

morphological knowledges and from the study of the Japanese species alone. He then began to research anatomical characters on some parts of plants of them and several foreign species.

The anatomical characters gave several important knowledges of the relationships between genera and between sections which could not be gained from the external morphological ones and which in a few points were even in conflict with the relationships inferable from these. To resolve these contradictions, the writer wishes to study about other foreign species related with those in Japan, especially pentamerous *Daphne* and *Wikstroemia* species in China, and genera at least from Far East. In this temporary stage, however, he inferred a possible system mainly on the basis of the anatomical characters.

The study of the *Thymelaeaceae* has a comparatively simple history in Japan. *Daphne odora* named by THUNBERG in 1783 is the first species of this family that was found or described in this country. Since then several other foreign taxonomists named many wild plants, and it was only about the last decade of the nineteenth century that the Japanese taxonomists began to deal with the *Thymelaeaceae* plants in Japan by themselves. Especially, NAKAI accomplished some valuable works in establishing *Diplomorpha* MEISSNER again and *Daphnimorpha* NAKAI as genera. But almost all works of them were parts of florae and had no style of monographs.

To Professor T. INOKUMA and Assist. Professor S. KURATA, the writer like to express his deep appreciation for their kindful leading and advices in this study. He is indebted to Mr. K. SHIMAJI for advising and helping him to advance his anatomical research, and to Mr. M. GOO and Mr. S. SATOO for their advices for the paraffin method. He is also indebted to the curators of the herbaria of Botanical Institute of University of Tokyo, of Botanical Institute of Kyoto University and of the National Museum of Science, Tokyo, for allowance to researches of the herbarium specimens.

II. GENERAL DESCRIPTIONS OF THE JAPANESE THYMELAEACEAE

In this chapter the general descriptions are given for the Japanese genera and species, and those of the family as a whole are omitted. Some foreign species belonging to the genera have been often studied, too. However, they are described not in this chapter, but in the related parts of the next chapter. 5 genera and 19 species are found in Japan, viz., *Daphne* (7 sp.), *Daphnimorpha* (2 sp.), *Diplomorpha* (7 sp.), *Edgeworthia* (1 sp.) and *Wikstroemia* (2 sp.).

§ 1. EXTERNAL MORPHOLOGICAL CHARACTERS

Stems and shoots. Shrubs or rarely small trees. Roots comparatively thick, long, possessing tenacious and white or light brownish bark. Stems 1–3 cm or often 5 cm in diameter, frequently branching very low above the earth (*Dipl. Ganpi*). As the general characteristic of the family (cf. GILG), they branch sympodially or sometimes trichotomously (*Edg. chrysantha*). In some species (especially of *Dipl.*) the upper parts of shoots wither more or less, and the remnants become

like needles or stalks. Bark usually brownish, smooth and glossy or covered by many prominent leaf scars (*Daphn.*) or dense hairs, very tenacious. Stems rarely fasciate in ornamental species (*Daphne odora*, etc.).

Leaves. Evergreen (*Daphne* sect. *Daphnanthoides*), or deciduous in summer (some of *Daphne* sect. *Daphne* and *Wikst.*) or in winter. Entire. Opposite, alternate or fascicled (*Daphnim.*), often opposite and alternate in a single species (*Daphne Genkwa*, etc.). Sessile, or long or short petiolate. Without stipules. Oblanceolate, obovate, oblong, ovate or lanceolate. Acuminate, acute, mucronate (*Daphne* sect. *Daphne*) or retuse (*Wikst.*) at the apex. Membranaceous (*Dipl. trichotoma*), herbaceous (*Daphne* sect. *Daphne* and *Daphnim.*), chartaceous (*Daphne Genkwa*, *Dipl.*, *Edg.* and *Wikst.*) or coriaceous (*Daphne* sect. *Daphnanthoides*). Glabrous or pubescent on both or the lower surface (*Dipl. Ganpi*, etc.). Green at the upper surface, greyish or pale green at the lower, rarely variegated (*Daphne odora*). Midribs and lateral veins prominent on the lower surface, often on the upper, too. Lateral veins pinnate. Leaves often look as scales or bracts (*Daphne odora*, etc.). Bud scales and bracts ciliate or densely pubescent outside.

Inflorescences. Terminal or/and axillary spikes (or racemes) or heads, sometimes paniculiform in all (*Dipl.*). There are otherwise such variations as, one consisting of several flowers which directly attach to the lateral side of a shoot with short pedicels (*Daphne* sect. *Daphne*), terminal heads surrounded by many bracts (*D.* sect. *Daphnanthoides*), involucrate and pedunculate heads (*Edg.*), or heads or short spikes with branched peduncles (*Daphnim.*). Pubescent or glabrous. The relation between the position of inflorescences and the development of shoots has generic diagnostic value. After flowering and defoliation the peduncles usually lignify and remain for a long time, but in *Diplomorpha* as mentioned above throughout wither and fall with the upper parts of the shoots.

Flowers. Bisexual, dioecious (two sect. of *Daphne*) or dimorphous (? *Dipl. sikokiana*), parthenogeneses rarely recorded; probably entomophilous. 4-merous, actinomorphic. Flowering seasons usually long. Calyces tubular (according to HEINIG's opinion, the writer recognizes floral tubes as calyces), articulating with pedicels immediately (*Dipl.*, etc.) or somewhat down (some of *Daphne* and *Wikst.*), without petaloid scales; lobes 4, outer 2 (one of which covers all other three before the anthesis) larger than the others, imbricate, spreading, ovate or elliptic. White, pink, purple or yellowish green. Membranaceous (*Dipl.* and *Daphnim.*) or thin fleshy, pubescent (*Daphne kiusiana* and some of *Dipl.*) or glabrous. The persistency of floral tubes is of taxonomic value; generally the tubes are caducous in the case of berries and more or less persistent in the case of dry fruits. Stamens 8, arranged in two rows, the upper opposite the lobes, the lower alternate, half-exposed from the tube or sometimes both fixed to the middle of this (*Daphnim.* and *Daphne kamtschatica*). Filaments very short, $\frac{1}{2}$ — $\frac{1}{5}$ of an anther in length, flattened, thin. Anthers innate, yellow*, oblong or long ovate, 2-celled, sometimes

*MAXIMOWICZ drew red anthers of *Daphne jezoensis* in his original figure, but this will be erroneous.

dehiscent before the anthesis. Ovaries superior, obovate or oblong, sessile or stipitate (*Dipl.* and *Daphnim.*), light green, glabrous (*Daphne*), pubescent or pilose; locule 1; carpels 2, but one of which markedly reduced in the anatomical view; ovule 1, anatropous and pendulous. Styles solitary, terminal, short or long (*Edg.*, etc.), slender, rarely puberulous (*Edg.* and *Daphne Championi*). Stigmata discoid or clavate (*Edg.*, etc.), usually papillose. Hypogynous discs membranaceous or a little fleshy, often glandular at the top (*Daphnim.*), light yellow or green, thick annular (*Daphne*), cup-shaped (*D.* sect. *Genkwa* and *Edg.*), scaly or subulate (*Wikst.* and *Dipl.*), or irregularly quadrate (*Daphnim.*), entire, lobate or parted. They are of some taxonomical value.

Fruits and seeds. Berries (*Daphne* excl. sect. *Genkwa* and *Wikst.*) or dry fruits, indehiscent. Berries globular or ovoid, scarlet when matured. Dry fruits fusiform, ovoid or elliptic with acute tops, stipitate or nearly sessile (*Edg.* and *Daphne* sect. *Genkwa*), green, often slightly pubescent. The sort of fruits has relation with the persistency of floral tubes and this relation is of taxonomical value as mentioned above. Seeds short or long ovoid, acute at the top, round or obtuse at the base; testa crustaceous, black or blackish brown; tegmen membranaceous, white or brown, adhered to the testa. Endosperm very poor or absent. Cotyledons half-globular in berries and half-ellipsoidal in dry fruits, fleshy, white; radicles superior, very short in the former and a little longer in the latter.

§ 2. MICROSCOPICAL CHARACTERS.*

1. Shoots

Cork layer. Very thick (ca 10 layers or more) or thin; the thickness varying in accordance with either habitats of plants or parts of plant body; component cells mostly with uniformly thickened walls. According to VAN TIEGHEM, whether the cork arises in the epidermis or in the outermost part of the cortex is of generic value, and all the Japanese genera belong into the former.

Cortex. The outer part of the primary cortex sometimes a little collenchymatous. Mucilaginous cells often recorded in the inner part.

Phloem. In transverse sections usually wide, separated by the widened distal ends of the rays (i.e., the phloem rays) and showing triangular groups with apices outwardly directed or more irregular bands. Fibers with lignified or unlignified walls of various thickness, almost always devoid of pits; very abundant; in transverse sections scattered in tangential bands or in triangular groups near the periphery of the phloem, or concentrically arranged in alternation with other phloem elements. The difference of such arrangements seems to be based on the difference not only of genera or species, but of the age of parts or parts themselves. No cell

*As the wood anatomical study will be performed in the next step of this study, only the features observed at comparatively low magnification are described, especially in the paragraph concerning to shoots. And unfortunately, the samples were too few to conclusively describe such features, which usually have large variations even in a single species, as the following. Therefore, any taxon is not indicated in this section unless any character is distinct for some groups.

layer to be named an endodermis is discriminated. Therefore, though the outer part of the phloem often has been called as a pericycle (cf. VAN TIEGHEM), this should be more accurately and widely investigated. Sieve-tube members and companion cells very slender, gathering into many small or large fascicles; in longitudinal sections straight, rarely ramified or anastomose (cf. LÉANDRI).

Xylem. Taking a form of a continuous cylinder traversed by narrow rays. The characters of the tracheary elements not so much different from those of leaves. No distinct type of vessel distribution as described by LÉANDRI can be found, for the shoots investigated perhaps are too young and slender. Small fascicles of xylem elements rarely observed inside the xylem ring with which they connect elsewhere. According to BAILEY (Journ. Arn. Arb. 14: 259—273), vested pits are present in the secondary xylem. But he observed only 3 genera and 3 species, and the writer had no time to ascertain this on the Japanese species.

Internal phloem (Intraxylary phloem). Always present and arranged in fascicles or irregularly continuous. Scattered fibers, similar to those of the external phloem, present along the inner margin of the internal phloem or absent (*Daphnim.*). Such difference in the quantity of the fibers is of important generic value. The internal phloem sometimes discriminated from the pith by the size of the cells. This tissue often accompanied by sclerenchymatous cells on the adaxial side of a leaf trace. This tissue also generated later than the external phloem (cf. LÉANDRI).

Pith. Composed of cells of big size, often its central part spongy.

Leaf traces. Nodes always unilacunar. The shape of the leaf traces in transverse sections shallowly or a little deeply crescent.

2. Leaves

Cuticle. On the upper surface of leaf axes nearly smooth (e.g., *Dipl. trichotoma*) or with shallow furrows parallel to the axes especially in the species that love sunny places (e.g., *Dipl. Ganpi* and *D. phymatoglossa*).

Epidermis. Composed of low cells, often of taller ones especially in the base of midribs and in petioles in some species. Multiseriate epidermis of 2 or more cell layers often observed at the upper surface. The epidermis at the upper surface sometimes contains the cells whose inner walls conspicuously swelled into the palisade tissue. Hairs, if present, always unicellular as those of all other parts, and often with more or less prominent projections (especially remarkable in *Edg. chrysantha*).

Stomata. Restricted to the lower surface, usually situated on the same level as the epidermis. Half-sunken ones in the epidermis recorded in some foreign species.

Mesophyll. Always bifacial. Palisade tissue composed of 1 to 4 layers of short cells, the uppermost erect, the lowermost irregular and procumbent. This tissue extends a little to the lower surface over the leaf margin in *Diplomorpha Chamaedaphne*. The mesophyll includes very densely intertwined sclerenchymatous fibers in *Eriosolena*. In transverse sections cells in the lower part of midribs com-

posed of isodiametric and somewhat collenchymatous cells which mostly have no chloroplasts but often have crystals (*Edg. chrysantha*). No endodermoid layer usually discriminated, but the lower part and the phloem may be distinguished by the size of their cells. Cells in the upper part of midribs slightly collenchymatous, without chloroplasts, arranged regularly, and the nearer to the leaf apex the more diminished in number owing to the invasion of the palisade tissue from both sides.

Vascular bundles. Showing a considerable range of shape in transverse sections taken at different levels in a single petiole and midrib. The typical is a thick and shallow crescent, but sometimes both ends of the bundle arc approach each other and then close into a ring near the distal end of the petiole (*Edg.*, some of *Dipl.* and of *Wikst.*). This character has important taxonomical value in relation with the distribution of the internal phloem. Vascular bundles often accompanied by sclerenchyma. Terminal ends of the smallest veins composed of helical or annular tracheids or sclerenchyma cells; the meshes of minor venations vary in size. This size seems to give influence upon the quality of leaves together with the thickness of cuticle, epidermis, palisade tissue and spongy tissue, but have only minor value for classification. Phloem with different thickness in transverse sections, containing scattered fibers of different or uniform diameter. Xylem containing tracheary elements with spiral thickenings of the secondary wall in some genera (*Daphne*, *Daphim.* and *Dipl.*). Spiral vessel members often observed. Vessels always simple-perforated. A few or many extended inner apertures of adjacent pits tend to coalesce and to give rise to horizontal or spiral (or oblique) striations or grooves in the vessel members especially of large diameter. Internal phloem present in the leaf axes in some genera (all but *Daphnim.* and *Daphne*), often accompanied by scattered fibers of small diameter (*Edg.* and *Wikst.*). Sclerenchyma cells of shape similar to parenchyma cells frequently appear in or near this tissue, perhaps as an anomalous form. The internal phloem and sclerenchyma rarely extend to major lateral veins.

3. Peduncles and Pedicels

The anatomical features of peduncles and pedicels in every species are not much different from those of the shoots, but in diminished form of the latter. Any taxonomical value thus can't be found in them.

As noted by LÉANDRI, the internal phloem in peduncles of *Edgeworthia chrysantha* is arranged in many fascicles in transverse sections, and each fascicle seems to be developing in the periphery of itself. But in the shoots, this tissue becomes irregular masses or continuous, and doesn't differ from those in other species, i. e., it doesn't serve much for classification. Generally, the internal and the external phloem in the peduncles interconnect directly with each other around the margins of the pedicel gaps. When the pedicel bundles regain the shape of ring after their separation from the peduncle bundles, some parts of the external phloem are enclosed into the rings at both ends of the pedicel bundle arcs and become the internal phloem of the pedicels.

Lacunae sometimes observed in the center of pedicels (e.g., some of *Dipl.*).

4. Flowers

In flowers, the writer has investigated only the vascular structure as well as particular parts described. He has found a few small differences from LÉANDRI's description, some of which will be described in the next chapter again, and a few important characteristics for generic classification.

Floral tubes. Tracheary elements exclusively helical or annular. The vascular bundle of the pedicel divided into several irregular strands above the articulation and arranged into a ring. A whorl of 8 bundles for sepals established at the base of the floral tube (receptacle in GILG's sense), and ovary bundles almost simultaneously separated inside them. All or some of 8 sepal bundles supply small vascular strands for discs immediately above the separation of the ovary bundles. Sepal bundles concentric or collateral, or transitional between these two types, not always uniform in a single species or a flower. Fibers appear sooner or later in the external phloem when observed by the serial sections taken upward from the pedicel, continuing to the lobes. Vascular supply for the filament of stamen departs (sometimes at the very low level) from the sepal bundle as if its internal phloem do, but usually contains 1 or 2 tracheary cells which often arrive at the connective. After the division of stamen strands, the sepal bundles radially divided several times and entering into the lobes (but the alternisepalous bundles showing distinct dichotomy and each of branched strands entering into different adjacent lobes). Floral tubes often with some lacunae especially when they are membranaceous (some of *Dipl.*).

Discs. Of several cells wide in transverse sections; the outermost cells sometimes wider in the surface view, giving a glandular appearance to the discs (*Daphnim.*), sometimes similar to those of the inner surface of the floral tubes, rarely some cells changing into hairs (*Daphne Genkwa* f. *taitoensis* and a specimen of *Dipl. trichotoma*). Vascular strands many in number, usually containing a few tracheary elements or often without them.

Ovaries. Ovary bundles usually concentric, sometimes accompanied by some phloem fibers. The bundles join into a ring within a short distance after separating from the sepal bundles. Then the ring redivides usually into 4 bundles in species with dry fruits (*Daphnim.* and *Dipl.*), viz., 2 opposite dorsal carpellaries (cf. HEINIG) and 2 commissural carpellaries which are very near to one of the former that occupies the place of placenta, or more than 4 in species with berries (*Daphne* excl. sect. *Genkwa* and *Wikst.*), viz., 2 opposite dorsal carpellaries, 2 commissural carpellaries which are farther from the dorsal on the side of placenta than the above-mentioned case, and 2 or a few median carpellaries (usually in the fertile carpel). Besides these, a few much slenderer strands often run into the carpels. Ovule traces divided from 2 commissural carpellaries run through the carpels, and gather into a concentric bundle in the ovule. At this level, the ovary bundles split into several small bundles, interconnecting with each other through some horizontal bundles, diminishing, and finally only as a small ring

of vascular strands entering into the style. Papillae of stigmata projecting more or less long.

Pollen grains. Spheroidal, forate; fine reticulate with thick exine or smooth (*Daphnim.*).

5. Chromosome Number

According to GUNDERSEN, the haploid number is 9 in the four genera except *Daphnimorpha* (unstudied). Among them, *Daphne odora* is usually sterile when cultivated in Japan, and its chromosome number is 12—14 for the gametophyte according to I. OSAWA (Journ. Coll. Agr. Imp. Univ. Tokyo, 4: 238—264; 1913). He considered that this sterility was due to the abnormalities of pollen-grains and of embryo-sacs caused by long cultivation or rather by mutation. But in *D. kiusiana* closely related with *D. odora*, and in *D. pseudo-mezereum*, he observed that the haploid number was 9 as usual. On the other hand, *Edgeworthia chrysantha* was described as $n:18$ by J. SATO.

§ 3. DISTRIBUTIONS AND HABITATS.

Each genus or section from Japan shows the range of distribution as follows:

<i>Daphnimorpha</i>	Kyüsyü.
<i>Daphne</i> sect. <i>Daphne</i>	From Kamchatka to Kyüsyü.
sect. <i>Daphnanthoides</i>	From Hokkaidö to tropical Asia.
sect. <i>Genkwa</i>	Corea and China, cult. in Japan.
<i>Diplomorpha</i>	From central Japan to Formosa and China.
<i>Wikstroemia</i>	From Lyükyü and the Bonin to tropical Asia or Australia.
<i>Edgeworthia</i>	From central China to Himalaya, cult. in Japan.

Though this family as a whole has its main range of distribution in the tropical and subtropical zone, some members are distributed chiefly in the northern regions, e.g., some species of *Daphne* in Kamchatka, etc.

Two closely related species may divide their distributions by a boundary line (*Daphne pseudo-mezereum* and *D. jezoensis*), or be distributed far apart from each other (*Dipl. pauciflora* and *D. yakushimensis*). Two species of *Daphnimorpha* have very restricted areas of occurrence, respectively.

Many species like shadow and humid places, but others rather do sunny places (e.g., *Dipl. Ganpi*). And still others grow in various habitats and often with comparatively wide range of life-form (e.g., *Dipl. yakushimensis*).

§ 4. USES.

Almost all members of *Edgeworthia* and *Diplomorpha* have been used for making Japanese paper for a long time. Especially *Edg. chrysantha* (and often *Dipl. sikokiana*, too) is now widely cultivated in this country for this purpose and has several races. In the others their bark has been gathered chiefly from wild plants, usually without discrimination of each species.

The bark of many members is locally used for making ropes because of the tenacity of the fibers which they contain. And some are valuable in gardens,

for their flowers are beautiful and odorous. In addition, such parts of some species as bark, flowers, fruits and others are used in local medicine, though not much important.

In practical forestry, *Edgeworthia chrysantha* may be mixed-planted with some other forest trees especially near pasture lands, because the poisonous substances which it contains protect the trees from injuries of wild rabbits, wood-mice or cattles.

III. DISCUSSION ABOUT CHARACTERISTICS USED FOR GENERIC CLASSIFICATION

Only major characteristics possessing taxonomical values for such higher taxa as genera or sections are discussed in this chapter, and minor ones will be explained by the keys and the descriptions in the following chapter.

Some of the major characteristics have been divided into some types, respectively. Not infrequently, there are transitions between members of the same kind of type, and the typification in such cases is inevitably artificial or for convenience' sake. But the writer has dared to use them in order to simplify expression of the keys and the subsequent descriptions.

To clarify the relationships between the Japanese groups as accurately as possible, some foreign species also have been studied. Those are enumerated here: *Daphne ambigua* MATSUDA, *D. arisanensis* HAYATA, *D. Championi* BENTHAM, *D. papyracea* WALL.; *Diplomorpha canescens* C.A. MEYER, *Dipl. Chamaedaphne* C.A. MEYER, *Dipl. mononectaria* HAYATA; *Edgeworthia Gardneri* MEISSNER; *Erioseola involucrata* VAN TIEGHEM; *Wikstroemia elliptica* MERRILL, *W. indica* C.A. MEYER, *W. lanceolata* MERRILL, *W. nutans* CHAMPION, *W. ovata* C.A. MEYER.

§ 1. EXTERNAL MORPHOLOGICAL CHARACTERISTICS.

1. The Branching Habits in Relation with Inflorescences (Fig. 1)

The position of buds and inflorescences and the seasons when shoots and leaves grow and fall are discussed and divided into three types in their relation with the sort of the inflorescences. Though these characters are usually considered as one more strongly influenced by habitat than others, the species dealt in this study are comparatively uniform in each genus or section on these characters. And in rare transitional forms there seems to be found something to clarify the relationships between the groups. Wider and more accurate studies on the relation between these habits and habitats, of course, are needful to this purpose.

a. *Daphne*-type

New shoots generally grow from the bases of inflorescences, regardless the sort of the latter. And after flowering, the remnants of the inflorescences, at least of the peduncles, lignify and remain for a long time. Though the small lateral branch which had flowers for several years may wither in some species, this habit is distinctly different from that of the next type. Four subtypes can be recognized.

a₁. *Mezereum*-subtype

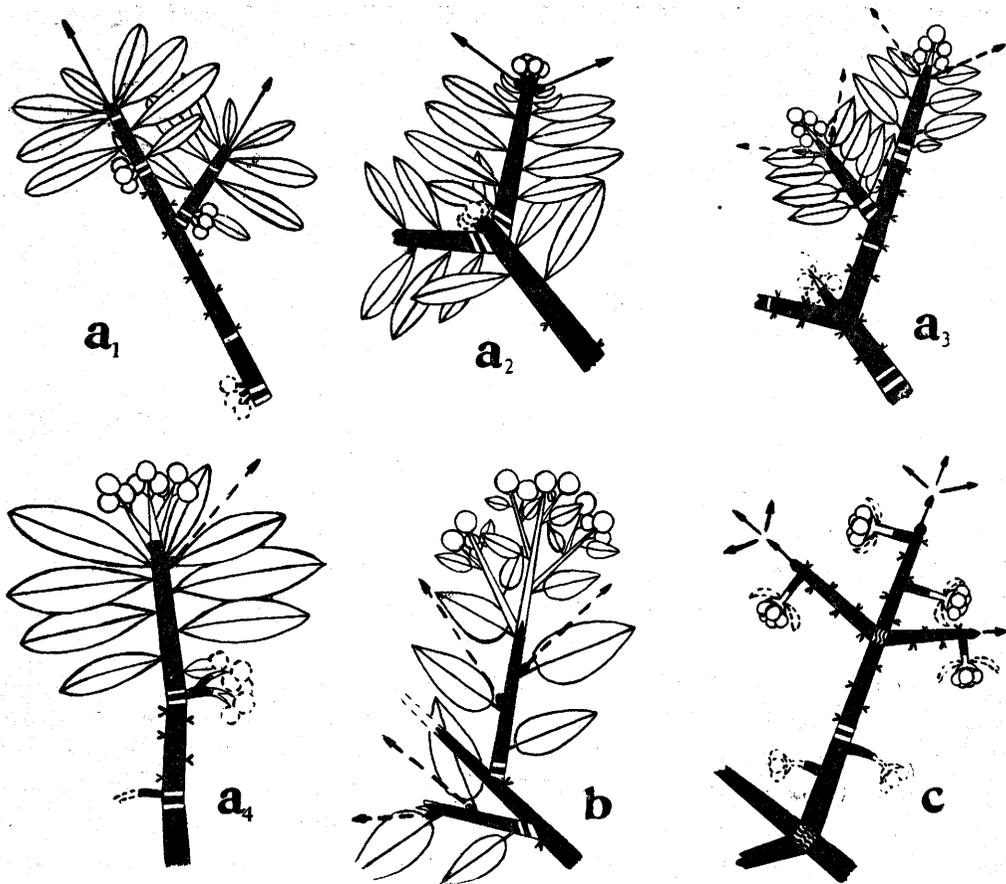


Fig. 1. The types of the branching habit schematically shown in the flowering season. Letters at the feet correspond to those in the text, respectively. Circular signs with stipes: inflorescences; \uparrow and \uparrow : new shoots in the same year as the flowering season and in the next year; v-shaped signs: scars of leaves that fell in or after the last year; the white area in shoots: the part that falls after flowering; the black area: the persistent part, where signs of single white bar represent only the change of year, signs of double white bars show that shoots develop from buds there, and the undulate part represents the peculiar trichotomous branching in *Edgeworthia*-type. All signs of dotted line represent the part that fell in the last year.

Soon after defoliation late in summer, at first an inflorescence and then a new shoot develop from a single bud early in autumn. When the flowers open early in the next year, the inflorescence looks lateral at the base of the shoot. The growth of the shoot is vigorous especially in the next spring and summer. As there is no visible peduncle, their pedicels look developing directly from the lateral side of the shoot and remain with a warty appearance after the flowering.

There are frequently anomalous cases either as local groups or as individual plants. In such cases, development of new leaves is controlled in a less-developed condition, sometimes even till the next spring (e.g., *Daphne pseudo-mezereum* from Mt. Bukó). On the other hand, inflorescences are formed at the tops of the shoots without the defoliation of old leaves and without (or with?) the formation of buds, about the same time as the normal form. The inflorescences alone, therefore, are seen on the naked plants after the old leaves fall late in autumn, i.e.,

in the extremity of these cases the plants look entirely winter-deciduous though the inflorescences pass through winter. The writer considers this anomalous habit to have some relation with that of *Daphne Mezereum*, a precocious species in Europe, in the same section with *D. pseudo-mezereum*, etc. And he expects the valid classificatory treatment of this case from the observation of the plants under cultivation.

Daphne sect. *Daphne* included in this subtype (with temporary exclusion of *D. Mezereum* by the time when the writer studies actual specimens of it).

a₂. *Daphnanthoides*-subtype

All species included in this are evergreen. Usually, terminal (or axillary) heads before anthesis are surrounded by many bracts in autumn. New shoots grow from the axiles of 1 to 3 uppermost bracts after flowering in early spring. The pedicels remain lignified between the new shoots like warts, for the peduncles are very short. In *Daphne Miyabeana*, however, a head with a long peduncle which is often branched is terminal on the shoot having grown in spring, and not surrounded by bracts. Then new shoots develop from its base more or less within the year, and several leaves on the base of the new shoots stay in form of bracts, the others normal.

Daphne sect. *Daphnanthoides* included in this.

a₃. *Wikstroemia*-subtype

In *Daphne Genkwa* which is usually winter-deciduous, buds issue short shoots and spikes which are terminal on those shoots, but the development of new leaves is begun during or after flowering. Then other new shoots develop from leaf axiles at the base of peduncles. The winter in the case of *D. Genkwa* can be thought phenomenally corresponding to the summer in the case of *Wikstroemia*. This subtype in the latter case is similar to the preceding subtype in relation with the season of growth. *Daphne Genkwa* has opposite leaves as *Wikstroemia*. These characters suggest, therefore, a close kinship between these two genera.

There can be observed an anomalous habit as that in the *Mezereum*-subtype, too.

Wikstroemia and *Daphne* sect. *Genkwa* are included in this, but from the latter *D. Championi* must be excluded, for it has very different inflorescences.

a₄. *Daphnimorpha*-subtype

A long, slender and branched peduncle has small heads or spikes on the tops of its branches in summer. The peduncle is terminal. Leaves are deciduous in winter.

Daphnimorpha included in this subtype.

b. *Diplomorpha*-type (Pl. X, O)

Inflorescences are spikes or heads, and in some species the upper part of a branched shoot has an appearance of a panicle (e.g., *Dipl. Ganpi*). After defoliation, the inflorescence and the upper part of the shoot become withered by the next flowering season at latest, leaving several lower nodes. In the next year, new shoots develop from some of the nodes left, and the part of the old shoot above

them takes a form of a long stalk or a short rigid needle. Then it falls sooner or later.

Diplomorpha belongs to this type.

c. *Edgeworthia*-type

Involucrate heads are terminal and lateral with long peduncles, and bloom precociously in spring. A new shoot develops from the top of the last year shoot. The growing apex of the new shoot suddenly withers about in July, and 2 to 5 (usually 3) secondary shoots develop from it at the same time. But often this apex may continue to grow appreciably (cf. M. KURATA). Each of those shoots has in autumn a few terminal and lateral heads which bloom in the next spring, but the involucre fall within the year.

The writer considers these involucre to be of a different character from the bracts of some of *Daphne*. In the latter group (e.g., *D. odora*), he observed that the leaves which were not near to the heads often took an entirely similar form to the bracts. The fact that in *Daphnanthoides*-subtype new shoots grow out of the axiles of the uppermost bracts, with this phenomenon, compels him to presume that the bracts in *Daphne* reserve the foliar character stronger than the involucre in *Edgeworthia*, and to give the genus *Edgeworthia* a systematical position enough to recognize as a different genus from *Daphne*. In other words, the involucre occupies a position on the distal end of the peduncle and has no relation with the growth of the shoot. Such an involucre is present in the genus *Eriosolena*, too. Though these two involucrate genera have been included into *Daphne* by some taxonomists, now they are recognized as independent genera by this writer according to the above-mentioned and other reasons.

Edgeworthia included in this.

2. Hypogynous Discs (Fig. 2)

The shape of hypogynous discs has been regarded as an important diagnostic feature by many taxonomists. For example, GILG (1895) divided *Daphninae* from *Wikstroemiinae* by it. NAKAI (1928 and 1937) distinguished likewise *Wikstroemia*, *Diplomorpha* and *Daphnimorpha*. But such division can not always be sharply performed because of the presence of some transitional forms. The writer thinks GILG's classification based on this alone too artificial. In *Diplomorpha* the number of disc scale is 1 to 4 and is not of much taxonomical significance. But some old taxonomists described that it was exclusively 4, even in species with scales less than 4. They must have considered, with preconception and without careful observation, that the number is immediately related with that of the sepal bundles or of the lobes. In the anatomical features, the disc traces are irregularly divided from the sepal bundles (according to HEINIG, they depart from the radial faces of the sepal bundles) in the receptacle. At first they are arranged in a continuous layer inside that of the sepal bundles, but are quite absent on the side lacking the disc scales. The number of the disc traces is indefinite, and appears to have no direct relation with that of the sepal bundles or to have changed so heavily that one cannot research their origin without large difficulty:

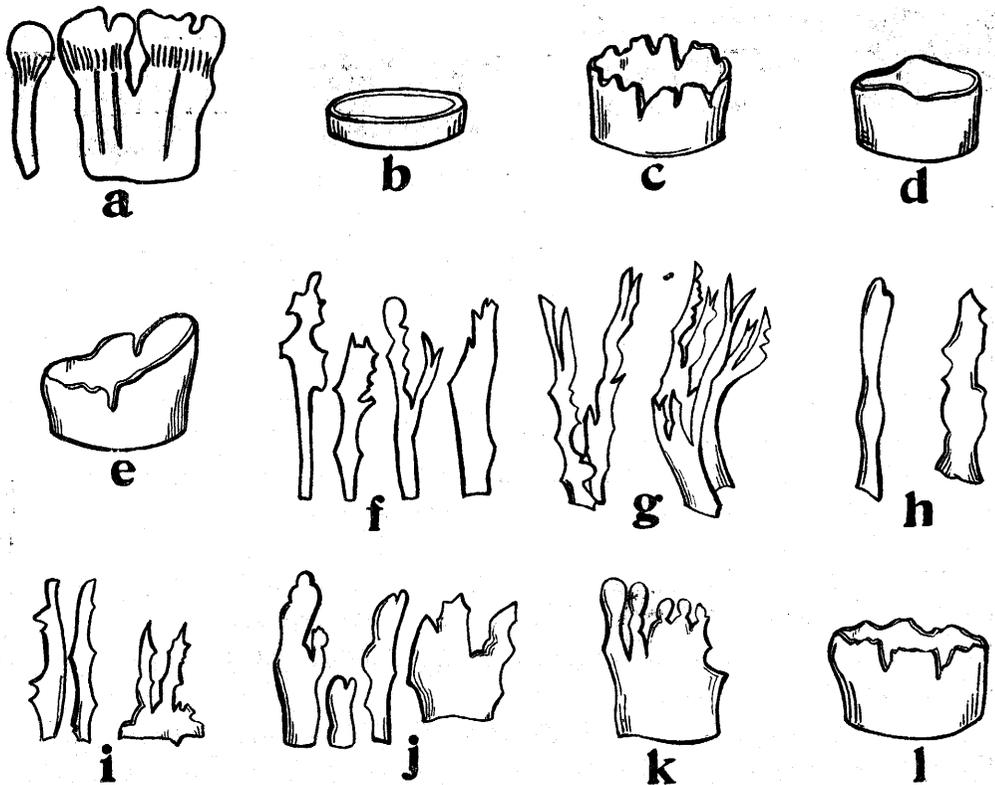


Fig. 2. Shape of discs in representative species of each genus. a: *Daphnimorpha Kudoi* NAKAI; b: *Daphne pseudo-mezereum* A. GRAY; c: *D. kiusiana* MIQUEL; d: *D. odora* THUNB.; e: *D. Genkwa* SIEB. et ZUCC.; f: *Diplomorpha trichotoma* NAKAI; g: *Dipl. Ganfi* NAKAI; h: *Dipl. Chamaedaphne* C.A. MEYER; i: *Wikstroemia nutans* CHAMPION; j: *W. retusa* A. GRAY; k: *W. elliptica* MERRILL; l: *Edgeworthia chrysantha* LINDLEY. (magnification various).

Typical shapes and groups showing them are as follows:

- a. Annular or cup-shaped: *Daphne* and *Edgeworthia* (and *Eriosolena*).
- b. Fan-shaped or half-cylindrical, with thick and glandular apices: *Daphnimorpha*.
- c. Scaly, subulate or clapper-shaped: *Diplomorpha* and *Wikstroemia*.

The cup-shaped discs in some cases are irregularly erose or lobate at their margins, or rarely entirely divided. According to REHDER (1916), each pentamerous species of *Daphne* and *Wikstroemia* in western China has a quadrate (*Daphne ambigua*, etc.) or wide clapper-shaped disc with an erose top (*Wikstroemia*). Such shape is also observed in the tetramerous *W. elliptica*. The transition in these species obstructs sharp separation of these two genera. Other characters observed in them also offer some very interesting problems and important clues to clarify their relation, but unfortunately most of these species can not be studied by this writer because of the absence of their specimens.

The disc scales are generally narrower and more profoundly parted in *Diplomorpha*, wider in *Wikstroemia*, but this difference is transitional and is often variable even in a single species. They may be slightly glandular in species of the other genera than *Daphnimorpha*.

3. Pedicels and Fruits (Fig. 3)

Two types can be discriminated by the position of articulation in pedicels and by the sort of fruits.

a. *Diplomorpha*-type

Floral tubes articulate immediately with pedicels at their bases. And as ovaries usually have distinct or indistinct stipes, the marcescent floral tubes remain at the base of long or short fruit stipes when fruits mature. Almost all members in this type have dry fruits. The floral tubes are entirely or partially persistent and envelop the fruits sometimes till they fall. The persistency is sometimes of taxonomical value for minor taxa.

Daphne sect. *Genkwa*, *Edgeworthia*, *Diplomorpha* and *Daphnimorpha* are included in this. But in the former two the fruits may be slightly fleshy, and the stipes are very short or nearly absent. That is to say, these two groups somewhat approach the sections of *Daphne* in the next type.

b. *Wikstroemia*-type

Floral tubes articulate more or less apart from their bases. And as ovaries usually have no stipes, the fragments of the floral tubes remain immediately at the base of fruits. In this type, the fruits are always fleshy and the floral tubes are caducous.

Daphne sect. *Daphne*, sect. *Daphnanthoides* and *Wikstroemia*. In the last, the pedicels above the articulation are considerably long (more than 1 mm), but in the others short.

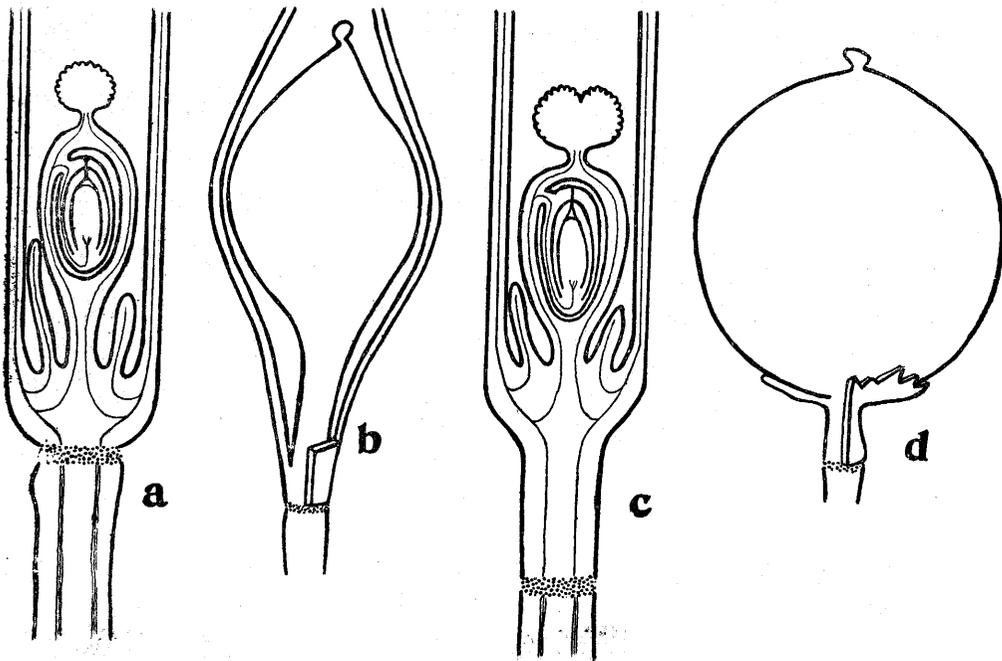


Fig. 3. The relative position of the pedicel articulation of flowers and fruits, and the division of sepal bundles and ovary bundles. a and c: flowers; b and d: fruits. a and b: *Diplomorpha*-type. c and d: *Wikstroemia*-type.

In both types, the members of *Daphne* constitute an intermediate group between the typicals of both.

4. Styles and Stigmata

In almost all genera, styles are very short, and stigmata are capitate or discoid. But in species of *Edgeworthia*, styles are long and stigmata are clavate. *Daphne Championi* has a long style and a little capitate stigma. *Eriosolena involucrata* has a long style and a discoid stigma. According to REHDER (1916), several species among the above-mentioned pentamerous *Daphne* have long styles. Data are too few to conclude any relationship by these characters.

§ 2. MICROSCOPICAL CHARACTERISTICS.

1. Internal Phloem Fibers in Shoots (Pl. VII)

The internal phloem is distributed in many small masses or an irregularly continuous ring inside the xylem. Fibers are usually distributed along the inner margin of the internal phloem, and sometimes are in somewhat separate layers from other elements of the phloem. These distributions are variable at different parts even in an individual plant as LÉANDRI noted, and there is not any taxonomical value in this character. The presence of the fibers of two classes of diameter is not always distinct, though this is sometimes very distinct in the external phloem. But the quantity of the fibers in it is nearly constant in each genus, as LÉANDRI also pointed out. Using only this character, therefore, each genus is clearly discriminated as follows (the foreign species that are listed above but not observed are in parentheses):

a. More or less abundantly present: *Daphne* (*D. Championi*, *D. ambigua*), *Edgeworthia* and *Wikstroemia* (*W. lanceolata*).

b. Only several in a transverse section, often absent: *Diplomorpha*.

c. Absent: *Daphnimorpha*.

The difference between *Diplomorpha* (b) and *Wikstroemia* (a) was pointed out by VAN TIEGHEM already in 1893.

When the internal phloem and fibers accompany with leaf traces, they enter into midribs through the two following ways (cf. LÉANDRI). Under observation of serial cross sections from a node to a midrib, in species with no internal phloem in the leaf bundle, it seems that the fascicles of the phloem and the fibers gradually move outward over both ends of the arc of leaf trace and unite with the external phloem about the abscission zone. That is, the external phloem and the internal phloem of a shoot appear to indirectly interconnect with each other by the mediation of the leaf trace. In species containing much internal phloem in the leaf bundle, on the other hand, some central fascicles seem to go into the petiole without moving outward. The phloem temporarily disappears or at least becomes difficult to observe near and in the abscission zone (or articulation) in both ways. There need not necessarily be thought any phylogenetically significant difference between these two ways of interconnecting of the internal and external phloem, because the latter group of species show both ways at the same time, and because this difference is rather in a parallel relation to the presence or ab-

sence of the internal phloem in the leaf axis.

2. Vascular Bundles in Leaf Axes (Fig. 4; Pl. VIII, Pl. K : H—I)

The writer has studied these parts especially in respect of the internal phloem and fibers. He has been able to more clarify the characteristics which were already researched by SUPPRIAN, VAN TIEGHEM and LÉANDRI, and to utilize them for the generic classification in the Japanese *Thymelaeaceae*.

i) As LÉANDRI reported, though the shape of the vascular bundles in trans-

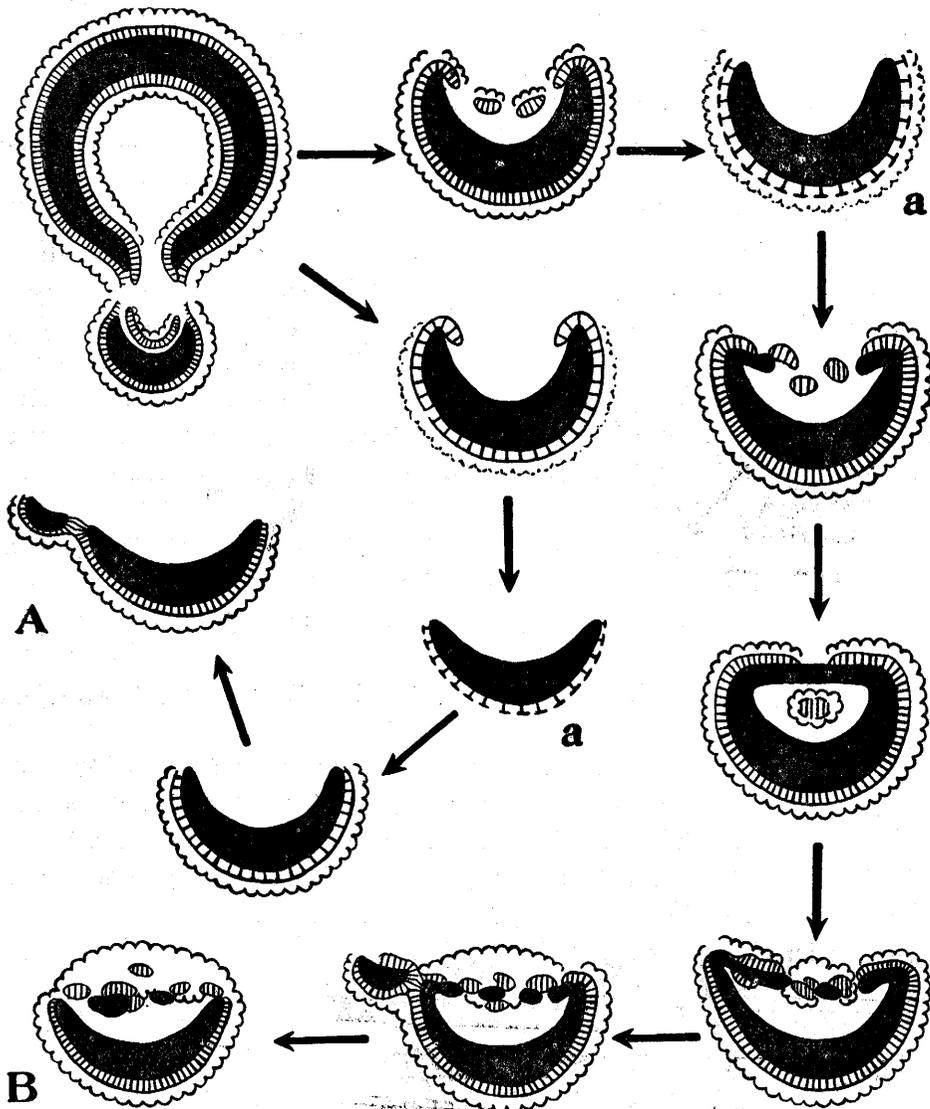


Fig. 4. Schemata of vascular bundles in transverse sections taken at various levels from leaf traces to midribs. A-series: an example of *Daphne*-type in which the bundle is always crescent; B-series: an example of *Wikstroemia*-type in which the petiolar bundle becomes a circle.

a: transverse features of leaf bundles in abscission zones. Black area represents the xylem; hatched area the phloem; area surrounded by undulate lines the phloem fibers; and broken or dotted line the inconspicuous situation of each element.

verse sections of these parts is very various in some foreign groups of this family, it is comparatively uniform in the group treated in this study. The leaf trace is usually shallowly crescent about where it enters into the petiole. But in some species it becomes deeper crescent as it approaches the abscission zone. After passing through the zone, it sometimes maintains the shallow crescent as before, or sometimes becomes more deeply crescent or a closed ring. In the latter case, the adaxial part of the ring is broken in the midrib and takes a form of two arms of the bundle or of a few fascicles of the xylem which gradually diminish earlier than the fascicles of the internal phloem. Then the body of the bundle maintains its shallow crescent shape without any conspicuous change and gradually diminishes itself as it approaches the tip of the leaf. Though the species may be separated into some groups in accordance with the degree of curvature of the bundle, it also may vary more or less even in a single species. Roughly speaking, in a leaf with a long petiole the bundle is apt to be a ring, and in one with an indistinct or short petiole a crescent.

The first lateral vein bundle is, in transverse sections, divided from either an end of the bundle arc or a corner of the ring in accordance with the degree of curvature of the bundle of midrib. In the latter way, if the body of the bundle is thick, it is divided without formation of any lateral vein gap (if this term permitted). This way of the separation gradually approaches the former as the arm or the internal xylem fascicles diminish.

ii) As the bundle of the leaf axis goes upward from the abscission zone, some fascicles of the phloem appear on the adaxial side of it in species of some genera. In the case where the arms of the bundle approach each other and often close into a ring, the external phloem does so in the most adaxial place, too. The two arms of the external phloem unite at first with the internal phloem and then with each other. At that time some fascicles of them are usually inclosed into the ring of the xylem. After that, as the adaxial parts of the ring or the arms become some fascicles of the xylem and then diminish, the adaxial phloem and the inclosed become the internal phloem and retain themselves for a considerably long distance—at least to the middle of the midrib. Small parts of these internal phloem rarely accompany with large lateral vein bundles on the adaxial side, or they sometimes connect with the external phloem of the lateral veins through the vein gaps.

iii) The external phloem fibers always appear sooner or later. In some genera fibers appear abundantly or poorly within the internal phloem, too. If abundant, they are distributed into several large and dense clusters in transverse sections. The fibers in the internal phloem are usually of smaller diameter than those in the external phloem.

iv) Sclerenchyma cells frequently appear in particular on the adaxial side of the bundle of the leaf axis or the leaf trace. In transverse sections, they sometimes are one or more, small and scattered masses, sometimes fill the space between both arms of the bundle inside or outside the internal phloem, and often

accompany with the lateral vein bundles. They often have very thick walls and large diameter. Their walls are irregularly serrate on the inner surface at times. In longitudinal sections in some species, they are of forms similar to those of parenchyma cells and have helical secondary walls (e.g., a sample of *Dipl. Chamaedaphne*). The longitudinal distance they continue is usually short. Consequently, the appearance of such cells seems to be occasional even in a single species. On the contrary, in the mesophyll of *Eriosolena involucrata* are observed the sclerenchymatous fibers which are so dense that the venations are difficult to be seen with cleared leaves (cf. VAN TIEGHEM). This, the writer thinks, is worthy of a taxonomical criterion for the genus.

v) By the mentioned above, especially the internal phloem and fibers, three types can be established in the vascular bundle of the leaf axis as follows:

a. *Daphne*-type

The internal phloem and fibers are absent. The transverse shape of the bundle is usually crescent, but may take a horseshoe shape. In the latter shape, the external phloem sometimes become a ring though incomplete, but it diminishes with the arms of the xylem arc and doesn't leave any element to be called the internal phloem (*Daphne Genkwa*). In the former shape, one or two minute fascicles of cells of very small diameter are rarely present in the center of the adaxial side, but are unusual (some samples in *Daphnim.*).

Daphne, *Daphnimorpha* and *Diplomorpha Chamaedaphne* are included in this.

b. *Diplomorpha*-type

The internal phloem is present. The internal fibers are usually absent, but only one or two fibers are rarely observed as in the shoots. The transverse shape of the bundle is a ring or an arc with small arms, and sometimes both shapes appear in a single species.

Diplomorpha and *Daphne ambigua* are included in this.

SUPPRIAN's description that *Diplomorpha* has no internal phloem is strange.

c. *Wikstroemia*-type

The internal phloem and fibers are present. The transverse shape of the bundle is crescent, horseshoe-shaped or circular.

Wikstroemia and *Edgeworthia* are included in this type. The internal fibers are very abundant in *Wikstroemia*, and a little fewer in *Edgeworthia*.

According to VAN TIEGHEM, species of *Eriosolena* have the internal phloem, too.

3. Spiral Thickenings of Tracheary Elements in Leaves (Pl. K : J—K)

The writer has observed the tracheary elements with spiral thickenings mainly by macerated materials of the bundles of the leaf axes. As he did not find any other important generic characteristics and make all kinds of measurement in other anatomical features of the vascular structure, only the spiral thickenings are treated here with some other related characters.

The spiral thickenings appear already even in scalariform or reticulate vessel members (or tracheids, too) at the middle part of the xylem in radial longitudinal

sections of some species, but usually slight. In the metaxylem (or more abaxial part of the xylem), those become much more conspicuous, and therefore the pits are usually visible with difficulty. In the most abaxial and small elements (of somewhat irregular forms), the thickenings are so conspicuous that even perforations can not be very often recognized, and whether such elements are vessel members or tracheids is indistinct. On the contrary, in the species in which the spiral thickenings are slight or entirely absent, the tracheids are usually distinguished from the vessel members with ease. The writer supposes from these facts that the development of the spiral thickenings is parallel in the vessel members and the tracheids in the ontogeny.

For reference, he has also studied the spiral thickenings by macerated wood materials of some species of every genus. He has found quite the same relation as in the vascular bundles of the leaves on the degree of their conspicuousness. In the wood, if the vessel members are distinctly recognizable, the slender and smaller they are, the more prominent the spiral thickenings are. It is not distinct as in the leaves whether the elements of small diameter are vessel members or tracheids. On the other hand, the pitted tracheids (or fiber-tracheids) commonly have slight or moderate spiral thickenings, too. The drum-like vessel members usually have slight, hardly visible, or no spiral thickenings, even in species with conspicuous thickenings.

If these facts are compared with the hypothesis of BAILEY and his associates, the spiral thickenings are apt to be more conspicuous in the tracheary elements with more primitive features. They may be consequently interpreted as another primitive feature from the view-point of the evolution of the tracheary elements. But decision of a phylogenetical order in such small groups as the Japanese five genera only by this is so dangerous that the writer refrains from it.

Now, each group may be arranged in the sequence of the degree of their conspicuousness in the tracheary elements of the leaf axes as follows:

- a. The spiral thickenings very conspicuous: *Daphne* and *Daphnimorpha*. But in *Daphne* sect. *Genkwa* the degree is somewhat low.
- b. The thickenings a little conspicuous to slight or absent: *Diplomorpha*. Among this, *D. pauciflora* and *D. yakushimensis* have the spiral thickenings as conspicuous as *Daphne* sect. *Genkwa*. In *Diplomorpha canescens* and *D. Chamaedaphne* they are very slight or absent. They may vary in a single species. In this group also, some cells often have distinct thickenings near their tails or ends.
- c. The thickenings quite absent: *Daphne Championi*, *D. ambigua*, *Edgeworthia*, *Erioseola involucrata* and *Wikstroemia*. *W. pseudoretusa* may have very slight thickenings.

According to SOLEREDER, some species of *Wikstroemia* have vessel members with spiral thickenings (without designation of species). The writer thinks they are probably included in the genus *Diplomorpha* which has often been treated as a section of *Wikstroemia*. According to REHDER (1916), VAN TIEGHEM pointed out that leaves in species of *Wikstroemia* contain pitted tracheids and in *Daphne* none.

The more prominent the spiral thickenings, generally, the more difficult the recognition of the pits or even of the perforations becomes, as mentioned above. And the pitted tracheids are easier to observe in such species with no or few thickenings as those included in **c** and **b** groups than **a**. The absence of the pitted tracheids in *Daphne* consequently seems only to mean the difficulty of recognizing the pits by reason of their prominent thickenings. (With regard to these elements, further study by wider sampling is necessary).

4. Ovary Bundles (Fig. 3, Pl. X : L—M)

As mentioned in the preceding chapter, LÉANDRI writes that the ovary bundles are already separated from the sepal bundles at the articulation of the pedicel. His figures are drawn in such a situation (p. 216, Fig. 20), too. But in all the genera in this study the writer has observed that the ovary bundles separate from the sepal bundles about the base of the floral tube above the articulation. (With concern to this situation, HEINIG's paper is more in detail). In transverse sections, the vascular bundle above the articulation is at first circular with irregular xylem strands (whose number is not always eight). It then divides into eight small sepal bundles at the base of the tube (in the receptacle). The ovary bundles are left inside and arranged in a ring, as the sepal bundles are separated outward. Behaviour of the internal phloem is very complicated at that time. In longitudinal sections, it can be apparently observed that the ovary bundles separate from the sepal bundles at a considerable distance above, but not at the articulation. It is more obvious in *Wikstroemia*-type of the pedicel articulation. From this anatomical point of view, the difference between both types of the pedicel articulation is principally based on the distance from the articulation to the dividing point of both bundles. Though HEINIG doesn't nearly describe about the articulation and others in the nature of her study, her figures and short description serve as reference.

By the way, GILG's opinion to regard the floral tube as a receptacle appears to have been nearly denied by the data of two anatomists, LÉANDRI and HEINIG, in spite of the former's minor errors and some differences between both yet. The writer also considers from these and his studies that the tubular elongation of the receptacle may be not much remarkable even though there have been done. He has, in fact, observed that the lower stamen traces of *Daphne jezoensis* are separated from the sepal bundles near the same level as the base of the ovary, though this level is a little higher than that observed by LÉANDRI and HEINIG in such genera as *Lasiosiphon*, etc. But in their point of view, origin of the hypogynous discs cannot be interpreted yet.

The number and arrangement of the ovary bundles are different between species with dry fruits and those with berries, as mentioned in the preceding chapter. The ovary bundle takes a form of an irregularly continuous ring in all after the division in the receptacle. Then the ring appears to be always condensed into four bundles (two dorsal and two commissural carpellaries). In species with dry fruits, the commissural carpellaries are very near to the dorsal in the

sterile carpel. This situation continues till the commissural carpellaries supply traces to the ovule. About that height the other dorsal carpellaries divides into several smaller strands. In species with berries, on the other hand, a few smaller bundles (viz., median bundles) appear between these four bundles at the comparatively low level. Their arrangement is often nearly equidistant and their sizes are comparatively similar, so that the first four bundles need careful observation for their recognition. To the ovule, small vascular traces which run almost horizontally in the carpel gather from the commissural carpellaries.

There are some examples eccentric from these typical forms. In the group with dry fruits, such examples are as follows: ① the dorsal bundle of the sterile carpel (viz., on the side of the placenta) are divided into two small bundles; ② similar to ①, but the dorsal divided in two and the commissural carpellaries are small and somewhat continuous (*Edg. chrysantha*); ③ the dorsal bundle of the sterile carpel is small and the other dorsal is divided into a few small bundles (*Daphnim. Kudoi*), etc. In the group with berries, on the contrary, four bundles are often distinctly larger than the median carpellaries. But whether these examples are occasional or constant in each species has not been assured.

The distribution of the ovary bundles also seems to have relation with the length of the stipes of ovaries or of fruits, i.e., in the dry fruits the stipes are long, in the berries short or nearly absent. It may be necessarily related with their fleshiness that the median bundles are in the less reduced condition in the berries.

In conclusion, it is thought that this difference in the distribution of ovary bundles is closely related with the sort of fruits and so with the length of their stipes, but that it is enough only to give ranks of genus or section and not enough to give a rank of subtribe or higher ones to each group that shows either of these types of distribution.

5. Crystals

The form of crystals has been thought to have no taxonomical value (cf. SOLEREDER and METCALFE & CHALK). *Edgeworthia chrysantha* alone has many druse crystals among the species studied by the writer. Those occur in the cortex, pith, mesophyll (even in the palisade tissue) and other parts. Several or more cells containing druses often constitute a long vertical series in the pith. According to VAN TIEGHEM, species of *Eriosolena* contain crystals, too. Therefore the occurrence of the crystals in these two genera is a remarkable characteristic to discriminate them from the other genera.

6. Pollen Grains

The exine of pollen grains is always smooth in *Daphnimorpha*. But in all other genera it is fine reticulate. The lumens of meshes are small in diameter and comparatively profound. This remarkable feature distinguishes clearly the genus *Daphnimorpha* from the related others.

§ 3. THE RELATIONSHIP OF THE JAPANESE GENERA (Table 1)

In GILG's system (1895), *Daphne*, *Edgeworthia* and *Eriosolena* (as a section

of *Daphne*) are included in the subtribe *Daphniinae*, *Wikstroemia* and *Diplomorpha* (as a section of *Wikstroemia*) in the subtribe *Wikstroemiinae*. *Daphnimorpha* has been thought for a member of *Wikstroemia* by some of Japanese taxonomists. Though both subtribes contain several genera respectively, the genera other than the above-mentioned can not be studied by the writer because of the absence in materials. These six genera likewise lack materials of many foreign species, especially of pentamerous species of *Daphne* and *Wikstroemia* in western China. When those are studied enough, many new knowledges will be found to fill the gaps left by the studies of the Japanese species only and will serve to properly evaluate the phylogenetical significance of each kind of types or characters. Till that time, the writer refrains from inducing at once any conclusive relationship, and so he discusses only about comparatively safe points.

Table 1.

Groups	Characteristics	Branching habit	Discs	Pedicel articulation	Internal phloem and fibers			Spiral thickenings	Exine of pollen grains	Crystals
					Shoots	Leaves				
						Fibers	Phloem			
<i>Daphnimorpha</i>		<i>a</i> ₄	<i>b</i>	<i>a</i>	—	—	—	++	sm.	—
<i>Daphne</i>	Sect. <i>Daphne</i>	<i>a</i> ₁	<i>a</i>	<i>b</i>	+	—	—	++	f.r.	—
	Sect. <i>Daphnanthoides</i>	<i>a</i> ₂	<i>a</i>	<i>b</i>	+	—	—	++	f.r.	—
	Sect. <i>Genkwa</i>	<i>a</i> ₃	<i>a</i>	<i>a</i> (fleshy)	+	—	—	+	f.r.	—
<i>Daphne Championi</i>		?	<i>a</i>	<i>a</i>	?	?	?	—	f.r.	—
<i>Daphne ambigua</i>		<i>a</i> ₃ ?	quadrate	<i>a</i>	?	+	—	—	f.r.	—
<i>Diplomorpha Chamadaphne</i>		<i>b</i>	<i>c</i>	<i>a</i>	+~—	—	—	—	f.r.	—
<i>Diplomorpha</i>		<i>b</i>	<i>c</i>	<i>a</i>	+~—	+	—	+~—	f.r.	—
<i>Wikstroemia</i>		<i>a</i> ₃	<i>c</i>	<i>b</i>	+	+	++	—	f.r.	—
<i>Edgeworthia</i>		<i>c</i>	<i>a</i>	<i>a</i> (fleshy)	+	+	+	—	f.r.	+
<i>Eriosoena</i>		<i>c</i> ?	<i>a</i>	<i>a</i> (fleshy)	?	+	?	—	f.r.	+

Each literal sign is that in the test. ++, +, +~—, —: from abundantly present (or conspicuous) to absent. sm.: smooth. f.r.: fine reticulate.

As shown in the Table 1 and by the keys in the next chapter, every genus now can be discriminated from each other, and recognized as an independent genus. The true relationship between them is, however, not induced yet. In the first place, because which characteristic should be permitted as the highest criterion for the relationship can not be decided with ease. In the second, because a relationship assumed due to a characteristic is frequently in conflict with those due to others. For example, the genera belonging to *Wikstroemiinae* differ from those to *Daphniinae* but *Eriosoena* and *Edgeworthia* by the types of the internal phloem in leaves. On the other hand, the spiral thickenings of the tracheary cells in leaves occur in both subtribes (cf. SOLEREDER and METCALFE & CHALK). Then, if only the genera studied in this work are considered, the three anatomical charac-

teristics (the internal phloem and fibers in shoots and leaves, and the spiral thickenings) are arranged in a common sequence of the genera, viz., *Daphnimorpha*—*Daphne* (sect. *Daphne*—sect. *Daphnanthoides*—sect. *Genkwa*)—*Diplomorpha*—*Wikstroemia*—*Edgeworthia* and *Eriosolena*. Only the poorness of the internal fibers in shoots in *Diplomorpha* is out of this sequence, and it is perhaps related with the fact that the researched parts of shoots are almost those that wither and fall after flowering. In this sequence of genera, one can suppose from the view-point of phylogeny, at first the internal phloem and then the internal fibers gradually extend from the shoots to the leaves, or in the opposite direction they diminish. And likewise in this sequence of genera, the spiral thickenings become less conspicuous or in the opposite direction become more. But it should not be forgot that in the order of the natural kinship some of other genera belonging to *Daphneae* are inserted in some spaces of this sequence or are arranged at either of both ends of it, consequently that they may bring about any kind of alteration to it by characters other than the mentioned above. The external morphological characteristics are more complicated and are in conflict with each other and with the anatomical, so that any clear and possible order cannot be gained only from them.

Some temporary conclusions are as follows :

i) *Daphne* and *Wikstroemia*, representatives of both subtribes, seem to be closely related with each other, probably through the pentamerous species (cf. REHDER ; 1916) or by the branching habit. That is, GILG's division of both subtribes which is based only on the hypogynous discs is not necessarily natural. But *Daphne ambigua*, the only pentamerous species that the writer has studied, lacks the spiral thickenings, contains the internal phloem in leaves, and moreover shows *Diplomorpha*-type of the pedicel articulation (fruits unseen). It thus approaches more closely to *Wikstroemia* or *Diplomorpha* than to *Daphne*.

ii) *Diplomorpha* occupies a position adjoining *Wikstroemia* in many characteristics except the branching habit and the pedicel articulation. But it has reasons to be recognized as a different genus, though it has been often treated as a section of *Wikstroemia*.

iii) *Daphnimorpha* is considered to be nearer to *Daphne* and further from *Wikstroemia* and *Diplomorpha* by the microscopical characters than it has been considered by the external morphological ones. With its particularity in the pollen grains, too, it is worthy of an independent genus and should not be inserted but be arranged at one end of the sequence mentioned above. This arrangement brings about an assumption that it is a relic genus, with help of the extremely restricted distribution of its species.

iv) *Edgeworthia* and *Eriosolena* are considered to be nearer to *Wikstroemia* and further from *Daphne* by the microscopical characters than they have been considered by the external morphological ones. The independence of *Eriosolena* as a genus is thus distinct, though it is treated as a section of *Daphne* by some taxonomists still now. Its discriminating features from *Edgeworthia* are the

dense sclerenchymatous fibers in the mesophyll (none in *Edg.*) and the berries (the dry fruits in the latter). But these two genera are very closely related.

v) *Daphne Championi* lacks the spiral thickenings, and moreover distinctly differs from *D. Genkwa* by its long styles and peculiar inflorescences. Consequently it should be at least removed from *Daphne* sect. *Genkwa*.

IV. THE SYSTEM OF THE JAPANESE SPECIES

The *Thymelaeaceae* is widely distributed in the temperate and tropical zones and many members grow especially in Africa, Australia, Mediterranean region and the steppe region in the central and western Asia. This contains ca 40 genera and 460–500 species, among which 5 genera and 19 species (including 1 variety and 4 forms) are found in Japan.

With regard to system higher than family, it is very difficult to research the affinity of this family to others and to determine its systematical position, because the interpretation of floral parts, especially of floral tubes and petaloid scales, are different according to authors. Therefore the writer points out only the fact that HEINIG, basing on her anatomical study of flowers, supposed a polyphyletic origin of this family in both the *Flacourtiaceae* and the *Tiliaceae*.

Fam. **THYMELAEACEAE** [nom. conserv.] C.F. MEISSNER in DC., Prodr. **14**: 493 (1857)—EICHLER, Bl.-diagn. **2**: 491 (1878)—BAILLON, Nat. Hist. Pl. **6**: 102 (1880)—GILG in ENGL., Pfl.-fam. **3-6 a**: 216 (1895)—REHDER, Bibl. Cult. Tr. Shr. 478 (1949)—GUNDERSEN, Fam. Dicot. 120 (1950)—HARA, Enum. Sperm. Jap. **3**: 230 (1954).

Vepreculae L., Phil. Bot. 33 (1751), p.p.

Thymelaeae JUSSIEU, Gen. Pl. 76 (1789).

Daphnoideae VENTENAT, Tabl. R \grave{e} g. V \acute{e} g. **2**: 235 (1799)—ENDLICHER, Gen. Pl. 329 (1836).

Daphnaceae J. ST. HILAIRE, Expos. Fam. Nat. **1**: 180 (1805)—C. A. MEYER in Ann. Sci. Nat. sér. 2, **20**: 45 (1843)—NAKAI, Fl. Sylv. Kor. **17**: 35 (1928).

Aquilarineae [R. BROWN, Cong. 25 (1818)]*—DE CANDOLLE in Prodr. **2**: 59 (1825)—ENDLICHER, l.c. 332 (1836).

Thymeleae DURANDE ; SPACH, Hist. Nat. Vég. Phan. **10**: 434 (1841).

Thymelaceae LINDLEY, Nat. Syst. ed. 2, 194 (1836).

Aquilariaceae LINDLEY, l.c. 196 (1836).

Subfam. DAPHNOIDEAE SUPPRIAN in ENGL., Bot. Jahrb. **18**: 306 (1891).

Thymelinae ENDLICHER, Gen. Pl. Suppl. **4-2**: 59 (1847), ut trib.

Thymeleae MEISSNER, l.c. 495 (1857)—BAILLON, l.c. 102 (1880), p.p.

Thymelaeoideae GILG, l.c. 222 (1895)—ENGLER et DIELS, Syll. Pfl.-fam. ed. II, 298 (1936).

Trib. **Daphneae** C. A. MEYER, l.c. 46 (1843)—ENDLICHER, l.c. 59 (1847), ut subtrib.—MEISSNER, l.c. 496 (1857)—GILG, l.c. 223 (1895)—REHDER, l.c. 478 (1949).

* The literatures in brackets were not seen by the writer.

Euthymelaeeae BENTH. et HOOK. fil., Gen. Pl. 3: 187 (1880).

Euthymeleae SUPPRIAN, l.c. 340 (1891), p.p.

GILG divided this tribe into several subtribes. But among them *Wikstroemiae* and *Daphninae* have no reason to be discriminated from each other as subtribes, as mentioned in the preceding chapter.

Keys to the Japanese Genera.

1. A Key by the External Morphological Characteristics.

- a₁ Discs fan-shaped or half-cylindrical, with glandular tops. Branching habit *Daphnimorpha*-subtype.i. *Daphnimorpha*.
- a₂ Discs annular or cup-shaped. Pedicel articulation *Diplomorpha*- or *Wikstroemia*-type.
 - b₁ Branching habit *Daphne*-type. Styles usually short.ii. *Daphne*.
 - b₂ Branching habit *Edgeworthia*-type. Styles very long.v. *Edgeworthia*.
- a₃ Discs scaly, subulate or clapper-shaped.
 - b₁ Branching habit *Diplomorpha*-type. Pedicel articulation *Diplomorpha*-type. iii. *Diplomorpha*.
 - b₂ Branching habit *Wikstroemia*-subtype. Pedicel articulation *Wikstroemia*-type.iv. *Wikstroemia*.

2. A Key by the Microscopical Characteristics.

- a₁ Crystals absent.
 - b₁ Exine of pollen grains smooth. Internal fibers absent in shoots. Vascular bundles of leaf axes *Daphne*-type. Spiral thickenings very prominent.i. *Daphnimorpha*.
 - b₂ Exine of pollen grains fine reticulate.
 - c₁ Internal fibers abundant in shoots. Vascular bundles of leaf axes *Daphne*-type. Spiral thickenings very prominent. ii. *Daphne*.
 - c₂ Internal fibers few in shoots. Vascular bundles of leaf axes *Diplomorpha*-type. Spiral thickenings slight or absent.iii. *Diplomorpha*.
 - c₃ Internal fibers abundant in shoots. Vascular bundles of leaf axes *Wikstroemia*-type. Spiral thickenings absent.iv. *Wikstroemia*.
- a₂ Druse crystals abundant. Other characteristics similar to *Wikstroemia*.
 -v. *Edgeworthia*.

i. **DAPHNIMORPHA** NAKAI in Journ. Jap. Bot. 13: 884 (1937)—HARA, Enum. Sperm. Jap. 3: 233 (1954).

Much- or little-branched shrubs. Bark tenacious, densely covered by prominent leaf scars. Branching habit *Daphnimorpha*-subtype. Leaves deciduous, nearly fascicled, herbaceous, glabrous, short petiolate, enveloping many white hairs in the axils. Inflorescences heads or short spikes, terminal, glabrous, long pedunculate; peduncles slender, branched. Pedicel articulation *Diplomorpha*-type. Flowers bisexual, 4-merous. Calyces tubular, membranaceous, glabrous, persistent; lobes usually lanceolate, obtuse at the apex. Stamens 8 in two rows, fixed at the middle of the tube; filaments very short; anthers oblong. Ovaries ellipsoidal or ovate, stipitate, pubescent; styles short, slender; stigmata capitate. Discs fan-

shaped, half-cylindrical or linear, glandular at the top. Fruits dry, stalked. Seeds fusiform.

Shoots lack the internal phloem fibers. Vascular bundles of leaf axes lack the internal phloem, usually crescent in transverse sections (*Daphne*-type); the tracheary elements show conspicuous spiral thickenings. Crystals absent. Pollen grains covered by the smooth exine.

2 endemic species in Japan.

a₁ Leaves small, 2–7 cm long, thick. Floral tubes 8–9 mm long, straight. Ovaries short stipitate. 1). *D. Kudoi*.

a₂ Leaves large, 5–18 cm long, thin. Floral tubes 10–13 mm long, bended. Ovaries long stipitate; stipes bended. 2). *D. capitellata*.

1) ***Daphnimorpha Kudoi*** (MAKINO) NAKAI in Journ. Jap. Bot. **13**: 884, fig. 4 E (1937)—HARA, Enum. Sperm. Jap. **3**: 233 (1954).

Wikstroemia Kudoi MAKINO in Bot. Mag. Tokyo, **25**: 50 (1910)—MASAMUNE, Fl. Geob. Stud. Isl. Yakus. 315 (1934)—OHWI, Fl. Jap. 802 (1953).

Diplomorpha Kudoi (MAKINO) MASAMUNE in Trans. Nat. Hist. Formos. **23**: 205 (1933).

Jap. Name: Shakunan-ganpi (MAKINO), Yakushima-ganpi, Shakunan (vernacular).

Ca 1.5 mm tall, densely branched. Shoots pubescent. Leaves nearly fascicled, thick herbaceous, glabrous, obovate-oblong or rhombic-obovate, mucronate or obtuse at the apex, long cuneate at the base, 1.5–7 cm long, 1–3.5 cm wide; petiole shorter than 1 mm. Inflorescences terminal, pedunculate; peduncles glabrous, ca 3 cm or more long, 1–4-branched, several–20 flowers in a cluster on each branch, blooming VII. Flowers light pinkish purple; tubes glabrous, straight, 8–9 mm long; lobes 3–4 mm long. Upper stamens fixed on $\frac{3}{4}$, lower ones on $\frac{1}{3}$ of the tubes in height. Ovaries oblong, pubescent; stipes 1.3 mm long. Discs 1–3, scaly, quadrate or clapper-shaped, lobate, glandular at the top. Fruits dry, green, pubescent, enveloped by marcescent tubes.

Distr.: Endemic in Isl. Yaku. This grows on the hillside or by streams (the altitude ca 1,500–1,900 m). (Pl. I ... x).

Uses: If its cultivation is possible, it will be valuable for gardens by its beautiful flowers.

2) ***Daphnimorpha capitellata*** (HARA) NAKAI in Journ. Jap. Bot. **13**: 884, fig. 4 D (1937)—HARA, Enum. Sperm. Jap. **3**: 233 (1954).

Diplomorpha capitellata HARA in Journ. Jap. Bot. **13**: 178 (1937).

Wikstroemia capitellata HARA ex HARA, l.c. 178 (1937), pro syn.—OHWI, Fl. Jap. 803 (1953).

Jap. Name: Tsuchibino-ki (HARA), Tsuchibino (vernacular).

Ca 1 m tall, little-branched. Shoots pubescent only at the base. Leaves nearly fascicled, thin herbaceous, glabrous, obovate or obovate-oblong, obtuse or mucronate at the apex, cuneate (often obliquely) at the base, 5–18 cm long, 2–7 cm wide; petioles 2–6 mm long. Inflorescences terminal, pedunculate; pedun-

cles glabrous, 5–20 mm long, simple or 1–2-branched, several—30 flowers in a cluster on each branch, blooming VI–VIII. Flowers white or light pink; tubes glabrous, bended, 10–13 mm long; lobes 2 mm (inner and smaller two) and 4.5 mm (outer two) long. Both rows of stamens fixed near the bending point of the tube and lower than the stigma. Ovaries oblong-ovate, pubescent; stipes 1.5 mm long, bended. Discs 1–2, half-cylindrical or clapper-shaped, cleft or parted, glandular at the top. Fruits dry, green, pubescent, enveloped. (Pl. X : N)

Distr.: Endemic in the northern part of Prov. Hyūga. Near the fall of Ochimizu by the Hōri-gawa river (the altitude ca 880 m), it grows within a few acres under the primeval woods. The plants cultivated in Tokyo bloom already in the middle of June. (Pl. I ...△).

ii. **DAPHNE** L., Sp. Pl. 356 (1753), p.p.; Gen. Pl. ed. 5, 167 (1754)—JUSSIEU, Gen. Pl. 77 (1789)—VENTENAT, Tabl. Règ. Vég. 2 : 238 (1799)—J. ST. HILAIRE, Expos. Fam. Nat. 1 : 181 (1805)—WIKSTRÖM, Diss. 1 (1817), p.p.—ENDLICHER, Gen. Pl. 330 et 1378 (1836); Suppl. 4-2 : 67 (1847)—SPACH, Hist. Nat. Vég. Phan. 10 : 438 (1841)—C. A. MEYER in Ann. Sci. Nat. sér. 2, 20 : 45 (1843)—MEISSNER in DC., Prodr. 14 : 530 (1857), p.p.—BAILLON, Nat. Hist. Pl. 6 : 111 et 133 (1880), p.p.—BENTH. et HOOK. fil., Gen. Pl. 3-1 : 190 (1880), p.p.—SUPPRIAN in ENGL., Bot. Jahrb. 18 : 336 (1891)—VAN TIEGHEM in Ann. Sci. Nat. sér. 7, 17 : 273 (1893)—GILG in ENGL., Pfl.-fam. 3-6 a : 237 (1895), p.p.—KEISSLER in ENGL., Bot. Jahrb. 25 : 29 (1898), p.p.—SCHNEIDER, Ill. Handb. Laubhk. 2 : 394 (1909)—REHDER in SARG., Pl. Wils. 2 : 594 (1916), in nota; Man. Cult. Tr. Shr. 658 (1940); Bibl. Cult. Tr. Shr. 478 (1949), p.p.—NAKAI, Fl. Sylv. Kor. 17 : 41 (1928)—MASAMUNE, Fl. Geob. Stud. Isl. Yakus. 314 (1934)—OHWI, Fl. Jap. 802 (1953)—HARA, Enum. Sperm. Jap. 3 : 231 (1954), excl. syn. *Eriosolena*.

Mezereum C. A. MEYER, l.c. 45 et 51 (1843).

Wikstroemia ENDL., emend. DOMKE in Notizbl. Bot. Gard. Mus. Berlin, 11 : 359 (1932), p.p.

Much-branched shrubs. Bark very tenacious. Branching habit *Daphne*-type. Leaves annual or biennial, alternate, fascicled or opposite, herbaceous, chartaceous or coriaceous, short petiolate or nearly sessile. Inflorescences heads or short spikes, terminal or lateral, sometimes bracteate. Length of pedicels above the articulation 0 or very short. Flowers dioecious or bisexual, 4- or 5-merous. Calyces tubular or infundibular, a little fleshy or membranaceous, glabrous or pubescent outside, caducous or persistent; lobes wide, imbricate. Stamens 8 or 10 in two rows, half-exposed or inserted; filaments very short; anthers oblong. Ovaries ovoidal, sessile or nearly so, pubescent or glabrous; styles very short, rarely long; stigmata capitate or discoid, papillose. Discs annular or cup-shaped. Fruits fleshy or dry. Seeds ovoid.

Shoots abundantly contain the internal phloem fibers. Vascular bundles of leaf axes usually have no internal phloem, usually crescent in transverse sections (*Daphne*-type); the tracheary elements show conspicuous spiral thickenings, rarely none. Crystals absent. Exine of pollen grains fine reticulate.

Bark and berries often very poisonous.

Ca 50 species widely distributed in Europe, Asia and the Malay Islands.

- a₁** Fruits fleshy. Pedicel articulation *Wikstroemia*-type. Floral tubes caducous.
- b₁** Branching habit *Mezereum*-subtype. Leaves herbaceous, deciduous. Inflorescences ebracteate. (i). Sect. *Daphne*.
- b₂** Branching habit *Daphnanthoides*-subtype. Leaves coriaceous, evergreen. Inflorescences bracteate. (ii). Sect. *Daphnanthoides*.
- a₂** Fruits dry. Pedicel articulation *Diplomorph*-type. Floral tubes persistent. Branching habit *Wikstroemia*-subtype. Leaves chartaceous, deciduous. (iii). Sect. *Genkwa*.

(i) Sect. DAPHNE

Sect. *Mezereum* SPACH, Hist. Nat. Vég. 10 : 439 (1841), p.p.—ENDLICHER, Gen. Pl. Suppl. 4-2 : 69 (1847), p.p.—MEISSNER in DC., Prodr. 14 : 530 (1857), p.p.—KESSLER in ENGL., Bot. Jahrb. 25 : 30 (1898)—REHDER, Bibl. Cult. Tr. Shr. 479 (1949).

Gen. *Mezereum* C. A. MEYER in Ann. Sci. Nat. sér. 2, 23 : 51 (1843).

Sect. *Eudaphne* BENTH. et HOOK. fil., Gen. Pl. 3-1 : 190 (1880), p.p.

Sect. *Eudaphne* §1 *Mezereum* GILG in ENGL., Pfl.-fam. 3-6 a : 238 (1895).

Small and branched shrubs. Bark tenacious. Leaves deciduous in summer (or winter), alternate or nearly fascicled, usually glabrous, herbaceous. Branching habit *Mezereum*-subtype. Inflorescences 2–10-flowered, ebracteate. Pedicel articulation *Wikstroemia*-type, but the pedicels above the articulation very short. Flowers dioecious, male ones large (tube 8–9 mm long) and female ones (4–6 mm) small, light yellowish green or purple; tubes a little fleshy, glabrous, caducous. Discs annular. Berries naked.

Tracheary elements of vascular bundles of leaf axes show conspicuous spiral thickenings.

Ca 4 species in Eurasia, 3 of which grow in Japan and its adjacent regions.

- a₁** Ratio of a lobe to a floral tube $\frac{1}{2}$ to 1 in length. Upper stamens half-exposed.
- b₁** Lateral veins of leaves irregular and poorly developed. Ratio near to $\frac{1}{2}$. Flowering season X—III. 1). *D. pseudo-mezereum*.
- b₂** Lateral veins of leaves regular and better developed. Ratio near to 1. Flowering season IV—V. 2). *D. jezoensis*.
- a₂** Ratio $\frac{1}{3}$ to $\frac{1}{2}$. Upper stamens entirely included. Flowering season V—VII. 3). *D. kamtschatica*.

1) *Daphne pseudo-mezereum* A. GRAY, Bot. Jap. 404 (1859)—MAXIM. in REGEL, Gartenfl. 15 : 34 (1866)—MIQUEL, Prol. Fl. Jap. 297 (1867)—FRANCH. et SAV., Enum. Pl. Jap. 1 : 405 (1875)—TANAKA et al., Useful Pl. Jap. 2 : no. 502 (1891), excl. pl. ex Echigo—MATSUMURA, Ind. Pl. Jap. 2-2 : 388 (1912)—REHDER, Man. Cult. Tr. Shr. 659 (1940); Bibl. Cult. Tr. Shr. 479 (1949)—MAKINO, Ill. Fl. Jap. 304 (1940)—OHWI, Fl. Jap. 801 (1953)—HARA, Enum. Sperm. Jap. 3 : 233 (1954)—HAMAYA in Journ. Jap. Bot. 30 : 37 (1955).

D. japonica SIEB. et ZUCC., Fl. Jap. Fam. Nat. 2 : 199 (1846), teste NAKAI ;

non THUNBERG 1792.

D. koreana NAKAI in Journ. Jap. Bot. **18** : 880 (1937)—KITAGAWA, Lineam. Fl. Mansh. 325 (1939).

D. kamtschatica auct. non MAXIM., NAKAI, Fl. Sylv. Kor. **17** : 45, t. 13 (1928).
Jap. Name : Oni-shibari, Natsu-bôzu, etc.

1—1.5 m tall, much-branched, glabrous. Bark smooth, tenacious. Leaves alternate or nearly fascicled near the shoot-top, oblong or oblong-obovate, acute or round at the apex, long cuneate at the base, 5—13 cm long, 1—3 cm wide ; lateral veins 7—9 pairs, some near the base poorly developed (Fig. 5). Flowers yellowish green, 2—10 in a group, blooming XII—III ; a lobe (2.5—5.5 mm) nearly a half of a tube (5—9 mm) in length. Upper stamens half-exposed, lower ones next them in height. Ovaries ellipsoidal, sessile, glabrous. Berries scarlet, maturing V—VII.

D. koreana NAKAI seems to be only an anomalous form of this species as mentioned in the preceding chapter (*Mezereum*-subtype of the branching habit).

Distr. : Central and southern Japan, southward from Kantô district ; Quelpaert ; Corea. In central Honshû this reaches 1,500 m from the sea level. The writer has not found any wild plants of this species in Ohwu district with exception of a peculiar specimen from Fukushima, Prov. Iwashiro (Nat. Mus. Sci. Tokyo, no. 24,211). So he supposes a boundary line between this and the next species in the distribution. (Pl. II...○).

Uses : In Prov. Izu, this was often used for making Ganpi-paper with other species. In Europe, this is cultivated in gardens. Its berries and bark are poisonous and rarely used for local medicine in Japan.

2) *Daphne jezoensis* MAXIM. ex REGEL in Gartenfl. **15** : 34, t. 496, f. 1—3 (1866)—MIQUEL, Prol. Fl. Jap. 297 (1867)—FRANCH. et SAV., Enum. Pl. Jap. **1** : 404 (1875), “*jezoensis*”—MAXIM. in Mém. Biol. **12** : 542 (1886), in observ., “*yezoensis*”—MATSUMURA, Ind. Pl. Jap. **2-2** : 388 (1912)—HARA in Bot. Mag. Tokyo, **50** : 304 (1936)—SUGAWARA, Ill. Fl. Saghal. **3** : 1331 (1940), “*jezoensis*”—HAMAYA, in Journ. Jap. Bot. **30** : 37 (1955).

D. rebunensis TATEWAKI in Journ. Sapp. Soc. Agr. For. **34** : 90 (1941).

D. kamtschatica var. *jezoensis* (MAXIM.) OHWI, Fl. Jap. 802 (1953), comb. nud. ; in Bull. Sci. Mus. Tokyo, **33** : 80 (1953)—HARA, Enum. Sperm. Jap. **3** : 231 (1954).

D. kamtschatica var. *rebunensis* (TATEW.) HARA, l.c. 231 (1954).

D. pseudo-mezereum auct. non A. GRAY, TANAKA et al., Useful Pl. Jap. **2** : no. 502 (1891), quoad pl. ex Echigo.

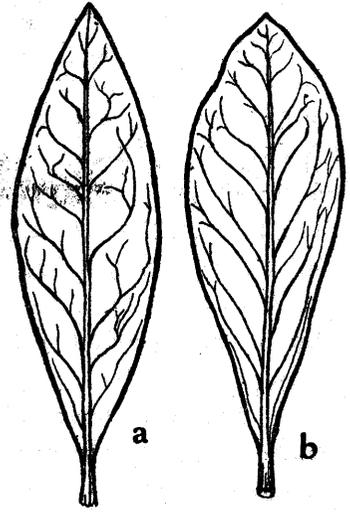


Fig. 5. Venation in *Daphne pseudo-mezereum* A. GRAY (a) and *D. jezoensis* MAXIM. (b). (×0.9).

Jap. Name : Naniwazu, Rebun-naniwazu (TATEWAKI).

0.5 m tall, glabrous. Bark tenacious. Leaves alternate or nearly fascicled near the shoot-top, obovate-oblong, mucronate or retuse at the apex, acuminate at the base, the widest near the tip, 3–8 cm long, 1–3.5 cm wide; lateral veins 4–7 pairs, some near the base better developed (Fig. 5). Flowers yellow, 2–10 in a group, blooming IV–V; a lobe (4–7 mm) nearly equal to a tube (4–9 mm) in length. Upper stamens half-exposed. Ovaries ellipsoidal, sessile, glabrous. Berries scarlet, maturing VIII–K.

D. rebunensis TATEWAKI seems to be based on female plants of this species.

Distr. : Northern Japan : northern Honshū, northward from Provs. Echigo and Shinano, Hokkaidō, Isls. Rishiri and Rebun; Isl. Kaiba; southern Sagalin. (Pl. II...△).

Uses : This was rarely used for making Japanese paper. In Pref. Iwate, its bark is used for making ropes in some mountain villages.

3) *Daphne kamtschatica* MAXIM., Prim. Fl. Amur. 237 (1859); in REGEL, Gartenfl. 15: 34 (1866)—SCHMIDT, Reis. Am.-Land. Ins. Sachal. 170 (1868)—KOMAROV, Fl. Mansh. 3: 79 (1907), “*kamczatika*”—MIYABE et MIYAKE, Fl. Sagal., 400, t. 11, f. 1–2 (1915)—KUDO, Fl. North Sach. 182 (1924)—HULTÉN, Fl. Kamt. 3: 140 (1929)—REHDER, Man. Cult. Tr. Shr. 659 (1940); Bibl. Cult. Tr. Shr. 479 (1949)—SUGAWARA, Ill. Fl. Sagh. 3: 1331, t. 612 (1940)—HARA, Enum. Sperm. Jap. 3: 231 (1954)—HAMAYA in Journ. Jap. Bot. 30: 37 (1955).

Jap. Name : Karafuto-naniwazu (MIYABE et MIYAKE), Kamchakka-naniwazu (NAKAI).

0.3–0.5 m tall, glabrous. Bark tenacious. Leaves nearly fascicled, oblong-ob lanceolate or obovate-elliptic, acute or mucronate at the apex, acuminate at the base, 3–5 cm long, 0.7–2 cm wide; lateral veins similar to the preceding species. Flowers greenish yellow, 2–5 in a group, blooming V–VII, a lobe (2–3 mm) $\frac{1}{3}$ – $\frac{1}{2}$ of a tube (6 mm) in length. Upper stamens inserted at $\frac{2}{3}$ of a tube in height. Ovaries obovate, sessile, glabrous. Berries red, maturing VIII–K.

Distr. : Hokkaidō (?); Kurile : Isl. Shikotan; Isl. Kaiba; Sagalin (?); Kamchatka; Ussuri (?); Amur (?). (Pl. II...×).

(ii) Sect. DAPHNANTHOIDES GILG in ENGL., Pfl.-fam. 3-6 a: 238 (1895).

Sect. *Eudaphne* SPACA, Hist. Nat. Vég. 10: 438 (1841), p.p.

Sect. *Daphnanthes* C.A. MEYER in Ann. Sci. Nat. sér. 2, 20: 52 (1843), p.p.—MEISSNER in DC., Prodr. 14: 532 (1857), p.p.—BENTH. et HOOK. fil., Gen. Pl. 3-1: 190 (1880), p.p.—REHDER, Bibl. Cult. Tr. Shr. 480 (1949).

Daphne b *Eudaphne* β *Daphnanthes* ENDLICHER, Gen. Pl. Suppl. 4-2: 69 (1847), p.p.

Sect. *Daphnanthes* subsect. *Daphnanthoides* (GILG) KEISSLER in ENGL., Bot. Jahrb. 25: 33 (1898).

Small and much-branched shrubs. Bark very tenacious. Leaves biennial, alternate or nearly fascicled, glabrous, coriaceous. Branching habit *Daphnanthoides*-subtype. Inflorescences many-flowered heads or spikes, usually terminal, very short

or long pedunculate, bracteate or not; bracts glabrous, ciliate or silky. Pedicel articulation *Wikstroemia*-type, but the pedicels above the articulation very short. Flowers bisexual or dioecious, red-purple or white; tubes fleshy, pubescent or glabrous, caducous. Upper stamens half-exposed. Discs annular or cup-shaped. Berries scarlet, naked.

Tracheary elements of vascular bundles of leaf axes show conspicuous spiral thickenings.

Ca 5 species in Asia, 3 species of which are found in Japan.

- a₁ Short racemes terminal on new shoots in VI, ebracteate. Peduncles and pedicels long. Discs annular.4). *D. Miyabeana*.
- a₂ Heads terminal on the last year shoots in spring, bracteate. Peduncles and pedicels very short. Discs cup-shaped.
- b₁ Little-branched shrubs. Leaves 4–16 cm long. Floral tubes pubescent outside. Discs irregularly cup-shaped.5). *D. kiusiana*.
- b₂ Densely branched shrubs. Leaves 4–9 cm long. Floral tubes glabrous. Discs regularly cup-shaped.
- c₁ Leaves entirely green.
- d₁ Flowers red-purple.6). *D. odora*.
- d₂ Flowers white and light pink outside.6-a). f. *rosacea*.
- d₃ Flowers pure white or yellowish white.6-b). f. *alba*.
- c₂ Leaves yellowish variegated along the margin.6-c). f. *marginata*.

4) *D. phne Miyabeana* MAKINO in Bot. Mag. Tokyo, 23: 35 (1914)—MAKINO et NEMOTO, Fl. Jap. 508 (1925)—HARA in Bot. Mag. Tokyo, 50: 304 (1936); Enum. Sperm. Jap. 3: 232 (1954)—MAEKAWA in Journ. Jap. Bot. 21: 45 (1947)—OHWI, Fl. Jap. 801 (1953).

D. odora β *kiusiana* (MIQ.) KEISSLER in ENGL., Bot. Jahrb. 25: 89 (1898), p.p.

D. sinensis var. *flore brevior* MAXIM. ex MIYABE (?).

D. sinensis auct. non LAMARCK, MAXIM. in Mém. Biol. 12: 542 (1886), in observ., p.p.

D. cannabina auct. non WALL., MAKINO in Bot. Mag. Tokyo, 11: 3 (1897), p.p.—MATSUMURA, Ind. Fl. Jap. 2-2: 387 (1912), p.p.

Jap. Name: Karasu-shikimi, Yama-shikimi.

Ca 1 m tall. Shoots stout, pubescent when young. Leaves alternate, oblong or oblanceolate, obtuse at the apex, acuminate at the base, 4–12 cm long, 1–2.5 cm wide; lateral veins irregular. Short racemes terminal on new shoots, ebracteate; peduncles 2–25 mm long, often branched, each branch 4–11-flowered, pubescent as pedicels; blooming VI. Flowers bisexual (?), white; tubes somewhat pubescent outside, 5 mm long; lobes 2 mm long. Ovaries ellipsoidal, sessile, glabrous. Discs annular. Berries maturing VII–VIII.

Distr.: Japan: Honshū (incl. Isl. Sadō) and Hokkaidō. In Honshū, Oku-nikō, Mt. Mitsutōge, Kurobe-valley, Mt. Hakusan, northern part of Prov. Yamashiro, Mt. Daisen and Isl. Oki are on the southern limiting line of its distribution. This line especially in central Honshū is at the same time the boundary line

of distribution between this and the next species. (Pl. III...△).

Even if a plant of this species has leaves only, it can be discriminated from the next species by their venations as between *D. pseudo-mezereum* and *D. jezoensis* (Fig. 6).

Uses : Unknown.

5) *Daphne kiusiana* MIQUEL, Prol. Fl. Jap. 298 (1867)—FRANCH. et SAV., Enum. Pl. Jap. 1 : 405 (1875)—NAKAI in Bot. Mag. Tokyo, 32 : 231 (1918) ; Fl. Sylv. Kor. 17 : 40, t. 11 (1928)—MASAMUNE, Fl. Geob. Stud. Isl. Yakus. 314 (1934)—KANEHIRA, Formos. Tr. 482 (1936)—MAKINO, Ill. Fl. Jap. 305 (1940)—MAEKAWA in Journ. Jap. Bot. 21 : 45 (1947)—OHWI, Fl. Jap. 801 (1953)—HARA, Enum. Sperm. Jap. 3 : 231 (1954).

D. odora β THUNBERG in Nova Act. Reg. Soc. Sci. Upsal. (Kaempf. Ill.) 4 : 34 (1783), p. p.

D. odora β *kiusiana* (MIQ.) KEISSLER in ENGL., Bot. Jahrb. 25 : 89 (1898), excl. pl. ex Yezo—REHDER in SARG., Pl. Wils. 2 : 546 (1916), sub *D. odoram*.

D. cannabina var. *kiusiana* (MIQ.) MAKINO, Phan. Pterid. Jap. Icon. Ill. 1 : t. 1 (1899).

D. odora var. *kiusiana* (MIQ.) T. ITO in Sanseidō, Encycl. Jap. 7 : 149 (1916).

D. sinensis auct. non LAMARCK, MAXIM. in Mém. Biol. 12 : 542 (1886), p. p.

D. cannabina auct. non WALL., MAKINO in Bot. Mag. Tokyo. 11 : 3 (1897), p. p.—MATSUMURA, Ind. Pl. Jap. 2-2 : 387 (1912), p. p.

Jap. Name. : Koshō-no-ki, Hana-chōji, Yama-rinchō.

Ca 1 m tall, little-branched. Shoots stout, glabrous. Leaves alternate, oblong or oblong-oblancoate, acute at the apex, acuminate at the base, 4–16 cm long, 1.5–4 cm wide ; lateral veins regular. Heads terminal, ca 10-flowered, bracteate ; peduncles very short, pubescent ; blooming III–IV. After flowering, pedicels remaining like warts between new shoots, pubescent for an year. Flowers dioecious, white ; tubes pubescent outside, 8–10 mm long ; lobes 4–6 mm long. Ovaries ellipsoidal, sessile, glabrous. Discs shallowly cup-shaped ; margin irregular. Berries maturing V–VII.

Shoots rarely fasciate—*D. kiusiana* f. *fasciata* (T. ITO) HARA, Enum. Sperm. Jap. 3 : 232 (1954). This phenomenon of malformation is often observed in cultivated plants of *D. odora* in various grades, too.

The writer doubts whether or not this species differs from *D. papyracea* WALL.

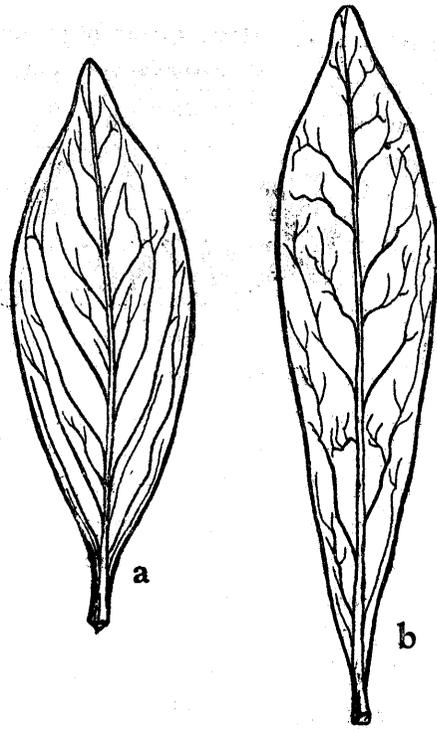


Fig. 6. Venation in *Daphne kiusiana* MIQUEL (a) and *D. Miyabeana* MAKINO (b). (×0.9).

and also whether *D. odora* from *D. sinensis* LAMARCK.

MAEKAWA gives a rank of geographical variety to the plants of this species that grow in central China and Formosa—*D. kiusiana* var. *atrocaulis* (REHDER) F. MAEKAWA in Journ. Jap. Bot. 21 : 45 (1947).

Distr. : Central and southern Japan, southward from the Bôsô Peninsula and Mt. Tsukuba (?) on the Pacific side, and from Kinki district on the Japan Sea side ; Quelpaert ; Corea ; Ryûkû. In Prov. Tosa, the writer observed it arrived at 800 m above the sea level. (Pl. III...O).

Uses : This has been rarely utilized for making paper. Berries are very poisonous. Sometimes this is cultivated in gardens.

6) *Daphne odora* THUNBERG in Nova Act. Reg. Soc. Sci. Upsal. (Kaempf. III.) 4 : 34 (1783), nom. nud., excl. β ; Fl. Jap. 159 (1784), p.p.—WIKSTRÖM, Diss. 26 (1817)—SIEB. et ZUCC., Fl. Jap. Fam. Nat. 2 : 199 (1846)—MEISSNER in DC., Prodr. 14 : 537 (1857)—MIQUEL, Prol. Fl. Jap. 297 (1867)—FRANCH. et SAV., Enum. Pl. Jap. 1 : 404 (1875), p.p.—HEMSLEY in Journ. Linn. Soc. 26 : 395 (1891)—KESSLER in ENGL., Bot. Jahrb. 25 : 89 (1898)—MAKINO, Phan. Pterid. Jap. Icon. III. 1 : no. 75 (1902) ; III. Fl. Jap. 305 (1940)—MATSUMURA, Ind. Pl. Jap. 2-2 : 388 (1912)—REHDER in SARG., Pl. Wils. 2 : 545 (1916) ; Man. Cult. Tr. Shr. 661 (1940) ; Bibl. Cult. Tr. Shr. 480 (1949)—MERRILL in Trans. Amer. Philos. Soc. n. ser. 24-2 : 276 (1935)—KANEHIRA, Formos. Tr. 482 (1936)—MAEKAWA in Journ. Jap. Bot. 21 : 45 (1947)—HARA, Enum. Sperm. Jap. 3 : 232 (1954).

D. triflora LOUREIRO, Fl. Cochinch. ed. 2, 291 (1793)—MEISSNER, l. c. 541 (1857), ut sp. obscurae—HEMSLEY, l. c. 396 (1891).

[*D. japonica* THUNBERG in Mus. Nat. Acad. Upsal. 13 : 106 (1792)].

D. kiusiana var. *odora* (THUNB.) MAKINO in Bot. Mag. Tokyo, 6 : 52 (1892).

D. japonica auct. non SIEB. et ZUCC., ENDLICEER, Gen. Pl. Suppl. 4-2 : 68 (1847)—MEISSNER, l. c. 537 (1857)—MIQUEL, l. c. 298 (1867)—FRANCH. et SAV., l. c. 404 (1875)—KESSLER, l. c. 88 (1898), p.p.—SCHNEIDER, Ill. Handb. Laubhk. 2 : 399, f. 268-g et 270-b (1909).

D. sinensis auct. non LAMARCK, KESSLER, l. c. 91 (1898), p.p.

Jap. Name : Jinchôge, Rinchô, Hana-goshô.

1–2 m tall, very densely branched. Shoots stout, glabrous. Leaves alternate, thick coriaceous, oblong or oblong-obovate, acute at the apex, acuminate at the base, 4–9 cm long, 1.5–3 cm wide; lateral veins inconspicuous. Heads terminal or axillary, ca 20-flowered, bracteate; peduncles very short, pubescent; blooming III (–V). After flowering, pedicels remaining like warts between new shoots, pubescent for 2–3 years. Axillary, long pedunculate and small heads rarely observed. Flowers dioecious, red-purple, with good fragrance; tubes glabrous but sparsely pubescent with white down when included by bracts in buds, 8 mm long; lobes 5 mm long. Ovaries ellipsoidal, sessile, glabrous. Discs regularly cup-shaped. Berries scarlet, maturing VI–VII.

Female (or fructiferous) plants very rare in Japan. I. OSAWA observed that the sterility of this species seemed to be caused by long cultivation or rather by muta-

tion (cf. Chapt. II, § 2).

D. triflora LOUREIRO and *D. japonica* SIEB. et ZUCC. (sensu ENDLICHER and KEISSLER, etc.) are only a form possessing axillary and long pedunculate heads as mentioned above (cf. MERRILL). But this kind of peduncle must be only an abnormal shoot, because a new shoot may grow from the base of the head, viz., the top of the peduncle. Such inflorescences and normal ones may be concomitantly formed on an individual plant.

Distr.: Formosa, China and Cochinchina. But its home is not accurately known. This also is widely cultivated in gardens in Japan, Europe and America.

Uses: This species is highly valued in gardens for its beautiful flowers and fragrant odour. In China, its root is used in local medicine, the bark for making paper.

6-a) *Daphne odora* f. **rosacea** (MAKINO) HARA, Enum. Sperm. Jap. **3**: 233 (1954).

D. odora var. *rosacea* MAKINO in Journ. Jap. Bot. **5**: 46 (1928)—CHEN Y., Ill. Man. Chin. Tr. Shr. 867 (1937).

Jap. Name: Usuiro-jinchôge (MAKINO).

Flowers white and light pink outside.

This is an intermediate form between the typical *D. odora* and the next form.

6-b) *Daphne odora* f. **alba** (HEMSLEY) HARA, Enum. Sperm. Jap. **3**: 232 (1954).

D. odora var. *leucaniha* MAKINO in Bot. Mag. Tokyo, **23**: 70 (1909); in Journ. Jap. Bot. **8-3**, t.1 (1932).

D. odora var. *alba* T. ITO in Sanseidô, Encycl. Jap. **7**: 149 (1916).

D. odora var. *alba* HEMSL., REHDER in BAILEY, St. Cycl. Hort. **1**: 963 (1930).

Jap. Name: Shiro-bana-jinchôge.

Flowers pure white or yellowish white.

This is not infrequently seen in gardens.

6-c) *Daphne odora* f. **marginata** MAKINO in Bot. Mag. Tokyo, **23**: 69 (1909)—HARA, Enum. Sperm. Jap. **3**: 233 (1954).

D. odora β *marginata* MIQUEL, Prol. Fl. Jap. 297 (1867).

D. odora var. *marginata* T. ITO in Sanseidô, Encycl. Jap. **7**: 149 (1916).

D. odora var. *variegata* BEAN, Tr. Shr. Brit. Isl. ed. 5, **1**: 472 (1929).

D. odora var. *marginata* Hort., REHDER in BAILEY, St. Cycl. Hort. ed. 2, **1**: 963 (1930).

D. odora var. *marginata* THUNB. apud CHEN Y., Ill. Man. Chin. Tr. Shr. 866 (1937).

Jap. Name: Fukurin-jinchôge.

Leaves yellowish variegated especially along the margin.

This is very frequently seen in gardens.

(iii) Sect. GENKWA BENTH. et HOOK, fil., Gen. Pl. **3-1**: 190 (1880)—GILG in ENGL., Ffl.-fam. **3-6a**: 238 (1895), excl. *D. Championi*—KEISSLER in ENGL., Bot. Jahrb. **25**: 30 (1898)—SCHNEIDER, Ill. Handb. Laubhk. **2**: 394 (1909), in subnota—REHDER, Bibl. Cult. Tr. Shr. 478 (1949).

Daphne a Mezereum ENDLICHER, Gen. Pl. Suppl. **4-2**: 69 (1847), p. p.

Sect. *Mezereum* SPACH, Hist. Nat. Vég. 10 : 439 (1841), p. p. —MEISSNER in DC., Prodr. 14 : 530 (1857), p. p.

Small and much-branched shrubs. Leaves deciduous, opposite or occasionally alternate, pubescent, chartaceous. Inflorescences small heads, ebracteate, pedunculate. Branching habit *Wikstroemia*-subtype. Pedicel articulation *Diplomorpha*-type. Flowers white or purple; tubes membranaceous, silky outside. Upper stamens half-exposed. Discs cup-shaped. Dry fruits enveloped by the persistent floral tubes (?).

Vascular bundles of leaf axes contain the tracheary elements with no spiral thickenings, too.

1 species in China and Formosa. *Daphne Championi* was formerly included in this section. But by the writer it has been removed from this, and its proper position will be decided in his future study.

7) **Daphne Genkwa** SIEB. et ZUCC., Fl. Jap. 1 : 137, t. 75 (1840); Fl. Jap. Fam. Nat. 2 : 199 (1846)—MIQUEL, Prol. Fl. Jap. 297 (1867)—FRANCH. et SAV., Enum. Pl. Jap. 1 : 404 (1875)—MAXIM. in Mém. Biol. 11 : 310 (1882), in adnot. —HEMSLEY in Journ. Linn. Soc. 26 : 395 (1891)—MATSUMURA, Ind. Pl. Jap. 2-2 : 388 (1912)—REHDER in SARG., Pl. Wils. 2 : 538 (1916); Man. Cult. Tr. Shr. 658 (1940); Bibl. Cult. Tr. Shr. 478 (1949)—NAKAI in Bot. Mag. Tokyo, 36 : 125 (1922); Fl. Sylv. Kor. 17 : 43, t. 12 (1928)—KANEHIRA, Formos. Tr. 481 (1936)—MAKINO, Ill. Fl. Jap. 305 (1940)—MAEKAWA in Journ. Jap. Bot. 21 : 46 (1947)—HARA, Enum. Sperm. Jap. 3 : 231 (1954).

D. Fortuni LINDLEY in Journ. Hort. Soc. London, 1 : 147 (1846)—FORTUNE in Journ. Hort. Soc. London, 2 : 34, t. 1 (1847)—MEISSNER in DC., Prodr. 14 : 531 (1857), "*Fortunei*".

D. Genkwa var. *Fortuni* (LINDL.) FRANCHET, Pl. David. 1 : 259 (1884), "*Fortunei*"—SCHNEIDER, Ill. Handb. Laubhk. 2 : 403 (1909).

Wikstroemia Genkwa (SIEB. et ZUCC.) DOMKE in Notizbl. Bot. Mus. Gard. Berlin, 11 : 363 (1932).

Daphne Championi auct. non BENTH., HAYATA, Fl. Mont. Formos. 190 (1908), teste HAYATA, Mat. Fl. Formos. 259 (1911).

Jap. Name : Chôji-zakura, Fuji-modoki, Shi-genji, Genkwa, etc.

Shrubs to 1 m tall, much-branched, silky-pubescent when young. Leaves opposite or occasionally alternate, lanceolate or oblong, acute at the apex, cuneate or obtuse at the base, 2–6 cm long, 0.5–1.5 cm wide, silky on the lower surface. Heads 3–7-flowered, pedunculate, precociously blooming I–III. Flowers lilac; tubes 8–11 mm long, silky outside; lobes 5–10 mm long. Ovaries oblong, short stipitate, pubescent. Discs irregularly cup-shaped, often parted. Fruits dry or somewhat fleshy (?), white.

D. Fortuni LINDLEY doesn't differ from this species as NAKAI mentioned.

Distr. : The home is in China, Formosa and southern Korea. In Japan, this is cultivated in gardens.

Uses : Leaves and bark are poisonous. Flowers are used for local medicine in China.

7-a) *Daphn. Genkwa* f. *taitoensis* (HAYATA) HAMAYA, form. nov.

D. taitoensis HAYATA in scida.

Discus hypogynus annularis pubescens vel ciliatus.

HAYATA at first regarded this as a different species from *D. Genkwa* by the shape of leaves and of calyx lobes. But it is in the range of variation of this species.

Distr : Formosa : Taitung (T.SOMA, Mar. 1913—type in Herb. Fac. Sci. Unib. Tokyo).

iii. **DIPLOMORPHA** [MEISSNER in Denkschr. Bot. Gesel. Regensb. 3 : 289 (1841), in nota]—C. A. MEYER in Ann. Sci. Nat. sér. 2, 20 : 45 et 50 (1843), p. p. — ENDLICHER, Gen. Pl. Suppl. 4-2 : 66 (1847), p. p. — NAKAI, Fl. Sylv. Kor. 17 : 37 (1928) ; in Journ. Jap. Bot. 13 : 881 (1937)—HARA, Enum. Sperm. Jap. 3 : 233 (1954).

Wikstroemia sect. *Diplomorpha* MEISSNER in DC., Prodr. 14 : 546 (1857)—BENTH. et HOOK. fil., Gen. Pl. 3-1 : 193 (1880)—SUPPRIAN in ENGL., Bot. Jahrb. 18 : 337 (1891)—GILG in ENGL., Pfl.-fam. 3-6 a : 235 (1895).

Shrubs, much-branched. Shoots sometimes pubescent. Bark very tenacious, branching habit *Diplomorpha*-type. Leaves deciduous, opposite or alternate, membranaceous or chartaceous, pubescent or glabrous, short petiolate. Inflorescences heads, umbels or spikes, sometimes in all paniculiform, generally terminal, pubescent. Pedicel articulation *Diplomorpha*-type. Flowers bisexual or dimorphic (?), 4- or 5-merous. Calyces tubular, membranaceous, pubescent or glabrous, caducous or persistent ; lobes unequal, imbricate. Stamens 8 or 10 in two rows, upper ones at the mouth of the tubes ; filaments very short ; anthers oblong. Ovaries stipitate, pubescent or glabrous ; styles short ; stigmata capitate, often papillose. Discs 1-4, scaly, subulate or clapper-shaped, parted. Fruits dry, stalked. Seeds fusiform.

Shoots contain only a few internal phloem fibers. Vascular bundles of leaf axes usually have the internal phloem but no internal fibers, deep crescent or circular in transverse sections (*Diplomorpha*-type) ; the tracheary elements show a little conspicuous or no spiral thickenings. Crystals absent. Exine of pollen grains fine reticulate.

Ca 20 species in eastern and southern Asia. 7 species are wild or cultivated in this country.

a₁ Shoots, leaves and flowers usually glabrous. Leaves opposite or rarely alternate. Floral tubes somewhat caducous. Ovaries very sparsely pubescent.

b₁ Shoots branched. Spikes terminal or axillary, paniculiform in all. Pedicels less than 1 mm long. Flowering season VII—K. Floral tubes 6.5—7.5 mm long ; lobes 1.7 mm long.

c₁ Shoots, leaves and flowers glabrous. Leaves opposite. ...1). *D. trichotoma*.

c₂ Shoots, leaves and flowers pilose. Leaves partially alternate.

.....1-a). f. *pilosa*.

c₃ Shoots, leaves and flowers pilose. Leaves entirely alternate.

.....1-b). var. *ohsumiensis*.

b₂ Shoots simple. Umbels 2-flowered, terminal. Flowering season V—VII. Pedi-

cels 1–9 mm long. Floral tubes 8–9 mm long; lobes 3 mm long.

- 2). *D. albiflora*.
- a₂** Shoots, leaves and flowers usually pubescent. Leaves alternate. Floral tubes usually persistent. Ovaries densely pubescent.
- b₁** Spikes small, in all paniculiform or fastigiata. Flowering season VII–K.
- c₁** Shoots densely and spirally foliate. Leaves elliptic. Spikes in all densely paniculiform or fastigiata. Floral tubes very persistent. Fruit stipes usually short.
- d₁** Stems very low (less than 20 cm); shoots fastigiata. Leaves oblong. Floral tubes 8–10 mm long. 3). *D. Ganpi*.
- d₂** Stems tall (1 m ?). Leaves lanceolate-oblong. Floral tubes 5–6 mm long. 4). *D. phymatoglossa*.
- c₂** Shoots sparsely foliate like distichous. Leaves ovate or lanceolate. Stems erect. Spikes in all sparsely paniculiform. Floral tubes persistent. Fruit stipes usually long.
- d₁** Leaves densely pubescent, acute at the apex, small. Panicles sparse. Floral tubes 5 mm long. 5). *D. pauciflora*.
- d₂** Leaves less pubescent, long acuminate at the apex, large. Panicles dense. Floral tubes 7–9 mm long. 6). *D. yakushimensis*.
- b₂** Shoots simple. Heads terminal. Flowering season V–VI. 7). *D. sikokiana*.

1) ***Diplomorpha trichotoma*** (THUNB.) NAKAI, Fl. Sylv. Kor. 17: 39, t. 10 (1928); in Journ. Jap. Bot. 13: 881, fig. 4 C (1937)—HONDA in Siebold Kenkyū, 568 (1938)—HAMAYA in Journ. Jap. Bot. 29: 123 (1954)—HARA, Enum. Sperm. Jap. 3: 235 (1954).

Rubia spicis ternis THUNBERG, Fl. Jap. 357 (1784).

Queria trichotoma THUNBERG in Trans. Linn. Soc. 2: 329 (1794); Icon. Pl. Jap. 5, t. 1 (1805); Pl. Jap. Nov. Sp. 5 (1824).

Stellera japonica SIEBOLD, Syn. Pl. Oecon. Jap. 22 (1830), nom. nud.—MEISSNER in DC., Prodr. 14: 550 (1857), ut sp. dubia.

Passerina japonica (SIEB.) SIEB. et ZUCC., Pl. Jap. Fam. Nat. 2: 200 (1846).

Diplomorpha (?) *japonica* (SIEB. et ZUCC.) ENDLICHER, Gen. Pl. Suppl. 4-2: 66 (1847).

Wikstroemia japonica (SIEB. et ZUCC.) MIQUEL, Prol. Fl. Jap. 298 (1867), "*Wikstroemia*"—FRANCH. et SAV., Enum. Pl. Jap. 1: 405 (1875)—MAXIM. in Mél. Biol. 12: 541 (1886)—SHIRAI in Bot. Mag. Tokyo, 5: 371 (1891), "*Wikstroemia*"—TANAKA et al., Useful Pl. Jap. 2: no. 355 (1891).

W. ellipsocarpa MAXIM. ex MAKINO in Bot. Mag. Tokyo, 5: 29 (1891), nom. nud.—MAXIM. in Diagn. Pl. Nov. Asiat. 8: 4 (1892)—OHWI, Fl. Jap. 803 (1953).

W. trichotoma (THUNB.) MAKINO in Bot. Mag. Tokyo, 11: 71 (1897); 15: 190 (1901); Ill. Fl. Jap. 304 (1940)—MATSUMURA, Ind. Pl. Jap. 2-2: 390 (1912)—NAKAI in Bot. Mag. Tokyo, 36: 125 (1922)—OHWI, l. c. 803 (1953).

Diplomorpha ellipsocarpa (MAXIM.) NAKAI, l. c. 881 (1937).

Jap. Name : Ki-ganpi, Ki-ko-ganpi, Tosa-ganpi (MAKINO).

Ca 1.5 m tall, much-branched. Shoots branched, slender, glabrous. Leaves opposite, membranaceous or chartaceous, glabrous, ovate-oblong or lanceolate, acute or acuminate at the apex, cuneate or round at the base, 1.5–7.5 cm long, 1–3.5 cm wide. Spikes small, terminal and axillary, in all densely or sparsely paniculiform, glabrous; pedicels less than 1 mm long; blooming VII–K. Flowers bisexual, white or yellow, glabrous; tubes 6.5–7.5 mm long; lobes 1.7 mm long. Ovaries obovate-oblong, sparsely pilose; stipes 1.3 mm long. Discs 1–3, scaly, wide subulate or linear, lobate. Fruits dry, slightly pilose; stipes 1–2 mm long. (Pl. X : O).

The writer found that *D. ellipsocarpa* didn't differ from this species, and published the reasons in detail (Journ. Jap. Bot. 29 : 123).

Distr. : Southern Japan, southward from Kinki district on the Pacific side and from Prov. Iwami on the Japan Sea side; Corea. This species grows lower than 1,000 m in altitude, and sometimes grows in groups. This generally loves rather shadowy places than sunny. (Pl. IV...O).

Uses : Bark has been locally gathered for making paper with other members of this genus. But now, such examples are few.

1-a) *Diplomorpha trichotoma* var. **trichotoma** f. **pilosa** HAMAYA, form. nov.

Jap. Name : Usuge-ki-ganpi (nov.).

Rami pilosi. Folia partim alterna pilosa. Inflorescentiae pilosae.

This new form is in the middle between var. *trichotoma* and var. *ohsumiensis*, but its general appearance is more similar to the former than to the latter.

Distr. : Hyūga : Masaki (K. MAEBARA, Aug. 1935—type in Herb. Fac. Agr. Univ. Tokyo); Higo : Aida. (Pl. IV...X).

1-b) *Diplomorpha trichotoma* var. **ohsumiensis** (HATUS.) HAMAYA, comb. nov.

Wikstroemia ohsumiensis HATUSIMA in Journ. Jap. Bot. 29 : 232 (1954).

Jap. Name : Takakuma-ki-ganpi (HATUS.).

Shoots, leaves and flowers pilose. Leaves entirely alternate.

HATUSIMA considered *W. ohsumiensis* to be a hybrid between *D. trichotoma* and *D. Ganpi*. But the writer regards this as a variety of *C. trichotoma*, studying the plant from Prov. Higo, which considerably coincides with HATUSIMA's description, on such characters as the branching habit, the cross shape of leaf axes and furrows of cuticle on the upper surface of midribs.

Distr. : Higo : Aida; Ohsumi : Mt. Takakuma (by HATUSIMA). (Pl. IV...X).

2) *Diplomorpha albiflora* (YATABE) NAKAI in Journ. Jap. Bot. 13 : 881 (1937); 15 : 781 (1939)—HARA, Enum. Sperm. Jap. 3 : 233 (1954).

Wikstroemia gynopoda MAXIM. ex MAKINO in Bot. Mag. Tokyo, 4 : 173 (Mai, 1890), nom. nud.; 6 : 52 (1892)—MAXIM. in Diagn. Pl. Nov. Asiat. 8 : 3 (1893).

W. albiflora YATABE in Bot. Mag. Tokyo, 5 : 217, t. 26 (Jul., 1891); Icon. Fl. Jap. 1-2 : 129, t. 35 (1906)—SHIRAI in Bot. Mag. Tokyo, 5 : 371 (1891), "*Wikstroemia*"—MATSUMURA, Ind. Fl. Jap. 2-2 : 389 (1912)—OHWI, Fl. Jap. 803 (1953).

Jap. Name : Miyama-ganpi (MAKINO), Hiō.

Ca 1 m tall, much-branched. Shoots simple, slender, glabrous. Leaves opposite, membranaceous, glabrous, ovate or ovate-oblong, acute or obtuse at the apex, cuneate or round at the base, 1–4 cm long, 0.7–2.5 cm wide. Umbels terminal, 1–4 (usually 2)-flowered; peduncles 1–10 mm long; pedicels 1–9 mm long; blooming V–VII. Flowers bisexual, white, glabrous; tubes 8–9 mm long; lobes 3 mm long. Ovaries obovate, pilose; stipes 2 mm long. Discs generally 1, half-cylindrical, lobate. Fruits dry, slightly pilose; stipes ca 4 mm long.

Distr. : This is distributed in the restricted regions—Yamato : Mt. Ohdaigahara; Kii : Nachi (?) : Iyo : Mt. Omogō (?); Tosa : Mt. Yokogura and Nanokawa village; Chikugo : Mt. Gongen; Bungo : Mt. Sobo; Hyūga : Mt. Ohkue and Mt. Ishidō. Generally speaking, this species loves high altitude (to 1,300 m). (Pl. IV...△).

Uses : In Prov. Hyūga, this was formerly barked when Japanese paper was demanded in a large quantity.

3) **Diplomorpha Ganpi** (SIEB. et ZUCC.) NAKAI in Journ. Jap. Bot. **13** : 883, fig. 4 A (1937)—HONDA in Siebold Kenkyū, 568 (1938)—HARA, Enum. Sperm. Jap. **3** : 234 (1954).

Stellera ganpi SIEBOLD, Syn. Pl. Oecon. Jap. 22 (1830), nom. nud.—MEISSNER in DC., Prodr. **14** : 550 (1857), “*Stellera* ?”.

Passerina Ganpi (SIEB.) SIEB. et ZUCC., Fl. Jap. Fam. Nat. **2** : 200 (1846).

Wikstroemia canescens var. *Ganpi* (SIEB. et ZUCC.) MIQUEL, Prol. Fl. Jap. 298 (1867), “*Wikstroemia*”—FRANCH. et SAV., Enum. Pl. Jap. **1** : 405 (1875).

W. Ganpi (SIEB. et ZUCC.) MAXIM. in Mém. Biol. **12** : 540 (1886)—SHIRAI in Bot. Mag. Tokyo, **5** : 370 (1891), “*Wikstroemia*”—MATSUMURA, Ind. Pl. Jap. 2-2 : 389 (1912), “*Ganpi*”—MASAMUNE, Fl. Geob. Stud. Isl. Yakus. 315 (1934)—MAKINO, Ill. Fl. Jap. 304 (1940)—OHWI, Fl. Jap. 804 (1953).

Diplomorpha lasiocarpa (HAYATA) NAKAI, l. c. 881 (1937), nom. nud. ex scida Hayatae.

Jap. Name : Ko-ganpi, Inu-ganpi, No-ganpi, Taiwan-ko-ganpi (NAKAI).

Ca 0.5 m tall. Stems less than 20 cm tall. Shoots pubescent, erect, fastigiata, almost all parts of them withering and leaving stalks. Leaves densely spiral, chartaceous, pubescent, oblong, acute or obtuse at the apex and the base, 1–4.5 cm long, 1–2 cm wide. Spikes terminal and axillary, densely fastigiata or paniculiform in all; pedicels short; blooming VII–K. Flowers bisexual, white or light pink, densely pubescent; tubes 8–10 mm long; lobes 2–3 mm long. Ovaries elliptic, acuminate to the stipe, densely pilose. Discs subulate or scaly, parted. Fruits dry, pilose, enveloped by marcescent tubes; stipes short.

The specimen of *D. lasiocarpa* (HAYATA) NAKAI doesn't differ from this species. Therefore, this species is newly added to the Formosan flora. *D. canescens* MEISSNER seems very similar to this species. The writer doesn't know how these two can be discriminated from each other, for he can not research many specimens of *D. canescens*.

Distr. : Central and southern Japan, southward from Kantō district (Mt. Ta-

kao and Mt. Akagi) on the Pacific side and from Prov. Echizen on the Japan Sea side, Isl. Yaku, Isl. Amami-Oshima; Formosa. This is a light-loving species and grows in groups or solitarily on hill-sides. (Pl. V...O).

Uses: Bark of roots has been used for making paper (like Tonoko-paper) in some regions.

4) *Diplomorpha phymatoglossa* (KOIDZ.) NAKAI in Journ. Jap. Bot. 13: 882 (1937)—HARA, Enum. Sperm. Jap. 3: 234 (1954):

Wikstroemia phymatoglossa KOIDZUMI, Pl. Nov. Amami-Oshim. 15 (1928); in Act. Phytot. Geob. 1: 172 (1932).

W. pauciflora var. *phymatoglossa* (KOIDZ.) HATUSIMA in Journ. Jap. Bot. 29: 233 (1954).

Jap. Name: Ohshima-ganpi (KOIDZUMI).

Ca 1 m tall (?). Shoots pubescent, usually erect, stout. Leaves densely spiral, thick chartaceous, pubescent, ovate or oblong-ovate, acute or round at the apex, cuneate or obtuse at the base, 2–6 cm long, 1–3 cm wide. Inflorescences similar to the preceding species, but a little sparser; pedicels short; blooming VII–VIII. Flowers bisexual, yellowish brown (?), densely pubescent; tubes 5–6 mm long; lobes 1.4–2 mm long. Ovaries obovate, acuminate to the stipes; densely pilose. Discs 1, scaly, cleft. Fruits unseen.

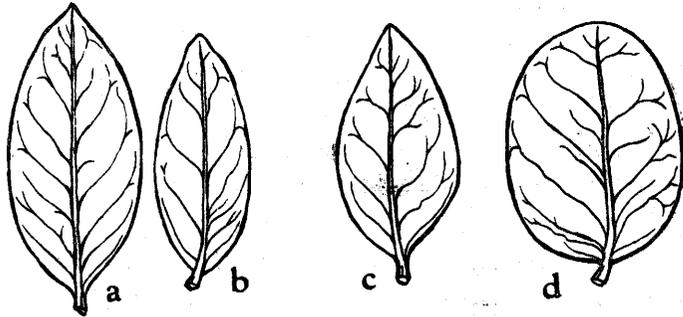


Fig. 7. Leaf shape in *Diplomorpha Ganpi* NAKAI (a and b) and *D. phymatoglossa* NAKAI (c and d). ($\times 0.9$).

Leaves of this species are of a form nearer to lanceolate than *D. Ganpi*, and to oblong than *D. pauciflora* (Figs. 7 and 8).

Distr.: Endemic in Isl. Amami-Oshima and Isl. Tokuno-shima. (Pl. V...Δ).

5) *Diplomorpha pauciflora* (FRANCH. et SAV.) NAKAI in Journ. Jap. Bot. 13: 883 (1937)—HARA, Enum. Sperm. Jap. 3: 234 (1954).

Wikstroemia pauciflora FRANCH. et SAV., Enum. Pl. Jap. 1: 404 (1875), sine diagn., quoad pl. ex Hakone—SHIRAI in Bot. Mag. Tokyo, 5: 370 (1891), "*Wikstroemia*"—MAKINO in Bot. Mag. Tokyo, 14: 36 (1900); 24: 51 (1910)—OHWI, Fl. Jap. 804 (1953).

W. canescens var. *pauciflora* FRANCH. et SAV., Enum. Pl. Jap. 2: 481 (1876), p. p.

W. Ganpi var. *pauciflora* (FRANCH. et SAV.) MAXIM. in Mém. Biol. 12: 541 (1886), p. p.—MATSUMURA, Ind. Pl. Jap. 2-2: 387 (1912), p. p.

W. Franchetii KOIDZUMI, Fl. Symb. Or.-Asiat. 32 (1930)—NEMOTO, Fl. Jap. Suppl. 504 (1936).

W. canescens auct. non MEISSNER, HEMSLEY in Journ. Linn. Soc. 26: 597

(1894), quoad syn. "*W. pauciflora*"—CHEN Y., Ill. Man. Chin. Tr. Shr. 866 (1937), quoad syn.

Jap. Name : Sakura-ganpi. Hime-ganpi (MAKINO), Inu-ko-ganpi (SHIRAI), Miyama-ko-ganpi (MATSUMURA).

Ca 2 m tall. Stems erect. Shoots patent, pubescent. Leaves sparsely arranged like distichous, chartaceous, densely pubescent, ovate, ovate-lanceolate or triangular-ovate, acute at the apex, truncate or cuneate at the base, 1–5.5 cm long, 0.5–3.5 cm wide. Spikes sparsely paniculiform in all ; pedicels short ; blooming VII–VIII. Flowers bisexual, light yellow, densely pubescent ; tubes 5 mm long ; lobes 2–2.5 mm long. Ovaries obovate, acuminate to the stipe, densely pilose. Discs 1–2, subulate, parted.

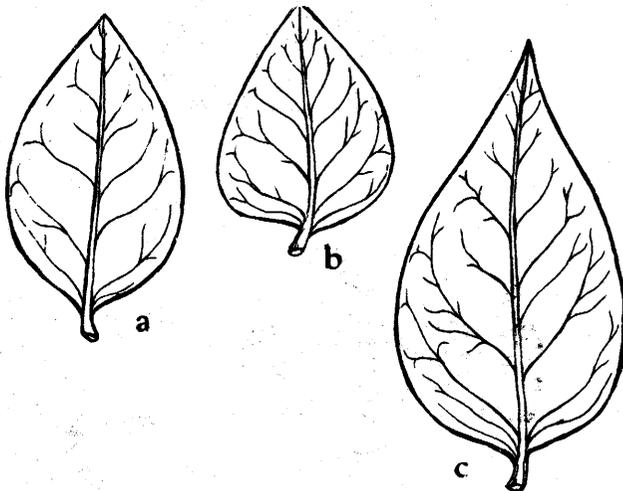


Fig. 8. Leaf shape in *Diplomorpha pauciflora* NAKAI (a and b) and *D. yakushimensis* MASAMUNE (c). ($\times 0.9$).

Fruits dry, pilose, enveloped by marcescent tubes ; stipes 1–1.4 mm long.

This species has leaves of acute tips and can be discriminated from the next species which usually has leaves of long acuminate tips (Fig. 8).

Distr. : Confined to Prov. Izu and the southside of Mt. Hakone. This loves comparatively sunny places. (Pl. VI...O).

Uses : In Prov. Izu, it was formerly barked for making Ganpi-paper.

6) ***Diplomorpha yakushimensis*** (MAKINO) MASAMUNE in Trans. Nat. Hist. Soc. Formos. 23 : 205 (1933)—NAKAI in Journ. Jap. Bot. 13 : 883 (1937), "*yakusimensis*"—HARA, Enum. Sperm. Jap. 3 : 235 (1954), "*yakusimensis*".

Wikstroemia pauciflora var. *yakushimensis* MAKINO in Bot. Mag. Tokyo, 24 : 52 (1910).

W. yakushimensis (MAKINO) NAKAI ex MASAMUNE, Prel. Rep. Veg. Yakus. 99 (1929) ; Fl. Geob. Stud. Isl. Yakus. 316 (1934)—OHWI, Fl. Jap. 804 (1954).

W. Franchetii var. *yakushimensis* (MAKINO) NEMOTO, Fl. Jap. Suppl. 504 (1936).

Jap. Name : Shima-sakura-ganpi (MAKINO), Shima-ko-ganpi, Sakura-ganpi (vernacular).

Ca 2 m tall. Stems erect or a little pendulous. Shoots patent, pubescent. Leaves sparsely arranged like distichous, chartaceous, sparsely pubescent, lanceolate or ovate, long acuminate at the apex, round or obtuse at the base, 1–7.5 cm long, 0.8–4.5 cm wide. Inflorescences denser than the preceding species ; blooming VII–VIII. Flowers bisexual, yellowish green, densely pubescent : tubes 8–9 mm long ; lobes 2–2.5 mm long. Ovaries obovate-oblong, acuminate to the stipes, densely pilose. Discs 1–2,

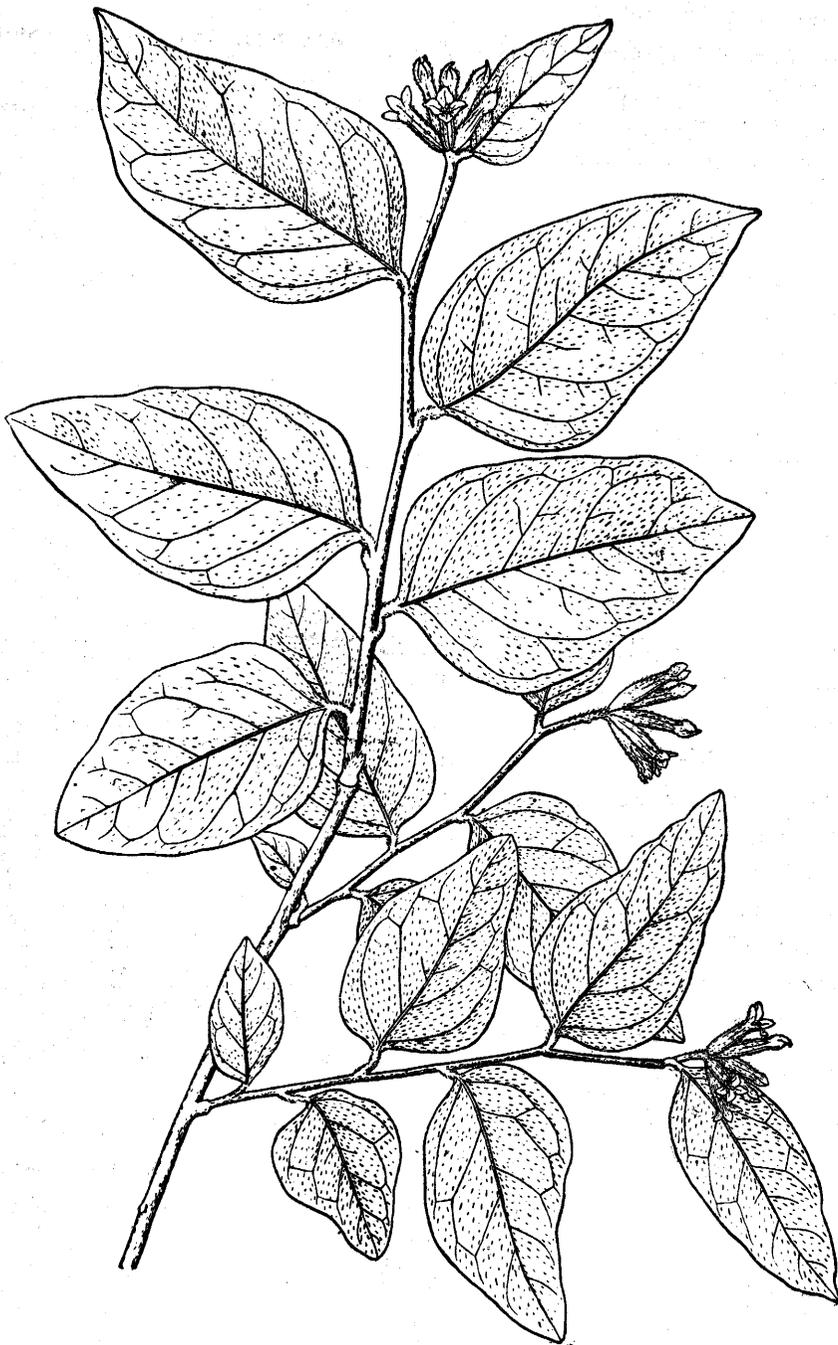


Fig. 9. *Diplomorpha sikokiana* HONDA from Mt. Ogasa, Prov. Tôtômi. ($\times 1$).

scaly or subulate, parted or lobate. Fruits dry, pilose, long stipitate, naked or enveloped by marcescent tubes.

Distr. : Kyûsyû : southern Bungo, eastern Higo, Hyûga, Ohsumi, Isl. Yaku and the Koshiki Isls. This species can grow in sunny places as well as under woods, reaching to 1,300 m above the sea level. This and the preceding species are closely related and yet their distributions are very restricted and far apart from each other. (Pl. VI...△).

Uses : In Prov. Hyûga, this species has been collected for its bark, too.

7) *Diplomorpha sikokiana* (FRANCH. et SAV.) HONDA in Tennen-kinenbutsu-Chôsa-Hôkoku, 10 : 21 (1930)—OKUYAMA in Journ. Jap. Bot. 19 : 131 (1943)—HARA, Enum. Sperm. Jap. 3 : 234 (1954).

Wikstroemia pauciflora FRANCH. et SAV., Enum. Pl. Jap. 1 : 406 (1875), quoad pl. ex Senano, fide KOIDZUMI 1930.

W. sikokiana FRANCH. et Sav., Enum. Pl. Jap. 2 : 481 (1877)—MAXIM. in Mél. Biol. 12 : 539 (1886)—SHIRAI in Bot. Mag. Tokyo, 5 : 369 (1891), "*Wikstroemia*"—MATSUMURA, Ind. Pl. Jap. 2-2 : 389 (1912)—KOIDZUMI, Fl. Symbol. Or.-Asiat. 32 (1930)—MAKINO, Ill. Fl. Jap. 303 (1940).

Diplomorpha sikokiana (FRANCH. et SAV.) NAKAI in Journ. Jap. Bot. 13 : 882, fig. 4 B (1937)—HONDA, Nom. Pl. Jap. 233 (1939).

Wikstroemia pauciflora auct. non FRANCH. et SAV., TANAKA et al., Useful Pl. Jap. 2 : no. 354 (1891).

Jap. Name : Ganpi, Kami-d no-ki, etc.

Ca 2 m tall. Stems erect. Shoots simple, erect-patent, silky. Leaves sparsely alternate, chartaceous, densely pubescent, ovate, acute or acuminate at the apex, cuneate or round at the base, 1.5—8 cm long, 1—4 cm wide. Heads terminal, 7—20-flowered; pedicels short; blooming IV—VI. Flowers bisexual or

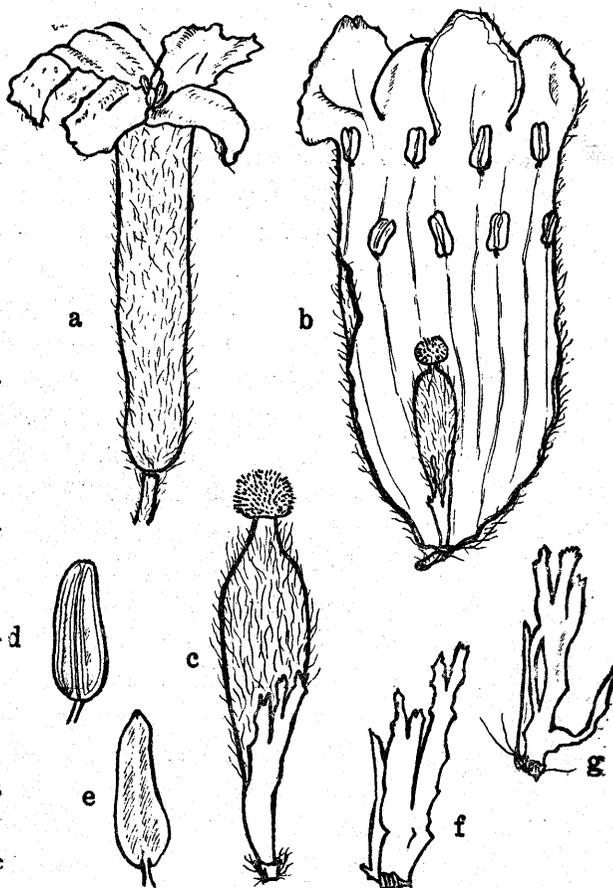


Fig. 10. *Diplomorpha sikokiana* HONDA from Mt. Ogasa. a : a flower, outside view ($\times 6$); b : ditto, inside view ($\times 7$); c : a pistil ($\times 11$); d : a stamen, front view ($\times 17$); e : ditto, back view ($\times 17$); f : a disc scale ($\times 17$); g : ditto, from another flower ($\times 17$).

dimorphic (?), light yellow, densely pubescent; tubes 8 mm long; lobes 2–3 mm long. Ovaries oblong, acuminate to the stipe, densely pilose. Discs 1–3, half-cylindrical or subulate, parted or lobate. Fruits dry, pilose, enveloped by tubes for a long time; stipes 1 mm long. (Figs. 9 and 10).

Distr.: Southern Japan, from the Ohwi-gawa on the Pacific side and from Prov. Kaga on the Japan Sea side probably to Prov. Hizen (Arita). This grows on comparatively sunny and sandy places. According to S. KITAMURA, it may prefer serpentine soil. (Pl. V...X).

Uses: This is one of the most valuable materials for making Ganpi-paper. Before 1890 it was much more used for money-paper than *Edgeworthia chrysantha*, because it contained better fibers than those of the latter. But now it has very reduced in quantity by collecting without plan. Its bark is collected in some localities, still now. On the other hand, this species is also cultivated and is studied on its breeding.

iv. **WIKSTROEMIA** [nom. conserv.] [ENDL., Prodr. Fl. Norfolk, 47 (1833); Icon. Gen. Pl. 22 (1838)]; Gen. Pl. 332 et 1378 (1836), "*Wickstroemia*"; Suppl. 4-2: 68 (1847)—C. A. MEYER in Ann. Sc. Nat. sér. 2, 20: 50 (1843), "*Wickstroemia*", p. p.—MEISSNER in DC., Prodr. 14: 543 (1857), excl. sect. *Diplomorpha*—BAILLON, Nat. Hist. Pl. 6: 112 et 134 (1880), p. p.—BENTH. et HOOK. fil., Gen. Pl. 3-1: 193 (1880), p. p.—MAXIM. in Mém. Biol. 12: 537 (1886), p. p.; in Diagn. Pl. Nov. Asiat. 8: 3 (1893), p. p.—SUPPRIAN in ENGL., Bot. Jahrb. 18: 337 (1891), p. p.—GILG in ENGL., Pfl.-fam. 3-6 a: 235 (1895), p. p.—LECOMTE, Fl. Gén. l'Indo-Chine, 5-3: 165 (1915), p. p.—DOMKE in Notizbl. Bot. Gard. Mus. Berlin, 11: 359 (1932), emend.—MASAMUNE, Fl. Geob. Stud. Isl. Yakus. 315 (1934), p. p.—MERRILL in Trans. Amer. Philos. Soc. n. ser. 24-2: 279 (1935), "*Wickstroemia*"—NAKAI in Journ. Jap. Bot. 13: 883 (1937)—REHDER, Man. Cult. Tr. Shr. 661 (1940), p. p.; Bibl. Cult. Tr. Shr. 481 (1949), excl. syn. *Diplomorpha*—HARA, Enum. Sperm. Jap. 3: 236 (1954); non *Wikstroemia* SCHRADER 1821 nec SPRENGEL 1826.

Small trees or shrubs, more or less pubescent. Bark very tenacious. Branching habit *Wikstroemia*-subtype. Leaves biennial, opposite or rarely alternate, chartaceous or thick membranaceous, pubescent or glabrous, short petiolate. Inflorescences short spikes or heads, terminal, pubescent or glabrous. Pedicel articulation *Wikstroemia*-type. Flowers bisexual, 4- or 5-merous. Calyces tubular, fleshy or membranaceous, glabrous or pubescent, caducous; lobes unequal, imbricate. Stamens 8 or 10 in two rows, upper ones at the mouth of the tube; filaments very short; anthers oblong. Ovaries obovate, sessile, pubescent or glabrous; styles short; stigmata capitate or clavate, often papillaceous. Discs 1–3, scaly, clapper-shaped or half-cylindrical, irregular at the tip. Fruits fleshy. Seeds subspheroidal.

Shoots contain abundant internal phloem fibers. Vascular bundles of leaf axes have the internal phloem and abundant internal fibers, crescent or circular in transverse sections (*Wikstroemia*-type); the tracheary elements show no spiral thickenings. Crystals absent. Exine of pollen grains fine reticulate.

Bark and berries are very poisonous.

20–30 (ca 100 species recorded with *Diplomorpha* species in Ind. Kew.) species in Australia, Oceania and tropical Asia. Often cultivated in gardens. 2 species are wild in Japan.

- a₁** 2-year-old branches glabrous. Leaf axes usually glabrous. Peduncles 7–30 mm long; pedicels 1–3 mm long. Floral tubes sparsely pubescent. Ovaries sessile, pilose only at the top. 1). *W. retusa*.
- a₂** 2-year-old branches pubescent around leaf-scars. Leaf axes sparsely pubescent. Peduncles 1–7 mm long; pedicels 1–2 mm long. Floral tubes densely pubescent. Ovaries stipitate, densely pilose. 2). *W. pseudoretusa*.

1) **Wikstroemia retusa** A. GRAY in Journ. Bot. **3** : 303 (1865)—MAXIM. in Mém. Biol. **12** : 538 (1886), excl. specim. ex Bonin.—SHIRAI in Bot. Mag. Tokyo, **3** : 371 (1891), excl. pl. ex Bonin., “*Wikstraemia*”—MATSUMURA, Ind. Pl. Jap. 2-2 : 389 (1912)—REHDER in SARG., Pl. Wils. **2** : 534 (1916)—NAKAI in Journ. Jap. Bot. **13** : 883 (1937)—HARA, Enum. Sperm. Jap. **3** : 236 (1954).

? *W. obovata* HEMSLEY ex FORB. et HEMSL. in Journ. Linn. Soc. **26** : 400 (1894).

Jap. Name : Ao-ganpi, Okinawa-ganpi (TASHIRO), Sakura-ganpi (NAKAI), Kabiki (vernacular).

1–3 m tall, much-branched. Shoots simple, stout, densely pubescent; 2-year-old branches almost glabrous. Leaves deciduous in summer or evergreen, densely opposite, thick chartaceous, nearly glabrous, obovate or oblong, obtuse or retuse at the apex, cuneate or obtuse at the base, 1.5–5 cm long, 1–3.5 cm wide; petioles usually glabrous. Spikes terminal, several–20-flowered; peduncles 7–30 mm long, persistent; pedicels 1–3 mm long; becoming VII–K. Flowers bisexual, greenish yellow, very sparsely pubescent; tubes 8 mm long; lobes 3 mm long. Ovaries obovate or oblong, sessile, slightly pilose at the top; stigmata large. Discs 2–3, scaly or clapper-shaped. Berries stipitate, glabrous.

According to the original description, *W. obovata* HEMSLEY differs from this species by its obtuse (not retuse) leaves, sparsely pubescent or glabrous floral tubes and glabrous ovaries. As *W. retusa* shows a range of variation on these characters, however, *W. obovata* seems to be included into that range.

Distr. : Ryūkyū, recorded also in Formosa and Isl. Amami-Oshima. (Pl. I ...O).

Uses : Bark and leaves are used for making paper.

2) **Wikstroemia pseudoretusa** KOIDZUMI in Bot. Mag. Tokyo, **33** : 119 (1919)—NAKAI in Journ. Jap. Bot. **13** : 883 (1937)—TERAZAKI, Nihon-Shokubutsu-Zufu, t. 2736 (1938)—HARA, Enum. Sperm. Jap. **3** : 236 (1954).

W. retusa auct. non A. GRAY, MAXIM. in Mém. Biol. **12** : 538 (1886), quoad specim. ex Bonin.

Jap. Name : Munin-ao-ganpi, Ogasawara-ganpi, Sakura-Kōzo (vernacular).

Ca 2 m tall, much-branched. Shoots simple, stout, densely pubescent; hairs persistent for 2–3 years. Leaves deciduous in summer or evergreen, densely opposite, thick chartaceous, oblong-obovate or oblong, acute to retuse at the apex, cune-

ate or acuminate at the base, 1.5–10 cm long, 1–4 cm wide; veins sparsely pubescent on the lower surface; petioles pubescent. Spikes terminal, 4–8-flowered; peduncles 1–7 mm long, persistent; pedicels 1–2 mm long; blooming VII–K. Flowers bisexual, yellow (?), densely pubescent; tubes 6–7 mm long; lobes 3–4 mm long. Ovaries obovate, stipitate, densely pilose; stigmata small. Discs usually 2, scaly or subulate, often cleft. Berries stipitate, slightly pilose.

Distr. : Bonin. This grows in somewhat sunny places.

Uses : Bark is used for the same purpose as the preceding. But when cut, the bark may bitterly poison collectors' skin.

v. **EDGEWORTHIA** [MEISSNER in Denksch. Bot. Gesel. Regensb. 3: 280 (1841)]; in DC., Prodr. 14: 542 (1857) — ENDLICHER, Gen. Pl. Suppl. 4-2: 66 (1847) — BENTH. et HOOK. fil., Gen. Pl. 3-1: 193 (1880) — SUPPRIAN in ENGL., Bot. Jahrb. 18: 336 (1891) — GILG in ENGL., Pfl.-fam. 3-6 a: 238 (1895) — SCHNEIDER, Ill. Handb. Laubhk. 2: 403 (1903) — NAKAI in Journ. Arn. Arb. 5: 81 (1924) — HARA, Enum. Sperm. Jap. 3: 235 (1954).

Daphne sect. *Edgeworthia* (MEISSN.) BAILLON, Nat. Hist. Pl. 6: 134 (1880), in subnota.

Much-branched shrubs. Bark very tenacious. Branching habit *Edgeworthia*-type. Leaves deciduous, alternate, thick membranaceous, silky, short petiolate. Inflorescences heads, lateral or terminal, long pedunculate, involucre; involucres caducous. Pedicel articulation *Diplomorpha*-type. Flowers precocious or coetaneous, bisexual, 4-merous. Calyces tubular, thick membranaceous, densely silky outside, caducous or persistent; lobes large, imbricate. Stamens 8 in two rows, fixed at the mouth of the tube; filaments very short; anthers oblong. Ovaries sessile, pubescent; styles very long, sometimes pilose; stigmata clavate, papillose. Discs irregularly cup-shaped. Fruits dry or a little fleshy. Seeds fusiform.

Shoots contain many internal phloem fibers. Vascular bundles of leaf axes have the internal phloem fibers, circular in transverse sections (*Wikstroemia*-type); the tracheary elements show no spiral thickenings. Druse crystals abundant. Exine of pollen grains fine reticulate.

4 species wild or cultivated in India, Nepal, Burma, China and Japan.

1) ***Edgeworthia chrysantha*** LINDLEY in Journ. Hort. Soc. London, 1: 148 (1846) — ENDLICHER, Gen. Pl. Suppl. 4-2: 66 (1847) — MEISSNER in DC., Prodr. 14: 543 (1857) — HEMSLEY in Journ. Linn. Soc. 25: 401 (1894) — MATSUMURA, Ind. Pl. Jap. 2-2: 388 (1912) — REHDER in SARG., Pl. Wils. 2: 550 (1916) — NAKAI in Journ. Arn. Arb. 5: 82 (1924) — CHEN Y., Ill. Man. Chin. Tr. Shr. 868 (1937).

Magnolia tomentosa THUNBERG in Trans. Linn. Soc. 2: 336 (1794), excl. syn.; non 1805 (Icon. Pl. Jap. 5, t. 8) nec 1824.

M. sericea THUNBERG. Pl. Jap. Nov. Sp. 8 (1824), nom. nud.

Daphne papyrifera SIEBOLD, Syn. Pl. Oecon. Jap. 22 (1830), nom. nud.

Edgeworthia papyrifera (SIEB.) SIEB. et ZUCC., Fl. Jap. Fam. Nat. 2: 199 (1846) — ENDLICHER, l. c. 65 (1847) — MIQUEL, Prol. Fl. Jap. 299 (1867) — FRANCK. et SAV., Enum. Pl. Jap. 1: 405 (1875) — MAKINO, Phan. Pterid. Jap. Icon.

III. 1 : t. 2 (1899) ; III. Fl. Jap. 203 (1940)—SCHNEIDER, III. Handb. Laubhk. 2 : 403 (1909), excl. fig.—NAKAI, l.c. 82 (1924)—OHWI, Fl. Jap. 804 (1953)—HARA, Enum. Sperm. Jap. 3 : 235 (1954).

E. tomentosa (THUNB.) NAKAI in Bot. Mag. Tokyo, 33 : 206 (1919).

E. Gardneri auct. non MEISSNER, HOOKER fl., Fl. Brit. Ind. 5 : 195 (1886), p. p.—HEMSLEY in Journ. Linn. Soc. 26 : 396 (1891), p. p.

Jap. Name : Mitsumata, Musubigi, Mitsumata-yanagi, etc.

Ca 2 m tall, usually trichotomous. Shoots pubescent when young. Leaves oblong or lanceolate, acute at the apex, long cuneate or acuminate at the base, 9–25 cm long, 2–6 cm wide, silky especially on the lower surface ; hairs possessing many projections. Heads terminal or lateral, 30–50-flowered ; an involucre consisting of more than 10 pubescent scales, caducous in XII ; peduncles silky, 8–20 mm long, becoming pendulous during or after the flowering in III–IV. Flowers precocious, yellow, densely silky with white or golden hairs outside ; tubes 8–13 (or 15) mm long ; lobes 2–3 mm long. Ovaries ellipsoidal, sessile, densely pilose ; stigmata clavate, together with styles 3.5–4.5 mm long. Discs cup-shaped, lobate. Fruits dry, green, enveloped by marcescent tubes, maturing V(?)–VII.

The reason was in detail discussed to regard *Magnolia tomentosa* THUNB. as a synonym of this species by REHDER (Pl. Wils. 2 : 550). NAKAI discriminated the Chinese plants from the Japanese ones of this species, the former for *Edgeworthia chrysantha* LINDL. and the latter for *E. papyrifera* SIEB. et ZUCC. by some characters (Journ. Arn. Arb. 5 : 82). The writer has found that only the stoutness of shoots of the Chinese plants is somewhat remarkable among those characters and that the others show gradual transition from the Chinese plants to the Japanese ones, especially to Kôchi race among three representative races cultivated in Japan. So he recognizes no need to divide such two species. With concern to its specific epithet, *Daphne papyrifera* SIEB. is only a nomen nudum. And according to REHDER, *Edgeworthia chrysantha* LINDL. was published several months earlier than *E. papyrifera* SIEB. et ZUCC. The former deservedly has the priority.

Distr. : From southern China to Himalaya, wild or cultivated. In many other countries, too, this is cultivated in glass-houses or gardens. It seems to have been introduced into Japan from China in Tokugawa feudal era, being widely escaped now.

Uses : This species is one of the most valuable crop trees in Japan. Before the modern paper industry was introduced into Japan, the bark of this species had been collected in a large quantity for Japanese paper like *Broussonetia* species, etc. And till now, it has been retaining the value in such special sides as material paper of paper-money. It also has several cultivated races in Japan (cf. M. KURATA, 1950).

LITERATURE CONSULTED

1. BAILEY, I.W. : The development of vessels in angiosperms and its significance in morphological research, Amer. Journ. Bot. 31 : 421–428 (1944).
2. ERDTMAN, G. : Pollen morphology and plant taxonomy : Angiosperm, 431–433, fig. 247 (1952).

3. FROST, F.H. : Specialization in secondary xylem of dicotyledons, III. Specialization of lateral wall of vessel segment, Bot. Gaz. 91 : 88-96 (1931).
4. GILG, E. : *Thymelaeaceae* in ENGLER, Die Natürlichen Pflanzenfamilien, 3-6 a, 216-245 (1895).
5. GUNDERSEN, A. : *Thymelaeaceae*, Families of Dicotyledons, 120 (1950).
6. HEINIG, H.K. : Studies in the floral morphology of the *Thymelaeaceae*, Amer. Journ. Bot. 38 : 113-132 (1951).
7. KURATA, M. : ミツマタ, 特用樹種, 51-66 (1950).
8. ————— : 桐・椿・三種の栽培, 114-214 (1951).
9. LÉANDRI, J. : Recherches anatomiques sur les *Thyméléacées*, Ann. Sci. Nat. Bot. sér. 10, 12 : 125-237 (1930).
10. METCALFE, C.F. & CHALK, L. : *Thymelaeaceae*, Anatomy of the Dicotyledons, 2 : 1169-1178 (1950).
11. NAKAI, T. : *Daphnaceae*, Flora Sylvatica Koreana, 17 : 31-45 et 91 (1928).
12. ————— : Notulae ad Plantas Asiae Orientalis: IV, Journ. Jap. Bot. 13 : 880-892 (1937).
13. RECORD, S.J. : Classifications of various anatomical features of dicotyledonous woods, Trop. Woods, 47 : 12-27 (1935).
14. REHDER, A. : *Thymelaeaceae* in SARGENT, Plantae Wilsonianae, 2 : 530-551 (1916).
15. SOLEREDER, H. : *Thymelaeaceae*, Systematic Anatomy of the Dicotyledons. English edition, translated by L.A. BOODLE and F.E. FRITSCH, 2 : 715-721 (1908).
16. SUPPRIAN, K. : *Thymelaeaceae* in ENGLER, Bot. Jahrb. 18 : 306-341 (1891).
17. VAN TIEGHEM, PH. : Recherches sur la structure et les affinités des *Thyméléacées* et des *Pénéacées*, Ann. Sci. Nat. sér. 7, 17 : 185-277 (1893).
18. WATARI, S. : 材解剖の進歩, 生物学の進歩, 1 : 71-95 (1943).

EXPLANATION OF PLATES

Plate I-VI : Distribution maps. See the explanation below the map on each plate.

Plate VII, A-C : Transverse sections of shoots.

A : *Daphne odora* THUNB. (ca × 120). Internal fibers abundant.

B : *Daphnimorpha capitellata* NAKAI (ca × 140). Internal fibers absent.

C : *Diplomorpha trichotoma* NAKAI (ca × 120). Internal fibers very few.

Plate VIII, D-G : Vascular bundles of leaves in transverse sections.

D : *Daphne*-type, *Daphnimorpha capitellata* NAKAI (ca × 75).

E : *Diplomorpha*-type, *Dipl. trichotoma* NAKAI (ca × 160). At a level in a petiole.

F : ditto, *Dipl. yakushimensis* MASAMUNE (ca × 120). At the base of a midrib.

G : *Wikstroemia*-type, *W. retusa* A. GRAY (ca × 200). Near the middle of a midrib, Internal fibers abundant.

Plate IX, H-I : Vascular bundles of leaves in transverse sections.

H : *Wikstroemia*-type, *W. elliptica* MERRILL (ca × 150). At the base of a midrib.

I : ditto, *Edgeworthia chrysantha* LINDLEY (ca × 90). Fibers comparatively few in this species.

J-K : Vessel members in macerated leaf bundles (ca × 500).

J : *Daphne odora* THUNB. The spiral thickenings very conspicuous.

K : *Edgeworthia chrysantha* LINDLEY. The spiral thickenings entirely absent.

Plate X, L-M : Longitudinal sections of the lower parts of flowers (ca × 90). The ovary bundles separate from the sepal bundles above the articulation of the pedicels.

L : *Daphne pseudo-mezereum* A. GRAY.

M : *Diplomorpha Ganbi* NAKAI.

N : A flowering plant of *Daphnimorpha capitellata* NAKAI cultivated in Tokyo (ca \times 1/2).

O : Plants of *Diplomorpha trichotoma* NAKAI cultivated in Tokyo (ca \times 1/4).
Withered parts of the last year shoots are observed.

日本産ジンチヨウゲ科樹木のモノグラフ (摘要)

大学院学生 濱谷稔夫

I. 和紙の原料植物の一としてミツマタとガンビは往時から極めて重視され、前者の如きは現在猶大量に栽培される。これはその強靱でしかも豊富な靱皮繊維に基くものである。両種の所属する本邦産ジンチヨウゲ科の全種がこの特徴を具えているので、地方的には同じく和紙の原料として採皮されたものも少くない。しかし一般にそれらの分類学的な研究は少く、あつても断片的であつて、その応用に当つてしばしば少くない不便があつた。筆者はこの科の樹木学的研究を以てその不便に対処すべく、まづその分類関係の整理を試みた。しかし所謂自然分類系は従来この科に対して主に用いられた外部形態学的知識のみからでは得がたいことを知つたので、更に若い枝・葉・花等各部の解剖学的研究を行つて、若干の重要な知見をも加えることができた。ただ遺憾ながら本邦産の種数が少く、関係5属の間の眞の類縁関係を推論するのに多心不安がある。従つて外国産種の標本の充実を俟つて、一層安全な分類体系を整備したいと考えるが、ここでは本邦産種のみを今後の研究の基礎の意味において述べた。

II. ジンチヨウゲ科の日本産のものは全て花に花卉状附属物がなく、萼は筒状をなし、四数性で8個の雄蕊が上下2輪をなすものである。花盤の突起の形は主要な分類上の基準とされてきた。仮軸的分枝も科の一大特徴である。解剖学的には幹・枝に材内篩部を有することが科の共通特徴とみなされている。その他外部形態学的形質・顕微形態学的形質・分布及び用途について総括的な記述を行つた。

III. 諸形質の中、分類学上特に重要と考えられるものにつき夫々幾つかの型を設け、それに属する分類群及びそれらの間の類縁関係の検討を行つた。

§ 1. 外部形態学的特徴

1. 花序との関係における分枝法：芽と花序の位置、落葉と新条生長の時期及び花序の種類により4型を設けた。a ジンチヨウゲ型 — 常に新条は花序の基部から出る。開花後数年は少くとも花序基部が宿存する、a₁ オニシバリ型 — 晩夏に落葉し、初秋頂芽から花序（開花は翌春）次で新条をのばす。従つて開花時には花序は側生状となる。花梗はなく小花梗は疣状に残る、a₂ ジンチヨウゲ型 — 常緑性で春に開花後頂生頭状花序の最上苞の腋から1~3本の新条をのばす。但し、初夏新条に頂生した花序基部から年内に更に枝をのばすものもある、a₃

アオガンビ型 — 落葉期を経た後短い新条に穂状花を頂生し、後花序の基部から枝をのばす。落葉期は冬又は夏である、**a** シヤクナンガンビ型 — 夏分岐した長花梗をもつ小頭状花序をつけ、秋落葉する；**b** ガンビ型 — 穂状（乃至総状）・頭状又は円錐状花序を頂生し、開花後花序及び若枝の大半又は上半が枯れて落ち、跡が尖る。冬季葉落性；**c** ミツマタ型 — 冬季落葉性。長い花梗と総苞をもつ頭状花序は秋に頂生又は側生し、翌春開花する。開花後枝端から出た新条は夏に急に三岐する。

2. 花盤：嘗てこれのみで属などの群を分けた学者が多いが、それ程の分類学的意義は認めがたく、移行型も多い。形態学的意義は未知である。次の3型に大別される。**a** 輪状又は浅盃状；**b** 舌状又は板状，上縁腺状；**c** 鱗片状，針状又は舌状。これらの形状については特に中国産種について解明すべき点が多い。

3. 小花梗と果実：花及び果実の各時期の小花梗関節の位置から2型が認められる。**a** ガンビ型 — 萼筒はその底で直ちに小花梗と関節する。子房柄は通常明瞭で乾果の柄の基部に萼筒（又はその残片）が残る；**b** アオガンビ型 — 小花梗の関節は萼筒底より多少下つてあり、子房はほゞ無柄故、漿果はその底部に萼筒残片をもつ。但し**a** で肉質果実のものや、**b** で小花梗の短い中間的存在のものがある。

§ 2. 顕微形態学的特徴

1. 若い枝の材内篩部繊維：本科では殆ど全種が幹・枝に材内篩部をもつ。しかし日本産5属中材内篩部に繊維を含むものと含まないものとを区別して3型がある。**a** 豊富に含む；**b** 極めて少数含む；**c** 全く含まない。

2. 葉柄・中肋の維管束：葉柄維管束の横断面形は三日月形から馬蹄形乃至輪状までであるが、その差は必ずしも属又は節の分類群と一致しない。むしろ葉質、葉柄長との関係が大きい。しかし中肋後半では全て三日月形となる。離層部以上の材内篩部・材内篩部繊維の存否及び量の関係には重要な差が認められる。**a** ジンチョウゲ型 — 横断面は三日月形か馬蹄形。材内篩部はない；**b** ガンビ型 — 横断面は輪状か弧状。材内篩部はあるが、それに殆ど繊維を含まない；**c** アオガンビ型 — 横断面は輪状又は内曲した小腕部をもつ三日月形。材内篩部繊維は豊富。

3. 葉の導管・仮導管の螺旋肥厚：これについては既に断片的な報告があるが、この研究で重要な属的特徴であることを知った。**a** 極めて顕著；**b** 中庸乃至極めて微弱或は全くない。近縁種間でその程度に相当の差がある；**c** 全くない。この3型がある。螺旋肥厚の系統的意義は詳かでないが、参考までに観察した材に於ても上の関係はほゞ平行的に見られた。又 BAILEY 一派がより原始的であると推論した形態を示す導管・仮導管においてより顕著のように思える。

4. 花の維管束：乾果になるものと漿果になるものとは、心皮内の維管束分布が若干異なるが、それぞれ少数の移行型や変異によつて両種類の果実の近縁なることを示す。又小花梗関節に

見た如き差異は花托以下の部分の縦断面における維管束の行動によつて特に明瞭になる。

5. 結晶： ミツマタ属及び *Erioselema* のみに金平糖状結晶を見出す。

6. 花粉粒の外層彫紋模様： シヤクナンガンビ属のみが平滑であるのに対し他属は何れも細網状紋がある。その網目は細く深いので側面観では細い柱状物が極めて密に生じたように見える。

§ 3. 類縁関係の検討

外部形態学的特徴の異種の型に間に平行な類縁的關係は見出しがたい。それに比べて材内篩部繊維と螺旋肥厚とは日本産 5 属に関する限り平行な關係を示す。即ちシヤクナンガンビ属 — ジンチョウゲ属 (オニシバリ節 — ジンチョウゲ節 — フジモドキ節) — ガンビ属 — アオガンビ属 — ミツマタ属 (及び *Erioselema*) の順に若い枝から葉へ、初めに材内篩部次いで材内篩部繊維が上昇し、逆に螺旋肥厚はこの配列順に減衰する。但しガンビ属で若い枝の材内篩部繊維の増加が遅れたか或は再び減少したと仮定しなければならぬ。又この關係も GILG の体系による他の近縁属も含めて考える時は必ずしも一致しない。ジンチョウゲ属の特に外部形態における多様性から見て、シヤクナンガンビ属からこれを経て他の属に至る二つ或はそれ以上の系統を想定すべきかも知れない。外国産種の材料を少ししか見ていない故、早急な決論は避けたいが、次のことは云えよう。(本文第 1 表参照)

i. ジンチョウゲ属とアオガンビ属は花盤の形・分枝法等において似た性質や中間形も多く、GILG の如く両者を代表とする 2 亜族 (*Daphninae* 及び *Wikstroemiinae*) を分つ必要が認められない。又両属の中国西部産五数性種の眞の帰属は今後の研究に俟つ。

ii. アオガンビ属とガンビ属は、以前同一の属に扱われた如く多くの形質で互に隣するが、ガンビ属はジンチョウゲ・アオガンビ両属の中間的性質が多く、別属として扱うのが妥当であろう。

iii. シヤクナンガンビ属は従来考えられた以上にジンチョウゲ属に近く、アオガンビ属より遠い。独立属の資格は充分である。解剖学的性質に基く前述の推論が正しければ、古い地質地帯に極めて限られた分布区域を示すことから見てもこれが遺存の属である可能性は大い。

iv. ミツマタ属と *Erioselema* の両者は時にはジンチョウゲ属の節として扱われたこともあるが、予想以上にそれとは縁遠く、アオガンビ属又はガンビ属に近い。両者は夫々独立の属とすべきである。

v. ジンチョウゲ属フジモドキ節より *Daphne Championi* BENTH. を除くべきである。但し後者が何れの節に属するかは不明である。

IV. 以上に基いて日本産 5 属の分類を試みた。それらはジンチョウゲ亜科 — ジンチョウゲ族に属するもののみである。属の検索表を以下に示す。

1. 外部形態学的特徴による検索表

a1 花盤は舌状又は板状、上縁腺状。分枝法はシヤクナンガンビ亜型。

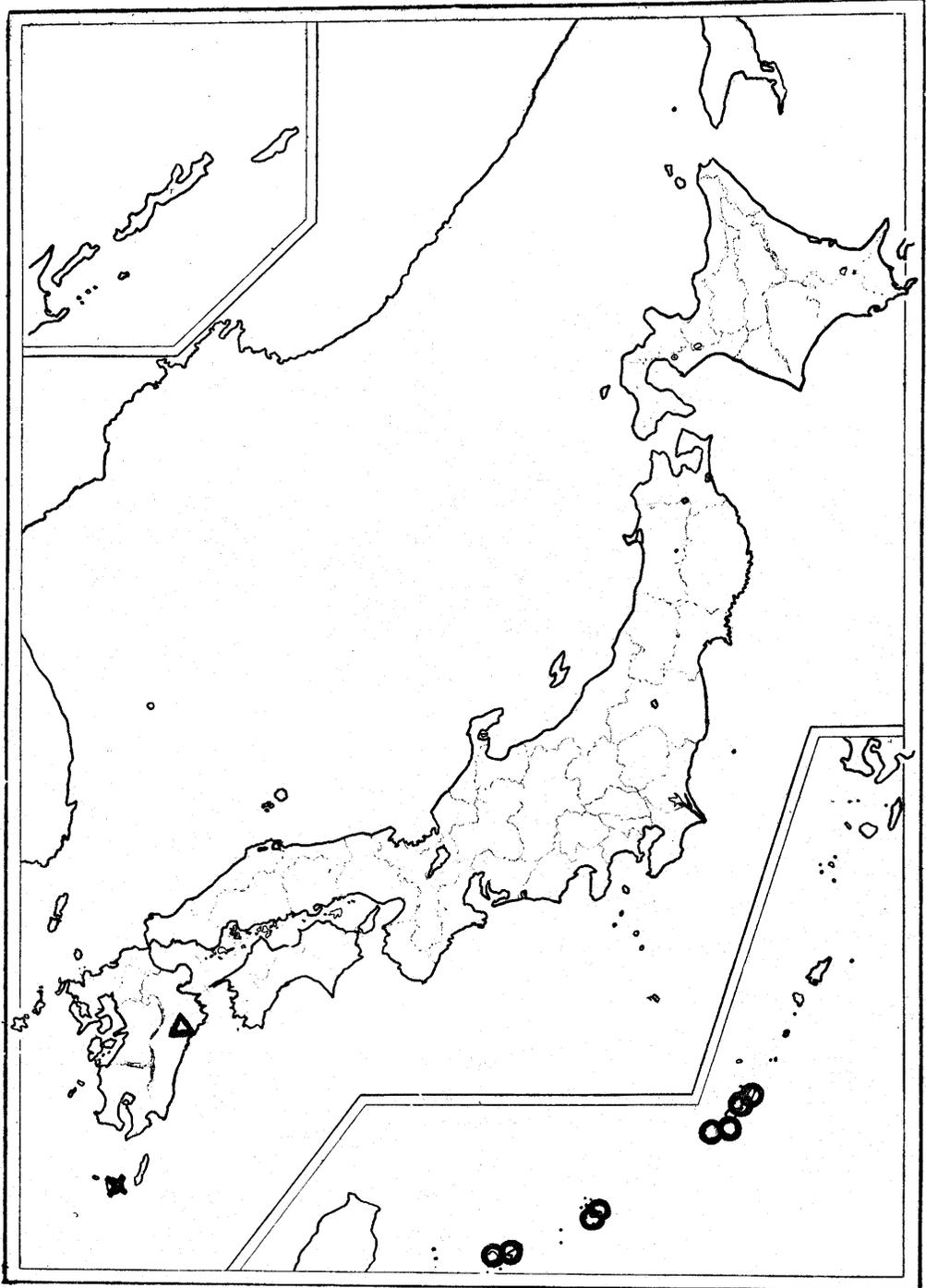
-i. シヤクナンガンピ属 (*Daphnimorpha*)
- a₂** 花盤は輪状又は浅盃状。小花梗関節はガンピ型又はアオガンピ型。
- b₁** 分枝法はジンチヨウゲ型。..... **ii.** ジンチヨウゲ属 (*Daphne*)
- b₂** 分枝法はミツマタ型。..... **v.** ミツマタ属 (*Edgeworthia*)
- a₃** 花盤は鱗片状, 針状又は舌状。
- b₁** 分枝法はガンピ型。小花梗関節はガンピ型。..... **iii.** ガンピ属 (*Diplomorpha*)
- b₂** 分枝法はアオガンピ型。小花梗関節はアオガンピ型。
..... **iv.** アオガンピ属 (*Wikstroemia*)

2. 顕微形態学的特徴による検索表

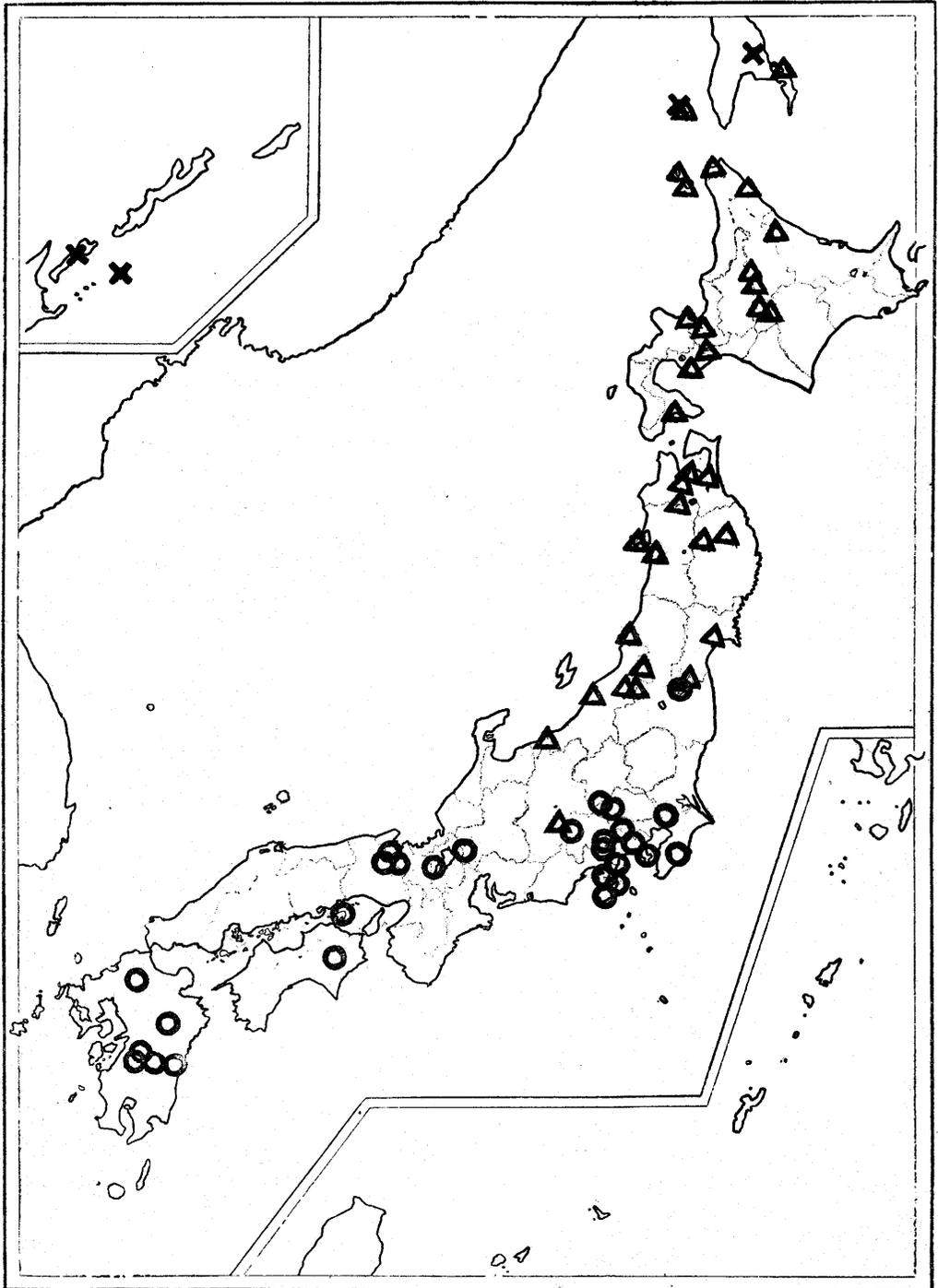
- a₁** 結晶を含まない。
- b₁** 花粉粒は平滑。若い枝に材内篩部繊維がない。
..... **i.** シヤクナンガンピ属 (*Daphnimorpha*)
- b₂** 花粉粒には細網紋がある。
- c₁** 葉の維管束はジンチヨウゲ型。若い枝に材内篩部繊維が多い。導管系細胞の螺旋肥厚は顕著。
..... **ii.** ジンチヨウゲ属 (*Daphne*)
- c₂** 葉の維管束はガンピ型。枝の材内篩部繊維は少い。螺旋肥厚は微弱。
..... **iii.** ガンピ属 (*Diplomorpha*)
- c₃** 葉の維管束はアオガンピ型。枝に材内篩部繊維が多い。螺旋肥厚は全くない。
..... **iv.** アオガンピ属 (*Wikstroemia*)
- a₂** 結晶を含む。他はアオガンピ属に似る。..... **v.** ミツマタ属 (*Edgeworthia*)
- 最後に筆者独自の見解に基づいて各属内の分類を行つた。

この研究を進めるに当り、種々御指導を仰いだ猪熊泰三教授、倉田悟助教授、又各種の助言を得た島地謙氏、佐藤清左衛門氏、郷正士氏及び貴重な腊葉標本の閲覧をお許し下さつた東京大学理学部植物学教室、京都大学理学部植物学教室並びに国立科学博物館植物学部の各位に心からお礼申上げる。

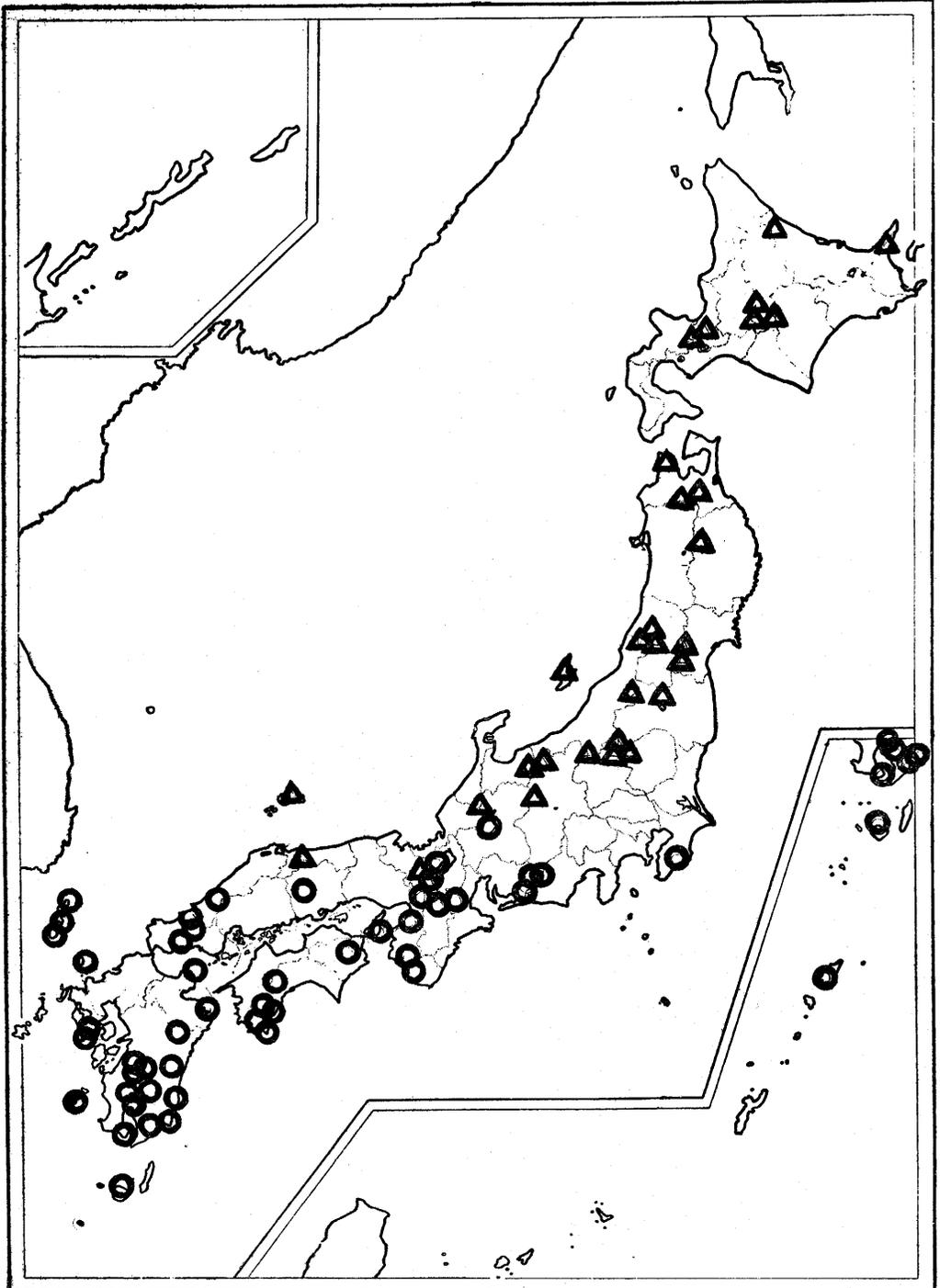
(昭和 30 年 7 月末日, 東京大学農学部森林植物学教室において)



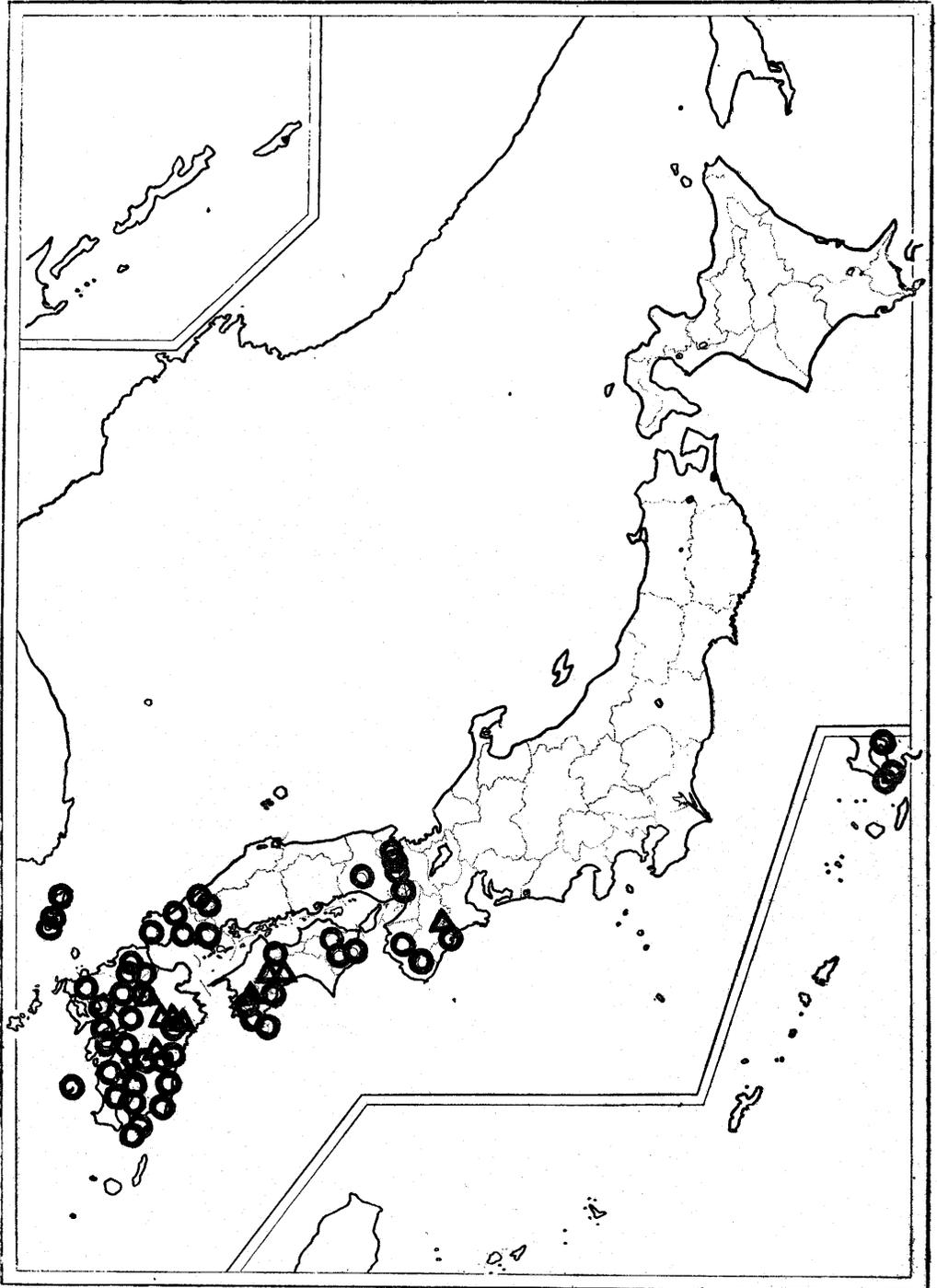
× : *Daphnimorpha Kudoi* NAKAI ; Δ : *D. capitellata* NAKAI ;
○ : *Wikstroemia retusa* A. GRAY.



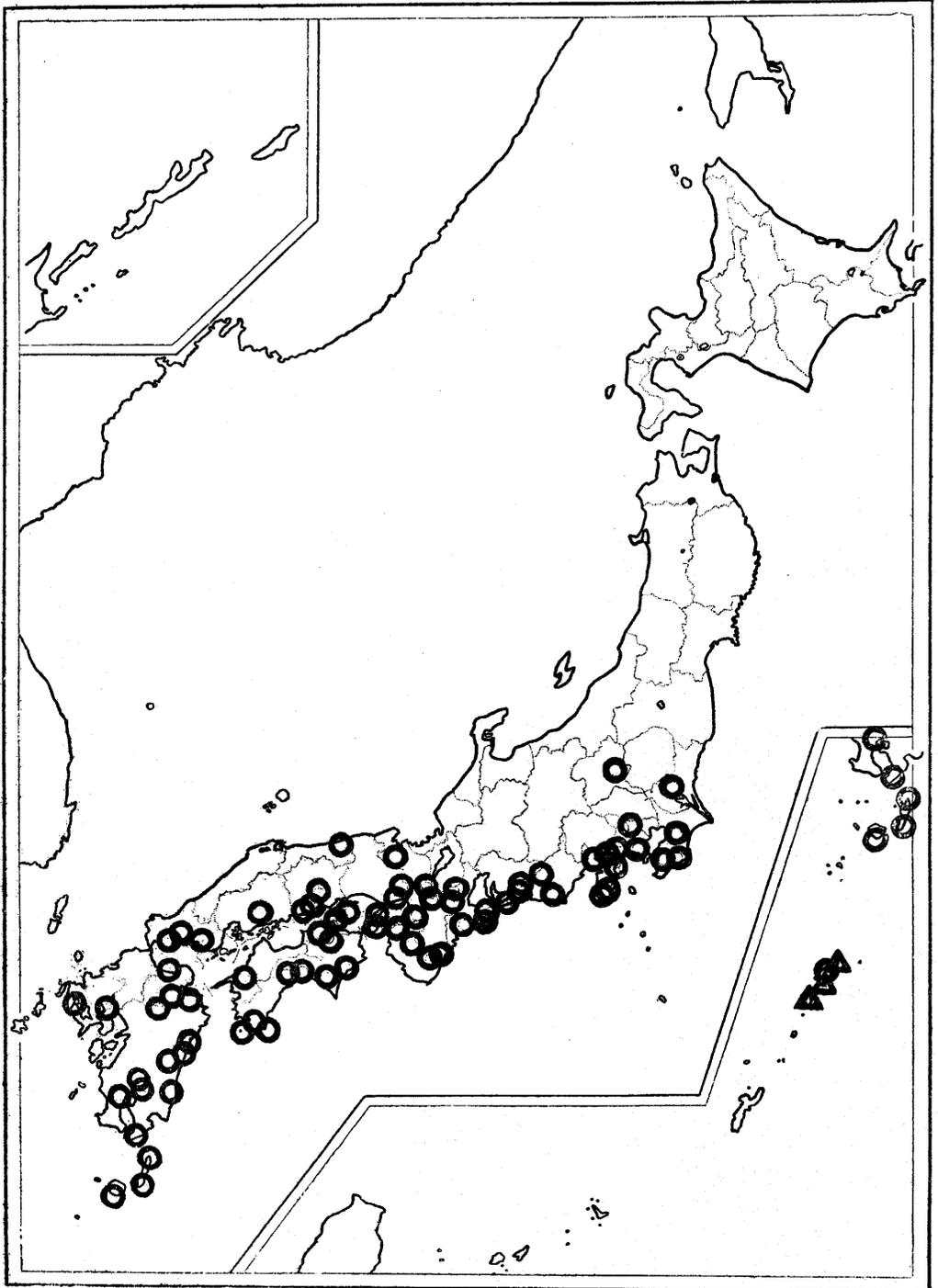
○ : *Daphne pseudo-mezereum* A. GRAY ; ⊖ : ditto, a peculiar specimen from Fukushima, Prov. Iwashiro ; △ : *D. jezoensis* MAXIM. ; × : *D. kamtschatica* MAXIM.



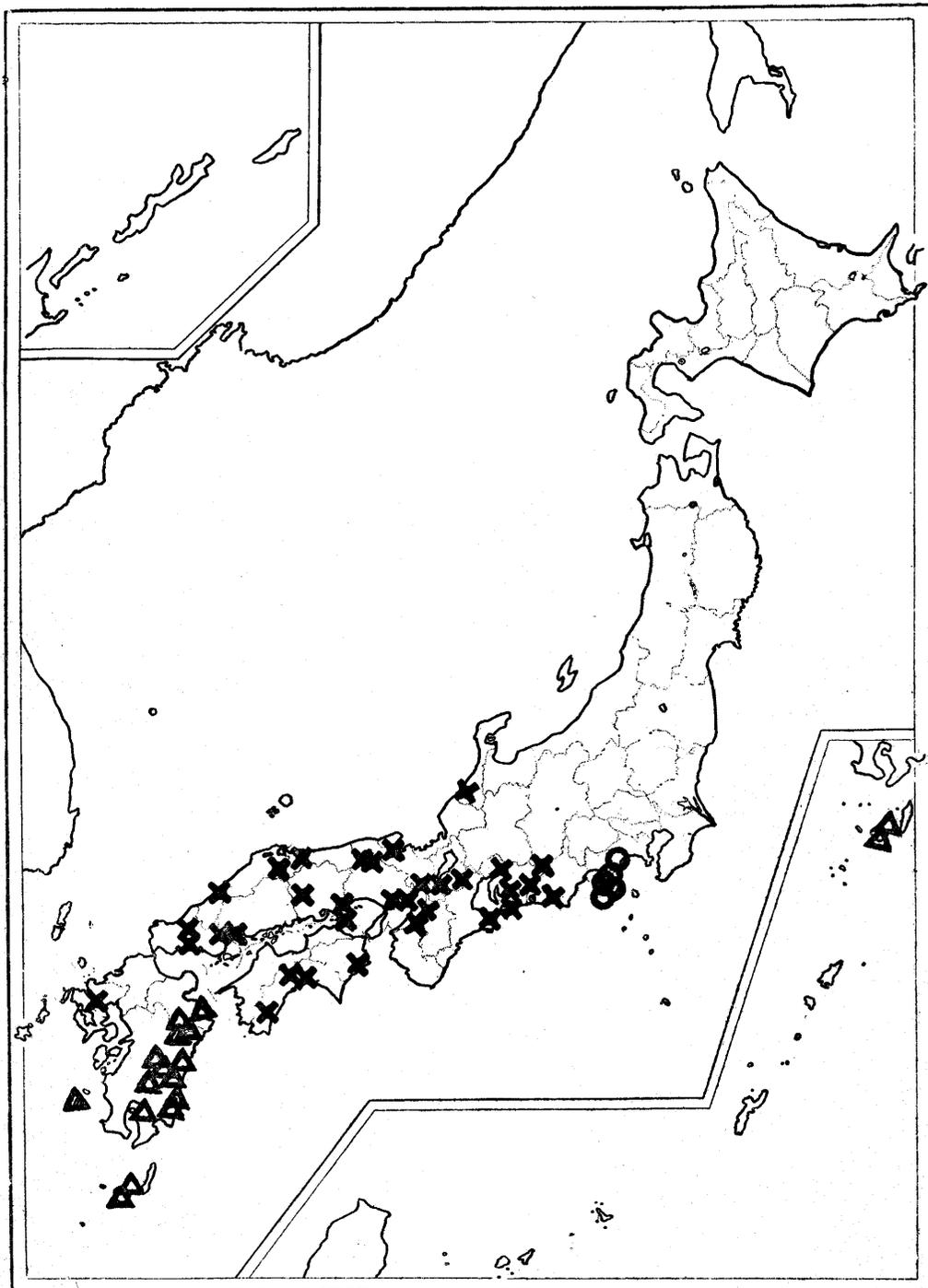
○ : *Daphne kiusiana* MIQUEL ; △ : *D. Miyabeana* MAKINO.



○ : *Diplomorpha trichotoma* NAKAI ; × : *D. trichotoma* var. *trichotoma*
f. *pilosa* HAMAYA and var. *ohsumiensis* HAMAYA ; △ : *D. albiflora* NAKAI.



○ : *Diplomorpha Ganpi* NAKAI ; △ : *D. phymatoglossa* NAKAI.



○ : *Diplomorpha pauciflora* NAKAI ; △ : *D. yakushimensis* MASAMUNE ;
× : *D. sikokiana* HONDA.

Plate VI

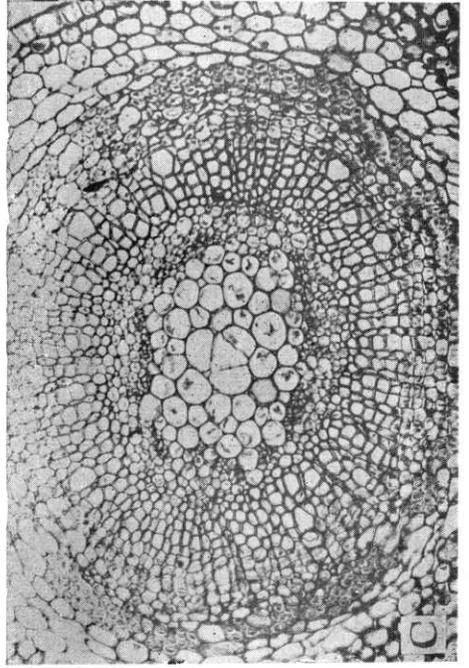
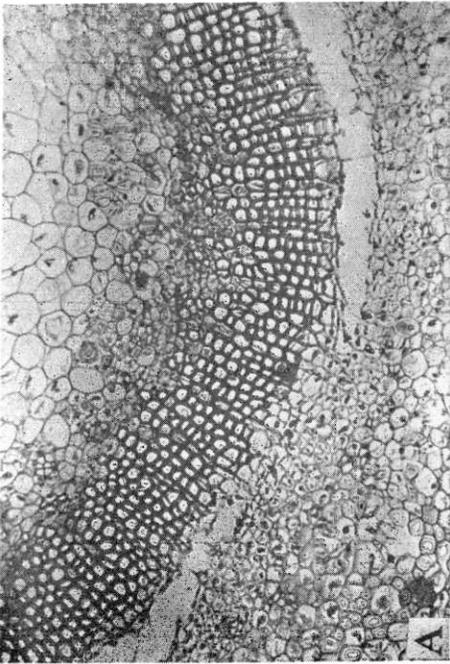
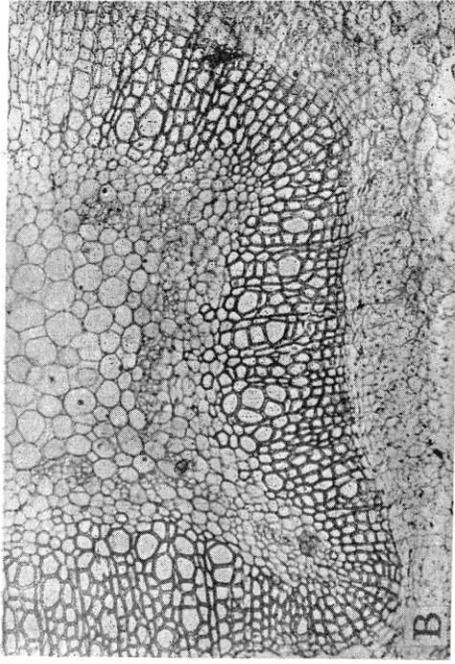


Plate VIII

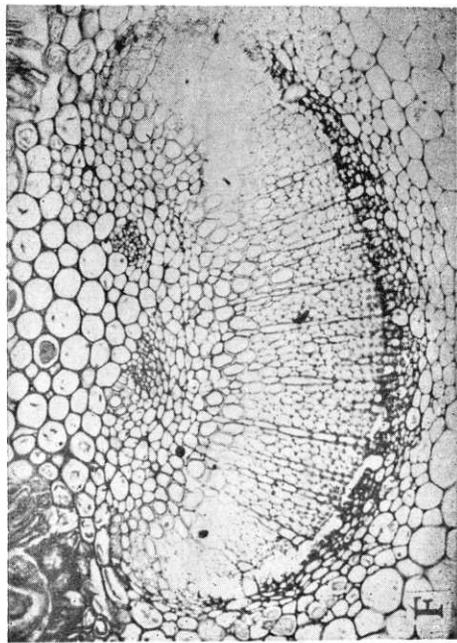
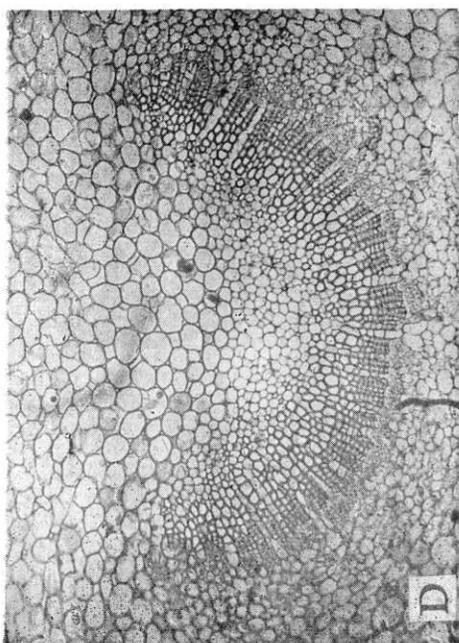
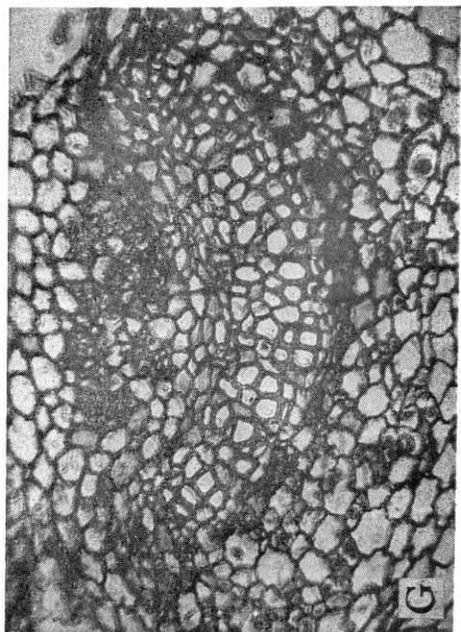
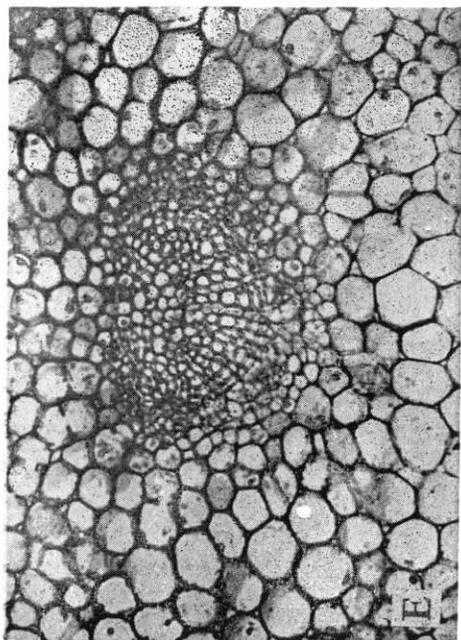


Plate K

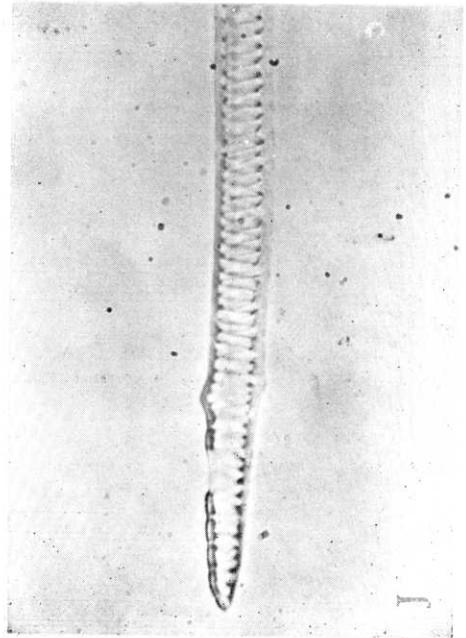
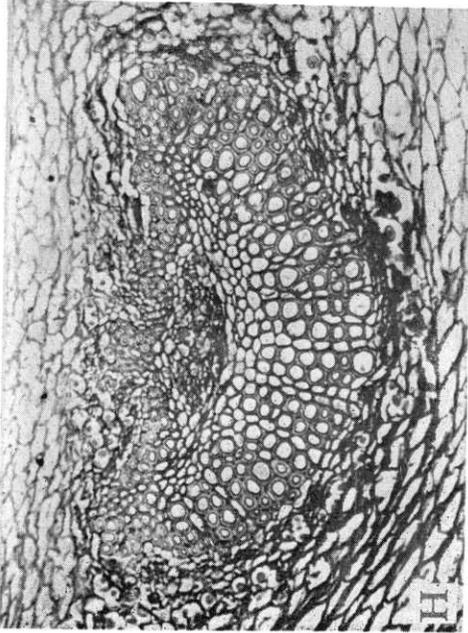
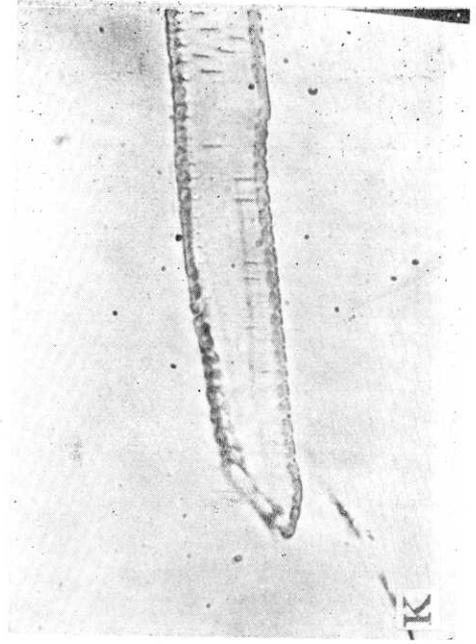
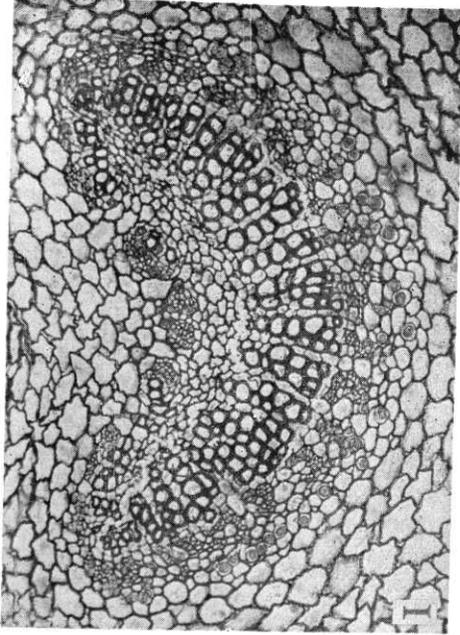


Plate X

