the soil ranges from silt to coarse sand or gravel.

(2) Brown forest soil -- The distribution of this soil is at a higher elevation level than the chestnut pedocals, generally between 3,500 and 4,000 meters. This soil is found wherever there are forests. Because of weaker sunlight and greater precipitation, there is a richness in compost decay in the soil which is mostly acid or neutral. The top soil is dull brown color with a light loamy texture that can hold large quantities of water. The top soil is between 15 and 20 centimeters in thickness. The subsoil is over 30 centimeters in thickness and yellowish brown in color. Its great fertility is the reason for the area being the forestation region for *Piceae*, *Betula* and *Iopulus*. The soil on the sunny slopes is light brown and its texture is similar to that of the brown soil. The top soil is thin with average fertility and less rich in compost. The subsoil is light yellowish brown and clay-like, and its thickness is about 40 centimeters. It is

distributed on the slopes the inclination of which is around 15-30°. The main vegetation on this region of the soil consists of *J. pseudo sabina* Fischer et Meyer and shru forests. Due to sparse growth, plants are easily washed away.

(3) Soil of the tall grass steppes -- This soil is found in the mounds, high grounds, and flat grass banks at the elevation level of 3,500-4,200 meters. Very little of this soil is found in the valley slopes or damp grounds below the elevation of 3,500 meters. Dead plants are difficult to decompose due to cold climate, and therefore the soil lacks compost materials. The soil contains tangled masses of partially decomposed roots which impart a foamy texture to the soil. Local inhabitants frequently use these partially decomposed materials for wall constructions and house repairs. The slightly claylike topsoil is 10-30 centimeters thick. The thickness of the subsoil is variable, greyish white, and contains much sand and gravel. The soil varies from slight acidity (poor drainage, low river bed, damp grounds) to slight alkalinity (mountain regions with fairly large slopes), and this is the main steppe area for the growth and distribution of Cobresiceae grasses and short grasses. It is an important summer pasture land.

### III. RELATIONSHIP BETWEEN ENVIRONMENTAL CONDITIONS AND PLANT DISTRIBUTION

#### A. Distribution of Plants

1. Discussion on survey of perpendicular order of plant distribution in this area: In the perpendicular order of plant distribution in this area, different plants sometimes show very little difference among them, but their height has great variations. This is due to the complex topographical nature of this area. Beginning from the bottom up, plants are found to be distributed in the following order: tall trees, shrub trees, and finally the grasses. The more clearly defined environmental-induced perpendicular type changes are found in the area labeled belt followed by the area labeled strata. This discussion follows this order [see Figure 2 appended at end].

(1) The forest steppe belt -- Altitude changes covered by this belt are very pronounced. Of the areas I have traversed, only Cha-hsi-ta-ts'ang (elevation 2,950 meters) on the banks of Lan-ts'ang River was under an elevation of 3,000 meters. We were over 3,000 meters at all

other times. At this low altitude the distribution of Piceae, for instance, had not reached the lower boundary of the forest belt. The upper boundary of this belt was generally limited to the elevation of 4,200 meters. However, many regions, due to their topographical features (flat), and climatic conditions (arid), are not suitable for forests at such a high altitude (most forest elevations average around 4,000 meters). Because the areas surveyed are narrow valleys at the northern end close to the steppes of Tsing-hai (the vast steppes of Yu-shu and Nan-ch'ien), the climate is cold and arid. Therefore on the slightly inclined mountain slopes many shrub forests (on shady slopes) and vast grasslands (on sunny and semi-sunny slopes) dot this belt. (for this reason this area is labeled the forest steppe belt which is both a forest and grazing area.) Going up from the bottom this belt can be divided into two strata:

(a.) Mixed stratum of summer green broad-leaves and acerose-leaves -- The elevation of this stratum is between 2,950 and 3,800 meters. The chief acerose-leaf tree found in this stratum is *Picea Balfouriana*, Rehder et Wilson which grows on shady slopes (small numbers of *Picea Purpurea*, Masters are among them). The next important species is *J. pseudo-sabina*, Fischer et Meyer that grows on the sunny slopes. Other species like *Larix Mastersiana*, Rehder et Wilson that is found at Che-to-sh'an, and *Abies Delavayi*, Franchet are very sparse in this stratum. *Betulaceae* are often found growing in *Piceae* forests. These sometimes grow heterogeneously at some places, and homogeneously as individual forests at other places. *Betulaceae* prefer sunlight and dampness, and most of them grew up over destroyed *Piceae* forests. If these two different types of trees are grown together, each will grow according to its natural abilities, but the *Betulaceae* will be overpowered and caused to die by the *Piceae*. The species *Populus Davidiana*, Dode is often found in this area, and since it prefers an abundance of moisture, it is limited to the valley swamps. The distribution of this species is at a lower altitude than the *Betulaceae* (3,000-3,400 meters). The brown soil in the *Piceae* forests is very rich and fertile, and very little sunlight falls upon it. At the forest edges the following shrubs are often found: Shrubs growing below the forests are *Potentilla*, *Spiraea*, *Sibiracca*, *Lonicera*, etc.

Shrubs along the gorges and edges of forests are *Salix*, *Rhamnus*, *Ribes*, *Prunus*, *Lonicera*, *Acanthopanax*, *Malus*, *Cornus*, *Evonymus*, *Syringa*, *Hippohae*, etc.

*J. pseudo-sabina*, Fischer et Meyer is found scattered on the sunny slopes. The shrubs that are often found below the forests are the Berberidaceae, *Caragana bicolor* Komarov, *Cotoneaster multiflora*, Bunge, etc. Besides these, there are many drought-resistant varieties of grasses that thrive in sunlight, forming large areas of grasslands on warm sunny or semi-sunny slopes.

(b.) Stratum of acerose-leaf forest -- This stratum is spread over the elevation between 3,800 and 4,000 meters, and sometimes goes as high as 4,200 meters due to topographical features and conditions. The chief forest tree is *Ficea Balfouriana*, Rehder et Wilson that grows on the shady slopes. Some species of *J. pseudo-sabina* were found opposite Cha-hsi-ta-ts'ang on the Lan-ts'ang River. Aside from the *Potentilla*, *Spiraea*, and *Lonicera* types of shrubs found below the forest, evergreen and deciduous *Rhododendrons*, like *Rhododendron Przewalskii*, Maximowicz and *Rhododendron Turdomii*, Rehder et Wilson, were also found. Some species of *J. pseudo-sabina*, Fischer et Meyer forests were found along the sunny or semi-sunny slopes, and in a few instances (such as at La-ma-la) some *Juniperus* trees were found. A heterogeneous growth of *Ficeae* and *Juniperus* was found along the slopes of narrow valleys that run north and south. On wide valleys timber forests are replaced by shrub forests, which in extreme cases replace steppes to become an important forestry and grazing region, with the latter as the important occupation.

(2) Alpine shrub and steppe belt -- This belt exists between the forest belt and the snow line at an elevation of 4,000-5,000 meters. Forests are completely absent in this region of Alpine shrub steppe. The only species of acerose-leaf tree found was the shrub-like *Juniperus squamata*, Lambert. Beginning from the bottom this belt can be divided into two strata:

(a.) The Alpine shrub stratum -- This stratum is situated at an elevation of 4,000-4,500 meters. With the exception of a few mountain peaks the inclination of the slopes is generally not great. Short tree forests are evenly scattered on the steeper sunny slopes where the species of *J. squamata*, Lambert is sometimes found. The form of the *J. squamata* is like a bun, and among this species a small number of short shrubs such as *Berberidacea* and *Caragana jubata*, Poiret are found. On the steeper and shady slopes there are large tracts of shrub forest which grew downward from the mountain peak to a definite boundary. Sunshine and evaporation increase because of the little changes in slope inclination, and these regions

change into grassy steppes. At a distance the lines separating the shrub forests from the grassy steppes can be seen very clearly. The important shrubberies of these forests are *Rhododendron fastigiatum*, Franchet; *Spiraea trilobata*, L.; *Prunus fructicosa*, L.; and the Salicaceae, etc.

Besides being spread out below shrub forests and on shady and less inclined slopes, mountain steppes are also found on the sunny and partly sunny slopes of flat and low mountain mounds, and they are almost completely covered by the two species of *Cobresia* *Royleana*, Boeck and *Cobresia fifida*, Tang et Wang grasses. The surface areas of these steppes are much greater than the surface areas covered by shrub forestation. These grasslands are important summer pasture grounds. All the grasses are of the short variety no taller than 15 centimeters, covering 70-80% of the ground. Between Pang-ta and Lang-la only one grass species, *Stipa conferta* Turczaninow, was found to reach the height of about 1 meter. This species was distributed over a large area of the rising sub-steppe at the elevation of around 4,000 meters. This type of grass deserves study as to its probable use.

(b.) Alpine in steppe stratum -- This stratum is found at the elevation of 4,500-4,800 meters. This is a short grass region with complete absence of shrub foliage. Snow and ice begin to cover this stratum around August and September of each year and thaw in May-June of the following year. This is the reason for the growth of special types of flora in this region. The most prominent grasses are the varieties of *Cobresia* and *Blysmus*. Scattered among these grasses are several species of *Gentiana*, *Polygonum viviparum* and *Polygonum sphaerostachyum*, two species of *Saussurea* sp., and several species of Caryophyllaceae, and species of *Arenaria* L., *Androsace* *Tapete* Maximowicz and other Caespitose plants of the *Androsaceae* family. Most of these plants can utilize the food stored in the deep long roots from the previous season and grow to maturity quickly forming seeds to insure their propagation. This cycle of growth, food storage, and maturity repeat themselves. All these Alpine plants are highly resistant to cold blooming and forming seeds even after frost and snow. Caespitose plants are especially adapted to resist wind and cold.

(3) The cold placodium belt -- This belt is at the elevation between 4,800 and 5,000 meters. Only several months of the year are snow and ice free (June-August). Neither grasses nor trees grow in this belt. After thawing of ice and snow, a small amount of mottled orange-yellow,

orange-red, and green placodium is found attached to the bare rocks.

(4) The snow-line -- The snow line exists around the elevation of 5,500 meters.

2. Different plant types seen along regions of survey route: The flora of this area can be divided into the following four types according to the law of horizontal regions (see fig. 1):

(1) Region of arid shrub steppe -- The elevation of this region is between 3,000 and 3,500 meters, including the alluvial fans and terraces in the river valley. Agriculture is flourishing. The population is comparatively dense. The forests have been completely cut and destroyed while the pasturelands are over-grazed. The natural flora remaining are all drought and alkaline resistant strains. In the shrub forest remnants only the following species of Caragana, Rosaceae, Sophora, Phellodendron, Rhamnus and Cotoneaster remain. Among the large group of herbaceous plants, the Cobresia, Stipa, Pennisetum, Secale, Oxytropis, and Astragalus continue to grow. The soil is chestnut pedocal. The farmers grow poplars along the gullies and at the edge of the villages. They use wood farm tools and obtain lumber from these trees. The important areas in this region are Kan-tzu, Teh-ke, Ch'ang-tu, Yen-to, Hsiang-tui, etc.

(2) Semi-arid forest steppe region -- This is a region of narrow river and valleys and steep mountain slopes situated at an elevation of 3,000-3,800 meters. It is important as a forest region. Shrubbery and grasses are interspersed throughout the region, which makes it a mixed forest and grazing area. The forests have the following kinds of trees: Picea Balfourina Rehder et Wilson, Picea Purpurea Masters, J. pseudo-sabina Fischer et Meyer, Juniperus chinensis L., Juniperus pseudosabina, Betula japonica var Szechuanica, and Populus Davidiana. These trees frequently are formed into large areas of virgin forests. The shrub trees found are: Rhododendrons, Spiraea, Spiraea alpina Pallas, Prunus fructicosa L., Salix, Cotoneaster multiflora, Berberis, Jambosa caryophyllus, Rosaceae, Caragana bicolor Komarov, Rhamnus, Rubus parvifolius L., Ribes alpestre, Araliaceae, Prunus tangutica, Prunus ansu, Malus kansuensis, etc. Gramineae and Blysmus plants are the most abundant in the steppe, covering about 70% of the area.

(3) Alpine shrub steppe region -- This region includes a small part of the alpine shrub and acerose leaf strata in the perpendicular order of plant distribution

mentioned previously, and it exists at an elevation of 3,800-4,500 meters. Incorporated in this region are the vast grassy steppes of northwest Szechwan and those south of Ch'ang-tu which are very important summer pasture lands. The shrub forests on the shady slopes are of secondary importance. The important steppe grasses are: *Blysmus compressa*, *Cobresia bifida*, and *Cobresia pygmaea*. The important shrubs are *Rhododendron*, *Prunus fructicosa*, *Populus Davidiana*, etc.

(4) Alpine steppe region -- This region exists at an elevation of 4,400-4,800 meters that includes the upper stratum of the high mountain shrubs, and the entire stratum of Alpine grassy steppe. Shrubs are very scarce in this region, and it is covered mostly by *Cobresia Royleana*, *Cobresia pygmaea*, etc. Scattered among these dominant grasses are a few small grasses like *Gentiana*, small leaf *Polygonum*, a few species of *Saussurea* and *Arenaria*, etc. Sheep and cattle are driven here for summer grazing.

3. Agricultural area boundary: *Hordeum vulgare*, L., var *nudun* Hk. f. is the main staple crop of this entire area. The line from Kan-tzu to Ch'ang-tu is generally between the elevation of 3,000-3,800 meters, and the lower limit of this boundary drops to 2,500 meters which is eastward from Kan-tzu. Southward along the Lan-ts'ang River to A-tsu (elevation 3,900 meters), Shih-pan-kou (elevation 3,800 meters), and Pang-ta (elevation 3,900 meters), the upper limit can reach 3,900 meters. Although there is frequent frost and snow in these three places, most of the *Hordeum vulgare* harvest is early harvest. In animal husbandry, the yak cannot adapt itself south of Chu-chia due to hot weather, and the P'ien-yu is substituted. (The P'ien-yu is a crossbreed between the yak and yellow ox. It can stand heat.) Therefore latitude 30.5° north is the dividing line between north and south. Crops like *Brassica campestris*, L., *Fagopyrum esculentum*, Moench, spring millet, *Pisum sativum*, *Lens culinaris*, Medicus, etc. are limited to south of this line. In the lower valley grounds spring millet can be grown. With the exception of *Brassica campestris* and *Fagopyrum esculentum*, the other three, spring millet, *Pisum sativum*, and *Lens culinaris*, are grown occasionally at valley bottoms below the elevation of 3,500 meters.

4. Types of area flora and their environmental adaptation: Plants in this area have developed special morphological and physiological changes and characteristics for adaptation to this complex natural environment.

(1) Analysis of plant families, genres, and species. Over 1,400 specimens were collected in this area

totaling 81 families. Among these the families that had more genres and species are: Compositae, Gramineae, Labiatae, Rosaceae, and Leguminosae. The important large genres in this collection are: Ephedra, Caragana, Lonicera, Cotoneaster, Rhamnus, Astragalus, Oxytropis, etc. This group contains the more arid resistant types of plants. From this, one can understand the semi-arid climate of this area. Many of the genres like the Pedicularis, Cobresia, Saxifraga, Saussurea, Gentiana, Meconopsis, Androsace, Arenaria, etc. are cold resistant strains. The total number of families and genres in this collection is not great, but the variety of species in one genus is much wider than plants found on level land. The following list of families and genres proves the point:

| Genus       | Number of Species |
|-------------|-------------------|
| Pedicularis | 23                |
| Polygonum   | 10                |
| Saussurea   | 8                 |
| Lonicera    | 8                 |
| Cotoneaster | 7                 |
| Oxytropis   | 16                |
| Androsace   | 6                 |
| Caragana    | 8                 |
| Astragalus  | 8                 |
| Gentiana    | 6                 |
| Ribes       | 4                 |
| Saxifraga   | 4                 |
| Ephedra     | 5                 |
| Cobresia    | 5                 |

(2) Abundance of high mountain type plants: Plants in this high mountain area are mostly highly capable of preserving their mountain type characteristics, and the following several types are the most prominent:

(a.) Prostrate plants -- It is exceedingly cold and windy in the high mountains, and the growth period for plants is short. Many shrubs found at the elevation over 4,000 meters exhibited short and prostrate forms. Because of the yearly short period of growth, the plant's main root or branches extend very little upward, and the branch stems creep outward as if they are crawling along. The most common species seen was the Juniperus squamata that profusely covered the mountain slopes. The crown of its foliage is flat like a round bun. It is about several meters tall with the small side branches creeping and spreading outwards. The diameter of the tree crown frequently reaches 4-5 meters. This tree has many morphological types which can be selected for garden landscapes. On the mountain

slopes at Hai-tsu, a species of creeping poplar was found. Its height was about 5-8 centimeters and clung to the surfaces of rocks. Its leaves were shiny and oily green in color, and at a glance it resembled the yellow poplar. On the mountain peaks at Chia-pi-na we also saw another species of creeping poplar whose height was under 1 meter with a crown diameter about 2-3 meters. The two species of *Cotoneaster horizontalis* and *Cotoneaster adpressa* were frequently seen. Morphologically they are very short plants clinging and creeping between cracks of rocks, and turn into a solid red in the fall which is quite beautiful. On the mountain slopes between Chu-chiah and L'ang-sh'an there was a species of creeping *Ephedra* which exhibited short and dense branches grouping into the shape of a bun. The branches of this plant are very hard.

(b.) Caespitose-Decumbent plants -- At all the high mountain passes between the elevation of 3,800 and 4,200 meters that we passed through, we found several species of perennial herbaceous caespitose-decumbent plants growing on flat slopes and slightly inclined mountain sides. The most prominent ones are the *Thylacospermum caespitosum* Schiskin of the Caryophyllaceae family, *Arenaria kansuensis*, *Stellaria decumbens*, and the caespitose-decumbent members of the Primulaceae family. All these plants are either caespitose or decumbent with long main roots growing deep in the ground. The side branches growing on the surface of the ground are very short and dense, stretching out irregularly. This type of plant can withstand cold, maintain the warm ground temperature and reduce evaporation at the same time. These are typical types of high mountain plants.

(c.) Bulb and Tuber plants -- The high mountains are covered with snow almost throughout the year with very cold climate. Because of the short growing period, the plants mostly draw upon the food substances stored in the previous year in their main roots, bulbs, or tubers for growth and seed formation requirements during the growing season. By the process of photosynthesis more food is manufactured and stored for future use. These are typical short life plants. There are both annuals and perennials in this group of plants. The prominent ones are the following: (i) plants with large and long main roots -- *Rheum palmatum*, *Gentiana macrophylla*, *Oxytropis*, etc., (ii) Bulbs -- *Fritillaria Roylea*, *Hooker*, etc., (iii) Tubers and corms -- *Potentilla anserina*, L., and *Polygonum*s.

(d.) Plants with small hairy leaves -- There are many plants of this type: *Meconopsis*, *Caragana*, *Thermopsis*, *Saussurea*, *Astragalus*, and *Oxytropis*.

(e.) Snow blooming plants -- On most of the high mountain passes and steppes, we saw many plants whose flowers frequently bloom in the snow. Some examples are the species of Saussurea, several species of Gentiana and Pleurospermum.

(f.) The family of Cobresiaceae grasses in the steppes -- Because of the high altitude and extreme cold in this region, the dominant grasses of the Cyperaceae are the Cobresia, and Blysmus species. The quality of the Blysmus compressus Panz is the best, and it is found in the shallow waters of the lowest region of the river bed, covering over 80% of such regions. The yield of this grass is rather high, and over a long period of time, it has spread over a wide area, providing good pasture lands for the winter. Cobresia Pygmaea C. B. Clarke is distributed over especially higher grounds. The quality of the grass is good and it covers about 70% of the ground. Although its yield is low, such lands are valuable for summer grazing (the most important grass feed for the Tsing-hai and Tibet yaks). The grass Cobresia bifida Tang et Wang is distributed in the regions between the above two grasses. It is important for spring and fall grazing. The remaining two grasses, Cobresia capillifolia C. B. Clarke and Cobresia Royleana Boeck, are limited in growth, and their quality is poor. The following chart presents this group of grasses clearly.

| Chinese name   | Scientific Name      | Growth Type    | Elevation of most abundant distribution (in meters) | Regions of Perpendicular Order of Distribution and Environmental Conditions                   |
|----------------|----------------------|----------------|---|---|
| Chi-nese       | Cobresia             | Cold-arid type | 4,000-4,800   | Alpine shrub stratum of the alpine shrub steppe and alpine steppe stratum (alpine grasslands) |
| hsi-sung grass | Pygmaea C. B. Clarke |                |   |   |

| Chinese Name    | Scientific Name                               | Growth Type         | Elevation of most Abundant Distribution (in meters) | Regions of Perpendicular Order of Distribution and Environmental Conditions                            |
|-----------------|---|---------------------|---|--|
| Kao-sung grass  | <i>C. Royleana</i><br>Boeck                   | Cold-damp type      | Around 4,000  | Alpine shrub stratum (Alpine grasslands)   |
| Ying-sung grass | <i>C. capillifolia</i><br><i>C. B. Clarke</i> | Cold-Temperate Type | 3,900-4,000   | Aerose leaf stratum of the forest steppe belt (peat soil)  |
| P'o-sung grass  | <i>C. bifida</i><br>Tang et Wang              | Warm-arid type      | 3,500-4,000   | Forest steppe belt (well drained arid slopes and calcareous earth)                                     |
| Shui-so grass   | <i>Blysmus compressus</i><br>Panz             | Warm-damp type      | 3,000-4,000   | Forest steppe belt (flat lands, peat and calcareous soil at places of shallow underground water table) |

(g.) Species of the Pedicularis family -- Species of the Pedicularis family are high mountain and high latitude plants. They are cold resistant and prefer much sunshine. Therefore they are very abundant in this region. 25 species were collected this time, and most of them were growing in the high mountain shrub steppe stratum of the high mountain shrub steppe belt (dominant specie *P. trichogiosa*) and the high mountain steppe stratum (dominant specie *P. ingens*). Very few species are distributed along the steppes of the forest steppe belt (dominant specie *P. kansuensis*). This entire family grew on sunny slopes, and most of them prefer to grow in the wet steppes (*P. longiflora* especially grows well in wet soil). It was impossible to find these species in the forests. Budding takes place in early spring between April and May, and

full maturity with seed formation is accomplished by most species in July-August. Most of these species produce beautiful and adorable flowers. (These plants in the future can be grown for enjoyment.) The chart in section IV gives a complete description of this family.

IV. ECONOMIC PLANTS OF THIS AREA

| ID No. | Scientific Name   | Place Found   | Flower Color  | Date of Collection |
|--------|---|---|---------------|--------------------|
| 1.     | <i>Pedicularis alaschanica</i> Maxim ssp. <i>tibetica</i> Maxim | Chieh-to-sh'an (4190)                               | Yellow, light | July 2-8, 1951     |
| 2.     | <i>P. cheilanthifolia</i> Schrenk                               | Teh-ke, Hai-tsu-sh'an (4967, 5012a)                 | Purplish red  | July 24            |
| 3.     | <i>P. confertiflora</i> Frain                                   | Chiang-ta to Chio-ya (5315)                         | Purplish red  | August 18          |
| 4.     | <i>P. crenolopha</i> Maxim                                      | Vicinity of Kan-tzu (4342)                          | Bright red    | July 11            |
| 5.     | <i>P. cyathophylloides</i> Limpr                                | Vicinity of Teh-ke (5149)                           | Purplish red  | August 5           |
| 6.     | <i>P. Elwesii</i> Hk. f.  | Je-ya (5462)  | Purplish red  | August 22          |
| 7.     | <i>P. Granieri</i> Bonsh  | E (5220)  | Yellow (?)    | August 11          |
| 8.     | <i>P. ingens</i> Maxim  | Teh-ke, Hai-tsu-sh'an (4989a)                       | Yellow        | July 28            |
| 9.     | <i>P. integrifolia</i> Hk. f. var. <i>integerrima</i> Tsoong.   | From Je-ya to Teh-puchia (5470)                     | Purplish red  | August 23          |
| 10.    | <i>P. kansuensis</i> Maxim                                      | Kang-ting (4170) E (5250a), Pai-li (5355)           | Purplish red  | July 1, Aug. 18    |
| 11.    | <i>P. lachnoglossa</i> Hk. f.                                   | Kan-tzu (4345), From Chiang-ta to Chueh-yung (5317) | Purplish red  | July 12- Aug. 18   |

| ID No. | Scientific Name  | Place Found                             | Flower Color              | Date of Collection |
|--------|--|---|---------------------------|--------------------|
| 12.    | <i>P. longiflora</i> Rudolph   | Teh-ke, Hai-tsu-sh'an (5013, 5024)      | Yellow                    | July 24            |
| 13.    | <i>P. melampyriflora</i> Franchet  | Teh-ke (5109)                           | Purplish red              | August 5           |
| 14.    | <i>P. Oederi</i> Vahl  | Teh-ke, Hai-tsu-sh'an                   | Light yellow              | July 24            |
| 15.    | <i>P. Oederi</i> var. <i>heteroglossa</i> Prain  | Chieh-to-sh'an (4219)                   | Yellow                    | July 3             |
| 16.    | <i>P. Przewalskii</i> Maxim. ssp. <i>microphyton</i> Li                                    | Chieh-to-sh'an (4224)                   | Yellow with purplish tint | July 3             |
| 17.    | <i>P. rhinanthoides</i> Schrenk var. <i>labellata</i> Prain                                | Chieh-to-sh'an (4235)<br>Kan-tzu (4264) | Purplish red              | July 3-12          |
| 18.    | <i>P. rupestris</i> Franchet   | To-pa to Je-ya (5430)                   | Purplish red              | August 22          |
| 19.    | <i>P. Siphonantha</i> Don  | Je-ya (5454)                            | Purplish red              | August 22          |
| 20.    | <i>P. Szetschanica</i> Maxim. ssp. <i>angustifolia</i> Bonati var. <i>normalis</i> Tsoong. | Teh-ke sung-lin-kou (4391, 4407)        | Purplish red              | July 15            |
| 21.    | <i>P. Szetschanica</i> Maxim. ssp. <i>typica</i> Li var. <i>normalis</i> Tsoong.           | Teh-ke sung-lin-kou (4364)              | Purplish red              | July 15            |
| 22.    | <i>P. tatsienensis</i> Franchet  | E-na (5269, 5275)                       | Purplish red              | August 12          |
| 23.    | <i>P. Tongolensis</i> Franchet(?)  | Teh-ke (5144, 5150a)                    | -----                     | August 5           |
| 24.    | <i>P. trichoglossa</i> Hk. f.  | E-na (5275a)<br>Hai-tsu-sh'an (4962)    | Purplish red              | July 24<br>-Aug 24 |
| 25.    | <i>P. verticillata</i> L.  | Teh-ke, Hai-tsu-sh'an (5012b)           | Purplish red              | July 24            |

1. Agricultural Plants

Because of the high physical features of this area, only the species *Hordeum vulgare* L., var. *nudum* Hk. f. (lo-m'ai) is grown, and it grows only at the bottom lands of the river bed. This species of *Hordeum vulgare* needs only four and one-half to five months to grow. If the early part of the year is good, the *Hordeum vulgare* can be harvested and another crop of *Fagopyrum esculentum* Moench or *Brassica campestris* L., var. *Rapa* Hk. f. et Anders can be planted. Sometimes spring millet (growing period is half a month longer than *Hordeum vulgare*) is grown in a few regions. In the low river valley grounds *Pisa sativum* and *Lens culinaris* are also grown but the cultivated areas are more limited. In the cultivated *Hordeum vulgare* fields, there is a species of wild *Avena sativus* L. Because this wild species ripens half a month earlier than the *Hordeum vulgare*, its seeds will fall to the ground before the *Hordeum vulgare* can be harvested, so that next year this wild species of *Avena sativus* will grow again. Prior to the regular harvest, the farmers pull up the wild *Avena sativus* entirely and use them for animal feed. In the agricultural area the introduction and growing of cold resistant and early ripening crops can be successful. Such crops that can be introduced are: potato, *Setaria italica* Beauvois, *Panicum miliaceum* L., *Panicum miliaceum* L. var. *effusum* Alefeld, *Avena sativus* L., *Avena nuda* L., *Secale cereale* L., *Cicer arietinum* L., *Linum usitatissimum* L., *Canabis sativa* L., *Nicotina rustica* L., etc.

2. Staple Plants

The staple food of the people of Tibet is *Hordeum vulgare* which is ground into flour and made into bread to be eaten with beef, mutton and milk products. At present over 20 kinds of vegetables have been introduced at Kan-tzu, Ch'ang-tu and Lhasa. According to our investigations, wild local plants that can be used for food are *Fritillaria Roylei* Hook, *Potentilla anserina* L. (called "chueh-ma" by the Tibetans), *Capsella Bursa-pastoris* Medicus, *Rheum palinatum* L, *Rhemu Alexandre Batal*, *Arctium lappa* L, *Malva sylvestris* L, *Portulaca oleracea* L, *Artemisia pectinata* Pallas, and *Setaria italica* Beauvois.

3. Timber Trees and Fuel Plants

The main forest timbers in this area are *Ficea Balfouriana* Rehder et Wilson and *Juniperus Pseudo-sabina* Fischer et Meyer. Their timber reserve is most extensive.

These timbers can be used for construction, for making tools and utensils, and as raw materials for paper making. The tannin content of the *Picea* bark reaches 16.13% (According to 1953 analytic report of the Central Ministry of Forestry and Agriculture.) Besides these two species, *Betula japonica* Siebold var. *Szechuanica* Schneider and *Populus Davidiana* Dode are also important timbers. In Tibetan, *Prunus fructicosa* L. is called "p'ien-ma", and in the construction of Lama monasteries in Szechwan and Tibet, the branches of this tree are often bundled together and dyed black and used as cushions under the eaves. They are strong and beautiful. In areas of dense population where there are few forests, shrubs are used for fuel. In nearby houses, one finds cut prickly shrubs such as *Sophora vicifolia* Hance, *Hippophae rhamnoides* L., *Caragana bicolor* Komarov, and *Rhamnus*. Shrubbery trees are found some distances from villages, and they consist of *Cotoneaster multiflora* Bunge, *Rhododendron fastigiatum* Franchet, *Spiraea trilobata* L., *Juniperus squamata* Lambert, *Prunus fructicosa* L., *Sibiraea laevigata* Maximowicz var. *angusta* Rehder, and *Lonicera*s. From this it can be seen that fuel is a very serious problem.

#### 4. Feed Plants and Poisonous Grasses

In the area surveyed, including the regions of Ia-su and Cheng-k'o, the homes of the 39 tribes are strictly pastoral. All the other regions are both agricultural and grazing country. Sheep and yaks are the chief animals raised, and in the summer and fall they are driven to high mountain pastures (elevation between 3,500 and 4,000 meters with the *Cobresia* and *Blysmus* as the main grazing grasses forming the main cyperaceae grassy steppe). In spring and winter the herds are driven to the lower part of the valleys (under 3,000 meters altitude). South of Ch'ang-tu along the arenaceous shale slopes of the lower valleys of the Lan-ts'ang River, four species of superior feed grasses, *Spodiopogon*, *Themeda*, *Bromus*, and *Pennisetum*, grow into a vast grassy land which can be used for grazing, or they can be cut and stored for animal feed. In some places, the grass *Urtica cannabina* L. is cut for winter feed. Along the highway from Kan-tzu to Ch'ang-tu only the species of *Pennisetum*, *Stipa*, and tall grasses were found. Their distribution is scattered, which makes it difficult to harvest. During the winter when heavy snow covers the mountains, the herds are forced to be driven to shrub forests for grazing. Therefore the cultivation of grazing grass is a serious problem. Poisonous grasses

in this area are many and varied, especially along both sides of the highway. Because the area is over grazed, more poisonous grasses grow. One of the most important poisonous grasses is *Stipa conferta* Poiret that grows at an elevation of 3,000-4,000 meters. It grows ruggedly in arid and alkaline calcareous soil and when fully mature, it reaches the height of one meter or more. After the animal has eaten it, the first symptom is a stomach-ache, followed by acute constipation and urinary obstruction leading to death of the animal. The next poisonous grass is the species *Astragalus secundus* De Candolle of the Leguminosae family which animals mistakenly eat. This grass is distributed throughout the farming regions that are below the elevation of 3,500 meters. After hungry animals have eaten a large quantity of this grass, they first show dementia behavior jumping and kicking and running in all directions. After continued eating of this grass they become more demented with their heads hanging low, and refuse to eat. Finally acute constipation and urinary obstruction set in. The animals become debilitated and finally die. The conditions exhibited are like loco poisoning. Other poisonous grasses such as tu-na-yung (phoneticized Tibetan) (aconitum), Melica, and Delphinium grow profusely along the highway roadsides. Studies should be made on their control and eradication.

##### 5. Pharmacological Plants

Besides animal derived pharmacological products such as musk, deer's antlers, and antelope horns, there are many varieties of pharmacological plants in this surveyed area. The important ones are listed below.

(1) Ch'ung-ts'ao (also known as Tung-ch'ung-hsia-ts'ao-Cordyceps sinensis Sacc.) -- This variety of plant commonly grows in damp regions in forests and shrub forests. They are dug up in April-May of each year. According to the 1950 estimate of the Office of Economics of the Si-kang People's Autonomous Government, the annual production of Ch'ung-Ts'ao in northwest Szechwan was over 20,000 catties. They are most abundant in Kang-ting, Li-hua, and Yu-shu regions. They are important tonics.

(2) *Rheum palmatum* Linnaeus -- Distribution of this plant is found in the wide sunny and semi-sunny valley slopes at an elevation of 3,000-4,000 meters. Sometimes they are found in large single homogenous groups. When the "tea" from boiling roots of this plant is fed to horses, it can cure their constipation and urinary obstruction. It is estimated that the annual production of this

plant in northwest Szechwan is over 500,000 catties. These are dug up and sliced in the spring of each year. The root bark is rich in tannin. During the year 1950-51 the Kan-ting Native products Company purchased 180,000 catties of this plant.

(3) *Fritillaria Hoylei* Hooker -- This plant is distributed among shrub forests at an elevation of 3,000-4,000 meters. According to the 1950 estimate of the Office of Economics of the Si-kang Area People's Autonomous Government the annual production of this plant in this surveyed area was between 40,000-50,000 catties. But according to the estimates made by the Kan-ting Native Products Company ending June 1959, over 58,000 catties have already been purchased. Kang-ting, Ch'iu-lung, Tao-fu, Teh-ke, Li-hua, and Ch'ang-tu hsiens produce large quantities of this plant.

(4) *Gentiana macrophylla* Pallas -- A large quantity of this plant is produced on the slopes of wide river beds at an elevation between 3,000 and 3,500 meters. Its growth is especially abundant along roadsides of highways because animals do not eat it. In late fall or early spring of each year, the roots are dug up for medicinal use.

(5) *Ephedra* -- Five species of *Ephedra* were collected in this surveyed area. Of these varieties, the species of *Ephedra Gerardiana* Wallich is widely distributed and produced. It has tall stems and long branches. The farmers around Kan-tzu cut and collect these for fuel. There are large distributions of these plants along the banks of Ya-lung-chiang and Chin-sha-chiang. There is another species that resembles *E. intermedia* Schrenk et Meyer (?) that grows in large groups along the banks of Lan-ts'ang River. The entire plant is white and is about half a meter tall. Along the banks of Lan-ts'ang River a small number of *E. sinica* Stapf was also seen among the shrub forests. There is another species, *E. Fedtschenkoae* O. Pauls that was sometimes seen along river sand banks. This is a very small plant that is no taller than 5 centimeters. Besides these species there is another species of *Ephedra* that has profuse, dense and hard branches forming the shape of a bun. This was found at Chu-chia on the banks of Lan-ts'ang River at approximately 4,000 meters elevation. The production of this species is quite abundant.

Production of the following plants -- *Paeonia Delavayi* Franchet, *Hyoscyamus agrestis* Kitaibel, *Anemarrhena asphodeloides*, *Xanthoxylum simulans* Hance, the *Saussureas*, and *Platycodon grandiflora*, is also great but they will not be dealt with here in detail.

(6.) Other special use plants -- Horticultural plants in this area that can be improved are the two species of *Ribes* family, *Ribes alpestre* Dene and *Rubus parvifolius* Rolfe, and the several species of *Trunus* ansu Komarov, *P. tangutica* Koehne, and the persimmon. These are all cold resistant fruit trees, and attempts should be made to encourage their cultivation.

V. COMPARATIVE CHART ON CHINESE and SCIENTIFIC PLANT Nomenclature

(1) Gymnosperms

- Pinaceae
  - Abies Delavayi* Franchet
  - Larix Mastersiana* Rehder et Wilson
  - Picea Balfouriana* Rehder et Wilson
  - P. Purpurea* Masters
- Cupressaceae
  - Juniperus chinensis* Linnaeus
  - J. pseudo-sabina* Fischer et Meyer
  - J. squamata* Lambert
- Gnetaceae
  - Ephedra Fedtschenkoae* O. Pauls
  - E. Girardiana* Wallich
  - E. intermedia* Schrenk et Meyer (?)
  - E. sinica* Stapf

(2) Angiosperms

- 1. Dicotyledons
  - Salicaceae
    - Populus Davidiana* Dode
    - P. cathayana* Rehder
    - Salix Souliei* Seemen
    - S. Matsudana* Koidz
  - Juglandaceae
    - Juglans regia* Linnaeus
  - Betulaceae
    - Betula japonica* Siebold, var. *Szechuanica* Schneider
  - Ulmaceae
    - Ulmus pumila* Linnaeus
  - Moraceae
    - Cannabis sativa* Linnaeus
  - Urticaceae
    - Urtica cannabina* Linnaeus
  - Polygonaceae
    - Fagopyrum esculentum* Moench
    - Polygonum sibiricum* Laxmann
    - P. tenuifolium* Kung
    - P. sphaerostachyum* Kung
    - P. viviparum* Linnaeus
    - Rheum Alexandre* Batal
    - R. palmatum* Linnaeus

|                 |                                 |
|-----------------|---------------------------------|
| Fortulacaceae   | Portulaca oleraceae Linnaeus    |
| Caryophyllaceae | Arenaria kansuensis Maximowicz  |
|                 | Stellaria decumbens Edgeworth   |
|                 | Thylacospermum caespitosum      |
|                 | Schischkin                      |
| Ranunculaceae   | Paeonia Delavayi Franchet       |
|                 | Aconitum sp.                    |
| Papaveraceae    | Meconopsis Horridula Hk. f.     |
|                 | et Thoms                        |
|                 | M. integrifolia Franchet        |
| Cruciferae      | Brassica campestris Linnaeus    |
|                 | var. Rapa Hk. f. et Anders      |
|                 | Capselia Bursa-pastoris Medicus |
| Saxifragaceae   | Ribes alpestre Dene var.        |
|                 | giganteum Janczewski            |
| Rosaceae        | Cotoneaster adpressa Bois       |
|                 | C. horizontalis Decaisne        |
|                 | C. multiflora Bunge             |
|                 | Malus kansuensis Schneider      |
|                 | Prunus Ansu Komarov             |
|                 | P. tangutica Koehne             |
|                 | P. Serrulata Lindl.             |
|                 | P. Tomentosa Thunberg           |
|                 | Potentilla anserina Linnaeus    |
|                 | P. bifurca Linnaeus             |
|                 | P. fructicosa Linnaeus          |
|                 | Rosa Omeiensis Rolfe            |
|                 | Rubus Parvifolius Linnaeus      |
|                 | Sibiraea laevigata Maximowicz   |
|                 | var. angusta Rehder             |
|                 | Spiraea alpina Pallas           |
|                 | S. trilobata Linnaeus           |
| Leguminosae     | Astragalus secundus De Candolle |
|                 | Bauhinia Bonatiana Tampanini    |
|                 | B. Faberi Oliv.                 |
|                 | Caragana bicolor Komarov        |
|                 | C. brevifolia Komarov           |
|                 | C. spinosa De Candolle          |
|                 | C. jubata Poiret                |
|                 | Cicer arietinum Linnaeus        |
|                 | Lens culinaris Medicus          |
|                 | Lespedeza dahurica Schindler    |
|                 | Salweenia Wardii Baker          |
|                 | Vicia amoena Fischer var.       |
|                 | oblongifolia Regel              |
|                 | V. unijuga Al. Braun            |
|                 | Sophora viciifolia Hance        |

- Linaceae                    *Linum perenne* Linnaeus var. *Sibiricum* Planchon
- L. usitatissimum* Linnaeus
- Rutaceae                   *Xanthoxylum simulans* Hance
- Malvaceae                  *Malva sylvestris* Linnaeus
- Tamaricaceae              *Myricaria bracteata* Royle
- Thymelaeaceae             *Stellera chamaejasme* Linnaeus
- Wikstromia canescens* Meisn.
- Elaeagnaceae              *Hippophae rhamnoides* Linnaeus
- Ericaceae                  *Rhododendron fastigiatum* Franchet
- R. Przewalskii* Maximowicz
- R. Purdomii* Rehder et Wilson
- Primulaceae                *Androsace Tapete* Maximowicz
- Gentianaceae              *Gentiana macrophylla* Pallas
- Solanaceae                 *Hyoscyamus agrestis* Kitaibel
- Nicotiana rustica* Linnaeus
- Atropantha lucida* Duval
- Bignoniaceae              *Amphicome arguta* Lindley
- Caprifoliaceae            *Lonicera glauca* Hk. f. et Thoms
- L. hispida* Pallas
- L. microphylla* Willdenow
- L. tangutica* Maximowicz
- L. tibetica* Franchet
- Compositae                 *Arctium Lappa* Linnaeus
- Artemisia pectinata* Pallas
- Saussurea* sp.
- 2. Monocotyledons
- Gramineae
- Avena fatua* Linnaeus
- A. nuda* Linnaeus
- A. sativa* Linnaeus
- Panicum miliaceum* Linnaeus
- P. miliaceum* Linnaeus var. *effusum* Alefeld
- Pennisetum flaccidum* Grisebach
- Secale cereale* Linnaeus
- Setaria italica* Beauvois
- Stipa conferta* Foiret
- S. mongolica* Turczaninow
- Hordeum vulgare* Linnaeus var. *nudum* Hk. f.
- Cyperaceae                 *Cobresia capillifolia* C. B. Clarke
- C. bifida* Tang et Wang
- Blysmus compressus* Panz
- Cobresia pygmaea* C. B. Clarke
- C. Royleana* Boeck
- Scirpus littoralis* Schrad.
- Liliaceae                   *Fritillaria Roylei* Hooker

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FIGURE APPENDIX

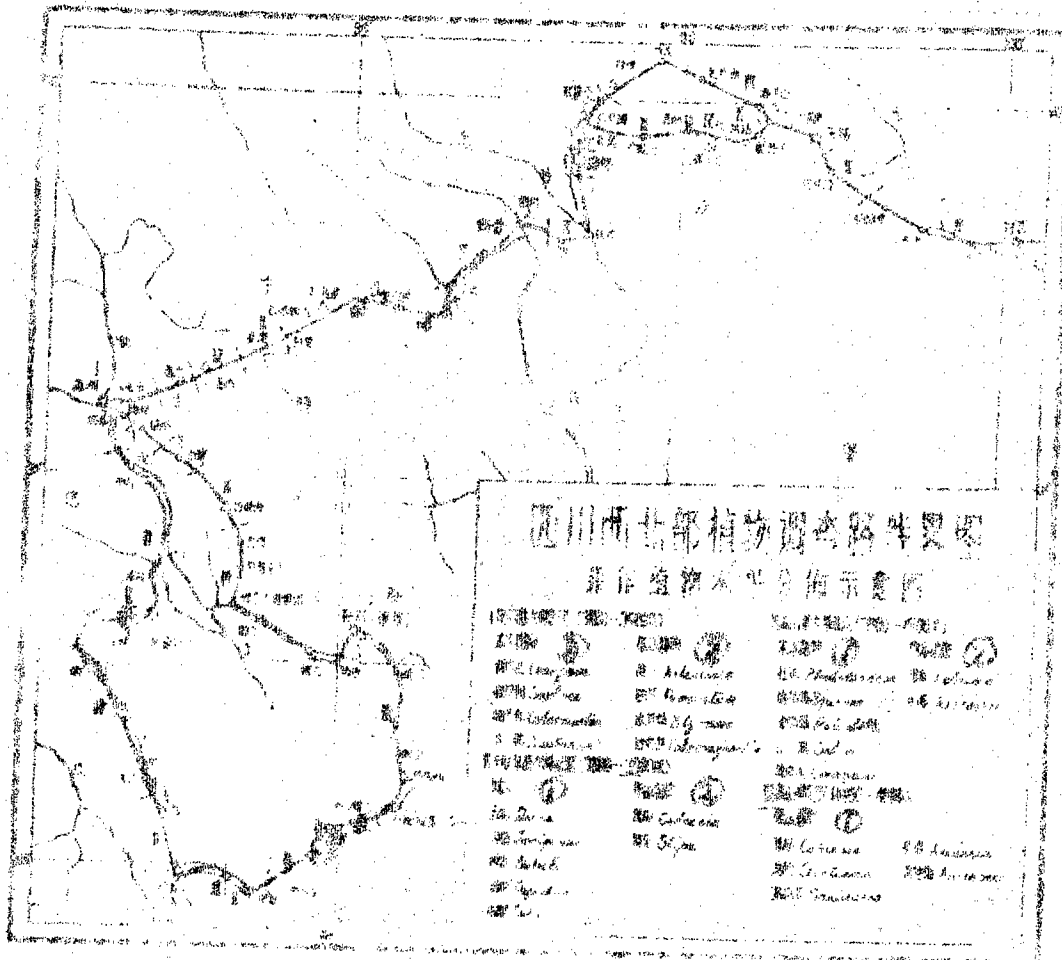


Figure 1. Map Showing Northwest Szechwan Phytosurvey Route and Perpendicular Order of Plant Distribution

- I. Arid Shrub Steppe Region (3,000-5,000 meters)
  - 1. Woody Plants
  - 2. Herbaceous Plants
- II. Semi-Arid Forest Steppe Region (3,000-3,000 meters)
  - 1. Grass
  - 2. Herbaceous Plants
- III. High Mountain Shrub Steppe Region (3,000-4,500 meters)
  - 1. Woody Plants
  - 2. Fervaceous Plants
- IV. High Mountain Steppe Region (1,400-4,800 meters)
  - 1. Herbaceous Plants

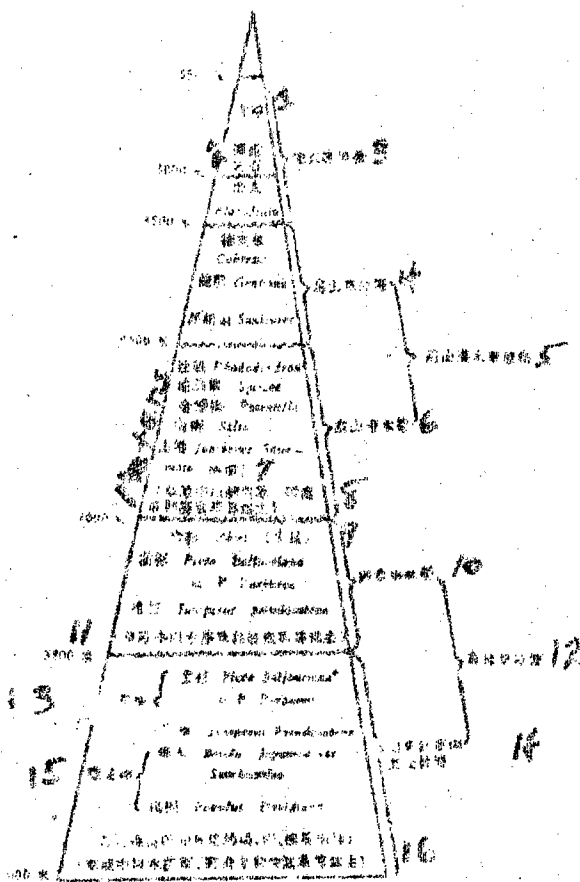


Figure 2. Chart Showing the Perpendicular Order of Plant Distribution in Northwest Szechwan and Chief Forest Species.

1. Snow line
2. Exposed bare rocks
3. Frozen pteridium belt
4. High mountain steppe strata
5. High mountain shrub and steppe belt
6. High mountain shrub strata
7. Sunny slopes
8. The main grasses in the steppes are *Cobresia pygmaea*, C. B. Clarke, *Cobresia capillifolia*, C. B. Clarke, *Cobresia Royleana*, Boeck, etc.
9. Small amount
10. Aesrosc-leaf forest strata
11. The chief grasses in the steppes are *Elysmus compressus*, Parz, *Cobresia bifida*, Tang et Wang, etc.

12. Forest steppe belt
13. Acerose-leaf trees
14. Mixed broad-leaf and Acerose-leaf trees strata . . .
15. Broad-leaf trees
16. (Land containing *Hordeum vulgare* L. Var *nudum* Hk f.  
used for the cultivation of Salicaceae, *Populus*, and  
Ulmaceae saplings)  
(The chief grasses in the steppes are *Blysmus*  
*compressus*, Panz, *Stipa* sp. and *Cobresia Bifida*,  
Tang et Wang)