ON THE SYNCHOROLOGICAL AND FLORISTIC TRENDS AND DISCONTINUITIES IN REGARD TO THE JAPAN-LIUKIU-FORMOSA AREA.*)

(with 21 tables, 2 maps and 6 photographs)

by

TAKAHIDE HOSOKAWA

(Department of Biology, Faculty of Science,
Kyushu University, Fukuoka, Japan) [1])

A monumental work in the taxonomy of Formosan vascular plants was made by B. HAYATA (1908, 1911, 1911-1921) from 1904 to 1921. After his work, since 1921, supplemental taxonomic works on the flora of Formosa have been done by several Japanese botanists. The flora of the Liukius has actively been studied by Japanese botanists, G. KOIDZUMI, G. MASAMUNE, and J. OHWI. There are many japanese botanists who have studied the taxonomy of the vascular plants of Japan, e.g., T. MAKINO, T. NAKAI, G. KOIDZUMI, Y. KUDO, M. HONDA, A. KIMURA, Y. SATAKE, S. KITAMURA, J. OHWI, H. ITO, F. MAEKAWA, M. TAGAWA, H. HARA, S. HATUSIMA, etc. Recently, however, H. HARA (1948-1954) and J. OHWI (1953) made timely publications as the results of their taxonomic studies of long duration.

Based on those taxonomic knowledges of the flora and various informations of the vegetation of the area (T. SUZUKI, 1939, 1948-1954; F. WATANABE, 1938; H. NAKANO, 1942, 1943; T. YAMANAKA, 1952, 1953; K. YOSHIOKA, 1952-1954; K. YATOH, 1954; T. MAEDA, 1950, 1951, 1952; T. KIRA, 1949, 1952; IMANISHI, 1935; T. HOSOKAWA, 1935, 1952) along with the knowledges of the recent contributions from modern taxonomists and phytosociologists, the writer would discuss in this paper some problems of the synchorological and floristic trends and discontinuities in regard to the Formosa-Liukiu-Japan area.

DISCUSSION

I. BETWEEN FORMOSA AND THE PHILIPPINES.

The phytogeographical discontinuity between the Philippines and Formosa has been fully discussed by E. D. MERRILL (1923). As the results of his considerations, he modified the position of the northern part of the WALLACE's line placing it between Formosa and the Philippines. Most botanists who have an interest in the phytogeography of Far Eastern Asia and Malaysia, seem to agree well with MERRILL's recognition of distinct discontinuity of plant dispersal between the Philippines and Formosa.

*) Received for publication 24.XI.1954.

[1]) The author delivered a special lecture on this subject before the botany class in the National Taiwan University, Taipei, Formosa (Taiwan), on December 4th 1953. — Contributions from the Department of Biology, Faculty of Science, Kyushu University, No. 38.

The phytogeographical position of the Botel Tobago Island, which lies between the Batan Islands and Formosa proper, should be considered. This small island is located about 49 miles from Taitô on the south-east coast of Formosa, and only 40 miles from the Batan Islands of the Philippines. T. KANO (1933, 1936, 1941) indicated the affinities of the faunas of Botel Tobago and the Philippines chiefly from the distribution of the avifauna and of Pachyrrhynchid weevils. He proposed a demarcating line between Botel Tobago, together with Samasna (the Kwasyoto Island), and Formosa, and connected it with the Neo-Wallace's line of DICKERSON and MERRILL. R. KANEHIRA (1935, 1936) quite agreed with KANO's opinion in respect to the phytogeography of the ligneous plants. The writer also quite agrees with such a way of thinking, according to the synchorological standpoint (HOSOKAWA, 1935) and the following floristic data (Table 1-4).

Table 1. The families which are found in Formosa and not the Philippines.

Valerianaceae	Dipsacaceae	Monotropaceae
Diapensiaceae	Myoporaceae	Phylidraceae
Trochodendraceae		

Table. 2. The families which are found in the Philippines and not Formosa.

Triuridaceae	Centrolepidaceae	Monimiaceae
Nepenthaceae	Cunoniaceae	Erythroxylaceae
Dichapetalaceae	Gonystylaceae	Ochnaceae
Dipterocarpaceae	Datiscaceae	Epacridaceae
Salvadoraceae	Stylidiaceae	Stackhousiaceae
Clethraceae		

No genus is confined to Formosa and the Philippines.

Table 3. The genera which are found in the Botel Tobago Island or the Samasna Island (Kwasyoto) and the Philippines, and not in Formosa proper.

Alyxia (Apocynaceae)	Boerlagiodendron (Araliaceae)
Tabernaemontana (Apocynaceae)	Cypholophus (Urticaceae)
Dysoxylum (Meliaceae)	Endiandra (Lauraceae)
Geniostoma (Loganiaceae)	Homalanthus (Euphorbiaceae)
Leucosyke (Urticaceae)	Maoutia (Urticaceae)
Myristica (Myristicaceae)	Pseudopinanga (Palmae)
Rourea (Connaraceae)	Timonius (Rubiaceae)
Pavetta (Rubiaceae)	Ixora (Rubiaceae)
Cyrtandra (Gesneriaceae)	Pygeum (Rosaceae)
Pterospermum (Sterculiaceae)	Poikilospermum ? (Moraceae)
Artocarpus (Moraceae)	Donax (Marantaceae)
Pothoidium (Araceae)	Epipernopsis ? (Araceae)
Saccolabium (Orchidaceae)	Mappia (Icacinaceae)
Flacourtia (Flacourtiaceae)	Pleomele (Liliaceae)

Table 4. The genera which are found in Formosa and Botel Tobago, and not the Philippines.

Stauntonia (Lardizabalaceae)	Osmanthus (Oleaceae)
Corydalis (Papaveraceae)	Idesia (Flacourtiaceae)
Peucedanum (Umbelliferae)	Codonacanthus (Acanthaceae)
Tricyrtis (Liliaceae)	

Concerning the forest-community types of Formosa and the Philippines, we need special attention to the fact that the Dipterocarp rainforests are well developed on the lowland of the Philippines while none of such forests can be found in Formosa. The lowland forests of Formosa consist chiefly of the species of *Fagaceae*, *Lauraceae*, *Symplocaceae*, *Theaceae*, and *Aquifoliaceae*. Similarly, attention should also be called to the fact that, the occurrence of the coniferous forests of Northern Hemisphere type, Chamaecyparidion taiwanensis, and the *Juniperus* and the *Abies* forests is conspicuous in the highland of Formosa, confronting the high-mountain forests of the Philippines, which are composed chiefly of *Phyllocladus*, *Dacrydium*, *Tristania*, *Leptospermum*, etc., elements of the flora of the Southern Hemisphere.

II. BETWEEN FORMOSA AND CONTINENTAL CHINA.

Since Formosa was connected geologically with Continental China during the Pliocene, the floras of both countries are closely related, as is clearly indicated especially by the distribution of the conifers. Out of 15 genera of Gymnosperms in Formosa, there are 4 genera confined to Continental China and Formosa; namely *Taiwania*, *Keteleeria*, *Cunninghamia* and *Amentotaxus*, and 11 species have the same restricted range (Table 5).

Table. 5. Gymnosperm species confined to Formosa and Continental China.

Amentotaxus argotaenia Pilger	Pinus formosana Hay.
Tsuga chinensis Pritz.	Pinus Massoniana Lamb.
Juniperus formosana Hay.	Pseudotsuga Wilsoniana Hay.
Juniperus squamata Lamb.	Taiwania cryptomerioides Hay.
Libocedrus formosana Florin	Keteleeria Davidiana Beissn.
Pinus Armandi Franch.	

It is noteworthy that *Larix* and *Torreya* are represented in Continental China and Japan, and not in Formosa, while *Chamaecyparis* occurs in Japan and Formosa and not in Continental China. Moreover *Libocedrus* occurs in Formosa and Continental China and not Japan.

Of the Angiosperms and Pteridophytes, the genera confined to Continental China and Formosa are as follows:

Table 6. The genera of Angiosperms and Pteridophytes which are confined to Formosa and Continental China.

Eustigma (Hamamelidaceae)	Alniphyllum (Styracaceae)
*Paulownia (Scrophulariaceae)	Eurycorymbus (Sapindaceae)
Koelreuteria (Sapindaceae)	Tetrapanax (Araliaceae)
Prinsepia (Rosaceae)	Archangiopteris (Marattiaceae)
**Rubiteucris (Labiatae)	

* cultivated also in Japan. ** also in the Himalayan region.

In addition to the above (Table 6), we have two more phytogeographically interesting genera; *Podophyllum* (*Berberidaceae*) found also in N. America, and *Titanotrichum* (*Gesneriaceae*) also in the Yaeyama Islands of the Liukius, besides the China-Formosa range.

There are quite a number of genera of Phanerogams, excluding tropical elements, which genera are found in Formosa, Continental China, and some others but Japan proper, for examples;

Table 7. Examples of the genera of Phanerogams which are found in Formosa and Continental China and not Japan proper.

Liquidambar (Hamamelidaceae)	Sassafras (Lauraceae)
Sloanea (Elaeocarpaceae)	Reevesia (Sterculiaceae)
Engelhardtia (Juglandaceae)	Perrottetia (Celastraceae)
Pistacia (Anacardiaceae)	Gordonia (Theaceae)
Podophyllum (Berberidaceae)	Titanotrichum (Gesneriaceae)

Genera occurring in Japan, Continental China, and some others but Formosa are *Aesculus* (*Hippocastanaceae*), *Populus* (*Salicaceae*), *Syringa* (*Oleaceae*), *Ostrya*, (*Betulaceae*), *Castanea* (*Fagaceae*), etc., and moreover we have 28 genera, confined to Continental China and Japan proper (Table 13), of this category of distribution.

KANEHIRA (1936) has pointed out that 82 ligneous species are confined to Formosa and Continental China, and we may expect more species of such plants in the future. It is also here noted, as it was stated by WILSON (1922), that, while there are no representatives of *Nyssaceae*, *Eucommiaceae*, *Cercidiphyllum* (*Cercidiphyllaceae*), *Euptelea* (*Eupteleaceae*) and *Hamamelis* (*Hamamelidaceae*) in Formosa, species of these genera are found frequently in Continental China. In Hainan occur species of *Vatica*, *Taraktogenos*, *Gironniera*, *Antiaris*, and many others which have no representatives in Formosa.

Outline of the vegetation together with the floristic characteristics of Formosa.

We can classify the climates of Formosa into 6 types after the KÖPPEN's method (1923) [Fig. 1]. The southern part of Formosa, south to Tainan in the west coast and to Taitô in the east, is tropical, corresponding to

KÖPPEN'S A climate or KIRA'S A "6 and A'5 climate (KIRA, 1945). In this area the western part has KÖPPEN'S Awa climate or KIRA'S A'5 climate, but the eastern part, including the Botel Tobago and Samasna (Kwasyoto Isl.) Islands, is in an Afw climate or KIRA'S A"6 climate. The south-western

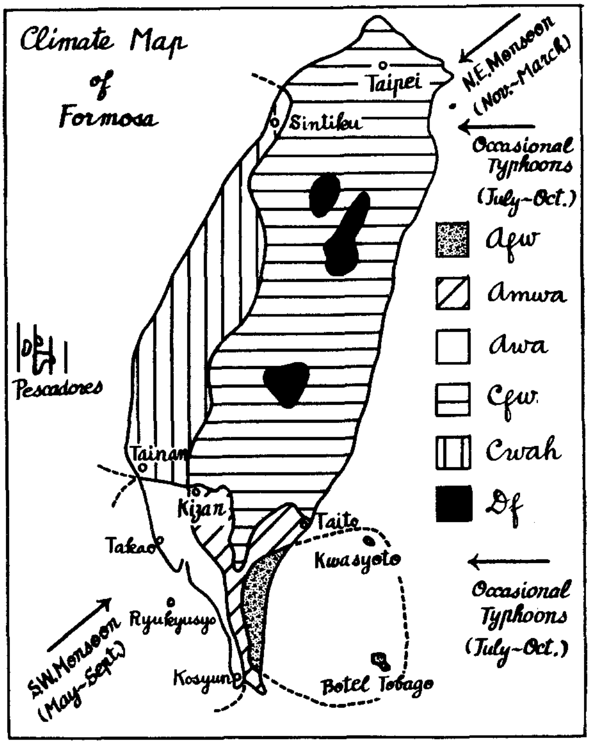

Fig. 1. A climate map of Formosa after the indication of KÖPPEN'S method.

part of Formosa has a dry climate from November to March caused by the N.E. Monsoon being interrupted by the Central Mountain Range of Formosa, while during the period from May to September it rains heavily by the effect of S.W. Monsoon which blows with wet air-mass against the Range. In the north-eastern part of Formosa the N.E. Monsoon stiffly blows wetly from the Pacific in winter or the former season mentioned above. However, the influence of the S.W. Monsoon in summer may be reversed by occasional typhoons which pass through Formosa frequently from the S.W. Pacific. In this case the east coast becomes a windward side so that the north-eastern part of Formosa is rainy nearly all of the year. Affected by such a macroclimate, tropical or subtropical rainforests are developed in Afw (or KIRA'S A"6) or Cfa (or KIRA'S A"5) climate areas of the lowland, while raingreen forests grow as a forest climax in the KÖPPEN'S Awa or KIRA'S A'5 climate areas. However, the greater part of the Cfa or KIRA'S A"4 climate areas in Formosa is covered by a forest climax of Laurisilvae, composed predominantly of diverse trees mostly of *Fagaceae*, *Lauraceae*, *Theaceae*, *Symplocaceae*, and *Aquifoliaceae*.

On the tropical and subtropical zones.

At altitudes of less than about 500 m with an Afw (or KIRA's A"6) or Cfa (or KIRA's A"5) climate in Formosa is found *Machilion Kusanoi* (T. SUZUKI, 1952) consisting of Ctenideto-Ficetum cuspidato-caudatae and Elatostemeto-Machiletum Kusanoi of tropical or subtropical rainforests. In addition to these forest communities, there occur in Botel Tobago with an Afw (or KIRA's A"6) climate, synchorologically significant stands of Pometietum pinnatae growing on slopes, especially along ravines, at altitudes of less than 300 m, and those of Astronietum formosanae on the higher altitudes between about 300 m and 540 m. On the contrary, the area of Awa (or KIRA's A'5) climate in the south-western part of Formosa, which more or less corresponds climatologically to the lowland of Kwangtung and Hainan of China, is covered by the raingreen forests of Albizziion procerae (HOSOKAWA, new alliance) consisting of Bridelieto-Albizzietum procerae (HOSOKAWA 1952) and Imperateto-Bombacetum Ceibae (HOSOKAWA 1952), as well as the Mangrove forests standing also on some parts of the south-western coast of Formosa. The Mangrove forests are well developed, particularly in the Takao Bay, while no vascular epiphytes can be found in any forest of Mangrove.

In this zone, excluding the Botel Tobago Isl., there are found *Podophyllum*, *Titanotrichum*, *Reevesia* (*Sterculiaceae*), *Pistacia* (*Anacardiaceae*) and *Gordonia*, all of which range over Continental China and Formosa proper in common and not Japan proper.

On the warm-temperate zone.

The altitudes between about 500 m and 2000 m above sea-level are affected by a wet- and warm-temperate climate or mostly Cfa (or KIRA's A"4) climate, differing from a subarid climate (KÖPPEN's Cwa or KIRA's A'4) of Continental China. There are well developed, in this zone, Laurisilvae or Evergreen Broad-leaved Forests, the most representative type of forest communities in Formosa. In this zone of the south-western part of Formosa, the development of Castanopsidion taiwanianae is recognized in the altitudes of about 400-1500 m, and Shiion longicaudatae in those of 800-2000 m. In correspondence with the altitudinal range of those two alliances in the south-western part of Formosa, we are able to outline the altitudinal distribution of forest communities of Laurisilvae in the north-eastern part of Formosa; namely Shiion stipitatae ranging from 300 m to 1500 m in alt. and Cyclobalanopsidion paucidentatae from 1100 m to 2600 m. On referring to Table 8, the reader can see an outline of the alliances.

Besides the above-mentioned forest-communities, there are found extensive areas of well developed Miscanthion japonici of montane grassland and Pine woods on slopes below about 2000 m altitude.

A very notable feature of the forest vegetation of Formosa is shown by the fact that there is developed scarcely any summergreen forest except the stands of Indocalameto-Fagetum Hayatae (belonging to Fagion Hayatae according to T. SUZUKI (1952), which are located in the restricted areas under a Cfa (or KIRA's A''4) climate at about 1000-1500 m alt. in the northern part of Formosa. In this deciduous forest community, subordinate evergreen trees of *Illicium arborescens* HAY., *Trochodendron aralioides* SIEB. et ZUCC., *Osmanthus* sp. (cf. *O. integrifolius* HAY.), *Adinandra formosana* HAY., *Daphniphyllum* sp., etc. are commixed with the dominant species of *Fagus Hayatae* PALIB. Absence of summergreen forests in the Himalayan region (K. IMANISHI, 1953) and Malaysia may synchorologically be an interesting aspect of the vegetation in tropical countries. Synecologically and synchorologically interesting problems are presented in the existence of *Fagus* forest stands in restricted small areas in Formosa and in the lack of summergreen forests in Yaku Shima, which is just south of Kagoshima of S. Japan, in spite of the existence of some deciduous trees growing in the coniferous forests of the island.

Table 8. The associations and alliances of Laurisilvae found in the warm-temperate zone of Formosa.

South-western part of Formosa	North-eastern part of Formosa
Alliance 1: Castanopsidion taiwanianae, under a Cfa or Amwa (or Kira's A″4) climate in the alt. of 400-1500 m. 1) Pileeto-Machiletum pseudolongifoliae 2) Athyrieto-Schimetum superbae 3) Bladhieto-Cyclobalanopsidetum gilvae 4) Elatostemeto-Machiletum pseudolongifoliae 5) Rumohreto-Cinnamommetum Camphorae	Alliance 2: Shiion stipitatae, under a Cfa (or Kira's A″4) climate in the alt. of 300-1500 m. 1) Diplazieto-Cyclobalanopsidetum gilvae 2) Selaginelleto-Lithocarpetum uraianae 3) Blasteto-Shiietum stipitatae 4) Maeseto-Cyclobalanopsidetum pseudomyrsinifoliae
Alliance 3: Shiion longicaudatae, under a Cfa (or Kira's A″4) climate in the alt. of 800-2000 m. 1) Polystichodryeto - Cyclobalanopsidetum pseudomyrsinifoliae 2) Rhodoreto-Shiietum longicaudatae	Alliance 4: Cyclobalanopsidion paucidentatae, under a Cfa (or Kira's A″4) and Cfb (or Kira's A″3) climates in the alt. of 1100-2600 m. 1) Camellieto-Cyclobalanopsidetum paucidentatae

In this zone, there are many endemic genera confined to Continental China and Formosa proper, such as *Eustigma* (*Hamamelidaceae*), *Alniphyllum* (*Styracaceae*), *Paulownia* (*Scrophulariaceae*), *Eurycorymbus* (*Sapindaceae*), *Koelreuteria* (*Sapindaceae*), *Tetrapanax* (*Araliaceae*), *Archangiopteris* (*Marattiaceae*), *Keteleeria* (*Abietaceae*), *Amentotaxus* (*Taxaceae*), and *Cunninghamia* (*Taxodiaceae*), and some others distributed in common in Continental China and Formosa proper and not Japan proper, as follows; *Libocedrus* (*Cupressaceae*), *Liquidambar* (*Hamamelidaceae*), *Sassafras* (*Lauraceae*), *Sloanea* (*Elaeocarpaceae*), *Engelhardtia* (*Juglandaceae*), *Gordonia* (*Theaceae*), *Podophyllum* (*Berberidaceae*), *Titanotrichum* (*Gesneriaceae*), etc.

On the cool-temperate zone.

The highland conditioned by a Cfb (KIRA's A"3) climate in altitudes of about 2000-3000 m is characterized by Chamaecyparidion taiwanensis named by T. SUZUKI (1953). In this zone, which corresponds to the midmountain forest region of Himalaya and Malaysia and the highland of Yünnan and Kweichow, there are found several phytogeographically interesting species of Gymnosperms, listed in the following table.

Table 9. Conifers growing in the cool-temperate zone of Formosa.

Chamaecyparis taiwanensis Masam. & S. Suzuki	Tsuga chinensis Pritzel
Chamaecyparis formosensis Matsum.	Juniperus formosana Hay.
Pinus taiwanensis Hay.	Pinus Armandi Franch.
Picea morrisonicola Hay.	Taiwania cryptomerioides Hay.
Cunninghamia Konishii Hay.	

These occur in the following forest-communities (Table 10).

Table 10. Associations of coniferous forests and subalpine grassland in the cool-temperate zone of Formosa (T. Suzuki 1943).

Alliance 1: Chamaecyparidion taiwanensis, under a Cfb (or Kira's A"3) climate in the altitudes of 1800-3000 m.
1) Rhodoreto-Chamaecyparidetum taiwanensis
2) Pellionieto-Tsugetum chinensis
3) Piceetum morrisonicolae (ranging 2500 m to 3000 m in alt.) (Added by T. Hosokawa).
Alliance 2: Miscanthion transmorrisonensis (Subalpine grassland ranging from 2000 m to 3000 m in alt.) (Added by T. Hosokawa).

In this zone occur 3 genera, *Taiwania*, *Prinsepia* and *Rubiteucris*, which are confined to Continental China and Formosa proper, and *Perrottetia* distributed in Continental China and Formosa proper in common and not Japan.

On the subfrigid zone.

The highest part of Formosa at about 3000-4000 m, which is conditioned by a Df (or KIRA's A"2) climate is occupied by the stands of Junipereto-Abietum Kawakamii, ranging from 2800 m to 3300 m high, and Rhododendreto-Juniperetum squamatae, from 3000 m to 3700 m high, as well as diverse associations of subalpine deserts, from about 3500 m to 4000 m altitudes. In addition to the dominant conifers, *Abies Kawakamii* ITO and *Juniperus squamata* LAMB., *Rhododendron pseudochrysanthum* HAY. and *Berberis morrisonensis* HAY., grow prominently in these forest-communities.

Subalpine deserts, which may be caused by edaphic and orographic factors and are supposed not to be climatic-climax communities, are often

Table 11. Altitudinal distribution of plant communities in the subalpine vegetation in Formosa (T. Suzuki 1939).

I. Associations of coniferous forests and scrubs.
  1) Junipereto-Abietum Kawakamii (ranging over 2800-3300 m in alt.)
  2) Rhododendreto-Juniperetum squamatae (ranging from 3000 m to 3700 m in alt.)
II. Subalpine deserts (ranging from 3500 m to 4000 m in alt.)
  1) The Epilobium nankotaisanense-Picris Ohwiana alliance
  2) The Festuca ovina alliance
  3) The Brachypodium Kawakamii alliance.

developed near or beyond the belt of Juniperetum squamatae of open type in this zone at about 3000-3700 m above sea-level.

T. SUZUKI recognized 3 alliances of subalpine deserts near the top of Mt. Nankotaizan (T. SUZUKI 1939), such as the *Epilobium nankotaisanense-Picris Ohwiana*, the *Festuca ovina*, and the *Brachypodium Kawakamii* alliances.

The major plants of subalpine deserts in this zone of Formosa are as follows:

Table 12. Major species of subalpine deserts in Formosa.

Anaphalis Nagasawai Hay.	Anaphalis morrisonicola Hay.
Leontopodium microphyllum Hay.	Artemisia borealis Pallas
Picris Ohwiana Kitamura	Leibnitzia Anandria Nakai
Scabiosa lacerifolia Hay.	Hemiphragma heterophylla Wall.
Gentiana arisanensis Hay.	Epilobium nankotaizanense Yam.
Potentilla tugitakayamensis Masam.	Potentilla leuconata Don.
Adenophora morrisonensis Hay.	var. morrisonicola Hay.
Deschampsia Kawakamii Honda	Sedum morrisonense Hay.
Aulacolepis agrostoides Ohwi	Geranium Hayatanum Ohwi
Cystopteris moupinensis Fr.	Festuca ovina L.
Berberis morrisonensis Hay.	Carex brachyathera Ohwi
Ranunculus Matsudai Hay.	Orchis Kiraishiensis Hay.
Luzula taiwaniana Satake	Dianthus pygmaeum Hay.
Veronica morrisonicola Hay.	Circium Hosokawai Kitamura

As was pointed out by E. H. WILSON (1922), we know so little about the flora of Continental China and the regions west to Sikkim that it will be long before exact knowledge of the affinities and geographical distribution of species will be possible. But so far as our present knowledge goes, the flora of Formosa is closely allied to Continental China; especially the conifers have closer relationships with those of Central and Western China than with those of the fairly adjacent coastal provinces of Continental China.

According to all of the above-mentioned data, the writer claims that the Formosan flora, especially of the highland, seems to have a closer relation to the south-western part of Continental China, and also to the Himalayan region, than to the other peripheral regions, as has been pointed out by several botanists (WILSON 1922; Y. KUDO 1930; R. KANEHIRA 1932, 1936; MASAMUNE 1937).

III. BETWEEN JAPAN PROPER AND CONTINENTAL CHINA TOGETHER WITH COREA AND THE EASTERN PART OF SIBERIA.

There are about 28 genera which are confined to China and Japan proper, and are not found in Formosa (Table 13).

Table 13. The genera which are confined to Continental China and Japan proper, and not Formosa. The asterisk shows wider range sometimes inclusing India, the Himalayan region, Corea or the Liukius.

Keiskea (Labiatae)	Monochasma (Scrophulariaceae)
Shibataea (Gramineae)	Hosiea (Icacinaceae)
Pterostyrax (Styracaceae)	*Nandina (Berberidaceae)
Cercidiphyllum (Cercidiphyllaceae)	Orixa (Rutaceae)
*Euptelea (Eupteleaceae)	*Hovenia (Rhamnaceae)
Chaenomeles (Rosaceae)	*Pternopetalum (Umbelliferae)
*Chionographis (Liliaceae)	Disanthus (Hamamelidaceae)
Tanakaea (Saxifragaceae)	Cryptomeria (Taxodiaceae)
*Loropetalum (Hamamelidaceae)	*Chikusichloa (Gramineae)
Phaenosperma (Gramineae)	Enkianthus (Ericaceae)
*Streptolirion (Commelinaceae) [1]	*Fatsia (Araliaceae)
Sasa (Gramineae) [2]	Hosta (Liliaceae)
Orostachys (Crassulaceae)	Peracarpa (Campanulaceae)
Pseudostellaria (Caryophyllaceae)	*Chosenia (Salicaceae) [3]

1) also in India. 2) also in Mandschuria, Kuriles and Saghalien. 3) also in Corea, Siberia, Yezo(Hokkaido), Saghalien, and not Continental China.

The existence of those genera as the above may support evidently a closer floristic relationship between Japan and Continental China.

Outline of the vegetation and floristic characteristics of Japan.

The greater part of Japan, especially the south-western part, is clearly conditioned by a Cf climate, and the north-eastern part of Japan, particularly the mountain region, by a Df climate. Under the climatic influence of monsoon there can be recognized two different types of climate in Japan. The Pacific coast of the south-western part of Japan is to be the leeward side of the winter monsoon; consequently, the development of vegetation along the Pacific coast is somewhat influenced by a rather dried climate. We can find there some forests of Durilignosa, a sclerophyllous forest, type. On the Japan Sea side, however, the climate condition is quite reverse; the winter monsoon highly loaded with vapour while crossing over the Japan Sea, brings heavy snowfall on this side. The difference of climatic condition between the Japan Sea and the Pacific sides is similar to some extent to the climate-relationship which is recognized between the north-eastern and the south-western parts of Formosa. It will also be noteworthy in Japan that such climatic relationship corresponds well with the ranges of S a s e t o - F a g e t u m c r e n a t a e of the Japan Sea side and S a s a m o r p h e t o - F a g e t u m c r e n a t a e of the Pacific side.

Table 14. The following genera are confined to the floristic area of Japan proper.

Sciadopitys (Taxodiaceae)	Thujopsis (Cupressaceae)
Hakonechloa (Gramineae)	Anemonopsis (Ranunculaceae)
Ranzania (Berberidaceae)	Pteridophyllum (Papaveraceae)
Deinanthe (Saxifragaceae)	Tripetaleia (Ericaceae)
Ephippianthus (Orchidaceae)	Peltoboykinia (Saxifragaceae)
Glaucidium (Ranunculaceae)	Allectorurus (Liliaceae)
Dactylostalix (Orchidaceae)	Japonolirion (Liliaceae)
Miricacalia (Compositae)	Pseudopyxis (Rubiaceae)
Wasabia (Cruciferae)	Struthiopteris (Polypodiaceae)

In addition to the above, we have two subendemic genera, *Kirengeshoma* (*Saxifragaceae*) in Japan proper and S. Corea, and *Neofinetia* (*Orchidaceae*) in Japan proper and the Liukius.

On the warm-temperate zone.

In Japan, some parts of the lowland and hilly areas, in altitudes of less than about 700-900 m, of Kyushu, Shikoku and the south-western part of Honshu, and in much lower altitudes of the central part of Honshu, as north as near Fukushima less than 100 m in alt. (YOSHIOKA, 1954), are naturally covered by Laurilignosa or Temperate Evergreen Broad-leaved Forest, which consist of evergreen trees or shrubs of *Fagaceae*, *Lauraceae*, *Theaceae*, *Symplocaceae*, *Podocarpus*, *Distylium*, *Ilex*, *Elaeocarpus*, *Illicium*, *Rapanea*, *Fraxinus*, *Tsuga*, *Abies firma*, etc.

After careful researches in field work, T. SUZUKI (1953) classified the Evergreen Broad-leaved Climax Forests of Japan as follows (Table 15);

Table 15. Associations of Evergreen Broad-leaved Forests or Laurilignosae in Japan proper, classified by T. Suzuki (1953).

Alliance 1: Shiion Sieboldi

1) Rumohreto-Machiletum Thunbergii
2) Polysticheto-Machiletum Thunbergii
3) Rapaneeto-Shiietum Sieboldi
4) Bladhieto-Shiietum Sieboldi
5) Sakakieto-Cyclobalanopsidetum stenophyllae
6) Illicieto-Distylietum racemosae

Alliance 2: Tsugion Sieboldii

1) Dryopteridieto-Fraxinetum commemoralis
2) Illicieto-Abietum firmae
3) Cariceto-Tsugetum Sieboldii

In addition to Laurisilvae, stands of Pittosporeto-Quercetum phillyraeoides of Durisilvae can be seen often in various places along the coast of the Inland Sea (Seto-Naikai) of Japan (SUZUKI 1952).

On comparing Continental China and its contiguous regions, we find that the warm-temperate areas of Japan correspond macroclimatically to S. Corea and the lowland and hilly areas along the Yangtze River, ranging over Chekiang, Fukien, Hunan, Kiangsi, Anhwei, Hupeh, Szechwan, Kwangsi, Kweichow, Yünnan and even extending through Sikang to the southern slopes of the Himalayan region and lower montane regions of Burma and Indo-China. The following genera occur in Japan and this Continental China area only: *Loropetalum*, *Chikusichloa*, *Cryptomeria*, *Disanthus*, *Chionographis*, *Nandina*, *Hosiea*, *Hovenia*, *Shibataea* and *Phanerosperma*. In addition to these genera, there are also some genera such as *Trochodendron*, *Ellisiophyllum*, *Skimmia*, *Botryopleuron*, *Stauntonia*, *Liriope*, *Ophiopogon*, *Buxus*, *Camellia*, *Broussonetia*, *Aulacolepis*, which are distributed over an even wider range than the former group of genera. On the contrary, there is only one genus confined to the warm-temperate areas of Japan proper, namely *Alectorurus* (*Liliaceae*).

On the cool-temperate zone.

The mountain regions of Kyushu and Shikoku from about 700-900 m to 1700 m in elevation belong to this zone in Japan. The farther north-eastwards we go from there the lower become the limits of this zone. It reaches at last the sea-level at about 41° of N. Latitude in the Aomori Prefecture, the northernmost part of Honshu (WATANABE, 1938). According to T. SUZUKI (1953) the forests of Fagion crenatae occupy this zone in Japan. The alliance consists of the Sasamorpheto-Fagetum crenatae on the Pacific side, and Saseto-Fagetum crenatae on the Japan Sea side. There are also developed the beech forests at lowland areas in the southern part of Hokkaido (SUZUKI, 1949; INOKUMA, SUZUKI and OKAMOTO, 1953). Deciduous broad-leaved trees constitute the forest climax. In the Far East, the mountain region of S. Corea and those lowland and mountain regions ranging from the central part of Corea and S. Mandschuria to the basin of the Hwang Ho (The Yellow River) and furthermore to the Mid-mountain forest region of Himalaya and Malaysia, all correspond to this zone of Japan.

The undermentioned genera recognized in Japan are distributed in parts of the areas; *Actinidia*, *Euptelea*, *Cercidiphyllum*, *Ainsliaea*, *Akebia*, *Aucuba*, *Cryptomeria*, *Deutzia*, *Damnacanthus*, *Weigela*, *Helwingia*, *Hovenia*, *Hosta*, *Omphalodes*, *Orostachys*, *Peracarpa*, *Pseudostellaria* and *Tricyrtis*. Many a species in this zone is strongly characteristic of the Japan flora. The endemic genera confined to this zone in Japan are as follows:

Table 16. The endemic genera which are confined to the cool-temperate zone in Japan.

Sciadopitys (Taxodiaceae)	Peltoboykinia (Saxifragaceae)
Thujopsis (Cupressaceae)	Hakonechloa (Gramineae)
Anemonopsis (Ranunculaceae)	Deinanthe (Saxifragaceae)
Tripetaleia (Ericaceae)	Ranzania (Berberidaceae)
Glaucidium (Ranunculaceae)	

On the subfrigid zone.

This zone of Japan is covered by Aciculisilvae or Evergreen Needle-leaved Forests (Betulion Ermani, NAKANO, 1942), consisting chiefly of *Betula Ermani* CHAM., *Abies Mariesii* MASTER, *A. Veitchii* LINDL., *Picea jezoensis* CARR., *Tsuga diversifolia* MASTER, etc. as predominant upper-layer trees. Such coniferous forests occur at 1500-2500 m alt. in the central part (S. HONDA, 1912; TAKEDA, 1926; NAKANO, 1930; IMANISHI, 1937; MAEDA, 1950-1952), and at 1000-1700 m alt. in the north-eastern part, of Honshu, while in the northern and eastern parts of Hokkaido (Yezo) these forests occur even in the lowland areas. In this zone, there are many genera which are common everywhere in the Northern Hemisphere. However, there are four endemic genera of Japan found in this zone, namely *Pterido-phyllum*, *Ephippianthus*, *Dactylostalix*, and *Tripetaleia*, the subfrigid species of the last one being different from the species of the same genus found in the cool-temperate zone of Japan.

On the frigid zone.

No areas of frigid zone can be found at low elevations in Japan. There are, however, very small areas of the frigid zone in the highlands of Japan, these confined to the alpine region at more than 2500 m in altitudes in the central part and at more than 1700-2000 m in the north-eastern part of Honshu (YOSHII and OIZUMI, 1954), and at more than 1500 m above sea-level in Hokkaido. Such areas are occupied nearly always by the lower scrubs of *Pinus pumila* REGEL (Pinion pumiliae). The most of the genera found in these areas are widely distributed everywhere in the frigid zone throughout the Northern Hemisphere. Only 1 genus, *Japono-lirion*, which is confined to Japan in this zone, is supposed te be a relict on serpentine substrata.

There are many genera and species in this zone of Japan which are common in the frigid zone of the Northern Hemisphere. A considerable number of species are common in Japan, E. Siberia, Kamchatka, the Aleutian Islands, and Alaska. Among them, *Arcterica nana* MAKINO comprising this monotypic genus of *Ericaceae*, is confined to the frigid region of Japan (Honshu), Hokkaido, the Kuriles and Kamchatka. Few or no species are common in the alpine regions of Japan, Continental China, and Himalaya. We have not many species confined to the alpine regions of Corea and Japan.

The Kamchatka Peninsula, the coastal region of Okhotsk and the Shikhota range have a Df climate. The highland of Japan is, therefore, more or less similar in climate conditions to the above-mentioned regions which have a Df climate. Attention should be called to the fact that the characteristic species of alliances of the highland forest-communities in Japan, e.g., *Pinus pumila* REGEL and *Betula Ermani* CHAM., are confined to the highland of Japan and such regions as the above, and the former species having a rather wide range is distributed in E. Siberia from the Great Khingan Mountains (TAKENOUCHI, 1941; KIRA, 1952) eastward, i.e., ranging from Longitude 113° to 180° E and Latitude 35° to 70°N (TATEWAKI, 1935).

Some predominant and characteristic species, *Abies Veitchii* LINDL., *Abies Mariesii* MASTER, *Tsuga diversifolia* MASTER, *Tsuga Sieboldii* CARR., and *Fagus crenata* BL. are all confined naturally to Japan, but *Shiia Sieboldi* MAKINO, a characteristic species of Shiion Sieboldi, ranges over the south-western part of Japan and Corea. It may be better to think that there is some synchorological relationship between the highland regions of Japan and the eastern coast of Siberia along with the Kamchatka Peninsula.

Most parts of Continental China have a Cw (or KIRA's A'4 and A'3) climate like the western part of Formosa. We know too little about the forest vegetation of Continental China to make any description and a comparison with that of Japan. It is supposed that the naturel forest-vegetation is mostly destroyed by human agencies in China. Since, in addition to this supposition, the representative climate-type of Continental China is indicated by a Cw (or KIRA's A'4 and A'3) climate, differing from that of Japan, a Cf (or KIRA's A"4 and A"3) type, it is probable in general speaking that the forest-vegetation types are rather different from each other under the influences of macroclimate conditions.

IV. BETWEEN FORMOSA AND JAPAN PROPER.

B. HAYATA pointed out the close relationship between Japan proper and Formosa, based on the coniferous trees (1905). He asserted this again in his „Flora Montana Formosae (1908)" from a consideration of the mountain flora of Formosa, while in the 3rd International Botanical Congress in Brussels, 1910, he stated that the flora of Formosa is closely related to that of S. China as well as Japan proper. At that time, however, the botanical survey in Formosa was being carried on and many of the species and genera were erroneously identified or not yet discovered. Nowadays, we think the relationship of the flora of Japan proper and that of Formosa is very weak, because there are no genera confined to both regions. The floras of Formosa and Japan proper are related to some extent because both are related to the flora of Continental China. This view is sustained by the genera which are confined to Formosa, Continental China and Japan proper, as follows:

Table 17. The genera which are confined to Formosa, Japan proper and Continental China, and sometimes extending to India, the Himalayan region and the Liukius.

Aucuba (Cornaceae)	Corylopsis (Hamamelidaceae)
Bredia (Melastomaceae)	Distylium (Hamamelidaceae)
Idesia (Flacourtiaceae)	Phellodendron (Rutaceae)
Raphiolepis (Rosaceae)	Tripterygium (Celastraceae)
Zelkova (Ulmaceae)	Trochodendron (Trochodendraceae)
Ellisiophyllum (Scrophulariaceae)	Skimmia (Rutaceae)
Botryopleuron (Scrophulariaceae)	Stauntonia (Lardizabalaceae)
Liriope (Liliaceae)	Ophiopogon (Liliaceae)
Akebia (Lardizabalaceae)	Stachyurus (Stachyuraceae)
Paraixeris (Compositae)	Crepidiastrum (Compositae)
Helwingia (Cornaceae)	Tricyrtis (Liliaceae)
Conandron (Gesneriaceae)	Kummerowia (Leguminosae)
Platycarya (Juglandaceae)	

It is prominent that the development of the tropical and subtropical rainforests is clearly possible in Formosa; the former is represented by both Pometietum pinnatae and Astronietum formosanae of Botel Tobago, the latter by Machilion Kusanoi of the moist lowland in Formosa proper, and of the raingreen forests of Albizzion procerae in the Awa climate area, all of these types of forests are never found in Japan. No Durilignosa in a forest climax is developed in Formosa, [1] however we recognize its occurrence in Japan, e.g., Pittosporeto-Quercetum phillyraeoides growing on some places along the coast of the Inland Sea of Japan. It is noteworthy that the most part of the forest area in Formosa is characterized by Laurilignosa under a Cf climate condition, such as the virgin forests of Castanopsidion taiwanianae, Shiion longicaudatae, Shiion stipitatae and Cyclobalanopsidion paucidentatae, while in the Cf climate area of Japan, a few is the growth of Laurilignosa, which is disturbed by human agencies and scarcely remained in natural condition in the restricted areas at lowland. The Laurilignosa of Japan is represented by the forests of Shiion Sieboldi.

The occurrence of Aestilignosa or the Temperate Deciduous Broad leaved Forest, Fagion Hayatae, in Formosa is restricted to small areas. In Japan, however, Fagion crenatae of Aestilignosa occupies the most part under a Cfb climate condition in the broad-leaved forest areas.

There are found Betulion Ermani and Pinion pumilae of Aciculilignosa, or Evergreen Needle-leaved Forest, in Japan, by which is covered correspondingly the subalpine or alpine region (the subfrigid or frigid zone). In addition to these, the members of Tsugion Sieboldii are recognized in the warm- and sometimes cool-temperate zones of Japan. This coniferous forest occurs at the altitudes above the upper limit of the range of Shiion Sieboldi and below the area of Fagion crenatae. The Formosan Aciculilignosa is characterized by Chamaecyparidion taiwanensis of the cool-temperate zone and both Junipereto-Abietum Kawakamii and Rhododendreto-Juniperetum squamatae of the subfrigid zone.

First of all, compared the forest communities of both countries, particular attention should be drawn to the fact that, the Laurilignosa of Formosa fairly covers the greater part of forest areas, while in Japan, instead of that forest type, Aestilignosa does it to a considerable extent and Laurilignosa, whose members may have been developed at lowland only, is almost destroyed at the present time by the human activities for cultivation. Such a synchorological difference recognized between them is distinctly attributable to the macroclimatic and geo-historical conditions of both countries and human activities. Furthermore, no stands of Pinion pumilae and Betulion Ermani occurring in Formosa is noteworthy, however the development of Juniperetum in the subalpine region of Formosa

[1]) *Pheonix* scrubs and *Acacia confusa* forests may be considered to be some kind of sclerophyllous type, and grow on the southernmost part of Formosa.

seems to correspond synchorologically with the occurrence of the former communities.

V. ON PHYTOGEOGRAPHICAL CONSIDERATIONS OF THE FLORAS OF THE LIUKIUS AND YAKU SHIMA.

The writer considers the Liukiu Archipelago to include all of the islands situated between Formosa and Yaku Shima (the Yaku Island), which belongs to Kyushu in Japan. The major islands of the Liukius are, from south to north, the Yaeyama Islands, the Miyako Island, the Okinawa Island, and the Amami Islands (Fig. 2).

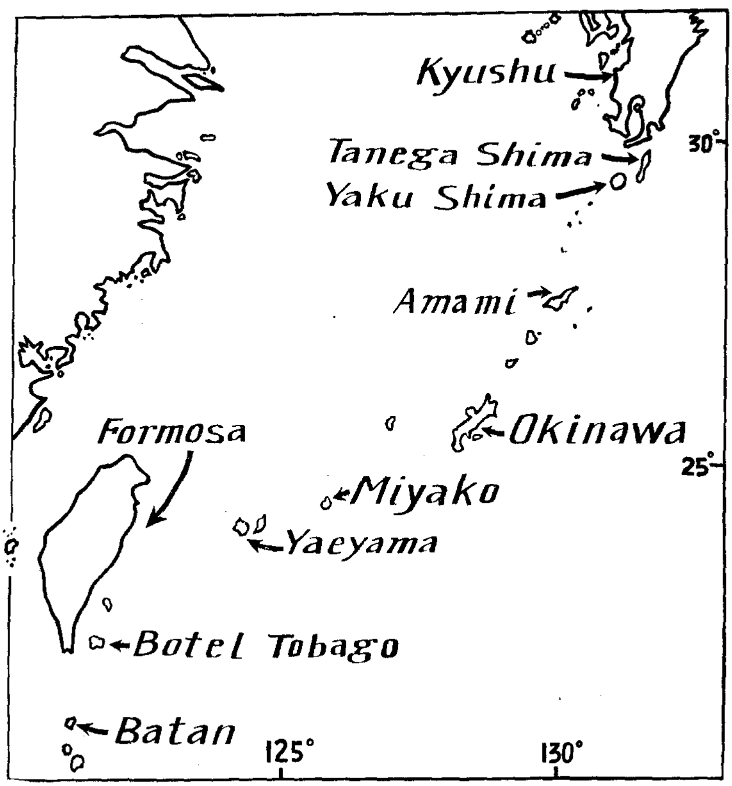

Fig. 2. A map showing the location of the major islands in the Liukius, Formosa and Kyushu.

The floristic and phytogeographical studies on the Liukius have been done actively by G. KOIDZUMI (1928) and G. MASAMUNE (1934, 1951-1954). There are 2 genera confined to both Formosa and the Liukius, namely *Suzukia* (*Labiatae*) and *Paracyclea* (*Menispermaceae*). On the other hand, there is only 1 genus, *Neofinetia* (*Orchidaceae*), confined to Japan proper and the Liukius, and 3 genera, *Tashiroea* (*Melastomaceae*), *Tutcheria* (*Theaceae*), and *Tetraplasia* (*Rubiaceae*), confined to Continental China and the Liukius. Therefore, we can feel some relationship to be recognized between Formosa and the Liukius, and between Continental China and the Liukius. The

Photo 1. A big *Machilus Thunbergii* S. et Z., on which trunk and trunk-base two large epiphytic ferns, *Neottopteris nidus* J. SM. of „Fascicularis" form grow, standing in the lowland (some 2 m alt.) forest of Ardisieto-Shiietum Sieboldi near Ambo, Yaku Shima.
(Phot. by T. HOSOKAWA).

Photo 2. *Ficus Wightiana* WALL., the screen of which numerous aerial roots intercept a way of getting through the *Shiia* forest, Ardisieto-Shiietum Sieboldi, occurring at lowland (some 2 m alt.) near Ambo, Yaku Shima. (Phot. by T. HOSOKAWA).

Photo 3. An interior view of the *Shiia* forest, Ardisieto-Shiietum Sieboldi, growing at about 270 m alt. in Mt. Sankaku near Ambo, Yaku Shima. Trees are *Shiia Sieboldi Makino* (*Fagaceae*), and undergrowth predominant-ferns are *Diplazium maximum* C. CHRIST. and *Rumohra aristata* CHING. (Phot. by T. HOSOKAWA).

Photo 4. Undergrowth predominant-ferns, *Diplazium maximum* C. CHRIST. (larger) and *Rumohra aristata* CHING (smaller ferns), growing on the forest floor of the *Shiia* forest, Ardisieto-Shiietum Sieboldi, which stands at the same locality as in Photo 3.
(Phot. by T. HOSOKAWA).

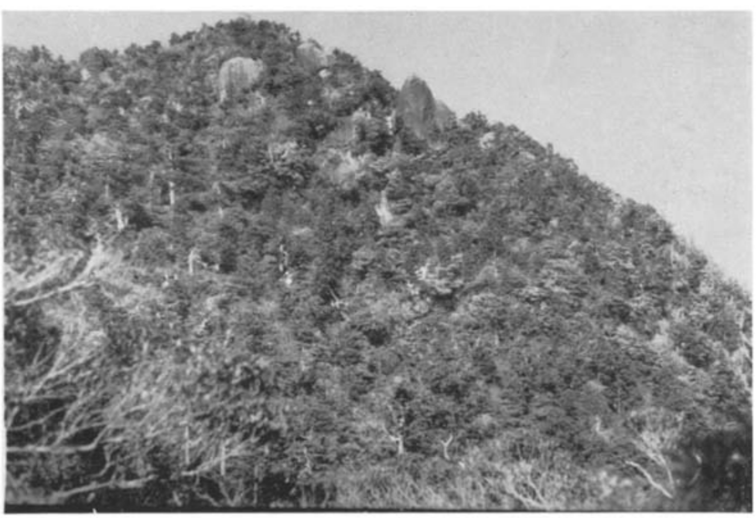

Photo 5. A distant view of the primary (natural) conifeous forest of *Cryptomeria japonica* D. DON, which occurs on the upper altitudes (900-1600 m) of Yaku Shima. The picture was taken at altitudes about 1300 m by T. HOSOKAWA. Look out for non pointed-cone-shaped, but rather flatt, crowns of this conifer.
(Photo by T. HOSOKAWA).

Photo 6. A conifer, *Cryptomeria japonica* D. DON, of which branches and boughs are covered by dense and thick coverings of mosses, growing in the coniferous forest of Cryptomerietum japnonicae at about 1300 m altitudes, Yaku Shima.

(Photo by T. HOSOKAWA).

floristic remarkable difference between such regions may well be due to the fact that the altitude of the Liukius is not great enough to permit the growth of highland plants occurring in Formosa, Continental China, and Japan proper.

From a consideration of the geographical distribution of genera, although no data of plant-sociology, we are unable to recognize any great phytogeographical discontinuity between Formosa and the Yaeyamas of the Liukius. Though there are about 26 genera (Table 18) which are found in the Yaeyamas and not Formosa, 21 genera among them belong to the Southern Elements and the other 5 genera probably to the Northern (Table 18). Moreover, we have 4 genera, *Begonia* (*Begoniaceae*), *Freycinetia* (*Pandanaceae*), *Pithecellobium* (*Leguminosae*) and *Dipteris* (*Polypodiaceae*), ranging from the south through Formosa to the Yaeyamas as a northern limitation of the geographical distribution. Since, in addition to the above facts, the greater part of the genera found in the Yaeyamas and Okinawa are distributed in Formosa, we would think that the flora of the Liukius is an extention of the Formosan flora.

Table 18. The genera found in the Yaeyamas and not Formosa. The genera with asterisk occur in Botel Tobago, and not Formosa proper.

Southern Elements:	
Acrostichum (Polypodiaceae)	Schizaea (Schizaeaceae)
*Maoutia (Urticaceae)	Schoeffia (Olacaceae)
Salsola (Chenopodiaceae)	Intsia (Leguminosae)
Pterocarpus (Leguminosae)	Cleidion (Euphorbiaceae)
*Mappia (Icacinaceae)	Sonneratia (Sonneratiaceae)
Lactaria (Apocynaceae)	*Cyrtandra (Gesneriaceae)
Agrostemma (Rubiaceae)	Cymodocea (Potamogetonaceae)
Parexuris (Triuridaceae)	Gahnia (Cyperaceae)
Exorrhiza (Palmae)	Nipa (Palmae)
Aerides (Orchidaceae)	Corymborchis (Orchidaceae)
Stereosandra (Orchidaceae)	*Vanda (Orchidaceae)
Northern Elements:	
Rhamnella (Rhamnaceae)	Cynoxylon (Cornaceae)
Zostera (Potamogetonaceae)	Chikusichloa (Gramineae)
Kalopanax (Araliaceae)	

The biogeographical position of Yaku Shima has been discussed by many zoologists (TOKUDA, 1941) and botanists (TATEWAKI, 1948). There are 2 categories of opinions concerning the Yaku Shima flora; one states that the flora and fauna of Yaku Shima belong to those of Japan proper, and the other that they belong to those of the Liukius.

G. KOIDZUMI (1928) and G. MASAMUNE (1934) studied this problem, and concluded that Yaku Shima belongs phytogeographically to Japan proper. However, G. MASAMUNE in 1949 published his recent concept that an important phytogeographical demarcation line is recognized between Kyushu and the Tanega Shima—Yaku Shima area and the latter area is a special transitional region between the Formosa (Taiwan) and Liukiu Floral Province and the South Nippon (Japan) Floral Province. He showed in that paper (MASAMUNE, 1949) 80 genera which are found in the southern part of Kyushu and are not found in Tanega Shima and Yaku Shima, and showed also 27 genera, whose northern limits of their distribution are found in Tanega Shima and Yaku Shima, as follows:

Abacopteris (Polypodiaceae)	Blechnopsis (Polypodiaceae)
*Acrostichum [1]) (Polypodiaceae)	Ophioderma (Ophioglossaceae)
Entada (Leguminosae)	Pongamia (Leguminosae)
Croton (Euphorbiaceae)	Kandelia (Rhizophoraceae)
Melastoma (Melastomaceae)	Bredia (Melastomaceae)
Blastus (Melastomaceae)	Erythraea (Gentianaceae)
Isanthera (Gesneriaceae)	Messerschmidia (Borraginaceae)
Codonacanthus (Acanthaceae)	Diplospora (Rubiaceae)
Morinda (Rubiaceae)	Myriactis (Compositae)
Scaevola (Goodeniaceae)	Trema (Ulmaceae)
Cassytha (Lauraceae)	Antidesma (Euphorbiaceae)
Blumea (Compositae)	Spinifex (Gramineae)
Musa (Musaceae)	Apostasia (Orchidaceae)
Arenga (Palmae)	

The Palm of the last one may, however, be introduced from other islands into Tanega Shima, and the writer thinks some of those genera as the above are distributed on either Tanega Shima or Yaku Shima as the northern limitation of their range and not on both Tanega Shima and Yaku Shima. In the same paper 34 genera which are found in Yaku Shima and Tanega Shima as the southern border of their range and 36 genera which distribute as north as the Amami Islands from the south are listed by Masamune. In addition to these facts, he gave another important fact that, while S. Kyushu has the Summergreen Broad-leaved Forest just above the Evergreen Broad-leaved Forest belt, no body can find such summergreen Broad-leaved Forest in Yaku Shima. From these considerations he concluded and gave his recent concept already described. At present, however, the greater part of the Japanese botanists may recognize a conspicuous floristic discontinuity between Yaku Shima and the Amami Islands (Amami Oshima).

According to S. Hatusima's opinion resulted from a consideration of the similarity of the endemic species of Yaku Shima to the species of the adjacent areas, excepting the most of the endemics of Pteridophytes, *Rhododendron yakuinsulare* MASAM., and *Asarum yakusimense* MASAM., numbers of endemic species occurring in Yaku Shima have closer relationships to the species of the floristic region north to Yaku Shima; out of 52 endemic species there are 42 species corresponding to this category. Many highland plants of Yaku Shima, in which the highest elevation is 1938 m above sea-level, occur also in the Central Mountain Range of Kyushu. Hence HATUSIMA (1950) claimed that the highland flora of Yaku Shima is an extention of the flora of the latter.

The floristic discontinuity between Yaku Shima and the Amamis indicated by the writer is shown in the following tables.

[1]) The writer can not find any fern of this genus in Yaku Shima or Tanega Shima.

Table 19. The genera which are found in the Liukius from the Amami Islands southward, and not in Yaku Shima or Tanega Shima.

Drymaria (Caryophyllaceae)	Hernandia (Hernandiaceae)
Pileostegia (Saxifragaceae)	Derris (Leguminosae)
Breynia (Euphorbiaceae)	Excoecaria (Euphorbiaceae)
Macaranga (Euphorbiaceae)	Gymnosporia (Celastraceae)
Abelmoschus (Malvaceae)	Abutilon (Malvaceae)
Thespesia (Malvaceae)	Heritiera (Sterculiaceae)
Barringtonia (Lecythidaceae)	Terminalia (Combretaceae)
Planchonella (Sapotaceae)	Maba (Ebenaceae)
Cerbera (Apocynaceae)	Leucas (Labiatae)
Thysanospermum (Rubiaceae)	Wendlandia (Rubiaceae)
Crossostephium (Compositae)	Dactyloctenium (Gramineae)
Thuarea (Gramineae)	Gahnia (Cyperaceae)
Flagellaria (Flagellariaceae)	Arenga (Palmae) [1])
Pandanus (Pandanaceae)	Bruguiera (Rhizophoraceae)
Schima (Theaceae)	Osteomeles (Rosaceae)
Erythrina (Leguminosae)	Alchornea (Euphorbiaceae)
Toddalia (Rutaceae)	Corchorus (Tiliaceae)
Cardiospermum (Sapindaceae)	Tetraplasia (Rubiaceae)
Egenolfia (Polypodiaceae)	Boerhaavia (Nyctaginaceae)
Pisonia (Nyctaginaceae)	Sesuvium (Aizoaceae)
Ormocarpum (Leguminosae)	Murraya (Rutaceae)
Sageretia (Rhamnaceae)	Helicteres (Sterculiaceae)
Adinandra (Theaceae)	Garcinia (Guttiferae)
Stimpsonia (Primulaceae)	Parsonia (Apocynaceae)
Cordia (Borraginaceae)	Heliotropium (Borraginaceae)
Hackelochloa (Gramineae)	

In addition to the above genera, there are about 5 important species which have the same range as the above;

Musa liukiuensis Makino
Viburnum Sandankwa Hassk.
Alsophila pustulosa Christ
Pinus luchuensis Mayer
Alsophila formosana Baker

[1]) The palm of this genus growing in Tanega Shima may be introduced from the other islands.

Table 20. The genera which are found in Japan proper and Yaku Shima but not further south in the Liukius. The genera and species with asterisk indicate those which occur also in Formosa.

Saxifraga (Saxifragaceae)	Chamaele (Umbelliferae)
Stewartia (Theaceae)	*Pyrola (Pyrolaceae)
Clethra (Clethraceae)	Enkianthus (Ericaceae)
Leucothoe (Ericaceae)	Tripetaleia (Ericaceae)
Mensiesia (Ericaceae)	Allectorurus (Liliaceae)
Melampyrum (Scrophulariaceae)	Tofieldia (Liliaceae)
*Metanarthecium (Liliaceae)	Penthorum (Crassulaceae)
Cryptomeria (Taxodiaceae)	*Cacalia (Compositae)
Mitchella (Rubiaceae)	Sasa (Gramineae)
*Salix (Salicaceae)	*Alnus (Betulaceae)
*Schizophragma (Saxifragaceae)	Amphicarpaea (Leguminosae)
Shibataea (Gramineae)	Pseudostellaria (Caryophyllaceae)
Hosta (Liliaceae)	Struthiopteris (Polypodiaceae)
Aruncus (Rosaceae)	*Sorbus (Rosaceae)
*Carpinus (Betulaceae)	Chionographis (Liliaceae)
*Astilbe (Saxifragaceae)	*Mitella (Saxifragaceae)
*Pedicularis (Scrophulariaceae)	*Berberis (Berberidaceae)
*Valeriana (Valerianaceae)	*Coptis (Ranunculaceae)
*Thalictrum (Ranunculaceae)	Lyonia (Ericaceae)
*Saussurea (Compositae)	*Isodon (Labiatae)
*Chrysosplenium (Saxifragaceae)	*Parnassia (Saxifragaceae)
*Deschampsia (Gramineae)	Maianthemum (Liliaceae)
*Paris (Liliaceae)	*Tsuga (Abietaceae)
*Abies (Abietaceae)	*Cephalotaxus (Taxaceae)
*Chamaecyparis (Cupressaceae)	Torreya (Taxaceae)

Among the above-mentioned genera, *Tripetaleia*, *Allectorurus* and *Struthipteris* are confined to Japan proper and *Cryptomeria* is subendemic to Japan. In addition to the above genera of Table 20, we have some noteworthy species which have the same range as the above genera of the same Table;

Pinus densiflora S. et Z.
Pinus amamiana Koidz.
Castanea crenata S. et Z.
Viburnum furcatum Bl.
**Lycopodium obscurum* L.
Lycopodium sabinaefolium Willd.
Calamagrostis hakonensis Fr. et Sav.
Pinus Thunbergii Parl.
Quercus acutissima Carr.
Anamtia stolonifera Koidz.
Tripterygium Regelii Sprague et Takeda
Viburnum urceolatum S. et Z.
**Agrostis flaccida* Hackel
Angelica longeradiata Kitagawa

In opposition to these facts of the generic distribution showing in Table 19 and 20, which are to pay due recognition of floristic discontinuity between Yaku Shima and the Amami Islands, there are only 27 genera which have the northern limits of their range in Tanega Shima or Yaku Shima, as was pointed out by MASAMUNE (1949), nearly all of which show the trend of rather wide distribution. On the other hand, one genus, *Egenolfia*, is confined to the floristic area from the Amamis southward. According to MASAMUNE (1949), there are, indeed, so many genera as eighty which are not found in Yaku Shima though they grow commonly in the Kyushu proper. But, it should be paid attention to the fact that three genera, *Tripetaleia*, *Allectorurus* and *Struthiopteris* which are confined to the area from Japan proper to Yaku Shima and one subendemic genus, *Cryptomeria*, all of which southern border of their range are marked in Yaku Shima.

The occurrence of the Sasa Owatarii consociation (= Pseudosasa Owatarii association, MASAMUNE 1934), a dwarf-bamboo community, which covers the highest part of the island higher than about 1600 m in alt., Cryptomerietum japonicae of coniferous forest ranging over about 900-1600 m in alt., and Ardisieto-Shiietum Sieboldi (HOSOKAWA, OMURA and NISHIHARA, a new association) of Laurilignosa which stretches to about 900 m in alt. from the lowland, distintly characterizes the island synchorologically. The existence of these three community types in Yaku Shima not only demarcates the southern border of their ranges on this island but also they predominate over the other community-types in the island and cover the greater part of the island area. Accordingly, they should be representative of the vegetation in the island.

Sasa-type communities occur in Japan from this island northward. The coniferous virgin forest of Cryptomerietum japonicae of Yaku Shima is composed chiefly of *Cryptomeria japonica*, *Abies firma*, *Tsuga Sieboldii*, *Chamaecyparis obtusa*, *Torreya nucifera*, *Cephalotaxus drupacea*, and some evergreen or deciduous trees. There is scarcely any virgin forest of *Cryptomeria japonica* in Japan proper, however the species ranges from the island northward to the northern part of Honshu.

The forest-members of Shiietum Sieboldi are developed at the lowland of Japan. We are able to find them in Japan from the island as north as the Tohoku-district near Fukushima, the middle part of Honshu. But, it is rather difficult to find any forest of this kind in natural condition. In the Ôsumi peninsula, the southern part of Kyushu, there are found the forests of Rapaneeto-Shiietum Sieboldi, which was published by T. SUZUKI (1951, 1952). The writer and his cooperators would call the *Shiia* forest of the island Yaku Shima by a new name of Ardisieto-Shiietum Sieboldi (Table 21). The characteristic species of this association are as follows:

Ardisia Sieboldii Miq.
Psychotria rubra Poir.
Diplazium maximum C. Christ.
Lasianthus Tashiroi Matsum
Symplocos kotoensis Hay.

The lack of the summergreen forest presents a remarkable aspect in the island vegetation, however there are some species of deciduous trees growing subordinately among coniferous trees in the area of Aciculilignosa. The summergreen forest characterized by *Fagus crenata*, Fagetum crenatae, ranges all over the cool-temperate area of Japan proper. On the contrary, no summergreen forests develop in the Liukius, and moreover in Formosa the growth of such a forest of Fagion Hayatae is restricted to small areas. No botanists have informed any Aestilignosa, or Summergreen Forest, from Malaysia.

It seems to the writer, as was pointed out by KIRA (1945), that these interesting facts suggest the small value of the annual range of temperature rather than the extremely moist and warmer environment causing any summergreen forest to be ill developed in those areas.

TABLE 21. ASSOCIATION TABLE OF ARDISIETO-SHIIETUM SIEBOLDI, OF YAKU SHIMA.
Coverage values of major species for 7 quadrats after the Braun-Blanquet's method of total estimation, in which case the quadrats were set to be 15 m×15 m for the level land and 20 m×20 m in size for the mountain-side.

Fidelity	Stratification	Name of association	Ardisieto-Shiietum Sieboldi (Hosokawa, Omura and Nishihara nov. ass.)							Rapaneeto-Shiietum Sieboldi (T. Suzuki)	
		Locality	Near Ambo (Yaku Shima)				In Mt. Sankaku near Ambo (Yaku Shima)			In the Ôsumi Peninsula, S. Kyushu	
		Orography	Level land				Mountain-side			Coverage	Constancy
		Altitude (m)	About 2				230	270	320		
		Exposition	No direction				N60E	S80E	N77E		
		Steepness	Flat ground				17°	27°	32°		
		Tree-height (m)	7—10				20—25	15—20	15—20		
3	Upper tree layer	Shiia Sieboldi Makino	5	4	5	2	4	1	4	5	V
3		Machilus Thunbergii S. et Z.	·	·	·	4	+	+	·	+	III
4		Distylium racemosum S. et Z.	·	·	·	·	2	3	3	·	·
3		Cinnamomum japonicum Sieb.	2	+	·	2	·	·	·	·	·
5		Meliosma rigida S. et Z.	1	2	·	+	+	+	·	·	·
3		Fiwa longifolia Nakai	·	·	·	·	2	·	1	·	·
5		Ardisia Sieboldii Miq.	2	2	1	2	·	+	+	·	·

·	Lower tree or shrub layer	(Ficus erecta Thunb.)	·	·	·	·	·	·	·	+	III
·		(Camellia japonica S. et Z.)	·	·	·	·	·	·	·	+	III
·		(Eurya japonica Thunb.)	·	·	·	·	·	·	·	+	III
·		Rapanea neriifolia Mez	·	·	·	·	+	·	·	1	III
4		Distylium racemosum S. et Z.	·	·	·	·	3	4	1	·	·
2		Illicium anisatum L.	·	·	·	·	1	·	+	·	·
5	Shrub or lower shrub layer	Ardisia Sieboldii Miq.	2	2	1	+	+	+	+	·	·
4		Rapanea neriifolia Mez	3	+	·	+	1	+	1	·	·
5		Symplocos kotoensis Hay.	2	+	+	2	·	·	·	·	·
5		Lasianthus Tashiroi Matsum.	+	·	+	1	+	3	3	·	·
2		Camellia japonica S. et Z.	+	2	+	1	·	·	·	·	·
5		Psychotria rubra Poir.	+	+	1	1	+	+	+	·	·
3	Under-growth herb layer	Rumohra aristata Ching var. pseudo-aristata H. Ito	2	·	2	3	·	·	·	1	II
3		Rumohra aristata Ching	·	3	·	·	3	3	2	1	III
2		Damnacanthus indicus Gaertn.	·	·	·	·	1	1	+	+	I
5		Diplazium maximum C. Christ.	·	·	·	·	+	2	2	·	·

It is conceivable to be caused by the geo-historical and orographical, or environmental, condition in Yaku Shima, the highest elevation of the island being 1938 m and rather higher than that of Kyushu, that such a floristic and synchorological marked discontinuity is recognized between Yaku Shima and the Amamis, considering not only from the range of the southern elements but also specially from a phytogeographical standpoint concerning the plant dispersal of the northern elements. Therefore, the conclusion here reached by the writer is that Yaku Shima may belong synchorologically to Japan proper, looking over the floristic and vegetational characteristics of the island, Yaku Shima.

CONCLUSION AND SUMMARY.

The author discussed the floristic and vegetational differences (a) between Formosa and the Philippines, especially between Botel Tobago and Formosa, (b) between Formosa and Continental China, (c) between Japan proper and Continental China together with Corea, Mandschuria and the eastern part of Siberia, (d) between Formosa and Japan proper, and then he discussed (e) the flora of the Liukius, especially the differences between the Yaeyama Islands and Formosa as well as between Yaku Shima and the Amami Islands. In addition he briefly outlined the vegetation of Formosa and Japan, especially the altitudinal distribution of various forest-communities.

The conclusions confirmed the floristic discontinuity between Formosa and the Philippines already set forth by E. D. MERRILL and several other botanists. Concerning the phytogeographical position of Botel Tobago, the writer confirms the opinion of T. KANO and R. KANEHIRA that the flora of Botel Tobago is an extension of that of the Batan-Babuyan Islands, the northern border of the Philippines.

The floristic close-relation between Japan proper and Continental China is evident from the phytogeographical distribution of the genera of higher plants found in Japan.

Data show that the Formosan flora, especially of the highland, is more closely related to the south-western part of China, and also to the Himalayan region, than to the other surrounding regions.

The writer considers that the relationship of the flora of Japan proper to that of Formosa is rather weak. He thinks, however, that their floras and vegetations are related to each other through their mutual relation to the lowland and lower montane flora of Continental China situated besides both of them.

It is concluded that the flora of the Liukius is an extension of the Formosan flora, judging by the distribution of the genera and species. Looking over the Japan-Liukiu-Formosa area, a conspicuous floristic and synchorological discontinuity is recognized between Yaku Shima and the Amami Islands, and it is conceivable that the Yaku Shima flora is a south-western extension of the flora of Kyushu or Japan proper, as well as the vegetation of Yaku Shima is closely related essentially to that of Japan proper.

The writer and his cooperators adopted a new name of Ardisieto-Shiietum Sieboldi to the *Shiia* forest of Yaku Shima.

The writer is unable to make any synchorological or plant-sociological precise comparison between Japan and Continental China along with the eastern part of Siberia and moreover between Formosa and Continental China, because of few or no plant-sociological detailed data of the continental area in the Far Eastern Asia.

REFERENCES

DICKERSON, R. E., 1928 — Distribution of life in the Philippines. pp. 121-167.

HARA, H., 1948-1954 — Enumeratio Spermatophytarum Japonicarum. I (1948), II (1952), and III (1954).

HATUSIMA, S., 1950 — Plants of Yakushima (Yakushima no Syokubutu). Report on a botanical survey of the candidate area of Kagoshima National Park. Reprint pages 1-54.

—, and M. KOMAKI, 1952 — Sociological studies on the forest vegetations to be found at central part of Ohsumi Peninsula. 1. *Mem. Fac. Agr.* **1** (1), 23-45.

HAYATA, B., 1905 — On the distribution of the Formosan Conifers. *Bot. Mag. Tokyo*, **19**, 43-61.

—, 1908 — Flora Montana Formosae. *Journ. Coll. Sci. Imp. Univ. Tokyo*, 25, Art. **19**, 4-38.

—, 1911 — Botanical survey by the government of Formosa, with short sketches on the vegetation and flora of the island (Bruxelles, 1910), Acta IIIme Congres Intern. Bot., Bruxelles, **2**, 61-82.

—, 1911 — Materials for a flora of Formosa. *Journ. Coll. Sci. Imp. Univ. Tokyo*, **30**, Art. 1.

—, 1911-1921 — Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam. I (1911) — X (1921).

HONDA, S., 1912 — An introduction of the forest-belts of Japan (Nippon Sinrinsyokubututai-Ron) (A book in Japanese).

HOSOKAWA, T., 1935 — Botel Tobago and its plants [Kôtôsho to Syokubutsu]. *Education Journal of Taiwan* (*Taiwan Kyoiku*). 1935. Oct. no. **399**, 74-88.

—, 1952 — On the relationship of climate to vegetation in the southern part of Formosa; in special reference to the raingreen forest. *Bull. Soc. Pl. Ecol.*, **2** (1), 1-9.

IMANISHI, K., 1935 — On the forest-limit line in the Japan-Alps. [Nippon-Arupusu no Sinrin-genkaisen ni tuite] Mountain [Sangaku]. **30**, 217-264.

—, 1953 — Nature of Nepal-Himalaya [Nepal-Himalaya no Sizen]. *Kagaku*, **23** (8-9), 406-416, 464-468.

INOKUMA, T., T. SUZUKI, and S. OKAMOTO, 1953 — On the beech-forest communities of Hokkaido, pp. 1-27 (In Japanese). Published from the Forestry Bureau of Hokkaido.

KANEHIRA, R., 1932 — Phytogeography of Formosan Trees. *Nippon Ringaku-kaishi* **14** (7), 456-473. (In Japanese).

—, 1933 — On the ligneous flora of Formosa and its relationship to that of neighboring regions. *Lign. Sci. Journ.*, **12** (2), 225-238.

—, 1935 — The phytogeographical relationships between Botel Tobago and the Philippines on the basis of the ligneous flora. *Nippon Ringaku-kaishi*, **17** (7), 530-535. (In Japanese).

—, 1935 — The phytogeographical relationships between Botel Tobago (Kôtôshô) and the Philippines on the basis of the ligneous flora. *Bull. Biogeogr. Soc. Jap*, **5** (4), 209-212.

—, 1936 — Formosan Trees. pp. 1-711. (A book in Japanese with English summ.)

KANO, T., 1933 — Zoogeographical studies of Botel Tobago, with a consideration of the northern part of Wallace's line. *Geogr. Rev. Jap.*, **9**, nos. 5-8. (In Japanese).

—, 1935-1936 — Some problems concerning the biogeography of Kotosho, near Formosa. *Geogr. Rev. Jap.*, **11**, 950-959, 1027-1055 (1935), ibid. **12**, 33-46, 154-177, 911-935, 997-1020, 1107-1135 (1936). (In Japanese).

—, 1936 — A consideration of Neo-Wallace's line. *Kagaku.*, 1936. (4): 151-155, (6): 244-247. (In Japanese).

—, 1941 — On the biogeographical position of Kotosyo, and modifying the northern part of Neo-Wallace's line. *Dai-nan'yo*, 219-323. (In Japanese).
KAWADA, M., and Y. HAYASHI, 1953 — The name-list of plants growing in two National Forests . . . and some notes on the plants listed from viewpoints of ecology. *Bull. Gov. For. Exp. Stat.* no. **63**, (Tokyo, Japan) (In Japanese).
KAWAKAMI, T., and S. SASAKI, 1916 — A list of plants of Kotosho. *Bot. Mag. Tokyo*, **30**, 69-82. (In Japanese).
KIRA, T., 1945 — New classification of climate applied to the south western Pacific. (Toa-nanpoken no Sin-kikoo-kubun) pp. 1-24. Kyoto. (In Japanese).
—, 1945 — A new system of climate classification in North-eastern Asia as the basis for agricultural geography. [Nogyo-chirigaku no Kiso tositeno Toa no Sin-kikoo-kubun] pp. 1-23. Kyoto. (In Japanese).
—, 1949 — The forest-belts of Japan. [Nippon no Sinrintai] *Ringyo Kaisetu Series* no. **17**.
—, 1952 — Ecological position of the deciduous conifer forest climax of Eastern Siberia. In „Explorations in the Great Khingan Mountains" (Report of the Japanese Great Khingan Expedition 1942, edited by Dr. K. IMANISHI) pp. 476-498. (In Japanese).
—, 1952 — List of collected plants. *Ibid.* pp. 499-507.
KOIDZUMI, G., 1928 — On the Tokara Strait, from a consideration of phytogeographical standpoint. *Rigaku-kai*, **26** (8), 6-8. (In Japanese).
KUDO, Y., 1930 — Formosan Plants. (Taiwan no Syokubutu) pp. 1-48. (In Japanese).
—, 1932 — The mangrove of Formosa. *Bot. Mag. Tokyo*, **46**, 147-156.
MAEDA, T., T. KATO, and Y. SHIMAZAKI, 1950 — Studies on forest vegetation of the Chichibu Mountains district. *Nippon Ringaku-kaishi*, **32** (10), 340-342. (In Japanese).
MAEDA, T., 1951 — Sociological study of Chamaecyparis obtusa Forest and its Japan-Sea Elements. *Misc. Inf. Tokyo Univ. Forests*, no. **8**. (In Japanese with English summ.)
—, et al. 1951-1952 — Studies on the vegetation of Chichibu Mountain Forest (1). *Bull. Tokyo Univ. Forests*. no. **29** (1951); ditto (2). ibid no. **42**, (1952). (In Japanese with English summ.).
MAEKAWA, F., 1949 — Makinoesia and its bearing to oriental asiatic flora. *Journ. Jap. Bot.*, **24**, 91-96. (In Japanese).
MASAMUNE, G., 1934 — Floristic and geobotanical studies on the Island of Yakushima, Province Osumi. *Mem. Fac. Sci. and Agr. Taihoku Imp. Univ.*, **11** (Bot.), 1-637.
—, 1934 — On the phytogeography of the Ryûkû Archipelago. *Bull. Biogeogr. Soc. Jap.*, **5**, 29-86. (In Japanese).
—, 1936 — Short flora of Formosa. pp. 1-302.
—, 1937 — Le caractère et les affinités de la flore alpine de Taiwan (Formosa). *Bot. Mag. Tokyo*, **51**, 232-235.
—, 1949 — On the importance of the Osumi Strait as a phytogeographical demarcation line. *Journ. Jap. Bot.* **24**, 31-33.
—, 1951-1954 — Enumeratio Tracheophytarum Ryukyu Insularum I. *Sci. Rep. Kanazawa Univ.* **1** (1): 33-54 (1951); *Ditto* II. Ibid. **1** (2): 167-199 (1951); *Ditto* III. Ibid. **2** (1): 87-114 (1953); *Ditto* IV. Ibid. **2** (2): 59-117 (1954).
MERRILL, E. D., 1923 — Die Pflanzengeographische Scheidung von Formosa und den Philippinen. *Engl. Bot. Jahrb.*, **58**, 599-604.
—, 1925-1926 — Enumeration of Philippine flowering plants. I-IV.
NAITO, T. and S. KAJIWARA, 1934 — A list of wild plants in Kagoshima Prefecture. *Bull. Kagoshima Imp. Coll. Agr. For. Ded.* 25th Ann. **L**, 349-506.
NAKAI, T., 1935 — Far Eastern Asiatic Plants. (Toa-syokubutu) (A book in Japanese) pp. 1-272.
NAKANO, H., 1930 — Plant communities and their succession. [Syokubutu-gunraku to sono Sen'i] (A pamphlet in Japanese) pp. 1-120.
—, 1942 — The subalpine forest vegetation in Central Japan. *Annals of Phytoecology*, **2**, 1-17. (In Japanese).
—, 1942 — The deciduous forest vegetation in Japan. *Ibid*, **2**, 57-72. (In Japanese).
—, 1942 — Forest vegetation in Japan. *Bot. Mag. Tokyo*, **56**, 186-190.

—, 1943 — The warm-temperate and subtropical forest vegetation in Japan. *Annals of Phytoecology*, **3**, 1-18. (In Japanese).

OHWI, J., 1953 — Flora of Japan. pp. 1-1251. (A book in Japanese).

SASAKI, S., 1932 — Notes on the flora of Kôtôsho. *Bull. Biogeogr. Soc. Jap.*, **3**, 24-35. (In Japanese).

SATO, W., 1946 — Studies on the plant-climate in the south-western half of Japn. I-V. *Journ. Sci. Kanazawa Nor. Coll.*, **1** (1), 1-107.

SONOHARA, S., S. TAWADA and T. AMANO, 1952 — Flora of Okinawa. pp. 1-237.

SUZUKI, T., 1948 — On the forest vegetation of Nekko and Hontani Preserved Forests, Amagi. *Tokyo Rinyu*, **1** (2), 20-26. (In Japanese).

—, 1949 — The temperate forest vegetation in the upper stream-area of River Tenryu. *Gizitsu Kenkyu Bur. Forest Tokyo*, no. **1**, 77-91. (In Japanese).

—, 1949 — The beech forest of Hiyama Subprovince, Hokkaido. *Nippon Ringaku-kaishi* **31** (5), 138-164. (In Japanese with English summ.).

—, 1951 — The warm temperate forest vegetation of Oosumi Peninsula. *Bull. Tokyo Univ. Forests* no. **41**, 57-73 (In Japanese with English summ.).

—, 1952 — The forest climaxes in East Asia. [Toa no Sinrin-syokusei]pp. 1-121. (A book in Japanese).

—, 1953 — The forest climaxes of East Asia. *Jap. Journ. Bot.*, **14**, 1-12.

—, 1954 — The forest vegetation of the North-Formosan Mountains. *Jap. J. Ecol.*, **4**, 7-13. (In Japanese with English summ.)

—, 1954 — Method of synecological survey. (Seitai-chosaho) pp. 1-139. (A book in Japanese).

—, N. FUKUYAMA and H. SIMADA, 1939 — On the alpine plant communities of Taiwan, with special reference to those of the alpine rocky cliffs and the talus lands near Bunakkei, Mt. Nankotaizan. *Bull. Biogeogr. Soc. Jap.*, **9**, 99-131. (In Japanese with English summ.).

—, and K. WADA, 1949 — The warm temperate forest vegetation of Province Awa. *Bull. Tokyo Univ. Forests*, no. **37**, 115-134. (In Japanese with English summ.).

—, and K. HATIYA, 1951 — The forest vegetation of Izu Peninsula. *Ibid.* no. **39**, 145-169. (In Japanese with English summ.).

TAKAHASHI, Matsuo, 1935 — The forest vegetation of central Japan. *Nippon Ringaku-kaishi*, **17** (12), 935-961. (In Japanese).

TAKAHASHI, Motoo, 1948 — On forest communities in the mountains of Japan. *Kyodo Shizen-kagaku no Kenkyu* **I**, 155-184. (In Japanese).

TAKAMINE, E., 1952 — Flora of Yaeyama-gunto. Report For. Exp. Stat. Ryukyu no. **1**, pp. 1-153.

TAKEDA, H., 1941 — Alpine plants of Japan. (A book in Japanese).

TAKENOUCHI, M., 1941 — A preliminary report on the conifers indigenous in Manchukuo, with special reference to their taxonomy and their distribution. *Zikkenrin Ziho Bur. Forest Manchukuo*, **III** (3), 243-298.

TATEWAKI, M., 1935 — On the distribution of *Pinus pumila* in N. Japan. *Ecol. Rev.* (Jap.) **1** (1), 23-36. (In Japanese).

—, 1948 — The distribution of Plants [Syokubutu no Bunpu] pp. 135-140. (A book in Japanese).

TOKUDA, M., 1941 — Biogeography of the Japan Archipelago, pp. 1-184. (A book in Japanese).

WATANABE, F., 1938 — Studies on the beech forest of Japan. [Bunarin no Kenkyu] pp. 1-382. (A book in Japanese).

WILSON, E. H., 1922 — A phytogeographical sketch of the ligneous flora of Formosa. *Journ. Arnold Arb.*, **2**, 25-41.

YAMANAKA, T., 1952 — Vegetation in the vicinities of Kochi City (2). *Bull. Soc. Pl. Ecol.*, **2**, 30-32. (In Japanese with English summ.).

—, 1953 — Studies on the vegetation of Mt. Ishidzuchi, Shikoku. *Res. Rep. Kochi Univ.*, **2** (4), 1-11. (In Japanese with English summ.).

—, 1953 — Studies on the forest vegetation on Mt. Taurugi, Shikoku. *Bull. Soc. Pl. Ecol.*, **3** (2), 53-59. (In Japanese with English summ.).

—, 1953 — The vegetation of Kashiyama Pass, Prov. Tosa, with special reference to the Fagus-Abies-Cyclobalanopsis community. *Bull. Fac. Educ. Kochi Univ. no.* **4**, 51-54.

YATOH, K., 1954 — The forest vegetation of the Ohsugidani National Forest. *Bull. Soc. Pl. Ecol.*, **4**, 277-281. (In Japanese).

YOSHII, Y. and T. OIZUMI, 1954 — Synecological studies on the vegetation of Mt. Hatimandaira. *Bull. Soc. Pl. Ecol.*, **4**, 271-276. (In Japanese).

YOSHIOKA, K., 1938 — Montane forests on Mt. Hakkoda (1). On the forests of Fagus-Sasa climax zone. *Ecol. Rev.*, **3**, 187-205, 322-338; *Ibid.* **4**, 27-38. (In Japanese).

—, 1952-1953 — Sociological studies of the forests in the Tohoku district. *Bull. Soc. Pl. Ecol.*, **1**, 165-175 (1952); *Ibid.*, **2**, 69-75 (1952); *Ibid.*, **3**, 38-46 (1953); *Ibid.*, **4**, 219-229 (1954). (In Japanese with English summ.).