

**STUDIES ON THE LIMESTONE FLORA OF
JAPAN AND TAIWAN
PART II***

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**CHAPTER IV GROUPING OF THE FLORISTIC COMPONENTS
IN THE LIMESTONE FIELD**

As stated in Chapter I, the vegetations of the calcareous and the surrounding non-calcareous field exhibit a strong contrast. However, the floristic components are never perfectly different between them. Sometimes many species are common to both the fields, and sometimes they are absent from either of them. The contrast of the vegetation between the calcareous field and the surrounding non-calcareous one should be attributed to the differences in abundance of some of the common species between them and also to the occurrence or the absence of some others. When a single field is the object of discussion, the component species in it can be grouped into the following four classes basing upon the degree of difference in abundance.

* The present paper is a part of the writer's thesis proposed to Kyoto University.

First, the plants which occur in the limestone field, but do not appear outside.

Second, the plants which appear in both the fields, but more abundantly in the former.

Third, the plants which appear in both the fields and do not exhibit the remarkable difference in abundance between them.

Fourth, the plants which appear in both the fields, but less abundantly in the former.

In addition, the plants which do not occur inside of the limestone field are recognizable as the fifth group.

When more than two fields of limestone are inclusively dealt with and when the plants which are not restricted to a single field are considered, the matter will be more complicated because, as mentioned in Chapter I, the plant occurring only in the limestone field within a district is not always so in another one or the plant growing more abundantly on the limestone field within a district is not always so in another one. Although it is most desirable that connection of any plant with limestone will be taken into consideration throughout its whole distribution area, as a matter of fact the data are too short to satisfy such a demand at least so far as most of the plants extending to the continent are concerned. For example, *Gentiana contorta*, though characteristically found on limestone cliffs in Japan, is doubtful if it is restricted to limestone fields also in the continent. Therefore I cannot help confining my consideration within Japan and Taiwan in this chapter. Anyway the above grouping of the component plants is not applicable when all of the selected fields described in Chapter III are aimed to be taken into consideration. Then the degree of connection of each species with limestone should be evaluated basing upon its frequency of occurrence in limestone fields throughout the whole geographical range as well as its abundance in each field. Some species are almost exclusively found in limestone fields but not so frequently, while some other species are found wherever limestone occurs but likewise frequently in the other habitats. Here the former is considered as closer in the relation to limestone than the latter. Thus, for the grouping of the plants from limestone fields, the conception of *fidelity* in the sense of phytosociology is well available. *Fidelity* is indicative of the degree with which a species is restricted to a particular kind of community. Five classes of *fidelity* are accepted by the current phytosociologists. According to OOSTING (1956), they are :

Fid. 1 Strangers, appearing accidentally

Fid. 2 Indifferents, without affinity for any community

Fid. 3 Preferents, present in several communities but predominantly in one of them

Fid. 4 Selectives, found especially in one community but met with occasionally in others

Fid. 5 Exclusives, found completely, or almost so, in only one community.

Here the species with fidelities 3 to 5 are termed *characteristic* species in a

community. Concerning the components of the limestone field, similarly the following five classes can be accepted.

Group I Exclusives, found completely, or almost so, only in the limestone field

Group II Selectives, found especially in the limestone field but met with occasionally in others

Group III Preferents, present in the limestone field as well as in the others, but predominantly where limestone occurs

Group IV Indifferents, without special connection with the limestone field

Group V Strangers, appearing accidentally in the limestone field.

Likewise the species belonging to Group I to III should be termed *characteristic* species of the limestone field. The term *calcicoles* should be applied to the plants of both Group I and II, and the members of Group I can be named *limestone species* or *limestone plants*. In this grouping of the plants their physiological preference for calcareous soils and the variation in lime contents of the soils are out of consideration. The term *calciphiles*, on the other hand, implies the plants which have been proved to be of physiological preference for calcareous soils. Though no plants can be accurately determined as *calciphiles* without cultural experiments, they will be empirically recognizable depending on their degree of bias toward limestone outside of the laboratory. In this respect, the plants of Group III are more or less calciphilous. Also some of *calcicoles* are of course *calciphiles*, but the others may be merely tolerable for the limestone field.

It must be noted here that the word *limestone field* used in this text means all the environmental conditions derived from limestone inclusively. So the relationship of any *characteristic* species with any particular environmental factors such as lime contents and pH value of soils are not estimated in this work. In relation to these respects, the works of some other investigators should be referred. DE SILVA (1934) proposes an opinion that *calcicoles* are the plants growing on soils containing a high amount of exchangeable calcium. STEELE'S definition (1955) of *calcicoles* is that they are the species found most characteristically and abundantly on neutral calcareous soils. LOUSELY (1950) takes lime contents of soils into consideration, and defines *calcicoles* as the plants which grow on soils specially containing a high percentage of lime. Most recently TERAO (1961), as referred in Chapter I, selected the calciphilous members depending upon his measurements of exchangeable calcium contents in the soils on which they grew. In his opinion, *calcicoles* inhabit soils containing a large amount of exchangeable calcium, and *calciphiles* are also members of the *calcicoles* but connect more strongly with such soils.

Speaking of grouping of the plants from the limestone field UNGER (1836)* already suggested that they might be grouped into three :

(1) Exclusive species, strictly confined to the limestone field. This is concordant with Group I above-mentioned.

* I could not see the original publication, so that I quoted from KAWATA'S interpretation (1932).

(2) Related species, with some bias toward the limestone field. Concordant with Group II and III.

(3) Indifferent species, not selective on the matter of soil. Concordant with Group IV.

Consequently no great differences from his grouping are recognized in my grouping and also in that proposed in some other later publications. For example, PESOLA'S opinion (1928) is :

- (1) Obligate calciphiles, growing always on high limed soils
- (2) Calciphiles, growing generally on high limed soils
- (3) Subcalciphiles, growing generally on low limed soils
- (4) Indifferents, growing on all kinds of soils.

Although in his classification two different factors, viz. frequency of plant and lime contents of soils, are considered, his *obligate calciphiles* are concordant with the above *exclusive* species while *calciphiles* together with *subcalciphiles* agree with the above *related* species. His *subcalciphiles*, according to its definition, may be grouped into either Group I or II in my grouping. Four classes of EKLUND (1946), which are nearly concordant with Group I to IV, are *Kalkstet*, *Stark kalkhold*, *Kalkgünstigt* and *Kalkindifferent*. Furthermore GILMOUR (1947) divides the characteristic species of the chalk land into *exclusive* and *constant* species. OOSTING (1956) accepts two categories of the characteristic plants of the limestone field, viz. *true calciphiles* and *obligate calciphiles*. The former means the plants found on calcareous soils more luxuriantly, while the latter those growing only on them.

In this paper, no experimental estimation of the preference of any species for the calcareous soil is presented. Accordingly my grouping is depending upon only field works as mentioned above. The resultant exemplification of each group is as follows. But, Group IV and V are excluded here because of want of the space.

Group I. Widely distributed species are few in this group. Most members are found in only one or in a few fields. Therefore some of them may be transferred to another group when more phytogeographical informations are acquired hereafter. All of the present members are shown in bold face in each article of Chapter III, and are going to be discussed in the next chapter.

<i>Adiantum capillus-junonis</i>	<i>Woodsia hancockii</i>
<i>Aleuritopteris krameri</i>	<i>Betula chichibuensis</i>
<i>Asplenium coenobiale</i>	<i>Cerastium calcicola</i>
A. <i>pulcherrimum</i>	C. <i>kaoi</i>
A. <i>ruta-muraria</i>	C. <i>mitsumorense</i>
<i>Cyrtogonellum fraxinellum</i>	var. <i>ovata</i>
<i>Hypodematum fauriei</i>	<i>Thalictrum foetidum</i>
H. <i>glanduloso-pilosum</i>	var. <i>iwatense</i>
<i>Polystichum deltodon</i>	T. <i>urbanii</i>
<i>Pteris angustipinna</i>	var. <i>majus</i>
P. <i>deltodon</i>	<i>Berberis chingshuiensis</i>
P. <i>yamatensis</i>	<i>Draba igarashii</i>
<i>Struthiopteris eburnea</i>	D. <i>nippnica</i>
var. <i>obtusa</i>	var. <i>linearis</i>

- Sedum drymarioides*
 var. *toyamae*
 S. *tosaense*
Corylopsis matsudai
Eriobotrya japonica
Pourthiaea chingshuiensis
Prunus incisa
 var. *bukosanensis*
Raphiolepis impressivena
Rosa luciae
 var. *rosea*
Spiraea tarokoensis
Lespedeza homoloba
 var. *higoensis*
Geranium robertianum
Euphorbia tarokoensis
Euonymus batakensis
Rhamnus chingshuiensis
 R. *yoshinoi*
 var. *velvetina*
 var. *yoshinoi*
Hypericum nokoense
Takasagoya geminiflora
 T. *nakamurai*
Angelica saxicola
 var. *yoshinagae*
 A. *shikokiana*
 var. *mayebarana*
 A. *tarokoensis*
Ligustrum seisuiense
Buddleja formosana
Gentiana contorta
 G. *kaoi*
- G. *tentyoensis*
Euphrasia maximowiczii
 var. *calcareo*
 E. *tarokoana*
Galium minutissimum
 G. *tarokoense*
Viburnum propinquum
Zabelia integrifolia
Patrinia glabrifolia
Adenophora maximowicziana
 A. *teramotoi*
 var. *hispidula*
 var. *teramotoi*
Anaphalis sinica
 var. *pernivea*
Artemisia somai
 var. *batakensis*
Chrysanthemum morii
Leontopodium hayachinense
 var. *miyabeana*
 L. *japonicum*
 var. *perniveum*
Senecio furusei
Youngia yoshinoi
Festuca ovina
 var. *chiisanensis*
Carex peikutusani
Lilium bukosanense
Tofieldia coccinea
 var. *akkana*
 var. *geibiensis*
 var. *kiusiana*
Tricyrtis macrantha

Remarks: Japanese plants 43, Taiwan plants 35, Common plants 4, Total 74.

Group II. Most of this members, though widely distributed are of rare occurrence, being discontinuously found mostly in the cliff region of limestone. Also these members are shown in bold face in Chapter III, and going to be discussed in the next chapter.

- Asplenium capillipes*
 A. *kobayashii*
Camptosorus sibiricus
Cyrtomium caryotideum
Gymnocarpium jessoense
Woodsia glabella
Juniperus sargentii
Salix kenoensis
Carpinus turczaninowii
Clematis psilandra
 C. *speciosa*
- C. *stans*
 var. *austro-japonensis*
 C. *williamsii*
Epimedium grandiflorum
 var. *higoense*
Sisymbrium luteum
Filipendula tsuguwoi
Potentilla fruticosa
 var. *mandshurica*
Rhodotypos scandens
Spiraea nervosa

var. latifolia	ssp. iinumai
var. nervosa	Hayataella michelloides
S. nipponica	Abelia chinensis
S. prunifolia	var. ionandra
var. pseudoprunifolia	Viburnum carlesii
Astragalus membranaceus	var. bitchiuense
Buxus microphylla	Adenophora pereskiaefolia
var. insularis	var. moiwana
Rhamnus costata	Chrysanthemum makinoi
R. oiwakensis	Tetraploid race.
Forsythia japonica	C. zawadskii
Clinopodium laxiflorum	Smilax elongato-reticulata
var. parvifolium	S. vaginata
Euphrasia insignis	var. stans

Group III. The plants which are almost always found where limestone occurs within their distribution areas and exhibit more abundance there than in the surrounding areas are included herein. They might be more or less calciphilous. The detection of such plants is completely based upon my own experience in the field observation. Probably the closer investigation adds further more examples to this group. The present result is shown in the following exemplification of the plant. Some plants are usually growing on shady gravelly slopes inside of the limestone district, while outside they are ordinarily found on rather shady and humid places such as at the river-side. Others are chasmophytic on rocks of limestone and also on siliceous rocks.

Athyrium okuboanum	var. hypoleucum
A. unifurcatum	var. stipellatum
Coniogramme intermedium	Berberis amurensis
Dennstaedtia wilfordii	var. bretschnideri
Polypodium someyae	var. japonica
Polystichum craspedosorum	B. thunbergii
Pteris vittata	B. tschonoskyana
Cephalotaxus harringtonia	Epimedium grandiflorum
Torreya nucifera	Nandina domestica
Chloranthus japonicus	Sinomenium acutum
C. serratus	Arabis flagellosa
Morus tiliaefolia	A. serrata
Laportea bulbifera	var. glauca
L. macrostachya	var. japonica
Pilea petiolaris	var. shikokiana
ssp. pseudopetiolaris	Deutzia gracilis
Buckleya lanceolata	Philadelphus satsumi
Euptelea polyandra	var. lancifolius
Cimicifuga acerina	var. nikoense
Clematis stans	var. satsumi
Paeonia japonica	Kerria japonica
P. obovata	Rubus yoshinoi
Thalictrum actaeofolium	Spiraea blumei
T. minus	Lespedeza buergeri

- Orixa japonica*
Zanthoxylum piperitum
Z. planispinum
Picrasma quassioides
Euphorbia sieboldiana
Mercurialis leiocarpa
Phyllanthus flexuosa
Securinega suffruticosa
Buxus microphylla
 var. *japonica*
 var. *sinica*
Rhus ambigua
Celastrus orbiculatus
Euonymus alatus
E. oxyphyllus
E. sieboldianus
Staphylea bumalda
Hosiea japonica
Berchemia berchemiaefolia
B. racemosa
Rhamnella franguloides
Rhamnus japonica
 var. *decipiens*
 var. *microphylla*
Daphne kamtschaticum
 var. *jezoense*
Alangium platanifolium
 var. *trilobum*
Angelica shikokiana
Bupleurum falcatum
B. longiradiatum
 f. *elatius*
Heracleum lanatum
- Seseli ugoensis*
Aucuba japonica
Helwingia japonica
Fraxinus lanuginosa
 var. *serrata*
F. sieboldiana
Ligustrum morrisonense
L. obtusifolium
L. tschonoskii
Syringia reticulata
Gardneria multiflora
Halenia corniculata
Cynanchum ascyrifolium
Marsdenia tomentosa
Lithospermum zollingeri
Galium kinuta
Anaphalis margaritacea
 ssp. *morrisonicola*
A. sinica
Artemisia keiskeana
Leontopodium japonicum
Syneilesis palmata
Carex duvaliana
Allium tuberosum
Fritillaria muraiana
Hosta longipes
Tricyrtis suzukii
Tofieldia coccinea
 var. *kondoi*
Veratrum formosanum
V. maackii
 var. *japonicum*
 var. *maackii*

CHAPTER V TAXONOMICAL AND PHYTOGEOGRAPHICAL CONSIDERATIONS OF THE CHARACTERISTIC SPECIES

In this chapter, the vascular plants put together in Group I and II are discussed from taxonomical and phytogeographical view-point. The new taxa proposed in Chapter III are described here. The plants are arranged in the way same with that in Chapter III, regardless of whether they are from Japan or Taiwan and also of whether they are grouped into Group I or II. The diagnosis of each taxon is mostly drawn from the specimens available to me. For this purpose, the works of KANEHIRA (1936), of KITAMURA, MURATA and HORI (1957), of KITAMURA and MURATA (1961), of LIU (1960), of OHWI (1953, 1957) and of TAGAWA (1959) are much helpful. For the phytogeographical data, all the specimens examined are cited with indication of the herbarium in which they are preserved. But, in most cases the collector's name and the date of the specimen are omitted. When the specimens from the same locality are found in more than two herbaria, mostly either one of them is noted. The indication of the main herbaria is done by the following signs. Here I wish to express my sincere thanks to the curators of these herbaria for their kind permission of examination of the specimens therein.

KYO—the herbarium of the University of Kyoto, Kyoto, Japan.

SHIN—the herbarium of Shinshu University, Ueda, Japan.

TAI—the herbarium of the National Taiwan University, Taipei, Taiwan.

TAIF—the herbarium of the Taiwan Forestry Research Institute, Taipei, Taiwan.

TI—the herbarium of the University of Tokyo, Tokyo, Japan.

TNS—the herbarium of the National Science Museum, Tokyo, Japan.

Further, when the specimen is either noted as "calcicolous" or considered as certainly so, the mark *asterisk* is added to its corresponding locality name ahead.

PTERIDOPHYTA

Adiantum capillus-junonis RUPR., Dist. Cr. Vasc. Ross. 49 (1845); MATSUM. et HAYATA, Enum. Pl. Formos. 615 (1906); TAGAWA, Acta Phytotax. Geobot. 1:101 (1932) & Journ. Jap. Bot. 14:312 (1938) & Col. Ill. Jap. Pter. 174 (1959).—*A. cantoniense* HANCE, Ann. Sci. Nat. sér. 4, 15:229 (1861).

A glabrous small fern with pinnate leaves. Pinnae shortly petiolate, rounded, without serration, 7~10mm in width.

Loc. KYUSHU. Pref. Ooita: *Onagara, Minamiamabe-gun (KYO); *Mt. Hakiyama, Nakano-mura (KYO).

Distr. Kyushu and ?Taiwan. Also in the continental China (Szechwan, Yunnan, Kwangtung, Hupeh and Manchuria).

Although I have not yet visited Ooita Prefecture, where the limestone lodes extend inwards from the coast in the southern half of the prefecture, TAGAWA (l. c. 1932) reported that the present fern occurred on limestone

there around. On the other hand, HENRY¹ recorded this fern from "Ape's Hill" which was regarded as Shoushan near Kaohsiung. If we accept his record in spite of TAGAWA's hesitation (l. c. 1938), it is of high probability that it was brought also from limestone crevices, because Shoushan is the hill constructed wholly with the coral limestone. It is known from no other localities both in Japan and in Taiwan. No materials with habitat data have come to my hand from the continent.

Aleuritopteris krameri (FR. et SAV.) CHING, Hongkong Naturalist 10:202 (1941); TAGAWA, Acta Phytotax. Geobot. 14:191 (1952). — *Cheilanthes krameri* FR. et SAV., Enum. Pl. Jap. 2:619 (1879); TAGAWA, Col. Ill. Jap. Pter. 189 (1959). — *C. kuhni* MILDE var. *brandtii* (FR. et SAV.) TAGAWA, Journ. Jap. Bot. 13:184 (1937), p. p. — *C. farinosa* (non KAULF.) H. ITO, Journ. Jap. Bot. 18:198 (1942).

Fronds bipinnate, 10~20cm long, 3~4cm broad, long stipitate, conspicuously white-farinose beneath.

Loc. HONSHU. Pref. Tokyo: *Nippara, Nishitama-gun (KYO).

Distr. Known only from the above locality.

This fern is very closely related to *A. kuhni* var. *brandtii* occurring rarely on dried rocky places in middle Honshu. The distinction between these two species is that *A. krameri* bears wider laminae with longer petioles.

Geographically the present fern is known only from Nippara in Tokyo Pref. Although MORIYA² states that this fern is discontinuously distributed in Yamaguchi Pref. (Akiyoshi), Tokyo Pref. (Nippara) and Gunma Pref. (Mt. Futago and Mt. Shiroishi), I intend to refrain from agreement with his announcement until the authentic materials come to my hand. The strong connection of this fern with limestone was already pointed out by TAKEDA³.

Asplenium capillipes MAKINO, Bot. Mag. Tokyo 17:77 (1903); TAGAWA, Col. Ill. Jap. Pter. 177 (1959). — *A. varians* WALL. var. *sakuraii* ROSENST., Fedde Repert. 13:123 (1914); H. ITO, Journ. Jap. Bot. 14:593 (1938).

Fronds patent, tender in texture, ordinarily 3~6cm long, bipinnate; pinules more or less lobate; lobes round or obtuse at the apex; rachis proliferous.

Loc. HONSHU. Pref. Tochigi: Mt. Koshinzan, 1500~1700m (KYO). Pref. Saitama: *Mt. Akasawa, east of the Jumoji-pass, Chichibu-gun (SHIN). Pref. Nagano: *Jumoji-pass to Azusa-shiraiwa, Minamisaku-gun (KYO); *Mt. Shiraiwa, Kamiina-gun, 1800m (KYO); *Makuiwa, Todai, Kamiina-gun, 1400m (KYO); Kashio to Sampuku-pass, Shimoina-gun, 1400m (KYO); *Tsubame-iwa and *Tenshu-iwa, upper Aoki river, Shimoina-gun (KYO). Pref. Shizuoka: in monte Tanzawa—type loc. of *A. varians* var. *sakuraii* (KYO). Pref. Nara: *near Dorogawa, Yoshino-gun, 1100m (KYO). Pref. Okayama: *Rashomon, Niimi-shi (KYO); *Kanatiana, Idono, Jobo-gun (KYO); Kamagatani, Niimi-shi (KYO); Ushiroyama, Higashiawakura-mura, Aida-gun (KYO). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (KYO). Pref. Ehime: Huzinoishi, Uma-gun—type loc. (TI). KYUSHU. Pref. Kumamoto: *near Momoki, Gokanosho (KYO); *Mt. Noke-eboshi, Kumagun (KYO).

1) HENRY, A. (1896) List Pl. Formos. 116.

2) MORIYA, T. (1958) Acta Phytotax. Geobot. 17:182.

3) TAKEDA, H. (1905) Bot. Mag. Tokyo 19:(295).

Distr. Honshu, Shikoku and Kyushu.

This fern resembles *A. varians* very much, being sometimes difficult to be discriminated from the latter. The distinction between these two species is that the leaves of the former are very tender in texture, patent and ordinarily proliferous, while those of the latter are somewhat hard in texture, erect and never proliferous.

A. capillipes is of rare occurrence on mossy cliffs. As evident from the above specimen citation, most of its records are due to limestone, but sometimes to siliceous rocks, for example, in the cases of Mt. Koshinzan, Mt. Tanzawa and others. *A. varians* is also found on mossy limestone throughout Japan, but not so characteristically as the present species.

A. coenobiale HANCE, Journ. Bot. 12:142 (1874); TAGAWA, Col. Ill. Jap. Pter. 177 (1959).—*A. fuscipes* BAKER, Journ. Bot. 17:304 (1879).—*A. toramanum* MAKINO, Bot. Mag. Tokyo 6:45 (1892).

Fronds with laminae narrowly triangular, 4~8cm long, 1.5~3cm broad, pale and dotted with minute green spots beneath, bipinnate; the lower pinnae the larger; stipes 3~10cm long, shining black.

Loc. SHIKOKU. Pref. Kochi: *Ryugado, east of Kochi, Kami-gun (KYO); *Jigokudani, Kamota-mura, Tosa-gun (TI); *Shirakidani, Kamikura-mura, Nagaoka-gun (TNS); *Hirose, Tosayama-mura, Tosa-gun (KYO); Mt. Sekkozan, Tosa-gun (TNS).

Distr. Shikoku. China (Kwangtung) and Indo-China.

This fern is characterized by its bipinnate triangular fronds and black shining slender stipes. In these respects, it most resembles *A. pulcherrimum* (BAKER) CHING, which differs from the present species in having more finely dissected fronds with evenly greenish undersurface.

As stated by YAMANAKA⁴, this is one of the most characteristic limestone species in Shikoku and is nowhere in Japan to be found.

A. kobayashii TAGAWA, Acta Phytotax. Geobot. 1:309 (1932) & Col. Ill. Jap. Pter. 178 (1959).

Fronds once pinnate. Pinnae pinnatilobed, adnate and decurrent to the rachis, hard chartaceous in texture.

Loc. HONSHU. Pref. Fukushima: *Oniana in Mt. Ootakine, Tamura-gun (KYO). Pref. Gunma: Isezaki-shi (KYO). Pref. Mie: *Yabata, Kasuga-mura, Ayama-gun, 150m (KYO).

Distr. Hokkaido, Honshu and Kyushu. China (Manchuria).

The broadly adnate and decurrent pinnae are peculiar to the present fern among the Asplenioid members of Japan. When KITAZAWA⁵ reported this fern on a porous andesite and a loamy cliff at Isezaki of Gunma Pref., he was of opinion that it might be a hybrid between *Asplenium incisum* THUNB. and *Camptosorus sibiricus* RUPR. Besides the localities cited above, HIRATA⁶ and WATANABE⁷ recorded this fern from Shiiba-mura of Miyazaki Pref. (Kyushu)

4) YAMANAKA, T. (1956) Acta Phytotax. Geobot. 16-95.

5) KITAZAWA, S. (1954) Journ. Jap. Bot. 29:186-188.

6) HIRATA, S. (1954) Ibid. 29:186.

7) WATANABE, S. (1956) Acta Phytotax, Geobot. 16:187.

and Mt. Oohira of Shiribeshi Prov. (Hokkaido), respectively. In both cases, the occurrence of this fern owes to limestone crevices. Therefore, in Japan *A. kobayashii*, except in the case of Isezaki, always comes from the limestone cliffs.

A. pulcherrimum (BAKER) CHING apud TARD. -BLOT, Aspl. Tonkin 52 (1932); TAGAWA, Acta Phytotax. Geobot. 9:206 (1940). — *Davallia pulcherrima* BAKER, Kew Bull. 53 (1895). — *A. calcicola* TAGAWA, Acta Phytotax. Geobot. 4:202 (1935).

Fronds extending to 15cm long, narrowly triangular, greenish beneath, bipinnate with pinnules 2~3-lobate, long petiolate; petioles 3~10cm long, shining black.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 500~1000m (KYO); *ibid. 1000m (KYO); *ibid. 1150~1650m (KYO); *Seraoka to Tabito—type loc. of *A. calcicola* (KYO);

*Taroko-dangai (TAI); *Sakahen to Kirai (KYO); *the Tienchang cliff (KYO).

Distr. Taiwan. China (Yunnan) and Tonkin.

As mentioned in the preceding page, this fern is closely related to *A. coenobiale*. Likewise in it, the present fern is also strictly restricted to sunny cliffs or rubbly ridges in Hualien Pref. so far as the matter is concerned with Taiwan.

A. ruta-muraria L., Sp. Pl. ed. 1, 1801 (1753); TAGAWA, Col. Ill. Jap. Pter. 179 (1959). — *Amesium ruta-muraria* (L.) NEWMANN, Hist. Brit. Ferns ed. 2, 10 (1844); SHIMIZU, Acta Phytotax. Geobot. 17:89 (1958).

Fronds caespitose, somewhat leathery in texture, pinnate to bipinnate, shorter than 7cm long; pinnules ovate, few 1~10, distinctly petiolulate, 3~8 mm broad.

Loc. HONSHU. Pref. Aomori: *Shirikari, Higashidori-mura, Shimokita-gun (TI). Pref. Iwate: *Akka and *Iwaizum, Iwaizumi-cho. Shimohei-gun (KYO); *Mt. Ureira, Shimohei-gun (KYO); *Otaomo-mura, Kamihei-gun (TI); *Geibikei, Higashiiwai-gun (KYO); *Kiwadabori, near Geibikei, Higashiiwai-gun (KYO). Pref. Tokyo: *Nippara, Nishitama-gun (KYO). Pref. Saitama: *Mt. Akasawa, Chichibu-gun (SHIN). Pref. Nagano: *Jumoji-pass to Mt. Mikuni, Minamisaku-gun (SHIN); *Mt. Shiraiwa, Kamiina-gun (KYO); *Makuiwa and *Shiraiwa, Todai, Kamiina-gun (KYO). Pref. Niigata: *Mt. Myojo, Nishikubiki-gun (SHIN). Pref. Toyama: *around Kanetsuri Hotspring, Kurobe (SHIN). Pref. Ishikawa: Mt. Hakusan (KYO). Pref. Shiga: *Mt. Ibuki (KYO); *Mt. Ryozen (KYO). Pref. Mie: Mt. Hatta (KYO). Pref. Nara: *Kawakami-mura, Yoshinogun (KYO). Pref. Okayama: *Tanagase, Niimi-shi (KYO); *Nagaya, Niimi-shi (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi, 1800m (KYO). Pref. Kochi: *Mt. Yokogura, Takaoka-gun, 700m (KYO). Pref. Ehime: *Oonogahara (TI). KYUSHU. Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun (KYO); *Mt. Shiraiwa, Higashiusuki-gun (KYO). Pref. Kumamoto: *Mominoki, Gokanosho (KYO). TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000~1800m (KYO); *ibid. 1800~2400m (KYO); *Taroko, Batakan to Tabito (KYO); *Seraoka to Tabito (KYO); *Panpien to Chilai (KYO); *the Tienchang cliff (KYO); *Noko-goe (KYO).

Distr. Hokkaido, Honshu, Shikoku, Kyushu and Taiwan. Widely distributed through Asia, Europe, North America and North Africa.

This is the most characteristic species of limestone districts throughout Japan and in Taiwan, growing in crevices of limestone at rather sunny dried

places. In Hokkaido, Mt. Ashibetsu⁸ (Prov. Ishikari) and Mt. Oohira⁹ (Prov. Shiribeshi) are all the localities from which it was so far reported. Regarding Honshu, Shikoku, Kyushu and Taiwan, the above cited localities are almost all known up to the present for this fern.

As often referred in Chapter I, *A. ruta-muraria* is also characteristic of the limestone district in Europe. BROWN¹⁰ teaches us that it is same in North America, too.

The most related species, *A. septentrionale* (L.) HOFFM. (= *Amesium septentrionale* (HOFFM.) NEWMANN), which is widely distributed in Europe, north Asia, Himalaya to Shensi and the western part of North America, is, though absent from Japan, found in Taiwan. But there it grows in the alpine region, being not even a stranger in the limestone field.

Camptosorus sibiricus RUPR., Crypt. Vasc. Ross. 45 (1845); SHIMIZU, Acta Phytotax. Geobot. 17:93 (1958) & 18:120 (1960); TAGAWA, Col. Ill. Jap. Pter. 189 (1959). — *Scolopendrium sibiricum* (RUPR.) HOOK., 2nd Cent. Ferns t. 25 (1860).

Fronds caespitose, simple, narrowly lanceolate, 5~15cm long, 5~10mm broad, conspicuously caudately elongated, proliferous at the apex, entire or irregularly repand on margin.

Loc. HOKKAIDO. Prov. Kitami: Takinoue-cho, Monbetsu-gun (KYO). Prov. Shiribeshi: *Garo-zawa, Tomarigawa (KYO); *along Oohira-gawa (TNS). Prov. Oshima: *along the Hekirichi river, Kamiiso-gun (KYO). Prov. Ishikari: Mt. Teine (KYO). HONSHU. Pref. Aomori: *Shirikari, Higashidori-mura, Shimokita-gun (TI). Pref. Iwate: *Akka and *Ryusenkutsu, Iwaizumi-cho, Shimohei-gun (KYO); *Geibikei, Higashiiwai-gun (KYO); *Kiwadabori near Geibikei, Higashiiwai-gun. (KYO). Pref. Akita: Yamase-mura, Kitaakita-gun (TNS); Mase, Yamori-mura, Yamamoto-gun (TNS). Pref. Yamagata: Yamadera, Higashimurayama-gun (TNS). Pref. Fukushima: *Oniana in Mt. Ootakine, Tamura-gun (KYO). Pref. Tochigi: *Mt. Izurusan, Tochigishi (KYO); Umagaeshi, Nikko (TI). Pref. Gunma: Kamimaki-mura, Kanra-gun (TNS); Mt. Nakai, Usui-cho, Usui-gun (TNS). Pref. Chiba: Mt. Kiyozumi (TNS). Pref. Tokyo: *Nippara, Nishitama-gun (KYO). Pref. Saitama: *Mt. Akasawa, Chichibu-gun, 1800m (SHIN); *Mt. Buko (KYO); *Mts. Mitsumine (KYO). Pref. Nagano: *Jumoji-pass to Azusashiraiwa, Minamisaku-gun (KYO); *Mt. Kamanashi, Kamiina-gun, 1700m (KYO); *Makuiwa and *Shiraiwa, Todai, Kamiina-gun (KYO); the Sampuku pass to Goshodaira, Shimoina-gun, 1500m, non-calcareous rock (KYO); Shiokawa, Oojika-mura, Shimoina-gun (TI); *Tenshuiwa and *Tsubameiwa, upper Aoki river, Shimoina-gun (KYO); Oiwake in Mt. Asama (TI); Mt. Togakushi, Kamiminochi-gun (TI); Shinden, Umegashima-mura, Abe-gun (TI). Pref. Yamanashi: Mitake (KYO); Mt. Mitsu-toge, siliceous rock (TNS). Pref. Kanagawa: Mt. Genjiyama, Kamakura (TI). Pref. Shizuoka: Mukagaito, Shironichi-mura, Iwata-gun (KYO). Pref. Aichi: Kamebuchidani, Ikeba, Kitashitara-gun, on tuff (KYO); *Sakurabuchi, Shinshiro, north of Toyohashi (KYO). Pref. Niigata: *Mt. Myojo, Nishikubiki-gun (SHIN). Pref. Toyama: Kagazawa, Hosori-mura, Furai-gun (KYO); *Kanetsuri, Kurobe (KYO); *Mt. Sogatake, Kurobe (TI); Oomaki-onsen (TI). Pref. Gifu: Yamada-mura, Gungami-gun (KYO). Pref. Shiga: *Mt.

8) TATEWAKI, M. (1935) Trans. Sapporo Nat. Hist. Soc. 14:69.

9) WATANABE, S. (1956) Acta Phytotax. Geobot. 16:187.

10) BROWN, M. (1938) Index to North American ferns.

Ibuki (KYO); *Mt. Ryozen (KYO); *Gongendani, Inukami-gun (KYO). Pref. Mie: *Yamanohata, Kasuga-mura, Ayama-gun (KYO); *Yabata, Kasuga-mura, Ayama-gun, 150m (KYO); *Shakudaijin near Ogisu, Suzuka-gun (KYO); *around Byobuiwa at the foot of Mt. Nonobori (KYO). Pref. Nara: *Kashiwagi, Kawakami-mura, Yoshino-gun (KYO); *Dorogawa, Kawakami-mura, Yoshino-gun (KYO); *along the Koonotani valley, Yoshino-gun (KYO); Mt. Oodaigahara, (KYO). Pref. Osaka: Hara to Idzuriha, north of Takatsuki-shi, 200m, not calcareous region (KYO). Pref. Wakayama: Imoo, Kawakami-mura, Hidaka-gun (TI). Pref. Hyogo: Hashigatani, Asago-cho, on efflorescent andesite (KYO). Pref. Okayama: *Rashomon, Niimi-shi (KYO); Tomiya-mura, Kawakami-gun (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO). Pref. Yamaguchi: *Sayama, Mito-cho, Mine-gun (KYO); *Katata, Shuho-cho, Mine-gun (KYO). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (TNS). Pref. Ehime: *Mimido, Hirohata-mura, Kamiukena-gun (KYO); *Oonogahara, 1400m (KYO); Mt. Odamiyama (TNS). Pref. Kochi: *Ryugado, east of Kochi, Kami-gun (TI); *Mt. Kurotakiyama to Mt. Tsutsunomori, Takaoka-gun, 1400m (SHIN); *Shinden to Tanono, Higashitsuno-mura, Takaoka-gun (SHIN); *eastern foot of Mt. Torigata, Takaoka-gun (KYO); *Funato to Nakamura, Takaoka-gun (KYO); *Shirakidani, Kamikura-mura, Nagaoka-gun (KYO); *Befukyo in Makiyama-mura, Kami-gun (KYO); *Mt. Yokogura, Takaoka-gun, 700m (KYO); *Kuwano, Tosayama-mura, Tosa-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (SHIN). Pref. Ooita: Natsuki, Minamiamabe-gun (KYO). Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun (KYO); *Mt. Shiraiwa, Higashiusuki-gun (SHIN); *Otenoo to Hizoe, Shiiba-mura, Higashiusuki-gun (KYO). Pref. Kumamoto: *Ootsuki, Kuma-mura, Kuma-gun (KYO); *Iboshi to Mt. Shiraga, Itsuki-mura, Kuma-gun (KYO); *Tenguiwa in Mt. Noke-eboshi, Kuma-gun (KYO); *Shiiba to Hotokeishi in Mt. Noke-eboshi, Kuma-gun (KYO); *near Momiki, Gokanoshō, 1000m (KYO); *Momiki to Mizukami-goe, Yatsushiro-gun (KYO); Mt. Shakaindake (KYO). Pref. Nagasaki: *Isl. Tsushima (TNS).

Distr. Hokkaido, Honshu, Shikoku and Kyushu. Korea, north China (Shantung and Manchuria), Amur and Baical.

This is a very common and characteristic fern of the limestone field throughout Japan, growing usually on shady cliffs. Though rarely, it occurs also on non-calcareous rocks here and there. Most localities without asterisk present such examples.

The North American counterpart, *C. rhizophyllus* (L.) LINK, which is characterized by the larger blades with cordate base, is also usually found on limestone and rarely on other kinds of rock.

Cyrtogonellum fraxinellum (CHRIST) CHING, Bull. Fan 8:329, pl. 7, f. 3 (1938); TAGAWA, Acta Phytotax. Geobot. 9:93 (1940).—*Aspidium fraxinellum* CHRIST, Bull. Herb. Boiss. 7:15 (1899).—*Polystichum fraxinellum* (CHRIST) DIELS in ENGL. et PRANTL, Nat. Pfl.-fam. 1(4): 194 (1899).

Fronds caespitose. Stipes 15~30cm long. Blades 10~25cm long, 10~15cm broad, pari-pinnate in plan; pinnae 3~6-jugate, lanceolate, 5~8cm long, 1.5~2.5cm broad, acuminate toward the apex, cuneate at the base, nearly entire on margin but crenate-serrate toward the apex, coriaceous in texture, shedding when dead, terminal pinnule nearly erect. Sori round, about 2mm in diameter, uniseriate on each side of the costa, nearly medial.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000m, (KYO); *ibid. 1150~1650m (KYO); *ibid. 1400~2100m (KYO); *Sakahen to Kirai (TAI); *the Tienchang cliff (SHIN).
Distr. Taiwan (Hualien Pref.). China (Yunnan and Kweichow).

In appearance, this fern resembles *Cyrtomium* species. But, unlike in them its blades are not imparipinnate; pinnae are never auricled at the base, shedding when dead; and the sori are arranged in one row. Although its habitats in the continent are unknown to me, in Taiwan it is completely restricted to limestone crevices at somewhat shady places within Hualien Pref.

Cyrtomium caryotideum (WALL.) PR., Tent. Pterid. 86 (1836); TAGAWA, Acta Phytotax. Geobot. 3:64 (1934) & Col. III. Jap. Pter. 196 (1959).—*Aspidium caryotideum* WALL. ex HOOK. et GREV., Ic. Fil. t. 69 (1828).—*Phanerophlebia caryotideum* (WALL.) COPEL., Gen. Fil. 111 (1947).

Fronds evergreen, extending to 80cm long, imparipinnate with distinct large terminal pinnae; lateral pinnae 3~6-jugate, obliquely lanceolate, acuminate toward the apex, 8~15cm long, 3~7cm broad, auriculate on upper side at the base, they aristate-serrate on margin. Indusia round, fimbriate.

Loc. HONSHU. Pref. Tochigi: *Izurusan, Tochigi-shi (KYO). Pref. Tokyo: Sawai, Nishitama-gun (TNS). Pref. Saitama: Kuroyamanotaki, Okumusashi (KYO). Pref. Chiba: Mt. Mitsuishi, Kimitsu-gun, not limestone (KYO). Pref. Kanagawa: Yamakita, Ashigarakami-gun (KYO); Kamakura (TNS). Pref. Shizuoka: Mt. Ryuso (KYO); Tamakawa-mura, Abe-gun (KYO); Miwa-mura (KYO); near Shimizu-shi (KYO); Takabe-mura, Iharagun (TNS); Nunozawa, Ihara-mura, Ihara-gun (TNS); Nakakamo-mura, Tagata-gun (TNS).? Pref. Okayama: *the Kanba water-fall, Katsuyama-cho (KYO). SHIKOKU. Pref. Ehime: Myoga, Sakuragi-mura, Shuso-gun (KYO). Pref. Kochi: *Kuвано, Tosayama-mura, Tosa-gun (KYO); *Hirose, Tosayama-mura, Tosa-gun (KYO); *Nanokawa, Takaoka-gun (KYO). KYUSHU. Pref. Ooita: Kiura, Onoichi-mura, Oono-gun (KYO). Pref. Miyazaki: Urayama, Iwato-mura, Nishiusuki-gun (KYO); Mitai, Takachiho-mura, Nishiusuki-gun (KYO); Takachihokyo, Nishiusuki-gun (KYO); Mt. Akagawa (KYO). Pref. Kumamoto: *Mt. Kosadake, Kamimashiki-gun (KYO); Taki, Kawara-mura, Kamimashiki-gun (KYO); *Koonose and *Watari, Kuma-mura, Kuma-gun (KYO); Mt. Naidaijin (KYO); Mt. Kurobaru (TAI). TAIWAN. Pref. Chia: Arisan (KYO). Pref. Kaohsiung: near Miharashi, Kizan-gun (KYO); Ishiyama to Takimi, Kizan-gun (KYO). Pref. Taitung: Kiri-yama to Tipponzan (KYO); Asahi to Izumo, Kwanzan-gun (KYO). Pref. Hualien: *Mt. Chingshui, 1800~2400m (KYO).

Distr. Honshu, Shikoku, Kyushu and Taiwan. China (Yunnan, Szechuan and Shensi), Himalaya, south India and Hawaii Isls.

This is characterized by the finely aristate-serrate pinnae and fimbriate indusia among the Far Eastern members of the genus. As suggested by TAKEDA¹¹ and TAGAWA¹², it is frequently found on the shady limestone though never exclusively. The other species of the genus such as *C. falcatum* (L. f.) PR. and *C. fortunei* J. SM. are commonly growing on limestone fields, too. But, they seem to be not selective on the matter of soil kind.

Gymnocarpium jessoense (KOIDZ.) KOIDZ., Acta Phytotax. Geobot. 5:40 (1936); SHIMIZU, Acta Phytotax. Geobot. 17:113 (1958); TAGAWA, Col. III. Jap. Pter. 217 (1959).—*Dryopteris jessoensis* KOIDZ., Bot. Mag. Tokyo 38:104 (1924).—*G. robertianum* (HOFFM.) NEWMANN var. *longulum* (CHRIST) H. ITO, Polypodiaceae Dryopterioideae I, 161 (1939), pro syn. — *Lastrea robertiana* (HOFFM.) NEWMANN var. *longula* (CHRIST) OHWI, Fl. Jap. Pter. 101 (1957).—*Aspidium*

11) TAKEDA, H. (1905) Bot. Mag. Tokyo 19:294.

12) TAGAWA, M. (1934) Acta Phytotax. Geobot. 3:64.

dryopteris BAUMG. var. *longulum* CHRIST, Bull. Herb. Boiss. sér. 2, 2:830 (1902).

Fronds nearly triangular, bi- or tripinnate, sparsely dotted with minute glandular hairs on stipes and ribs.

Loc. HOKKAIDO. Prov. Teshio: Toikanbetsu, serpentine (KYO); Nupuro-mapporo, serpentine (KYO). Prov. Ishikari: Mt. Furano, serpentine—type loc. (KYO); Mt. Tomamu. Minamifurano, serpentine (KYO). Prov. Oshima: *the Garo-mine, Kamiisogun (KYO). HONSHU. Pref. Iwate: *Akka and *Ryusenkutsu, Iwaizumi-cho, Shimoheigun (KYO); *Mt. Ureira, Shimoheigun (KYO). Pref. Gunma: *Mt. Futago (KYO); Mt. Shibutsu, serpentine (KYO). Pref. Saitama: *Mt. Akasawa, Chichibu-gun (SHIN). Pref. Nagano: *Jumoji-pass to Mt. Mikuni, Minamisaku-gun, also on siliceous rock (SHIN); Mt. Yatsugadake (KYO); Mt. Norikura (KYO); Mt. Nyugasa, 1850m (KYO); *Mt. Kamanashi, Kamiina-gun, 1700m (KYO); Mt. Senjo (KYO); Kashio to Sampukupass, Shimoina-gun, serpentine (KYO); *Mt. Jizodake, Kamiina-gun, 2300m (KYO); Mt. Matsumine to Kashiwagi, Kamiina-gun, serpentine (KYO); *Mt. Shiraiwa, Kamiina-gun, 1800m (KYO); *Makuiwa and *Shiraiwa, Todai, Kamiina-gun (KYO); *Tenshuiwa and *Tsubameiwa, upper Aoki river, Shimoina-gun, 1600m (KYO); Shirahoneonsen, Minamiazumi-gun (KYO). Pref. Yamanashi: Mt. Kinpuzan to Matsutomi, Kitakoma-gun, 2200m (KYO). Pref. Toyama: *Mt. Higashikanetsuri, Kurobe, 1000m (KYO); Mt. Shirouma (KYO). Pref. Nara: *near Dorogawa, Tenkawa-mura, Yoshinogun, 1100m (KYO). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (KYO). Pref. Ehime: Mt. Higashiakaishi, serpentine (KYO). Pref. Kochi: *Mt. Ishidate (KYO).

Distr. Hokkaido, Honshu and Shikoku. East Siberia, Korea and North China (incl. Manchuria).

Compared with its related species, *G. dryopteris* (L.) NEWMANN which is widely distributed in the north hemisphere and also in Japan, this is distinguishable in having minute glandular hairs on stipes and rachis and triangular laminae. *G. dryopteris* is lacking in glandular hairs on any parts of plant, its lowest pinnae being large enough with the result that the blade is almost quinquangular in shape. One more related and exotic fern, *G. robertianum*, is distinguishable from the present fern by its denser glandular hairs and its narrower and more finely dissected pinnules.

As noted above, *G. jessoense* is almost always restricted to the limestone fields, otherwise to the serpentine. *G. robertianum* is also characteristic of the limestone districts in Europe and in North America¹³ (vide Chapter III, PART I, p. 16), while *G. dryopteris* seems not to be of such peculiarity at least in Japan.

Hypodematium fauriei (KODAMA) TAGAWA, Journ. Jap. Bot. 27:320 (1952) & Col. Ill. Jap. Pter. 219 (1959); SHIMIZU, Acta Phytotax. Geobot. 18:128 (1960). — *Dryopteris fauriei* KODAMA in MATSUM., Ic. Pl. Koisik. 2:11, pl. 90 (1914). — *H. crenatum* (non KUHN), auct. jap.

Remarkable with shining brown paleae at the base of stipes and on rhizomes, being 1~2.5cm long and 1~3mm broad. Fronds extending to 50cm long, bi- or tripinnate, ultimate pinnules pinnatilobed, covered with minute acute hairs on both sides.

Loc. HONSHU. Pref. Tochigi: *Izurusan, Tochigi-shi (KYO). Pref. Gunma: *Kosaka-

13) BROWN, M. (1938) Index to North American ferns 136.

TRYON, R. M. (1954) Fern and fern allies Minnesota 96.

mura, Kanra-gun (KYO); *near Yotsumata, Nanmoku-mura, Kanra-gun (TNS); Mt. Myogi, on conglomerate—type loc. (KYO). Pref. Saitama: *Mt. Buko (KYO). Pref. Tokyo: *Nippara, Nishitama-gun (KYO). SHIKOKU. Pref. Kochi: *Nishiyama, Ogawamura, Takaoka-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (KYO). Pref. Miyazaki: *Mt. Togawa, Nishiusuki-gun (KYO). Pref. Kumamoto: *Takenokawa, Itsuki-mura, Kuma-gun (KYO); *Kozuru, Itsuki-mura, Kuma-gun (KYO).

Distr. Honshu, Shikoku and Kyushu.

This species of *Hypodematum* is characterized by the presence of acute hairs and the absence of glandular hairs on plant. In this respect, it is most affined to the south Asiatic *H. crenatum* KUHN. This is separable from that in denser hairiness, more closely placed pinnae and pinnules, and a little larger indusia.

Geographically *H. fauriei* occurs rarely but almost always on dry cliffs of limestone. The record from Mt. Myogi seems to be only one exceptional case, where it grows on conglomerate but not on limestone. On the other hand, *H. crenatum*, though I could not see it on siliceous rocks in Hualien Pref. of Taiwan, is found also in the prefectures of Nantow, Kaohsiung and Taitung, where it is not always confined to limestone cliffs. Its range extends from south China through north India to Arabia and north Africa.

H. glanduloso-pilosum (TAGAWA) OHWI, Bull. Nat. Sci. Mus. 3:98 (1956). — *H. crenatum* KUHN f. *glanduloso-pilosum* TAGAWA, Journ. Jap. Bot. 27:321 (1952) & Col. Ill. Jap. Pter. 219 (1959).

Basal paleae 1~1.5cm long. Fronds provided with both minute acute hairs and glandular ones; nerves impressed on upper surface; ultimate pinnules so close as to be more or less overlapping.

Loc. HONSHU. Pref. Okayama: *Ishiga to Ikura, Niimi-shi (KYO); *Taniai, Niimi-shi (SHIN); *Iwayadani, Fuka-mura, Kawakami-gun (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun—type loc. (KYO). Pref. Yamaguchi: *Mizuta to Hosono in Akiyoshidai (SHIN); *Shuhodo, Shuho-cho, Mine-gun (KYO). SHIKOKU. Pref. Ehime: *Mimido, Mikawa-mura, Kamiukena-gun (KYO). Pref. Kochi: *Ryugado, east of Kochi, Kami-gun (SHIN); *Mt. Yokogura, Takaoka-gun (KYO).

Distr. West Honshu and Shikoku. South Korea.

Compared with the previous species, this fern is discriminated by the presence of glandular hairs on the fronds and the densely placed and impressinerved pinnules. In these respects, this fern resembles *H. fordii* (BAKER) CHING known from Isl. Okinawa (Liukiu) and Kwangtung. But, it has only glandular hairs on the blades.

Geographically all the records of the present fern noted above owe to crevices in sunny limestone cliffs. *H. fordii* is also known from the limestone cliff at Ishiyama of Hedo in Kunigami-mura in Okinawa Island.

Polystichum deltodon (BAKER) DIELS in ENGL. et PRANTL, Nat. Pfl.-fam. 1(4) : 191 (1899) TAGAWA, Acta Phytotax. Geobot. 8:26 (1939) & Col. Ill. Jap. Pter. 247 (1959); SHIMIZU, Acta Phytotax. Geobot. 18:163 (1960). — *Aspidium deltodon* BAKER, Gard. Chron. n. s. 14:494 (1880). — *A. tosaense* MAKINO, Bot. Mag. Tokyo 13:61 (1899). — *P. tosaense* (MAKINO) MAKINO, Bot. Mag. Tokyo 23:144 (1909).

Fronds narrowly lanceolate, once pinnate, 15~40cm long, 2~2.5cm broad,

chartaceous, not proliferous; pinnae 15~30-jugate, acutely serrated along upper margin. Sori rather marginal, terminal or nearly so on veinlets.

Loc. HONSHU. Pref. Yamaguchi: *Irimi, Oomine, Mine-shi (KYO); *Nakaodo and *Shuhodo, Shuho-cho, Mine-gun (KYO); *Kuzugaana and *Ohkubonokomoriana, Ohta, Mito-cho, Mine-gun (KYO). SHIKOKU. Pref. Kochi: *Hirose, Tosayama-mura, Tosa-gun (KYO); *Takeyashiki, Monobe-mura, Kami-gun (TNS); *Togano-mura, Takaoka-gun—type loc. of *P. tosaense* (TNS); *Karatani, Togano-mura, Takaoka-gun (TI); *Nanokawa-mura, Agawa-gun (TI). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (KYO). Pref. Kumamoto: *Oose and *Iwato, Kuma-mura, Kuma-gun (KYO); *Yaritaoshi, Kuma-mura, Kuma-gun (TI); *Sakaime, Kuma-mura, Kuma-gun (KYO); *Kozuru, Itsuki-mura, Kuma-gun (KYO); *Shiroishi-shonyudo, Oono-mura, Ashikita-gun (KYO); *Yoshio-mura, Ashikita-gun, (KYO).

Distr. West Honshu, Shikoku and Kyushu. China (Szechuan, Yunnan, Huhpei and Kwangsi).

As reported by YAMANAKA¹⁴ and by me (l. c. 1960), this fern is completely restricted to limestone crevices rather in shady places such as at the mouth of the limestone cave or at the foot of the cliff. *P. pseudodeltodon* TAGAWA (= *P. deltodon* var. *pseudodeltodon*) from Taiwan, which is most resembling the present fern and differs from it merely in small size and depressed obsolete teeth of the pinnae, has not so strong connection with limestone as it.

Among the members of *Polystichum* of Japan, *P. craspedosorum* (MAXIM.) DIELS can be mentioned as one more characteristic species of the limestone field, growing on humid or shady surfaces of limestone usually.

Pteris angustipinna TAGAWA, Acta Phytotax. Geobot. 4: 203 (1935).

Fertile fronds with (3 or) 5 linear pinnae 2~4mm broad; terminal pinnae 10~27cm long, upper lateral pinnae 15~20cm and lower ones 10~15cm long often bipartite. Sterile fronds with 3 or often 5 linear pinnae usually 2~3mm broad, provided with depressed acute teeth on margin; terminal pinnae 10~17 cm long and lateral ones 5~10 cm long.

Loc. TAIWAN. Pref. Nantow: *Hattukwan to Tompo—type loc. (KYO).

Distr. Known only from the type locality.

This fern is characterized by the very narrow pinnae of the fronds. TAGAWA¹⁵ states that it comes from the limestone cliff. The most related species, *P. yamatensis* (TAGAWA) TAGAWA (= *P. angustipinna* var. *yamatensis* TAGAWA), is also inhabiting the limestone cliff as mentioned later.

P. deltodon BAKER, Journ. Bot. 26:226 (1888); TAGAWA, Acta Phytotax. Geobot. 4:205 (1935), excl. pl. ex Liukiu & 14:45 (1950) & Journ. Jap. Bot. 36: 207 (1961).

Fronds with usually 3 often 5 pinnae 1~3cm broad; terminal pinnae 3~10 cm long; lateral ones shorter than half length of them, with patent deltoid teeth on margin.

Loc. KYUSHU. Pref. Kumamoto: *Amango, Itsuki-mura, Kuma-gun, 350m (KYO); *Oose, Kuma-mura, Kuma-gun (KYO); *upper course of the river Mae-gawa, Yamae-

14) YAMANAKA, T. (1956) Acta Phytotax. Geobot. 16:95.

15) TAGAWA, M. (1935) Ibid. 4:206.

mura, Kuma-gun (KYO); *Iwato, Kuma-mura, Kuma-gun (SHIN); *Yaritaoshi limestone cave, Kuma-mura, Kuma-gun (KYO); *Seishokonoiwa, Oono-mura, Ashikita-gun (SHIN). TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000m (SHIN); *ibid. 1000~1800m (KYO); *Sakahen to Kirai (KYO); around Panpien, siliceous rock (KYO); Totokun to Tosato, Tamazato-gun (KYO). Pref. Taitung: *near Kakayo, Kwanzan-gun (KYO).
Distr. Kyushu and Taiwan. China (Yunnan, Kweichow, Szechuan and Kwang-tung).

The most important characters for this taxon are small number of the pinnae and distinct deltoid serration. As TAGAWA (l. c. 1961) pointed out, the present fern is strongly connected with limestone both in Kyushu and in Taiwan. Usually it is inhabiting limestone in shady places.

P. yamatensis (TAGAWA) TAGAWA, Journ. Jap. Bot. 30:280 (1955) & Gol. III. Jap. Pter. 252 (1959).—*P. angustipinna* TAGAWA var. *yamatensis* TAGAWA, Acta Phytotax. Geobot. 4:204 (1935).

Fertile fronds extending to 40cm long with linear pinnae 2~3mm broad; lateral pinnae 1~3-jugate; terminal ones longer than them, extending to 25cm. Pinnae of sterile fronds a little wider than the fertile, irregularly serrated.

Loc. HONSHU. Pref. Nara: *Kashiwagi, Kawakami-mura, Yoshino-gun—type loc. (KYO).

Distr. Known only from the type locality.

In the respect that this fern has the linear pinnae, it is most affined to *P. angustipinna* from Taiwan. The distinction between them is in serration of the pinnae. The pinnae of *P. yamatensis* are provided with irregular and not depressed teeth, while those of *P. angustipinna* have regular and depressedly incurved teeth. TAGAWA¹⁵ pointed out that the former species came from the limestone cliffs around Kashiwagi in Nara Pref. No other localities of it are so far reported.

Among the other members of *Pteris*, *P. cretica* L. and *P. multifida* POIR. are usually but not characteristically found in limestone crevices at sunny dried places in Japan. *P. vittata* is one of the most frequent species in the limestone field in Taiwan.

Struthiopteris eburnea (CHRIST) CHING var. *obtusa* (TAGAWA) TAGAWA, Acta Phytotax. Geobot. 14:192 (1952). — *Spicantopsis eburnea* (CHRIST) TAGAWA var. *obtusa* TAGAWA, Acta Phytotax. Geobot. 9:88 (1940).

Sterile fronds narrowly lanceolate, 10~20cm long, 1~2cm broad, with stipes 2~5cm long, pectinate-pinnatisect; pinnae thick in texture, oblong, 3~5 mm broad, obtuse or round at the apex, the margin entire and strongly reflexed. Fertile fronds nearly equal to the sterile in length, but the pinnae-remote, linear-oblong, 3mm wide.

Loc. TAIWAN. Pref. Hualien: *Tienchang cliff—type loc. (KYO).

Distr. Known only from the type locality

Compared with var. *eburnea* from south China, this variety is characterized by the pinnae obtuse or round at the apex. TAGAWA¹⁶ mentions that this fern occurs on a limestone precipice, Tienchang cliff, and I have also found

16) TAGAWA, M. (1940) Acta Phytotax. Geobot. 9:89 & 95.

it at the same station.

Woodsia glabella R. BR. ex RICHARDS. in FRANKLIN, Narr. Journ. App. 754 (1823); TAGAWA, Acta Phytotax. Geobot. 5:253 (1937) & 6:255 (1937) & Col. III. Jap. Pter. 261 (1959). — *W. yazawae* MAKINO, Bot. Mag. Tokyo 18:132 (1904).

Fronde 2~15cm long, 0.5~2cm broad, bipinnate, glabrous; stipes 0.5~4cm long, articulated at middle, with entire scales at the base. Indusia fimbriate.

Loc. HONSHU. Pref. Saitama: *Mt. Akasawa, Chichibu-gun (SHIN); *Unkai-shonyudo near Jumoji-pass, Chichibu-gun (TNS). Pref. Nagano: *Jumoji-pass to Mt. Mikuni, Minamisaku-gun (SHIN); Mt. Yatsugadake (KYO); *Mt. Shiraiwa, Kamiina-gun (KYO); *Makuiwa, Todai, Kamiina-gun (KYO); *Mt. Jizodake, Kamiina-gun (KYO); *Tsubameiwa and *Tenshuiwa, Upper Aoki river, Shimoina-gun (KYO). Pref. Yamana-shi: Mt. Yokogawa (KYO); Mt. Kitadake (KYO).

Distr. Hokkaido and Honshu. Kamtchatka, Saghalien, north Korea, China (Manchuria and Kansu), middle and north Europe and northern part of North America.

This is a small tender fern characterized by the glabrous fronds, nearly entire paleae and fimbriate indusia. It is worth notice that this fern is almost always found on limestone in middle Honshu otherwise in the alpine zone.

W. hancockii BAKER, Ann. Bot. 5:196 (1891); TAGAWA, Acta Phytotax. Geobot. 5:252 (1936) & 6:256 (1937) & Col. III. Jap. Pter. 261 (1959). — *W. tsurugisanensis* MAKINO, Bot. Mag. Tokyo 28:177 (1914).

Fronde 5~15cm long, 1~1.5cm broad, bipinnate, glabrous; stipes 1.5~3 cm long, articulated on the middle part, having finely incised brown scales at the base. Indusia 5~6-lobed.

Loc. SHIKOKU. Pref. Tokushima: *Mt. Tsurugi—type loc. of *W. tsurugisanensis* (KYO).

Distr. Shikoku. North Korea and China (Hopei, Shansi and Manchuria).

This fern resembles the previous species very much. The distinction between them is recognizable merely in the form of scales and indusia. In the present species, scales are finely incised and indusia are irregularly 5~6-lobed. Geographically Mt. Tsurugi in Shikoku is the sole locality for it in Japan. YAMANAKA¹⁷ is of opinion that this is a relic on limestone cliffs there.

GYMNOSPERMAE

Juniperus formosana HAYATA, Fl. Mont. Formos. 209, t. 38 (1908) & Ic. Pl. Formos. 7:39 (1918); KANEH., Formos. Tr. ed. rev. 60, f. 21 (1936); LI, Taiwania 1 (Nos. 2-4): 307 (1950); LI & KENG, Taiwania No. 5, 79 (1954). — *J. formosana* var. *concolor* HAYATA, l. c. f. 25 (1918); KANEH., l. c. (1936); LI, l. c. (1950); LI & KENG, l. c. (1954).

An erect dioecious tree, 1~5m high, much ramose. Leaves 3-verticillate, linear, 5~23mm long, 1~2mm broad, spinulate at the apex, glaucous or greenish beneath. Cones berry-like, globose, 7~10mm in diameter.

Loc. TAIWAN. Pref. Miaoli: Mt. Tsugitaka (TI). Pref. Chiai: Mt. Hsinkao-shan, 8100 ped. (TI); ibid. 13000 ped. (TI); Tozan, Nitak (TI); Seizan (TI); Tataka to Paiyung-

17) YAMANAKA, T. (1954) Acta Phytotax. Geobot. 15:155.

shanchuang, 3000m (SHIN). Pref. Pingtung: Mt. Daibu (TI). Pref. Hualien: Shinjo to Batakan (TI); *Panpien to Chilai (KYO); *Tienchang cliff (KYO); *Mt. Chingshui, 1400~2100m (SHIN); *ibid. 1800~2400m (TAI); *Chingshui to Chongde (SHIN); Busegan to Seisui, B. HAYATA et S. SASAKI s. n. May 2, 1917, two sheets—type of var. *concolor* (TI). No special data indicated—type (TI).

Distr. Taiwan.

According to the interpretations of HAYATA (l. c. 1918), KANEHIRA (l. c. 1936), LI (l. c. 1950) and LI and KENG (l. c. 1954), var. *concolor* is characterized by the *concolor* leaves being 2cm long, the broad stomatic bands and the large cones 10~12mm in diameter. The examination of the type specimens of var. *concolor*, however, reveals that they are provided with the *concolor* leaves being 7~20mm long (mostly 10~15mm long) and the cones 7~9mm across. On the other hand, the trees referable to *J. formosana* are much abundantly growing wherever limestone occurs in Hualien Pref. The leaves of them are mostly 10~15mm long (sometimes extending to 23mm long), their undersurface being sometimes greenish and sometimes glaucous. The size of their mature cones is variable, ranging from 6mm to 9mm in diameter. Consequently my opinion is that var. *concolor* may be not a distinct form from var. *formosana*. *J. formosana* is an alpine plant of the central mountain region of Taiwan and at the same time a dominant species of the limestone field on the east side.

J. sargentii (HENRY) TAKEDA ex NAKAI, Bot. Mag. Tokyo 44:511 (1931); SHIMIZU, Acta Phytotax. Geobot. 17:143 (1958) & 18:128 (1960).—*J. chinensis* L. var. *sargentii* HENRY ex ELWES et HENRY, Trs. Gr. Brit. and Irel 6:1432 (1912).—*J. chinensis* var. *tsukusiensis* MASAM., Journ. Soc. Trop. Agr. 2:152 (1930) & 3:20 (1931); KANEH., Formos. Tr. ed. rev. 60 (1936); LI, Taiwania no. 5, 83 (1954).—*J. tsukusiensis* (MASAM.) MASAM., Mem. Fac. Sci. Agr. Taihoku Imp. Univ. 9 (Bot.) 4:131 (1934); LI, Taiwania 1 (Nos. 2-4):308 (1950).

A procumbent tree. Leaves scale-like, triangular, 1~2mm long, rarely needle-like 2~3mm long. Cones globose about 4mm across.

Loc. HOKKAIDO. Prov. Hidaka: Mt. Apoi (KYO). HONSHU. Pref. Aomori: *Mt. Kappata, Shimokita-gun (TI). Pref. Iwate: *Mt. Ureira, Shimohei-gun, 100m (KYO). Pref. Akita: Mt. Kenashi, Oga-shi, 400m (KYO). Pref. Yamagata: Mt. Gassan (KYO). Pref. Gunma: Mt. Shibutsu, serpentine (KYO). Pref. Tochigi: Mt. Maeshirane, Nikko (KYO). Pref. Nagano: *Mt. Shiraiwa, Kamiina-gun (KYO); Mt. Senjo (KYO); Kitashiojiri (KYO). Pref. Fukui: Mt. Mitsumine, Oono-gun (KYO). Pref. Nara: Oosako to Obadani, Yoshino-gun (KYO); Oosako, Yoshino-gun (KYO); Obadani to Shirakawawatashi, Yoshino-gun (KYO). Pref. Hyogo: Mt. Hyonosen (KYO). SHIKOKU. Pref. Kochi: *Mt. Ishidate (KYO). KYUSHU. Pref. Ooita: Mt. Kujyu (KYO). Pref. Miyazaki: *Mt. Shiraiwa, Higashiusuki-gun (KYO); Mt. Kirishima (KYO). Pref. Kumamoto: *Yamae-mura, Kuma-gun (KYO); *Mt. Noke-eboshi, Kuma-gun (KYO). Pref. Kagoshima: Mt. Kuromi, Mt. Miyanoura and Mt. Ishizuka, Isl. Yaku (KYO); Mt. Yuwan, Isl. Amami-Oshima (KYO). TAIWAN. Pref. Hualien: *Mt. Chingshui, 2200m—type loc. of var. *tsukusiensis* (TAIF); *Mt. Houshao-shan, Taroko Forest, 2000~2600m (TAI). Distr. Hokkaido, Honshu, Shikoku, Kyushu and Taiwan. Kuriles, Saghalien and Korea.

This tree is of very rare occurrence though widely distributed. Its decumbent or pendulous habit is the most important character for distinguishing

it from *J. chinensis*.

Besides the localities cited above, it is also occurring on limestone cliffs in Mt. Toyokuchi (Nagano Pref.), the upper district of the Aoki river (Nagano Pref.), Mt. Kurohime (Niigata Pref.), Mt. Myojo (Niigata Pref.) and the upper district of the Nariwa river (Okayama Pref.) (Vide Chapter III).

ANGIOSPERMAE

Dicotyledoneae

Salix kenoensis Koidz., Bot. Mag. Tokyo 27:265 (1913).

A chasmophytic shrub. Young branches reddish, shining. Young leaves nearly glabrous above, densely sericeo-tomentose beneath. Adult leaves coriaceous, 2~10cm long, 0.8~4cm broad, glabrous above, sericeo-pilose on nerves beneath, obtuse to round at the base, acute at the apex, mucronulate-serrate on the margin; petioles 0.5~1cm, long pilose. Rachis of catkin densely pilose; bracts long pilose; ovary glabrous, 3~4mm long, with distinct stipes and styles; stigma shallowly 4-lobes at the apex; filament 2, distinctly connate on the lower half.

Loc. HONSHU. Pref. Gumma: Mt. Soma in Mts. Haruna (TI); *Kanayama, Nakazatomura, Tano-gun (TI). Pref. Saitama: *Mt. Buko (KYO); *Mt. Mitsumine, Chichibu-gun (KYO); *Mt. Akasawa, Chichibu-gun (SHIN).

Distr. Honshu.

This willow is characterized by the coriaceous adult leaves and the connate styles. It is a common plant of the limestone fields in the Kanto district, especially in Chichibu Province (Saitama Pref.).

Betula chichibuensis HARA, Journ. Jap. Bot. 31:122, f. 1 (1956) & 32:60, f. (1957).

Young branches densely villose, eglandulous. Leaves ovate or oblong-ovate, 3~6cm long, 1.5~3.2cm broad, round or widely cuneate at the base, finely serrated on the margin; veins 14~18-paired, impressed above; petioles 4~7mm long, villose. Female catkins elliptical, 1.5~2.5cm long, erect; scales tripartite with slender lobes, villose and eglandulous outside. Nucules hardly alate.

Loc. HONSHU. Pref. Saitama: *Mt. Buko (KYO); *Mt. Maeshiraiwa in Mts. Mitsumine, 1550m—type loc. (TI); *Mt. Futago (TNS); *Mt. Akasawa, Chichibu-gun (SHIN). Distr. Honshu (Saitama Pref.).

This birch is characterized by many pairs of the lateral veins of the leaves, the short petioles, the small female catkins with tripartite and villose scales, the nearly wingless nucules and the absence of glandulous spots on any parts of plant.

It is completely restricted to limestone cliffs or rubbly lands in the above recorded localities.

Carpinus turczaninovii HANCE, Journ. Linn. Soc. Lond. Bot. 10:203 (1896); NAKAI, Bot. Mag. Tokyo 40:162 (1926); HATUS., Acta Phytotax. Geobot. 4:208 (1935).—*C. tanakaeana* MAKINO, Bot. Mag. Tokyo 28:32 (1914).—*C. coreana* NAKAI, l. c.

A shrub. Leaves ovate, 2.5~5cm long, 1.8~2.5cm broad, finely serrated along margin, round at the base; veins 10~13-paired; petioles 5~12mm long,

villose. Female catkins not pendulous, with 4~8 foliaceous scales.

Loc. HONSHU. Pref. Okayama: *Kawanose, Niimi-shi (KYO); *Tanagase, Niimi-shi (KYO); Tabara, Hirakawa-mura, Kawakami-gun (KYO); Mt. Tenjin, Kawakami-gun (KYO); *Hebiana-limestone cave, Shitsuki-gun (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO). SHIKOKU. Pref. Kagawa: Isl. Shodo (KYO); Yashima, Takamatsu-shi (TI). Pref. Ehime: *Oonogahara (KYO). Pref. Kochi: *Mt. Ishidate (KYO); *Befukyo, Makiyama-mura, Kami-gun (KYO); *Hirose, Tosayama-mura, Tosa-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (KYO); Hojo-mura, Tagawa-gun (KYO); Mt. Hikosan, Tagawa-gun, siliceous rock (TNS). Pref. Kumamoto: Kanayama, Yoshio-mura, Ashikita-gun (TNS); Yokoigi, Taura-mura, Ashikita-gun (TNS). Pref. Nagasaki: Mt. Shishiki, Isl. Hirato, andesite (KYO); Mt. Kurocho, Isl. Tsushima (KYO); *Mt. Shiratake, Isl. Tsushima (TI). Distr. West Honshu, Shikoku and Kyushu. Korea and North China.

This is only one shrubby species among the Japanese representatives of *Carpinus*, and remarkable with the small leaves and patent not pendulous female catkins. In west Japan, this hornbeam is one of the most important members at sunny rocky ridges of limestone, being very rarely found in non-calcareous fields. The records from Isl. Shodo, Yashima, Mt. Hikosan and Mt. Shishiki are the special cases in which it grows on siliceous rocks.

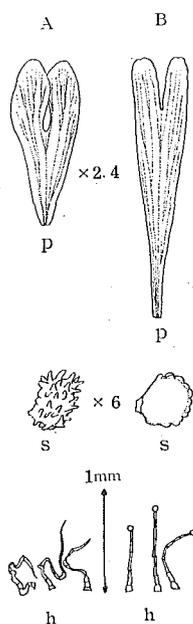


Fig. 2 Comparison of *Cerastium calcicola* (A) with *C. morrisonense* (B).

p. petal, s. seed, h. hairs of the stem

A: Tienchang cliff, T. SHIMIZU 11286 (KYO), B: Isosyntype, NAGASAWA 681 (KYO).

Cerastium calcicola OHWI, Fedde Repert. 36: 46 (1934). —*C. morrisonense* HAYATA var. *calcicola* (OHWI) OHWI, Acta Phytotax. Geobot. 12:113 (1943). (Fig. 2, A).

A small caespitose herb, 10cm or so tall. Stems slightly hairy in two rows on lower part but denser pubescent on the upper part. Leaves opposite, oblanceolate, 5~10mm long, 1.5~2.5mm broad, glabrous except slightly ciliated base. Sepals about 4mm long, hairy outside and also at margin. Hairs consisting of 7 to 10 cells, markedly crispate and not glandulous on any part of plant. Petals about 8mm long, 4mm broad, distinctly bifid, cuneate at the base. Capsules cylinder-like, 4~5mm long, 10~dentate. Seeds compressed, suborbicular, $2/3$ mm in diameter, minutely tuberculate; tubercles more prominent along marginal part than on both sides.

Loc. TAIWAN. Pref. Hualien: *near Kiraikei —type loc. (KYO); *Tienchang cliff (SHIN). Distr. Taiwan (Hualien Pref.).

This species is known only from open sunny places of the so-called Tienchang cliff and its vicinity. After originally described *C. calcicola*, OHWI reduced it the varietal rank of *C. morrisonense* without interpreting

the reason. Examining one of the isosyntypes of *C. morrisonense* (NAGASAWA 681 in KYO) and the materials of *C. calcicola* above cited, however, I arrived at the conclusion that these two plants might be desirably accepted as specifically different. *C. morrisonense* much resembles *C. calcicola* in appearance. Both the species are the small plant having nearly glabrous small leaves 0.5~2cm long. Upper part of stems, pedicels and sepals outside are pubescent in them. But it should be pointed out that hairs of *C. morrisonense* were straight and mostly glandular, while those of *C. calcicola* were apparently crispate and never glandular. The petals of the former are longer and narrower than those of the latter. Further, seeds of the former are glanular only on the margin, while those of the latter are conspicuously tuberculose all over. These distinctions will deserve, in my opinion, their respective specific ranks. *C. kaoi* T. SHIMIZU, sp. nov. — *C. kaorii*, nom. nud. in Chapter III (PART I) 93. (Fig. 3)

Herba perennis caespitosa, 15~30cm alta, caule basi ramoso ascendente erecto, inferne pilis retrorsis adpressis uniseriatim instructo, superine patentipiloso. Folia opposita obovata basi attenuata apice rotundata mucronulata usque ad 2cm longa 8mm lata supra verruculosa impressa uninervata margine longe pilosa, pilis 1~2mm longis 3~4-cellulatis, subtus verruculosa glabra. Inflorescentia laxa pauciflora verruculosa dense patente pilosa, bracteis ovatis margine scariosis 2.5~3mm longis 1mm latis distincte ciliatis extus verruculosus, pedicellis 1.2~2cm longis, sepalis 5 lanceolatis apice obtusis margine scariosis extus minute verrucosis basi pauce ciliatis, petalis 5 albis ca. 8mm longis 6mm latis quam calyce duplo longioribus, staminibus 10 ca. 5mm longis, filamentis glabris subulatis, antheris ca. 0.8mm longis ellipticis ochroleucis, stylis 5 2.5mm longis, capsulis cylindricis 7~8mm longis 10-dentatis, seminibus compressis bruneis suborbiculatis 1~1.2mm in diametro, faciebus ruguloso-tuberculatis, praecipue ad marginem tuberculis longioribus cristatis.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, ca. 1000m alt.; T. SHIMIZU 12600—type (KYO; isotype in MAK** & SHIN); *ibid. 1400~2100m, T. SHIMIZU & M. T. KAO 11812 & 11862 (SHIN).

Distr. Taiwan (Hualien Pref.).

This new species is characterized by the taller stems extending to 30cm high. The leaves and the flowers are largest as compared with those of the other representatives of the genus in Taiwan. Hairs on the stem never glandular. Hairs on the lower part are adpressed and sparsely arranged in one row, while those on the upper part are patent and numerous. Leaves covered with similar but longer 4~5-cellular straight hairs on the upper surface. Sepals about 5mm long nearly glabrous on both sides but slightly ciliated at the base. Petals obovate 8mm long and 6mm wide, distinctly bifid at the apex. Styles 5. Capsules 6~8mm long, 10-dentate at the apex. Seeds a little compressed and prominently tuberculate especially along the margin.

The present species is most affined to the previous one. However, this

** This sign indicates the Commemorable Herbarium of Dr. T. Makino at the Tokyo Municipal University in Tokyo, Japan.

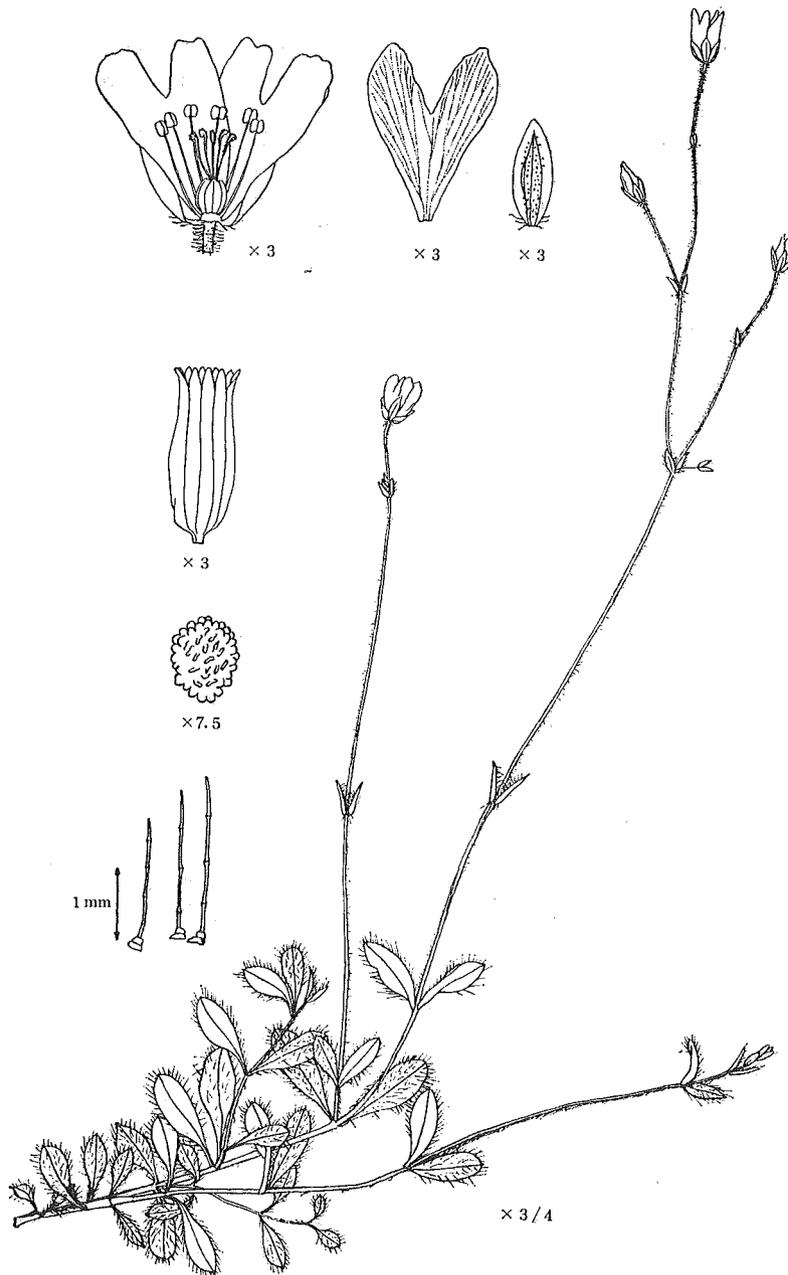


Fig.3 *Cerastium kaoi*, sp. nov.

can be easily distinguished from that by much smaller habit (stems 10cm or so tall, leaves 0.5~1cm long) and its crispate hairs on the whole plant. Moreover, the leaves of *C. calcicola* are glabrous except the base slightly ciliated.

The granules of its seeds are more conspicuous than those of *C. kanoi*.

The samples of this new species were all collected from limestone crevices at sunny ridges more than 1000m above sea level.

Clematis psilandra KITAG., Journ. Jap. Bot. 13:352 (1937). —*C. heracleifolia* DC. var. *taiwanica* T. SUZUKI et HOSOK., Trans. Nat. Hist. Soc. Formos. 23:96 (1933).

An erect subshrub, extending to 1.5m tall. Leaves hard chartaceous, ternate, long petiolate; terminal leaflets 3~5-lobate, lobes roughly dentate, round or truncate at the base, long petiolulate; lateral leaflets hardly petiolulate, nearly equal in shape to the terminal ones but of oblique form. Inflorescences paniculate, terminal and axillary. Sepals 4, densely sericeo-tomentose outside; stamens about 5mm long, quite glabrous; anthers oblong, about 2mm long; ovaries and achenes densely pilose.

Loc. TAIWAN. Pref. Kaohsiung: at the foot of Mt. Mutoo, between Hannoki and Adel—type loc. (TAI). Pref. Hualien: *Mt. Chingshui, 1800~2400m (KYO).

Distr. Taiwan.

This species is very near to *C. stans* SIEB. et ZUCC. and *C. heracleifolia* DC. But it is well distinguishable from them by its quite glabrous stamens. In this respect, my materials from Mt. Chingshui are well concordant with *C. psilandra*. The original description of HOSOKAWA, on the other hand, teaches us that the present species is to 40cm in height, provided with quite glabrous stems, petioles and petiolules and with sparsely pilose leaflets beneath. It is worth notice that the plants from Mt. Chingshui are very larger, extending to 1.5m high, their leaves are densely pilose on petioles, petiolules, veins beneath and on margin of the leaflet, and moreover their petioles are hardly 7cm long, being shorter than those of the type specimen. Therefore they should be relevantly given a varietal rank of the species, though I refrain from such a treatment because of poor materials at my hand.

Anyway I met with them on a mild rocky slope of limestone at the upper part of Mt. Chingshui and did not find elsewhere.

C. speciosa (MAKINO) MAKINO, Journ. Jap. Bot. 1:39 (1918); KITAG., Journ. Jap. Bot. 13:345 (1937); SHIMIZU, Acta Phytotax. Geobot. 18:121 (1960). —*C. heracleifolia* DC. var. *speciosa* MAKINO, Bot. Mag. Tokyo 6:50 & 170 (1892) & 11:332 (1897).

An erect subshrub. Leaves ternate, with petioles 4~10cm long, chartaceous in texture; terminal leaflets ovate often trilobed, 10~18cm long, 4~10cm wide, widely cuneate at the base, remotely and minutely serrated along the margin, with petiolules 3~5cm long; lateral leaflets ovate, a little smaller than the terminal ones, truncate to cordate at the lower base but cuneate at the upper base, with petiolules 5~15mm long. Inflorescences terminal, paniculate. Sepals 20~25mm long; stamens 6~8mm long, nearly glabrous; anthers 2~3mm long.

Loc. SHIKOKU. Pref. Kochi: Higashiyama-mura, Hata-gun (KYO); at the foot of Mt. Donomori (TI). KYUSHU. Pref. Ooita: Mado National Forest, Tano-mura, Oonogun (KYO). Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun (KYO); Mitake, Iwato-mura, Nishiusuki-gun (KYO); Aminose, Higashiusuki-gun (KYO); Kamiya to Segoshi, Noyamura, Nishimorokata-gun (KYO). Pref. Kumamoto: *Mt. Noke-eboshi, Kuma-gun (KYO); *Kozuru, Itsuki-mura, Kuma-gun (KYO); *Mt. Yatsuharu, Kuma-gun (KYO);

*Sakaime, Kuma-mura, Kuma-gun (KYO).

Distr. Shikoku and Kyushu.

Likewise in the previous species, this is also a member of Subsect. *Tubulosae* in Sect. *Viorna*. For its distinction from the nearest species, *A. stans* SIEB. et ZUCC., the characters such as remote minute serration of the leaflets, unsymmetrical bases of the lateral leaflets and large flowers being 20~25mm long should be mentioned.

Geographically this is rarely found in Shikoku and Kyushu. In my experience, it is always characteristically growing on shady gravelly lands of limestone. YAMANAKA¹⁸, on the other hand, pointed out that it came from non-calcareous habitats in Hata-gun of Kochi Pref. In regard to the other localities without asterisk, it is not clarified whether the plants came from the limestone fields or not.

C. stans SIEB. et ZUCC. var. **austro-japonensis** (OHWI) OHWI, Bull. Nat. Sci. Mus. Tokyo no. 33, 71 (1953); SHIMIZU, Acta Phytotax. Geobot. 18:121 (1960).
—*C. austro-japonensis* OHWI, Acta Phytotax. Geobot. 7:45 (1938).

An erect subshrub. Leaves ternate, chartaceous; terminal leaflets ovate, often trilobed, 3~5cm long, 2~4cm broad, cuneate at the base, grossly dentate, with petiolules 1~2cm long; lateral leaflets ovate, a little smaller than the terminal, cuneate and nearly symmetrical at the base, with petiolules 2~3mm long. Inflorescences terminal, paniculate. Sepals about 10mm long; stamens about 10mm long, pilose; anthers about 3mm long.

Loc. SHIKOKU. Pref. Tokushima: *Mt. Tenguzuka, Miyoshi-gun (SHIN). Pref. Ehime: *Oonogahara (SHIN); Mt. Sasagamine, Niihama-shi, siliceous rocks (SHIN). Pref. Kochi: *Mt. Torigata, Takaoka-gun (SHIN). KYUSHU. Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun—type loc. (KYO); *Mt. Shiraiwa, Higashiusuki-gun (KYO). Pref. Kumamoto: *Mt. Noke-eboshi, Kuma-gun (KYO); Mt. Naidaijin, Kamimashiki-gun (KYO).

Distr. Shikoku and Kyushu.

Compared with var. *stans*, this is characterized by the filaments longer than the anthers.

Besides the localities above noted, YAMANAKA¹⁸ reported that this plant occurred in Nanokawa and in Mt. Ishidate both in Kochi Pref. Ecologically this plant is almost always growing in limestone crevices or on gravelly lands except in the cases of Mt. Sasagamine (Shikoku) and Mt. Naidaijin (Kyushu). Var. *stans* is also a characteristic plant occurring in Hokkaido (Oshima Prov.) and Honshu, being most commonly found where limestone occurs.

C. williamsii A. GRAY ex PERRY, Jap. Exp. 2:306 (1856); SHIMIZU, Acta Phytotax. Geobot. 18:121 (1960).

A scandent subshrub. Leaves ternate; leaflets 2~3-lobate, with gross few teeth, shortly petiolulate. Flowers solitary at the base of the present year's branches, pendulous; pedicels 2~4cm long, with bracteoles on the upper part; sepals 4, white, tomentose outside, erect; stamens glabrous.

Loc. HONSHU. Pref. Saitama: Yokose-mura, Chichibu-gun (TNS). Pref. Kanagawa: Miura Peninsula (KYO); Jimmudera (TNS); Daisen (TNS). Pref. Shizuoka: Irozaki-cape

18) YAMANAKA, T. (1961) Acta Phytotax. Geobot. 19:21.

(TNS); Mt. Mashiro, Tagata-gun (TNS). Pref. Nara: *Kashiwagi, Kawakami-mura, Yoshino-gun (KYO); Obadani to Shirakawa-watashi, Yoshino-gun (KYO). Pref. Wakayama: *Ena to Oobiki, Yura-cho, Hidaka-gun (KYO); Yabata-mura, Arita-gun (KYO). SHIKOKU. Pref. Tokushima: Naka-mura, Oe-gun (TNS); Nishio-mura, Oe-gun (KYO). Pref. Kochi: *Hirose, Tosayama-mura, Tosa-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (KYO); *Hiraodai, south of Kokura (KYO). Pref. Kumamoto: *Isshochi, Kuma-mura, Kuma-gun (TNS); *Yoshino-mura, Ashikita-gun (KYO); *Oono-mura, Ashikita-gun (KYO).

Distr. Honshu, Shikoku and Kyushu.

This plant is characterized by the scandent habit, the axillary flowers at the present year's branches and the glabrous stamens, being only one Japanese member of Sect. *Cheiropsis*. Apart from its habitats in the prefectures of Kanagawa and Shizuoka, in the other parts of its area it is closely connected with limestone (YAMANAKA¹⁹ and SHIMIZU²⁰).

Thalictrum foetidum L. var. **iwatense** T. SHIMIZU, Acta Phytotax. Geobot. 17:149 (1958), sub subsp. *glabrescens*.

A perennial herb, 10~50cm tall. Stems glabrous sometimes dotted with minute glandulous hairs on the upper part. Leaves pinnately 3~5-ternate, with petioles 0.5~5cm long; leaflets ovate, trilobed into 3~5-dentate lobes, cordate at the base, 3~11mm rarely 2cm long, 3~10mm rarely to 3cm broad, impressinerved and somewhat farinose above, prominently nerved and glaucous beneath. Inflorescences much ramose, paniculate, loosely floriferous. Flowers long pedicellate. Petioles, leaflets on both sides, inflorescences and achenes all densely glanduliferous.

Loc. HONSHU. Pref. Iwate: *Okawame, Kuji-shi (KYO); *Akka, *Iwaizumi and *Takasuka, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Ureira, Shimohei-gun (KYO); *Mt. Kakeyama, Shimohei-gun (KYO).

Distr. Honshu (Iwate Pref.).

This plant is remarkable with dense coverage of the minute glandulous hairs on all parts of the plant except on stems. Var. *foetidum*, which is widely distributed in Manchuria, Mongolia, Siberia and Europe, is closely related to the present plant. In my opinion, it is distinguishable from that by less hairiness on the stems and not fetid nature of the plant. The two other allied plants from Hokkaido, viz. var. *apoiense* T. SHIMIZU and var. *glabrescens* TAKEDA, are different from this by their glabrous leaflets above specially.

Geographically the present plant is endemic in Iwate Pref., growing in crevices of sunny limestone bluffs around the localities cited above.

T. urbanii HAYATA var. **majus** T. SHIMIZU, var. nov. (Fig. 4)

Herba perennis, 20~40cm alta, glaberrima. Radix tuberosus. Caulis teres stramineus saepe petiolusque roseopurpurascens. Folia radicalia longipetiolata bi- vel triternata; folia caulina 1~2, breviter petiolata, ternata vel biternata. Inflorescentia corymbosa laxiflora 2~5-florifera. Flores albi interdum leviter purpurascens bifformes; magni 2~3cm in diametro, minimi vix

19) YAMANAKA, T. (1956) Acta Phytotax. Geobot. 16:95.

20) SHIMIZU, T. (1960) Ibid. 18:121.

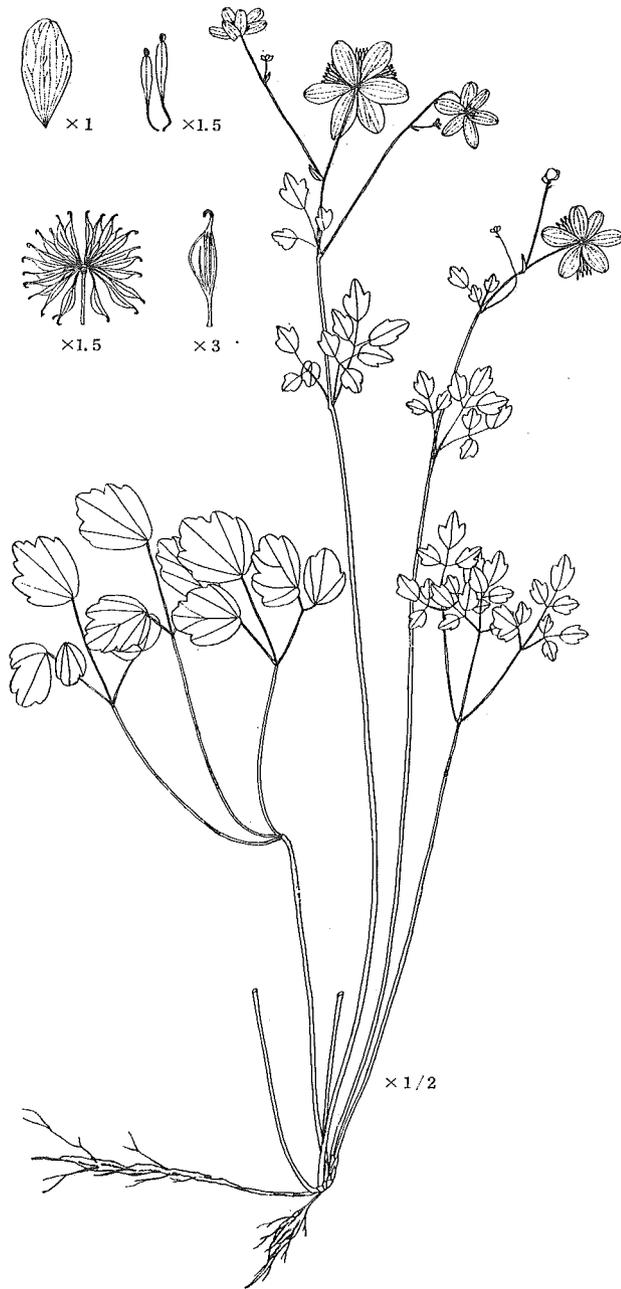


Fig. 4 *Thalictrum urbanii* var. *majus*, var. nov.

1cm in diametro. Sepala 6 (~9) elliptica. Stamina numerosa, filamentis spathulatis latioribus quam antheris.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 600~1400m alt., T. SHIMIZU & M. T. KAO 11776 (KYO); *ibid. 1800~2400m, T. SHIMIZU 12514 (SHIN); *ibid. 1400~2100m, T. SHIMIZU & M. T. KAO 11802 (KYO); *Tienchang cliff, 1600m alt., T. SHIMIZU 11271—type (KYO; isotype in SHIN); *ibid. T. SHIMIZU 11301 (KYO); *Panpien to Chilai, 1600m alt., T. SHIMIZU 11317 (KYO).

Distr. Taiwan (Hualien Pref.).

Compared with *T. urbanii*, this plant is characterized by the larger flowers. Both the plants, var. *urbanii* and var. *majus*, have two-formed flowers; one the terminal and large, and the other lateral and small. The sepals of the terminal flowers of var. *urbanii* are 2.5~6mm long and 1.5~3mm wide, whereas those of var. *majus* are 8~15mm long and 3~8mm wide. In the latter, the small and the large flowers are more strongly contrasted in size than in var. *urbanii*.

So far as size of the flower is concerned, var. *majus* resembles *T. rubescens* OHWI from the central mountain of Taiwan. Examining the type specimen of this species, however, I found that this was the plant bearing 4 sepals in a flower. The achenes of it are nearly sessile. Contrariwise the present new variety is provided with distinctly stipitate achenes and with usually 6-sepaliferous flowers.

Geographically it seems to be restricted to limestone cliffs or rubbly ridges in Hualien Pref. I never came across this plant in the siliceous fields.

Berberis chingshuiensis T. SHIMIZU, sp. nov. (Fig. 5)

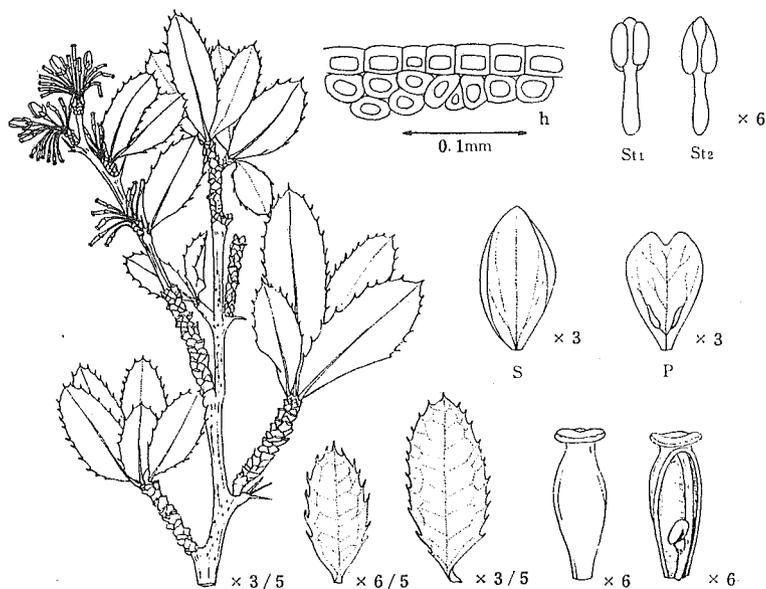


Fig. 5 *Berberis chingshuiensis*, sp. nov.

h. hypodermis, st₁. ventral view of stamen, st₂. dorsal view of stamen, s. sepal, p. petal

Frutex ramosissimus; ramulis glabris, juvenilibus nitidis leviter rufescentibus sulcatis vel striatis, vetustioribus cinerascentibus leviter sulcatis, spinis ternatis mediis lateralibusque 3~8mm longis. Folia plerumque 3~5-fasciculata coriacea glaberrima oblongo-elliptica 1.5~4cm longa 8~17mm lata, supra hypodermate instructa, margine utrimque 5~15- plerumque 9~13-spinuloso-serrata, spinulis ca. 1mm longis inter se 1~3mm distantibus ascendentibus, apice spinuloso-apiculata, basi late cuneata vix petiolata, costis supra impressis subtus distincte elevatis, nervis lateralibus utrimque 5~10 supra leviter elevatis subtus elevatis laxe reticulatis. Flores flavi ca. 5mm in diametro 8~15-fasciculati pedicellati, pedicellis glabris 4~8mm longis clavatis valide angulatis; sepalis extimis 3 deltoideo-ovatis ca. 2.5mm longis, interioribus late ellipticis navicularibus apice obtusis 3~4mm longis, intimis interioribus subaequiformibus sed extus valde concavis majoribus 5~6mm longis; petalis 6, obovatis apice distincte emarginatis 4~5mm longis, nectariis 2 elongato-ovalibus ca. 0.8mm longis praeditis; staminibus ca. 2.5mm longis connectivis leviter productis rotundatis instructis; ovariis cum stigmatibus disciformibus ca. 3mm longis, ovulis solitariis breviter stipitatis. Baccae vix maturae cylindricae nigrae, epruinosa, maturae ignotae.

Loc. TAIWAN. Pref. Hualien: *the summit of Mt. Chingshui, ca. 2400m alt., T. SHIMIZU 12520—type (KYO; isotype in SHIN & TAI).

Distr. Known only from the type locality.

Branches and branchlets glabrous, more or less sulcate. Spines ternate, weak, not foliaceous, 3~8mm long. Leaves evergreen, very thick, provided with hypodermis under the upper epidermis, not revolute along margin and with distinctly elevated nerves beneath. Flowers 8~15-fasciculate, bearing pedicels 4~8mm long. Styles indistinct. Ovules solitary, rarely geminate, shortly stalked. Fruits black, not pruinose. These characters of the present species inform us that it is a member of Sect. *Wallichianae* and further of Subsect. *Euwallichianae* SCHNEID. which is characterized by the solitary ovule and the thick leaves with hypodermis and distinctly reticulate veinlets. According to the monograph of AHRENDT²¹, eleven species and two hybrids are included in Subsect. *Euwallichianae*. Among those members *B. ferdinandicoburgii* SCHNEID. from Yunnan could be mentioned as most affined to *B. chingshuiensis*. Although I have no materials of the former, AHRENDT's interpretation affords some distinctions between these two species; *B. ferdinandicoburgii* has leaves with "scarcely elevated open reticulation" beneath, pedicels 1~2cm long and subsessile ovules, while *B. chingshuiensis* has leaves with distinctly elevated close reticulation beneath, pedicels 4~8mm long and shortly but distinctly stalked ovules.

There has been described no Taiwan member assigned for this subsection. Only two species of the Taiwan representatives characterized by the uniovulate ovary are so far reported, viz. *B. brevisepala* HAYATA (Subsect. *Leves*) and *B. hayatana* MIZUSHIMA (Subsect. *Subleves*). *B. chingshuiensis* is distinguishable from the former in its enervate leaves with fewer serrations, smaller petals,

21) AHRENDT, L. W. A. (1961) Journ. Linn. Soc. Bot. 57: 1-405.

shorter stamens and sessile ovules. Also it is easily separable from the latter basing upon its absence of hypodermis in the leaves, fewer spinulate serrations of them and only 1~2-flowered inflorescences.

I found this new barberry at the summit of Mt. Chingshui, growing in limestone crevices in sunny places.

Epimedium grandiflorum MORR. var. **higoense** T. SHIMIZU, Acta Phytotax. Geobot. 18:126 (1960).

A perennial herb with bold rhizomes. Leaves triternate, deciduous, long petiolate; leaflets ovate, 2.5~3cm long, 1.5~2cm wide, profoundly cordate at the base, gradually attenuate toward the obtuse or shortly acute apex, setose on the margin, thinly pubescent with erect minute hairs above, glabrous beneath when matured. Flowers several in botrys, white; petals with slender spurs.

Loc. KYUSHU. Pref. Kumamoto: Takamori, Aso-gun (KYO); Oguni, Aso-gun (KYO); *Watari, Watari-mura, Kuma-gun ——— type loc. (KYO); *Yamae-mura, Kuma-gun (KYO); *Mt. Noke-eboshi, Kuma-gun (KYO).

Distr. Kyushu (Kumamoto Pref.).

This variety is near to var. *grandiflorum*, being characterized by presence of erect minute hairs on leaflets above. In the southern part of Kumamoto Pref., it is fairly abundant and characteristically growing in limestone crevices so far as I experienced. According to YAMANAKA²², *E. macranthum* MORR. et DECNE. (= *E. grandiflorum*), which is distributed in the Kinki district of Honshu and Shikoku, is in Shikoku mostly occurring in the limestone field.

Draba igarashii S. WATANABE, Acta Phytotax. Geobot. 16:126 (1956).

A perennial herb, 18~24cm tall. Stems simple, covered with minute dichotomous hairs and also stellate hairs. Rosulate leaves numerous, oblanceolate, to 3cm long and 4~7mm broad, entire or 1~2-dentate, tomentose with minute stellate hairs on both sides. Cauline leaves 4~8, oblongly ovate, sessile, to 21mm long, 8mm broad. Pedicels densely pubescent with simple and dichotomous minute hairs. Petals 4.5~5mm long. Siliques lanceolate, 7~10mm long, 1.5~2.5mm wide, glabrous; styles 1~1.8mm long. Seeds ovate, not carunculate.

Loc. HOKKAIDO. Prov. Shiribeshi: *upper Tomarigawa, foot of Mt. Oohira, T. IGARASHI & S. WATANABE—type (Hb. Fac. Agr. Univ. Hokkaido).

Distr. Known only from the type locality.

I have seen no plants of this species. According to the original interpretation, this is closely related both to *D. nakaiana* HARA and to *D. sachalinensis* TRAUTV., being distinguishable from the former by shape and size of the rosulate leaves and from the latter by its smaller flowers, shorter styles and densely pubescent fruits.

It has been reported only from a limestone cliff at the foot of Mt. Oohira.

D. nipponica MAKINO var. **linearis** (SATAKE) KITAM., Acta Phytotax. Geobot. 20:202 (1962). — *D. linearis* SATAKE, Journ. Jap. Bot. 16:422, f. 1 (1940).

A glabrous stoloniferous herb, about 20cm tall. Rosulate leaves linear or linearly oblanceolate, acutely 1~2-dentate on each side, 2.5cm long, 2.5~7mm

22) YAMANAKA, T. (1953), Acta Phytotax. Geobot. 15:26.

wide; cauline leaves ovate-elliptical, somewhat amplexicaul, 1~1.5cm long, 5mm wide. Siliques oblong, 1~1.5cm long, patent. Seeds 1.5mm long.

Loc. HONSHU. Pref. Nagano: *Mt. Shiraiwa, Kamiina-gun (KYO); *Tenshigan in Mt. Toyokuchi, Shimoina-gun—type loc. (TNS); *Tsubameiwa, upper Aoki river, Shimoina-gun (KYO).

Distr. Honshu (Nagano Pref.).

This is a glabrous form of *D. nipponica*. I could find that growing on shady limestone cliffs with the plants of var. *nipponica* side by side in Mt. Toyokuchi and in the upper district of the Aoki river. The localities above cited are all known so far for the present variety.

Sisymbrium luteum (MAXIM.) O. E. SCHULZ in ENGL., Pfl.-reich 86:69 (1924); SHIMIZU, Acta Phytotax. Geobot. 17:146 (1958).—*Hesperis lutea* MAXIM., Mél. Biol. 9:12 (1873).

A perennial herb. Stems 60~120cm tall, puberulous. Leaves ovate, 10~16cm long, 3~8cm broad on middle part of stem, puberulous on both sides, repand and remotely serrated along margin, shortly petiolate. Flowers yellow. Siliques 10~15cm long, patent.

Loc. HONSHU. Pref. Aomori: *near Shiriya, Shimokita-gun (TI). Pref. Iwate: *Akka and *Ryusenkutsu, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Ureira, Shimohei-gun (KYO); Hiratsuto, Kawai-mura, Shimohei-gun (KYO); Mt. Hayachine (KYO). Pref. Nagano: Kakumakyo at the foot of Mt. Eboshi, Chiisagata-gun, siliceous field (SHIN); *Jumoji-pass to Azusashiraiwa, Minamisaku-gun (KYO); Mt. Kamanashi, Kamiina-gun (KYO); the middle district of the Azusa-gawa, Minamiazumi-gun (KYO). Pref. Yamanashi: Mt. Kantoku (TNS). Pref. Toyama: *Kanetsuri, Kurobe (KYO). Pref. Shiga: *Mt. Ibuki (KYO). Pref. Nara: *Mt. Gyojagaeri to Mt. Misen, Yoshino-gun (KYO). Pref. Okayama: Uyama, Niimi-shi (KYO). KYUSHU. Pref. Nagasaki: Tsutsu-mura, Shimoagata-gun, Isl. Tsushima (KYO); Koojima, Isl. Tsushima (TNS).

Distr. Honshu and Kyushu (Isl. Tsushima).

This is a perennial large plant with yellow flowers, occurring rarely and discontinuously in Japan. Most of its geographical records owe to the limestone field, where it grows on rather humid places with black deep soils. As to the geographical data of it should be referred also to HARA and KANAI²³.

Sedum drymarioides HANCE var. **toyamae** HARA, Journ. Jap. Bot. 3:352 (1960).

Flowering stems 5~20cm tall, glanduloso-pubescent, hapaxanthic. Leaves usually alternate, ovate or roundly ovate, 1~4cm long 8~22mm broad, fleshy, sparsely covered with glandular hairs. Inflorescences lax with 4~10 flowers, glanduloso-pubescent. Flowers with slender pedicels 4~12mm long; sepals slightly glanduloso-pilose.

Loc. KYUSHU. Pref. Nagasaki: *Nanatsugama, Sakai-mura, Nishisonogi-gun—type loc. (TI).

Distr. Known only from the type locality.

According to HARA (l. c.), this plant grows on limestone around Nanatsugama. It is different from var. *drymarioides* merely in more sparsely hairiness and longer pedicels. Var. *drymarioides* from south China and Taiwan is densely covered with glandular hairs on stems, petioles, leaf margins and

23) HARA, H. & KANAI, H. (1959) Distr. Maps Fl. Pl. Jap. Map. 130.

on sepals, and has 2~5mm long pedicels. In Taiwan it is questionable if it is growing on limestone.

S. tosaense MAKINO, Bot. Mag. Tokyo 6:52 (1892) & 15:35 (1901).

A small plant without rhizomes, 10cm or so tall, glabrous. Leaves usually alternate, flattened, roundly obovate, fleshy, 10~15mm long, 5~12mm wide, attenuate toward the base, distinctly notched at the apex. Inflorescences ramose, laxly with 3~10-flowers. Flowers without pedicels. Carpels patent.

Loc. SHIKOKU. Pref. Kochi: * Ryugado, Yamada-cho, Kami-gun (KYO); *Tosayama-mura, Tosa-gun (KYO); *Karatani, Togano-mura, Takaoka-gun—type loc. (KYO).

Distr. Shikoku (Kochi Pref.).

This is an endemic species of Shikoku characterized by the distinctly notched and alternately arranged leaves. Basing upon these characters, it is easily distinguishable from its most resemblant species, *S. makinoi* MAXIM., which is widely distributed in Honshu to Kyushu and very frequently met with on limestone but not exclusively.

Corylopsis matsudai KANEH. et SASAKI, Trans. Nat. Hist. Soc. Formos. 20:383 (1930); YAMAMOTO, Suppl. Ic. Pl. Formos. 2:25, f. 8 (1932); KANEH., Formos. Tr. ed. rev. 251, f. 196 (1936). (Fig. 6)

A deciduous low tree, with glabrous branches. Leaves chartaceous ovate-oblong or widely ovate, to 5cm long and 3cm broad, shallowly cordate at the base, aristate-dentate on the margin, glabrous above, villose on the nerves beneath; lateral veins 7~9-jugate; petioles 5~7mm long, densely hirsute. Inflorescences spicate, 1~4cm long, 5~10-floriferous, pendulous, glabrous; bracts ovate, smaller than 7mm long, acute at the apex, densely villose with silky hairs inside, glabrous outside, caducous. Flowers precocious, about 5mm in diameter, without pedicels; bracteoles ovate, smaller than 4mm long, densely tomentose inside, glabrous outside, caducous; calyx obconical, about 1.5mm across, glabrous; calyx lobes 5, ovate, 1~1.3mm long, irregularly dentate on the margin; petals 5, yellow, nearly orbicular, 3~4mm in width, unguicular, alternate to calyx lobes; stamens 5, nearly equal to petals in length, 3~4mm long, somewhat thickened on the lower half, glabrous, opposite to calyx lobes; staminodes 5, oblong, 0.5~0.7mm long, acutely bifid at the apex; styles 2, about 3mm long, a little shorter than stamens; ovaries perigynous, 2-locular.

Loc. TAIWAN. Pref. Hualien: Mt. Tencho, MATUDA 21866—type (TAIF.; *ibid.*, MATUDA s. n. (TAI); *Mt. Chingshui, T. NAKAMURA 3854 & 5296 (TAI); **ibid.* 600~1400m, T. SHIMIZU & M. T. KAO 11736 (KYO).

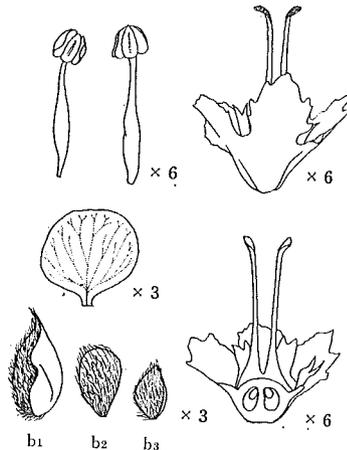


Fig. 6 *Corylopsis matsudai*

b₁-b₃, bracts

Material: Mt. Chingshui, T. SHIMIZU and M. T. KAO 11736 (KYO).

Distr. Taiwan (Hualien Pref.).

Although the flower of this tree had been unknown, we could find it blooming on a gravelly slope of limestone under the mixed deciduous forest in Mt. Chingshui. The above full description of the inflorescence and the flower is based upon T. SHIMIZU & M. T. KAO 11736 thoroughly. The glabrous 5~10-floriferous spikes and the small flowers about 5mm in diameter are the important characters on which the plant is distinguishable from the other Taiwan members and also from the Japanese members of the genus.

The note of NAKAMURA's specimens tells us that they came from the limestone field likewise in our materials. Those from Mt. Tencho must be also from the limestone field, because the mountain is wholly constructed with limestone. It may be relevant to regard this plant as a limestone plant. The other localities of the present plant are unknown up to the present.

On the other hand, *C. pauciflora* SIEB. et ZUCC., which is distributed in Honshu but not characteristic of the limestone field there, is known also from the above noted mountain, Mt. Tencho, which is its only one locality in Taiwan. Further, it is worth notice that one of the Japanese representatives of the genus, *C. spicata*, is confined within the serpentine district in Shikoku.

Eriobotrya japonica (THUNB.) LINDL., Trans. Linn. Soc. 13:102 (1821); SHIMIZU, Acta Phytotax. Geobot. 18:128 (1960). — *Mespilus japonica* THUNB., Fl. Jap. 206 (1784).

An evergreen arbor with yellow pulpous fruits. Leaves stipulate, oblanceolate or narrowly obovate, 15~25cm long, 3~5cm broad, densely tomentose with rusty hairs beneath, remotely serrated on the margin; lateral veins excurrent at the apex of teeth. Inflorescences terminal, paniculate, densely tomentose with rusty hairs. Ovaries hypogynous. Fruits fleshy, pomaceous pseudocarps.

Loc. HONSHU. Pref. Saitama: *Iwadono-kannon, Okumusashi (TNS). Pref. Nara: *Kashiwagi, Kawakami-mura, Yoshino-gun (KYO). Pref. Wakayama: *Oobiki to Minamori, Yura-cho, Hidaka-gun (KYO); *Ena to Oobiki, Yura-cho, Hidaka-gun (KYO); Tanabe-cho, Nishimuro-gun, escaped (TI). Pref. Okayama: *Hirose, Niimi-shi (KYO); *Tanagase, Niimi-shi (KYO). SHIKOKU. Pref. Kochi: *Hirose, Tosayama-mura, Tosa-gun (KYO). KYUSHU. Pref. Fukuoka: *Hiraodai, south of Kokura (SHIN). Pref. Kumamoto: *Yaritaoshinose, Kuma-mura, Kuma-gun (KYO). Pref. Nagasaki: Kario, Kamiagata-gun, Isl. Tsushima (TI).

Distr. Honshu, Shikoku and Kyushu. China and Burma.

This loquat is an important cultivated tree in Japan. The wild trees are also known almost exclusively on limestone bluffs or on gravelly slopes of limestone. Compared with the plant in cultivation, the wild plant bears smaller fruits and larger seeds.

Besides the localities above cited, I also found it in Akiyoshi (Yamaguchi Pref.) and Ryugado (Kochi Pref.) and in both cases on rocky places of limestone (Chapter III). Further KOSHIMIZU²⁴ detected it on limestone in Shiraya

24) KOSHIMIZU, T. (1954) Naraken-Sogobunkachosa-Hokokusho 164.

(Nara Pref.), and TERAO²⁵ also on limestone in Yose (Okayama Pref.) and in Yagawa (Hiroshima Pref.). Earlier MIYOSHI²⁶ reported the wild loquat from the limestone hills in Minamiamabe-gun (Oita Pref.), whereas he surprised at the discovery of it on siliceous habitats in Isl. Kanja (Fukui Pref.)²⁷ and Isl. Iwaizima (Yamaguchi Pref.).²⁸ The latter are the exact exceptional cases in which the wild loquat is growing outside of the limestone districts.

Filipendula tsuguwoi OHWI, Acta Phytotax. Geobot. 15:115 (1954); SHIMIZU, Journ. Fac. Tex. Sci. Technol. Shinshu Univ. no. 26, 19 (1961). — *F. multi-juga* (non MAXIM.) HARA ex HIRATA, Journ. Hattori Bot. Laborat. no. 13, 20 (1955).

A perennial herb, 40~70cm tall, glabrous but pubescent on the upper part. Radical leaves 1~2 in anthesis, 20~30cm long, pinnatisect; terminal leaflets 8~13cm long and so much broad, palmately 5~7-fid, profoundly cordate at the base; lateral leaflets 3~4-jugate, ovate, much smaller than the terminal, round or truncate at the base, sessile. Cauline leaves similar to the radical, but the upper the smaller and the simpler. Stipules 2, semicordate, 1~1.5cm long, herbaceous, more or less amplexicaul. Inflorescences pubescent with ascendent minute hairs. Flowers dioecious, with tetra- or pentamerous floral segments. Carpels 4~6, glabrous, sessile, semiovate, twisted. Achenes 3~4mm long, glabrous.

Loc. SHIKOKU. Pref. Kochi: *Mt. Ishidate—type loc. (TNS); Mt. Komochigongen, siliceous fields (TNS). Pref. Ehime: Mt. Ishizuchi, siliceous fields (TNS). KYUSHU. Pref. Miyazaki: *Mt. Shiraiwa, Higashiusuki-gun (KYO).

Distr. Shikoku and Kyushu.

This species is a dioecious perennial herb characterized by stipeless and semiovate twisted carpels among the genus. It grows on gravelly places of limestone or conglomerate in the high mountains over 1000m above sea level. Thanks to YAMANAKA²⁹, we can add two more records of it, viz. Mt. Torigata and Mt. Kanpu both in Kochi Pref., where it was proved to be growing on limestone in the former and on siliceous rock in the latter. These six mountains are all of its localities known up to the present.

Potentilla fruticosa L. var. **mandshurica** MAXIM., Mém. Biol. 9:158 (1878). — *P. fruticosa* var. *leucantha* MAKINO, Bot. Mag. Tokyo 24:32 (1910). — *P. fruticosa* var. *glabrata* MAKINO, Bot. Mag. Tokyo 15:98 (1901). — *Dasiophora fruticosa* (L.) RYDB. var. *leucantha* (MAKINO) NAKAI, Journ. Bot. 15:600 (1939). — *D. fruticosa* var. *veitchii* (WILSON) NAKAI, l. c. 601.

A scandent deciduous shrub. Leaves imparipinnate; petioles 0.5~1cm long, ascendently pilose together with costae; leaflets 3 or 5, narrowly obovate or elliptical, 1~2.5cm long, 3~10mm broad, apiculate at the apex, cuneate or attenuate at the base, without petiolules, pilose above, pilose all over or

25) TERAO, S. (1955) Educational St. pt. 2, 3:79, 80 & 83.

26) MIYOSHI, M. (1925) Tennenkinenbutsu-chosahokoku (Bot.) 2:151-154.

27) ——— (1926) Ibid. 4:73-75.

28) ——— (1922) Shisekimeisho-tennenkinenbutsu-chosahokoku no. 28, 12.

29) YAMANAKA, T. (1962) Acta Phytotax. Geobot. 20:64.

merely on nerves beneath. Flowers terminal, solitary, 2~2.5cm in diameter; pedicels 1~1.5cm, densely pilose; sepals ovate, 5~7mm long; petals obovate, white.

Loc. HONSHU. Pref. Saitama: *Mt. Akasawa, Chichibu-gun, 1800m (SHIN). Pref. Nagano: *Mt. Shiraiwa, Kamiina-gun (KYO); *Makuiwa and *Shiraiwa, Todai, Kamiina-gun (KYO); *Mt. Toyokuchi, Shimoina-gun (TNS); *Kogochizawa, Shimoina-gun (TNS); *Tsubameiwa, upper Aoki river, Shimoina-gun (TNS); Jigokudani, Oojika-mura, Shimoina-gun (TNS). Pref. Nara: Mt. Odaigahara (TNS). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (TNS). Pref. Kochi: *Mt. Ishidate (KYO).

Distr. Honshu and Shikoku. Korea, west Siberia and north China.

This is only one shrubby representative of the genus *Potentilla* in Japan. We can find it rarely creeping on rocky places rather in the shade, and especially in the limestone fields.

Because of much variability of hairiness on the leaflets, many a varietal name was proposed for the respective races³⁰. However, it is reasonable that the group of *P. fruticosa* is simply divided into two varieties, viz. var. *fruticosa* with golden flowers and var. *mandshurica* with white flowers. Var. *fruticosa* is also known from Japan, i. e. Hokkaido to middle Honshu. It grows in the alpine zone, being not found in the limestone districts.

***Pourthiaea chingshuiensis* T. SHIMIZU, sp. nov.**

Frutex decumbens ramosus. Folia chartacea obovato-lanceolata 10~40mm longa 4~12mm lata minute serrulata 3~5-fasciculata in breviramulis alternata in ramulis floriferibus, petiolis ca. 1mm longis purpureo-nigrescentibus pilosis. Flores terminales 1~3- raro 5-fasciculati, pedicellis gracilibus 3~18mm longis glabris vel sparse pilosis, calycibus 5-lobatis lobis triangularibus irregulariter serrulatis ca. 1.5mm longis intus pilosis, petalis albis glabris orbiculatis basi unguiculatis ca. 5mm longis, staminibus filamentis subulatis ca. 20 in numero, ovariis apice dense pilosis, stylis apice bifidis.

Loc. TAIWAN. Pref. Hualien: *around Mt. Chingshui, 600~1400m, T. SHIMIZU & M. T. KAO 11749—type (TAI; isotype in KYO, SHIN & TI); *ibid. 1400~2100m, T. SHIMIZU & M. T. KAO 11825 (KYO, SHIN, TAI & TI); *ibid. 800m, T. SHIMIZU 12403 (KYO & SHIN).

Distr. Taiwan (Hualien Pref.).

This is one of the abundant shrubs at sunny gravelly ridges of limestone in Mt. Chingshui. The materials we acquired are very near to *P. kankoensis* HATUS. or *P. parvifolia* E. PRITZEL. The former was delimited by its smallest leaves among the Taiwan members of the genus. Although I could not examine the type specimen, both the original description³¹ and KANEHIRA's interpretation³² of *P. kankoensis* denote that it is an erect tree about 3m tall with leaves 3~4cm long, calyces as well as inflorescences densely white-tomentose with caducous hairs. Our materials also bear similarly small leaves. But they are decumbent shrubs the flowers and pedicels of which are completely glabrous or nearly so even at young stage. Their inflorescence is less floriferous. Bark is greyish but not black unlike in *P. kankoensis*.

30) NAKAI, T. (1939) Journ. Jap. Bot. 15:595-601.

31) HATUSIMA, S. (1933) Enshurin Hokoku Kyusyu Imp. Univ. 3:99.

On the other hand, Li³³ was of opinion that *P. kankoensis* is conspecific with *P. parvifolia*. Unfortunately no materials of *P. parvifolia* came to my hand at all. Judging from the original description³⁴, the interpretation of SCHNEIDER³⁵ and of CARDOT³⁶, however, I arrived at the conclusion against Li's. *P. parvifolia* is characterized by the small caudately acuminate ovate leaves being 3~4cm long and 1.5~2cm broad and by the elongated subsolitary pedicels to be 4cm long. SCHNEIDER's explanation and figures supplement that its pedicels are hairy at earlier stage and its calyces glabrous. Consequently our materials are different from these explanations in their shorter pedicels 3~18mm long and slenderer leaves 4~12mm wide, though it still remains questionable if *P. parvifolia* is a decumbent shrub.

Prunus incisa THUNB. var. **bukosanensis** (HONDA) HARA, Journ. Jap. Bot. 28:230 (1953). — *P. nipponica* MATSUM. var. *bukosanensis* HONDA, Bot. Mag. Tokyo 51:56 (1937).

Near to var. *incisa*, but different from it in the larger obovate and nearly glabrous leaves, 5~8cm long and 3~5cm broad.

Loc. HONSHU. Pref. Saitama: *Mt. Buko—type loc. (TI).

Distr. Honshu (Saitama Pref.).

Beside the type locality, this variety is reported from Mt. Futago and Mt. Shiroishi both in Saitama Pref. and both from the limestone field³⁷.

Raphiolepis impressivena MASAM., Trans. Nat. Hist. Soc. Formos. 30:340, f. (1940).

An evergreen tree, 1~2m tall. Leaves coriaceous, alternate, lanceolate, 2.5~5cm long, 1~2cm wide, obtuse at the apex, attenuate toward the base, with 5~6 obtuse teeth on each side, somewhat reflexed on the margin, glabrous; petioles 5~10mm long but indistinct because of the decurrent blades; costae and nerves conspicuously impressed above. Inflorescences terminal, paniculate, 5~10-floriferous, 2~4cm long, densely tomentose with rusty hairs together with pedicels and calyces outside. Flowers about 1cm in diameter, bracteate; bracts linearly lanceolate, about 4mm long, caducous; pedicels 3~5 mm long; calyces obconical, about 3mm across; calyx lobes 5, narrowly lanceolate, 3~3.5mm long, 1mm wide, slightly serrated, ciliated and tomentose with rusty hairs on both sides; petals 5, white, obovate, 8~9mm long, 4~5mm wide, acute at the apex, ciliated and tomentose at the base inside; stamens about 20, subulate, connected at the base, unequal in length, 4~7mm long, glabrous; anthers about 1mm long; styles 8~9mm long, profoundly bifid; ovaries hypogynous, bilocular.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000~1200m, T. NAKAMURA 365 fr. — type (TAI); *ibid. 600~1400m, T. SHIMIZU & M. T. KAO 11758 (KYO); *ibid. 1000~1800 m, T. SHIMIZU 12455 (KYO); *ibid. 1150~1650m, T. SHIMIZU & M. T. KAO 11973 (KYO);

32) KANEHIRA, R. (1936) Formos. Tr. ed. rev. 267, f. 214.

33) LI, H. L. (1951) Lloydia 14:233.

34) PRITZEL, E. (1900) Engl. Jahrb. 29:389.

35) SCHNEIDER, C. K. (1906) Ill. Handb. Laubholz. 1:711.

36) CARDOT, M. J. (1920) Bull. Mus. Nat. Hist. 26:571.

37) MORIYA, T. (1958) Acta Phytotax. Geobot. 17:183.

**ibid.* 1400~2100m, T. SHIMIZU & M. T. KAO 11836 (KYO).

Distr. Known only from the above cited mountain.

This tree is one of the dominant species at sunny gravelly ridges of limestone in Mt. Chingshui. In appearance it resembles *R. indica* LINDL. var. *tashiroi* HAYATA. But, the conspicuously impressinerved leaves are peculiar to the present species. Because of no accounts on its floral parts, just I proposed their full description basing upon our own collections.

Rhodotypos scandens (THUNB.) MAKINO, Bot. Mag. Tokyo 27:126 (1913).—*Corchorus scandens* THUNB., Trans. Linn. Soc. 2:335 (1793).—*R. tetrapetal* MAKINO, Bot. Mag. Tokyo 17:13 (1903).—*R. kerrioides* SIEB. et ZUCC., Fl. Jap. 1:187, t. 199 I (1835).

A deciduous shrub. Leaves opposite, ovate, 4~6cm long, 2~4cm broad, more or less pilose beneath; petioles 2~3cm long. Flowers terminal, solitary, 3~4cm in diameter; pedicels 7~20mm long, pilose; sepals 4, narrowly ovate, 1~1.5cm long, acutely serrated, pilose outside; sepaloids 4, opposite to the sepals, linearly lanceolate, 4~8mm long; petals 4, white, orbicular; stamens numerous, much shorter than petals; carpels 4. Achenes 4, shining black.

Loc. HONSHU. Pref. Hyogo: Mt. Hokke (TNS). Pref. Okayama: *Ishiga to Ikura, Niimi-shi (KYO); *Taniai, Niimi-shi (TI); *Kusama, Niimi-shi (TNS); Mt. Tenjin, Kawakami-gun (KYO).

Distr. West Honshu. Korea and China.

This is a cultivated shrub in Japan. The tetramerous floral parts with sepaloids are peculiar to this species. The limestone bluffs in Okayama Pref. are important dwellings of the spontaneous plants of it.

Rosa luciae FRANCH. et ROCH. var. **rosea** H. L. LI, Lloydia 14:235 (1951).

Different from var. *luciae* in the rosy and smaller flowers 1.5cm in diameter.

Loc. TAIWAN. Pref. Hualien: *Seisui, on limestone, E. H. WILSON 11067—type (US).

Distr. Known only from the type locality.

I have seen no specimens referable to this variety. According to the original explanation, "this particular plant, growing on limestone cliffs of the steep coast of the east, differs from those of other places in the smaller pink flowers".

Spiraea nervosa FR. et SAV., Enum. Pl. Jap. 2:331 (1878); KITAM., Acta Phytotax. Geobot. 14:154 (1952); SHIMIZU, Acta Phytotax. Geobot. 18:164 (1960).—*S. nervosa* var. *kiusiana* (NAKAI) KOIDZ., Bot. Mag. Tokyo 43:404 (1929).—*S. kiusiana* NAKAI, Bot. Nag. Tokyo 29: (228) (1915).

A deciduous shrub, with young shoots being not angulate. Leaves ovate or widely ovate or rhomboid-elliptical, 2~4cm long, 8~20mm broad, grossly ducicato-dentate, sometimes trilobed at the apex, cuneate to round at the base, nearly glabrous above, more or less tomentose with brownish hairs beneath; nerves impressed above, prominent beneath; petioles 3~6mm long, pilose; stipules absent. Inflorescences terminal on short branches, umbel-like, tomentose. Flowers 6~8mm in diameter; pedicels 10~15mm long; calyx obconical, tomentose; calyx lobes triangular, patent, nearly glabrous on both sides; petals white; carpels 5, liberated; follicles glabrous or more or less ciliated on the ventral margin.

Loc. HONSHU. Pref. Shiga: *Mt. Ibuki (KYO); *Mt. Ryozen (KYO); Seritani-mura, Inukami-gun (KYO); Ootaki, Inukami-gun (KYO). Pref. Mie: *Mt. Fujiwara (KYO); Hatta-toge (KYO); *foot of Mt. Nonobori (KYO); Karakukyo (KYO); Mt. Ifukuda, Isshi-gun (KYO). Pref. Wakayama: Inari-mura, Tanabe-gun (KYO). Pref. Hyogo: Kakuraguchi in Mt. Hyonosen (KYO); Yagi, Takayanagi-mura, Yabu-gun (KYO); Sekinomiya-mura, Yabu-gun, serpentine (KYO); Kamakurakyo, Arima-gun (KYO). Pref. Yamaguchi: Chomonkyo (KYO). SHIKOKU. Pref. Kagawa: Ootaku-mura, Isl. Shodo (KYO). Pref. Ehime: Mt. Ishizuchi (KYO); Mt. Hanaga, Narutae-mura, Kitauwa-gun (KYO); Iwayadera, Kamiukena-gun (KYO); *Oonogahara (KYO). Pref. Kochi: *Mt. Torigata, Takaoka-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO); *Hirose, Tosayama-mura, Tosa-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun—type loc. of *S. hiusiana* (KYO). Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun (KYO); *Mt. Shiraiwa, Higashiusuki-gun (KYO); Mt. Amikake, Tawara-mura (KYO). Pref. Kumamoto: *Oono, Ashikita-gun (KYO); *Mt. Noke-boshi, Kuma-gun (KYO); Mt. Gongen, Amakusa-gun (KYO); *Sajiki, Ashikita-gun (KYO). Pref. Saga: Mt. Kokuzo (KYO); Hayase, Nokomi-mura, Fujitsu-gun (KYO); Ooshima-mura, Nishisonogi-gun (KYO); Isl. Ooshima (KYO); Isl. Hirato, andesite (KYO).

Distr. West Honshu, Shikoku and Kyushu.

The brown tomentose leaves beneath, the prominent reticulation beneath and the tomentose umbel-like inflorescence are the important characters for this species. Follicles are glabrous or ciliated only along the ventral margin.

It is very commonly predominant on sunny cliffs or rocky ridges of limestone in west Japan. But often it grows also on non-calcareous rocks.

Var. **latifolia** (NAKAI) KITAM., l. c. 154 (1952).—*S. yatabei* NAKAI var. *latifolia* NAKAI, l. c. (227) (1915).

Very near to var. *nervosa*, but different from it in having villose follicles all over.

Loc. HONSHU. Pref. Mie: *foot of Mt. Nonobori (KYO). Pref. Wakayama: Inari-mura, Nishimuro-gun (KYO). Pref. Oosaka: Settsu-yabakei (KYO); Minomo (KYO); Katsuedera National Forest, Oosaka (KYO). Pref. Hyogo: Kakuraguchi to Sotono, Yabu-gun (KYO); Takamiyama, Nishishikata-gun, Innan-gun (KYO); Mt. Seppiko (KYO); entrance to Mt. Hyonosen, Mikata-gun (KYO). Pref. Okayama: *Kanba-waterfall, Katsuyama-cho, Maniwa-gun (KYO); *Ikura, Niimi-shi (KYO); *Tabara, Hirakawa-mura, Kawakami-gun (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO); Sandankyo (KYO). Pref. Shimane: Dangyoikei, Ouchi-gun (KYO); Tachikue (KYO); Misen (KYO); Gongen, Onsen-mura, Nita-gun (KYO). SHIKOKU. Pref. Kagawa: Ootaku-mura, Isl. Shodo (KYO); Mt. Goken (KYO). Pref. Ehime: Iwatanidera (KYO). Pref. Kochi: *Hirose, Tosayama-mura, Tosa-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO). KYUSHU. Pref. Fukuoka: Kuroki, Yame-gun (KYO); Harada, Hirokawa-mura, Yame-gun (KYO). Pref. Ooita: Yabakei (KYO); Tsutami-mura, Shimoge-gun (KYO); Toyosaki-mura (KYO). Pref. Kumamoto: *Takenokawa, Itsuki-mura, Kuma-gun (KYO). Pref. Nagasaki: Mt. Kurokami (KYO); Shishiki, Kitamatsuura-gun (KYO).

Distr. West Honshu, Shikoku and Kyushu. China (Kwangtung and Changsu).

The distinction of this variety from the previous one is based on the villose follicles all over. Some plants have densely villose follicles, while the other have slightly villose ones. In some districts such as Tosayama, Mt. Yokogura (both in Kochi Pref.) and Itsuki-mura (Kumamoto Pref.), the both forms, i. e. var. *latifolia* and var. *nervosa*, are detectable and some indi-

viduals are often difficult to be decided to which they should be referred.

Anyway the present variety also very commonly predominates on sunny cliffs or rocky ridges of limestone in west Japan.

S. nipponica MAXIM., Bull. Acad. Sci. St. Pétersb. 31:40 (1886); KITAM., Acta Phytotax. Geobot. 14:152 (1952); SHIMIZU, Acta Phytotax. Geobot. 17:148 (1958).—*S. nipponica* f. *rotundifolia* MAKINO, Bot. Mag. Tokyo 20:28 (1906).—*S. nipponica* f. *oblanceolata* NAKAI, Bot. Mag. Tokyo 43:441 (1929).—*S. dissomorpha* KOIDZ., Acta Phytotax. Geobot. 5:123 (1936).

A deciduous shrub, with angulate young shoots. Leaves obovate or elliptical, 1~3cm long, 5~25mm broad, 0~7-dentate only at the apex, cuneate to round at the base, completely glabrous on both sides; petioles 1.5~5mm long, glabrous. Inflorescences terminal on short branches, corymbose to compoundly corymbose, glabrous. Flowers 6~7mm in diameter; pedicels 10~25mm long; calyces obconical, glabrous; calyx lobes triangular, erect, pilose with brownish hairs inside; petals white. Follicles villose especially on ventral margins.

Loc. HONSHU. Pref. Iwate: *Akka and *Iwaizumi, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Ureira, Shimohei-gun (KYO); Iwanebashi, serpentine (KYO); *Geibikei, Higashiiwai-gun—type loc. of *S. dissomorpha* (KYO). Pref. Yamagata: Mt. Gando, east of Yamagata (KYO); Yamadera, northeast of Yamagata (KYO); Mt. Omoshiroyama, northeast of Yamagata (TNS). Pref. Fukushima: Yagushi, Oono-mura, Ishiki-gun (KYO). Pref. Gunma: Oze (KYO); Mt. Shibutsu, serpentine (KYO). Pref. Tochigi: Nikko (TNS). Pref. Tokyo: *Nippara, Nishitama-gun (KYO). Pref. Saitama: *Mt. Buko (KYO); at the foot of Mt. Ryojin (KYO); *Mt. Akasawa, Chichibu-gun, 1800m (SHIN); Pref. Nagano: *Jumoji-pass to Mt. Mikuni, Minamisaku-gun, 1800~2100m (SHIN); *Mt. Kamanashi, Kamiina-gun (KYO); *Mt. Shiraiwa, Kamiina-gun (KYO); *Shiraiwa, Todai, Kamiina-gun (KYO); *Mt. Jizodake, Kamiina-gun (KYO); *Mt. Toyokuchi, Shimoina-gun (KYO); Kashio to Sampuku-pass, Shimoina-gun, serpentine (KYO); Shio-kawadani, Oojika-mura, Shimoina-gun (TNS). Pref. Yamanashi: Mt. Mitsutoge, siliceous rock (TNS). Pref. Shizuoka: Mt. Fuji (KYO). Pref. Aichi: *Mt. Ishimaki, east of Toyohashi (KYO). Pref. Niigata: *Mt. Myojo, Nishikubiki-gun (SHIN); *Mt. Kurohime, Nishikubiki-gun (KYO). Pref. Toyama: *Kanetsuri, Kurobe (KYO); Harinokipass to Taira, Nakashinkawa-gun, granite (KYO). Pref. Shiga: *Mt. Ibuki (KYO).
Distr. North and middle Honshu.

This is characterized by the completely glabrous ovate leaves with a few obtuse teeth only at the apex.

In north and middle Honshu, it is characteristically found on sunny cliffs or rubbly ridges of limestone, though sometimes found also on non-calcareous rocks as indicated above.

S. prunifolia SIEB. et ZUCC. var. **pseudoprunifolia** (HAYATA) H. L. LI, Lloydia 14:236 (1951); KITAM., Acta Phytotax. Geobot. 14:150 (1952).—*S. pseudoprunifolia* HAYATA ex NAKAI, Bot. Mag. Tokyo 29:75 (1915).—*S. prunifolia* (non SIEB. et ZUCC.) MATSUM. et HAYATA, Enum. Pl. Formos. 119, pl. 12 (1906).

A deciduous shrub, with angulate young shoots. Leaves elliptical, 0.5~2cm long, 3~12mm broad, entire or finely serrated on upper halves, cuneate at the base, round or obtuse at the apex, nearly glabrous above, tomentose or thinly pilose only on nerves beneath; petioles 1~3mm long, pilose. Leaves of floriferous branches apt to be smaller and entire. Inflorescences terminal on

short branches, fasciculate, 5~6-floriferous. Flowers 6~8mm in diameter; pedicels 3~15mm long, pilose to nearly glabrous. Calyces obconical, pilose to glabrous; calyx lobes ovate, pilose inside; petals white. Follicles ciliated on the ventral margin.

Loc. TAIWAN. Pref. Hualien: *Batakan to Tabito (KYO); *Lungchien to Panpien (KYO); Hahabi to Tahun, Tamazato-gun (KYO); Esira to Tahun, Tamazato-gun (KYO); near Karapao (KYO). Pref. Taitung: Momijidani to Seisui, Kwanzan-gun (KYO); near Kotobuki, Kwanzan-gun (KYO).

Distr. Taiwan. Central China.

This is the native form of the cultivated *S. prunifolia*, from which it differs in its simple flowers and shorter pedicels being 3~15mm long. In Taiwan I could meet with this plant on a sunny limestone cliff between Lungchien and Panpien for once. Likewise in the specimens "inter Batakan et Tabito" to which KITAMURA (l. c. 1952) referred, my materials are much less hairy on leaves beneath than the specimens from the other parts of Taiwan. Whether the other specimens cited above came from limestone cliffs or not is unknown.

S. tarokoensis HAYATA, Ic. Pl. Formos. 9:38 (1920); KITAM., Acta Phytotax. Geobot. 14:153 (1952).

A deciduous shrub, with pubescent angulate young shoots. Leaves ovate or elliptical, 1~3cm long, 6~17mm broad, sometimes shallowly trilobed, with several gross and obtuse teeth on the upper half, round or cuneate at the base, glaucous beneath, glabrous or nearly so above, pilose beneath especially on veins; petioles 1~4mm long, pilose. Inflorescences terminal, nearly umbel-like, stalked. Flowers 6~8mm in diameter; pedicels 5~10mm long, glabrous or slightly pilose; calyces obconical, glabrous; calyx lobes triangular, conspicuously pilose with reddish hairs inside, patent in anthesis; carpels 5, ciliated on the ventral margin.

Loc. TAIWAN. Pref. Hualien: *Naitaroko, Karenko—type loc. (TAIF); *Tabito to Karapao (KYO); *Tabito to Miharashi (KYO); *Chongde to Wenshan (KYO).

Distr. Taiwan (Hualien Pref.).

Pilose and glaucous undersurfaces of the leaves, much shortened racemes contracted to umbels and densely pilose sepals inside are the important characters for delimitation of this species. Geographically it is confined within the above noted localities around, and always growing on sunny limestone cliffs.

Astragalus membranaceus (FISCH.) BGE., Astrag. geront. 1:25 (1868); BOISS., Bull. Herb. Boiss. 6:664 (1898); SHIMIZU, Acta Phytotax. Geobot. 17:91 (1958). —*Phaca membranacea* FISCH. ex LINK, Enum. Pl. Hort. Berol. 2:252 (1822). —*A. membranaceus* var. *obtusus* MAKINO, Bot. Mag. Tokyo 20:124 (1906), p. —*A. yezoensis* MIYABE et TATEW., Trans. Sapporo Nat. Hist. Soc. 15:205 (1938).

A perennial herb, 15~50cm tall. Leaves oblong-ovate, pinnate; rachis white-pilose; leaflets 5~9-jugate, oblong-ovate, to 2.5cm long and 1cm broad, obtuse at the apex, round at the base, nearly glabrous above, white-pilose beneath, very shortly petiolulate; stipules linearly lanceolate, 5~10mm long.

Racemes terminal and axillary, long pedunculate, 5~10-floriferous, with black-pilose axes being 15~25mm long. Flowers yellowish white, 15~20mm long; pedicels 3~7mm long, black-pilose; calyces black-pilose, 5~7mm long; calyx lobes minutely triangular, 1mm long at best; ovaries minutely pilose. Fruits conspicuously swelling.

Loc. HOKKAIDO. Prov. Ishikari: Zenibako (KYO). Prov. Shiribeshi: Nagatoyo, Shimamaki-mura, Shimamaki-gun (KYO); *Mt. Oohira, Shimamaki-gun—type loc. of *A. yezoensis* (KYO). HONSHU. Pref. Iwate: *Akka, Iwaizumi-cho, Shimohei-gun (KYO). Distr. Hokkaido and northern Honshu. East Siberia, Manchuria and Korea.

The yellowish white flowers, pilose ovaries and much swelling fruits are the important characters of this species. The plants originally named *A. shinanensis* OHWI from the alpine zone of central Honshu is most related to it. As OHWI³⁸ and I³⁹ pointed out, it is different from that in longer axes of racemes, linear but not ovate stipules, smaller flowers, less hairiness of calyces, smaller and shorter calyx lobes and minute hairs of ovaries. In my opinion, however, it is more relevant to regard these two kinds of plant as conspecific, and to divide into two varieties, viz. var. *membranaceus* and var. *obtusus* MAKINO emend.

In Mt. Oohira⁴⁰ (Shiribeshi Prov.) and Akka³⁹ (Iwate Pref.), the present plant is growing on open rubbly places of limestone.

Lespedeza homoloba NAKAI var. **higoensis** T. SHIMIZU, var. nov. (Fig. 7)

Affinis var. *homolobae*, sed a qua differt: calycibus brevioriter 4-lobatis, lobis haud 1mm longis; petalis atropurpureis.

Loc. KYUSHU. Pref. Kumamoto: *Tenguwa, west of Itagi, Itsuki-mura, Kumagun, ca. 900m alt., T. SHIMIZU 5102 —type (KYO; isotype in SHIN).

Distr. Known only from the type locality.

This bush-clover was found growing with *L. buergeri* Miq. side by side at the rocky ridge of limestone somewhat shaded by the arborous layer.

The materials at my hand are provided with spirally arranged scales of the bud; roundly obovate and distinctly emarginate leaflets being mostly 1~2cm long; round calyx lobes never extending to 1mm long; not luxuriant inflorescences bearing 4~5 flowers at most; and blackish purple petals, especially vexillum and carinae. So far as the emarginate leaflets and the round calyx lobes are concerned, these

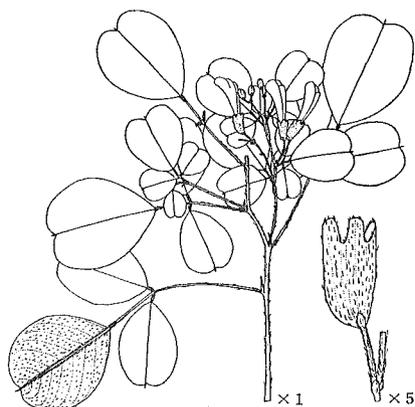


Fig. 7 *Lespedeza homoloba* var. *higoensis*, var. nov.

38) OHWI, J. (1936) Acta Phytotax. Geobot. 5:181 & 187.

39) SHIMIZU, T. (1958) Ibid. 17:90-91.

40) WATANABE, S. (1956) Ibid. 16:188.

samples represent the form of *L. rotundiloba* NAKAI, which is regarded as conspecific with *L. homoloba* by the current taxonomists. But, the shorter calyx lobes and blackish petals in them should be mentioned as distinct characters from this plant. On the other hand, the small inflorescences, the blackish petals and the shallowly lobed calyces of them remind us of *L. melanantha* NAKAI from south Korea. According to NAKAI's interpretation, however, this species is characterized by nearly glabrous leaflets beneath, pedicels and calyces, and moreover by the largest lateral petals. My materials of var. *higoensis*, contrariwise, have adpressed numerous minute hairs on leaflets beneath, on pedicels and on calyces. The petals of them are unlike in that. The characters such as persistency and length of hairs on each part of the bush-clover are considered as taxonomically significant according to the respective species, so that I prefer to accept no closer relationship of var. *higoensis* to *L. melanantha* than to var. *homoloba*.

Geranium robertianum L., Sp. Pl. ed. 1, 2:681 (1753); HAYATA, Fl. Mont. Formos. 64 (1908); HARA, Journ. Fac. Sci. Univ. Tokyo sect. 3, 6:81 (1952) & Enum. Spermat. Jap. 3:3 (1954).

A fetid annual herb, bearing crispate hairs on all parts and glandulous hairs on upper parts of stems, on pedicels and on sepals outside. Rosulate leaves nearly pentangular, 3~6cm broad, tripartite with lobes pinnate to bipinnatisect, long petiolate. Inflorescences terminal and axillary, long pedunculate, biflowered. Flowers pedicelulate, 8~12mm in diameter; styles pubescent, shallowly 5-fid; capsules glabrous.

Loc. HONSHU. Pref. Shiga: *Mt. Ibuki (KYO); *Mt. Ryozen (KYO); *Yosonjo to Kuregahata, Samegai-mura, Sakata-gun (KYO); *Gongendani, Taga-cho, Sakata-gun (KYO); *near Ochiai, 8km east of Hikone (KYO); Ojigahata, Inukami-gun (KYO). Pref. Mie: *Mt. Oike (KYO); Hatta-toge (TNS). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (KYO). Pref. Kochi: *Mt. Ishidate (Kochi U.). TAIWAN. Pref. Ilan: Shikikun to Pianan-anbu, Rato-gun (KYO); Pianan-anbu to Mt. Nankotaizan (KYO); Ugan to Pianan-anbu (TAI); Mt. Pinanshuzan (TAI). Pref. Hualien: *Mt. Chingshui, 1800~2100m (KYO); *Tabito to Karapao (KYO); *Noko-goe (KYO); *Nokogoe to Higashinoko (TAI); Totokun to Midori, Tamazato-gun (KYO); Sekigahara to Seraoka, Tamazato-gun (KYO); Tomasu to Eshira, Tamazato-gun (KYO). Pref. Nantow: the upper district of Taiko-kei, Tosei-gun (KYO); Shikayo-banchi (TAI). Pref. Taitung: Asahi to Izumo, Riroshicho (TAI). Pref. Kaohsiung: Kanzan-goe (KYO).

Distr. Honshu, Shikoku and Taiwan. Widely distributed in north Europe, North America and north Africa.

Somewhat fetid habit and finely dissected leaves are peculiar to this species among the Far Eastern representatives of the genus.

In Japan it is extremely local and isolated, being merely known from Mt. Ibuki, Mts. Suzuka (Honshu) and Mt. Tsurugi and Mt. Ishidate (Shikoku). And it is restricted to limestone gravelly places and crevices in limestone open or in the woods. In Taiwan I found it colonizing on a sunny rocky slope of limestone in Mt. Chingshui and not elsewhere around there. Deducing from the localities of it recorded above, however, it seems not to be connected so strongly with limestone fields in Taiwan as in Japan. On the other hand, this species is rather adventive and weedy in Europe and eastern North America

(cf. HARA, l. c. 1952). But it is worth notice that EKLUND regarded this as "Stark kalkhold" species (Chapter III, p. 7).

Euphorbia tarokoensis HAYATA, Ic. Pl. Formos. 7:34, pl. 9 (1918); HURUSAWA, Journ. Jap. Bot. 16:461 (1940); KENG, Quart. Journ. Taiwan Mus. 4:257 (1951) & Taiwania no. 6, 47 (1955).—*Galarhoeus tarokoensis* (HAYATA) HARA, Journ. Jap. Bot. 14:356 (1938); HURUSAWA, Journ. Fac. Sci. Univ. Tokyo sect. 3, 6:250, f. 17 (1954).

A perennial ramose erect herb, to 40cm tall. Leaves alternate but verticillate at uppermost part of the stem, estipulate, linearly oblong, 3~5cm long, 3~4mm broad, entire, round or emarginate at the apex, glabrous on both sides. Cyathium glabrous inside; involucre glands truncate, briefly bicorniculate; masculine bracteoles filiform, not piliferous; capsules nearly smooth; seeds smooth, carunculate.

Loc. TAIWAN. Pref. Hualien: *Naitaroko to Batakan—type loc. (TI & TAIF); *Gukutsu (TAI); *Chongde to Wenshan (KYO); *Shinjo to Tabito (KYO); *Noko-goe (KYO).

Distr. Taiwan (Hualien Pref.).

This species is characterized by the linearly oblong alternate leaves, briefly corniculate involucre glands, smooth capsules and smooth seeds. It is confined to crevices of sunny limestone cliffs around the localities cited above.

Buxus microphylla SIEB. et ZUCC. var. **insularis** NAKAI, Bot. Mag. Tokyo 36:63 (1922); HATUS., Journ. Dept. Agr. Kyushu Imp. Univ. 6:331 (1940), sub subsp. *sinica* & Journ. Jap. Bot. 37:106 (1962).

An evergreen much ramose shrub. Young shoots and bud scales usually pubescent. Leaves coriaceous, opposite, elliptical, 8~18mm long, 5~10mm broad, entire, notched or emarginate at the apex, attenuate toward the base, conspicuously reflexed underneath along the margin, usually minutely pubescent on basal uppersurfaces and on basal margin; petioles indistinct because of the decurrent blades, minutely pubescent.

Loc. HONSHU. Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO).

Distr. Honshu. Korea and east China.

This kind of box is characterized by the conspicuously reflexed leaves on the margin. HATUSIMA (l. c. 1962) mentions that the hairiness of young shoots, of bud scales and of foliar bases together with petioles is another important character for delimitation of var. *insularis* within the species. However, such hairiness seems to be much variable and not to be peculiar to var. *insularis* only. For example, the specimens of var. *japonica* from Mt. Kurohime and Mt. Myojo both in Niigata Pref. are provided with young shoots as well as leaves more distinctly pubescent than in var. *insularis* from Taishakukyo in Hiroshima Pref. which is only one locality of it in Japan so far reported. According to my examination, the plants referable to var. *insularis* are inhabiting limestone cliffs only in the locality mentioned and nowhere in west Japan. On the other hand, it is worth notice that the plants from Isl. Sado may be referable to this variety.

Var. *japonica* (MUELL.-ARG.) REHD. et WILSON (=var. *riparia* (MAKINO) MAKINO) is distinguishable from var. *insularis* in having flat leaves. They are much variable in size, 1~3cm long and 5~15mm broad, usually glabrous but

sometimes slightly pubescent on petioles and on basal part. Var. *japonica* is inhabiting cliffs here and there in middle and west Honshu, Shikoku and Kyushu. The limestone districts from which this plant was detected are as follows.

HONSHU. Pref. Niigata: Mt. Kurohime and Mt. Myojo, both in Nishikubiki-gun (SHIN). Pref. Nara: Kashiwagi, Kawakami-mura, Yoshino-gun (KYO). Pref. Okayama: Kanba water-fall, Katsuyama-cho, Maniwa-gun (KYO); Tanagase, Niimi-shi (KYO).

KYUSHU. Pref. Kumamoto: Yaritaoshinose, Kuma-mura, Kuma-gun (KYO). Moreover Mt. Kosho in Fukuoka Pref. is a famous limestone mountain for the wild box-trees⁴¹.

Euonymus batakensis HAYATA, Ic. Pl. Formos. 9:11, f. 7 (1920); Nakai, Journ. Jap. Bot. 17:619 (1941), in nota. — *Genitia batakensis* (HAYATA) NAKAI, Acta Phytotax. Geobot. 13:23 (1943). — *E. tanakae* (non MAXIM.): MATSUM. et HAYATA, Enum. Pl. Formos. 83 (1906); HAYATA, Ic. Pl. Formos. 1:137 (1911); KANEH., Formos. Tr. ed. rev. 391, f. 348 (1936), quoad pl. ex Naitaroko.

An evergreen shrub. Leaves opposite, coriaceous, lanceolate, 3~8cm long, 2~3.5cm broad, attenuate or round at the apex, cuneate at the base, crenulate on the margin; petioles 1~6mm rarely 10mm long. Inflorescences axillary, dichasia, 3~7-floriferous; peduncles 2~3cm long. Flowers 1~1.5cm in diameter, tetramerous; pedicels about 1cm long; calyces rounded-flat, 5~6mm across, much shallowly 4-lobed; lobes truncate; petals yellowish white, nearly orbicular, 5~6mm long; discs thickened, fleshy, provided with prominent elliptical glands being 2~2.5mm in long axis and standing alternately to petals; stamens inserted in the center of these glands; filaments 2mm long; anthers 0.7mm long with articulated connectives; ovaries 4-angled, conical, 4-locular; locules (3~) 6~9-ovuliferous in two rows; styles 1.5 mm long. Capsules 4-angled.

Loc. TAIWAN. Pref. Hualien: *Shinjo to Batakan, B. HAYATA 1122—type (TI);

*Chongde to Wenshan, T. SHIMIZU 12634 (KYO, SHIN & TAI).

Distr. Taiwan (Hualien Pref.).

This species is closely affined to *E. tanakae* MAXIM., which is a coastal inhabitant of Kyushu, Liukiu and Taiwan. *E. tanakae* is different from this species in its grosser habit, bolder branches, larger leaves ranging 7 to 15cm long, longer petioles 1~2.5cm long, more elongated peduncles 4~7cm long and more numerously floriferous dichasia.

On the other hand, these two kinds of plant are greatly different from the other representatives of the genus in having prominent large glands on the disc and in 6~9-ovuliferous locules of the ovary. Basing upon these peculiar characters, NAKAI⁴² proposed an independent genus for them, *Genitia*, when he erroneously mentioned that each locule of the ovary had 3~6 ovules arranged in one row. The ovules, as pointed out by HOU⁴³, are exactly arrang-

41) Nakai, T. (1927) Tennen-kinenbutsu-chosahokoku (Bot.) 7:69-78.

42) NAKAI, T. (1943) Acta Phytotax. Geobot. 13:20-24.

43) HOU, D. (1950) Taiwania 1 (Nos. 2-4):189-191.

ed in two rows and can be counted 6 to 9 in number at least so far as *E. batakensis* is concerned.

HOU⁴³ united the present species with *E. carnosus* HEMSL. and proposed the new name for the resultant taxon, *Genitia carnosus* (HEMSL.) LI et HOU. Owing to no materials of *E. carnosus* at my hand, unfortunately I cannot but help still being regardless of his treatment.

Ecologically *E. batakensis* is inhabiting sunny cliffs or rubbly slopes of limestone.

Rhamnus chingshuiensis T. SHIMIZU, sp. nov. (Fig. 8)

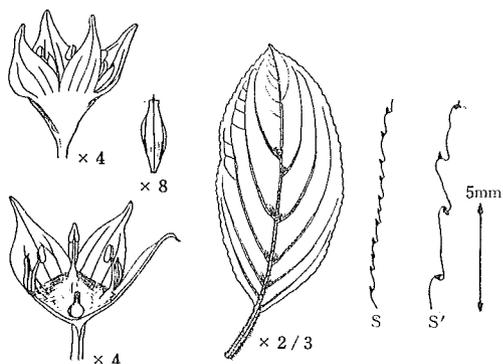


Fig. 8 *Rhamnus chingshuiensis*, sp. nov.
s. serration, s'. serration of *R. liukiuen-*
sis (Isl. Amami-Oshima, Z. TASHIRO s.
n. in KYO).

Frutex erectus, 1.5m altus ramosissimus. Ramus praesertim juvenior cortice nitido nigropurpurato, valide spinescens. Folia ad ramos breve vulgo 3~6-fasciculata, ad ramo longos rarissime alternata, stipulis linearilanceolatis 2~3mm longis ciliatis, petiolis 1~1.5cm longis circumcirca minutissime pubescentibus, laminis ellipticis ad 6cm longis 3cm latis minute serratis apice breviter acutis vel rotundatis basi late cuneatis, venis lateralibus 4~6-jugis, costis venisque lateralibus supra impressis subtus prominentibus utrimque minute pubescentibus supra

sursum nudiusculis, ad axillas nervorum lateralium dense pilosa. Flores dioeci; floribus masculinis ad axillas foliorum 2~5-fasciculatis, pedicellis gracilibus 7~8mm longis glabris, sepalis 4 triangularibus apice paulo elongatis obtusis glabris trinervatis flavovirentibus 2.5mm longis 1.8mm latis, petalis 4 ovatis glabris nigrescentibus ca. 1.3mm longis 0.5mm latis, staminibus 4, filamentis basi crassioribus ca. 1.5mm longis antheris ca. 0.5mm longis, ovariis minutissimis ca. 1mm longis glabris, stylis trifidis; floribus femineis fructisque ignotis.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1800~2400m alt., T. SHIMIZU 12490 ♂ —type (KYO; isotype in SHIN).

The materials of this new species were obtained on a rocky sunny mild slope of limestone, where small colonies of a shrubby pine (*Pinus morrisonicola*), a small leaved buckthorn (*Rhamnus oiwakensis*), a calcicolous viburnum (*Viburnum propinquum*), an erect clematis (*Clematis psilandra*), etc. were scattered.

Among the Taiwan members of *Rhamnus* so far reported, this species resembles *R. liukiensis* (WILS.) KOIDZ. and *R. oiwakensis* HAYATA in the respect that it is an erect shrub with fasciculated leaves and flowers. In *R. liukiensis*, however, the branchlets are not spinous and the leaves are widely ovate to orbicular usually caudately acuminate toward the apex. They are completely glabrous except slightly pubescent adaxial side of petioles. Their

serration is coarser (Fig. 8, s'). As the female plants of *R. chingshuiensis* have not come to my hand, I cannot propose the detailed comparison of the flowers. From *R. oiwakensis*, on the other hand, this new species is easily distinguishable by considerable difference in size of both leaves and flowers. Regarding *R. oiwakensis*, the discussion will be proposed in the following. Moreover, *R. chingshuiensis* may be not conspecific with *R. calcicola* HATUS. from Isl. Okinawa, for its leaves, according to the original description, are provided with remote and obscure serrations.

R. costata MAXIM., Rham. Or. -Asia. 17, f. 1~14 (1866); HARA, Enum. Spermat. Jap. 3:127 (1954).

A deciduous dioecious shrub. Branches not spinous, glabrous. Leaves sub-opposite, elliptical, 5~15cm long, 2~8cm broad, finely serrated, acuminate toward the apex, cuneate or round at the base, glabrous above but densely tomentose beneath with yellowish hairs especially on veins sometimes nearly glabrous (f. *nambuana* (HONDA) HARA); lateral veins 17~23-jugate running in parallel, prominent beneath; petioles 3~6mm long. Flowers 5mm in diameter, axillary, fasciculate, few in number; pedicels 2~4cm long, filiform, glabrous; sepals triangular, acute at the apex, 2.5~3mm long, yellow. Fruits black, 5~8mm across.

Loc. HONSHU. Pref. Iwate: *Takasuka, Shimohei-gun—f. *nambuana* (KYO); Tanohata mura, Shimohei-gun (TNS); *Geibikei, Higashiiwai-gun (KYO); Yanakawa-mura, Iwate-gun (KYO); Mt. Hayachine (KYO). Pref. Fukushima: *Mt. Ootakine, Tamura-gun (KYO); Egawa-mura, Minamiaizu-gun (KYO); Mt. Yomogita, Ishikawa-gun (KYO). Pref. Yamagata: Mt. Kurobuse (KYO). Pref. Tochigi: Nikko (TNS). Pref. Gunma: Mt. Ichinojiyama (TNS). Pref. Saitama: *Mt. Buko (KYO). Pref. Tokyo: *Nippara, Nishitama-gun (TNS). Pref. Nagano: *Jumoji-pass to Mt. Mikuni, Minamisaku-gun (SHIN); *Makuiwa, Todai, Kamiina-gun (KYO); Mt. Komagadake (KYO); Koshiji, Oojika-mura, Shimoina-gun (TNS); *Mt. Toyokuchi, Shimoina-gun (TNS); *Tenshuiwa, upper Aoki river, Shimoina-gun (SHIN). Pref. Yamanashi: Mt. Kurodake (TNS). Pref. Gifu: National Forest in Mt. Ena (TNS). Pref. Nara: *Mt. Misen to Mt. Gyojagaeri, Yoshino-gun (KYO). Pref. Hiroshima: Mt. Dogo, Hiba-gun (KYO); Mt. Kario (KYO). SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (KYO). Pref. Ehime: Mt. Odami (KYO).

Distr. Honshu and Shikoku.

Yellow-tomentose leaves beneath, numerous prominent lateral nerves in them and slender long pedicels are peculiar to this species among the Japanese members of the genus. It occurs rarely in Honshu and Shikoku, and many of its records are owed to the limestone fields as indicated above.

R. oiwakensis HAYATA, Ic. Pl. Formos, 6:14 (1916); KANEH., Formos. Tr. ed. rev. 426, f. 383 (1936). —*R. pianensis* KANEH., l. c. 425, f. 382 (1936), nom. subnud. —*R. kanagushi* sensu HATUS., Sci. Bull. Agr. & Hom. Ec. Univ. Ryukyu no. 3, 21 (1956), quoad pl. ex Taiwan. (Fig. 9)

A decumbent or erect small shrub. Branchlets much spinous, grayish black in bark tint. Leaves 3~5-fasciculate on short branches, ovate, 0.3~2cm long and 2~10mm broad, attenuate toward the

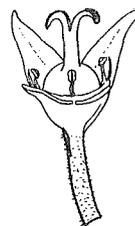


Fig. 9 A pistillate flower of *Rhamnus oiwakensis*
Material: Mt. Chingshui,
T. SHIMIZU 12495 (KYO), ×6

petioles, above glabrous to pubescent merely on nerves or sometimes all over, beneath slightly pilose at the axile of the lateral veins; lateral veins 2~4 on each side, indistinct, remotely 2~6-serrated on the margin; petioles 1~2mm long, minutely pubescent especially on adaxial sides. Flowers dioecious, 1~4 on short branches, 2~2.5mm in diameter, yellowish; pedicels 2~3mm long, minutely pubescent; sepals 4, triangular, glabrous, 1.5mm long, 1mm wide, obtuse at the apex, with indistinct nerves; petals 4. Pistillate flowers with subulate petals being ca. 0.5mm long, 4 vestigial stamens equal to petals in length and styles ca. 1mm long being bifid at the apex. Staminate flowers with ovate petals ca. 0.8mm long, 4 stamens and vestigial pistils.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000~1800m (TI); *ibid. 1400~2100m (SHIN); *ibid. 1500~2400m (TI); *Chongde to Wenshan, 400m (SHIN); *Tienchang cliff, 1600m (TI).

Distr. Taiwan (Hualien Pref.).

This buckthorn is very frequently and almost exclusively found on the limestone fields in Hualien Pref. The much small leaves and small flowers are peculiar to this species among the Taiwan members of *Rhamnus*. Probably depending on this character, HATUSIMA (l. c. 1956) regarded this species as same with *R. kanaguski* MAKINO of Isl. Okinawa. This is a completely glabrous shrub on any part of plant. On the contrary, *R. oiwakensis* is minutely pubescent both on pedicels and on petioles, pilose at the axile of the lateral veins on undersurface of the leaves, and moreover sometimes hairy also on the leaves above. In this respect, it will be relevant to consider these two species as different. Although the pistils of *R. kanaguski* are unknown, the bifid styles of *R. oiwakensis* may provide another distinction from both *R. ching-shuiensis* and *R. liukiensis* the styles of which are 3~4 fid.

R. yoshinoi MAKINO, Bot. Mag. Tokyo 18:97 (1904); MOMIYAMA, Journ. Jap. Bot. 28:216 (1953); HARA, Enum. Spermat. Jap. 3:129 (1954); SHIMIZU, Acta Phytotax. Geobot. 18:163 (1960).—*R. schneideri* LÉV. et VAN., Fedde Repert. 6: 265 (1908).

A deciduous dioecious shrub. Branchelets loosely spinous, shining black-purple. Leaves fasciculate on short branches, usually obovate, 2~8cm long, 1~4cm broad, acuminate toward the apex, cuneate at the base, mucronately serrated, glabrous above, thinly pubescent on veins beneath, costae prominent beneath; lateral veins 3~6 on each side, somewhat prominent beneath; petioles 5~15mm long. Flowers axillary, 6mm long; pedicels a little longer than flowers. Fruits about 7mm across, greenish.

Loc. HONSHU. Pref. Hyogo: Mt. Mino, Ako-gun (KYO). Pref. Okayama: Miyagochi, Tetta-cho, Atetsu-gun—type loc. (TI); *Nagaya and *Tanagase, Niimi-shi (KYO); Mt. Kenashi, Maniwa-gun (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO); Fujio-mura, Ajina-gun (TNS). SHIKOKU. Pref. Kochi: *Hirose, Tosayama-mura, Tosa-gun (KYO); *Mt. Ishidate (KYO); *Mt. Torigata (SHIN). KYUSHU. Pref. Fukuoka: *Mt. Kwaradake, Tagawa-gun (KYO); Mt. Togami, Oosato (KYO); *Hiraodai, south of Kokura (KYO). Pref. Kumamoto: Mt. Naidajin, Kamimashiki-gun (KYO); *Watari, Kuma-mura, Kuma-gun (KYO); *Mt. Noke-eboshi, Kuma-gun (SHIN).

Distr. West Honshu, Shikoku and Kyushu. Korea and Manchuria.

This is one of the rarest plants of Japan, being characterized by black-

purple young shoots and greenish fruits. Basing on these characters, it is possible to distinguish it from its nearest species, *R. japonica* MAXIM., which is always provided with cinereous branches and blackened mature fruits. Almost all of the geographical records of the present species have come from sunny cliffs or rubbly ridges of limestone.

Var. **velvetina** T. SHIMIZU, l. c. 163 (1960).

Different from var. *yoshinoi* in velvety hairiness on leaves above.

Loc. HONSHU. Pref. Okayama: *Kuraida, Niimi-shi (KYO); *Izumi, Banzai-mura, Atetsu-gun, 350m (SHIN). Pref. Hiroshima: *Taishakukyo, Hiba-gun—type loc. (KYO).

I could detect the plant referable to this variety merely from three localities above cited. Its habitat is strictly confined to limestone crevices in open places.

Hypericum nokoense OHWI, Acta Phytotax. Geobot. 6:48 (1937); KIMURA, Bot. Mag. Tokyo 54:85 (1940) & in NAKAI et HONDA, Nov. Fl. Jap. (Hypericac.) 226 (1951).

A caespitose small perennial herb, 5~10cm tall. Leaves densely arranged with internodes 1~3mm long, thickened in texture, elliptical, 2~6mm long, 1~2.5mm broad, obtuse to round both at the apex and at the base, sparsely black-punctate. Inflorescences terminal, 1~5-floriferous. Bracts linearly lanceolate, 3~3.5mm long, acute at the apex. Sepals lanceolate, acuminate, 3~4mm long, 1~1.5mm broad, punctate with pellucid and black dots; petals obovate-elliptical, 9.5~10mm long, 4.5mm broad; stamens 5~8mm long; ovaries 2mm long; styles 4~5mm long. Capsules 4mm long, with longitudinal pellucid lines; seeds elliptical, blackish, finely foveolate all over, not angled, 0.7mm long, 0.4mm across.

Loc. TAIWAN. Pref. Hualien: *Noko-goe, J. OHWI 2971—type, 2958—paratype (KYO); *Panpien to Chilai, T. SHIMIZU 11356 (SHIN).

Distr. Taiwan (Hualien Pref.).

This species is characterized by the tiny thickened leaves with only black dots, sharply pointed bracts and black punctate acuminate sepals. I could find it on a sunny cliff of limestone en route from Panpien to Chilai in Hualien Pref. and not elsewhere in this route. OHWI's type collections from "Noko-goe" were also from the same limestone cliff probably, for the route "Noko-goe" is the same with that I took.

Takasagoya geminiflora (HEMSL.) Y. KIMURA, Bot. Mag. Tokyo 50:501 (1936) & in NAKAI et HONDA, Nov. Fl. Jap. (Hypericac.) 93, f. 40 (1951). —*Hypericum geminiflorum* HEMSL., Ann. Bot. 9:144 (1895); MATSUM. et HAYATA, Enum. Pl. Formos. 41 (1906); HAYATA, Ic. Pl. Formos. 1:79 (1911).

A deciduous glabrous shrub. Leaves narrowly ovate or elliptical, 2.5~3.5 cm long, 7~15mm broad, acute toward the apex, cuneate at the base, densely punctate with pellucid dots. Flowers 1(~3) terminal and axillary, 2.5~3cm in diameter; pedicels 6~13mm long; sepals ovate, about 1.5mm long, round at the apex; petals obovate, 10~13mm long, 6~6.5mm broad; stamens 7~10mm long; ovaries 5-locular, 3.5mm long; styles wholly united into 1, 5~6mm long. Capsules cylindrical, 8~10mm long; seeds tailed toward both ends.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 600~1400m (SHIN); *Chongde to Wenshan (KYO); Tienshang, siliceous fields (KYO); Shinjo, Taroko (KYO); prope Tabito (KYO);

*Patakang to Tienhsiang (KYO); *Batakan to Dangai, Taroko (TAI); *Taroko (TAI); *Dangai, Taroko (TAI); *Naitaroko (TAI); *ad saxum, Taroko (TAI); Tausai, Naitaroko (TI).
Distr. Taiwan (Hualien and Kaohsiung Pref.).

This is characterized by smallest sepals among the representatives of the genus.

We came across this plant very frequently and almost always at sunny rubbly ridges or else on sunny cliffs of limestone but not in the case of Tien-hsiang. Its record from "Ape's Hill"⁴⁴ in Kaohsiung must have come from limestone crevices, for the so-named hill is regarded as a limestone hill called Shoushan at the present.

T. nakamurai MASAM., Trans. Nat. Hist. Soc. Formos. 30:410 (1940); KIMURA in NAKAI et HONDA, Nov. Pl. Jap. (Hypericac.) 91 (1951).

A shrub resembling the previous species. Leaves 1~3cm long, 0.5~1cm broad. Sepals oblong, 5~6mm long, 1~1.5mm broad, obtuse at the apex, reflexed after anthesis; petals unsymmetrically bifid; styles 15mm long.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 2000m, T. NAKAMURA 3734—type (TAI); *ibid. 1800~2400m, T. SHIMIZU 12543 (KYO); *ibid. 1400~2100m, T. SHIMIZU & M. T. KAO 11859 (TAI).

Distr. Known only from the above cited mountain.

In the respect that this species presents elongated sepals, it is most related to *T. formosana* (MAXIM.) Y. KIMURA. But this has larger leaves 3~6cm long and 1.5~2cm broad, longer and wider sepals extending to 9mm long and 3mm wide, and shorter styles about 8mm long. As our materials were all at fruiting stage, we could examine no flowers of the present species. However, unsymmetrically bifid petals and long styles, according to the original explanation, may be other important characters for its distinction from the previous one.

The specimens above cited are all from sunny rubbly ridges of limestone, and no other exact records of this plant are known to us.

Angelica saxicola MAKINO var. **yoshinagae** (MAKINO) MURATA et YAMANAKA, Acta Phytotax. Geobot. 18:27 (1959). — *A. shikokiana* MAKINO var. *yoshinagae* (MAKINO) HARA, Enum. Spermat. Jap. 3:298 (1954). — *A. yoshinagae* MAKINO, Journ. Jap. Bot. 3:5 (1926); KITAGAWA, Bull. Nat. Sci. Mus. Tokyo no. 46, 8 (1960) & Journ. Jap. Bot. 36:240 (1961), in nota. — *A. shikokiana* sensu HIROE et CONSTANCE, Umbel. Jap. 113 (1958), p. p.

A perennial herb with bold rhizomes, extending to 1m tall. Stems pubescent. Radical leaves 1~2 (~3)-ternate or pinnately ternate; petioles 20~30 cm long, pubescent, sheathing; leaflets ovate, 2~5cm long, 1~2cm broad, 2~3-lobate, serrated, greenish not shining above, glaucous beneath, pubescent on both sides especially on veins and on margin. Cauline leaves reduced upward. Umbels terminal, several in number, pubescent; rays 20~30, 3~6cm long, densely pubescent on adaxial sides. Umbellules 25~40-floriferous, with linear involucels; pedicels 5~10mm long, similarly pubescent on adaxial sides. Flowers lacking in calyx teeth; petals white, oval to obovate; styles slender, 2~3

44) HENRY, A. (1896) List Pl. Formos. 19.

times longer than conic stylopodium; ovaries glabrous. Fruits elliptical 5~8 mm long, glabrous.

Loc. SHIKOKU. Pref. Kochi: *Tosayama-mura, Tosa-gun—type loc. (KYO); *Mt. Ishidate, Kami-gun (KYO).

Distr. Shikoku (Kochi Pref.).

This is an endemic species of Shikoku, being distinguished from var. *saxicola* by the wider and more shallowly lobed leaflets not shining above and pubescent on both sides and absence of calyx teeth.

According to YAMANAKA⁴⁵ and YAMANAKA et al.⁴⁶, it is strictly confined to sunny limestone cliffs or rubbly places of limestone and also found in Mt. Kurotaki, Mt. Torigata and Kagami-mura of Tosa-gun besides the localities noted above.

A. shikokiana MAKINO var. **mayebarana** (KOIDZ.) HARA, Journ. Jap. Bot. 31:188 (1956); SHIMIZU, Acta Phytotax. Geobot. 18:119 (1960); KITAGAWA, Bull. Nat. Sci. Mus. Tokyo no. 46, 7 (1960).—*Peucedanum mayebaranum* KOIDZ., Bot. Mag. Tokyo 39:5 (1925).—*A. mayebarana* (KOIDZ.) KITAG., Rep. Inst. Sci. Res. Manch. 2:279 (1938); HARA, Enum. Spermat. Jap. 3:297 (1954).—*A. shikokiana* sensu HIROE et CONSTANCE, Umbel. Jap. 113 (1958), p. p.

A perennial herb with bold rhizomes, 30~80cm tall. Stems glabrous except just below umbels, striate, somewhat nitid. Radical leaves 3~4-ternate or pinnately ternate, long petiolate; petioles glabrous, sheathing; leaflets narrowly rhomboid or lanceolate, sometimes 3-lobed, usually 1~1.5cm wide, serrated, acute toward the apex, narrowly cuneate at the base, glaucous beneath, completely glabrous on both sides. Cauline leaves reduced upward. Umbels terminal, several in number; rays 13~20, 3~6cm long, slightly puberulous on adaxial sides. Umbellules 20~30-floriferous, with 0~2 linear involucels; pedicels 5~10mm long, nearly glabrous. Calyx teeth indistinct. Fruits 5mm long, glabrous, auriculate at the base.

Loc. KYUSHU. Pref. Kumamoto: *Mt. Noke-eboshi, Kuma-gun (KYO); *Yaritaoshinose, Kuma-mura, Kuma-gun (KYO); *Shitomi, Kuma-mura, Kuma-gun (TI); Koonose-mura, Kuma-gun (TNS); *Isshochi, Kuma-mura, Kuma-gun—type loc. (KYO); *Seishokonoiwa, Oono-mura, Ashikita-gun (KYO); *Oono, Ashikita-gun (KYO).

Distr. Kyushu (Kumamoto Pref.).

Compared with var. *shikokiana*, the present variety is characterized by 3~4 times pinnately ternate leaves, narrower leaflets or lobes and nearly glabrous umbels. Though sometimes they are not clearly cut each other, var. *shikokiana* is provided with 2~3 times ternate leaves, wider leaflets being 1.5~3cm broad and densely pubescent umbels. The plants from the district along the Kuma river are exactly referable to var. *mayebarana*, while those from the mountain sides in Mt. Noke-eboshi exhibit intermediate forms between both the varieties.

As I (l. c. 1960) pointed out, both the plants are characteristically growing on sunny limestone cliffs in the southern part of Kumamoto Pref., and var. *mayebarana* is an endemic form found there around only.

45) YAMANAKA, T. (1956) Acta Phytotax. Geobot. 16:95.

46) ——— et al. (1963) Journ. Jap. Bot. 38:21.

A. tarokoensis HAYATA, Ic. Pl. Formos. 10:27 (1921); HIROE, Umbel Asia no. 1, 166 (1958); LIU, CHAO et CHUANG, Quart. Journ. Taiwan Mus. 14:21, pl. 4, f. 7 (1961).

A perennial herb with bold rhizomes, 30~50cm tall. Leaves coriaceous, pinnate with 3~7 leaflets; petioles 5~10cm long, glabrous, sheathing; terminal and upper leaflets oblong-lanceolate, 5~8cm long, 1~2cm broad, acuminate or acute toward the apex, attenuate or round or shallowly cordate at the base, serrated on the margin, pubescent on veins above, glabrous and glaucous beneath; lower pinnae usually ternate, petiolulate. Umbels pubescent or glabrous, with linearly lanceolate involucre about 1cm long; rays 20~25, 3~4cm long. Umbellules 1.5cm long, 2cm across, with linear involucels 4~7mm long. Calyx teeth minute, deltoid; petals white, glabrous; styles short, about equal to conic stylopodium. Fruits oblong, 5mm long, 3mm wide, glabrous, truncate at the base.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000m (SHIN); *ibid, 1150~1400m (SHIN); *Batakan to Naitaroko—type loc. (TI); *Dangai in Mt. Sankakusuzan, Naitaroko (TAI); *Gukutsu, Karenko (TAI); *Fongshan, 2000m (TAI).

Distr. Taiwan (Hualien Pref.).

This species is characterized by once pinnate leaves with 3~7 leaflets. In Mt. Chingshui, Fongshan and also in Tailuko we came frequently across this plant and always on sunny limestone fields. LIU et al. (l. c. 1961) reported this species from Pingtung Pref., the southern part of Taiwan, too.

Forsythia japonica MAKINO, Bot. Mag. Tokyo 28:105, f. 5 (1914); NAKAI, Tr. & Shr. ed. 2, 359, f. 167 (1927); HARA, Enum. Spermat. Jap. 1:113 (1948).—*Rangium japonicum* (MAKINO) OHWI, Acta Phytotax. Geobot. 1:140 (1932).

A deciduous shrub. Branches indistinctly bistriate, glabrous, often pendulous. Leaves opposite, simple and never lobate, widely ovate, 7~12cm long, 4~6cm broad, attenuate toward the apex, round at the base, serrated except the basal part, glabrous above, pubescent beneath especially on veins; petioles 6~8mm long, thinly pilose. Flowers precocious, solitary in axillary buds; pedicels 2~3mm long; calyx lobes elliptical, 2.5~3mm long, ciliate; corollae yellow, with 4 patent lobes 12mm long and 5~6mm wide and with obconical short tubes 4mm long; stamens 2, 4mm long; styles exserted, 5mm long; ovaries ovoid-globose, 2-cellular. Capsules ovate-elliptical, about 1cm long, glabrous.

Loc. HONSHU. Pref. Okayama: *Nagaya, Niimi-shi (KYO); *Ikura, Niimi-shi (TI); Koitaki, Niimi-shi (KYO); Kawaguchi, Fukuwatari-cho, Kume-gun (KYO); Nonoguchi, Mitsu-cho, Mitsu-gun, on cliff (TNS). Pref. Hiroshima: *Taishaku-kyo, Hiba-gun (KYO); Fujio-mura, Ashina-gun (TNS); *Nakura, Hisayo-mura, Hiba-gun (KYO). SHI-KOKU. Pref. Kagawa: Kankakei, Isl. Shodo (KYO).

Distr. West Honshu and Shikoku (Isl. Shodo).

This is characterized by rather circular branches, pilose leaves beneath and their entire base, by which it is clearly distinguished from any other species of the genus.

Many of its geographical records are owed to limestone cliffs as shown above.

Ligustrum seisuiense T. SHIMIZU et KAO, Acta Phytotax. Geobot. 20:67, f. 1

(1962).

An evergreen shrub, 1~1.5m tall. Present year's branchlets densely pubescent. Leaves coriaceous, glabrous, lanceolate or narrowly lanceolate, 3~6cm long, 1~2cm broad, usually caudately acuminate toward the apex; petioles about 1mm long, somewhat purplish. Inflorescences cylindrical, 1~2.5cm rarely 3.5cm long, pubescent; peduncles 0.2~1.5cm long. Flowers with 1~2mm long pubescent pedicels; calyces about 2mm long, 4-dentate; corollae white, tubiform, 7~8mm long, shallowly 4-lobed.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 600~1400m—type loc. (TAI); *ibid. 1150~1650m (KYO); *ibid. 1000m (KYO).

Distr. Known only from the above cited mountain.

This species is very near to *L. pricei* HAYATA mainly from the central mountains of Taiwan. The distinction between them is merely in length of the inflorescences and in leaf shape. *L. seisuiense* has shorter inflorescences and slenderer caudately pointed leaves than in *L. pricei*.

All the samples of *L. seisuiense* were acquired either from gravelly slopes under the forest or from shrubberies at rubbly ridges of limestone.

Buddleja formosana HATUS., Bull. Arts & Sci. Div. Univ. Ryukyu (Math. & Nat. Sci.) no. 3, 106 (1959).—*B. curviflora* (non HOOK. et ARN.): SASAKI, Trans. Nat. Hist. Soc. Formos. 20:169 (1930); KANEH., Formos. Tr. ed. rev. 623 (1936).

A deciduous shrub, with tetragonal tomentose branches. Leaves opposite, narrowly lanceolate, 5~11cm long, 1~3.6cm broad, long attenuate toward the apex, cuneate at the base, nearly entire on the margin, glabrescent above, rufo-tomentose beneath; petioles 5~8mm long, rufo-tomentose. Inflorescences terminal several in number and axillary, single, cylindrical, 10~25cm long, 2~2.5cm across, erect, densely tomentose. Flowers 3~5 at the node of the axis, pedicellate, with subulate bracteoles about 3mm long; calyces cupuliform, 5-dentate, tomentose and densely gland-dotted outside; calyx lobes triangularly ovate, about 1mm long; corollae purple, about 1.3cm long, curvate, tomentose and densely gland-dotted outside; stamens inserted at middle part of corollae. Capsules ovoid, 4~5mm long, glabrous.

Loc. TAIWAN. Pref. Hualien: Mt. Namako, Taroko—type loc. (KAG); *Patakang to Tienshang (KYO); Gukutsu, Kwarenko (TAIF).

Distr. Taiwan (Hualien Pref.).

This plant is near to *B. venenifera* MAKINO from Shikoku and Kyushu, being different from it in more or less tetragonal branchlets, narrower leaves and gland-dotted corollae. Our materials collected between Patakang and Tienshang are without flowers but at the fruiting stage. Contrary to HATUSIMA's description "flores 3~5-fasciculati subsessilis", they are provided with distinct peduncles below the capsules.

The specimens above cited are all known to us, and are probably all from limestone cliffs.

Gentiana contorta ROYLE, Ill. Bot. 278, t. 68, f. 3 (1839); TOYOKUNI, Hokuriku Journ. Bot. 6:33 (1957).—*G. yamatsutae* KITAG., Bot. Mag. Tokyo 48:104 (1934).—*Gentianella contorta* (ROYLE) H. Sm. in HAND.-MAZZ., Symb. Sin. 7:

977 (1936). — *Gentianopsis contorta* (ROYLE) MA, Acta Phytotax. 1:14 (1951).

A biennial herb, usually 8~15cm tall. Stems smooth, single or ramose merely on the upper part. Rosulate leaves scale-like or absent; cauline leaves opposite, elliptical to ovate-elliptical, sessile, 10~15mm long 4~9mm broad, obtuse or round at the apex, cuneate at the base, obscurely dentate on the margin. Flowers terminal, solitary, tetramerous; pedicels 1cm or so long; calyces tubiform to narrowly obconical, 10~15mm long; calyx lobes two-formed, deltoid, 1/4 to 1/5 of calyces in length; corollae tubiform, about 2cm long, violet, secondary lobes lacking; staminodes 4, inserted at the base of corollae, 0.6~1mm long. Capsules narrowly oblanceolate, shortly stipitate.

Loc. HONSHU. Pref. Saitama: *Azusashiraiwa, northeast of Jumoji-pass, Chichibu-gun (TNS).

Distr. Middle Honshu. East Himalaya and China (Yunnan, Shangtung and Manchuria).

Basing upon the characters of two-formed calyx lobes, absence of both fimbriellae and plicae from the corolla and presence of staminodes, this gentian is grouped into Subgen. *Gentianopsis* (MA) TOYOKUNI (=Genus *Gentianopsis* MA) as well *G. yabei* TAKEDA which is only known from the alpine zone of Mt. Shirouma in middle Honshu. It differs from *G. contorta* in having elongated pedicels extending to 10cm long and finely serrated corolla-lobes.

In Japan *G. contorta* is merely recorded from Azusashiraiwa in Chichibu-gun of Saitama Pref. and Shiraiwa in Todai of Nagano Pref.⁴⁷, and in both the cases from crevices in the huge limestone bluffs.

G. kaoi T. SHIMIZU, sp. nov. — *G. kaorii*, nom. nud. in Chapter III (PART I) 94. (Fig. 10)

Herba annua 4~13cm alta. Caulis simplex vel superne 2~3-ramosus, minute scabriusculus. Folia radicalia rosulata ovata ad 14mm longa 7mm lata apice acuta basi contracta, breviter petiolata, connato-vaginata, vaginis ca. 1mm longis, margine albo-lamellata integra basin versus minute ciliato-denticulata. Folia caulina opposita in 4~6 paribus disposita, ovata apice acuta basi contracta, connato-vaginata 2~4mm longa 1~3mm lata. Flores ad apices ramorum solitarii; calycibus tubiformibus 5~6mm longis 5-lobatis, lobis 2.5~3mm longis acutis haud reflexis; corollis caeruleis tubuloso-campanulatis 10~13mm longis, lobis primariis 5, ca. 3mm longis triangularibus acutis haud reflexis

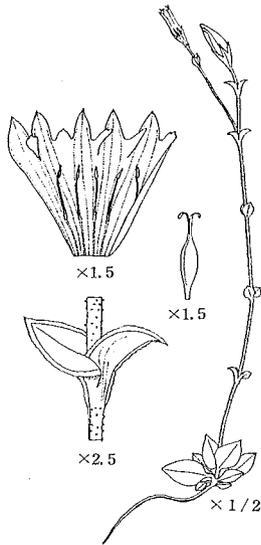


Fig. 10 *Gentiana kaoi*,
sp. nov.

sub anthesi, lobis secundariis 5, ad sinos plicatis lobis primariis duplo minoribus ovatis leviter dentatis tenuissimis; staminibus 5 ad medium tubi corollae affixis, filamentis ca. 4mm longis bsis latioribus, antheris oblongis ca. 1mm

47) TOYOKUNI, H. & SATOMI, N. (1957) Hokuriku Journ. Bot. 6:35.

longis; ovariis stipitatis oblongo-obovoideis cum stipitibus ca. 5mm longis, stylis ca. 2mm longis, stigmatibus 2 recurvatis. Capsulae ignotae.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1800~2400m, T. SHIMIZU 12535—type (KYO).

Distr. Known only from the type locality.

This species is a slender gentian with scabrous stems and well developed rosulate leaves. Never crowded. Not branching or only 2~3-branched in the upper part. Cauline leaves remotely 4~6-paired, very small and much contrasted with rosulate ones. Flowers blue. Calyx 5~6mm long, with straight lobes neither reflexed nor patent. Corolla 10~13mm long, with secondary smaller lobes. These are the important diagnostic characters for this new species.

In appearance it resembles *G. thunbergii* GRISEB. But the stems of *G. thunbergii* are branched at the base and smooth throughout. Its flowers are larger than that. Compared with the Taiwan members, this new species is also near to *G. tenuissima* HAYATA in the appearance and the size of leaves. However, this is provided with smaller flowers and smooth stems. From *G. loureiri* GRISEB. and *G. squarrosa* LEDEB., the present species differs in their extremely ramose stems and densely arranged leaves.

I could find this new species at only one station in Mt. Chingshui where large lumps of limestone form a mild sunny slope.

G. tentyoensis MASAM., Trans. Nat. Hist. Soc. Formos. 32:1 (1942). (Fig. 11)

An annual erect herb about 3 cm tall. Stems unbranched, smooth. Leaves ovate or roundly ovate, very often emarginate at the apex; rosulate leaves about 10mm long, 8mm wide; cauline ones smaller than them, about 6mm long, 6mm broad. Flowers terminal, solitary. Calyx campanulate-tubiform, 8mm long, 5-lobed; lobes ovate-oblong, about 4mm long, slightly recurvate. Corollae purplish, campanulate-tubiform, about 1.5cm long, 5-lobate; lobes ovate acute at the apex, about 3mm long, patent in anthesis; secondary lobes present. Ovaries obovate-oblong, about 12mm long, more or less stipitate. Capsules unknown.

Loc. TAIWAN. Pref. Hualien: *Tentyo Dangai (limestone), T. KUSUMOTO s. n. Dec. 27, 1940—type (TAI).

This species is closely affined to *G. squarrosa* LEDEB. The morphological distinction of *G. tentyoensis* from it is in the simple and smooth stems and the round or emarginate leaves. The stem of *G. squarrosa* is much ramose and scabrous, and its leaves are acute to be more or less apiculate at the apex.

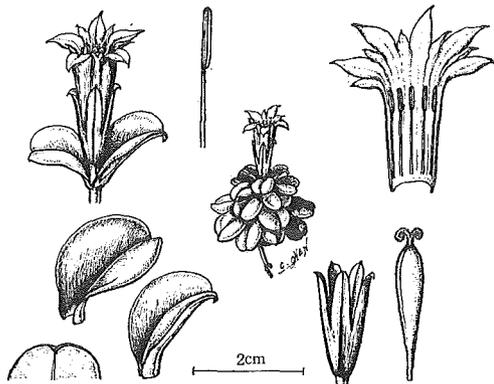


Fig. 11. *Gentiana tentyoensis* (type)

Del. C. CHEN

Geographically the present species is only known from the Tienchang Cliff and represented only by the type specimen.

Clinopodium laxiflorum (HAYATA) T. SHIMIZU var. *parvifolium* T. SHIMIZU, var. nov. (Fig. 12)

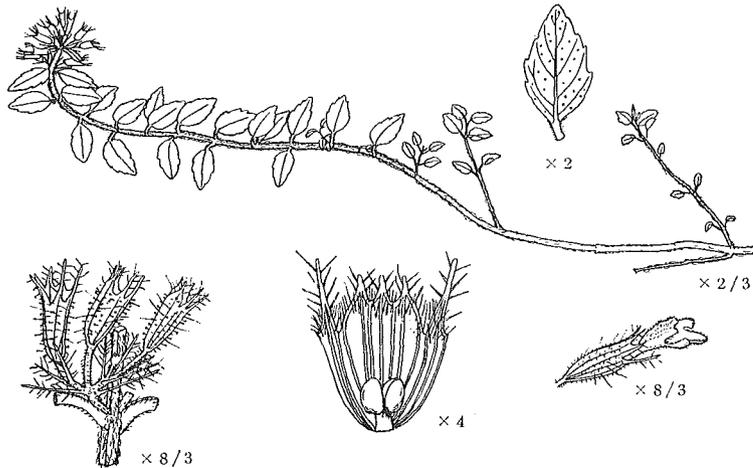


Fig. 12 *Clinopodium laxiflorum* var. *parvifolium*, var. nov.

Herba procumbens, caulibus adpresse retrorse-pubescentibus obtuse tetragonis. Folia opposita petiolata ovata apice obtusa basi rotundata 5~12mm longa 3~6mm lata a medio sursum parce serrulata deorsum integra utrimque glabrata, subtus purpurascens glandulifera, petiolis 1~2mm longis pubibus minutis ascendentibus vestitis, venis lateralibus 3~4 subtus costisque elevatis. Cyma axillaris 3~5-florifera, pedicellis 1~2mm longis minute pubescentibus. Calyx 4~5mm longus 12-nervatus pilis ad 1mm longis et pilis glandulosis 0.3 mm longis commixte vestitus sed saepe eglandulosus, intus ad faucem hispidulus, bilobatus, labio posteriore patente 3-dentato dentibus cuspidatis, labio anteriore 2-partito, segmentis linearibus. Corolla exserta 7~8mm longa tomentosa intus anteriore circa partem mediam tomentosa, staminibus 4 didynamis, discis aequalis, stylis lobis anterioribus longioribus complanatis. Fructus globosus laevis ca. 1.2mm longus 4-partitus.

Loc. TAIWAN. Pref. Hualien: *Panpien to Chilai, ca. 1600m, T. SHIMIZU 11320—type (KYO); ibid., on trunk, T. SHIMIZU 11308 (SHIN); *Tienchang Pass, S. SASAKI s. n. (TAI); Noko to Onoue, S. SASAKI s. n. (TAI); Mt. Gokwan to Hituroku, S. SASAKI 380438 (TAI); Mt. Kiraisyunanpo, S. SASAKI s. n. (TAI); Nokozan, E. MATUDA s. n. (TI).

Distr. Taiwan (Hualien Pref.).

The syntype specimens of *C. laxiflorum* from Mt. Morrison, viz. T. KAWAKAMI & U. MORI 1900 & 1921 (TI), have the adult leaves being 15~18mm long and the flowers extending to 18mm long.⁴⁸ Their calyces, 7~8mm long,

48) HAYATA, B. (1911) Mater. Fl. Formos. 228.

are lacking in glandular hairs. Contrariwise, the plants from 'Panpien to Chilai' have the leaves being 5~12mm long and the corollae 7~8mm long. The calyces are densely covered with glandular hairs. However, the leaves of var. *laxiflorum* are often variable to be as small as those of var. *parvifolium*. For example, the specimens such as "Arisan, T. SATO 393 (TI)" and "Mt. Niitaka, S. SASAKI s. n. (TAI)" are mostly provided with small leaves 1cm or so long. The character in relation to presence or absence of glandular hairs on the calyces are also flexible in this species likewise in others of the genus. On some specimens of var. *laxiflorum*, "Mt. Niitaka, S. SASAKI s. n. (TAI)" and "Ibid., T. KAWAKAMI & U. MORI 2269 (TI)", the glandular hairs of the calyces are detectable, while they lack on those of var. *parvifolium*, viz. "Mt. Kiraishunanpo, S. SASAKI s. n. (TAI)." After all, the most important diagnostic character between these two varieties is the distinction in size of the flowers. The flowers of var. *laxiflorum* are 13~15mm long, and those of var. *parvifolium* are about 8mm long. The relative length of corollae to calyces are apparently smaller in the latter than the former.

Geographically var. *laxiflorum* occurs in the district surrounding Mt. Morrison, while var. *parvifolium* in the northern mountain region especially in the limestone district.

Euphrasia insignis WETTSTEIN subsp. **inumai** (TAKEDA) YAMAZAKI, Acta Phytotax. Geobot. 19:165 (1963).—*E. inumai* TAKEDA, Kew Bull. 193 (1910); HARA, Enum. Spermat. Jap. 1:248 (1948).

Stems retrorsely pubescent. Leaves and bracts obovate to rhomboid-elliptical, 7~10mm long, 5~7mm broad; teeth 2~4 on each side, obtuse not aristate. Calyces about 4mm long, nearly equally 4-lobed; calyx lobes acute at the apex, about 1.5mm long. Corollae bilabiate; upper lips 7~9mm long, bilobed; lower lips larger than the upper ones, trilobed. Capsules obovate-elliptical, a little shorter than calyces; seeds elliptical, 1.2~1.4mm long.

Loc. HONSHU. Pref. Gifu: Jokoji (TI). Pref. Shiga: *Mt. Ibuki (KYO); *Mt. Ryozen (KYO).

Distr. Middle Honshu.

The glabrous leaves with obtuse and usually 3-jugate teeth and nearly equally 4-lobate calyces with aristately pointed lobes are the important characters for this species. The three localities cited above are all records of its area known up to the present. In Mt. Ibuki it is growing on rubbly open grassland of limestone. Probably the case is same in Mt. Ryozen, though I could not find it there, for this mountain presents us also the similar limestone field everywhere throughout.

E. maximowiczii WETTST. var. **calcareea** YAMAZAKI, Journ. Jap. Bot. 27:199 (1952) & Acta Phytotax. Geobot. 19:165 (1963).

Accordant with var. *maximowiczii* in main characters, but different from it in the narrowly ovate leaves and their acute but not aristate teeth.

Loc. HONSHU. Pref. Nagano: *Shiraiwa, Todai, Kamiina-gun, 1200m—type loc. (KYO).

Distr. Known only from the type locality.

This is a small delicate plant with narrow leaves, being found only on

a limestone bluff at the above cited locality. As pointed out by YAMAZAKI⁴⁹, the plant referable to var. *maximowiczii* is growing also in this district but outside of this bluff.

E. tarokoana OHWI, Acta Phytotax. Geobot. 2:149 & 306 (1933).

An ascendent perennial herb. Stems 10~15cm long, densely pubescent with patent minute hairs and with sparsely mixed glandulous hairs. Leaves and bracts round or ovate, 3~6mm long and so broad, 2~4 grossly dentate on each side, pubescent and glanduloso-pubescent on both sides but not sticking; nerves impressed above, prominent beneath. Flowers solitary at the axile, sessile or shortly pedicellate; pedicels to 5mm long, likewise pubescent together with calyces; calyces narrowly obcampanulate, 5~5.5mm long, unequally 4-lobed laterally to 3mm and dorsoventrally to 2mm deep; calyx lobes obtuse to round at the apex, pubescent on both sides with simple hairs and more densely with glandulous hairs; corollae bilabiate, pubescent outside; inner lips 12~17mm long, bilobed; lower lips 18~23mm long, 3-lobed with each lobe further bifid. Capsules obovate, 4.5~5mm long, thinly pilose all over.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000m (KYO); *ibid. 1400~2100m (SHIN); *ibid. 1800~2400m (KYO); *ibid. 2000m (TAI); Tabito to Karapao, Taroko—type loc. (KYO); *Dangai, Taroko (TAI).

Distr. Taiwan (Hualien Pref.).

The leaves of this species together with bracts are conspicuously pubescent on both sides with erect acute hairs and with less glandulous ones. Calyces are also provided with both kinds of hair, but remarkable with erect glandulous hairs.

We came across this plant very frequently and always in limestone crevices at open rocky ridges. Probably the type specimen, J. OHWI 1141 (KYO), was also due to limestone crevices. If so, all the records of this species available to me are strictly dependent on limestone.

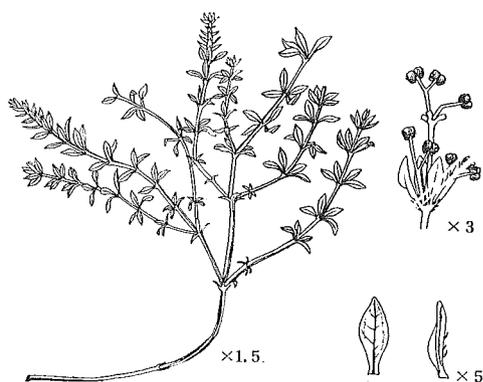


Fig. 13 *Galium minutissimum*, sp. nov.

Galium minutissimum T. SHIMIZU, sp. nov. (Fig. 13)

Caulis ascendens dense caespitosus 2~3cm altus ramosus 4-angulatus glaberrimus, internodiis inferioribus longioribus superioribus sursum brevioribus, nodiis saepe paucissime setuliferis. Folia cum stipulis 4-quasi-verticillata rhomboideo-oblonga vulgo 2mm longa 0.8mm lata, maxima 3mm longa 1mm lata apice obtusa basi attenuata, costis supra indistinctis subtus inferiore elevatis, venis lateralibus utrimque indistinctis, gla-

49) YAMAZAKI, T. (1962) Acta Phytotax. Geobot. 20:162.

bra sed subtus ad costas saepe setulis 2~3 ascendentibus vestita. Cyma terminalis vel axillaris pauciflora, pedicellis vix 2mm longis. Fructus reniformis setulis superiore paulo recurvis adpressis conspersus.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1800~2400m, T. SHIMIZU 12564—type (KYO).

Distr. Known only from the type locality.

This species is characterized by the extremely small habit, being only 2~3cm tall and bearing leaves less than 2mm long in majority. Compared with *G. morii* HAYATA, which is also a very small plant with leaves 2~3mm long, the present species is distinguishable in the difference in the leaf shape. According to HAYATA's description, the leaves of *G. morii* are round and trinervate bearing fine bristles on the nerves above. On the contrary, in *G. minutissimum* they are oblong-rhomboid and uninervate, being completely glabrous above. Consequently *G. minutissimum* corresponds with *G. tarokoense* HAYATA so far as the leaf shape is concerned. However, at the first sight this can be distinguished from that by its larger habit bearing larger leaves and larger cymes. The various characters of *G. tarokoense* and the comparison between these two species will be referred to in the next.

Anyway *G. minutissimum* was collected at only one site of the limestone ridge of Mt. Chingshui.

G. tarokoense HAYATA, Ic. Pl. Formos. 7:33, pl. 7 (1917).

An ascendent caespitose herb, 5~10cm tall. Stems glabrous but often slightly setuliferous at the nodes. Leaves with stipules 4-quasiverticillate, oblong-ovate attenuate toward the short petioles, triangular or round and mucronulate at the apex, 5~8mm long and 2~3mm broad, lateral veins indistinct, midribs more or less elevated on both sides, glabrous but often setuliferous on midribs above. Cymes 5~10mm long including peduncles 3~5 mm long, terminal or axillary, 3~10-flowered. Fruits densely covered with unciform setulae.

Loc. TAIWAN. Pref. Hualien: *Mt. Seisui (TAI); *Chongde to Wenshan (KYO); *Dangai, Taroko (TAI); Noko-goe (KYO); *Tienchang cliff (KYO); *Kirai to Sakahen, Tenchono-dangai (TAI).

Distr. Taiwan (Hualien Pref.).

Not only the type specimen, "Inter Shinjo et Batakan, S. SASAKI & B. HAYATA s. n. (TI)", but also all the specimens cited above must have been acquired from limestone crevices, though no detailed indication of the habitat was seen on any sheet except my own collections. In my experience it is strictly restricted to crevices in sunny limestone cliffs.

In spite of the original interpretation, the present species is sometimes hispid on midribs of the leaves above. Also in this respect it is different from *G. minutissimum* which is quite glabrous on the leaves above but sometimes hispid beneath only. Furthermore, apart from the remarkable difference of the plant size between them, the more or less petiolate leaves with above elevated midribs afford the other distinctions from *G. minutissimum*.

Hayataella michelloides MASAM., Trans. Nat. Hist. Soc. Formos. 24:206 (1934). (Fig. 14)

A creeping annual herb. Stems pubescent. Leaves opposite, ovate, entire,

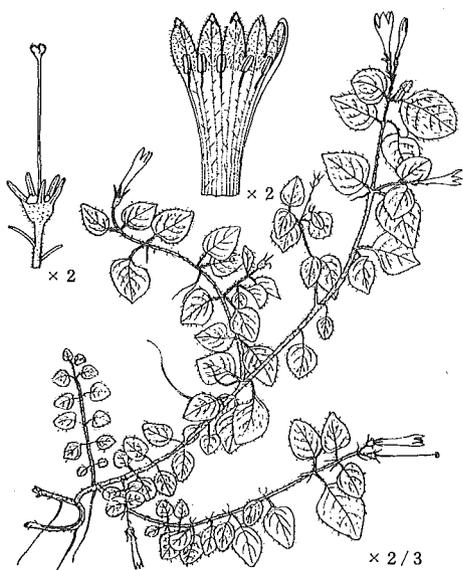


Fig. 14 *Hayataella michelloides*

Material: Chingshui to Chongde,
T. SHIMIZU 11135 (KYO).

(KYO); *the Tachingshui valley, T. SHIMIZU & M. T. KAO 11653 (KYO); *Taroko Forest, 1000m, M. TAMURA et al. 21400 (SHIN).

Distr. Taiwan (Hualien Pref.).

Only our collections above cited could be examined. Depending on them, I present here a drawing of the plant since no figures have yet published and no specimens seem to be in any herbarium of both Japan and Taiwan. The type specimen has been lost.

So far as the floral part is concerned, this genus is most affined to *Ophiorrhiza*. Both the genera, *Hayataella* and *Ophiorrhiza*, are characterized by bilocular ovary, numerous ovules, pentamerous flowers and tubiform corollae more or less pubescent inside. Although I could not see the fruits of *Hayataella*, MASAMUNE (l. c. 1934) states that they resemble those of *Ophiorrhiza*. Consequently distinction of the floral part between them is recognized only in shape of calyx tubes, of discs and of stigmas. It is on their vegetative part that we can easily discriminate these two genera as distinct. *Hayataella* is the creeping small herb with terminal and solitary or geminate flowers, while *Ophiorrhiza* is much larger and erect or ascendent perennial herbs with bostryx-like inflorescence.

I found the present species on mossy siliceous rock and on shady calcareous one. This is of much rare occurrence around there.

Abelia chinensis R. BR. var. *ionandra* (HAYATA) MASAM., Trans. Nat. Hist. Soc. Formos. 28:436 (1938); HARA, Enum. Spermat. Jap. 2:34 (1952).—*A. ionandra* HAYATA, Ic. Pl. Formos. 7:31, t. 5 (1917); KANEH., Formos. Tr. ed.

pubescent above, glabrous beneath, to 25mm long and 15mm broad; petioles 2~5mm long, pubescent. Flowers white, pedicellate, terminal, 1~2. Calyx tubes hemispheric, pubescent, ca. 2mm in diameter; calyx lobes 5, linearly lanceolate, ciliate or glabrous, ca. 2mm long. Corollae tubiform, 10~13mm long, sparsely pilose inside, 5-lobate at the apex; lobes triangular, ca. 3mm long, densely pubescent inside. Stamens adnate to the upper part of corollae; anthers oblong, ca. 1.5mm long; filaments filiform, ca. 2mm long. Ovaries 2-locular; styles filiform, glabrous, ca. 12mm long; stigmas verrucose and bifid. Ovules numerous in each locule.

Loc. TAIWAN. Pref. Hualien: Tungmen to Lungchien, ca. 500m alt., on mossy rock, T. SHIMIZU 11135

rev. 691, f. 646 (1936).—*A. chinensis* (non R. Br.) HAYATA, Mater. Fl. Formos. 138 (1911).

A deciduous ramose shrub, 1~1.5m tall. Young shoots reddish, villose. Leaves opposite, ovate to narrowly oblong, 1~2cm long, 4~15mm wide, glabrescent on both sides, 2~4-dentate on each side, cuneate to round at the base, acute toward the apex; petioles 1~2mm long. Flowers glomerated in terminal cymes, sessile, two-flowered; sepals 5, ciliate but later glabrescent, accrescent; corollae tubiform, tomentose outside; ovaries tomentose. Capsules oblong, about 5mm long, hirsute.

Loc. TAIWAN. Pref. Taipei: Neiliao, Keelung (TAI); Isl. Keelung (TAI). Pref. Hualien: *Mt. Chingshui, 600~1400m (SHIN); *Batakan to Tabito (KYO); Gukutsu (TAI); Tabito to Miharashi (KYO); Takimi (TAI); Eboshi to Takimi (TAI); *Panpien to Chilai (SHIN); *Tienchang cliff (SHIN); *Tienchang to Chilai (TAI); eastern coast of Taroko—type loc. of f. *salicina* MASAM. (TAI). Pref. Nantow: Onoue to Tonbara (TAI).

Distr. Taiwan and Liukiu (Isl. Okinawa and Isl. Amami).

Owing to no materials from the continent, I could not compare the Taiwan plants with the continental ones and here I would follow MASAMUNE's treatment to regard the former as a variety of the latter. Anyway the present plant is only one representative of *Abelia* for the Taiwan flora. In my opinion, f. *salicina* MASAM. is merely a young form of var. *ionandra* bearing narrower leaves.

Geographically the sunny rocky places of limestone in Hualien Pref. are the important dwellings of this plant, where it is one of the dominant plants. ***Viburnum carlesii* HEMSL. var. *bitchiuense* (MAKINO) NAKAI**, Bot. Mag. Tokyo 28: (295) 1914, ut *bitchuense*; NAKAI, Tent. Syst. Capr. Jap. 20 (1921); HATUSIMA, Acta Phytotax. Geobot. 4:208 (1935); HARA, Enum. Spermat. Jap. 2:55 (1952).—*V. bitchiuense* MAKINO, Bot. Mag. Tokyo 16:156 (1902).—*Solenolantana carlesii* (HEMSL.) NAKAI var. *bitchuense* (MAKINO) NAKAI, Journ. Jap. Bot. 24:14 (1949).

A deciduous small tree, to 3m tall. Buds naked, densely tomentose with rusty stellate hairs. Young branches likewise tomentose. Leaves ovate, 3~10 cm long, 1.5~7cm broad, round or subcordate at the base, triangular and obtuse at the apex, repand and mucronate-crenate on the margin, pubescent with stellate hairs on both sides; petioles 4~8mm long, likewise pubescent. Cymes terminal, 2~5cm across, without neutral flowers, pedunculate. Corollae hypocraterimorphous, shorter than 1cm long in tubes.

Loc. HONSHU. Pref. Okayama: *Kusama to Ikura, Niimi-shi (TNS); *Ishigasato, Niimi-shi (KYO); *Tanagase, Niimi-shi (KYO); Sabuse, Niimi-shi (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO); Oose, Nagato-mura, Jinseki-gun (KYO); Fujio-mura, Ashina-gun (KYO). SHIKOKU. Pref. Kagawa: Mt. Gongen, Isl. Shodo (KYO). Pref. Ehime: Isl. Toshima, Kitauwa-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kawaradake, Tagawa-gun (KYO); *Toogamine in Hiraodai, south of Kokura (KYO). Distr. West Honshu, Shikoku (Isl. Shodo and Isl. Toshima) and north Kyushu.

This is much resembling var. *carlesii* from Korea and Isl. Tsushima, being distinguishable from it in having triangularly ending leaves with obtuse apex and smaller flowers with longer pedicels and with long filaments being twice as long as anthers. In var. *carlesii*, the leaves are widely ovate to

roundly ovate acuminate toward the apex, and the flowers are 1~1.3cm long in corolla tubes and have anthers being twice as long as filaments.

Most records of the present plant are from the limestone field, though it comes from the siliceous fields in the coastal regions of Shikoku.

V. propinquum HEMSL. in FORBES et HEMSL., Ind. Fl. Sin. 1:355 (1899); HAYATA, Ic. Pl. Formos. 4:14, t. 3 (1914); NAKAI, Tent. Syst. Capr. Jap. 48 (1921); KANEH., Formos. Tr. ed. rev. 702, f. 659 (1936).—*V. recurvifolium* HOSOKAWA, in shed.

An evergreen glabrous shrub, to 2m tall. Buds not naked. Leaves coriaceous, lanceolate, acuminate toward the apex, cuneate at the base, remotely mucronulate-serrate, sometimes reflexed underneath, distinctly trinerved; petioles 1~2cm long, black-red; laminae 5~8cm long, 1.5~3.5cm broad; veins and veinlets impressed above, prominent beneath though veinlets indistinct. Cymes terminal, compoundly umbel-like, 3~5cm across, pedunculate; pedicellules 1~4mm long; calyces 1mm in diameter; calyx lobes triangular but round at the apex, 0.5mm long; corollae ca. 3mm long, halfly or more 5-lobed; lobes elliptical, reflexed in anthesis; stamens exerted.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 2400m (KYO); *ibid. 1150~1650m (SHIN); *ibid. 600~1400m (KYO); *Batakan-dangai, T. Hosokawa 5132—type of *V. recurvifolium* in shed. (TAI); *Suiroku-no-dangai, Taroko (TAI); Saramao (TAI); Tabito to Miharashi (KYO); *Shinjo to Tabito (KYO); *Mt. Tencho to Kiraikei (TAI); *Kiraikei (TAI); *Nokogoe (KYO); *Panpien to Chilai (SHIN); *Tienchang cliff (SHIN).

Distr. Taiwan (Hualien Pref.). China.

This species is characterized by the coriaceous and distinctly trinerved leaves. Contrary to KANEHIRA's interpretation and illustration (l. c. 1936), our materials present the corollae being profoundly 5-lobed up to more than half length of them. Owing to no materials from the continent at my hand, I cannot but refrain from agreement with HOSOKAWA's opinion that the Taiwan plants should be separated as another species, *V. recurvifolium* HOSOKAWA, from the continental *V. propinquum* HEMSL.

Geographically, in Taiwan this species is only known from Hualien Pref., and in my experience it is strictly confined to sunny limestone fields either forming shrubberies at rocky ridges or inhabiting cliffs sporadically.

Zabelia integrifolia (KOIDZ.) MAKINO ex HARA et HISAUCHI, Journ. Jap. Bot. 29: 144 (1954); SHIMIZU, Acta Phytotax. Geobot. 18:168 (1960).—*Abelia integrifolia* KOIDZ., Bot. Mag. Tokyo 29:312 (1915); NAKAI, Tent. Syst. Capr. Jap. 59 (1921); HARA, Enum. Spermat. Jap. 2:34 (1952).

A deciduous ramose shrub. Adult branches longitudinally 6-sulcate; this year's branches reddish, retrorsely pilose. Leaves chartaceous, obovate or elliptical-obovate, 2~5cm long, 1~2cm broad, acuminate toward both ends, entire or 2~3-incised on each side, pilose on both sides and also on the margin, shortly petiolate; petioles 2~5mm long, connate at the base and shortly sheathing. Flowers terminal 1 or 2, shortly pedicellate; calyx lobes 4, oblanceolate, 6~7mm long; corollae salverform, 1.5~2cm long, coarsely pilose both outside and inside, shallowly 4-lobed; lobes patent, 2~3mm long; stamens included, with pilose filaments. Achenes flat, 1.5cm long, pilose all over.

Loc. HONSHU. Pref. Gunma: *Iwato, Nanmoku-mura, Kanra-gun (TNS). Pref. Saitama: *Mt. Buko (KYO). Pref. Aichi: *Mt. Ishimaki, east of Toyohashi (KYO). Pref. Shiga: *Mt. Ibuki (KYO). Pref. Mie: *Mt. Fujiwara (KYO); *Kurakake-toge at the foot of Mt. Fujiwara (KYO); Mt. Oike (KYO); Mt. Nonobori (KYO); Miyama National Forest (KYO). Pref. Nara: *Kashiwagi, Kawakami-mura, Yoshino-gun (KYO); Obadani to Shirakawawatashi, Yoshino-gun (KYO). Pref. Osaka: Yamamoto, Kawabegun (TNS). Pref. Okayama: *Tanagase, Niimi-shi (KYO); *Shoden, Niimi-shi (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO); Fujio-mura, Ashina-gun (KYO). SHIKOKU. Pref. Tokushima: Ookubo, Aioi-cho, Naka-gun (TNS). Pref. Kochi: *Mt. Ishidate (KYO); *Hirose, Tosayama-mura, Tosa-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO). KYUSHU. Pref. Fukuoka: *Mt. Kwaradake, Tagawa-gun (KYO); Isl. Ooshima, Munakata-gun (KYO). Pref. Kumamoto: *Mt. Noke-eboshi, Kuma-gun (KYO). Pref. Nagasaki: Isl. Tsushima (KYO).

Distr. Middle and west Honshu, Shikoku and Kyushu.

Basing upon IKUSE and KUROSAWA's morphological analysis of this plant⁵⁰, it was validly separated from the related genus, *Abelia*. Six-sulcate branches, pilose young shoots, basally connated petioles, salviform corollae without distinct dorsoventrality, etc. are important characters of this genus.

Geographically this species occurs very rarely and much discontinuously throughout Honshu to Kyushu, and almost always in sunny limestone fields. The above noted localities are nearly all known up to the present (cf. HARA and KANAI⁵¹).

Patrinia glabrifolia YAMAM. et SASAKI, Trans. Nat. Hist. Soc. Formos. 19:106 (1929); YAMAM., Suppl. Ic. Pl. Formos. 5:31 (1932).

A perennial herb, 30~100m tall. Stems 5~6mm across, pubescent merely on the upper part. Rosulate leaves opposite, 10 or so jugate, coriaceous, completely glabrous, oblong-lanceolate, 5~20cm long, 2~5cm broad, acute at the apex, long acuminate toward the base, roughly dentate on each side; petioles 2~5cm long but indistinct because of the long decurrent blades, connate-perfoliate. Cauline leaves equal to rosulate ones in shape and texture but smaller upward, remotely 3~5-jugate. Cymes divaricate, duplicately corymbose; primary axes biserially pubescent, but branches and branchlets pubescent only on adaxial side; bract linear, smaller upwards. Corollae yellow, infundibuliform, 3mm long, halfly 5-lobed; lobes elliptical, patent; tubes pilose inside; calyces reduced to be annular; stamens 4, adnate at the base of the corolla, exserted; filaments pilose beneath; ovaries obovate, 2mm long, pilose backward; bracteoles obovate, 1.2mm long, shallowly trilobed at the apex, glabrous, accrescent. Fruits densely pilose.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1500~2400m (KYO); *Naitaroko (TAI); *ad saxum, Taroko (TAI); *Dangai, Taroko (TAI); *Batakan Dangai (TAI); *Suiroku-no-dangai (TAI); *Chongde to Wenshan (TAI); Noko-goe (KYO); Sakahen (TAI); *Sakahen to Kiraikei (TAI); Kiraikei (KYO); *Tencho-riosen (TAI); *Mt. Tarokotaizan (TAI).

Distr. Taiwan (Hualien Pref.).

Compared with *P. formosana* KITAM., the present species is characterized

50) IKUSE, M. & KUROSAWA, S. (1954) Journ. Jap. Bot. 29:107-110.

51) HARA, H. & KANAI, H. (1959) Distr. Maps Fl. Pl. Jap. 2. Map 187.

by the glabrous stem and the glabrous coriaceous leaves. It is known only from Hualien Pref., growing on sunny limestone bluffs. All of its records above cited are probably owed to limestone crevices even in the unasterisked cases.

Adenophora maximowicziana MAKINO, Bot. Mag. Tokyo 20:38 (1906); HARA, Enum. Spermat. Jap. 2:88 (1953). — *A. verticillata* FISCH. var. *maršpiiflora* (non TRAUTV.) MAKINO, Bot. Mag. Tokyo 12:(61) (1898).

A glabrous perennial herb, 40~60cm tall. Radical leaves ovate to cordate, long petiolate. Cauline leaves alternate, linearly lanceolate, attenuate toward both ends, nearly entire, 8~20cm long, 5~10mm broad, smaller upward; petioles indistinct. Inflorescences terminal, divaricate. Pedicels filiform, 2~6cm long; sepals linear, entire, 4~6mm long; corollae campanulate, about 1cm long, white; discs tubiform, 2mm tall, longer than width.

Loc. SHIKOKU. Pref. Ehime: *Oonogahara (KYO). Pref. Kochi: *Shirosari, Higa-shitsuno-mura, Takaoka-gun (KYO); *Mt. Yokogura, Takaoka-gun (KYO); *Nanokawamura, Takaoka-gun (TI).

Distr. Shikoku.

This species is characterized by slender and nearly entire leaves, long filiform pedicels, white corollae and tubiform discs.

Geographically it is very rarely known only from the above denoted several localities, where, as YAMANAKA⁵² pointed out, it exhibits a strict connection with limestone fields. In addition the chromosome number was proved to be 34 in somatic cells likewise in some other species of the genus⁵³.

A. pereskiaefolia FISCH. var. **moiwana** (NAKAI) HARA, Journ. Jap. Bot. 26:281 (1951) & Enum. Spermat. Jap. 2:90 (1952); SHIMIZU, Acta Phytotax. Geobot. 17:86 (1958). — *A. moiwana* NAKAI, Bot. Mag. Tokyo 36:126 (1922).

A perennial small herb, 10~30cm tall. Stems decumbent, glabrous. Cauline leaves hard chartaceous, usually 3~4-verticillate but alternate upward, ovate, 2.5~6.5cm long, 1~2cm broad on the middle part of the stem, widely cuneate at the base, acute toward the apex, crenate; petioles indistinct. Inflorescences single to paniculate. Sepals lanceolate, entire, 3~4mm long; corollae campanulate, 15~20mm long; styles long exserted; discs flat, about 0.8mm tall.

Loc. HOKKAIDO. Prov. Ishikari: Mt. Moiwa—type loc. (TI); Mt. Goken (KYO). Prov. Hidaka: Mt. Apoi, serpentine (KYO); Horoman, Samani-mura, Samani-gun (KYO); Horoman to Omeshibe (TI); Mt. Rakuko (TI); Mt. Toyoni (TI); Mt. Tokachi (TI). HONSHU. Pref. Aomori: *Mt. Kappata, Shiriya-cape (TI). Pref. Iwate: *Akka, Iwaizumi-cho, Shimohei-gun (KYO); Mt. Hayachine, serpentine (KYO).

Distr. Hokkaido and north Honshu.

Var. *pereskiaefolia* from the continent is the robust plant with taller erect stems and with steadily verticillate larger leaves. Compared with this, the present variety is characterized by small and usually decumbent habit. In Hokkaido it is sporadically found on rocky places such as serpentine areas, while the limestone areas in the prefectures of Aomori and Iwate present its

52) YAMANAKA, T. (1954) Acta Phytotax. Geobot. 15:15.

53) cf. DARLINGTON, C. D. & WYLIE, A. P. (1955) Chrom. Atlas Fl. Pl. 289.

important records in Honshu.

f. **petrophila** (HARA) T. SHIMIZU, l. c. 86 (1958).—*A. petrophila* HARA, Journ. Jap. Bot. 11:826 (1935).—*A. nikoensis* FR. et SAV. var. *petrophila* (HARA) HARA, Journ. Jap. Bot. 13:468 (1937) & l. c. 89 (1952).

Different from f. *moiwana* in having lanceolate to oblongly lanceolate leaves being 3~10cm long and 0.6~2.5cm broad.

Loc. HOKKAIDO. Prov. Iburi: Date-cho, Usu-gun (KYO). Prov. Oshima: *Kamiiso-cho, Kamiiso-gun—retroresely hispid on leaves beneath (KYO). HONSHU. Pref. Iwate: *Akka, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Takeyama, Shimohei-gun (SHIN); *Sennin-pass, Toono-shi (KYO); *Geibikei, Higashiwai-gun (KYO). Pref. Miyagi: Iwakami, Akiu-mura, Natori-gun (KYO). Pref. Gunma: Mt. Myogi, siliceous rock (KYO). Pref. Saitama: ? *Mt. Buko (KYO); *Mt. Akasawa, Chichibu-gun, recorded as ?*A. nikoensis* in Chapter III, p. 36 (SHIN).

Distr. Southwest Hokkaido and north and middle Honshu.

This form is characterized by the falcately elongated leaves. But, this group is much difficult to be clearly defined. The plants from Mt. Myogi and Mt. Akasawa present the comparatively steadily verticillate leaves, the large flowers with 4~5mm long entire sepals and with 2cm long corollae and the divaricate inflorescences, though a few plants of Mt. Akasawa are provided with dentate sepals extending to 8mm long. In the plants from Iwate Pref., on the other hand, the inflorescences are similarly divaricate, but the leaves are loosely verticillate and the flowers are smaller with 3~4mm long sepals and about 15mm long corollae. Therefore, as I (l. c. 1958) pointed out, they are related on one hand to *A. moiwana* in having small flowers and on the other hand to *A. petrophila* in having divaricate inflorescences. Although HARA (l. c. 1935) mentions that *A. petrophila* differs from *A. moiwana* in having longer and narrower leaves without retrorse hairs beneath and more spreading branches of inflorescences, it will be more relevant not to regard them as two different species. For, the same author (l. c. 1951) was aware of a fact that the inflorescence of *A. moiwana* was usually simple but sometimes branching, and for, the both forms with lanceolate leaves (*A. petrophila*) and with ovate leaves (*A. moiwana*) are occurring side by side in the limestone district of Iwate Pref. Consequently the distinction between these two forms is merely recognizable in the difference of leaf shape. This is a reason why I combined *A. petrophila* with *A. moiwana* as a form. However, it is worth notice that f. *petrophila* is mainly distributed in Honshu, whereas f. *moiwana* in Hokkaido.

The plants of Kamiiso-cho in Hokkaido have steadily verticillate leaves retroresely hispid on midribs beneath and simple inflorescences with large flowers. In these respects, they might have to be referred to a form within var. *heterotricha* (NAKAI) HARA.

f. **linearifolia** T. SHIMIZU, l. c. 87 (1958).

Different from the preceding two forms in linear leaves being about 6cm long and 3mm or so broad.

Loc. HONSHU. Pref. Iwate: *Akka, Iwaizumi-cho, Shimohei-gun—type loc. (KYO); *Mt. Takeyama, Shimohei-gun (SHIN).

Distr. Honshu (Iwate Pref.).

This form is known only from the above noted localities. Around there three forms of var. *moiwana* are always growing on sunny limestone cliffs and sometimes side by side.

A. *teramotoi* HURUSAWA ex YAMAZAKI, Journ. Jap. Bot. 27:199 (1952).

A perennial pendulous herb. Cauline leaves alternate, narrowly lanceolate to linearly lanceolate, 5~20cm long, 5~15mm broad, acuminate toward the apex, nearly sessile, remotely dentate along the margin, minutely hispid on the midrib and on the marginal part above, completely glabrous to minutely hispid on the midribs beneath. Inflorescences divaricate. Calyx lobes lanceolate, entire. Discs about 1.5mm tall, as tall as width.

Loc. HONSHU. Pref. Nagano: *Mt. Shiraiwa, Kamiina-gun (KYO); *Makuiwa and *Shiraiwa, Todai, Hase-mura, Kamiina-gun—type loc. (KYO); *Mt. Jizodake, Kamiina-gun (KYO); *Mt. Toyokuchi, Shimoina-gun (KYO). Pref. Yamanashi: foot of Mt. Kitadake (KYO).

Distr. Middle Honshu.

This species is characterized by pendulous habit and alternate narrow leaves. The plant from the type locality is provided mostly with linear and elongated leaves being completely glabrous beneath, while that from the other localities has somewhat wider and shorter leaves being thinly hispid also on the undersurface. However, they can be separated on one hand from *A. nikoensis*-group by the pendulous habit, the divaricate inflorescences and the taller discs, and on the other hand from *A. divaricata* FR. et SAV. by the pendulous habit and the narrower alternate leaves being not puberulous. My experience of cultivation since 1959 exhibits that the pendulous habit of *A. teramotoi* is one of the steady characters.

Geographically the present species is known from limestone bluffs in the Akashi mountain region. But the plants from Mt. Kitadake are not clarified with regard to their habitats.

Var. ***hispidula*** T. SHIMIZU, var. nov.

Abs typo distinguenda: foliis distincte ciliatis subtus aperte hispidulis, corollis majoribus 15~20mm longis.

Loc. HONSHU. Pref. Nagano: *Tsubameiwa, Oojika-mura, Shimoina-gun, M. FURUSE s. n. Aug. 30, 1931—type (KYO); *ibid., T. SHIMIZU 5299 (KYO & SHIN).

Distr. Known only from the type locality.

This plant can be distinguished from var. *teramotoi* by the leaves being conspicuously ciliated and apparently hispid beneath and by somewhat larger flowers with exerted styles. Var. *teramotoi*, as mentioned above, is thinly and minutely hispid on the marginal part on the leaves above but not ciliated. Its flowers present 10mm or so long corollae and hardly or shortly exerted styles.

The present plant is hanging down from the limestone bluff named Tsubameiwa in the upper district of the Aoki river in the southern part of Nagano Pref. ***Anaphalis sinica*** HANCE var. ***pernivea*** T. SHIMIZU, var. nov.

A var. *sinica* distinguenda: omnibus partibus semper dense albo-lanatis.

Loc. HONSHU. Pref. Nagano: *Makuiwa, Todai, Hase-mura, Kamiina-gun, T. SHIMIZU 5691—type (KYO; isotype in SHIN).

Distr. Known only from the type locality.

This is the extreme form with regard to hairiness of the plant, being densely white-lanate on all parts of the plant during the whole season. Around its type locality, also the plants referable to var. *sinica*, which are not so densely lanate especially on leaves above, occurs abundantly. The plant corresponding to the present variety is rather few.

It is interesting that the same relationship is seen between *Leontopodium japonicum* MILD. and its variety, var. *perniveum* (HONDA) KITAM. Var. *perniveum* is a similarly white-lanate form and occurring in the same locality, too.

On the other hand, var. *sinica* is widely distributed in the continent as far as Tibet. In Japan it occurs mainly in middle Honshu, and rarely in west Honshu, Shikoku and Kyushu⁵⁴. In the former case it is a common but not exclusive plant of the limestone field, while in the latter case it is strictly confined to the limestone field.

Artemisia somai HAYATA var. **batakensis** (HAYATA) KITAM., Acta Phytotax. Geobot. 9:32 (1940) & Compos. Jap. 2:393 (1940).—*A. batakensis* HAYATA, Ic. Pl. Formos. 8:64 (1919).

A perennial herb with bold rhizomes, 15~40cm tall. Leaves 4~10cm long, 2~4.5cm broad, pinnately lacinate, densely white-lanate beneath and thinly above; laciniae 2~5-jugate, 2~4mm wide. Inflorescence 1~7, axillary, 15~30cm long, shortly branching. Heads 4~6mm long and so wide, shortly pedunculate, secund. Involucres white-lanate; scales 3~4-seriate, imbricate. Hermaphrodite florets fertile. Achenes barbate at the apex.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1000m (KYO); *ibid. 1000~1800m (KYO); *ibid. 1150~1400m (KYO); *ibid. 1400~2000m (KYO); *Batakan to Tabito (KYO); *Shinjo to Tabito (KYO); *Tienchang cliff (KYO); *Panpien to Chilai (KYO); Noko-goe (KYO); Tomiri to Ruran, Tamazato-gun (KYO).

Distr. Taiwan (Hualien Pref.).

In appearance this is much resembling var. *somai*, being distinguished from it by having barbate achenes.

Var. *somai* is an alpine and silicolous plant of the central mountains, while var. *batakensis* is calcicolous, growing either on sunny rocky ridges or on sunny bluffs of limestone. In my experience it was never found outside of the limestone field.

Chrysanthemum makinoi MATSUM. et NAKAI, Bot. Mag. Tokyo 42:462 (1928); KITAM., Compos. Jap. 2:357 (1940); HARA, Enum. Spermat. Jap. 2:160 (1952). Tetraploid race. A perennial herb. Leaves ovate, usually trilobed, cuneate at the base, pubescent above, densely cinereo-tomentose beneath; lobes dentate, acute at the apex. Heads 2.5~5cm across. Ligulate flowers white. Pollen grains elliptical, about 40 μ in long axis. Somatic chromosome number 36.

Loc. HONSHU. Pref. Shiga: *Mt. Ibuki (KYO); *Mt. Ryozen (KYO).

Distr. Middle Honshu.

In my previous paper⁵⁵, I reported that *C. makinoi* was completely repre-

54) cf. HARA, H. & KANAI, H. (1958) Distr. Maps Fl. Pl. Jap. 1: Map. 67.

55) SHIMIZU, T. (1962) Journ. Jap. Bot. 37:16-20.

sented by the tetraploid form both in Mt. Ibuki and Mt. Ryozen. There it occurs abundantly on open gravelly grasslands of limestone at upper elevation and occasionally on siliceous fields at lower elevation. Its morphological distinction from the ordinary form is merely found in pollen grains. Those of the diploid *C. makinoi* are spherical and about 30μ in diameter.

Geographically the present tetraploid race might be restricted to the Ibuki and the Suzuka mountains. An elaborate investigation of TANAKA⁵⁶ could not detect the tetraploid of this species so far as west Japan was concerned. *C. morii* HAYATA, Ic. Pl. Formos. 8:61 (1919); KITAM., Acta Phytotax. Geobot. 9:30 (1940) & Compos. Jap. 2:352 (1940), excl. syn.

A procumbent perennial herb. Leaves obovate, 2.5~5.5cm long, 1~4cm broad, long attenuate toward the base, palmately or pinnately 3~5-lobed, pubescent or more or less glabrescent above, densely argentate-lanate beneath; veins palmate or nearly so; lobes acute at the apex, sometimes a few dentate. Heads terminal and solitary on branches, 2.5~4cm across, long pedunculate. Involucres hemispherical, about 1.5cm across; scales imbricate, outer scales larger than inner ones. Ligulate flowers white, 1~1.5cm long, 3~4mm wide.

Loc. TAIWAN. Pref. Hualien: *Mt. Chingshui, 1150~1400m (KYO); *Chongde to Shaochingshui (KYO); *Batakan to Tabito (KYO); *Patakang to Tienhsiang (KYO); *Naitaroko (TAIF); *ibid., on cliff (TAIF); *Panpien to Chilai (KYO); *Tienchang cliff (SHIN); Chakan-kei 5000ped.—type loc. (TI).

Distr. Taiwan (Hualien Pref.).

The procumbent habit, the leaves having long attenuate base and silvery undersurface and the solitary large heads are the important characters for this species. On the other hand, *C. horaimontanum* MASAM. from Mt. Sikayotaizan was regarded as same with the present species by KITAMURA (l. c. 1940). Examining the type specimen of that, "Mt. Sikayotaizan, K. MORI s. n. Oct. 25, 1936 (TAI)", however, I arrived at the conclusion that these two species were separable each other. *C. horaimontanum* has in most cases pinnately 5-fid leaves with pinnatilobed or pinnatidentate laciniae. Accordingly their secondary veins are pinnate but not palmate. In these respects, its leaves are rather like those of *C. arisanense* HAYATA. The undersurfaces of the leaves of *C. horaimontanum* are sordid to be brownish in tint. Its ligulate flowers are smaller being 5~6mm long in corolla length. It is an alpine plant and known also from Mts. Tsugitaka 8000ft. (T. SHIKANO s. n. TAI).

Anyway *C. morii* is abundantly colonizing on the surface of sunny limestone cliffs or on screes around the localities cited above. I came across this plant nowhere outside of the limestone field. Although the type specimen is noted as "Taito, Chakan-kei, 5000 ped.", the valley Chakan-kei is not situated in Taito (Taitung) Pref. but in Hualien Pref. Probably it was brought from a limestone cliff in the upper district of this river.

C. zawadskii HERB., Add. Fl. Galic. 43, t. (1831); KITAM., Compos. Jap. 2:360, t. 6, f. 1 (1940); HARA, Enum. Spermat. Jap. 2:166 (1952); SHIMIZU, Acta Phytotax. Geobot. 17:111 (1958).—*C. hakusanense* MAKINO, Bot. Mag. Tokyo

56) TANAKA, R. (1959) Journ. Sci. Hiroshima Univ. ser. B, Div. 2 (Bot.) 9:17-30.

24:302, f. 21 (1910).

A perennial erect herb, 10~60cm tall. Radical leaves bipinnatisect, 3~8 cm long, 1~4cm broad, long petiolate, nearly glabrous on both sides, gland-dotted beneath; petioles 2~4.5cm long. Heads terminal and solitary on branches, 3~6cm across. Involucres 6~7mm long; scales 3-seriate, nearly equal in length, outer scales linear and inner ones ovate. Ligulate flowers white. Achenes about 2mm long, much mucous when get wet.

Loc. HONSHU. Pref. Iwate: *Okawame, Kuji-shi (KYO); *Akka, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Ureira, Shimohei-gun (KYO); *Mt. Kakeyama, Shimohei-gun (KYO). Pref. Ishikawa: Mt. Hakusan, on andesite (KYO). Pref. Fukui: Mt. Karasudake, Oono-gun (KYO); Mt. Sannomine, Oono-gun (KYO). Pref. Nara: Mt. Odaigahara (KYO). Pref. Tottori: Mt. Senjo, on andesite (KYO). SHIKOKU. Pref. Kochi: Mt. Kanpu (KYO). KYUSHU. Pref. Miyazaki: * Mt. Dadake, Nishiusuki-gun (KYO); *Mt. Shiraiwa, Higashiusuki-gun (KYO). Pref. Kumamoto: *Mt. Noke-eboshi, Kumagun (KYO).

Distr. Honshu, Shikoku and Kyushu. Korea, Manchuria, north China and Siberia to Carpathia.

This chrysanthemum is characterized by the nearly glabrous and membranaceous leaves and the solitary large heads with white florets. Although the leaves are usually narrowly bipinnatisect, as stated in my previous paper⁵⁷, some plants from Iwate Pref. are provided with the leaves accordant with those of var. *latilobum* (MAXIM.) KITAM. in shape. I called such plants "broadly lobed race". Var. *latilobum* is in Japan known from only three localities, viz. Mt. Isomadake, Isl. Hirato and Isl. Tsushima all in Kyushu, where it occurs never sympatrically with var. *zawadskii* and has the larger heads extending to 8cm across.

The somatic chromosome number⁵⁸ was proved to be always 54 both in var. *zawadskii* and var. *latilobum* and regardless of the habitat so far as the Japanese plants are concerned.

C. zawadskii is a relic polyploid species being distributed widely but much discontinuously, and its occurrence often owes to limestone fields. Besides the above cited localities, recently one more record was added by YAMANAKA⁵⁹, who found it growing on limestone in Mt. Torigata of Kochi Pref. in Shikoku.

Leontopodium hayachinense HARA et KITAM. var. **miyabeanum** S. WATANABE, Acta Phytotax. Geobot. 16:127 (1956).

A caespitose perennial herb. Stems ascendent or erect, 7~20cm tall, lanate with white hairs. Cauline leaves linear or linearly oblanceolate, 1.5~3.5cm long, 2.5~7mm broad, usually obtuse at the apex, somewhat amplexicaul, densely white-lanate beneath but thinly above. Rosulate leaf present in anthesis, more or less acute at the apex. Heads 4~9, glomerate. Involucres globose, 5.5mm long; scales wooly tomentose outside. Corollae 3~4mm long, glabrous but slightly pilose on lower parts.

57) SHIMIZU, T. (1958) Acta Phytotax. Geobot. 17:107-112.

58) ——— (1961) Journ. Jap. Bot. 36:176-180.

59) YAMANAKA, T. (1962) Acta Phytotax. Geobot. 20:64.

Loc. HOKKAIDO. Prov. Shiribeshi: *Mt. Oohira, Shimamaki-gun—type loc. (KYO).
Distr. Known only from the type locality.

According to the original interpretation, this is different from var. *hayachinense* in densely arranged cauline leaves being broader and obtuse at the apex and in corollae being slightly pilose on the lower part. WATANABE⁶⁰ reported that it came from cliffs or rubbly slopes of limestone.

L. japonicum Miq. var. **perniveum** (HONDA) KITAM., Compos. Jap. 1:229 (1937); HARA, Enum. Spermat. Jap. 2:225 (1952).—*L. perniveum* HONDA, Bot. Mag. Tokyo 46:374 (1932).—*L. japonicum* f. *perniveum* (HONDA) OHWI, Bull. Nat. Sci. Mus. Tokyo no. 33, 87 (1953).

An erect small herb, 10~20cm tall. Stems densely white-lanate. Rosulate leaves absent in anthesis. Cauline leaves lanceolate, about 2cm long, 5~7mm broad, acute at the apex, densely white-lanate on both sides but less on the uppersurface.

Loc. HONSHU. Pref. Nagano: *Makuiwa and *Shiraiwa, Todai, Kamiina-gun (KYO); along the Koshibu-gawa, Oojika-mura, Shimoina-gun, 1100m (TI).

Distr. Honshu (Nagano Pref.).

This variety is distinguishable from var. *japonicum* by the smaller leaves being densely lanate on both sides. YAMAZAKI⁶¹ pointed out that this plant was occurring only on limestone cliffs or screes in Todai of Nagano Pref., and I also could not see it outside of the limestone field there around. Probably the type specimen, "Todai-gawara, MATSUNAMI et al., Jul. 18, 1931 (TI)", came from the same limestone cliffs there. Regarding another record of it from Oojika-mura, the habitat is not clarified.

Var. *japonicum* is a frequent plant of the limestone field and, to be noticed, strictly confined to limestone rubbly ridges in Kyushu.

Senecio furusei KITAM., Acta Phytotax. Geobot. 14:147 (1952).

A perennial herb, 45cm or so tall. Stems erect, branching at the upper part, araneously pubescent. Rosulate leaves oblanceolate, membranaceous, 4~5.5cm long, with long alate petioles, araneously puberulous on both sides. Cauline leaves similar to the rosulate, 8~8.5cm at the middle part of the stem, amplexicaul. Heads several in the lax corymb, 2.5~3cm across. Involucres 5~7mm long, 10~14mm across, puberulous, ebracteate. Ligulate flowers yellow, uniseriate; ligules 12~16cm long; tubes 2.5~3.5mm long. Tubular flowers yellow, 5.5~9mm long. Achenes hirsute.

Loc. HONSHU. Pref. Gunma: *Nakazato-mura, Tana-gun (TNS). Pref. Saitama: *Mt. Futago—type loc. (KYO).

Distr. Known only from the type locality and its surroundings.

This is characterized by having yellow corollae, by which it is distinguished from both the related species, *S. flammeus* TURCZ. ssp. *glabrifolius* (CUFOD.) KITAM. and *S. takedanus* KITAM. According to MORIYA⁶², it is growing on limestone only in Mt. Futago which stands over the border district between both prefectures of Saitama and Gunma. Probably the specimen only

60) WATANABE, S. (1956) Acta Phytotax. Geobot. 16:189.

61) YAMAZAKI, T. (1952) Journ. Jap. Bot. 27:198.

62) MORIYA, T. (1958) Acta Phytotax. Geobot. 17:82.

noted as "Nakazato-mura" also came from the same limestone field.

Youngia yoshinoi (MAKINO) KITAM., Acta Phytotax. Geobot. 11:127 (1942) & Compos. Jap. 4:122 (1955).—*Lactuca denticulata* MAXIM. var. *yoshinoi* MAKINO, Bot. Mag. Tokyo 24:302 (1910).—*L. yoshinoi* (MAKINO) MAKINO et NAKAI, Bot. Mag. Tokyo 26:327 (1912).—*Paraixeris yoshinoi* (MAKINO) NAKAI, Bot. Mag. Tokyo 34:158 (1920); HARA, Enum. Spermat. Jap. 2:234 (1952).—*Ixeris yoshinoi* (MAKINO) KITAM., Acta Phytotax. Geobot. 6:273 (1937).

A perennial glabrous herb, 7~50cm tall. Radical leaves emarced in anthesis, elliptical or oblong-ovate, 5~20cm long, 17~36mm broad, remotely mucronulate on the margin, long decurrent toward the base; petioles 2.5~10cm long. Cauline leaves oblong-lanceolate or oblanceolate, 4.5~12cm long, 10~25mm broad, long attenuate toward the base; petioles 0.5~1cm but more or less indistinct because of the decurrent laminae, remotely mucronulate on the margin, never amplexicaul at the base. Heads somewhat numerous in terminal or axillary corymbs; peduncles slender, 4~10mm long; bracts 1~3, ovate, 0.5~1mm long. Involucres cylindrical, 7~8mm long, 2.5~3mm across; outer scales ovate, 0.5~1mm long; inner ones 5, linearly oblong. Florets 5~6; corollae yellow, 9~13mm long; tubes 3~3.5mm long, puberulous. Achenes fusiform, a little compressed, 4mm long, 0.7mm wide, very shortly rostrate. Pappi white, 3.5mm long, bristles scabrous, singly caducous.

Loc. HONSHU. Pref. Okayama: *Hayama, Nariwa-cho, Kawakami-gun—type loc. (KYO); *Ikawa, Hirakawa-mura, Kawakami-gun (KYO); *around the limestone cave, Hirasomura, Kawakami-gun (KYO); *Tanagase, Niimi-shi (KYO); *Ikura to Ishiga, Niimi-shi (KYO). Pref. Hiroshima: *Taishakukyo, Hiba-gun (KYO).

Distr. Honshu (Okayama and Hiroshima Pref.).

This is a perennial herb characterized by the leaves being not amplexicaul and the florets in small number in a head. Its most related species, *Y. denticulata* (HOUTT.) KITAM., presents distinctly amplexicaul leaves and 10~13-florets in a head. The somatic chromosomes of *Y. yoshinoi* was proved to be 10⁶³ likewise in *Y. denticulata* and *Y. chelidonifolia* (MAKINO) KITAM.

Geographically the present species is strictly confined to the limestone districts both in Okayama and Hiroshima Pref., growing on sunny limestone cliffs or on rubbly places at their foot. Though *Y. denticulata* is also occurring on limestone around there, it is an apparently indifferent species usually growing on open waste lands throughout Japan.

Monocotyledoneae

Festuca ovina L. var. **chiisanensis** OHWI, Acta Phytotax. Geobot. 10:111 (1941).

A perennial caespitose plant. Culms 20~40cm tall, pubescent on the upper part. Leaves less than 3mm in width, tender in texture, sulcate. Inflorescence paniculate, 4~8cm long. Spikelet 5~7mm long, 3~6-floriferous. Glumes 2.5~3.5mm long, lanceolate, acute at the apex. Lemmae 3.5~4.5mm long, awned. Anthers 1.5~2.5mm long.

63) SHIMIZU, T. (1958) At the 23rd Meeting of the Botanical Society of Japan.

Loc. SHIKOKU. Pref. Tokushima: *Mt. Tsurugi (KYO).

Distr. Shikoku. South Korea.

The present grass is characterized by the pubescent culms and grooved leaves. According to the correspondence with YAMANAKA, it is growing on limestone in the above-noted mountain, which is its sole inhabitation throughout Japan.

Carex peikutusani KOMAR., Acta Hort. Petrop. 18:445 (1901); OHWI, Cyper. Jap. 1:315 (1936); AKIYAMA, Caric. Far East. Reg. 110, t. 99 (1955); OMURA et KOYAMA, Journ. Jap. Bot. 31:192 (1956).—*C. hancockiana* MAXIM. var. *peikutusani* (KOMAR.) KUEKENTH., Cyper.-Caric. 395 (1909).

Culms scabrous, with purple basal sheaths. Leaves 2~4mm broad. Spikes 3~4, cernuous, 10~25mm long, long pedunculate; terminal spikes gynaeandrous; lateral ones female; bracts setaceous, not sheathing at the base. Pistillate scales ovate, acute at the apex, tawny, nearly as large as perigynia. Perigynia flat-trigonal, glabrous, pale green, 3~3.5cm long, finely plurinerved, acutely bifid at the apex, loosely inclosing an achene. Achenes trigonal, 2mm long, without appendages at the apex; stigmas 3.

Loc. HONSHU. Pref. Nagano: *Mt. Toyokuchi, Shimoina-gun, 2500m (TI).

Distr. Honshu (Nagano Pref.). Korea, Manchuria and Amur.

From the nearest species, *C. japonalpina* T. KOYAMA, which is found rarely in the alpine zone of Honshu, the present species is well distinguished by its tawny pistillate scales. OMURA and KOYAMA (l. c. 1956) detected this sedge on the exposed limestone in the mountain above cited.

Lilium bukosanense HONDA, Ic. Pl. As. Orient. 4:404 (1942).

Stems slender, 30~50cm long, pendulous but ascendent on the upper part. Leaves alternate, narrowly lanceolate to linear, 5~8cm long, 4~10mm broad, attenuate toward the apex, sessile, 3~5-nerved, scabrous on the margin and on the veins beneath. Flowers terminal, usually solitary, directed upward; perianths orange, maculate, lanceolate, 8~10cm long, 2~2.5cm broad, obtuse at the apex, reflexed in anthesis.

Loc. HONSHU. Pref. Saitama: *Mt. Buko—type loc. (TI).

Distr. Known only from the type locality.

This lily is very near to *L. maculatum* THUNB., being different from it in the pendulous slender stems, the narrower leaves and the reflexed perianths.

L. maculatum is usually growing on the coastal rocks in Honshu and Shikoku, though in Iwate Pref. it is abundantly inhabiting limestone cliffs about 15km far from the sea coast. *L. bukosanense* is hanging down from limestone cliffs in Mt. Buko. These are of rare examples in which the lilies grow on limestone.

Smilax elongato-reticulata HAYATA, Mater. Fl. Formos. 357 (1911) & Ic. Pl. Formos. 9:127, f. 43, 7-14 (1920).—*S. elongato-umbellata* f. *elongato-reticulata* (HAYATA) T. KOYAMA, Quart. Journ. Taiwan Mus. 10:12 (1957).

A decumbent ramose subshrub. Stems smooth or loosely prickly. Leaves coriaceous, oblongly ovate to narrowly lanceolate, 2.5~10cm long, 0.5~3cm wide, glabrous, gradually attenuate toward the apiculate apex, round at the base, 3- or 5-nerved; veins and veinlets prominent on both sides; petioles 5~10mm long, alate at lower half and sheathing, cirrhose. Inflorescences simple

umbels, 4~10-floriferous; peduncles 10~20mm long. Flowers with pedicels 7~10mm long; perianths 4.5~5mm long, erect or slightly patent in anthesis. Fruits globose, bluish black, pruinose, 6~8mm across.

Loc. LIUKIU. Isl. Okinawa, Futenkanchiho (KYO). TAIWAN. Pref. Hualien: *Mt. Chingshui, 600~1400m (KYO); *ibid. 1150~1400m (KYO); *ibid. 1400~2100m (KYO); *ibid. 1800~2400m (KYO); *Chingshui to Chongde (KYO); *Batakan to Tabito (KYO); Tabito to Karapao (KYO); *Tienchang cliff (SHIN); *Panpien to Chilai (SHIN). Pref. Taichung: Pianan-anbu to Shikayosha (KYO). Pref. Kaohsiung: Aderu to Shimopaiwan (KYO).

Distr. Liukiu (Isl. Okinawa) and Taiwan.

The above description was drawn from the material from Hualien Pref., where this plant is very abundantly and characteristically inhabiting sunny limestone cliffs or rocky ridges.

Taxonomically basing upon that *S. elongato-reticulata* was only a young form of *S. elongato-umbellata*, KOYAMA (l. c. 1957 & 1960) united these two species adopting the name *S. elongato-umbellata* for representation of the resultant taxon. The adult materials from Hualien Pref. at my hand exhibit a broad variation of leaf shape ranging linearly lanceolate to lanceolate, but they have constantly small and few flowered umbels. These characters imply that they are well concordant with *S. elongato-reticulata*, but in having small umbels not well identified with *S. elongato-umbellata*. HAYATA's description shows that the umbels of *S. elongato-umbellata* are rather like compound-racemes owing to the elongated rachis and the divaricate pedicels, being 3cm long and 4cm across in size and having 4cm long peduncles and 2.5cm long pedicels, while KOYAMA's explanation (l. c. 1957) teaches us that the umbels of *S. elongato-umbellata* are 13~24- and 9~28-flowered as for the pistillate and staminate flower respectively and having 2.5~4cm long peduncles. If these differences of umbels in size could be attributed to difference in ecological condition of habitats is suspensive until the cultivation of both plants is carried out, as suggested by KOYAMA (l. c. 1957).

S. vaginata DECNE. var. *stans* (MAXIM.) T. KOYAMA, Quart. Journ. Taiwan Mus. 10:15 (1957) & 13:50 (1960).—*S. stans* MAXIM., Bull. Acad. St. Pet. 17:170 (1872) & Mém. Biol. 8:407 (1872); FR. et SAV., Enum. Pl. Jap. 2:50 (1876); SHIMIZU, Acta Phytotax. Geobot. 17:147 (1958).

An erect ramose subshrub, extending to 1m tall. Stems smooth. Leaves triangularly ovate, petiolate; laminae 2~7cm long, 1.5~6cm broad, apiculate at the apex, truncate or shallowly cordate at the base, glaucous beneath, (3~) 5-nerved; petioles 8~15mm long, sheathing at the lower half, without tendrils. Inflorescences simple umbels, axillary, few flowered; peduncles 1.5~2cm long. Pistillate flowers 3mm long, with 6-staminodes; pedicels 3~8mm long. Fruits globose, bluish black, about 6mm across. Staminate flowers unknown.

Loc. HONSHU. Pref. Iwate: *Akka, *Takasuka, *Ryusenkutsu and *Iwaizumi, Iwaizumi-cho, Shimohei-gun (KYO); *Mt. Kakeyama, Shimohei-gun (KYO); Tamayamamura, Iwate-gun (KYO); Hakomori, Iwate-gun (KYO); *Geibikei, Higashiiwai-gun (KYO); *Kiwadabori near Geibikei, Higashiiwai-gun (KYO). Pref. Yamagata: Higashimura, Minamimurayama-gun (KYO); Okuyamadera, northeast of Yamagata (TNS);

Togo-mura, Kitamura-yama-gun (TNS). Pref. Fukushima: Mt. Atago, Tajima-cho, Minamiaizu-gun (KYO); Tatano-mura, Asaka-gun (TNS). Pref. Tochigi: Shiobara (TI). Pref. Gunma: Mt. Haruna (TI). Pref. Saitama: *Mt. Buko (KYO); *Mts. Mitsumine, Chichibu-gun (SHIN). Pref. Tokyo: *Nippara, Nishitama-gun (KYO); Mt. Gozen, Nishitama-gun (TI). Pref. Nagano: Suwa (KYO); Koseto, Kamiina-gun, probably on limestone (TNS); *Makuiwa, Todai, Kamiina-gun (KYO); Oojika-mura, Shimoina-gun (TI); *Tsubameiwa, upper Aoki river, Shimoina-gun (KYO); Shirahone-onsen, Minamiazumi-gun (TNS); Matsumoto (TI). Pref. Gifu: Mt. Kasagadake, Yoshiki-gun (KYO); Mt. Funabuse, Yamagata-gun (KYO). Pref. Niigata: *Mt. Myojo, Nishikubiki-gun (SHIN). Pref. Shiga: *Mt. Ibuki (KYO). Pref. Kyoto: Mt. Eboshi, Amada-gun (KYO). Pref. Nara: Mt. Kongo (KYO); Shionoha, Kawakami-mura, Yoshino-gun (KYO). Pref. Shimane: Mt. Sarumasa, Nita-gun (KYO). Pref. Hiroshima: Eshita, Yuki-cho, Saiki-gun (KYO). SHIKOKU. Pref. Ehime: *Oonogahara (KYO). Pref. Kochi: *Mt. Kurotaki, Nagaoka-gun (TI). KYUSHU. Pref. Miyazaki: Mt. Sobo (KYO); *Mt. Dodake, Nishiusuki-gun (KYO).

Distr. Honshu, Shikoku and Kyushu.

This plant is characterized by the erect and smooth stems, the non-cirrhose petiolar sheaths, the herbaceous and basally truncate leaves, the patent not reflexed perianths and the black berries. According to KOYAMA (l. c. 1960), the present variety is different from var. *vaginata* and var. *pekingensis* (A. DC.) T. KOYAMA merely in shape of the leaf blades⁶⁴.

Besides the above cited localities, this plant is recorded from the limestone field at Izurusan of Tochigi Pref⁶⁵. Thus many of its geographical records have come from the limestone districts, where it is growing on rubbly sites in sunny or shady places. YAMANAKA⁶⁶ mentions that it is rare and exclusively in the limestone areas at least in Shikoku.

Tofieldia coccinea RICHARD. var. **akkana** (T. SHIMIZU) T. SHIMIZU, stat. et comb. nov. — *T. akkana* T. SHIMIZU, Acta Phytotax. Geobot. 17:153 (1958).

A perennial herb. Radical leaves equitant, linearly subfalcate, 5~10cm long, 1~2.5mm broad, long acuminate toward the acute apex, 5~7-nerved, scabrous along the margin. Scapes 15~20cm long, glabrous, unifoliate. Racemes 3.5~6.5cm long, laxly flowered. Flowers solitary rarely geminate; pedicels 5~8mm long, apparently longer than flowers; perianth segments biform in size, 3mm long and 1.5~2mm long, alternate; stamens slightly longer than large perianths; styles 1mm long. Capsules 3mm long, yellowish.

Loc. HONSHU. Pref. Iwate: *Akka, Iwaizumi-cho, Shimohei-gun—type loc. (KYO).

Distr. Known only from the type locality.

Var. **geibiensis** (M. KIKUCHI) HARA, Journ. Jap. Bot. 36:393 (1961), excl. syn. *T. akkana*. — *T. kiusiana* OKUYAMA var. *geibiensis* M. KIKUCHI, Ann. Rep. Gakugei Fac. Iwate Univ. 11:67, f. 2 (1957); SHIMIZU, l. c. 154 (1958), excl. syn.

Resembling the preceding variety, but different from it in: perianth segments nearly equal in size; stamens distinctly exerted.

Loc. HONSHU. Pref. Iwate: *Geibikei, Higashiiwai-gun—type loc. (KYO).

64) Also vide, KOYAMA, T. (1960) Nat. Sci. & Mus. 27:3-4, f. 9, 2.

65) SEKIMOTO, H. (1934) Journ. Jap. Bot. 10:466.

66) YAMANAKA, T. (1954) Acta Phytotax. Geobot. 15:150.

Distr. Known only from the type locality.

Var. *kiusiana* (OKUYAMA) HARA, l. c. 393 (1961). — *T. kiusiana* OKUYAMA, Journ. Jap. Bot. 26:294 (1951); SHIMIZU, l. c. 153 (1958). — *T. nutans* WILLD. var. *kiusiana* (OKUYAMA) OHWI, Bull. Nat. Sci. Mus. Tokyo no. 33, 68 (1953).

Resembling the preceding two varieties, but different from them in: perianth segments nearly equal in size, 3~4mm long; capsules 4~5mm long.

Loc. KYUSHU. Pref. Miyazaki: *Mt. Dodake, Nishiusuki-gun—type loc. (KYO).

Distr. Known only from the type locality.

After I⁶⁷ revised *T. nutans*-group attaching importance to such characters as length of pedicels and direction of the flowers, HARA⁶⁸ again revised this group and included *T. nutans* sensu lat. in *T. coccinea* from the northern part of North America, when he pointed out that in this group the flowers always directed upward in anthesis but nutant after matured, so that the character concerning with direction of the flowers was taxonomically meaningless. Although once I described *T. akkana* basing upon a character of the biform perianth segments, the inner segments are apt to be more or less shorter than outer ones in this group. *T. akkana* is an extreme form as for such declination. Consequently the above three varieties are reasonably regarded as the infraspecific forms of *T. coccinea*, being characterized by loosely flowered racemes and long pedicellate flowers. Geographically these three are restricted to limestone crevices in the respective localities.

Tricyrtis macrantha MAXIM., Mém. Biol. 12:928 (1888); KITAGAWA et KOYAMA, Journ. Jap. Bot. 33:253 (1958). — *Brachycyrtis macrantha* (MAXIM.) KOIDZ., Bot. Mag. Tokyo 38:101 (1924).

A pendulous perennial herb. Stems ascendently hispid on the upper part. Leaves alternate, oblong-ovate, sessile, 7~13cm long, 2.5~4cm broad, long acuminate toward the apex, cordate at the base with both auricles above the stem, hispid beneath, ciliate on the margin. Flowers yellow, solitary and axillary, campanulate-tubiform, 3.5~4cm long, cernuous; pedicels about 1.5 cm long, glabrous; outer segments of perianth distinctly calcarate at the base.

Loc. SHIKOKU. Pref. Kochi: *Mt. Yokogura, Takaoka-gun—type loc. (KYO).

Distr. Shikoku.

This species is grouped into Sect. *Brachycyrtis* (KOIDZ.) KITAG. et T. KOYAMA, which is characterized by the distinctly calcarate outer tepals. The distinction from its nearest species *T. macranthopsis* MASAM., which is rarely found in the Kii Peninsula, is merely in the leaves being not amplexicaul at the base but with both auricles on one side of the stem.

As early as 1888, MAXIMOWICZ noted that his plant came from limestone crevices. According to KITAGAWA and KOYAMA (l. c. 254, 1958), it is also known from Miyazaki Pref. in Kyushu, though I am not aware of its habitat there.

67) SHIMIZU, T. (1958) Acta Phytotax. Geobot. 17:151-154.

68) HARA, H. (1961) Journ. Jap. Bot. 36:389-393.

CHAPTER VI GENERAL CHARACTERISTICS OF THE LIMESTONE FLORA OF JAPAN AND TAIWAN

In this chapter, the discussion of the general characteristics of the *limestone plants*, the generalization of the limestone flora of Japan and Taiwan and its comparison with serpentine flora in Japan are attempted. The following three sections are assigned to the respective problem.

§ 1. General characteristics of the limestone plants

In Chapter IV, I defined characteristic plants of the limestone field and grouped them into three classes. Then I termed the members of Group I and II *calcicoles* and those of Group I *limestone species* or *limestone plants*. From the definition of the word, it is self-evident that the *limestone plant* is occurring in one or a few locations on the same lodes of limestone, or discontinuously distributed. The number of the *limestone plant* exemplified amounts 74, among which 43 are in Japan and 35 are in Taiwan. The species common to Japan and Taiwan are only 4.

Phytogeographically some of these *limestone plants* have retired and survived on limestone fields depending on their tolerability and the absence of the competitors. Such plants become either old endemics or isolated species, having no relatives in the surrounding areas. These *limestone plants* can be termed *relic elements*. Some of these plants might have differentiated after isolated. Others have been more or less modified from their mother species owing to the isolation on limestone and may be more or less distinct taxonomically. Such plants are young endemics, having some relatives in the surrounding areas as a rule. In some particular cases, the same differentiation may occur polytopically. These *limestone plants* are termed *modified elements*. These two elements have in some cases not only tolerability but also physiological preferences for limestone or calcareous soils. The third elements are apparently *calciphilous* plants. These will occur mostly where limestone appears and indifferently to the age of the limestone escarpments. Their distribution areas are broad. However, these elements are difficult to be discriminated from the *relic elements*, though the distinction between them is reliant on that the former are occurring indifferently to the age of escarpments but the latter are confined to the old limestone outcrops.

In these respects, the discussion of the *serpentine plants* proposed by KITAMURA (1950) is applicable also to the *limestone plants*. Studying the serpentine flora of Japan, he exemplified 30 *serpentine plants*, 11 of which were regarded as relics (*Serpentinorelics*, *relic elements*) and 9 as ecotypes (*Serpentinomorphoses*, *modified elements*). All of these plants are endemic to Japan. Twenty-three are endemic to Hokkaido. Twelve belong to the Compositae. Basing upon these aspects of the *serpentine plants*, he pointed out that the *serpentine plants* would be formed as the result of the long isolation of some particular plants on old serpentine outcrops and the plants with the shorter life cycles and with the more productive and changeable natures such as the

Compositae would be the more advantageous for differentiation.

In the case of the *limestone plants* listed in Chapter IV, two species, viz. *Asplenium ruta-muraria* and *Geranium robertianum*, are circumpolar plants, and eleven of Japan and five of Taiwan are continental (i. e. also distributed in the Asiatic Continent) or Sino-Himalayan plants. The rest is endemic to either Japan or Taiwan. Judging whether each *limestone plant* is relic, modified or calciphilous, the following results are obtained. The signs added after the plant name, C, CP and E, mean that the corresponding plant is a continental plant, a circumpolar plant or a plant endemic to either Japan or Taiwan, respectively.

Japan. The relic elements are *Adiantum capillus-junonis* (C), *Aleuritopteris krameri* (E), *Asplenium coenobiale* (C), *Hypodematium fauriei* (E), *H. glandulosopilosum* (C), *Polystichum deltoodon* (C), *Pteris deltoodon* (C), *Woodsia hancockii* (C), *Betula chichibuensis* (E), *Thalictrum foetidum* var. *iwatense* (E, differentiated), *Draba igarashii* (E, differentiated), *Sedum drymarioides* var. *toyamae* (E, differentiated), *S. tosaense* (E), *Eriobotrya japonica* (C), *Geranium robertianum* (CP), *Rhamnus yoshinoi* (C), *Angelica saxicola* var. *yoshinagae* (E), *Gentiana contorta* (C), *Zabelia integrifolia* (E), *Adenophora maximowicziana* (E), *Leontopodium hayachinense* var. *miyabeana* (E, differentiated), *Senecio furusei* (E), *Youngia yoshinoi* (E), *Festuca ovina* var. *chiisanensis* (C) and *Tricyrtis macrantha* (E). The modified elements are *Pteris yamatensis* (E, stenophyllism), *Cerastium mitsumorense* var. *ovatum* (E), *Draba nipponica* var. *linearis* (E, glabrism), *Prunus incisa* var. *bukosanensis* (E, glabrism), *Lespedeza homoloba* var. *higoensis* (E), *Rhamnus yoshinoi* var. *velvetina* (E, pubescentism), *Angelica shikokiana* var. *mayebarana* (E, dissected leaves, stenophyllism and glabrism), *Euphrasia maximowiczii* var. *calcareae* (E, stenophyllism and nanism), *Adenophora teramotoi* (E), *A. teramotoi* var. *hispidula* (E, pubescentism), *Anaphalis sinica* var. *pernivea* (E, pubescentism), *Leontopodium japonicum* var. *perniveum* (E, pubescentism), *Lilium bukosanense* (E, stenophyllism), *Tofieldia coccinea* var. *akkana* (E), *T. coccinea* var. *geibiensis* (E) and *T. coccinea* var. *kiusiana* (E). The calciphilous elements include *Asplenium ruta-muraria* (CP).

Taiwan The relic elements are *Adiantum capillus-junonis* (C), *Asplenium pulcherrimum* (C), *Cyrtogonellum fraxinellum* (C), *Pteris deltoodon* (C), *Struthiopteris eburnea* var. *obtusata* (E, differentiated), *Cerastium calcicola* (E), *C. kaoi* (E), *Berberis chingshuiensis* (E), *Corylopsis matsudai* (E), *Spiraea tarokoensis* (E), *Geranium robertianum* (CP), *Euphorbia tarokoensis* (E), *Euonymus batakensis* (E), *Rhamnus chingshuiensis* (E), *Takasagoya geminiflora* (E), *T. nakamurai* (E, differentiated), *Angelica tarokoensis* (E), *Buddleja formosana* (E), *Gentiana kaoi* (E), *G. tentyoensis* (E), *Euphrasia tarokoana* (E), *Galium tarokoense* (E), *Viburnum propinquum* (C), *Patrinia glabrifolia* (E) and *Chrysanthemum morii* (E). The modified elements are *Pteris angustipinna* (E, stenophyllism), *Thalictrum urbanii* var. *majus* (E), *Pourthiaea chingshuiensis* (E), *Raphiolepis impressivena* (E), *Rosa luciae* var. *rosea* (E, nanism), *Hypericum nokoense* (E, nanism and crassism), *Ligustrum seisuiense* (E), *Galium minutissimum* (E, nanism) and *Artemisia somai* var. *batakensis* (E). The calciphilous elements are also represented by *Asplenium ruta-muraria* (CP).

The similar grouping is applicable also to the members of Group II and III. The *relic elements* in Group II are found mostly on limestone but occasionally on serpentine or other rocks. Such examples are *Gymnocarpium jessoense*, *Juniperus sargentii*, *Carpinus turczaninovii*, *Sisymbrium luteum*, *Filipendula tsuguwoi*, *Potentilla fruticosa* var. *mandshurica*, *Rhamnus costata*, *Viburnum carlesii* var. *bitchiuense*, *Chrysanthemum zawadskii*, *Smilax vaginata* var. *stans*, etc. However, the *modified elements* are hardly recognized in this group. The tetraploid race of *Chrysanthemum makinoi*, which is growing mainly on the limestone field and occasionally on the surrounding siliceous one, might be assigned to this example. The *calciphilous element* of this group are well represented by *Camptosorus sibiricus*.

The *relic elements* of Group III are *Berberis amurensis* (incl. varr.), *Nandina domestica*, *Zanthoxylum planispinum*, *Securinega suffruticosa*, *Hosiea japonica*, *Daphne pseudomezereum*, etc. Many of the rest may be *calciphilous elements*. The good examples of them are *Coniogramme intermedium*, *Dennstaedtia wilfordii*, *Polystichum craspedosorum*, *Clematis stans*, *Euonymus spp.*, *Artemisa keiskeana*, etc.

§ 2. Phytogeographical affinity of the limestone flora among the main districts

When I described each limestone florula in Chapter III, the age of each limestone field was not taken into consideration. As stated in the previous section, the *limestone plant* occurs on the broad and continuously exposed old limestone formations. If a certain limestone field has recently appeared owing to human agency or topographical changes such as erosion and landslip, it will present a poor flora including the waste-land plants from the surrounding area and at most a few *calciphilous elements*. There are found neither *relic elements* nor *modified elements*. The florulas in Menashidomari (Kitami Prov.), Iwaya (Kitami Prov.), Kamiiso (Oshima Prov.), Kanagasaki (Fukui Pref.) and Tone (Fukui Pref.) are such examples. On the other hand, the limestone florula along or near the sea coast is also poor and has few characteristic plants. The coastal and maritime plants which are highly tolerable for dryness of the habitats are dominant and suppress the other plants. The florulas in Kanagasaki (Fukui Pref.), Matsuodera (Kyoto Pref.), Yura (Wakayama Pref.) and Mt. Ryuho (Kumamoto Pref.) are such examples.

Surveying the limestone flora in Japan and Taiwan throughout, the *limestone plant* covering all the districts from Hokkaido to Taiwan is only one species, viz. *Asplenium ruta-muraria*. As stated above, the *limestone plants* common to Japan and Taiwan are 4, 2 of which (*Adiantum capillus-junonis* and *Pteris deltoidea*) are found only in Kyushu so far as Japan is concerned, and one of which (*Geranium robertianum*) is rather indifferent to soil kinds in Taiwan. Other characteristic species common to Japan and Taiwan are *Cyrtomium caryotideum*, *Juniperus sargentii* (Group II), *Mercurialis leiocarpa* and *Securinega suffruticosa* (Group III).

The characteristic species which are distributed from Hokkaido to Kyushu are *Camptosorus sibiricus* (Group II), *Dennstaedtia wilfordii*, *Polystichum craspedosorum*, *Cephalotaxus harringtonia* (incl. ssp. *nana*), *Clematis stans* (incl.

The noteworthy accounts concerning each district are briefly mentioned below.

Hokkaido: Compared with serpentine areas, limestone areas are almost negligible except in Oshima Peninsula. In Mt. Oohira, some alpine plants common to the central mountains of Hokkaido or Isl. Rebun and Isl. Rishiri are isolated on limestone fields there (WATANABE 1956). *Cerastium mitsumorense* var. *ovatum*, *Draba igarashii* and *Leontopodium hayachinense* var. *miyabeorum* are endemic to this mountain. In Kamiiso, though the limestone plant could not be noticed, some *calciphilous elements* are detectable. Among them, *Clematis stans* should be written specially because of its northernmost locality.

Tohoku: The endemic limestone plants are *Thalictrum foetidum* var. *iwatense*, *Tofieldia coccinea* var. *akkana* and *T. coccinea* var. *geibiensis*. In this district, it is striking that the limestone fields retain the northern plants such as *Thalictrum foetidum*, *Spiraea miyabei*, *Astragalus adsurgens*, *A. membranaceus*, *Hypericum yezeense*, *Adenophora pereskiaefolia* var. *moiwana* and *Allium splendens*. These plants are exclusively or nearly exclusively found on limestone in Tohoku, whereas they are rather indifferent to soil kinds in Hokkaido. To be contrasted, *Juniperus rigida* the main area of which is from Kanto to Kyushu is characteristically found on sunny rocky places of limestone. On the other hand, the presence of the relic elements such as *Sisymbrium luteum*, *Rhamnus costata*, *Smilax vaginata* var. *stans*, etc. shows the affinity of this district with central Honshu, too. In shady rocky places, generally the *calciphilous elements* such as *Cimicifuga acerina*, *Philadelphus satsumi*, *Kerria japonica*, *Rhamnus japonica*, *Alangium platanifolium* var. *trilobum* and *Helwingia japonica* are found. On sunny ridges or cliffs, they are replaced by *Deutzia gracilis*, *Spiraea nipponica*, *Lespedeza buergeri*, *Berberis amurensis* var. *japonica*, *Seseli ugoensis*, *Leontopodium japonicum* and *Hosta longipes*. All of them are also common to the limestone flora of the Kanto district and more southern districts, but not found in Hokkaido.

Hokuriku: No endemics and no limestone plants except *Asplenium ruta-muraria* are found. The dominant species are *Berberis amurensis* var. *japonica* and *Spiraea nipponica* likewise. The relic elements such as *Gymnocarpium jessoense*, *Juniperus sargentii*, *Sisymbrium luteum* and *Smilax vaginata* var. *stans* are important members of the limestone flora in this district, too. It is worth notice that many characteristic plants occurring in the districts of Kanto, Chubu and westward are absent (Table 3). In this respect, the limestone flora of the present district is rather affined to that of the Tohoku district. *Buxus microphylla* var. *japonica* is only one characteristic plant of the western elements.

Kanto: The endemic limestone plants are *Aleuritopteris krameri*, *Betula chichibuensis*, *Prunus incisa* var. *bukosanensis*, *Senecio furusei* and *Lilium bukosanense*. *Salix kenoensis* (Group II) is also endemic to this district. A northern plant, *Adenophora pereskiaefolia* var. *moiwana* (Group II) does not extend beyond this district. Contrariwise, the southwestern plants such as *Hypodematum fauriei*, *Eriobotrya japonica*, *Zabelia integrifolia* (Group I), *Asplenium capillipes*, *Cyrtomium caryotideum*, *Clematis williamsii* (Group II), *Galium kinuta*,

Anaphalis sinica, etc. (Group III) end their areas here. The dominant and constant species are similarly *Berberis amurensis* varr. and *Spiraea nipponica* in dried rocky places, and *Orixa japonica*, *Staphylea bumalda*, *Alangium platanifolium* var. *trilobum*, etc. on shady places. *Gymnocarpium jessoense*, *Sisymbrium luteum*, *Potentilla fruticosa* var. *mandshurica* and *Smilax vaginata* var. *stans* (Group II) are important relics on limestone.

Chubu: The Akashi mountain region affords several continuous lodes of limestone running north to south at 2000m or so elevation. It is remarkable that the limestone fields of this mountain region are holding some alpine plants, as stated in Chapter III. The endemic limestone plants are *Draba nipponica* var. *linearis*, *Euphrasia maximowiczii* var. *calcareae*, *Adenophora teramotoi*, *A. teramotoi* var. *hispidula*, *Anaphalis sinica* var. *pernivea* and *Leontopodium japonicum* var. *perniveum*. These are growing with the related species side by side, and may be young endemics differentiated from them. The dominant and constant species are *Berberis amurensis* varr. and *Spiraea nipponica* in this district, too. *Gymnocarpium jessoense*, *Woodsia glabella*, *Potentilla fruticosa* var. *mandshurica*, *Rhamnus costata* and *Smilax vaginata* var. *stans* are important relics.

In the southern part of the district (Aichi Pref.), the limestone flora is characterized by the southwestern plants such as *Eriobotrya japonica*, *Zabelia integrifolia* (Group I), *Nandina domestica*, *Zanthoxylum planispinum*, *Securinega suffruticosa*, *Mercurialis leiocarpa*, etc. (Group III). Except the first two, they are not yet found beyond this district. This fact means that the limestone flora there is affined to that of southwest Japan.

Kinki: The limestone fields in this district are roughly grouped into those in the Ibuki-Suzuka range and those in the Kii Peninsula. The former is of high phytogeographical significance. The remarkable species of the northeastern limestone flora, *Spiraea nipponica*, ends its area here and is replaced by *S. nervosa*, which is a constant and dominant species of the limestone flora of southwest Japan. On the contrary, the present limestone fields afford the eastern limit of the distribution to *Arabis flagellosa*, *Rhamnus japonica* var. *microphylla* (Group III) and the western limit to *Veratrum maackii* var. *japonicum* (Group III). Furthermore, it is interesting that the tetraploid race of *Chrysanthemum makinoi* is known only from the Ibuki-Suzuka range and that this range provides *Geranium robertianum* with the sole habitat in Honshu.

In the latter (the limestone fields in the Kii Peninsula), on the other hand, *Pteris yamatensis* (endemic), *Eriobotrya japonica*, *Zabelia integrifolia* (Group I), *Clematis williamsii* (Group II), *Berchemia berchemiaefolia* and *Spiraea blumei* (Group III) are noteworthy. *Spiraea blumei* and *Zabelia integrifolia* are dominant at sunny rocky ridges, while *Orixa japonica*, *Alangium platanifolium* var. *trilobum*, *Helwingia japonica*, etc. are conspicuously abundant on shady rocky places. *Anemonopsis macrophylla*, *Sisymbrium luteum*, *Kirengeshoma palmata* and *Rhamnus costata* are good examples of the relics. *Anemonopsis macrophylla* is a plant of the coniferous zone in the Chubu district. *Kirengeshoma palmata* is a rare plant of Shikoku and Kyushu.

Chugoku: The endemic limestone plants are *Rhamnus yoshinoi* var. *velvetina*

and *Youngia yoshinoi*, *Polystichum deltoodon*, *Rhamnus yoshinoi* (Group I), *Carpinus turczaninowii*, *Spiraea nervosa* var. *latifolia* and *Viburnum carlesii* var. *bitchiuense* (Group II) are common to Shikoku and Kyushu, while *Hypodematium glanduloso-pilosum* (Group I) and *Forsythia japonica* (Group II) are common to Shikoku. This fact implies the mutual affinity of the limestone flora of Chugoku, of Shikoku and of Kyushu. Except *Youngia yoshinoi*, these plants have either the same plants or the close relatives in the continent especially in Korea. The dominant and constant species are *Carpinus turczaninowii*, *Deutzia gracilis*, *Spiraea nervosa* var. *latifolia* and *Zabelia integrifolia*.

Shikoku: The endemic limestone plants are *Sedum tosaense*, *Angelica saxicola* var. *yoshinagae* and *Adenophora maximowicziana*. *Festuca ovina* var. *chiisanensis*, *Asplenium coenobiale* and *Woodsia hancockii* are the continental plants, being known only from Shikoku throughout Japan. As shown in Table 3, most of the other characteristic plants of Shikoku are common to those of Kyushu and Chugoku districts. The phytosociological accounts should be referred to YAMANAKA (1955 c).

Kyushu: The endemic limestone plants are *Sedum drymarioides* var. *toyamae*, *Lespedeza homoloba* var. *higoensis*, *Angelica shikokiana* var. *mayebarana* and *Tofieldia coccinea* var. *kiusiana*. *Epimedium grandiflorum* var. *higoense* (Group II) is also endemic to this district. The continental ferns, *Adiantum capillus-junonis* and *Pteris deltoodon* are common to Taiwan. It is interesting that some plants which are mainly distributed in middle Honshu are preserved in the limestone field of Kyushu. Such examples are presented by *Berberis amurensis* var. *bretschneideri*, *Acanthopanax hypoleucus*, *Bupleurum longiradiatum* f. *elatius*, *Anaphalis sinica* and *Leontopodium japonicum*. The records of *Chrysanthemum zawadskii* var. *zawadskii* are all from the limestone fields in Kyushu at least. As dominant and constant plants *Deutzia gracilis* var. *zenta-roana* (Group III) and *Spiraea nervosa* (Group II) are mentioned.

Taiwan: Thirty-five taxa of the limestone plant have been detected. This number should be compared with number (43) of the limestone plant from Japan throughout. Of 35 limestone plants from Taiwan, 28 are endemic. Of 35, 32 are found in Hualien Pref., and 26 are endemic to Hualien Pref. Such high endemism of the limestone plant in this prefecture should be ascribed to surprising enormosity of the limestone escarpments there. Enormous bluffs must have been much effective for the isolation and the preservation of many plants. As only a few characteristic plants common to both Japan and Taiwan are recognized (Table 3), the affinity of the limestone flora between them cannot be accepted. Also between the general floras of Japan and Taiwan, rather remote relationship is generally recognized by the present-day taxonomists (cf. MASAMUNE, 1937, HOSOKAWA 1958).

§ 3. Comparison of the limestone flora with the serpentine flora

In these ten or so years, the floristic or vegetational researches of the serpentine fields in Japan have been also greatly accelerated by several authors. Their works are listed as follows:

General survey: KITAMURA (1950) and YAMANAKA (1952 b, 1959 d).

Hokkaido: HIROE (1952), TOYOKUNI (1955 a b, 1956 a b c, 1957 a b, 1958 a b, 1960 a b) and KITAMURA (1956, 1957).

Tohoku: KITAMURA (1952 b, 1953).

Kanto: KITAMURA (1952 a).

Chubu: KITAMURA, MURATA and TORII (1953), MURATA and SHIMIZU (1956) and SUGIMOTO (1958).

Kinki: KITAMURA, HIROE and NAKAI (1950), OGAWA (1950), KITAMURA and MOMOTANI (1952) and TANIGUCHI (1958).

Chugoku: YAMANAKA (1958 b).

Shikoku: YAMANAKA (1950, 1951, 1952 a c, 1953 a b c, 1954, 1955 a b, 1956, 1958 a c, 1959 a b c d) and KITAMURA and MURATA (1952).

Basing upon the floristic materials proposed in these works, in this section I intend to consider both similarity and difference in the floristic components between the limestone flora and the serpentine one.

Group I According to the definition, the members of Group I of the limestone flora do not occur outside of the limestone field. Although YAMANAKA (1952 b, 1959 d) mentions that *Zabelia integrifolia* is often noticed also on serpentine in Shikoku, no precise locality verifying such case is indicated in any works above cited and only one specimen of the species brought from serpentine habitats has come to my hand, i. e. "Pref. Tokushima: Okubo, Kamiyama-cho, Myozai-gun (Hb. Kochi Univ.)." Such cases must be extremely exceptional.

It is an interesting fact that one of the related plants which are remotely isolated each other is a *limestone plant* while the other a *serpentine plant*. Such examples are:

Ex. 1. *Thalictrum foetidum* var. *iwatense* (on limestone in Iwate Pref.) and var. *apoiense* (on serpentine in Hidaka Prov.).

Ex. 2. *Leontopodium hayachinense* (on serpentine in Iwate Pref.) and var. *miyabeannum* (on limestone in Shiribeshi Prov.).

These plants were isolated to be relics and have been differentiated on the respective habitats.

Group II Some members of Group II often occur on serpentine as relics. *Gymnocarpium jessoense*, *Juniperus sargentii*, *Potentilla fruticosa*, *Spiraea nervosa* and *S. nipponica* are the striking examples. These plants are extraordinarily rare outside of the serpentine and the limestone field. The phytogeographical data of them are proposed in the previous chapter. As pointed out by YAMANAKA (1952 b), this fact means that both serpentine and limestone play similar roles to have some rare plants retain in common.

Among the calciphilous elements, *Camptosorus sibiricus* is occasionally found on serpentine and on other kinds of rock (YAMANAKA 1952, 1953 b).

Group III The most striking examples of the *relic elements* which are also found on serpentine are *Berberis amurensis* varr. and *Buxus microphylla* var. *japonica*. The former is occurring on serpentine in Toikanbetsu (Teshio Prov.), Mt. Shiratori, Mt. Yubari (both in Ishikari Prov.), Mt. Apoi (Hidaka Prov.), Mt. Shibutsu (Gunma Pref.), *Mt. Dogo (Hiroshima Pref.), *Mt. Higashikaishi and *Mt. Nishiakaishi (both in Ehime Pref.) and on limestone in Shiriya-cape (Aomori Pref.), Akka, Iwaizumi, Geibikei (all in Iwate Pref.), Mt.

Ootakine (Fukushima Pref.), Mt. Buko, Mts. Mitsumine, Mt. Akasawa (all in Saitama Pref.), Mt. Kamanashi, Mt. Shiraiwa, Todai, Mt. Toyokuchi, Oojika-mura (all in Nagano Pref.), Mt. Myojo (Niigata Pref.) and *Mt. Shiraiwa (Miyazaki Pref.). The other localities of this species in Japan are not so many, and in west Japan four records with asterisks are all known to us. The latter is known from the serpentine fields in Jsugeno (Aichi Pref.), Isl. Sugashima, Mt. Asama (Mie Pref.), Mt. Kurosawa (Wakayama Pref.) and Tomisato (Ehime Pref.). Its records from the limestone field are noted in the previous chapter. This plant is rarely known from the other habitats, too.

Besides these two species, the following members of Group III, most of which might be *calciphilous elements*, are reported from one or more serpentine fields studied by the workers mentioned above. They are *Coniogramme intermedium*, *Dennstaedtia wilfordii*, *Polystichum craspedosorum*, *Cephalotaxus harringtonia*, *Torreya nucifera*, *Chloranthus japonicus*, *C. serratus*, *Buckleya lanceolata*, *Euptelea polyandra*, *Clematis stans*, *Thalictrum minus* varr., *Berberis thunbergii*, *B. tschonoskyana*, *Epimedium grandiflorum*, *Sinomenium acutum*, *Arabis serrata* varr., *Deutzia gracilis*, *Kerria japonica*, *Spiraea blumei*, *Lespedeza buergeri*, *Orixa japonica*, *Zanthoxylum piperitum*, *Z. planispinum*, *Euphorbia sieboldiana*, *Securinega suffruticosa*, *Rhus ambigua*, *Euonymus alatus*, *E. oxyphyllus*, *E. sieboldianus*, *Staphylea bumalda*, *Hosiea japonica*, *Berchemia racemosa*, *Alangium platanifolium* var. *trilobum*, *Bupleurum falcatum*, *B. longiradiatum*, *Seseli ugoensis*, *Fraxinus lanuginosa* var. *serrata*, *F. sieboldiana*, *Ligustrum obtusifolium*, *Artemisia keiskeana*, *Leontopodium japonicum*, *Syneilesis palmata*, *Carex duvaliana*, *Tofieldia coccinea* var. *kondoi* and *Veratrum maackii* (incl. var.). Among these plants it is worth notice that those exhibiting considerable abundance on shady and rubbly limestone fields such as *Euptelea polyandra*, *Kerria japonica*, *Orixa japonica*, *Zanthoxylum planispinum*, *Securinega suffruticosa*, *Staphylea bumalda* and *Alangium platanifolium* var. *trilobum* are rather strangers in the serpentine field not forming dense shrubberies. Contrariwise the plants of *Berberis*, *Lespedeza*, *Euonymus* and *Fraxinus* are similarly abundant on both limestone and serpentine. To be interested, these are the plants on rather sunny habitats.

Floristic contrasts: I just mentioned the characteristic plants of the limestone field common to the serpentine one. Reversely the following members should be noted because they are not yet found in the serpentine flora in spite of their considerable constancy or abundance inside of the limestone field. They are *Laportea bulbifera*, *L. macrostachya*, *Pilea petiolaris* ssp. *pseudopetiolaris*, *Cimicifuga acerina*, *Nandina domestica*, *Arabis flagellosa*, *Mercurialis leiocarpa*, *Berchemia berchemiaefolia*, *Rhamnella franguloides*, *Daphne pseudomezereum*, *Aucuba japonica*, *Helwingia japonica*, *Syringia reticulata*, *Halenia corniculata*, *Galium kinuta* and *Anaphalis sinica*. These plants are mostly growing on shady places, and may be of same ecological nature as the plants exemplified above, viz. *Euptelea polyandra*, *Kerria japonica*, etc., which are less abundant on the serpentine than on the limestone field.

On the other hand, many of the constant or abundant plants in the serpentine flora are scarcely found in the limestone one. Thanks to the works

of KITAMURA (1950), YAMANAKA (1959 d) and others, such plants can be summarized as below.

Dicranopteris dichotoma, *Gleichenia japonica*, *Pteridium aquilinum* var. *latiusculum*, *Struthiopteris niponica*, *Osmunda* spp., *Castanea crenata*, *Parabenzoin trilobum*, *Rhus trichocarpa*, *Clethra barbinervis*, *Eurya japonica*, *Enkianthus* spp., *Rhododendron* spp., *Pieris japonica*, *Vaccinium* spp., *Hugeria japonica*, *Arundinaria* spp., *Sasa* spp., *Sasamorpha purpurascens*, *Lilium japonicum*, etc.

These plants are usually growing on red soils poor in humus and on sunny places. Within the limestone districts, they are usually absent from the limestone field, though occasionally found on the lime-leached deep red soils.

In my opinion the comparison of the floristic components between limestone fields and serpentine ones as well as precise examination of their physiological or ecological characteristics may contribute to the solution of the question whether a certain plant occurs on a particular habitat depending upon the chemical nature or physical nature of the substratum. The presence of some plants growing both on limestone and on serpentine may suggest that they are biased to the features common to both kinds of the substrata such as dryness. On the contrary, the presence of some other plants which are not found in either of limestone fields or serpentine ones may suggest that those plants are biased to the features peculiar to either of these kinds of substrata. Thus the analysis of the substrata, limestone habitats and serpentine habitats, in various senses will be needed hereafter.

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