Transactions

of the KOREA BRANCH of the

ROYAL ASIATIC SOCIETY

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TRANSACTIONS

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ERRATA.

Page 10. line 2. Omit repeated words, "daily range was about the."
,, 10. ,, 14. For "superatuated," read "supersaturated."
,, 13. ,, 26. For "*Glycyine.*" read "*Glycine.*"
,, 13. ,, 27. After "*hispida,*" insert "are."
,, 15. ,, 9. For "*aquilegiflium.*" read "*aquilegifolium.*"
,, 15. ,, 27. For "*Amperopsis,* read "*Ampelopsis.*"
,, 16. ,, 26. For "*Panuncus pensylvanicus,*" read *Ranunculus pennsylvanicus,*"
,, 20. last 4 lines, should read, "*Pedicularis resupinata, P. oppositifolia* and *P. spicata, Polystichium acauleatum, Rhamnus parvifolia, Salix multinervis* and *Torilis japonica.* Others in the preceeding summary belong here also."
,. 22. line 8. For "os" read "of."
,, 22. ,, 14. For "*Ranuculus,*" read "*Ranunculus.*"
,, 23. ,, 14. For "*Crataagus,*" read *Crataegus.*"
,, 25. ,, 32. For "*uffinis,*" read "*affinis.*"
,, 25. ,, 34 For "*Sciryus,*" read "*Scirpus.*"
,, 25. ,, 36. For "*stritum,*" read "*strictum.*"
,. 25. ,, 37. For "*Anagollis,*" read "*Anagallis.*"
,, 26. ,, 1. For "meet," read "most."
,, 27. ,, 2. Insert "be" after "to."
,, 27. ,, 18. For "genetis," read "genetic."
,, 28. ,, 27. For "rariation," read "variation.
,, 28. ,, 29. For "certaint," read "certain."
,, 30. ,, 20. For "ofter," read "often."
,, 32. ,, 4. For "*heterorphylla,*" read "*heterophylla.*"
,, 32. ,, 30. For "*punescens,*" read "*pubescens.*"
,, 33. ,, 34., For "*Mours,*" read "*Morus.*"
,, 34. ,, 20. Omit word "found"
,, 36. ,, 3. Insert, "convex side in the" after "the."
,, 38. next to last line, For "of," read "on."
,, 39. line 32. For "light," read "high."
,, 40, next to last line, For "*bulbose,*" "*bulbosa.*"
,, 43. line 6. Insert "plants," after "mesophytic."
,, 43. ,, 21. For "*akenensiz,*" read "*akenensis.*"
,, 43. ,, 35. For "*Koreensis,*" read "*koreensis.*"
,, 44. ,, 34. For "Stellipila," read "stellipila."
,, 48. ,, 36. For "semiconstatum," read "semicostatum."

ECOLOGICAL STUDIES IN THE TONG-NAI RIVER BASIN, NORTHERN KOREA.*

RALPH GARFIELD MILLS, A. B., M. D.

The peninsula of Korea is essentially mountainous with the principal range running nearer the eastern coast from a whorl of mountains in the north clustered about "Paik Tu San," the "Ever-white Mountain," clear to the extreme south, the peaks becoming lower and lower as you go southward. A smaller range branches from this main one and runs westward toward Manchuria just north of the 40th parallel. Another small range springs from the main axis a little farther north and runs northwest forming with it an angle of perhaps 30°. The Tong-Nai River is one of the water courses which drain part of the western slope of the principal range and the adjacent sides of the subsidiary ranges, two branches uniting about 60 miles above Kang-Kai (Japanese pronounciation, Ko-Kei) into a stream perhaps 100 yards wide. By the time it has reached Kang-Kai it is nearly 175 yards wide and at its mouth another 60 miles farther down it has attained a width of fully 250 yards. The general direction of its flow is north and west until it unites with the Yalu River or "Am-Nok-kang" which has its source farther north.

The country drained by this river is entirely mountainous and is very old geologically. The hills are largely composed of granite and similar rocks in more or less advanced stages of decay, but a few outcrops of good limestone and marble occur. Volcanic action was apparently operative at some former time as "Paik Tu San" is an extinct volcano with a lake in its crater. However, at the present time not even traces in the form of hot springs remain. It might be noted, however, that a piece of tufa was discovered floating down the Yalu River about four years ago by Mr. H. E. Blair. A

*Article No. 7. Research Department, Severance Union Medical College, Seoul, Korea. (Chosen)

dense forest of pine covered the hills clear to the top until the hand of man carrying torch and axe produced a very material change everywhere except in the most remote parts. The larger trees have all been removed and near the towns and villages even the underbrush is gathered for fuel. The patches of ground are cleared by fire in view of the spring planting and this left to itself, spreads to the hills where it does great damage.

The climate of this northern country is comparable to that of lower Canada. The winters are cold and bracing and the river is frozen over for a period of three and a half months. The summers are not hot but sufficiently warm to ensure good crops. The prevailing southwest summer wind brings the moisture from the warm ocean current that strikes Japan from the south and precipitates it over almost the whole of Korea, producing a distinct rainy season during the month of July and portions of June and August. The hills being largely denuded of forest, these heavy rains make quick impressions on the river. One rain in July, 1909, caused a rise in the Tong-Nai River at Kang-Kai of twenty feet in five hours.

The Tong-Nai River has been explored from one end to the other during the course of this study which covers the seasons of 1909-11 inclusive, the source of one branch at the Tai-Kai Pass being visited once, another source at the Kai-Au-Kai Pass three times and three trips were made down the river as far as Antung, Manchuria, at the mouth of the Yalu River. It seems to be the same as any river in a mountainous country being restrained quite frequently in its course by barriers of solid rock. There are no falls but the rapids are very numerous and the current is everywhere swift. Between these rapids the river often spreads out a little and the current becomes somewhat slowed, but nowhere does it become slow enough to change from a bed-eroding stream to one whose banks are chiefly affected. Hence it is not surprising to find no wide flood planes or ox-bow lakes and the bed of the stream is always broadly V-shaped. Such conditions do not allow changes of topography to occur very

rapidly yet the effect of the forces that are operative can always be seen.

The bed of the river is of three kinds only,—the solid rock bottom with considerable variation in the velocity of the current; the rapids filled with boulders; and the intermediate reaches of rocks, gravel and angular sand. Mud is a factor that needs no consideration. Here and there small tributary streams have created an almost endless variety of local conditions along the banks, but the bed of the river is practically unaffected.

This study has been limited to the main stream with some attention to two large tributaries, the Poong-Moun River and the Ma-Ma-Hai River, which unite with the Tong-Nai, one on either side of the city of Kang-Kai. The influence of small streams joining the larger one has been carefully eliminated as it tends to confuse rather than elucidate the problem. Likewise the "torrent portion" of the river's origin has not been studied for the same reason. This leaves a stretch of river 175 miles long for our consideration.

In many places it is possible to distinguish an advancing and an eroding bank and occasionally the difference is quite marked. Physiographically the zone at the water's edge and for a few feet back, is the same on both sides except where very active erosion of an easily affected bank is taking place. Another exception to this statement is noted both above and below any large rocky obstruction on one side of the river. Here the erosion of the bank has been at a minimum and vegetation has grown clear down to the water's edge. Typically this water's edge zone designated "A" in the classification scheme, is made up of sand gravel interspersed with boulders of various sizes. It is subject to frequent changes of water level and to the action of ice in the spring. It is truly a "zone of stress."

The intermediate zone which comes next above is the "zone of annual inundation." At least once a year during the rainy season this portion is submerged for from two weeks to a month and may be washed clean or covered with a layer of sand. On the advancing shore this bank is quite

sloping, rough and stony, the monotony being broken here and there by bushes and drift wood. Deltas created by tributaries during high water often modify this topography and high water cut-off channels are not infrequent. "B" is used to designate such a bank composed of rocks with a small varying amount of sand, and "C" means a stretch of almost pure sand well back from the water's edge. These sandy places are occasionally found and are usually due to some local condition regularly modifying the strength of the current during high water. A large one occurs below the mouth of the Ma-Ma-Hai River and a still larger one bears the same relation to the Poong-Moun River. On the eroding shore the bank is much steeper, and bare rock or earth and evidences of undermined and fallen bank are common. Trees and bushes with uncovered roots loaded down with drift wood are often seen. "G" means a bank in this middle zone composed of rock only.

The upper zone is one subject to a great deal of variation. It is rarely under water and then only for a very short time. It is the connecting link between the river and the bases of the hills and wherever circumstances permit, is used for agricultural purposes. The hand of man has modified it by ditches, rice paddies and cultivated fields of corn and beans, but there remain many places still untouched. These are usually next to the river where for fear of losing a crop from especially high water the land is allowed to lie uncultivated. Such land is covered with a fairly good growth of grass and is spoken of as "E"

The zone about the high water mark on a rocky bank is called "H," and is practically the same as the middle zone "G" and continuous with it.

Any system of classification so artificial in nature as to be based upon the variation of any one factor no matter how important it may appear, is almost certain to be found unsatisfactory in many ways. In this study no such simple classification suggested itself, on the other hand the multiplicity of influencing factors is everywhere evident. Meteorological conditions were practically constant for all the zone and the

plants found there, totaling 396 species and varieties are all "facultative hydrophytes," being able to withstand immersion for a time. If the water content of the soil were the criterion then the flora of the water's edge would be constant whether the bank were rock, gravel, or sand. In this case the amount of sand available for the roots to take hold of was apparently the determining factor, but this in turn was dependent upon the variations in the current and factors which influenced it.

The moisture and the character of the soil were identical in "C" and in the "willow islands" formed upon it, but the character of the vegetation was markedly different. The former is added to slightly each year.

"B" is productive or not in proportion to the extent of the action of the forces which would cause a deposition of small amounts of sand between the boulders. When willows gain a hold upon such soil they change the character of the secondary flora back toward that found on sandy beaches but still retaining some distinct differences. In a few places the character of "B" has been modified in another direction. In addition to the deposits of sand there has been incorporated a little earth. Such a soil becomes firm and supports a still different flora, and it for convenience is designated "D"

After all, the study of ecology refers back to the individual plant or species as to whether the conditions found in any particular locality are favorable or not for growth and development. In a mountainous country it can be taken for granted that the seeds of practically every species at some time or other have been washed down by the rains and floods and spread broadcast over the river bottoms. Perhaps a considerable proportion of these seeds did not find conditions suitable for any development but simply decayed and were gone. Still another portion germinated and developed until the floods came and they too disappeared. The number of these seedlings seen in the spring which could not with any degree of certainty be identified was quite large. Still others were able to attain full development in certain of the various conditions which are found in the river bottoms and a more or less detailed study of these stragglers gives us new light

on their adaptability to environment different from that gained from observing them under more favorable circumstances.

The presence or absence of any plant within the range of the river's influence is an indication then of the successfulness of its means of dissemination and of its ability to live under the conditions found. The relative abundance of any species is an index of the importance of one or both of these factors. This applies primarily to seedlings, whereas the development of a plant to the point of fruit-bearing is a matter that concerns its ability to adapt itself to the new environment, especially to that of immersion for a time. Some of these annuals reached maturity before the rainy season began, while others made very little growth until after it was past. The perennials which were able to live and multiply under these severe conditions were the best means of comparison of the different zones of life.

From the standpoint of the essentials which each plant demands for its continued existence this study is incomplete and is merely a contribution toward a knowledge of the life history of each, from the standpoint of dissemination by water and growth under certain definite meteorological conditions.

During the spring and summer of 1911, observations were taken of the condition of the weather and the monthly averages are given in the accompanying table. Through the kindness of Dr. Y. Wada, Chief of the Weather Bureau of the Government General in Chosen, the following instruments were secured:—

1. Thermograph
2. Centigrade Thermometer
3. Lambrecht's Polymeter and Hygrometer
4. Pluviometer registering in m. m.
5. Evaporimeter registering in m. m.

Observations were made three times daily with these instruments and in addition note was made of the direction and velocity of the wind, variety and extent of the clouds and any special condition that arose.

Wind was a factor of very little importance, there being no very strong wind, merely an afternoon breeze and some-

times a slight one in the evening. The "Land of the Morning Calm" well deserves its name.

Clouds were estimated quantitatively on a basis of 10, meaning thereby a sky completely covered. The daily average of the three readings was made out to one decimal place and then the monthly mean calculated. The result followed very closely the amount of precipitation for the corresponding months.

Perhaps the most noticeable of the general meteorolgical conditions was the rarity of electrical phenomena. Thunder and lightning do occur, but during three years there was no discharge which made one think something must have been struck and indeed no reports of injury to man, beast or tree have been received. On very rare occasions there have come in reports of damage done by lightning in other parts of Korea, especially in the littoral zone, but even there this phenomenon is unusual.

The month of April was cold and raw, during the first half the thermometer registering below zero Centigrade on a number of occasions. The snow that had covered the ground all winter was practically gone when the month opened. The earth was still frozen to a considerable depth. Snow fell in slight amounts on two occasions. Rain was recorded on half the days of the month and dew was practically absent. The temperature generally remained low with an average daily range of 11.79° C. In protected places the early flowers got a little start so that by the last of the month several were in bloom.

May opened with the weather pleasant and fairly well settled. The nights were still quite cool but the midday average was relatively high, giving a daily range of 15.81° C. Rain fell on one third of the days but the actual amount was not large. Rapid evaporation and low humidity graphically show that May was a dry month in comparison with those that followed. Vegetation was now advancing rapidly and most of the spring flowers were in bloom.

The same kind of weather that characterized May was also found during the first week or two of June. The nights

as well as the days by this time had become much warmer and the daily range was about the daily range was about the same, i. e. 11.11° C. Rain fell on four fifths of the days and the actual amount of the precipitation was greatly increased, evaporation considerably decreased and the humidity correspondingly increased in spite of the higher temperature. Showers and sunshine frequently alternated and vegetation quickly became rank. The excess of precipitation over the evaporation made veritable hot-beds out of the sand stretches and those previously barren areas were soon thickly carpeted with vegetation.

July was the middle of the rainy season and during this month came most of the high water. The heavy rains lasting from hours to days falling on an already superaturated earth, caused very rapid rises in the rivers and the banks were soon overflowed. The geographical distribution of these heavy rains usually more or less localized, caused considerable variation in the relative overflow of the different tributaries and influenced the character of the damage done by the current. Here and there the bank was torn out bodily and where ever there was any obstruction to the current there sand was deposited. The amount of this deposition was never very great, often just a thin layer among the plants that still maintained their hold. Rain fell on four fifths of the days and the amount exceeded that of June. Evaporation was a little less and the humidity much higher in spite of higher night temperatures. At times this humidity was quite oppressive although less so than in most other parts of Korea. There were heavy dews every night and everything dripped with moisture. The rank growing plants were now in abundance and the smaller vernal forms were completely lost sight of.

The rainy season lasted until nearly the middle of August. Records were personally kept during the first two weeks and then the instruments were turned over to another. In some way the record was not quite completed although that which is lacking is not essential. By the middle of August the growth of most plants is complete so that those able to come to flower would be able to reach maturity.

With the first of September the nights began to turn colder and the colors in the maples appeared. The entire month was quite dry and several frosts occurred before its close. Snow then was frequently seen in the mountains and ice began to form along the river bank.

METEOROLOGICAL RECORDS DURING 1911.

Temperature.	April	May	June	July	August	Sept.
Aver. 5.30 A. M.	2.77	7.20	14.06	19.07	15.26	14.4
,, 1.30 P. M.	12.48	21.24	24.22	24.3	28.17	24.52
,, 9.30 P. M.	3.19	13.77	17.09	21.13	21.73	16.93
,, Maximum	13.76	22.36	24.71	28.74	29.99*	
,, Minimum	1.47	6.47	13.61	18.84	18.66*	
,. Daily range	11.79	15.81	11.11	9.55	11.35*	
Humidity.						
Aver. 5.30 A. M.	70.53	86.10	91.5	93.87	60.2	83.96
,, 1.30 P. M.	46.93	33.33	51.97	57.26	47.69	56.26
,, 9.30 P. M.	93.47	61.00	85.97	93.68	52.10	85.57
Clouds. (basis of 10)						
Aver. daily	6.72	5.01	6.39	7.37	7.05	5.10
Precipitation. (in mm.)						
Total for month.	72.70	66.60	159.45	251.85	87.64	76.80
Aver. daily	2.345	2.15	5.315	8.12	2.82	2.53
No. of rainy days	16	10	24	24	13	10
No. rainless days	14	21	6	7	18	20
Evaporation.						
Total in mm.	83.2	178.9	137.85	127.2	122.67	102.6
Aver. daily	2.776	5.77	4.595	4.1	3.96	3.42

* First 17 days only.

THE "MESOPHYTIC" DEVELOPMENT OF A BANK.

The river bank opposite the city of Kang-Kai which stretches across the mouth of a short wide valley, shows three distinct terraces formed during the past history of the river. The upper probably represents the bed of the stream when it made a long detour around an isolated hill that now rises from the midst of the old original flood plane. Then the river made a short cut in the line of its present channel but about 40 feet above its usual water level, forming a middle terrace. The

lower terrace is shown as the top of the bank in figure I and is about 20 feet above low water mark. The exposed face and top of this lower terrace only is available for study as all above is in rice fields. The stones composing the bank are greatly water worn and are of all sizes from that of the fist to that of a man's head. On the top is a layer of sand and earth that supports a vigorous vegetation and during the process of lateral erosion of this bank it has been somewhat undermined, but, still bound together by roots, it has applied itself to the face of the slope. The upper end of this mile of river bank is somewhat exposed to active erosion, but about the middle of its extent the current deviates to the opposite side and allows changes to take place in its character. These terraces are more nearly level than the present river bed so that in the lower half of its extent there is a narrow but gradually widening strip of bank that is above high-water mark. The result is that whereas the upper end is unfavorable for plant growth and is consequently relatively unproductive, a combination of conditions affects the middle and lower parts encouraging a more luxuriant vegetation:—

Figure I. was taken near the upper end of this eroding stony bank and shows the first steps of the reclaiming of a bank when for some reason it is protected from active erosion by the current, although vertical erosion due to its steepness is still quite active. It is evident from the illustration that invasion of this barren land is taking place from two directions; the beach line flora is creeping upward in proportion as there is sand deposited between the rocks and the sodland flora from above is gradually spreading downward where that which is undermined can find enough soil for growth. List I. includes all the plants found on this section below the evident edge of the sodland above and excluding the wet sand flora at the water's edge. The list includes 93 varieties of which 9 are shrubs. One plant especially common in this locality is *Artemisia vulgaris*, shown as the tall weeds in the foreground of Fig. I. In addition the more common and characteristic plants were *Rosa davurica, Silene repens, Crataegus pinnatifida, Euphorbia pilosa* and *Artemisia scoparia.*

Fig. I. The upper end of the mile stretch of river bank opposite Kang-Kai. The plant prominent in the foreground is *Artemisia vulgaris*. Note the strip of sod-land vegetation that is creeping down from above.

In list II. have been tabulated the plants found in the sodland above this bank which is typical of that designated "E" and when compared with list I. there are varieties in the latter whose presence cannot be explained supposing virtual transplantion from above.

The relationhips of some of these 49 plants are quite varied; *Crataegus pinnatifida* and *Acer ginnala* are found on any river bank in most any situation; *Peucedanum decursivum* where other vegetation is low and where there is plenty of humus and moisture, hence the rarity here; *Silene repens* and *Clematis Koreana* are characteristic of open stretches of gravel "B". Those found more on dry sandy stretches are *Lactuca denticulata*, and *Equisetum arvense* and those in wet sand near the water's edge are *Nasturtium montanum* and *N. palustre, Polygonum perfoliatum, Ranunculus chinensis, Hosta lancifolia and Carex heterolepis.* Several more are those whose better development is found in more mesophytic conditions as *Cuscuta japonica, Euonymus alata, Rubus crategifolius, Vicia Cracca, Moehringia lateriflora* and *Patrinia scabiosaefolia.* Another group is found elsewhere in waste ground and represented here by *Geranium sibiricum, Arabis perfoliata, Geum strictum, Carduus crispus* and *Humulus japonica.* Of those that remain *Corydallis pallida* is typical of rich humus banks anywhere that are eroding to such an extent that most other plants cannot maintain a foothold in the loose shifting earth. *Fagopyrum esculentum* and *Glycyine hispida* extensively cultivated in the mountains and loads of them are carried back and forth so that their presence could be explained in numerous ways. The two grasses *Poa pratensis* and *Agropyrum semicostatum*, var. *ciliare* are both found in this modified strip of sod above and retain a place in the further develtpment of the bank in lists III and IV The former occurred in this series only, while the latter is more widely distributed, being found with this exception in almost every condition in the river bottoms. The absence of these two forms in "E" is not readily explained unless the dominence of *Zoysia pungens* creates conditions incompatible with life and only when this influence is removed can they develop at all.

Several species were represented by immature specimens only; *Artemisia Messerschmidtiana, A. silvatica, Chrysanthemum sibiricum.* var. *acutilobum, Lactuca laciniata, Oenanthe stolonifera, Peucedanum terebinthaceum, Polygonum polymorphum*, var. *undulatum* and *Siegesbeckia orientalis.*

Mention was made of the undermining of the edge of the the sod until it applied itself to the upper few feet of the sloping bank. Apparently the only change that has taken place is the transition from a horizontal plane to a north slope with a gradient of perhaps 30°. This much was sufficient, however, to make radical changes in the vegetation. It is still essentially a close sod, even the pieces undermined, completely separated and slid down the bank a little ways retaining that character, yet the *Zoysia pungens*, the characteristic grass of "E" has been completely replaced by *Hierochloe odorata, Agropyrum semicostatum* var. *ciliare, Carex drymophylla,* var. *akanensis, C. breviculmis, Poa pratensis* and *P. trivialis.* Seven new plants found in neither list I. or II. have appeared, all perennials and five of them shrubs; they are *Securinega fluggeoides, Neillia Millsii, Ulmus japonica, U. pumila, Thalictrum aquilegifolium, Rhamnus parvifolia* and *Selaginella helvetica.* All of these plants with the exception of the two species of *Ulmus* are characteristic of mesophytic hillsides and figure more prominently in lists III and IV which show the mesophytic development of the bank. *Selaginella* is the only one of these that seems to prefer a northern slope and plenty of shade. A number of plants with mesophytic tendencies that are sparingly represented in lists I and II become much more common in this strip. Fig. II represents the bank as it appears in its middle section and shows the process still further advanced. The foreground among the rocks resembles Fig. I very closely, the plants *Artemisia lavandulaefolia* and *A. vulgaris*, being quite prominent. But from above the mesophytic vegetation has made considerable advance over the upper half of the bank. From this point on the river has sunk to such a level that the top of the bank is above high-water mark. Here the plants characteristic of the wooded ravine and hillside have invaded in considerable

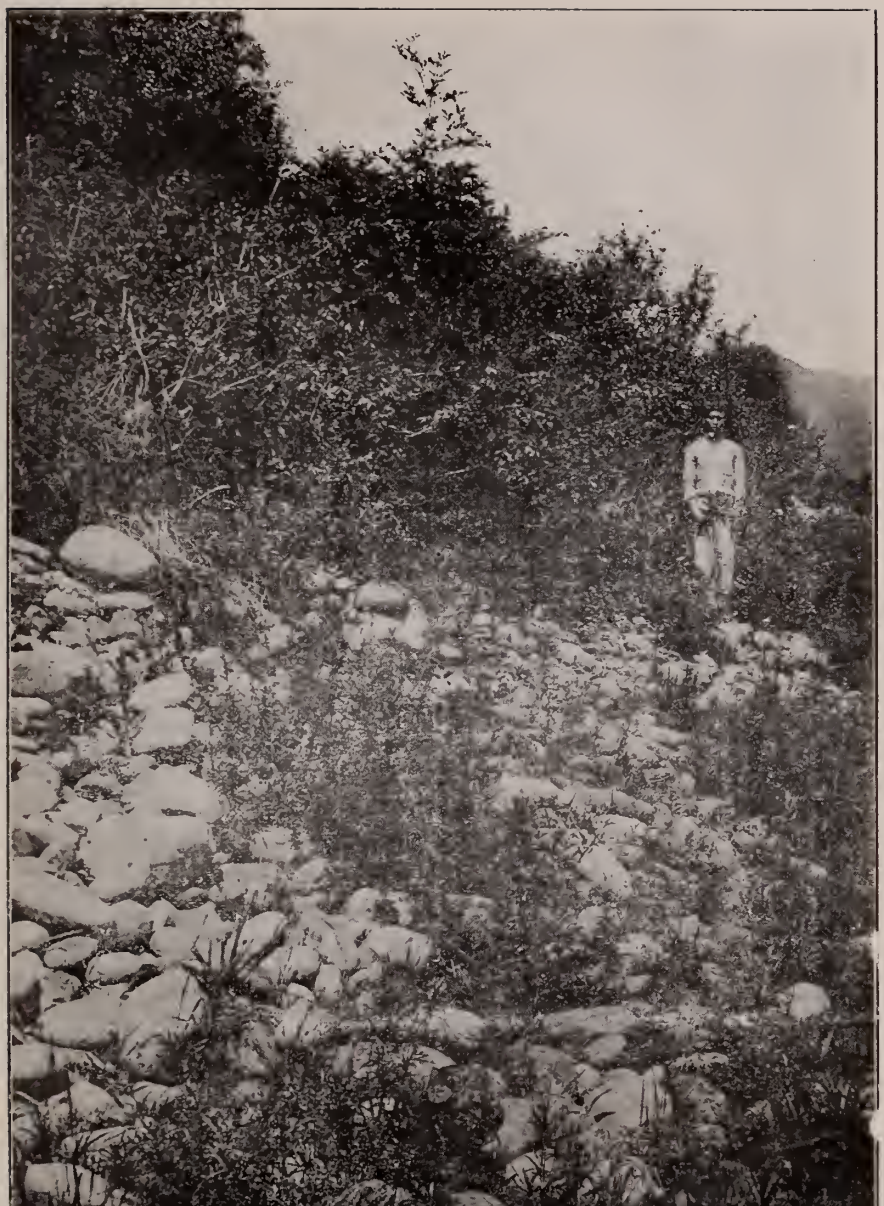

Fig. II. View typical of the middle section of the bank described in the text, showing the development of a more vigorous growth in the upper part and less change in the lower. The plants prominent in the foreground are *Artemisia Lavandulaefolia, and A. vulgaris.*

numbers. Most all the plants in list I are greatly increased in abundance and those which are especially characteristic are:—

Campanula glomerata	Clematis fusca
Clematis, recta var. mandshurica	Crataegus pinnatifida
Lespedeza bicolor, var. Sieboldii	Malus baccata, var. manshurica
Oxalis corniculata	Peucedanum decursivum
Philadelphus Schrenkii	Prunus ssiori

Thalictrum aquilegiflium

Some of the plants which have taken advantge of the conditions favorable for mesophytic growth and hence appear in list III and not in list I are the following:—

At and above high water mark—

Trees.

Acanthopanax sessiliflorum.
Juglans manshurica
Malus baccata, var. manshurica

Shrubs.

Berberis amurensis
Corylus heterophylla
Lespedeza bicolor, var. Sieboldii
Philadelphus Schrenkii
Rhododendron davuricum
Trypterygium Regelii
Viburnum Sargentii

Woody Climbers.

Amperopsis heterophylla
Celastrus articulatis
Schisandra chinensis
Vitis amurensis

Herbs.

Angelica cartilagino-marginata
Campanula glomerata
Chelidonium majus
Hemerocallis Middendorfii
Polygonum multiflorum
" nodosum
Thalictrum aquilegifolium

Herbaceous climbers.

Calystegia sepium
Clematis fusca
Codonopsis lanceolata
Dioscorea acerifolia, var. manshurica
Menispermum davuricum
Smilax herbacea

Xerophytes.

Sedum Aizoon

Ferns.

Athyrium nipponicum
,, spinulosum
Onoclea germanica

The 31 plants represented in this list are practically all distinct wooded ravine and hillside forms and together with *Securinega fluggeoides* found also in list I, represent the overlapping of the more pronounced mesophytic flora, The remaining plants in the list that follows occur well below high water mark and the presence of practically all can be explained on a basis of change in character and stability of the soil rather than by extension from adjacent areas. A brief description of these may throw a little light upon their ecological relationships.

Iris sibirica, common on open grave sites and half sodded land.

Panuncus pensylvanicus, var. *chinensis*, usually in damp places along streams.

Lysimachia barystachys, common on upland hillsides, but abundant in open grass land above high water mark.

Gentiana yokusae, var. *japonica*, being no more than ½ inch high it is only found where surrounding plants are not very tall. Abundant among the short grass of "E," it is quite hardy and resists drought well.

Selaginella helvetica, only found where rich earth, stable soil, dampness and shade are combined.

Orobanche caerulescens, although *Artemisia scoparia* on whose roots it is parasitic is very wide-spread in its distribution it is confined to loose sand or an eroding sandy loam

bank. It penetrates from three to six inches deep to tap the root and here is found only in the softer not thickly vegetated places.

Fraxinus rhynchophylla, as yet found nowhere but in this sort of a situation.

Pyrus ussuriensis, characteristic of just such localities, though following small streams up in the same way, where it reaches its maximum development,

Potentilla centigrana, var. *manshurica*, spreads over gravelly banks not far from the water's edge.

Aquilegia vulgaris, Most abundant beside very small spring streams in very rich wet earth. Occasionally as here in earth just as rich but not constantly wet, although prevented from complete drying by other vegetation.

Cerastium serpyllifolium, very slender annual in damp places. Noted also common in upland rice fields. Matures before the rainy season.

Senecio campestris, very abundant on open gravelly sites but rare where rank weeds compete. Plant very hairy and more adapted for resisting drying than growing in fairly moist mesophytic surroundings.

Phragmitis pumila, usually prefers rocky ground with wet subsoil where the long runners can spread widely. Noted also in damp ravines and along small streams.

Hypericum Ascyron, a typical river bottom plant.

Stachys aspera, a common weed in open moist waste land.

Agrostis scabra, widely but not abundantly or characteristically distributed.

Potentilla Kleiniana, found in virtually the same places in which species of Ranunculus would be expected.

Spirea salicifolia, in rich sandy moist places.

Sorbaria sorbifolia, var. *stellipila* in our studies matured sparingly in only this situation.

Hemerocallis minor, found commonly in open pasture land and hence rarely here.

Calamagrostis arundinacea, observed in moist or wet places and where a mesophytic development is taking place.

Spiraea chamaedrifolia, observed here only and to a very limited extent.

Tilia amurensis, rare here, a hillside form.

Veronica spurea, a few here and in the next higher stage of mesophytic development.

Syringa amurensis, observed only in this situation and some on "H."

Rhamnus globosa, a mesophytic shrub found commonly along the banks of streams.

Carex Maackii, found nowhere else as yet.

Achillea sibirica, occurs sparingly in mesophytic societies, especially where other plants are not very high.

Plectranthus inflexus, fairly common here and in the crevices of rocks in situations "G" and "H."

Euonymus Maackii, one of the characteristic plants of list IV and occurs in direct proportion to the richness of the soil.

Several plants were found only in lists III and IV, they are *Carex siderosticta*, *Silene firma*, and *Spodiopogon sibiricus*.

Young immature specimens of *Leonurus macranthus* and *Sanguisorba officinalis* were found.

The following were observed only in this situation, *Aster scaber*, *Carex drymophila*, *Galium boreale*, var. *latifolium*, *Lactuca lanceolata*, *Salix vagans*, var. *cinerascens*, *Saussurea koraiensis* and *Sonchus arvensis*.

Although quite a list of plants has been added to the flora of the bank incident to its transition toward a more mesophytic condition, there are a few that have dropped out in list III and do not reappear in list IV.

Carex heterolepis	wet sand group
Moehringia lateriflora	,, ,, ,,
Lactuca versicolor	weed waste ground
Erigeron canadensis	,, ,, ,,
Polygonum aviculare, var. *laxum*	,, ,, ,,

Of the remaining 13, five were limited sharply to list I, and three more are so short as to be easily overgrown by the heavy vegetation. The last five are very heterogeneous and

Fig. III. Bank completely covered with vegetation. Picture was taken half way up the bank.

do not lend themselves to classification. There is apparently nothing surprising about the disappearance of these plants except to further indicate that the change is away from those conditions favorable for their growth and development.

The lower end of the bank has been completely covered with a thick growth of vegetation until the character of the underlying soil in nowhere visible. Fig. III shows the general appearance of this growth very well. It is quite evident from a study of this development that under the meteorological conditions to be found here, a rich mesophytic growth of plants can overcome the vertical erosion of even a bank as steep as this one which is still subject to high water inundation when the effect of the horizontal erosion of the current is removed. As would be expected the difference between lists III and IV would not be great so far as the strictly mesophytic plants are concerned. In reality the visible difference is rather one of quantity than quality, most of the plants being simply increased in number.

The list of plants found for the first time in this location were:—

Polemonium coeruleum, as yet found only in this locality.

Aruncus silvester, a moist hillside form.

Osmunda cinnamomea, moist hillsides.

Impatiens nole-tangere, grows abundantly in the bottom land on good ground becoming especially rank during the rainy season.

Commelina communis, a very troublesome weed that during the rainy, season apparently fills in with a vigorous growth every otherwise unoccupied space. When pulled up by the roots and left lying on the ground it invariably takes root again from every joint.

Cnidium Monnieri, probably several species are included in this report as immature forms were hard to differentiate.

Hosta caerulea, common in shady damp ravines.

Lilium elegans, rich hillsides.

Veratrum Maacki, open rich hillsides where not shaded by trees.

Lycopus lucidus, same situations.

Ulmus japonica, hillsides.

Sanguisorba officinalis, noted in crevices of rocks filled with humus, in "G" and also on the island among the willows.

Filipendula rufinervis, seen along a stream in a high mountain ravine and on the mesophytic sand flat or "C meso."

Aster incisus, occurs at about the same distance from the water's edge in the mesophytic nooks among the rocks and on the "mesophytic bank" as per list XII.

Astilbe chinensis, open hillsides.

Circaea alpina var. *caulescens*, in damp shady places especially under projecting ledges of rock.

Viola chinensis, var. *subsagittata*, where there is good soil, no sod and among plants that do not grow very tall at least by blooming time.

Convallaria majalis, open hillsides without much shade, grows taller and the plants farther apart the steeper and looser the soil.

Galium asprellum, var. *dahuricum*, on rich hillsides, grows up as high as the surrounding vegetation when this is not over five feet high.

Lysimachia vulgaris, var. *davurica*, among weeds along streams.

Silene aprica, along streams where earth is dry and hard and other plants not too pressing.

Geranium Maximowiczii, rich hillsides where other plants are not very high and where there is plenty of moisture.

Rubia cordifolia, rich hillsides.

The presence of a plant in this society which does not occur in any other of our studies is indicative of the inability of that form to withstand the local conditions, presumably the temporary immersion. There are a few of these mentioned, *Aegopodium alpestre, Angelica anomala, Asarum Sieboldii, Aster Maackii, Melampyrum laxum, Microlepia Wilfordii, Pediculalaris resupinata, P. oppositifolia* and *P. spicata, acauleatum, Rhamnus Parvifolia, Saliz multinervis*, and *Polystichium Torilis japonica.* Others in the preceeding belong here also.

It is noticeable how many of those absent in lists I, II and III and present here for the first time occur once or twice in the other lists yet to be described. Naturally these situations are the ones nearest allied to the mesophytic type of life, to wit, the "meso nook" (list IX) "C meso" (list XVI) and a few on the rocky banks "G" and "H" (lists X-XI). This stage in the development of a mesophytic flora sees the end of practically all the forms that were at all characteristic of the rocky river bank, giving place to those more distinctive of the mesophytic hillside and damp ravine :—

Comparing list IV with list III it appears that a number of plants that were found in this and previous lists have disappeared, some of these are.

Gentiana yokusae, japonica, plant too small to receive any sunlight.

Orobanche caerulescens, found in more open situations.

Potentilla centigrana, var. *manshurica,* on open grave sites.

Aquilegia vulgaris, other vegetation too tall.

Carduus crispus, found in open situations where it can rise well above surrounding vegetation.

Onoclea germanica, generally in wetter, more open places, often along irrigation ditches.

Senecio campestris, prefers open grass land.

Fagopyrum esculentum, other plants too tall.

Juglans mandshurica, observed in Manchuria as a typical upland mesophytic forest tree, but here all cut out for its valuable wood. Small trees are occasionally found along the river banks in just this sort of situations.

Phragmitis pumila, vegetation too rank.

Humulus japonica, usually in less stable plant societies.

Lactuca denticulata and *L. lanceolata,* more common on walls and exposed surfaces where erosion is a prominent factor.

Zoysia pungens, disappears where the tall plants create much shade.

Anemone Koreana, prefers more open formati ons.

Artemisia lavandulaefolia and *A. silvatica*, are more abundant where plant equilibrium is not so well maintained.

Schisandra chinensis and *Celastrus flagellaris*, are hillside forms.

Rubus crataegi-folius, is a road side and field margin type.

Salix gracilistyla, is never found so far up the hill sides.

Viola chinensis, and *Hemerocallis minor*, would be crowded out on account os their small size.

Chenopodium glaucum, is a road side and field weed.

The remaining ones of more or less importance are mentioned without comment, *Corydalis pallida*, *Geranium sibiricum*, *Lespedeza juncea*, *Panicum sanguinale*, *Peucedanum decursivum*, *Salix vagans*, var. *cinerascens*, *Silene firma* and *S. repens*, *Ranuculus pennsylvanicus*, var. *chinensis*, and *Thesium chinense*.

In the area covered by list IV is to be found the nearest approach to a typical mesophytic plant society seen anywhere along the river course. That it differs in many particulars from that found at the base of the hills well above high water mark is to be expected, but the exact detailed comparison of the two is of necessity reserved for later study. We may, however, consider that this development is about as high as is possible under the conditions imposed by the annual inundation. The characteristic plants of this society are:—

Cuscuta japonica	Lysimachia vulgaris
Clematis recta, var. mandshurica	Thalictrum aquilegifolium
Vitis amurensis	Selaginella helvetica
Neillia Millsii	Rhamnus parvifolia
Tripterygium Regelii	Corylus heterophylla
Acer ginnala	Euonymus Maackii
Viburnum Sargentii	Lespedeza bicolor, var. Sieboldii
Polemonium coeruleum	Aruncus silvester
Calystegia sepium	Spirea salicifolia
Polygonum multiflorum	Metaplexus japonica
Campanula glomerata	Rhamnus globosa
Filipendula rufinervis	Aster incisus

Astilbe chinensis

To attempt to shorten this list would involve one in great difficulties; to say of two equally common plants that one is more characteristic than another would be arbitrary at best.

Fig. IV. This is another view of the bank of which fig. III. represents the upper part and shows in the center of the foreground such a shore line which has become decidedly sandy. In addition another step in the process of development of the bank has taken place. In the background a little farther up stream there has developed on the sandy bank a further obstruction to the current to be described later as the "willow island formation." This newly-formed tongue of land has projected out into the current and is somewhat curved down stream until there has developed quite a little protected corner. The flora that has developed in this corner is described in list VII.

Nor is it possible to say that these plants are characteristic of this society alone for with the exception of *Polemonium coeruleum* and *Aruncus silvester*, found only in list IV and *Campanula glomerata* in III and IV, these are all found in considerable abundance on the mesophytic hillsides. Several of these however, are fairly closely limited to the river bottoms and are not found to any great extent elsewhere. They are *Neillia Millsii, Rhamnus parvifolia, Tripterygium Regelii, Acer ginnala,* and *Euonymus Maackii.*

To this list of shrubs and trees should perhaps be added the names of a few others that reach their maximum development in other situations but to which this limitation applies equally well. I refer to—

Crataagus pinnatifida	list I and III
Prunus ssiori	list III
Philadelphus Schrenkii	list III
Malus baccata, var. manshurica	list III
Salix gracilistyla	"willow island formation"
Maackia amurensis	list X
Pyrus ussuriensis	beside tributaries

The Ordinary Shore Line, "A."

The same factor, i. e. the deflection of the current which allowed the changes depicted in fig. I—III to take place in the upper part of the river bank has also produced changes in the lower. Fig. I shows to a slight extent that instead of exhibiting a rugged waterworn beach of boulders as would be expected from the character of the bank, there has been a deposition of sand. As the presence or absence of sand is the chief determining factor in the amount of vegetation in any given beach line we find the absolute barren condition at the tip of any advancing bank at one extreme, and that in the foreground in fig. IV at the other. The average shore line as described in the introduction and designated "A" occupies a middle position, in that here and there are little deposits of sand in the crevices between the boulders sufficient to support a scant vegetation. This is a transient flora being completely destroyed each year by the movements of water and

ice but renewed annuallv from seeds washed in and deposited with the sand. The enumeration of these plants then in list V is an indication not of their ecological value in this connection but rather of their abundance farther up stream and a measure of their adaptation to dissemination by water. The same may be said with equal propriety about this same set of plants in whatever zone they may be found.

It is hard to single out any one species as being characteristic, for quite a number are occasionally found and none in any great abundance. This list would be a great deal longer if it were possible to identify more of the seedlings before the flowering time comes. Of those that were recognized a large percentage are annuals and most, if not all of those that are ordinarily perennials showed only the first year's growth. In spite of these difficulties it is evident that a considerable number of these plants perpetuate themselves in this situation by reason of the fact that they mature before the floods come. If any plants could be called characteristic of this sitnation they would doubtless be these,—

Carex heterolepis

Ranunculus pennsylvanicus, var *chinensis*

Viola biflora

Moehringia lateriflora, generally found on damp mesophytic hillsides

Trigonotis peduncularis, appears very early in the spring, matures and is lost sight of before most plants are well started.

Draba nemorosa, another very early form appearing on any bare spot exposed to the warm spring sun.

Capsella Bursa-pastoris, matures quite early.

Androsace filiformis, found typically at the edge of rice fields, where there is a saturated soil. Matures before the time of spring plowing.

The Sandy Shore Line.

The conditions found on the sandy shore line of the river are in a great many respects much more favorable for plant growth and development than those associated with the or-

dinary condition described as "A." The very presence of sand in any amount means that the bank is at least temperarily advancing and that such plants as are found there would suffer from the deposition of sand rather than from erosion about their roots. The rate of this deposition, however, is believed to be so small that the absence of any plants in list VI that belong in list V is apparent rather than real. On the other hand quite a number of plants occur on the sandy beach that were practically or entirely absent on the ordinary shore line. Some of those which occur in list VI and not in list V are as follows :—

Viola canina, while not very common here, yet this represents the hydrophytic limit in the range of this plant's growth. The maximum development is reached on the mesophytic banks of smaller streams and again there is a decrease farther up the dryer hillsides.

Oxalis corniculata, also found commonly in mesophytic societies, seems to depend more upon moisture than the amount of sunshine or shade.

Brunella vulgaris, occurs chiefly in rather damp or wet places usually in fairly rich earth.

Orobanche caerulescens and *Artemisia scoparia.*

Acorus Calamus, ordinarily found in ponds and wet places where drainage is poor.

Juncus effusus, a pond or sand-flat form. The root system is extensive and is not influenced by sand deposition.

Beckmannia eruciformis, similar to the last in distribution, is a good sand binder and matures just about flood time, hence is widely disseminated by water.

Xanthium Strumarium, springs up on the sand-flats everywhere, very common also on "C."

Saussurea uffinis, generally an upland plant and associated with other weeds.

Sciryus tabernaemontani, same as *Juncus effusus.*

Other species are—*Carex heterolepis*, *Cerastium vulgatum*, *Geranium sibiricum. Geum stritum*, *Humulus japonica*, *Mentha arvensis*, *Onoclea germanica*, *Veronica Anagollis* and *Vicia Cracca.*

The plants meet characteristic of this situation are,—

Nasturtium montanum, abundant here but reaches its highest development under like conditions of moisture but where there is a little earth mixed with the sand, in "D."

Ranunculus pennsylvanicus var. *chinensis*, here a perennial.

Viola biflora, grows luxuriantly beside spring brooks and as small yearling plants here.

Equisetum arvense, vegetative forms quite abundant.

Rumex crispus, although immature plants are often seen in "A" before the floods they have not been noted afterward. Plants here usually come to maturity in spite of the high water.

Cerastium serpyllifolium, matures here before the high water.

Mazus japonicus, occurs here frequently lying close to the ground, more common in damp places where there is rich earth.

Alopecurus fulvus, grows commonly at the edge of the water and matures at flood time.

The Submerged Sand-flat.

The plants along the shore line are practically a repetition of those enumerated under the sandy beach flora so that special interest centers in those plants that are found out in the water. They form the transition to the drained pond flora. Since this is a special study of a single place all the plants found there could be said to be characteristic of it.

The following were very abundant and composed the majority of the plants there.

Juncus effusus.

" " var *compactus.*

Alisma Plantago.

Rumex crispus, not quite as common as on the sandy beach at or above the ordinary water line.

Scirpus tabernaemontani.

Beckmannia eruciformis.

Alopecurus fulvus, not very common.

Fig. V. A general view looking up the river. On the right is an advancing bank with its islands of willow and clumps of Maackia. The left bank should be an eroding shore and would be but for the presence of the mass of rock from which the picture was taken. Instead it is a protected sand beach completely covered with vegetation and growing vertically from high-water sand deposition and apparently suffering little from the lateral erosion of the current. On the contrary the small mass of willows that have caught root out in the stream would suggest a positive aggression. This "willow flat" is shown at closer range in fig. VI.

Fig. VI. A nearer view of the "Willow Flat" shown in fig. V. It has become completely covered with vegetation during the long protection from erosion. Note the sharp demarcation of this society from that of the river bank above.

These were all found in water varying from 2 inches to a foot in depth and seemed to little influenced by any ordinary deposit of sand. With extensive root systems they seemed to be very firmly anchored to the bottom.

The "Willow Flat."

When a bank is for a long period of time protected from erosion by a conveniently placed mass of rock there results a stage of development that is more advanced than that shown in fig. IV, such a condition is indicated by fig. VI. The topography and vegetation indicate that the shore line once followed its present form in the upper part of the picture, that it continued in this same line across the figure almost to the extreme left edge, then described a curve back again as shown by the edge of the taller vegetation in the foreground. All the land between this ancient shore line and its present one has been filled in by a gradual deposition of sand aided by the vegetation which has developed there.

It is difficult to speak of the genetis development of this area but it is evident that the willow *Salix graciliglans* has had a great deal to do with it. There is nothing to indicate that this was even a sand-flat on which such plants as those found in list VII were prominent, in fact the edge nearest the water would lead one to think that the willows had done it all. The entire area is practically uniform being raised in small mounds and presenting a sort of mammillated apppearance. These little sand piles fairly bristle with the short simple willow shoots that seldom reach the height of 2 feet. The hollows between the mounds dip down in places to water level and in others are very little above it, they too being fairly well covered with willow branches. All the available sand among the willows is thickly set with *Hosta lancifolia* and these plants are especially abundant in the little depressions between the mounds. Other plants found there are *Agropyrum semicostatum* var. *ciliare*, and *Lythrum salicaria* var. *tomentosa;* the former being widely distributed over the bottom lands and is never abundant in nor especially characteristic of any situation, while the

latter often grows in fixed sandy or gravelly soil very close to water level.

In addition were the following, *Trifolium Lupinaster, Oxalis corniculata, Vicia Cracca, Viola biflora, Equisetum arvense, Spirea salicifolia* and *Inula britanica*, var. *japonica*. The floods had cleared this area of those seedlings found associated with the "Willow Islands" and named in list XIII, the ones enumerated being only those able to survive. None of these seem to be damaged by the prolonged immersion although *Agropyrum* is just coming into maturity at that time and *Lythrum* is in full bloom.

The "Mesophytic Sandy Nook."

Along rocky bluffs otherwise exposed to a severe current are frequently to be found protected nooks that support an entirely different vegetation. In size these vary from a handfull of sand to a stretch of a hundred yards in length. Their inclination is usually steep showing the effect of the repeated deposition of sand out as far as the current will allow, the steep edge thus formed being usually bound by the interlaced roots of a wide variety of plants. Such a formation can be regarded as quite stable, modified only by an occasional, at least annual immersion and the deposition of a thin layer of sand during the high water to compensate for that lost by vertical erosion the rest of the year. In the upper part of these nooks a considerable amount of humus collects making the soil quite fertile and this in many places reaches down quite close to the water's edge. This rariation seems to be responsible for the differences in the relative abundance of certaint strictly mesopnytic wet-sand plants when comparing one nook with another. The remains of such a bank is shown in fig. VII and its original character is seen in the point of land which apparently pushes out into the river. Two years ago this bank extended out to a line between this point and the lower left hand corner of the picture, but during an exceedingly high flood in 1909 the Ma-Ma-Hai River cut a new channel across its own delta at a tangent to its former course. This was sufficient to turn the current partly against this

Fig. VII. A "Mesophytic Sandy Nook" opposite the mouth of the Ma-Ma-Hai River that is being actively eroded.

fifteen foot bank with the evident result. A rise in the water a few days before the picture was taken carried away a mass of roots and debris that had accumulated from erosion during the preceeding winter and spring. The stratified structure of the bank is well shown in the figure.

The flora of an unmodified bank of this sort is resolvable into two zones only, being occupied by plants that follow in the natural course of evolution of the sand beach, while from above the plants characteristic of the hillsides come down remarkably close to the water. The plants found in this locality are catalogued in list IX. The characteristic plants of this society are,—

Neillia Millsii, quite common.

Ulmus japonica, although dropping out quite early in the mesophytic development of the bank yet appears quite commonly here, never reaching any size however.

Carex heterolepis, this is abundant in small pockets of catch sand near the usual level of the water. Its roots form a dense network and catch still more sand. The seeds mature at the time of high water, are torn off the plant and scattered broadcast over the river bottoms.

Iris sibirica, typical of moist places farther up the bank, it is able to approach nearer the water's edge in this situation than in any other.

Cannabis sativa, commonly cultivated in the river bottoms but escaped and thrives in sandy soil such as this and "C." When found in "E" the soil occupied is a little more firm and other plants are rarely intermingled.

Hemerocallis Middendorfii, a characteristic plant of "E" yet like *Iris sibirica* is found commonly here approaching quite close to the water's edge.

Calystegia sepium, commonly in or near cultivated fields in the bottom lands and from this as a center spreads into the sandy areas below high water mark.

Stachys aspera, although often a wasteland weed, yet it seems to demand plenty of either humus or moisture in the soil, there being an apparent reciprocal relation between the

two factors. Here where both conditions are combined the growth is quite abundant.

Polygonatum verticillatum, a fairly permanent bed of loose sand well up to or above high water mark is the only situation in which this form has as yet been found.

Spirea salicifolia, seldom grows so far above the water level that its roots cannot penetrate to saturated soil.

Calamagrostis arundinacea, roots demand considerable moisture.

While not especially characteristic of this society a number of plants deserve at least some mention.

Lysimachia barystachys, although characteristic of "E." like a number of others it comes down very close to the water's edge.

Polygonum polymorphum, finds its highest development on the rich hillsides above high water mark where the brush wood has been largely replaced by rich mesophytic growth and where it can raise its flower stalk well above the surrounding plants, It constitutes a part of this society.

Ampelopsis heterophylla, ofter associated with the grape in the river bottoms but differs markedly in its distribution in that it comes down close to the water's edge here and does not extend to any great extent up the hillsides.

Eupatorium Lindleyanum, in this study reported only from this situation.

Hosta caerulea, a considerably larger plant that *H. lancifolia* and like it requires considerable moisture. It is however found abundantly in the cool, moist, shady ravines of the river bluffs and does not grow below high water mark to any great extent.

Aster hispidus, reported only from this situation.

Arabis pendula, ,, ,, ,, ,, ,,

Saniculata elata, ,, ,, ,, ,, ,,

PART II.

The Rocky Bluff, "G" and "H".

The flora of the rocky bluff whether in zone "G" or "H" is on final analysis dependent upon the same processes that produce the large protected sandy nooks and their well developed flora. The crevices in the rocks catch a small amount of sand and plants once rooted there continue to develop. The chief plants found here are those able to live with little moisture at times and total immersion at others, as well as a number more that have extensive root systems and are able to provide suitable conditions for themselves. The parts of the plants above ground are subjected to conditions that are occasionally severe. The floods carry down drift wood that scours off the vegetation from the face of the cliffs and at other times the amount of heat reflected from the bare rocks is very great. In this regard, of course, the direction of the slope is quite important, but the humidity of the hottest summer months compensates in a large degree for what might otherwise be unbearable conditions. Hence the vegetation of a north bank is not materially different in the number of species from that found on a southern exposure.

Of all the plants found in this region only two are especially characteristic of "G" alone.

Trifolium Lupinaster, seems to need very little soil to support the root system, cracks in the rocks of quite small size seem capable of doing this. It has not been noted above the zone of annual inundation.

Maackia amurensis, this form is even more limited in its distribution than the last, being found in any abundance only here and on the border line between "B" and "E", Fig. XV. Quite a number of plants are equally characteristic of "G" and "H".

Asperula Platygalium, a small pocket of sand especially that to which a small amount of earth has been added whether found in "G", "H" or "B" seems well suited to this plant's growth.

Neillia Millsii, the only form equally characteristic of "G", "H" and mesophytic sandy nooks ; this seems surprising when considering the similarity in origin of the three.

Corylus heterorphylla, generally a mesophytic hillside form, though its occurrence on the bank next to be described coming down almost as near the water as the grass itself, seems rather to confuse than simplify the understanding of this plant's needs.

Lespedeza bicolor var. *Sieboldii*, a typical hillside form found more abundantly above the limits of our study.

Poa palustris, forms tufts of grass the roots of which often more than fill the crevices that give them support.

Rhamnus globosa, hillsides, but not often found far from the river banks. Still others are characteristic of "H" only, they are,—

Securinega fluggeoides, grows abundantly over the hillsides often well toward the top. The canes are much sought for weaving into wicker fences.

Saxifraga Rossii, this very interesting plant is a xerophyte that apparently needs an annual soaking and is then able to spend the remainder of the year perched on the rocks without special soil or water. The roots are heavy and strong, firmly wedging themselves into small crevices in the rocks. The apparent age of these plants judging from the conformation of the roots is great.

Sedum hyleoidum, a xerophyte commonly found on southern exposures in unprotected places in the dry scanty soil where earth and rock meet. Sometimes also in the dry shallow crevices in the rocks.

Spirea punescens, in this study found only sparingly in "G" but more commonly in "H." Here from overlying earth or some crevice the shrubs scramble out over the rocks in irregular masses of closely set branches.

Arundinella anomala, found in the same sort of a situation and often associated with *Poa palustris*. The crevices in which it is found are usually fairly moist.

Ulmus japonica never reaches any special size here.

Quercus mongolica, quite common in this situation, much

Fig. VIII. Shows conditions typical of "G." and "H." The umbrella stands at about the dividing line between the two. This is a northern slope but the opposite one is very little different. Follow the upper limit of "H." down the river as it is indicated by the absence of trees and shrubs.

less so in "G." Growth is quite sturdy but the plants never reach any great size; this however might be due partly to its value as firewood.

Other interesting observations may be recorded about a number of plants occurring here.

Crataegus pinnatifida, on the banks of small streams this tree reaches its highest development, although small specimens are quite common on "G" and fairly so on "H."

Carex heterolepis, although quite common in "G" it drops out altogether in "H," a fact quite in keeping with its previously described habits.

Ulmus pumila, is not especially characteristic of the river bottoms, although here and there small stunted specimens are found. By far the finest elm trees to be seen are on the embankment of the city wall where for four hundred years they have been protected. None of those standing show any signs of senility, the only one destroyed during recent years was damaged by the digging away of the wall for mud with which to plaster the houses and hacking the exposed roots for firewood. The annual levy on the sprouts and lower branches for fuel, a depredation that all trees in Korea must bear, seems nót to have damaged them in the least, the trunks appearing just as bristly as before.

Sedum Aizoon, structurally this plant is apparently a xerophyte yet its presence here, on the sandy nook and the advanced stages of the mesophytic bank would lead one to think otherwise.

Rhododendron davuricum, this plant is abundant on hillsides and among the rocks and by its presences here in "H," indicates that it can to a slight extent endure an excess of water.

Carex gifuensis, var *Koreana*, finds something in common between "G," "H" and the "island."

Mours bombycis, found here only rarely.

Agrimonia Eupatoria, ordinarily a waste land weed, yet occurs here to some extent.

Diervilla florida, common along the mountain streams in

the steeper ravines but not to any great extent along the rivers within reach of the high water.

Platycodon grandiflorus, typical of and abundant on the open hillsides among grave sites, it reaches one of the limits of its distribution in "H." An occasional plant was found in the upper part of the sandy nooks.

Cotyledon japonica, reaches its highest development on the lichen covered tiles of the native roofs. Unless occasionally cleaned off the growth is sometimes so thick as to cause the roof to leak ; this is especially noticeable in Seoul.

Deutzia grandiflora, occasionally found in "H," it is more common on the hillsides farther up.

Galium verum, rather common here and on the mesophytic developed river bank, but usually found farther up the hillsides associated with a luxuriant growth of other plants.

Thalictrum simplex, var. *affine*, often found on the sandy nooks and in crevices in the rock even down close to the water's edge. Immersion does not seem to kill it.

Hypochaeris grandiflora, a few found in "H."

Lilium concolor, found found typically in the loose humus that collects in, and in places covers over, the rocky debris broken off from the decomposing hillsides. Occasionally such a deposit of humus occurs in the larger crevices in the rocks.

Silene capitata, in rich soil between the rocks on the hillsides usually above high water mark.

Angelica cartilagino—marginata mesophytic hillsides ordinarily.

The "Permanent Grassy Bank."

A permanent grassy bank is shown in fig. VI, being all the visible land back of that newly formed portion previously described and that farther up stream constituting the present river bank. This has been vertically reduced to a flood plane basis but practically uninfluenced by the current because of the rocky obstruction below. It is possible that this represents the permanent stage of the process involved and where there is the leveling influence of drainage from a considerable

amount of adjacent bottom land. The more level the surface the more the grass land flora "E" predominates. Secondary streams cutting across the area create xerophytic conditions on the banks and hydrophytic ones in the ravines. The subsoil is nearly always wet and where this water comes to the surface a spring brook flora develops. Where the slope is a little steeper than that which supports a typical "E" flora, the sod is broken and many plants especially of the waste land variety appear.

This is such a heterogeneous society that the affiliations of each plant should be stated separately although it shows some similarity to "E." Four of the plants characteristic of "E" are greatly reduced in importance here, viz, *Sophora flavescens*, *Potentilla chinesis*, *Lysimachia barystachys*, and *Gentiana yokusae*, var. *japonica*. On the other hand three new ones appear to take their places, *Rumex crispus*, *Potentilla Kleiniana* and *Ranuculus acris*, var. *japonicus*. It is probable that the difference in water content of the soil is sufficient to account for the substitution, at least the other reported situations of these plants would strongly suggest it. *Zoysia pungens* is not complete master of the situation as in "E," hence the appearance of the common weeds *Geum strictum Polygonum multiflorum*, *Erigeron Canadensis*, *Humulus japonica*, *Xanthium Strumarium*, and *Commelina communis* in the bare spots and of *Nasturtium montanum*, *Ranunculus pennsylvanicus*, var. *chinensis*, *Brunella vulgaris*, *Viola biflora*, *Equisetum arvense*, *Cardamine flexuosa* and *mazus japonicus* in the wet ones.

Hostalancifolia is quite common down near the water's edge.

Scirpus Eriophorum, was only found here, so other facts regarding it are lacking.

Inula britanica var. *japonica*, has a wide range from the pond edge to dry upland fields, though nowhere abundant.

Leonurus macranthus, is usually found in a cluster of several plants together on an unsodded piece of ground where there is some moisture and much humus. Seldom near other plants of any size.

The "Willow Island Formation."

Very early in the study it was apparent that the willows played an important part in the ecology of the river bank. The advancing bank which is the bend of the river is nearly always very sloping and current-swept to a large extent by the high water during the rainy season. The willow is one of the chief plants that gradually creep out on this stretch catching root as best they can. Fig IX shows this condition very well. We note that the down stream ends of the patches are usually straggly and that there is a deposit of sand below each one in which the plants catch root. The principal line of growth then is down stream. During high water two processes are at work on such a beach as this. Ordinary unprotected places are somewhat eroded but where the closely set branches of the willows offer some resistence there is actually a deposition of sand.

These "islands" then grow in height by additions of sand on top and by erosion of adjacent land. One of these "islands" that has united with several in line below has formed a solid dike 3 feet high, 10 feet wide and more than 100 feet long. This is shown in fig. X. In order to determine the relative importance of the two factors creating such a formation, this one was dug into, going well below the water line, in all about 3 1/2 feet. At this depth there were living willow roots as large as the index finger which evidently went much deeper, those above being progressively smaller until the upper surface was reached. Nor were the ramifications of the roots confined only to this bank; many were noticed spreading out under the intervening channels giving rise to branches on the sloping sides. From the top to a depth slightly above the level of the adjacent rocky channels the sand showed evidences of having been laid down layer by layer. From this point upward there were bits of driftwood and dead roots of grass mingled with the living willow roots. The evidence all pointed clearly to the importance of sand deposition during the course of a very few years and to the fact that erosion was a very small factor. The next figure

Fig. IX. The beginning of the "Willow Island Formation." The darker colored bushes in a line just behind and to the left of the Korean are Maackia. Immediately behind is an open strip of grass, *Zoysia pungens* and still a little farther back is the area occupied chiefly by *Sophora flavescens* and shown in fig. XVII. Note the difference in size of the "islands" and their method of spreading in streaks parallel with the current at high water. The deposition of sand at the lower end of the "island" is shown to the right of the two "islands" lowest in the picture.

Fig. X. A more advanced stage of "Willow Island Formation." The one between the two men was dug into just after the picture was taken.

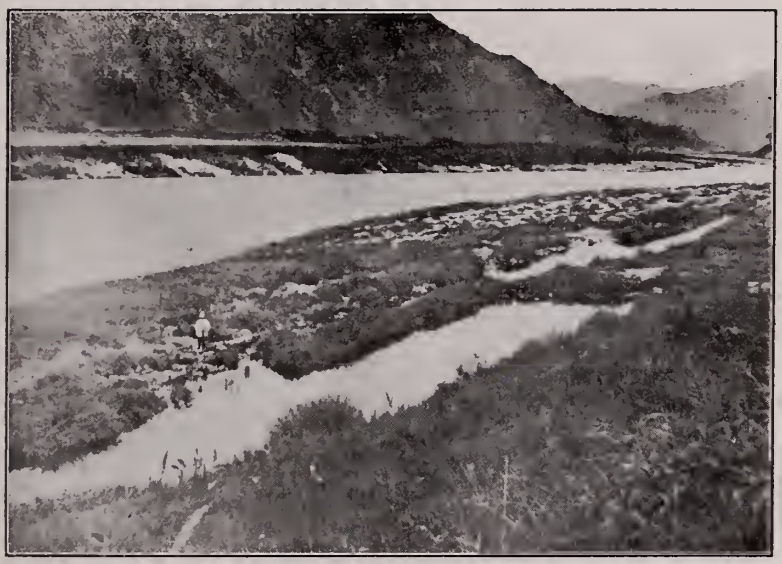

Fig. XI. "Willow Island Formation" showing several stages of development. Near the shore line on the right is shown the formation in its early stages. Coming closer to the bluff from which the picture was taken the growth is seen to be confluent in rows parallel with the river. The oldest stage is in the fore ground where the rows have been bridged across into a net work enclosing the irregular bodies of water. These ponds are barely reached now at high water so that erosion no longer plays any part in their development. The water stands in these ponds all year long and coincident with this certain changes have developed. The bottom is becoming covered with slime, and *Limnea minor*, a snail rarely found in the river even in protected places, lives here abundantly. Potamogeton has appeared and several marsh plants are taking hold.

Fig. XII. Taken from the "bridge" across the end of one of the ponds shown in the last figure. The river is seen in the distance. *Salix graciliglans*, waist-high fringes the edges, while in the fore ground a grass, *Agropyrum semicostatum* var. *ciliare* is shown growing with it. There is a bunch of *Carex heterolepis* among the stones at the edge and at the extreme lower right hand corner is shown *Beckmannia eruciformis*.

Fig. XIII. "Willow Island Formation" on a "C" basis. This photograph was taken in June before the high water and shows the willows in patches on top of the mounds and other plants getting a foothold in the depressions between.

Fig. XIV. The same as XIII, taken from the top of a bluff across the river. The mouth of the Ma-Ma Hai River and its old delta are at the lower right hand corner of the figure.

shows a still more advanced stage in which the process began near the water level and the growth not only developed longitudinally but here and there are to be found cross bridges that have produced small ponds refilled with water during every rainy season but never going dry ad interim.

Local Conditions Secondary to the "Willow Island Formation."

The growth of willows creates an entirely new set of conditions apparently very uniform in character yet sheltering a diversified flora. Many of these plants are vernal forms that complete their reproductive cycle before the floods come and quite a number are ordinarily perennials, only a part of which are able to live here for more than a year. The total immersion for a time and the slight deposition of sand, not enough however to apparently inconvenience the plant, must be held accountable for these changes. The force of the current only seriously affects those plants whose growth has exceeded that of the willows but the roots are not disturbed in the least. The seedlings of a great many plants are destroyed before they reach maturity but a number of perennials as *Anemone Koreana*, and *Polygonatum officinale*, var. *japonicum* are not affected by the destruction of the aerial portions after the seed has matured. The most prominent plants in this formation are,—

Pennisetum japonicum, Quite a common form in "E" and "G" and "H."

Spirea salicifolia, finds sufficient moisture here for its roots.

Lythrum salicaria, var. *tomentosum*, fairly abundant.

Rumex acetosa, smaller, earlier blooming and found in drier places than *R. crispus*.

Lysimachia vulgaris, though widely distributed over the river bottoms it is not found to any extent elsewhere.

A number of plants deserve some mention in this connection.

Thlaspi arvense, common on waste ground especially where the surface becomes so hard that most other plants do not develop.

The essential point of similarity between these two conditions is as yet not clear.

Pyrus ussuriensis, seldom able to maintain a growth above the level of the willows.

Lactuca versicolor, often quite alone on bare spots of clay on banks or the city wall where erosion prevents most other plants from securing a foothold.

Plantago major, var. *asiatica*, the habits of this plant are so well known that description is unnecessary, although its prevalence in very wet places even down to the water's edge was a little surprising.

The Stony Beach "B."

The flat boulder-covered tongue of land that projects out into nearly every bend of the river is made up of the formation designated "B." Its position indicates that it is a part of the advancing shore, as the strength of the current is exerted against the opposite shore which usually is a rocky bluff, and its appearance is always that of a barren flood-swept beach. Hence any constructive forces that may exert themselves upon this area can produce only temporary results. Since the presence or absence of vegetation here is dependent upon the deposition of sand it is evident that the extent of the vegetation is absolutely governed by the physical forces concerned. There are piles of rocks where no plants could possibly grow and there are places where spaces between are so filled up with sand that a fairly representative flora is supported. Fig. IX shows the upper edge of the beach where the willows are encroaching upon it. Fig. XV. shows the line of *Maackia* that divides ecologically the beach "B" from the grass land "E" and marks the transition from one to the other. The vegetation growing between the rocks is replaced when the sand has accumulated to some extent and *Zoysia pungens* appears encouraging the deposition of more sand until the rocks are completely buried. Fig XVI represents a section of "B" a little below high water mark of which *Phragmites pumila* has gained a good foothold. *Patrinia*

scabioseafolia ordinarily an open hillside form was also found quite commonly. The characteristic plants are,—

Asperula Platygalium, seems to be better able to survive alone even in hard stony ground than as a part of any extensive plant society.

Dianthus chinensis, especially on hard sandy places, but noted also on open mesophytic hillsides.

Salix gracilistyla, chiefly as a part of the "Willow Island Formation," and as such plays an important role in the reclaiming of the beach.

Silene repens, on hard sandy spots among the rocks. Its manner of growth in such situations is peculiar in that the stems of which there are often more than one are usually not erect but inclined and there is an irregularity and angulation at the surface of the ground. Any traction on the stem breaks it at this point leaving the root uninjured. This ensures a perennial growth here.

Maackai amurensis, marks the boundary line between "B" and "E."

It is interesting to speculate on what has killed these bushes on the land now occupied by "E" when the demarcating line was farther up the bank than now. No bushes taller than 8 feet have been observed, the usual hieght is from 3—4 feet.

Euphorbia pilosa, rather common through the bottom lands where other plants find it difficult to live. The root system is usually well developed and adapted to withstand severe conditions.

Rosa davurica, usually the bushes are very much dwarfed and deformed although in the more protected places a good size is attained.

Phragmites pumila, its prominence in a light protected situation was noted in fig. XVI.

There are several others not so common or characteristic but concerning which some observations have been made.

Corydalis pallida, an occasional specimen was seen on an otherwise barren beach attaining a good size as though the

free plants found difficulty in starting, but once well under way they found favorable conditions for their maximum development.

Chenopodium glaucum, normally a waste land plant, it apparently finds conditions favorable here.

Cardamine macrophylla, spring brook form that also occurs among the willows and in "D."

Anemone daurica, this variety differs from *A. Koreana* chiefly in color, it being very pale. This has been found on two occasions growing under the same sort of conditions and in some abundance. The roots penetrate to quite a distance down between the rocks.

A. Koreana occurs here but rarely, it being more characteristic of open hillsides.

Galium boreale, found sparingly in "B" and "C."

Berberis amurensis, an occasional dwarfed specimen was seen but seldom more than a foot in height, being able to maintain itself only under the protection afforded by the larger boulders.

The Gravelly Beach with Soil Incorporated.

"D" is a modification of the condition described as "B" with the addition of a small amount of loam to the sand. It is seldom found along the course of the Tong-Nai River but is of more frequent occurence in connection with both the Ma-Ma-Hai and Poung-Moun Rivers. Although such a place may be frequently swept by high water yet the soil maintains a fair degree of permanency. In this situation there flourishes a luxuriant growth of plants practically all of which are found in lists XIV and XV but a number which are found there occasionally become very much more abundant. *Nasturtium montanum*, *Cardamine macrophylla*, *C. flexuosa*, *Euphorbia pilosa*, *Ranunculus acris*, var. *japonicus*, *Asperula Platygalium*, *Viola chinensis*, *Plantago major* var. *asiatica*, *Hosta lancifolia*, *Potentilla fragarioides*, *P. chinensis*, *Silene firma*, *Chrysosplenium sphaerospermum*, *Anemone daurica*, *Equisetum arvense*, *Corydalis bulbose*, *Erigeron canadensis*, *Ranunculus pennsylvanicus*, var. *chinensis*, *Viola biflora* and *Draba*

nemorosa, are the most important. Some of the first mentioned reach their greatest development in this zone while the remainder are common elsewhere.

The Sand Flat.

There exists the same relationship between the sandy stretch "C" and the rocky one "B" that is found between the sandy mesophytic nook and the bluff conditions "G" and "H"; the physiographic variant is the same, the sand deposit. All possible intermediate stages exist between the two and a study of them only emphasizes the truth of the statements regarding the extremes. During the month of May and parts of April and June the conditions are not very favorable for growth on the stretches of sand. The upper few inches are quite dry so that rapid root development would be necessary to reach the moist sand below. Hence the list of early plants is not large and most of these are perennials able to grow from a previously established root system. Common examples of this are *Anemone Koreana*, *Lactuca denticulata*, *Potentilla flagellatis*, *Rumex crispus* and *R. Acetosa* and *Chelidonium majus*. Very few annuals are able to make any headway at this time except *Capsella* and occasionally another where a rock gives shade and conserves moisture.

In June a decided change takes place. Many seeds already started to germinate during the dry season grow very rapidly when the rains begin. In a remarkably short time the surface is so completely covered with vegetation that few bare spots remain and when the floods come the sand is well matted together with roots. Only to a very limited extent is this growth damaged, for the presence of sand is itself an indication of the relative freedom from the affects of erosion. Sand is, however, deposited quite abundantily in places, in fact the amount is greater than in any other situation so that plants affected by immersion and sand deposition are scarecely able to survive. The most prominent plants are,—

Cuscuta japonica, apparently needs only a fair amount of moisture and other plants upon which to climb. The charac-

ter of the soil seems to be of little consequence, although it is not often seen outside of the river bottoms.

Chenopodium glaucum, an annual that occurs commonly on waste ground anywhere and here quite abundant in midsummer.

Polygonum multiflorum, similar to the last but with more of a preference for wet places.

Salix gracilistyla, in some places gains quite a hold.

Astragalus dahuricus, attains an extensive growth especially for an annual that gets a late start. Found here and there throughout the bottom land, its best development is undoubtedly observed here where humus is at a minimum.

Erigeron canadensis, a waste land annual that becomes quite prominent after the rainy season.

Vicia Cracca, nowhere especially abundant, its long rambling stems usually depend upon other plants for support. A few plants have been observed on "C" that had no such support and had grown much more bushy and compact.

Potentilla flagellatis, is one of the earliest spring flowers, appearing on upland hillsides having a southern exposure and sends out short flower stalks from flat rosettes of leaves that have remained over winter. On "C" this form is less common than the taller later plants and the first plants of the year, the abundance of which give the plant this special mention.

Cannabis sativa, becomes quite abundant in midsummer.

Cassia mimosoides, barely a trace appears until late in June.

Xanthium Strumarium, an annual that becomes quite common.

Commelina Communis, develops rapidly as soon as the rains commence.

Melilotus suaveolens, not widely distributed but observed also on waste land at the foot of the city wall where the earth was dry, hard and rich in humus, conditions just the opposite of those found in "C."

Polygonum aviculare, var. *laxum,* usually in waste hard-

packed ground where traffic etc. kills out most taller weeds. Grows quite commonly here also.

Other plants about which observations should be recorded are :—

Arabis perfoliata, often noted on protected hillsides that are lacking in sod and associated with various mesophytic like *Moehringia*. Occasionally as here in soil less rich and more sandy then usual.

Hierochloe odorata, recorded in this situation only,

Orobanche caerulescens, its presence here parasitic on the roots of *Artemisia* and the similarity to a condition observed on the dunes in Michigan lead to the development of this study.

Cucumis microsperma, an occasional escape from cultivation.

Aretium Lappa, not very common and reported only from this locality.

Chelidonium majus, a waste land plant that depends upon a soil rich in humus and loose in texture although the amount may be small and filling in the chinks between rocks.

Carex drymophila, var. *akenensiz*, reported only from this situation *Polygonum orientale*, common in damp places and on clay recently excavated.

Mesophytic Development On An Old Sand Flat.

In the absence of special erosion there is a constant tendency for stretches of sand that are constantly damp to become covered with a good growth of vegetation. The right bank of the Poung-Moun River extending up one fourth mile from the mouth is such a locality that has become completely covered and now is scarcely affected by high water. The part played in this constructive process by "willow island formation" is still to be seen in many places, and *Salix gracilistyla* has disappeared. The peculiar corrugated surface only remains with the former depressions nearly filled up and still fringed by a few willows of considerable size (*Salix Koreensis*). Here and there are to be seen depressions originally deeper than the rest which are now being gradually filled up.

Fig. XVIII represents such a condition, a small pond fringed with willows in the midst of a sand flat now covered with vegetation. Nearer the river this flat is still higher above the water level and has been put into cultivation. The size of the willow trees, as large as a man's body and that of an elm near by fully three times that size are the only indications as to the age of the formation. The elm is about the size of the largest of the elms growing on the city wall which are said to be 400 years old. The willows are much younger and are faster growing trees than the elm.

The flora of this formation is quite varied being composed of 89 recognized species and varieties of which number 10 were immature specimens. It is the most closely allied to "C" having 57 species in common with it. A considerable number of these forms were also described previously in the discussion of the mesophytic development of the river bank and 8 of them have that as the only other observed occurrence in this study. The "meso nook" (list IX) and the eroding field (list XIX) have three species each which are peculiar to these two societies. The characteristic plants are not very numerous because of the heterogeneous nature of the assemblage. *Aster incisus*, *Chrysosplenium sphaerospermum*, *Dryopteris flaccidus*, *Circaea alpina*, var. *caulescens*, *Galium asprellum*, var. *dahuricum*, *Lysimachia vulgaris*, var. *davurica*, *Osmunda cinnamomea*, *Salix koreensis*, *Scilla chinensis*, and *Viola phalacrocarpa* are the outstanding ones. There are several more which are not numerous here but have not been seen elsewhere. They are, *Aquilegia oxysepala*, *Arctium lappa*, *Artemisia nutantiflora*, *A. selengensis*, *A. Sieversiana*, *Geranium Krameri*, *Lophanthus rugosus*, *Lycopus Maackianus*, *Pennisetum purpurascens*, var. *viridescens*, *Poa annua*, *Polygonum aviculare*, *P. scandens*, var. *dentato-alatum*, *Potentilla filipendula*, *Siegesbeckia orientalis*, *Sorbaria sorbifolia*, var. *Stellipila Stachys glabra*, *Stellaria aquatica*, *Urtica angustifolia*, *Viola Ishidoyana*, and *V. verecunda*.

Fully half of the forms in "C" have been lost in the transition. Some of them being small plants would be lost amid the larger forms, *Mazus japonicus*. *Cerastium serpyl-*

Fig. XV. *Maackia* growing at the junction between "B" and "E".

Fig. XVI. A portion of "B" in which the development of the vegetation has reached an advanced degree. The chief plant here is *Phragmitis pumila*. On the opposite side of the river is the bank whose mesophytic development is considered in list IV, showing the relation it bears to the hills behind.

lifolium, *Polygonum aviculare*, var. *laxum*, and *Orobanche caerulescens*. Others are frequenters of less stable plant societies as, *Arundinella anomala*, *Aster indicus*, *Astragalus dahuricus*, *Chenopodium acuminatum*, *Euphorbia pilosa*, *Hibiscus trionus*, *Hierochloe odorata*, *Humulus japonica*, *Phragmitis pumila*, *Salix graciliglans*, *S. gracilistyla*, *Saussurea affinis* and *Zoysia pungens*. The soil is possibly not wet enough for *Equisetum arvense* or *Poa palustris* while *Clematis koreana* is a virtual hermit, being rarely found even near any other plant.

The Grass Land "E."

The final stage in the development of the river bank before it can be put under cultivation is the open grass or sod land call "E." This zone is never wide because of narrow flood planes but is quite constant being present nearly everywhere except associated with the rocky bluff. As the bed of the stream cuts deeper and deeper this strip progresses by reason of its position, but is constantly being encroached upon at its upper edge for agricultural purposes. It is the ultimate result of any of the stages heretofore described and can be said to begin whenever *Zoysia pungens* is able to gain a foothold. On protected mesophytic banks of an even slope as previously described, it comes almost to the water's edge; where the slope is uneven and rough other plants are apt to intervene. On the typical advancing shore the transition from "B." is very apparent. The spaces between the stones are gradually filled up with a little sand until a network of sod gradually covers everything and a row of *Maackia* often marks the junction line. Where the bank is quite steep as in the first study the more rank mesophytic growth gets a start and the short stiff grass is apparently unable to spread. A typical stretch of sod land is covered with a variety of plants in great abundance, the chief being *Sophora flavescens*, *Zoysia pungens*, *Lespedeza striata*, *Gentiana yokusae*, var. *japonica*, *Lysimachia barystachys*, *Hemerocallis minor* and *Scilla chinensis*. Whenever for any reason the continuity of the sod land is broken the following plants occur more abundant-

ly,—*Ranunculus acris*, var. *japonicus*, *Viola chinensis*, *V. phalacrocarpa*, *Potentilla chinensis*, *Anemone koreana*, *Lactuca versicolor*, *Taraxicum officinale*, *Draba nemorosa*, *Chelidonium majus*, *Capsella Bursa-pastoris* and *Satureia chinensis*.

Cerastium vulgatum, grows in small clumps on rich sandy soil, mixed with other plants.

Sophora flavescens, see fig. *XVII*. Has a very extensive root system that penetrates several feet into the ground. Growth is so extensive that the exclusion of proper sunlight must eliminate many plants from this society. Although characteristic of this situation it does occur to some extent in undisturbed land like the ditch outside the city wall and about old graves.

Potentilla chinensis, common on "E" but sparingly found in a number of societies chiefly in the bottom land. Often by the roadside or on banks whose original flora has been disturbed in farming.

Taraxicum officinale, the habits of this plant, are too well known for comment.

Lysimachia barystachys, commonly on the stable soils of "E" and the shady mesophytic nook.

Duchesnea indica, quite common on the grassy banks of small streams, where other vegetation is not very tall and the soil rich. The fruit is apparently not disturbed by birds but is often gathered by children in spite of its insipid taste. Occurs sparingly elsewhere in our studies.

Artemesia scoparia, although quite common is not parasitised by *Orobanche caerulescens*.

Lactuca versicolor, a paler variety occurs here to some extend whose distribution has not been sufficiently observed to warrant a dogmatic statement.

Corydalis bulbosa, commonly found on rich mesophytic hillsides where the soil is loose and the sod absent. Shade seems to be unimportant. The stem is so angulated in its preparation for the following year's growth that traction on the stem breaks it, leaving the tuber and new bud undisturbed. "E" is quite unsuited for its extensive development.

Fig. XVII. A dense growth of *Sophora flavescens*. The underlying grass layer is chiefly *Zoysia pungens* with here and there a few *Lysimachia barystachys*.

Fig. XVIII. Pond Formation in Mesophytic "C".

Viola phalacrocarpa, at first with difficulty definitely distinguished from *V. chinensis*, but a difference in the distribution of the two is of value. This form is nevr found any nearer the river than "E" and it appears a little later in the spring.

Belamcanda chinensis, typical of the open grassy hillsides and grave sites but invades "E" to some extent. This plant also has a well developed root system that is not affected by the spread of the grass roots.

Satureia chinensis, moist rich earth in various places,

Phalaris arundinacea, found chiefly in this situation.

Scilla chinensis, typical of open hillsides and grass land everywhere.

Pond Formation.

There is comparatively little opportunity for ponds to develop in the narrow valley of a rapidly eroding river, yet a few occur Fig. XI shows how the "Willow island formation" can practically build up a wall around an area of shore until a permament pond results. Such a pond is usually not deep, the water reaching about to the knees under ordinary conditions of rainfall. In this the various aquatic plants such as *Potamogeton* etc. begin to develop.

A later stage of the same process is shown in fig. XVIII where the walls have developed from high water deposition of sand more rapidly than the hole was filled up by it, the current swirling about tending to keep the bottom cleaned out. When, however, this formation came to lie at or above high water mark both these processes ceased and the bottom began to fill up of itself. The aquatic flora increased in its profusion and the "Willow island" flora of the bank was gradually overcome by a more rank mesophytic one. The same process is noted here that played an important part in covering the terrace in the first study, viz. the steep sides of the pond tend to become more sloping even without the help of any current action and the firmly united growth above hangs over the water as a redundent fold. The trees growing at the margin are given a decided slant by the same

process. That this is of later development and independent of current action is shown by comparison with the upright, clean-cut walls of the "willow island formation" in its earlier stages while exposed to active erosion.

The pond margin still retains the character given it by the current when at flood time the water came into it at one end and out the other. The upper sloping edge is consequently the only one capable of supporting any vegetation, the other being precipitous or projecting and composed of grass and roots. The soil in this situation is always saturated and the water level is not constant, varying with the rainfall and regulated through the porous subsoil by the height of the river. The composition of the soil is quite rich from the accumulation of humus both in the water and on the banks. Erosion is practically a negligible factor. Comparison with the condition most similar,—the sandy beach "A,"—a number of physiographic differences are apparent in the latter.

1. Soil pure sand, no humus.
2. Movement of the water slight at low water time.
3. Movement more active during high water, but no erosion.
4. Slight deposition of sand during high water.

A comparison of the flora reveals almost no points of similarity, there being only 9 plants in common out of a total of 44 and the relative frequency of these being quite similar in both. A glance at the list which is here given shows that with the exception of *Polygonum*, the habitat of all is quite varied.

Plantago major, var. *asiatica*
Ranunculus pennsylvanicus, var. *chinensis*
Viola biflora
Rumex crispus
Potentilla centigrana, var. *mandshurica*
Mazus japonicus
Agropyrum semiconstatum, var. *ciliare*
Calamagrostis arundinacea
Polygonum Thunbergii, var. *stoloniferum*

Where the field of observation is limited to so few ponds general statements are hard to make but attention is called to a few species only.

Alisma Plantago, is found both on the edge and growing out in the water to a depth of several inches. It was previously noted on the sandy nook below the willow island in list VI.

Carex neurocarpa, was only found here at the edge and out in the water.

Polygonum orientale, grows quite commonly in the mud.

The plants found out in the water were just as characteristic as they were limited in number.

Acorus Calamus, usually in marsh land and where the waterlevel is fairly constant.

Juncus effusus, found also at the edge.

Beckmannia eruciformis, shown in fig. XII in the more recent "willow island pond."

Alisma Plantago, on the margin as well as in the water.

Carex neurocarpa, not very abundant.

Veronica Anagallis, luxuriant growth.

Salix purpurea, noted here only.

Sium cicutaefolium ,, ,,

The following had no connection with the margin flora.

Callotriche japonica, grows very thickly attached to the bottom in water from 1 to 1½ feet in depth.

Potamogeton limosellifolius, abundant growth.

Myriophyllum spicatum, ,, ,,

M. verticillatum, ,, ,,

Oenanthe stolonifera, a prolific hydrophyte.

A pond of a little different origin was found not far from the last. At one time the Poung-Moun River had a high water accessory channel extending from its mouth up about a mile cutting across what was practically a delta. The levels are such as to indicate that this channel was in its active stage about the time the top of the lower terrace described in the first study represented the ordinary water level in the Tong-Nai. Some change must have taken place at that time by which the Tong-Nai River cut away its bed at a much more rapid

rate than formerly, allowing the Poung-Moun River to do the same in the line of its present channel. The accessory channel was thus left unused at about high water mark and the present pond, which in appearance is somewhat akin to an ox-bow lake but genetically different from it is all that remains. Only during high water is there any connection with the river and that at the upper end, the remainder of the year being without drainage.

The list of plants found in this pond was even smaller than that of the one just described, but the plants of each kind were much more abundant.

Glycerina aquatica
Elaeocharis tetraquetra
E. avicularis
Typha orientalis
Acorus Calamus
Juncus effusus
Beckmannia eruciformis
Agropyrum semicostatum, var. ciliare
Scirpus lacustris
S. tabernaemontani
Alisma Plantago
Aeschynomene indica

The Eroding Field.

The channel of a river like the Tong-Nai is almost everywhere under the control of bluffs and rocky obstructions leaving very little opportunity for it to wander across a flood plane. Here and there special local conditions make this possible and there is to be found the active erosion of a bank once laid down in the flood plane area. Fig. VII shows a bank composed entirely of sand being eroded so rapidly by a change in the direction of the current that no plants are able to withstand it. This paragraph, however, has reference to the changes taking place in a soil rich enough in humus to be valuable for agricultural purposes and at a rate sufficient to include certain plants and exclude others. The old accessory channel that was instrumental in producing the special pond last described started the erosion of the bank shown in Fig. XIX.

Fig. XIX. Eroding edge of cultivated field.

The path recently built near the water's edge has had little effect upon the bank as the steepness of it well shows. Several plants should be mentioned in this connection.

Sophora flavescens common at the edge of the field above, but bearing disturbances of the soil quite poorly; survives only where a slip in the bank takes place.

Corydalis pallida, characteristic of such banks because of rapid growth and an ability to elongate and bend around objects even tho two thirds be covered by falling earth.

Artemisia scoparia, quite common and the conditions are very favorable for the growth of *Orobanche* on its roots.

Calystegia sepium, common in the fields in spite of annual disturbance of the land, hence its occurrence in this loose earth is to be expected.

Veronica serpyllifolia, along small streams in damp rich places.

Chrysosplenium alternifolium, a quick growing spring plant apt to be found in any damp rich soil in some shade.

Adoxa Moschatellina, found in only two places thus far, one in a damp rich shady place with other plants and the other here referred to on a moist slope at the edge of a field having a northern exposure.

Polygala triphylla, found once on a north slope in a ravine and twice on the face of a bank like this associated with *Cassia mimosoides*.

Carex leiorhyncha, as yet found only here.

Luzula campestris, var. *pauciflora*,

Abutilon avicennae, surprisingly uncommon for this plant,

Hibiscus trionus, found also in new earth excavated for a new bank, road, etc.

Populus suaveolens, occasionally found about or above high water mark in various situations.

The following are weeds whose wide distribution indicates their great adaptability.

Chenopodium glaucum *Xanthium Strumarium*
Erigeron canadensis *Commelina communis*
Humulus japonica *Polygonum aviculare*, var. *laxum*

Island Formation

Island formation in the Tong-Nai River is not common altho masses of rock that obstruct or divide the current are not infrequently seen. There is one about three miles above the city of Kang-Kai that is shown in figure XX. This was visited early in July just after the rainy season had begun and a representative collection made of every plant found on it. This is reproduced in list XX.

Attention is called to the description of the islands and their flora given by Dr. Cowles in his paper "The Physiographic Ecology of Chicago and Vicinity, a study of the origin development and classification of Plant Societies" * pp. 99—101 with figs. 8, 9 and 10. The writer has seen these islands at Starved Rock in the Illinois River and is well acquainted with the river at this and other places so is well able to appreciate the contrast presented. The essential distinction is that the Tong-Nai is not a depositing stream but an active bed-eroding one, hence this island is one created not by an obstruction in the stream with a gradual deposition of sand, but by an active erosion affecting a relatively wide area and cutting away the two sides more than it has the central part. It is interesting to note the relation that this island and a few others farther down the river bear to the contour of the channel. The bank on the opposite side from the one from which the photograph was taken is seen to be a steep one and by reason of a slight bend in the river the force of the current is thrown against that side during ordinary conditions. During higher water however, the direction is somewhat changed and coincides with the channel on the near side which is much the shallower of the two. Rapids are often found abreast of these islands, the one in the main channel showing the greater wear by being situated farther up stream. Viewed from either bank the ground level of the islands seems to correspond to the tangent projected from the surface of the stream as it flows over the rapids.

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* Reprinted from the Botanical Gazette, Vol. XXXI, Feb. and Mar., 1901.

Fig. XX. The island from above.

The figure shows that it rises only a few feet above ordinary water level and coincident with the establishment of this condition there began a little deposition of sand below the principal boulders. Willows soon become implanted and from then on the history is that of the "Willow island formation" as seen on the developing banks. Practically no plants can gain a foothold except in the sand caught by the willows, even *Phragmitis pumila* which is usually quite independent of protection in its growth does not wander far from these little willow patches. The lower end of the island is bare and is the lowest and youngest part, but is not due to a sand bar in process of formation. It is a barren stony stretch that will remain so until the willows are able to reach it. This will doubtless take considerable time.

PART III.

From Kang-Kai, Korea, To Antung, Manchuria.

This journey of fully 250 miles has been made three times by boat in the summer and once in the winter on the ice. Such notes and impressions as have any bearing on the study have been collected and combined into one narrative.

With the exception of the few miles just above the junction with the Yalu River, the Tong-Nai has apparently never been used for the carrying of freight by the Koreans as has been the Yalu by the Chinese. Of course logs have been floated down until the mountains have been stripped of their forests for great distances inland, but ordinary traffic in salt, fish etc. was either carried on in the winter on the ice or confined to horse loads from the Chinese cities along the Yalu. This may have been partly due to the pecularities of the people but the rapidity of the current has doubtless been the determining factor. The mouth of the Tong-Nai widens out perceptibly and for a mile above the current is correspondingly decreased. The banks are slightly muddy in places and the bottom is composed of more sand than usual. Here was found *Potamogeton Maackianus* firmly attached in two feet of water.

Along the southern bank were several small islands of much the same character as the one near Kang-Kai except that grass had followed the willows and now completely covered the rocks. The flora there was identical with that found on the "Permanent Grassy Bank E" previously described, especially where it approached the water's edge and was correspondingly moist.

The Yalu at the junction with the Tong-Nai is about the same size as the latter, but the water carries considerably more earth in suspension. The "Hawn" River, (sometimes called "Hun" or "Eastern Hun") a tributary from the Manchurian side, is especially noteworthy in this respect. The valley of the Yalu is relatively much wider than that of the Tong-Nai, but the banks and the vegetation they support were identical. Below Chosan the Yalu cuts through the subsidiary range mentioned in the geographical introduction and

describes a very serpentine course. One of these loops is about 7 miles enclosing a peninsula that is about 300 yards across its base with the water level from 20-30 feet higher on one side than the other. The neck of land rises precipitously above to a height of about 245 feet, but slopes away very gradually below. Along this and other promontories the vegetation corresponds to "G" and "H."

Between the old walled city of Chang-Sung and the river is a wide stretch of sand that is several miles in length. Many of the plants found here corresponded to those of the sand flats "C", but some were noted here for the first time. *Salsola collina* was a small annual growing in bunches about which the wind had piled the sand in little mounds. There were, however, no traces of these mounds made the year before. In some places the underlying rocks had been uncovered and the "B" flora found. New plants had also appeared in this society.

About 10 miles below the town of Sak-ju farther down the river is a large island about a half mile long by a quarter mile wide. Perhaps one third of its area is above high water mark and under cultivation. The east shore is gently sloping and corresponds in topography to "B" and in places to "C". The opposite side next to the Manchurian shore is steeper, being the site of some active erosion. The channel here is narrow and has recently been cut through at high water. A cultivated field is here being actively eroded and its character is essentially the same as previously described. The plants found and their habitat are given in the appended list.

From this point on no new conditions were observed The river gradually widened and the current slackened until Wi-ju, Korea was reached, this being 12 miles above Antung. This is the upper limit of tide water and the banks are somewhat abruptly changed in character, becoming very muddy and with a marshy strip marking the lateral limits of tidal influence. Between these two last mentioned cities the river becomes much wider and there are a number of small islands whose character is determined by the tide water rather than by the forces producing those already studied.

Name of Plant	Chang-sung	Sak-ju Island
Agropyrum semicostatum, var. ciliare	B —	B Edge cult. field
Allium japonicum....	H. W. M.	....
Anemone koreana....	B —	B
Artemisia japonica	.... —	C
Artemisia lavandulaefolia	B — —	B at H. W. M.
Artemisia Messerschmidtiana, var. viridis	— — —	C
Artemisia vulgaris	C seedings 6 in. high —	C edge cult. field
Artemisia vulgaris, var. integerrima, Koni.	B	....
Arundinella anomala	B — —	B and C at H. W. M.
Asperula Platygalium	B — —	—
Aster indicus	— — —	C edge cult. field
Calamagrostis Epigejos, Roth....	C	at H. W. M.
Calystegia sepium	— .... —	edge cult. field
Cassia mimosoides	— — —	C
Celastrus articulatus	—	H. W. M.
Chenopodium aristatum....	C — —	—
Chenopodium (?) glaucum	C — —	—
Clematis koreana	B —	—
Clematis recta, var. mandshurica	—	above H. W. M.
Corispermum elongatum, Bunge	—	edge cult. field
Crataegus pinnatifida	B few — —	—
Cyperus amuricus....	C — —	above H. W. M. weedy ground
Cyperus glomeratus, L.	C .... —	—
Dianthus sinensis....	B — —	B few
Equisetum arvense	— — —	eroding bank cult. field
Equisetum ramosissimum	C .... —	....
Eragrostis pilosa	C —	—
Erigeron canadensis	B few C some	B few
Eriochloa villosa	.... — —	H. W. M.
Euphorbia pilosa	B .... —	B few
Fraxinus rhynchophylla....	— — —	C at H. W. M. and E
Hosta lancifolia	— — —	above H. W. M.
Indigofera Kirilowi, Maxim.	B — —	—
Inula britanica, var. linariaefolia, Regel .... — —	.... — —	edge cult. field
Lactuca denticulata —	.... —	B few
Lactuca laciniata — — —	— — —	B and above H. W. M.
Lactuca versicolor —	B few —	—
Lactuca Sp. — — — —	B seeding —	—
Lespedeza bicolor, var. Sieboldii —	.... —	above H. W. M. weedy ground
Lespedeza cyrtobotrya, Miq. —	— — —	above H. W. M. weedy ground
Lespedeza juncea.... —	B — —	B, C and E above H. W. M. (upper part of specimen damaged by water)
Lespedeza striata.... —	B common —	B some

H. W. M.=High Water Mark.

Name of Plant.	Chang-sung	Sak-ju Island
Lysimachia barystachys	....	above H. W. M. weedy ground
Lysimachia vulgaris	....	above H. W. M. weedy ground
Lysimachia vulgaris, var. davurica	....	above H. W. M. weedy ground
Maackia amurensis	....	H. W. M.—
Metaplexis japonica	....	above H. W. M.
Miscanthus sacchariflorus, Benth, et Hook.	....	edge cult. field
Nasturtium montanum	B few	....
Orobanche caerulescens	C	....
Panicum Crus-Galli, var. submuticum	....	edge cult. field above H. W. M. among rank weeds
Panicum sanguinale	C	B
Phragmitis pumila	B at H. W. M. some	B
Polygonum multiflorum	B and C common	B some
Polygonum lavatherifolium	Sandy shore	....
Populus suaveolens	....	above H. W. M.
Portulaca oleracea, L.	C some	....
Potentilla chinensis	....	C
Potentilla sp ?	B seedlings	....
Quercus mongolica	....	few
Rottboellia compressa, var. japonica	B	H. W. M.
Rumex crispus	B and C	....
Salix koreensis	C and sandy shore line	H. W. M. tree 15 feet high
Salix gracilistyla	B	....
Salix viminalis, L.	....	waste ground above H. W. M. and edge eroding field
Salsola collina, Pall.	C	....
Senecio argunensis, Turcz.	C	B
Setaria viridis	B at H. W. M.	C at H. W. M.
Setaria sp ?	B	H. W. M.
Silene aprica	....	above H. W. M. weedy ground
Siler divaricatum, Benth, et Hook.	....	above H. W. M.
Sophora flavescens	B few	C
Sophora japonica, L.	....	bank eroded by current
Thalictrum simplex, var. affine	....	C top damaged by water but still able to flower
Ulmus pumila	....	above H. W. M.
Vicia Cracca	B few C some	B few
Viola chinensis	....	B few
Xanthium Strumarium	C some	....
Zoysia pungens	B few scattered	....

In conclusion the author wishes to express his appreciation of the assistance rendered by several individuals thereby making possible this work. An invitation to accompany a party of botanists on a trip to study the flora of the sand dunes of Michigan, extended by Prof. Henry C. Cowles of the University of Chicago, was the starting point of this investigation. The finding of certain plants in Korea, especially *Orobanche* parasitic on *Artemisia*, similar to some found in Michigan but under entirely different surroundings was the actual beginning. It has developed without help or suggestion from book or individual other than those mentioned, until it has assumed its present form.

Dr. Takenoshin Nakai, Rigakushi, Rigakukakushi, Professor of Botany, Science College, Imperial University, Tokyo, Japan, has rendered valuable assistance in the determination of specimens collected. Mr. S. T. Dunn, B. A. (Oxon) F. L. S., F. R. G. S., Botanist at the Kew Botanical Gardens, London, England, was a great help in the beginning in determining the first three hundred specimens. Just before publication Prof. Ernest H. Wilson, M. A. Botanist to the Arnold Arboretum, Harvard University, Cambridge, Mass, U. S. A. has been very helpful in the clarification of many doubtful points in the synonomy.

Valuable literary work was done for me by my wife, Rev. H. E. Blair kindly completed some meteorological observations and Dr. Roy K. Smith drew the map. The photographs were largely taken for me by an itinerant Chinese portrait photographer who worked faithfully under many climatic and other difficulties.

Note. In the Praecursores ad Floram Sylvaticam, IV, Spiraeaceae, "Bot. Mag." XXIX, p. 342, 1915, is the statement by Dr. Nakai that in the "Botanical Magazine" issued in 1912 was a description of *Neillia Uekii*, which is the same species as described by Dunn in the same year as *N. Millsii*. The specimens were collected in 1909 in Kangkai and sent to Dunn the following year, but in the absence of the two journals in question a definite statement as to priority of publication is impossible.

The descriptions of the new species and varieties mentioned in this article and the general information regarding all determined specimens can be found in the following articles.

Dunn. S. T. "Some additions to the Korean Flora". Royal Botanical Gardens, Kew, Bulletin of Miscellaneous Information, No. 1, Article IX, pp. 108-9. 1912.

Nakai, T. "Plantae Millsianae Koreanae, enumerantur a T. Nakai, The "Botanical Magazine," Tokyo, Vol. XXVI, No. 302, pp. 29-49, 1912.

Nakai. T. "Praecursores ad Floram Sylvaticam Coreanum," VII, Rosaceae, ibid. Vol. XXX, No. 354, 1916.

Nakai. T. "Notulae ad Plantas Japonicae et Coreae," ibid. Vol. XXX, No. 356, 1916.

Nakai. T. "Notulae ad Plantas Japonicae et Coreae," ibid. Vol. XXXI, No. 361, 1917.

TABULATION OF PLANT SITUATIONS

Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Abutilon avicennae, Gaertn	....	....	....	....	....	....	....
Acalypha australis, L.	....	....	....	....	....	....	....
Acanthopanax sessiliflorum, Rupr. et Maxim.	....	....	S	S	....	....	....
Acer ginnala, Maxim.	S	....	S	[C]	....	....	....
Acer pictum, Thunb.	....	....	....	....	....	....	....
Achillea sibirica, Ledeb.	....	....	F	?	....	....	....
Acorus Calamus, L.	....	....	....	....	....	F	....
Adenophora latifolia, Fischer	....	....	....	....	....	....	....
Adenophora verticillata, Fischer	R	F	....	S	....	....	....
Adoxa Moschatellina, L.	....	....	....	....	....	....	....
Aegopodium alpestre, Ledeb.	....	....	....	F	....	....	....
Agrimonia Eupatoria, L.	....	....	F	F	....	....	....
Agropyrum semicostatum, var. ciliare, Hackel	S	....	S	S	S	C	....
Agrostis scabra, Willd.	....	C	S	S	S	....	....
Alisma Plantago, L.	....	....	....	....	....	....	....
Allium macrostemon, Bunge	....	....	....	....	....	....	....
°Allium sacculiferum, Maxim.	....	....	....	....	....	....	....
Alopecurus fulvus, Sm.	....	....	....	....	S	[C]	F
Amaranthus Blitum, L.	....	....	....	....	....	....	....
Amethystea caerulea, L.	....	....	....	....	....	....	....
Ampelopsis heterophylla, var. Bungei, S. et Z.	....	....	F	....	....	....	....
Androsace filiformis, Retz.	....	....	....	....	S	....	....
Aneilema keisak, Hassk.	....	....	....	....	....	....	....
Anemone koreana, Nakai	R	[C]	F	....	....	....	....
Anemone daurica, Fischer	....	....	....	....	....	....	....
Angelica anomala, Lallem.	....	....	....	R	....	....	....
*Angelica cartilagino-marginata, Nakai	....	....	F	S	....	....	....
Angelica crucifolia, Kom.	....	....	....	....	....	....	....
Angelica davurica, Maxim. (decursiva, Fran. et Sav.?)	....	....	....	....	....	....	....
Aquilegia oxysepala, Trautv. et Mey.	....	....	....	....	....	....	....
°Aquilegia vulgaris, L.	....	....	F	....	....	....	....
Arabis pendula, L.	....	....	....	....	....	....	....
Arabis perfoliata, Law.	F	....	F	R	....	....	....
Arctium Lappa, L.	....	....	....	....	....	....	....
Artemisia japonica, Thunb	Y	F	....	....	....	....	....
°Artemisia japonica, var. recedifolia, Takeda	....	C	....	....	....	....	....
Artemisia lavandulaefolia DC.	Y	Y	S	....	C	Y	S
Artemisia Messerschmidtiana, Bess.	Y	....	....	....	....	....	....
°Artemisia mongolica, Fischer	....	....	....	....	....	....	....
*Artemisia nutantiflora, Nakai	....	....	....	....	....	....	....
Artemisia scoparia, Willdst. et Kit.	[C]	C	C	R	....	F	....
Artemisia selengensis, Turcz.	S	....	....	....	....	....	....

[C]=Characteristic or dominant. C=Common.

S=Some. F=Few.

TABULATION OF PLANT SITUATIONS

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2nd-ary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
....	....	....	....	....	....	....	....	S	....	....	S	....
....	....	....	....	....	....	Y	S	C	....	....	C	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	S	....	....	....	....	....	....	S	....	....	....	....
....	F	....	....	....	....	....	....	....	....	....	....	....
....	F	....	....	F	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	S	....	....
....	F	....	....	....	....	....	....	....	....	....	....	....
....	S	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	S	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	S	S	S	....	....	....	....	C	....	....	....	....
C	S	S	....	S	S	S	S	S	S	....	F	S
....	S	....	....	....	C	....	S	....	....	....	S	....
....	....	....	....	....	....	....	....	....	S	C	....	....
....	....	....	....	....	....	F	....	....	....	....	....	....
....	....	....	S	....	S	....	....	....	....	....	....	....
....	S	....	....	....	....	....	C	....	....	....	....	....
....	....	....	....	....	....	....	F	F	....	....	....	....
....	....	....	....	....	....	....	F	F	....	....	....	....
....	F	....	....	....	....	....	....	....	....	....	....	....
....	S	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	F	....	....	....
....	F	F	S	C	S	F	S	....	....	....	....	....
....	....	....	....	....	....	C	....	....	....	....	....	....
....	....	....	....	....	....	....	....	Y	....	....	....	....
....	....	F	....	....	....	....	....	....	....	....	....	....
....	Y	....	....	....	....	....	....	Y	....	....	....	....
....	F	....	....	....	....	....	Y	....	....	....	....	....
....	....	....	....	....	....	....	Y	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	F	....	....	....	....	R	....	....	....	....	....	....
....	....	....	....	....	....	....	F	F	....	....	S	....
....	....	....	....	....	....	....	F	F	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	....
S	Y	....	....	....	S	....	....	S	....	....	....	Y
....	Y	C	C	....	....	....	....	Y	....	....	....	....
....	Y	Y	Y	Y	....	....	....	Y	....	....	S	Y
....	....	....	....	....	....	....	C	....	....	....	....	....
....	S	F	S	C	....	C	C	C	S	....	C	....
....	....	....	....	....	....	....	....	....	F	....	....	....

R=Rare. Y=Young or Immature. °=New to Korea, not listed in "Flora Koreana," Vol. I & II, 1909-11 T. Nakai. *=New species and varieties

Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
°Artemisia selengensis, var. serratifolia, Kom.	....	....	....	....	....	....	....
Artemisia Sieversiana, Willd.	....	....	....	....	....	....	....
°Artemisia silvatica,	Y	....	S	....	....	....	....
Artemisia vulgaris, L.	....	....	....	....	....	....	....
Artemisia vulgaris, var. mongolica, Bess.	....	C	....	Y	....	....	....
Aruncus silvester, Kostel	....	....	....	C	....	....	....
Arundinella anomala, Steud.	F	S	S	F	....	....	....
Asarum Sieboldii, Miq.	....	....	....	F	....	....	....
Asparagus Schoberoides, Kunth	....	....	....	....	....	....	....
Asperula Platygalium Maxim	C	S	C	F	....	....	....
Aster hispidus, Thunb.	....	....	....	....	....	....	....
Aster incisus, Fischer,	....	....	Y	C	....	....	....
Aster indicus, L.	F	....	....	S	....	....	F
°Aster Maackii, Regel	....	....	....	F	....	....	....
Aster scaber, Thunb.	....	....	F	....	....	....	....
Astilbe chinensis, Fran. et Sav.	....	....	....	C	....	....	....
Astragalus dahuricus, DC.	F	C	R	R	....	....	....
Athyrium nipponicum, Hance	....	....	C	C	....	....	....
Athyrium spinulosum, Milde.	....	....	F	?	....	....	....
Beckmannia eruciformis, Host.	....	....	....	....	....	C	C
Belamcanda chinensis, Leman	....	S	....	....	....	....	....
°Berberis amurensis, Rupr.	....	....	S	S	....	....	....
Bidens parvifolia, L.	....	....	....	....	....	....	....
Brassica campestris, L.	....	....	....	....	....	....	....
Brunella vulgaris, L.	....	F	....	....	....	S	....
Bupleurum falcatum, L.	....	....	....	F	....	....	....
Calamagrostis arundinacea, Roth	....	....	S	S	F	....	....
Calamagrostis villosa, Mutel.	....	....	....	S	....	....	....
°Callitriche japonica, Engelm.	....	....	....	....	....	....	....
°Calystegia sepium, R. Br.	....	S	F	C	....	....	....
°Calystegia sepium, var. japonica, Makino	....	Y	....	....	....	....	....
Campanula glomerata, L.	....	....	C	C	....	....	....
Cannabis sativa, L.	....	C	....	....	....	....	....
Capsella Bursa-pastoris, Moënch	....	C	....	....	S	....	....
Cardamine flexuosa, With.	....	....	....	....	S	S	....
°Cardamine macrophylla, Willd	....	....	....	....	....	....	....
Carduus crispus, L.	R	....	F	....	....	....	....
Carex breviculmis, R. Br.	F	....	....	....	....	....	....
Carex drymophila, Turcz,	....	....	F	....	....	....	....
Carex drymophila, var. akanensis, Kuk.	....	....	....	....	....	....	....
Carex gifuensis, var. koreana, Nakai	....	....	....	....	....	....	....
Carex heterolepis, Bunge	S	....	....	....	....	C	....
Carex leiorhyncha, C. A. Mey.	....	....	....	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2ndary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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F	S	S	C	S	----	S	S	----	----	----	----	----
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----	F	----	----	----	----	----	----	----	----	----	----	----
----	S	C	C	----	S	C	S	F	----	----	----	----
----	S	S	S	----	----	----	----	----	----	----	----	----
----	S	----	----	S	----	----	----	C	F	----	----	----
----	S	----	----	----	----	Y	S	----	----	----	----	----
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Carex Maackii, Maxim.	....	....	S	....	....	....	....
Carex neurocarpa, Maxim.	....	....	....	....	....	....	....
Carex siderosticta, Hance	....	....	S	S	....	....	....
Carpesium sp?	....	....	....	....	....	....	....
Cassia mimosoides, L.	....	C	....	....	....	....	....
Celastrus flagellaris, Rupr.	F	....	F	....	....	....	....
°Celastrus articulatis, Thunb.	....	....	F	F	....	....	....
Cerastium serpyllifolium, L.	....	....	C	S	C	[C]	....
Cerastium vulgatum, L.	S	C	S	F	....	S	....
Chelidonium majus, L.	....	C	F	F	....	....	....
Chenopodium acuminatum, Willd.	....	....	....	....	....	....	....
Chenopodium aristatum, L.	....	....	....	....	....	....	....
Chenopodium glaucum, L.	F	F	S	....	F	....	....
Chrysanthemum indicum, L.	....	....	....	F	....	....	....
Chrysanthemum indicum, var. lavandulaefolium, Fischer	....	....	....	....	....	....	....
Chrysanthemum sibiricum, var. acutilobum, DC.	Y	....	Y	....	....	....	....
°Chrysosplenium alternifolium, L.	....	....	....	....	....	....	....
Chrysosplenium sphaerospermum, Max.	....	....	....	S	....	....	....
°Circaea alpina, var. caulescens, Kom	....	....	....	S	....	....	....
Cirsium pendulum, Fischer	....	Y	....	....	....	....	....
Clematis fusca, Turcz	....	S	[C]	S	....	....	....
Clematis koreana, Rehder	C	....	F	R	....	F	....
Clematis recta, var. mandshurica, Nakai	F	C	[C]	[C]	....	....	....
Cnidium Monnieri, Cuss	....	....	....	S	....	....	....
Codonopsis lanceolata, Benth. et Hook.	....	....	F	S	....	....	....
Commelina communis, L.	....	....	....	S	....	C	....
Convallaria majalis, L.	....	....	....	F	....	....	....
Corydalis bulbosa, DC.	....	F	....	....	....	....	....
Corydalis pallida, Pers.	F	....	F	....	R	....	....
Corylus heterophylla, Fischer	....	S	C	[C]	....	....	....
Cotyledon japonica, Maxim.	....	....	....	....	....	....	....
Crataegus pinnatifida, Bunge	[C]	....	[C]	S	....	....	....
Cryptotaenia japonica, Hassk	....	....	....	....	....	....	....
Cuscuta japonica, Choisy	F	....	S	[C]	....	....	....
Cyperus amuricus, Maxim	....	....	....	....	....	....	....
Deutzia grandiflora, Bunge	....	....	....	....	....	....	....
Dianthus sinensis, L.	S	F	S	S	....	....	....
Diervilla florida, S. et Z.	....	....	....	F	....	....	....
°Dioscorea acerifolia var. manshurica, H. Burkill	....	....	F	F	....	....	....
Draba nemorosa, L.	....	C	....	....	C	....	....
Dryopteris flaccida, O. Kuntze	....	....	....	F	....	....	....
Dryopteris Filix-Mas, Schott	....	....	....	S	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2ndary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Dryopteris Phegopteris, C. Christ	....	....	F	....	....	....	....
Dryopteris Thelypteris, A. Gray	....	....	....	....	....	....	....
Duchesnea indica, (Andr) Focke	....	S	....	F	....	....	....
Equisetum arvense, L.	F	....	S	C	F	[C]	....
Eragrostis ferruginea, Beauv.	....	....	....	....	....	....	....
Eragrostis pilosa, Beauv.	....	....	....	....	....	....	....
Erigeron acre var. manshuricus, Kom.	....	....	....	....	....	....	....
Erigeron canadensis, L.	C	C	....	....	C	C	....
Eriochloa villosa, Kunth	....	....	....	....	....	....	....
Euonymus alata, S. et Z.	F	....	S	S	....	....	....
Euonymus Maackii, Rupr.	....	....	S	[C]	....	....	....
Eupatorium Lindleyanum, DC.	....	....	....	....	....	....	....
Euphorbia humifusa, Willd.	....	....	....	....	....	....	....
°Euphorbia pilosa L.	[C]	R	S	F	C	S	....
°Fagopyrum esculentum, Moench.	F	....	F	....	....	....	....
Filipendula palmata Maxim.	....	....	....	....	....	....	....
*Filipendula rufinervis, Nakai	....	....	....	[C]	....	....	....
°Fraxinus rhynchophylla, Hance	....	....	R	....	....	....	....
°Galium asprellum var. dahuricum. Turcz.	....	....	....	F	....	....	....
Galium boreale, L.	....	....	....	....	....	....	....
Galium boreale, var. latifolium, Turcz.	....	....	F	....	....	....	....
Galium verum, L.	F	S	....	S	....	....	....
°Gentiana yokusae, var. japonica	....	[C]	F	....	....	....	....
Geranium krameri, Fr. et Sav.	....	....	....	....	....	....	....
Geranium Maximowiczii, Regel	....	....	....	S	....	....	....
°Geranium sibiricum, L.	F	....	F	....	....	R	....
Geum strictum, Ait.	F	....	F	F	....	S	....
Glycine hispida,	R	....	F	S	....	....	....
°Glycine ussuriensis, Regel et Maack.	....	....	....	....	....	....	....
Hemerocallis Middendorfii, Trautv. et Mey.	....	C	R	F	....	....	....
Hemerocallis minor, Miller	....	[C]	F	....	....	....	....
Hibiscus trionus, L.	....	....	....	....	....	....	....
Hieracium umbellatum, L.	Y	....	....	Y	....	....	....
Hierochloe odorata, L.	....	....	....	....	....	....	....
Hosta claerulea, Tratt.	....	....	....	S	....	....	....
Hosta lancifolia, Engl.	F	....	F	F	S	S	....
Humulus japonica, S. et Z.	F	....	F	....	....	F	....
Hypericum Ascyron, L.	....	Y	R	F	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2nd-ary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Hypericum attenuatum, Chois.	....	....	....	....	....	....	....
Hypochaeris grandiflora, Ledeb.	....	....	....	....	....	....	....
Impatiens nole-tangere, L. ...	....	....	....	C	....	....	....
Inula britanica, var. japonica, Fr. et. Sav.	....	S	....	....	....	....	....
Iris sibirica, L.	....	F	F	C	....	....	....
Juglans manshurica, Maxim.	....	....	R	....	....	....	....
Juncus effusus, L.	....	....	....	....	....	$\boxed{C}$	C
°Juncus effusus, var. compactus, Lej. et Court ..	....	....	....	....	....	$\boxed{C}$	C
Kyllingia brevifolia, Rottb. ...	....	....	....	....	....	....	....
Lactuca Bungeana, Nakai. ...	....	....	....	....	....	....	....
Lactuca denticulata, Maxim.	R	....	R	....	....	....	....
°Lactuca laciniata, Maxim. ...	Y	....	Y	....	....	....	....
°Lactuca lanceolata, Makino ...	....	....	R	....	....	....	....
°Lactuca versicolor, Schultz-Bip.	F	C	....	....	....	....	....
Leonurus macranthus, Maxim.	....	....	Y	....	....	....	....
Leonurus sibiricus, L.	....	....	....	....	....	....	....
Lespedeza bicolor, var. Sieboldii, Maxim.	....	Y	$\boxed{C}$	$\boxed{C}$	....	....	....
Lespedeza juncea, Pers. ...	S	$\boxed{C}$	Y	....	....	....	....
Lespedeza sericea, Miq. ...	....	Y	....	....	....	....	....
Lespedeza striata, Hook. et Arn.	F	$\boxed{C}$	?	F	....	....	....
Lilium concolor, Salisb.	....	....	....	....	....	....	....
°Lilium elegans, Thunb.	....	....	....	S	....	....	....
Lonicera Maackii, Rupr. ...	....	....	....	S	....	....	....
Lophanthus rugosus, Fischer et Mey.	....	....	....	....	....	....	....
°Luzula campestris, var. pauciflora, Buchanan	....	....	....	....	....	....	....
Lycopus lucidus, Turcz.	....	....	....	S	....	....	....
°Lycopus Maackianus, Kom. ...	....	....	....	....	....	....	....
Lysimachia barystachys, Bunge	....	$\boxed{C}$	F	F	....	....	....
Lysimachia davurica, Ledeb.	....	....	....	S	....	....	....
Lysimachia vulgaris, L.	F	S	C	$\boxed{C}$	....	....	....
Lysimachia vulgaris, var. davurica, R. Kunth	....	....	....	F	....	....	....
Lythrum salicaria, var. tomentosum, DC.	....	....	....	....	....	....	....
Maackia amurensis, Rupr. et Maxim.	F	F	S	F	....	....	....
Malus baccata, var. manshurica, ...	....	....	$\boxed{C}$	S	....	....	....
Mazus japonicus, O. Kuntze	....	....	....	....	C	$\boxed{C}$	....
Melampyrum laxum, L.	....	....	....	F	....	....	....
Melilotus suaveolens, Ledeb.	....	....	....	....	....	....	....
Menispermum davuricum, DC.	....	....	S	F	....	....	....
Mentha arvensis, L.	....	....	....	....	....	S	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2ndary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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F	F	....	....	F	....	....	....	S	S	....	....	....
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....	C	[C]	[C]	....	....	....	S	....	....	....	....	....
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....	....	F	F	....	....	F	Y	Y	....	....	....	....
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Metaplexis japonica, Makino	F	F	S	C	....	....	....
Microlepia Wilfordii, Moore..	....	....	....	F	....	....	....
°Microlespedeza stipulacea, Makino	....	....	....	....	....	....	....
Miscanthus sinensis, Anders.	....	....	....	....	....	....	....
Mnium sp ?	....	....	....	....	....	....	....
Moehringia lateriflora, Fenzl.	F	....	....	....	F	....	....
Morus bombycis, Koidz.... ...	....	....	....	....	....	....	....
Mosla grosse-serrata, Maxim.	....	....	....	....	....	....	....
°Myriophyllum spicatum, L. ...	....	....	....	....	....	....	....
°Myriophyllum verticillatum L.	....	....	....	....	....	....	....
Nasturtium montanum, Wall.	C	....	C	F	....	C	....
Nasturtium palustre. DC. ...	S	....	....	....	....	....	....
*Neillia Millsii, Dunn...	....	....	C	C	....	....	....
Oenanthe stolonifera, DC. ...	Y	....	....	....	....	....	....
°Onoclea germanica, Willd. ...	....	....	F	....	....	R	....
Orobanche caerulescens, Steph.	....	....	S	....	....	S	....
Osmunda cinnamomea, L. ...	....	....	....	C	....	....	....
Oxalis corniculata, L.	F	F	C	S	....	C	....
Panicum crus-galli, var. submuticum, Mey.	....	....	....	....	....	....	....
Panicum sanguinale, L.	S	F	....	....	....	....	....
Patrinia scabiosaefolia, Fischer	F	....	F	S	....	....	....
°Pedicularis resupinata, var. oppositifolia, Miq.	....	....	....	F	....	....	....
Pedicularis resupinata, var. spicata, Nakai	....	....	....	R	....	....	....
Pennisetum japonicum, Trin.	....	C	....	....	....	....	....
°Pennisetum purpurascens, Makino	....	F	....	....	....	....	....
°Pennisetum purpurascens, var. viridescens. Mak. ..	....	....	....	....	....	....	....
Penthorum chinense, Ness. ...	....	....	....	....	....	....	....
Peucedanum decursivum, Maxim.	R	....	C	....	....	....	....
Peucedanum terebinthaceum, Fischer	Y	....	....	....	....	....	....
Phalaris arundinacea, L. ...	....	F	....	F	....	....	....
*Phaseolus pendulus, Nakai ..	....	....	....	....	....	....	....
Philadelphus Schrenkii, Rupr	....	....	C	?	....	....	....
°Phragmitis pumila, Willk. ..	....	....	F	....	F	S	....
Phteirospermum chinense, Bunge	....	....	....	....	....	....	....
Phyteuma japonicum, Miq. .	....	....	....	S	....	....	....
Picris japonica, Thunb.	R	....	....	....	....	....	....
°Pilea viridissima, Mak.	....	....	....	....	....	....	....
Plantago major, var. asiatica, Dcne.	S	C	S	S	F	F	....
Plantago depressa, Willd. ...	....	....	....	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2nd-ary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Platycodon grandiflorus, A. DC.	....	S	....	....	....	....	....
Plectranthus excisus, Maxim.	....	....	....	....	....	....	....
Plectranthus glaucocalyx, Maxim.	....	....	....	....	....	....	....
Plectranthus inflexus, Vahl	....	....	S	S	....	....	....
Plectranthus serra, Maxim.	F	....	....	....	....	....	....
°Poa annua, L.	....	....	....	....	....	....	....
°Poa palustris, L.	....	....	....	....	....	....	....
Poa pratensis, L.	S	....	S	S	....	....	....
Poa trivialis, L.	F	....	....	....	....	....	....
Polemonium coeruleum, L.	....	....	....	C	....	....	....
Polygala triphylla, Ham.	....	....	....	....	....	....	....
Polygonatum officinale, All	....	....	....	....	....	....	....
Polygonatum officinale, var. japonicum, Maxim.	F	C	S	S	....	....	....
°Polygonatum verticillatum, All.	....	....	....	....	....	....	....
Polygonum aviculare, L.	....	....	....	....	....	....	....
°Polygonum aviculare, var. laxum, Ledeb.	S	C	....	....	....	....	....
Polygonum multiflorum, Thunb.	....	....	S	C	....	....	....
Polygonum nodosum, Pers.	....	....	S	....	....	....	....
Polygonum orientale, L.	....	....	....	....	....	....	....
Polygonum polymorphum, Ledeb.	C	S	S	S	....	....	....
°Polygonum polymorphum, var. undulatum, Ledeb.	Y	....	....	....	....	....	....
°Polygonum scandens, var. dentato-alatum, Max.	....	....	....	....	....	....	....
Polygonum perfoliatum, L.	F	....	F	R	F	....	....
°Polygonum Thunbergii, var. stoloniferum, Fr. Schmidt	....	....	....	....	F	....	....
Polystichium aculeatum, Schott.	....	....	....	F	....	....	....
°Populus Simonii, Carr.	....	....	....	....	....	....	....
Populus suaveolens, Fischer	....	....	....	....	....	....	....
Potamogeton limosellifolius, Maxim.	....	....	....	....	....	....	....
Potentilla centigrana, var. manshurica, Maxim.	....	....	F	....	F	....	....
Potentilla chinensis, Ser.	F	C	F	F	....	....	....
°Potentilla filipendula, Willd.	....	....	....	....	....	....	....
Potentilla flagellatis, Willd.	R	F	C	C	....	....	....
Potentilla Kleiniana, Wight. et Arn.	....	....	F	C	....	....	....
Prunus padus, L.	....	....	....	....	....	....	....
Prunus ssiori	....	....	C	S	....	....	....
Pycnostelma chinense, Bunge	....	....	....	....	....	....	....
Pycreus sanguinolentis, Nees	....	....	....	....	....	....	....
Pyrus ussuriensis, Maxim.	....	....	S	S	....	....	....
Quercus mongolica, Fischer	....	....	R	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2nd-ary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
....	F	....	S	....	....	....	....	....	....	....	....	....
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Ranunculus acris, var. japonicus, Maxim.	F	C	F	S	Y	S	....
°Ranunculus chinensis, Bunge	F	....	....	....	....	....	....
Ranunculus pennsylvanicus, var. chinensis, Maxim.	....	F	F	....	C	C	....
Rhamnus globosa, Bunge	....	....	S	C	....	....	....
Rhamnus parvifolia, Bunge	....	....	?	C	....	....	....
Rhododendron davuricum, L.	....	....	R	....	....	....	....
Rosa davurica, Pall.	C	F	C	C	....	....	....
Rottboellia compressa, var. japonica.	....	....	....	....	....	....	....
Rubia cordifolia, L.	....	....	....	S	....	....	....
Rubus crataegifolius, Bunge	F	....	F	....	....	....	....
Rumex acetosa, L.	....	S	....	....	Y	....	....
Rumex crispus, L.	F	S	S	F	S	C	S
Salix acutifolia, Willd.	....	....	....	....	F	S	....
*Salix graciliglans, Nakai	....	....	....	....	....	....	....
Salix gracilistyla, Miq. (S. Thunbergiana, Bl.)	....	....	....	....	....	....	....
Salix koreensis, Anders.	....	....	....	....	....	....	....
Salix multinervis, Fr. et Sav.	....	....	....	F	....	....	....
Salix purpurea, L.	....	....	....	....	....	....	....
°Salix stipularis, Sm.	....	....	....	....	....	....	....
°Salix vagans, var. cinerascens, Anders.	....	....	F	....	....	....	....
Sanguisorba officinalis, L.	....	....	Y	S	....	....	....
Sanicula elata, Ham	....	....	....	....	....	....	....
Satureia chinensis, Briquet	S	C	S	S	....	....	....
Saussurea affinis, Sprengel	....	....	....	....	....	F	....
Saussurea koreiensis, Nakai	....	....	F	....	....	....	....
Saxifraga Rossi, Oliv.	....	....	....	....	....	....	....
Schisandra chinensis, Baill.	....	....	F	....	....	....	....
Scilla chinensis, Benth.	S	C	S	S	....	....	....
Scilla japonica, Baker	....	Y	....	....	....	....	....
Scirpus Eriophorum, Michx.	....	....	....	....	....	....	....
°Scirpus tabernaemontanii, Gmell.	....	....	....	....	....	C	C
Scorzonera austriaca, Willd.	F	....	....	....	....	....	....
°Scorzonera radiata, Fischer	....	....	....	....	....	....	....
Securinega fluggeoides, Muell. Arg.	....	....	S	F	....	....	....
Sedum Aizoon, L.	....	....	F	S	....	....	....
°Sedum hyleoidum, L.	....	....	....	....	....	....	....
Sedum viviparum, Maxim.	Y	Y	....	....	F	....	....
Selaginella helvetica, Link.	....	....	C	C	....	....	....
Selaginella involveus, Spr.	....	....	....	....	....	....	....
Selaginella Rossi, Moore	....	....	....	....	....	....	....
Senecio campestris, DC.	Y	Y	R	....	....	....	....
Setaria glauca, Beauv.	....	....	....	....	....	....	....
Setaria viridis, Beauv.	....	....	....	....	....	....	....
Siegesbeckia orientalis, L.	Y	....	....	....	....	....	....
Silene aprica, Turcz.	....	....	....	F	....	....	....
Silene capitata, Kom.	....	....	....	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2ndary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
Silene firma, S. et. Z.	....	S	S	....	....	....	....
Silene repens, Patri	C	....	F	....	....	....	....
Sium cicutaefolium, Gmell	....	....	....	....	....	....	....
°Smilax herbacea, L. var.?	....	....	F	C	....	....	....
Smilax Oldhami, Miq.	....	....	....	....	....	....	....
Sonchus arvensis, L.	....	....	R	....	....	....	....
Sophora flavescens, Ait.	F	C	F	S	....	....	....
Sorbaria sorbifolia, var. stellipila, Schneid.	....	....	F	....	....	....	....
°Spiraea chamaedrifolia, L.	....	....	F	....	....	....	....
Spiraea pubescens, Turcz.	....	....	....	....	....	....	....
Spiraea salicifolia, L.	....	....	S	C	....	....	....
°Spiraea salicifolia, var. lanceolata, Torr. et Gray.	....	....	....	....	....	....	....
Spodiopogon sibiricus, Trin.	....	....	F	F	....	....	....
Stachys aspera, Michx.	....	....	F	S	....	....	....
*Stachys glabrata, Nakai	....	....	....	....	....	....	....
Stellaria aquatica, Scop.	....	....	....	....	....	....	....
Syringa amurensis, Rupr.	....	....	F	....	....	....	....
Taraxicum officinale var. platycarpum, H. Dahls	S	C	S	F	S	S	....
Thalictrum aquilegifolium, L.	....	....	C	C	....	....	....
°Thalictrum simplex, var. affine, Regel	....	....	....	....	....	....	....
Thesium chinense, Turcz.	F	C	F	....	....	....	....
Thlaspi arvense, L.	....	S	....	....	....	....	....
Tilia amurensis, Kom.	....	....	R	....	....	....	....
Torilis japonica, DC.	....	....	....	S	....	....	....
Trifolium Lupinaster, L.	F	F	F	S	....	....	....
Trigonotis peduncularis, Benth.	....	....	....	....	F	....	....
Tripterygium Regelii, Sprague et Takeda	....	....	C	C	....	....	....
Ulmus japonica, Sarg.	....	....	S	?	....	....	....
Ulmus pumila, L.	S	....	....	....	....	....	....
Urtica angustifolia, Fischer	....	....	....	....	....	....	....
Veratrum Maacki, Regel	....	....	....	S	....	....	....
Veronica Anagallis, L.	....	....	....	....	....	F	....
Veronica angustifolia, Fischer	F	S	....	F	....	....	....
Veronica serpyllifolia, L.	....	....	....	....	....	....	....
Veronica spuria, L.	....	....	F	F	....	....	....
Viburnum Sargentii, Koehne.	....	....	F	C	....	....	....
Vicia Cracca, L.	F	....	C	C	....	F	....
Viola biflora, L.	....	....	....	....	C	C	....
Viola canina, L.	F	S	F	F	....	F	....
Viola chinensis, G. Don.	C	C	....	....	F	F	....
°Viola chinensis, var. subsagittata, Maxim.	....	....	....	F	....	....	....
Viola hirta, L.	F	....	....	....	....	....	....
*Viola Ishidoyana, Nakai	....	....	....	....	....	....	....
Viola phalacrocarpa, Maxim.	....	C	....	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2nd-ary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
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....	....	....	....	....	....	F	F	F	....	....	S	....
....	F	....	....	....	....	....	....	....	....	....	....	....
....	[C]	S	[C]	....	....	F	....	....	....	....	....	....
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....	....	....	....	....	....	....	....	[C]	....	....	....	....

TONG-NAI RIVER BASIN, NORTHERN KOREA

Name of Plant	I	II "E"	III "Half Meso"	IV "Entire Meso"	V A Shore	VI Sandy Shore	VII Sand flat, Submerged
°Viola pinnatifida, var. chaerophylloides, Regel	....	....	....	....	....	....	....
Viola verecunda, A. Gray	....	....	....	....	....	....	....
Vitis amurensis, Repr.	....	....	F	C	....	....	....
Xanthium Strumarium, L.	....	....	....	....	....	S	....
Zoysia pungens, Willd.	F	C	S	....	....	....	....

VIII "Willow flat"	IX "Meso nook"	X "G"	XI "H"	XII "Meso bank, grassy"	XIII "Willow island, 2ndary"	XIV "B"	XV "C"	XVI "C Meso"	XVII Pond Edge	XVIII "Meso Pond," in water	XIX Eroding Field	XX Island
....	....	....	....	....	....	....	....	....	F	....	....	....
....	....	....	....	....	....	....	Y	....	....	....	....	....
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....	S	....	....	S	....	....	C	S	....	....	S	....
....	....	....	....	C	....	....	C	....	....	....	....	....

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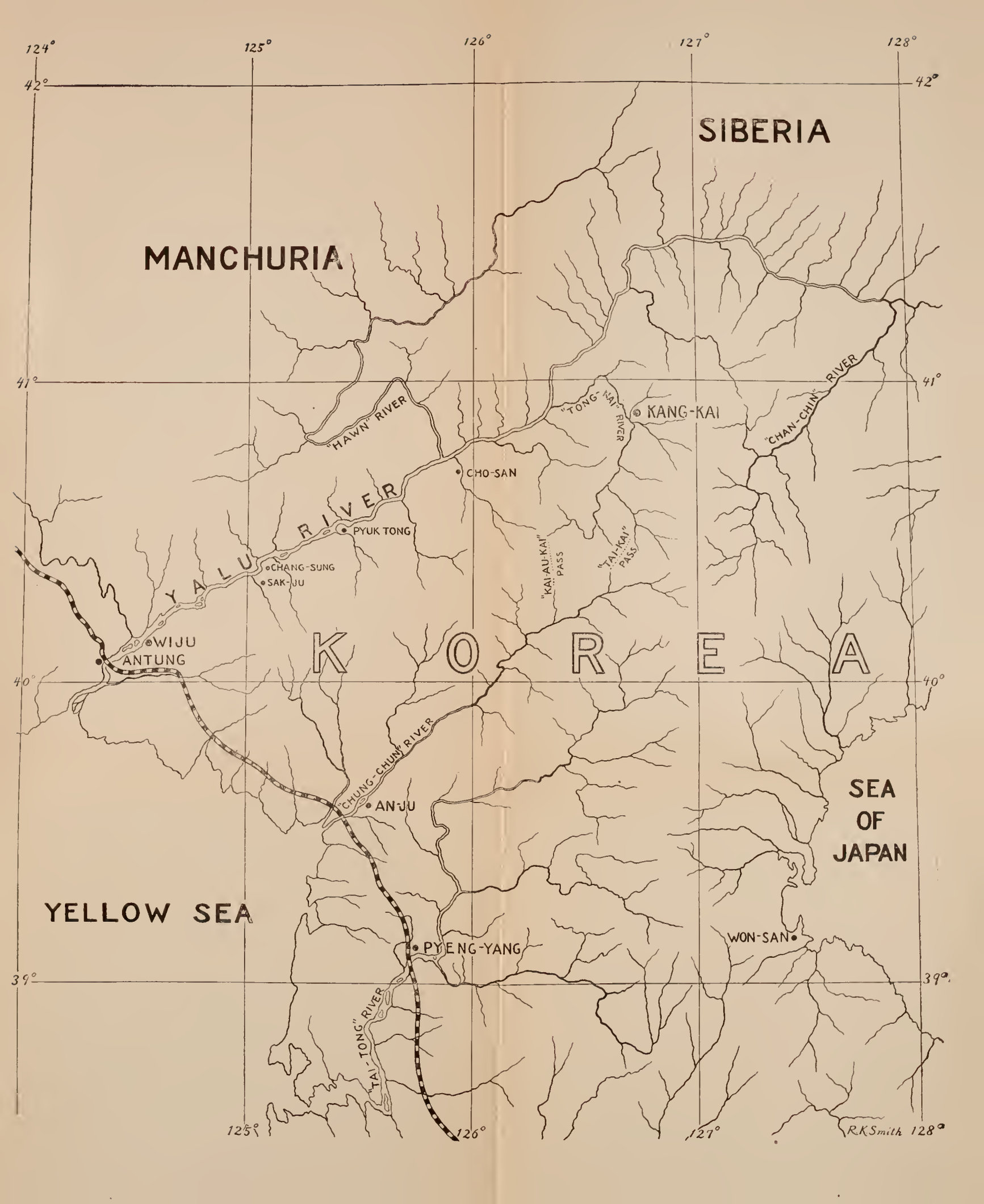
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125°
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127°
128°
42°
41°
40°
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SIBERIA
MANCHURIA
"HAWN" RIVER
"TONG-NAI" RIVER
KANG-KAI
"CHAN-CHIN" RIVER
CHO-SAN
YALU RIVER
PYUK TONG
CHANG-SUNG
SAK-JU
"KAI-AU-KAI" PASS
"TAI-KAI" PASS
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